Enclosure

Supplemental Environmental Report for the Amendment of Special Nuclear Material License No. SNM-124

(64 pages to follow)

21T-21-0890
LIC-01-02
GOV-01-55-04
ENV-04-03

BWXT
Nuclear Fuel Services, Inc.

SUPPLEMENTAL ENVIRONMENTAL REPORT FOR THE AMENDMENT OF SPECIAL NUCLEAR MATERIAL LICENSE NO. SNM-124

Prepared for:
United States Nuclear Regulatory Commission
Office of Nuclear Material safety and Safeguards
Division of Fuel Safety and Safeguards
Fuel Cycle Licensing Branch

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November 2021

UNCLASSIFIED

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Table of Contents

Table of Contents

Table of Contents

List of Tables

List of Figures

List of Abbreviations

Abbreviation	Definition
1,2-DCE	1,2-dichloroethylene
ADU	Ammonium Diurinate
AHF	Anhydrous Hydrogen Fluoride
ALARA	As Low as is Reasonably Achievable
ALOHA	Area Locations of Hazardous Atmospheres
AOC	Area of Concern
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning Engineers
BFE	Base Flood Elevation
BLEU	Blended Low Enriched Uranium
BPF	BLEU Preparation Facility
Ca(OH)2	Calcium Hydroxide
CEDE	Committed Effective Dose Equivalent
COC	Contaminant of Concern
CSX	Chessie Seaboard Multiplier (Railroad Transportation Co.)
DOE	United States Department of Energy
DOWR	Division of Water Resources
EA	Environmental Assessment
EPA	Environmental Protection Agency
EPOTW	Erwin Publicly Owned Treatment Works
Facility	NFS Erwin Facility
FAP	Facility Action Plan
FEMA	Federal Emergency Management Agency
ft^3/s	Cubic feet per second
HEPA	High Efficiency Particulate Air
HEU	High Enriched Uranium
HF	Hydrogen Fluoride
HSWA	Hazardous and Solid Waste Amendments
HVAC	Heating, Ventilation, and Air Conditioning
Kg	kilogram
Lb	pound
MCL	Maximum Contaminant Level
MEI	Maximally Exposed Individual
Mg	milligram
Mph	miles per hour
NAAQS	National Ambient Air Quality Standards
NFS	Nuclear Fuel Services, Inc.
NMSS	Nuclear Material Safety and Safeguards
NNSA	National Nuclear Security Agency
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission

NRHP	National Register of Historic Places
PCE	Tetrachloroethylene
pCi/l	picocuries per liter of air
Ppm	parts per million
Rem	roentgen equivalent man
ROI	Region of Interest
SNM	Special Nuclear Materials
SWMU	Solid Waste Management Unit
Tc-99	Technetium
TCE	Trichloroethylene
TDEC	Tennessee Department of Environment and Conservation
TEDE	Total Effective Dose Equivalent
U	Uranium
uCi/ml	Microcurie per milliliter
UF_6	Uranium Hexafluoride
UNH	Uranyl Nitrate Hexahydrate
USGS	United States Geologic Survey
VAGAS	Versatile Automated Gamma Assay System
VCI	Vinyl Chloride
WWTF	Wastewater Treatment Facility

1.0 Introduction

This Supplemental Environmental Report provides environmental information on Nuclear Fuel Services, Inc. (NFS) facility in Erwin, TN ("NFS Erwin Facility" or "Facility") to supplement the Special Nuclear Materials (SNM) license amendment request for NFS' Uranium Purification and Conversion Services.

NFS' Supplemental Environmental Report was prepared in accordance with NUREG 1748, Environmental Review Guidance for Licensing Actions Associated with the Office of Nuclear Material Safety and Safeguards (NMSS) Programs.

The contents of this Supplemental Environmental Report address the impacts to human health and the environment required to construct and operate the Uranium Purification and Conversion Services process, and update information last provided by NFS in its 2009 Environmental Report for the Renewal of Special Nuclear Material License No. SNM-124 (May 2009).

The following changes have been made to the Facility since 2009:

- Built new security wall around the perimeter of the main NFS site (started in 2007 and completed in 2012);
- Modernized the ammonia stripping tower (2012);
- Replaced exit/entry access control point (2012);
- Redesigned and installed the main stack (2014);
- Replaced the fan house (2014);
- Decommissioned the Blended Low Enriched Uranium (BLEU) Complex (2018);
- Decommissioned the northern burial ground area and surface water impoundments (2018);
- Relocated and replaced the meteorological tower (2020);
- Added a new office building (2020); and,
- Relocated and modernized the Versatile Automated Gamma Assay System (VAGAS) (2021).

1.1 PURPOSE AND NEED FOR THE PROPOSED ACTION

The proposed action is the amendment of NFS SNM-124 license to include the Uranium Purification and Conversion Services process.

Legacy uranium processing equipment at the National Nuclear Security Agency's (NNSA) Y-12 plant in Oak Ridge, Tennessee is tentatively planned for shutdown in the 2023 timeframe. Based upon available information, NNSA plans to partially replace this legacy uranium processing system capability with new electrorefining technology to purify high-enriched uranium (HEU) metal. However, this new process will not be available until 2023 at the earliest and will not be capable of converting oxides to metal until completion of a separate future project. Therefore, to maintain the ability to convert oxides to metal, NNSA requires separate HEU purification and conversion capability. To provide both this oxide conversion capability and to hedge against the technology risk associated with the new electrorefining facility, NNSA contracted with NFS to design, license, and demonstrate the capability to perform uranium purification and conversion to uranium metal at the NFS Erwin Facility which is an NRC licensed Category 1 HEU manufacturing facility.

The SNM-124 license allows the operation of the NFS Erwin Facility. The primary licensed activity is the production of nuclear fuel for the United States Navy. NFS is the only facility that produces naval nuclear fuel in the United States. This license also provides the following services for the United States Government:

- Chemical processing of high enriched uranium material to produce material for fuel fabrication and uranium recovery;
- Uranium recovery, conversion, and purification for the U.S. Department of Energy (DOE); and,
- Reduction of weapons-grade nuclear material into commercial-grade nuclear material for power production.

1.2 PROPOSED ACTION

The proposed action advocated by this Supplemental Environmental Report is the amendment of the NFS SNM-124 license to include specific new processes associated with Uranium Purification and Conversion Services process. NFS proposes to construct a new approximately 4,100 square foot Utilities Building located within the protected area of the site just west of the main processing building.

The Facility is located in the Town of Erwin, Unicoi County in northeast Tennessee. The NFS Erwin Facility occupies approximately 82 acres of land on Carolina Avenue. Carolina Avenue bounds the Facility on the southeastern side, with the Chessie Seaboard Multiplier (CSX) Railroad line on the northwest side, and Martin Creek bounding the northeastern side of the Facility (see **Figure 1**, NFS Erwin Facility Location and **Figure 2**, NFS Erwin Facility and Vicinity).

The NFS SNM-124 license amendment application will be submitted to the Nuclear Regulatory Commission (NRC) by November 2021.

Figure 1. NFS Erwin Facility Location

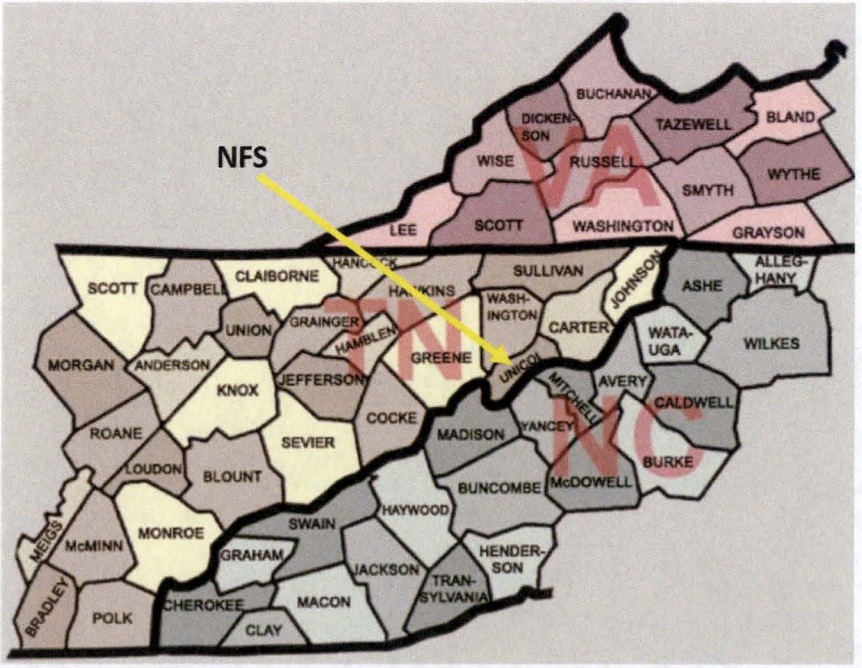

Figure 2.

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2.0 Alternatives

2.1 DETAILED DESCRIPTION OF THE ALTERNATIVES

2.1.1 No-Action Alternative

Failure of the NRC to approve the license amendment request could deprive the NNSA of strategically important nuclear material, and if not conducted by NFS would have to be conducted by another NRC licensed / DOE Operated facility. The operation of the NFS Facility has produced no significant adverse effects on the local environment. Conduct of this work at another licensed facility would have no net positive effect on the environment but could increase unemployment in the Erwin, Tennessee area and increase the cost to the United States Government for fuel material fabrication.

2.1.2 Proposed Action

The proposed action is to amend NFS' SNM-124 license to conduct Uranium Purification and Conversion Services. This action would include the receipt, possession, processing, storage, and shipment of authorized special nuclear materials. Current operations at NFS are described below, which are inclusive of those that are associated with this amendment request:

Description of Current Operations

1. **Product Processing**: Product processing activities which have been carried out during the current license period and which are expected to continue under the current license, and similar activities which could occur during the amended license, are described below:

    - UF_6 Conversion – Conversion of highly enriched uranium hexafluoride (UF_6) to other compounds;
    - Fuel Manufacturing – Production of fuel containing highly enriched uranium;
    - Uranium Recovery – Recovery and purification of highly enriched uranium from scrap generated either internally or at other facilities, or from surplus or legacy strategic nuclear materials;
    - Enrichment Blending as liquid uranyl nitrate hexahydrate (UNH) – Enrichment blending of highly enriched uranium with natural uranium or very low enriched uranium to produce low-enriched uranium materials; and,

2. **Laboratory Operations**: Laboratory activities include wet chemical and physical testing.

3. **General Services**: The following general services, ancillary to primary operations occur:

    - Storage of special nuclear material compounds and mixtures in areas with containers arranged specifically for maintenance of radiological and nuclear safety;
    - Maintenance and repair of special nuclear materials processing equipment and auxiliary systems; and,
    - Decontamination of equipment and materials, including personnel protective clothing and respiratory devices.

4. **Research and Development**: Research and development work is performed on source and special nuclear material compounds and mixtures.

5. **Radioactive Waste Management**: The following radioactive waste management activities occur:

- Treating basic and acidic waste streams at the National Pollutant Discharge Elimination System (NPDES) permitted wastewater treatment facility (WWTF);
- Decontamination of liquid waste streams and of process equipment;
- Packaging and storage of both liquid and solid wastes contaminated with or containing non-recoverable uranium;
- Shipment of radioactive wastes to licensed facilities or to licensed burial sites for disposal;
- Volume reduction by compaction, distillation, reuse, and/or evaporation of waste materials containing enriched uranium; and,
- Solidification.

6. **Decommissioning**: NFS has been actively engaged in decommissioning portions of the NFS Erwin Facility since the mid-1980s. A number of processing buildings and former waste disposal and storage areas have been either fully or partially decommissioned. The current focus is on legacy building decommissioning.

   The impact of decommissioning activities was evaluated and documented in the NRC's 2011 Environmental Assessment (EA) supporting the 1996 renewal of the SNM-124 license. Decommissioning activities are ongoing and have been previously evaluated by the NRC.

Waste Confinement and Effluent Control

1. **Gaseous Effluents**: Various control devices are used to remove radioactive particulates and chemicals from gaseous effluents. The primary systems are described below:

   - Main Process Cleaning System - The Facility's main process ventilation system combines air effluents from the primary highly enriched uranium processing areas. This combined effluent is cleaned by venturi and demisting scrubbers and high efficiency particulate air (HEPA) filtration.
   - 30% American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) prefilters - Used on heating, ventilation, and air conditioning (HVAC) recirculation room air handlers in a large portion of the Facility.
   - Packed-bed or Sieve Tray Scrubbers - Used in several buildings. Sodium hydroxide, water, and sulfuric acid are used as scrubbing solutions.
   - HEPA filters - Used throughout the Facility for high-efficiency (99+%) removal of airborne particulates. In some instances, multiple HEPA filters are used in series to achieve higher removal efficiencies.

2. **Liquid Waste Storage**: NFS' wastewater storage tanks are housed inside secondary containment structures. The majority of the secondary containment structures are designed to hold the contents of the largest structure, or the tank volume is administratively limited. This is a safeguard measure to prevent release of liquid waste to the environment.

3. **Liquid Effluents**:

   - NFS WWTF - The NFS Erwin Facility produces liquid effluents from a number of different activities: fuel production, highly enriched uranium recovery, UF6 conversion, enrichment blending, laboratory operations, laundry activities and Facility decommissioning activities. This wastewater is batch treated, sampled, and then discharged from the on-site WWTF, if levels are below 10 CFR Part 20.1301 and in compliance with the Facility's NPDES Permit. Treatment

typically involves adjustment of pH using sodium hydroxide/sulfuric acid, and precipitation and removal of fluoride ions and uranium through addition of lime slurry, calcium hydroxide Ca(OH)2. Dissolved ammonia is removed, as needed; using air stripping and the pH is re-adjusted to discharge levels. Discharges are made directly to the Nolichucky River.

- Sanitary Wastes - Sanitary waste from the Facility consists of bathrooms and showers. The Facility discharges under an Erwin Publicly Owned Treatment Works (EPOTW) permit.
- Stormwater Run-off - The primary pathway for run-off is from south to north across the Facility and into Banner Spring Branch and Martin Creek. Banner Spring Branch flows into Martin Creek which subsequently flows into North Indian Creek and then into the Nolichucky River. Drainage exits the Facility's Protected Area through two (2) sluice gate valves into Martin Creek. The gates are in place to allow the flow to be stopped in the event of a spill of hazardous material.

Figure 3 (Liquid Effluent Discharge Points) shows the stormwater liquid effluent discharge points for the NFS Erwin Facility.

4. **Radioactive Solid Waste Management:** The Facility contains various former on-site disposal and storage locations for process wastes and for radioactively contaminated soil and sediment (**Figure 4**, Former Waste Disposal and Storage Areas). No new waste material has been added to these areas since 1978. Currently waste generated on-site is packaged for off-site burial at a licensed radioactive waste disposal facility. Prior to 1978, several on-site areas were used for radioactive material disposal. These are briefly described below.

   - The Pond 4 Disposal Area – Former process waste burial area. Removal of waste and contaminated soil in this area is complete.
   - Surface Impoundments (ponds - Three surface impoundments were used for liquid process waste treatment prior to the start-up of the NFS WWTF in 1978. Sludge and sediment from the bottom of these former ponds was removed during the period of 1991 to 1994. They have been drained and excavation of contaminated soil is completed.
   - The North-Site Burial Grounds - This was a former 10 CFR Part 20.304 process waste burial area. Materials buried in the trench included process wastes, laboratory trash, contaminated equipment, and construction rubble. Remediation of the Demolition Landfill and Radioactive Burial Ground began in April 1997. Excavation of debris and soil is complete.
   - The Southwest Burial Trenches - Two former burial trenches containing low-level uranium and thorium contaminated scrap metals and equipment. Excavation of debris and contaminated soil is complete.

   In addition to the above disposal areas, a soil mound that was used for storage of sediment and soil with elevated radioactivity levels from the relocation of Banner Spring Branch has been removed to a licensed off-site disposal site and excavation is complete.

5. **Mixed Waste Management**: NFS manages "mixed" waste (hazardous waste which is radioactively contaminated) in accordance with applicable federal and state hazardous waste management regulations. NFS has a Hazardous Waste Management Facility permit, issued by the Tennessee Department of Environment and Conservation's (TDEC) Division of Solid Waste Management, which allows storage of specific kinds of mixed waste in containers. Most of the mixed waste stored on-site is mercury contaminated waste (waste code: D009) generated by NFS laboratory operations. Much smaller amounts of other mixed wastes (including waste codes: D008, D038, D039) are also stored.

The corrective action conditions for the solid waste management units (SWMU) and areas of concern (AOC) are also included as part of the permit. NFS is required to notify TDEC and investigate any releases of hazardous waste or hazardous constituents at the facility and to take appropriate corrective action for any such releases.

NFS periodically conducts mixed waste treatability studies in accordance with applicable federal and state regulations. Such studies have been performed on waste generated by NFS.

6. **Non-Radioactive Hazardous Waste**: NFS generates hazardous waste which is not radiologically contaminated. In accordance with applicable regulations, NFS temporarily stores such waste on-site and then ships it to an authorized off-site treatment, storage or disposal facility.

7. **Non-Radioactive/Non-Hazardous Waste**: NFS generates non-radioactive/non-hazardous waste (such as waste oil, paper and cafeteria waste) in the normal course of operations. All waste materials are shipped off site for treatment, recycling and/or disposal at appropriate facilities.

Emergency Preparedness

NFS maintains a detailed Emergency Plan, which specifies accidents with potential off-site consequences. The accidents with potential for off-site consequences are: nuclear criticality, UF_6 release, uranium solution release, major fires, anhydrous hydrogen fluoride (AHF) release, anhydrous ammonia release, natural phenomena and security emergencies. With the exception of a criticality accident, accidents at NFS are of comparable probability, nature and magnitude with those of non-nuclear chemical processing operations. NFS facilities are designed with extensive engineering and administrative safeguards to preclude most accidents.

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Environmental Releases

NFS has engineered and administrative controls in place to prevent and mitigate environmental releases. Implementation of these plans is supported through on-going training of NFS personnel at all levels. The effectiveness of these plans, in combination with NFS' overall operating procedures is demonstrated by the low number of releases that occurred during the current license period and the short- and long-term responses taken when a release occurred or threatened to occur.

Table 2 (Environmental Releases which Triggered an Outside Notification) provides information addressing environmental compliance events that triggered outside notification from June 1996 through December 2020. NFS experienced fifteen (15) events during this period, requiring outside notification. Of these, four (4) events exceeded permit limits (Erwin POTW); however, none of these events resulted in a violation of Federal standards. The August 3, 2000, event was caused by a non-representative sample and thus did not result in a radioactive material release. None of these events had a significant and/or lasting impact on the environment.

Safeguards

NFS provides nuclear material safeguards in accordance with the requirements set forth in 10 CFR Parts 70 and 73.

The NFS material accounting and control program includes facility organization requirements, material control arrangements, accountability measurements, statistical controls, inventory methods, shipping and receiving procedures, material storage practices, records report requirements, and management controls.

The NFS physical security and protection program has provisions for both "fixed site" and "material in transit".

2.1.3 Reasonable Alternatives

The alternative of not amending the SNM-124 license to include the Uranium Purification and Conversion Services will result in the work having to be conducted elsewhere, which provides no environmental benefit, an increase in area unemployment, and a potential increase in United States Fuel manufacturing costs. Additionally, for this work to be conducted at another site, it is likely that a significant environmental impact might be incurred due to construction and start-up activities, since other currently available licensable facilities are limited.

Table 2. Environmental Releases which Triggered an Outside Notification

Date	Event	Agency Notified	NFS Response
8/29/97	Ground Water leak during transfer to WWTF	TDEC NRC	Line leak was caused by weight of a large rock on the discharge line. The line was repaired.
9/4/98	Sewer discharge to Erwin POTW exceeded Gross Beta limits of 300 picocuries per liter of air (pCi/l).	Erwin Utilities NRC	A sanitary sewer manhole near a building being decommissioned was determined to be the cause. The line was capped and filled with concrete. The action was effective.
5/12/99	Sewer discharge to Erwin POTW exceeded 25 pCi/l for ^{238}U	Erwin Utilities NRC	The cause was determined to be a leak in a laboratory sump and adjacent manhole. The items were repaired.
8/3/00	The May 2000 monthly isotopic composite sample result for WWTF discharges was elevated.	NRC	Terminated WWTF discharges. Investigated cause and validity of sample results. The composite sample was not representative. Procedures and training were modified to address the issue.
8/8/00	Groundwater infiltration caused an overflow of lab wastewater pit	TDEC NRC	Sealed the sump to prevent ground water infiltration
11/29/00	A defect in the floor trench of the WWTF was identified during an inspection	TDEC	Repaired defects
9/22/03	The WWTF discharged a batch with elevated nitrite plus nitrate attributes	TDEC	Reinstruction of operation
2/05 & 3/05	Sewer discharge to the EPOTW exceeded the Technical Review Criteria and the monthly Average permit limit for U-238 in March 05.	EPOTW NRC	Plugged abandoned sanitary sewer line.
2/5/09	Sanitary sewage leak from a portable toilet into the storm water drainage system.	TDEC	Sanitary sewage leak was caused by freezing temperatures. The following corrective actions were taken: 1. Portable toilet removed from plant site; 2. Freeze protection implemented on portable structures with exposed piping; 3. Enhanced monitoring schedule on portable structures; and 4. Storm Water Pollution Prevention Plan reviewed and no revision necessary.
4/28/10	Water and molasses leached from a ground water monitoring well into the storm water drainage system.	TDEC	A 1% molasses and 99% water solution injected into groundwater monitoring wells migrated into a storm water ditch. The following corrective actions were taken: 1. Well injection stopped; 2. Solution pumped from storm water ditch; 3. Absorbent materials applied; 4. pH and radiological samples collected; and

Date	Event	Agency Notified	NFS Response
			5. Investigation implemented.
10/4/10	Water and molasses leached from a ground water monitoring well into storm water drainage system.	TDEC	A 3% molasses and 97% water solution injected into groundwater monitoring wells migrated into a storm water ditch. The following corrective actions were taken: 1. Well injection stopped; 2. Solution pumped from storm water ditch; 3. Absorbent materials applied; 4. pH and radiological samples collected; and 5. Investigation implemented.
5/3/18	City water and soil were discharged into a storm water drainage system.	TDEC	A break in a fire water line caused city water and soil to be discharged into a storm water ditch. The following corrective actions were taken: 1. Storm water sluice gates were closed; 2. City water shut off; 3. Water and soil removed from storm water drainage ditch; and 4. pH and radiological samples collected.
8/29/18	Water and emulsified vegetable oil leached into the storm water drainage system.	TDEC	A 3% emulsified vegetable oil and 97% water solution injected into to a groundwater monitoring well migrated into a storm water ditch. The following corrective actions were taken: 1. Well injection stopped; 2. Solution pumped from storm water ditch; 3. Absorbent materials applied; 4. pH and radiological samples collected; and 5. Investigation implemented.
12/9/19	Sanitary Sewer pH of 9.14 standard units (su) exceeded the permit limit of 9.0 su.	Erwin Utilities	The following corrective actions were taken: 1. pH samples were analyzed twice; 2. Maintenance activities and facility boiler discards for 12/6-8/2019 were evaluated; 3. Analytical quality control verified; and 4. Follow-up samples collected and analyzed from 12/10-16/20.
7/23/20	Rupture of a hydraulic seal on a facility elevator, released hydraulic fluid into the storm water drainage system. The hydraulic seal ruptured occurred during a large rain event.	TDEC	The following corrective actions were taken: 1. Spill containment measures were immediately implemented in the storm water drainage system, in Banner Spring Branch and Martin Creek; 2. Elevator placed out of service until repaired; and 3. Investigation into cause of seal rupture and overflow discharge point location. 4.

Date	Event	Agency Notified	NFS Response
9/9/2021	Groundwater treatment injection mixture leached into the storm water drainage system	TDEC	A groundwater treatment injection mixture leached into the storm water drainage system. The following corrective actions were taken: 1. Well injections stopped; 2. Solution pumped from storm water ditch; 3. Absorbent materials applied; 4. pH and radiological samples collected; 5. Investigation implemented

Source:
Various NFS notifications to outside agencies

Figure 3. Liquid Effluent Discharge Points

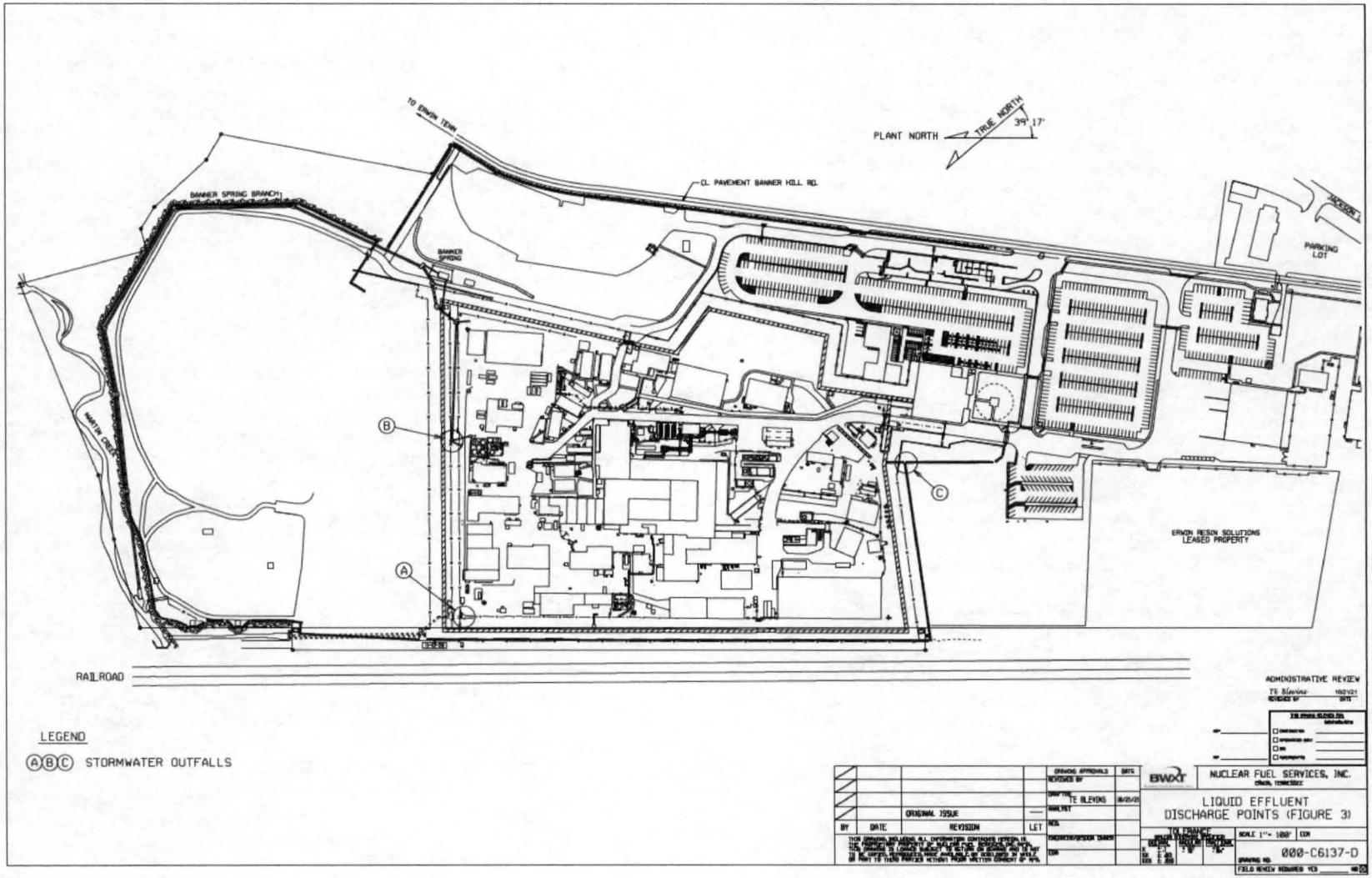
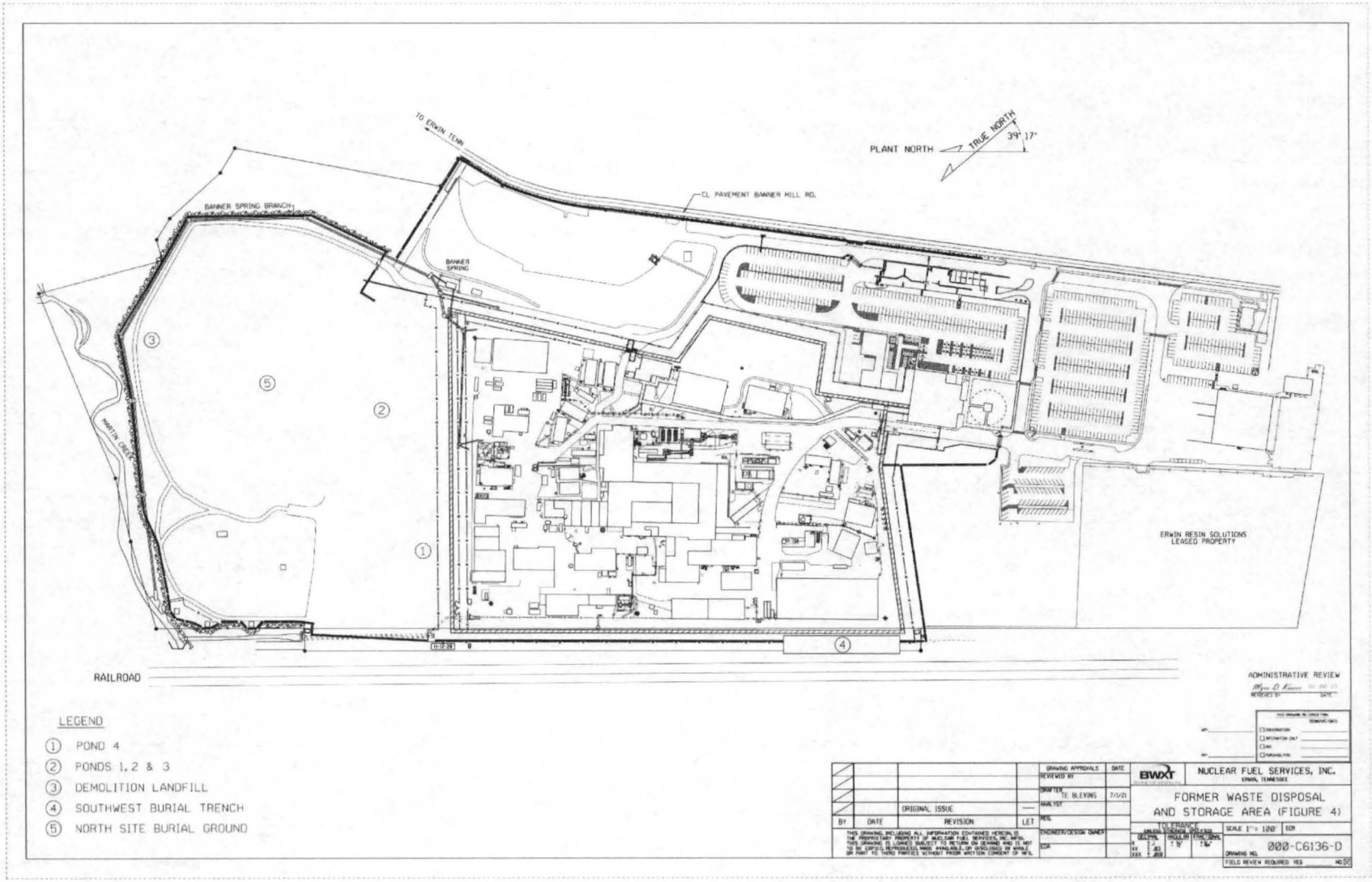


Figure 4. Former Waste Disposal & Storage Area



3.0 Description of the Affected Environment

3.1 LAND USE

The NFS Erwin Facility utilizes about 78.1 percent of the 81.9-acres site area for licensed activities and includes process buildings, warehouses, offices, parking lots, and waste management areas. The remainder of the Facility consists of open fields and small areas of woods and/or brush. **Table 3** (NFS Erwin Facility Land Use) provides a breakdown of the land use by size and percent of total Facility area.

Table 3. NFS Erwin Facility Land Use

Use	Size (acres)	Percent of Site
Buildings and grounds	38.1	46.5
Former waste ponds and solid waste burial grounds	17.3	21.1
Parking lot	8.6	10.5
Open fields	17.0	20.8
Woods and brush	0.9	1.1
Total	81.9	100

Source:
Google Earth Imagery, October 17, 2019

3.1.1 Adjacent Areas

The land within a one-mile radius of the Facility is dominated mainly by residential use, followed by public and semi-public uses, and agriculture. The Riverview Industrial Park is located west of the NFS Erwin Facility adjacent to the CSX railroad, which bounds the western side of the Facility. Interstate 26 lies west of the industrial park and is adjacent to the east bank of the Nolichucky River, a popular recreational area. The northern portion of the Facility is bounded by Martin Creek and a small woodlot that separates the NFS Erwin Facility from residential properties. The area east of the Facility consists of various residential and commercial properties, including the Erwin State Trout Hatchery that is located approximately 600 feet east of the Facility. The area south and west of the NFS Erwin Facility is bounded by Jackson Love Highway and further residential and commercial development. **Table 4** (Land Use within a 1-Mile Radius of the NFS Erwin Facility) provides a breakdown of the percent land use within this area.

Table 4. Land Use within a 1-Mile Radius of the NFS Erwin Facility

Use	Percent of Area
Residential	23.7
Public and Semi-public Uses	19.2
Agricultural	16.3
Timber/Forest	9.5
Vacant	8.5
Transportation	8.4
Industrial	6.2
Commercial	5.1
Water	3.1
Total	100

Source:
TN Comptroller Digital Parcel and CAMA Data 2/4/2019

Locally important crops include hay, corn, tomatoes, strawberries, and apples (USDA 2017). In 2015, total direct agricultural output was estimated to be $15.7 million and 148 people were employed in county agriculture (UT 2018).

3.2 TRANSPORTATION

The NFS Erwin Facility is located in the Town of Erwin, in Unicoi County, which is in the northeastern portion of the State of Tennessee (**Figure 1**, NFS Erwin Facility Location). The Facility is accessed by Interstate 26 via Jackson Love Highway and Carolina Avenue from the southwest; a CSX Railroad line on the northwest boundary (to support licensed activities including radioactive waste shipments); and Banner Hill Road on the southeast boundary. The NFS Erwin Facility is approximately 0.6-mile, by road, to Interstate 26.

3.3 GEOLOGY AND SOILS

3.3.1 Physiography and Geography

The NFS Erwin Facility lies in the Valley and Ridge physiographic province of northeastern Tennessee. The stratigraphy of the area is very complex because much folding and faulting has occurred. The topography consists of a series of alternating valleys and ridges that have a northeast-southwest trend, with the Facility occupying a valley (USDA 1985).

Three dolomite formations underlie the valley: the Shady, Knox, and Honaker Formations. They are associated with a large band of sandstone, siltstone, shale, dolomite, and limestone called the Rome Formation. Large areas of these formations are covered by deep soils found in the colluvium from the adjacent mountains and alluvium from larger streams. The present topography of the valleys is the result of stream erosion of softer shales and limestones; the ridges are underlain by the more resistant shale, sandstone, and quartzite. Metamorphic and intrusive rocks of the Blue Ridge physiographic province lie southwest and southeast of the NFS Erwin Facility (USDA 1985).

3.3.2 Foundation Geology

The bedrock strata at the NFS Erwin Facility are consolidated, providing firm foundations for buildings that lie directly on the strata or that are supported by footings. Structures that are constructed on the unconsolidated alluvium from the former flood plain and terraces of the Nolichucky River are subject to settlement during the first 2 to 3 years after construction (NRC 1991).

The NFS Erwin Facility is not likely to experience slope failure. Such failures are common in the mountainous terrain surrounding the site, but not on the former flood plain where slopes are flat. Structures are set back sufficiently from the Nolichucky River to avoid destabilization by erosion or slope failures along the riverbank (NRC 1991).

3.3.3 Mineral Resources

The principal mineral resources of Unicoi County are sand and gravel used by the construction industry, and metallurgical grade manganese, and iron ore (NRC 1991d). Extraction of sand and gravel from the bed and flood plain of the Nolichucky River and North Indian Creek began in the 1940s and was more or less continuous until the mid-1970s when large-scale operations ceased. Manganese deposits are

contained mostly in the clay rich residual soils of the Shady Dolomite. Manganese is also found in residual soils of the Honaker Dolomite and lower portions of the Rome Formation. Manganese mines began producing near the end of World War II. Many manganese deposits in the area remain untapped. Small iron ore deposits were mined before World War I, but the industry was unable to sustain itself.

3.3.4 Seismicity

The NFS Erwin Facility lies in the moderately active Appalachian Tectonic Belt. The United States National Seismic Hazard Model indicates the NFS site is located in an area of moderate seismic hazard (USGS 2018). The Facility is cut by many inactive faults formed during the late Paleozoic Era. There is no evidence of capable faults (as defined by 10 CFR Part 100) in the immediate area of the NFS Erwin Facility. The nearest capable faults are located 62.1 miles southwest and 124 miles northeast of the Facility. Strong earthquakes originating in more active regions southwest of the Facility have been felt in eastern Tennessee, but no damage has been experienced at the Facility (DOE 1996). A maximum horizontal ground surface acceleration of 0.18 gravity at the Facility is estimated to result from an earthquake that could occur once every 2,000 years. The buildings at the NFS Erwin Facility that are utilized for processing significant quantities of radioactivity were designed to withstand an earthquake with an acceleration of 0.18 gravity (NFS 1996b and 2007 ISA Summary Report).

3.4 WATER RESOURCES

3.4.1 Surface Water

There are four major surface water bodies in the vicinity of the NFS Erwin Facility: Banner Spring Branch, North Indian Creek, Martin Creek, and the Nolichucky River. Banner Spring Branch is located entirely within the Facility and is completely enclosed inside an underground pipe. North Indian Creek is located north of the Facility boundary; Martin Creek is just beyond the Facility's north boundary; and the Nolichucky River is located west of the Facility boundary (**Figure 5**, Surface Water Bodies in the Vicinity of the NFS Erwin Facility).

In 2005, Banner Spring Branch was enclosed inside an underground pipe to prevent contamination, during decommissioning activities. It is a small spring-fed stream that flows east at a rate of approximately 0.35 to 0.71 cubed feet per second (ft^3/s). It empties into Martin Creek at the Facility boundary. Banner Spring Branch is approximately 1,700 feet in length from source to confluence with Martin Creek. Banner Spring Branch receives input from the NFS Erwin Facility surface water run-off.

Martin Creek is fed from mountain springs, rain, and snow melt drainage from Martin Creek Hollow. The flow of the creek varies seasonally from 2.11 to 11.0 ft^3/s. Martin Creek empties into North Indian Creek approximately 3,500 feet north of the NFS site, and North Indian Creek empties into the Nolichucky River approximately 4,000 feet downstream of the Facility.

The Nolichucky River is formed by the North Toe River and the Cane River in Yancey and Mitchell Counties. The river flows west from North Carolina and southwest through Tennessee to join the French Broad River, whose watershed forms part of the upper Tennessee River Basin.

The 99-year average flow of the Nolichucky River is 1,394 ft^3/s as measured at the Embreeville USGS gauge station located approximately 2.2 miles (mile 96.8) downstream of the NFS NPDES permitted WWTF Outfall 001. The highest peak flow since May of 1901 was on November 6, 1977, when the Nolichucky

River reached a gauge height of 21.52 feet with a flow velocity of 110,000 ft^3/s. The lowest annual mean stream flow recorded at the Embreeville gage station was 656.9 ft^3/s in 1988 (USGS 2021). A thirty-year low annual river flow at Outfall 001 was calculated to be 589 ft^3/s (16.7 m^3/s) (NFS 2001d).

The NFS Erwin Facility is not within the 100-year floodplain of the Nolichucky River. Development and related activities over the last 30 years have changed the topography in such a way to preclude the Facility from being within the 100-year floodplain for the river. For example, the construction of US Routes 19/23, and the re-channeling/increase in depth of the river, which accompanied the highway construction combined with the re-routing of Martin Creek to enter the Nolichucky River downstream of the Facility, have had the indirect effect of protecting the Facility from a 100-year flood of the Nolichucky River. A significant flood of the Nolichucky River (92% of greatest recorded flow) which occurred in 1977 did not result in the flooding of any building at the Facility.

Currently, the northern portion of the NFS Erwin Facility is depicted as being within the 100-year floodplain of Martin Creek (which flows adjacent to the northern boundary) on 2008 National Flood Insurance Maps issued by FEMA. Martin Creek passes through a culvert at the CSX Railroad to the north of the Facility. In the past, the size of this culvert was inadequate during high flow floods, causing a backwater or damming effect on the northern portion of the Facility nearest the culvert. In 1990, the culvert was enlarged to accommodate expansion of the railroad. Additionally, grading has been performed on the north side since 1979 which is year the survey was performed to develop the effective Base Flood Elevation. Finally, newer more accurate field survey and LIDAR data was used to perform the 2021 ARCADIS floodplain analysis. This analysis shows the 100-year Base Flood Elevation (BFE) immediately upstream of the railroad is 3.38 feet higher than the effective BFE at this location and is 3.03 feet lower than the effective BFE approximately 1,500 feet upstream of the railroad near Spar Mill Road. The effective Flood Insurance Rate Map 47171C0068C depicts the Facility within the 100-year floodplain of Martin Creek (FEMA 2008). The 2021 ARCADIS Floodplain study shows that the Facility's Protected Area is completely outside of the 100-year floodplain and that much of the northern portion of the NFS property is also outside of the 100-year floodplain. A portion of the northern part of the site, 600 feet off Martin Creek along the railroad, and a small section along the Protected Area wall is within the 100-year floodplain based on 2021 ARCADIS floodplain analysis.

As part of decommissioning activities in 2010, two (2) small wetlands totaling approximately 0.35-acre were filled under an Aquatic Resource Alteration Permit (NRS09.332). As conditions of the permit, NFS was required to restore 0.7 acre of wetlands at a nearby site and to purchase 0.7 acre of credits from a wetland mitigation bank (Shady Valley Wetland Mitigation Bank). No wetlands are currently present on the NFS Erwin Facility.

Quality

The streams and creeks of Tennessee are classified by the TDEC. The classifications are defined in the State of Tennessee Water Quality Standards. Classifications are based on water quality, designated uses, and resident aquatic biota. Banner Spring Branch, Martin Creek, and the Nolichucky River are all classified for fish and aquatic life, livestock watering and wildlife, irrigation, and recreation. The Nolichucky River is also classified for industrial use and as a domestic water supply (TDEC 2019).

NFS has three outfalls covered by NPDES permits. One outfall carries process-related effluents while the two others carry (covered by separate permits) storm water. In addition, NFS discharges sanitary wastewater to the EPOTW in accordance with Industrial Pretreatment Permit (013) issued by Erwin

Utilities. **Table 5** gives the approximate discharge volumes and, where applicable, the volume allowed to be discharged under each permit.

Table 5. NFS Permitted Outfalls

Outfall	Average Output (L/yr)	Discharge Location
Wastewater Treatment Facility (NFS)	7,043,437	Nolichucky River (TN0002038)
Storm water (NFS)	N/A	Banner Spring Branch & Martin Creek (TNR050873)
Sanitary Sewer (NFS)	41,837,157	Erwin POTW (013)

Source:
NFS EDMS 2009-2020

The ambient non-radiological water quality characteristics are summarized in **Table 6** (Non-Radiological Surface Water Quality). Non-radiological characteristics for Banner Spring Branch, Martin Creek, and the Nolichucky River are not routinely measured; however, 2002 chemical data is presented in **Table 6**. The results are typical for the area. Martin Creek water quality is likely to be affected by the Creek's passage through the Erwin Fish Hatchery located approximately 600 feet upstream from the NFS Erwin Facility.

Table 6. Non-Radiological Surface Water Quality

Parameter	Water Quality Benchmark [a] (mg/l)	Nolichucky River [c] (mg/l)	Banner Spring Branch [c] (mg/l)	Martin Creek [c] (mg/l)
Ammonia	N/A	<0.36	<0.333	<0.331
Fluoride	4 [d]	0.417	0.387	0.303
Mercury	0.002 [e]	<0.0002	<0.0002	<0.0002
Nitrate/Nitrite	10 [d]	0.424	1.821	1.059

Notes:
[a] For comparison only, unless noted referenced value is from applicable TDEC water quality criteria and standard
[b] Data from 2002 water samples downstream of NFS discharge
[c] National Secondary Drinking Water Standard (40 CFR Part 141)
[d] National Primary Drinking Water Standard (40 CFR Part 143)
[e] Tennessee State Water Quality Standards

Use

Banner Spring Branch and its source, Banner Hill Spring, are located entirely on the NFS Erwin Facility within the Owner Controlled Area. The Branch receives discharge from the NFS storm water system at a point near its confluence with Martin Creek. Banner Spring Branch is completely enclosed inside a pipe and discharges into Martin Creek on the northside of the NFS Erwin Facility.

The main portion of Martin Creek, which is upstream of NFS, is used for recreational fishing. Fishing in the portion of Martin Creek near the NFS Erwin Facility is infrequent due to limited access. About 600 feet upstream from NFS is a State-operated fish hatchery located on Love Spring Branch, a tributary to Martin Creek. The hatchery requires over 1 million gallons per day to operate. The creek is not classified as a trout stream by the State of Tennessee, nor is it used as a potable water source. It is, however, classified for fishing, recreation, irrigation, livestock watering, and wildlife use.

The Nolichucky River in the vicinity of the NFS outfall is classified for domestic water supply, industrial, fishing, recreation, irrigation, livestock watering, and wildlife use. The City of Jonesborough is the nearest municipal user of the water as a source of drinking water (approximately 1 million gallons/day). The City

of Jonesborough Treatment Plant's water intake is approximately 8 miles downstream from the NFS discharge point. The closest known crop irrigation use of river water occurs over 10 miles downstream of the NFS discharge. Irrigation is rare due to the adequacy of rainfall in this area for crop production. Irrigation is primarily used in the spring and fall to reduce crop damage from frost (e.g., strawberries and tomatoes) and to extend the growing season and preserve the quality of tomato crops. Recreational use of the Nolichucky River includes fishing (bass, walleye, and catfish), boating (canoeing/rafting), swimming, and picnicking. The Erwin Utilities POTW discharges into the same reach of the Nolichucky River, as does NFS.

3.4.2 Groundwater

Quality

The groundwater quality in the area is generally good. The principal dissolved constituents of the groundwater are calcium, magnesium carbonate, and bicarbonate, regardless of the production zone geology. This reflects the regional influence of dolomitic host rocks on groundwater quality.

Data on the ambient non-radiological water quality is summarized in **Table 7** (Ambient Non-Radiological Groundwater Quality). Ambient non-radiological characteristics for groundwater are assessed routinely by measurements of an up-gradient well (NFS well #52).

Table 7. Ambient Non-Radiological Groundwater Quality

Parameter	Unit	Water Quality Benchmark [a]	Up-gradient Well [b]
Fluoride	mg/l	4 [c]	0.14
Mercury	mg/l	0.002 [e]	0.0002
Sulfate	mg/l	250[d]	12.0
Tetrachloroethylene (PCE)	mg/l	0.005 [c]	0.6922
Temperature	°C	N/A	14.40
Total organic carbon	mg/l	N/A	1.0

Notes:

[a] For comparison only

[b] Average of available data for well #52 from June 1996 through 2008. Nitrate/Nitrite, chloride, and Phosphate were not collected during this time period.

[c] National Primary Drinking Water Standards (40 CFR Part 141)

[d] National Secondary Drinking Water Standards (40 CFR Part 143)

[e] Tennessee State Water Quality Standards

Use

Groundwater elevation measurements and modeling indicate that, generally, groundwater flows in a northwest direction towards the Nolichucky River, which is a major discharge zone for the groundwater flowing beneath the NFS site. There are no known household, public, or industrial users of groundwater down gradient of the site (GMI 1996).

Most drinking water sources are provided by the local municipality; however, wells and springs are an important source of water supply for individuals and several communities in the area (Erwin and Chestoa quadrangles). A water-well survey has been performed for the NFS Erwin Facility consisting of a TDEC - TN Water Well Desktop Application [3.0-PUBLIC] records search for the surrounding area. The TDEC records are the most comprehensive water well survey in Tennessee, are traceable to individual users, and provide sufficient information to evaluate well installation practices. The state of Tennessee requires

domestic wells to be cased and to be developed in the most favorable water quality source available. Review of the TDEC records indicate that domestic wells are cased and installed in bedrock formations to tap water present in the deeper portions of the aquifer. Because public water well locations are considered confidential, a separate wellhead/source water request was sent to the TDEC Division of Water Resources (DOWR).

The well search consisted of determining water wells located within a 1-mile radius and 3-mile radius of the NFS facility. One public water system wellhead protection area (DOWR 2021) and two residential wells were listed within 1 mile from the NFS Erwin Facility (**Table 8**, TN Water Well Desktop Application and DOWR Search within 1 Mile of NFS Erwin Facility). The public groundwater well, approximately 0.75-mile northeast (up gradient) of the NFS Erwin Facility, is owned by Erwin Utilities and is listed as the Railroad Well. Modeling done in 1996 indicated that groundwater withdrawn from the Railroad Well does not originate beneath or down-gradient from the NFS Erwin Facility (GMI 1996). The two residential wells are located approximately 0.9-mile (Resident 1) and 1-mile (Resident 2) south of the NFS Erwin Facility. No other wells were identified from the database within 1 mile from the NFS facility. The DOWR also noted that the 1-mile area of interest around the NFS Erwin Facility falls within the Jonesborough Water Department Source Water Protection Area.

Table 8. TN Water Well Desktop Application and DOWR Search within 1 Mile of NFS Erwin Facility

Name	Source	Water Source Type
Erwin Utilities	Railroad Well	Groundwater
Resident 1	Residential Well (April 22, 2021)	Groundwater
Resident 2	Residential Well (May 30, 2002)	Groundwater

Note:
Five NFS monitoring wells have been excluded from the results presented in **Table 8**.
Sources:
Tennessee Department of Environment and Conservation - TN Water Well Desktop Application, July 16, 2021
Division of Water Resources 2021

Four public wellhead protection areas within a 3-mile radius of the NFS Erwin Facility were identified by the DOWR (DOWR 2021) (**Table 9**, TN Water Well Desktop Application and DOWR Search Within 3 Miles of NFS Erwin Facility). The four public water intakes are listed as a groundwater source or groundwater under the direct influence of surface water source. Erwin Utilities obtains water from two wells (one of which is the Railroad Well) and one spring located northeast of the Facility. In addition to the two residential wells, noted above, located within one mile of the Facility there were seven residential wells, two test wells, one commercial well, one irrigation well, and one well with an undefined use within three miles of the Facility. The DOWR also noted the 3-mile area of interest around the Facility falls within the Jonesborough Water Department, USA Raft, and Nolichucky Gorge Campground Source Water Protection Areas.

Table 9. TN Water Well Desktop Application and DOWR Search within 3 Miles of NFS Erwin Facility

Name	Source	Water Source Type
Erwin Utilities	Birchfield Well	Groundwater Under Direct Influence of Surface Water
Erwin Utilities	O'Brien Spring	Groundwater Under Direct Influence of Surface Water
Erwin Utilities	Railroad Well	Groundwater
Resident 3	Residential Well (October 21, 2009)	Groundwater
Resident 4	Residential Well (September 8, 1994)	Groundwater
Unicoi County School Board/ New Middle School	Commercial Well (February 19, 2008)	Groundwater

Name	Source	Water Source Type
Resident 5	Residential Well (May 21, 2019)	Groundwater
Erwin Utility District	Test Well (February 11, 1993)	Groundwater
Erwin Utility District	Test Well (October 28, 1993)	Groundwater
Resident 6	Residential Well (July 29, 1998)	Groundwater
Resident 7	Residential Well (July 28, 2019)	Groundwater
Resident 7	Undefined (July 31, 2019)	Groundwater
Resident 8	Residential Well (March 21, 1995)	Groundwater
Resident 9	Residential Well (April 30, 1995)	Groundwater
Unicoi County School Systems	Irrigation Well (April 30, 2009)	Groundwater

Note:
Five NFS monitoring wells have been excluded from the results presented in **Table 9**.
Source:
Tennessee Department of Environment and Conservation - TN Water Well Desktop Application, July 16, 2021

3.5 ECOLOGICAL RESOURCES

3.5.1 Terrestrial Biota

Plant communities at the NFS Erwin Facility are characteristic of the intermountain regions of central and southern Appalachia. Major forest types in the Erwin area are oak-hickory, oak-pine, and white pine (NRC 1991e). Valley floors, mountains, and mountain coves have their individual characteristic vegetation types. The natural vegetation in the vicinity of the Facility is a forest community dominated by red or white oak with subdominants including yellow poplar, hickories, other oaks, and some southern pine species (NRC 1991f).

The NFS Erwin Facility lies within Indian Creek Valley. Plant communities in this valley consist of second growth forests and open grassy areas. Most of the Facility is occupied by buildings, building grounds, and open fields. Limited areas consist of woods, shrub swamp, and brush. Nearby mountainous areas are largely undisturbed and support extensive forests and wildlife resources (NRC 1991).

The terrestrial fauna of the Erwin region includes a large number of vertebrate species including 70 mammals (NRC 1991g), 140 birds (NRC 1991h), 35 reptiles, and 34 amphibians; however, most of these species would not be expected to occur in the Indian Creek Valley because of extensive disturbance and lack of natural habitats. Eastern cottontails, mourning doves, and northern bobwhites are present in most areas within the Indian Creek Valley (NRC 1991). The woods, swamps, and brushy areas on-site or in the vicinity are likely to support some smaller wildlife species. Common species in the region include European starling, northern cardinal, mourning dove, Carolina chickadee, opossum, eastern cottontail rabbit, and house mouse. Important game species of the region include whitetail deer, eastern gray squirrel, ruffed grouse, and wild turkey, which occur in the forests of the surrounding mountains but are not common on-site. Carnivores, such as the gray fox, and raptors, such as the red-tailed hawk, are ecologically important groups in the vicinity of the Facility (DOE 1996).

3.5.2 Aquatic Biota

Aquatic habitat on or adjacent to the NFS Erwin Facility ranges from the Nolichucky River to several small streams. Banner Spring Branch contains several species of minnows where it converges with Martin Creek. Martin Creek is typical of creeks in eastern Tennessee. The stream bed is composed of sand, pebbles, rocks, and some organic matter. A state-operated fish hatchery is located on a tributary to Martin Creek approximately 600 feet upstream of the Facility. The Nolichucky River in the Erwin vicinity

contains a substrate of rocks, sand, boulders, and some aquatic moss. Riffles and large pools provide good smallmouth bass habitat. Other fish species present in the Nolichucky River include olive darters, catfish, largemouth bass and spotted bass, central stonerollers, and white crappie (DOE 1996).

3.5.3 Threatened and Endangered Species

No state or federally listed threatened or endangered species are known to occur on-site. The United States Fish and Wildlife Service's (USFWS) Information for Planning and Consultation (IPaC) database was consulted to determine the potential presence of federally listed threatened and endangered species in the vicinity of the NFS Erwin Facility. A Request for Environmental Review was submitted to the TDEC on July 15, 2021, to obtain information on any documented occurrences of state or federally listed threatened or endangered species in the vicinity of the Facility. The IPaC database indicates that five listed animal species and one listed plant species could potentially be impacted by activities at the Facility (USFWS 2021). The TDEC's August 20, 2021, response indicates that seven state-listed plant and animal species have been documented within one mile of the Facility. Additional species are documented by TDEC within four miles of the Facility; however, no impacts to any species are anticipated at such a great distance from the Facility. The TDEC species list does not document occurrences of any IPaC identified species within one mile of the Facility. Listed plant species are not afforded legal protection unless located on TDEC lands (in the case of state listed species) or federal lands (in the case of federally listed species). The seven federal and/or state listed threatened or endangered species that potentially occur in the region are presented in **Table 10** (Federal and State Listed Threatened and Endangered Animal Species). IPaC did not indicate a need to analyze potential effects to established critical habitat(s) for any of these species.

Table 10. Federal and State Listed Threatened and Endangered Species

Common Name	Scientific Name	Status – Federal	Status - State
Gray bat	*Myotis grisescens*	E [a]	E
Indiana bat	*Myotis sodalis*	E [a]	E
Northern long-eared bat	*Myotis septentrionalis*	T [a]	T
Appalachian elktoe	*Alasmidonta raveneliana*	E [a]	E
Cumberland bean	*Villosa trabalis/Venustaconcha trabalis*	E [a]	E
Virginia Spiraea	*Spiraea virginiana*	T [a]	E
Mountain bush-honeysuckle	*Diervilla sessilifolia var. rivularis*	--	T [b]
Cow-parsnip	*Heracleum maximum*	--	S [b]
Southern nodding trillium	*Trillium rugelii*	--	E [b]
Carolina hemlock	*Tsuga caroliniana*	--	T [b]
Highfin carpsucker	*Carpiodes velifer*	--	D [b]
Allegheny woodrat	*Neotoma magister*	--	D [b]
Tangerine darter	*Percina aurantiaca*	--	D [b]

Notes:

[a] Listed as potentially occurring in the vicinity of the NFS site by IPaC.

[b] Occurrence records indicated by TDEC within one mile of the site.

Status codes: E = endangered; NL = not listed; T = threatened; S = Special Concern; D = Deemed in Need of Management.

Sources:

50 CFR Part 17.11

TWRA 2016

3.6 METEOROLOGY, CLIMATOLOGY, AND AIR QUALITY

3.61 Meteorology

The average annual precipitation in the Erwin area is 47.0 inches. The average annual snowfall in the Erwin area is 9.3 inches (NOAA 2021a). Prevailing winds tend to follow the southwest to northeast orientation of the valley and the average wind speed (as measured at the nearby Tri-Cities Airport over the period from 1984 to 2018) is 6.9 miles per hour (mph) (NOAA 2019).

Winds, Tornadoes and Storms

Severe storm conditions are rare in the Erwin region, which is east of the center of tornado activity, south of most blizzard conditions, and too far inland to be affected by hurricanes (NRC 1991a). Only two tornadoes have been recorded in Unicoi County since 1950 (NOAA 2021b). One tornado occurred on July 10, 1980, on the eastern end of Unicoi County approximately 6 miles from the NFS Erwin Facility. The tornado magnitude was an F3, with wind gusts of between 162-209 mph, twelve (12) individual injuries occurred, no deaths were reported, with property damage of $250K, and with no crop damage occurring (NOAA 2021b). A second tornado occurred on April 09, 2011, on the southern end of Unicoi County approximately 8 miles from the Facility. The tornado magnitude was an F0, with a maximum wind speed of 70 mph, no injuries occurred, no deaths were reported, with property damage of $15K, and with no crop damage occurring (NOAA 2021b).

3.62 Climatology

The climate in the vicinity of the NFS Erwin Facility is characterized by warm, humid summers and relatively mild winters. Cooler, drier weather in the area is usually associated with polar continental air masses, whereas warmer, wetter weather is associated with gulf maritime masses (NRC 1991).

The average annual temperature is 55.4°F; the lowest average daily temperature is 35.5ºF in January; and the highest average daily temperature is 74.0°F in July (NOAA 2021a).

3.63 Air Quality

As of June 2021, Unicoi, Washington, and Carter Counties were designated as in attainment with respect to National Ambient Air Quality Standards (NAAQS), as specified in 40 CFR Part 81.343. Sullivan County was in nonattainment status for the lead standard between 2010 and 2016 and has been in nonattainment status for the sulfur dioxide standard since 2013 (EPA 2021).

One Prevention of Significant Deterioration (PSD) Class I area (as defined by 40 CFR § 52.21) can be found in the vicinity of the NFS Erwin Facility, Great Smoky Mountains National Park, which is located approximately 47 miles southwest of the Facility. The Andrew Johnson Memorial (National Historic Site), Appalachian Trail (National Scenic Trail), Over Mountain Victory Trail (National Scenic Trail), Tennessee Civil War National Heritage Area, New River (South Fork) (Wild and Scenic River), and Obed River (Wild and Scenic River) are in proximity of the Facility but do not appear to meet the requirements for classification as Class I areas. Since the promulgation of the PSD regulations (40 CFR Part 52.21) in 1977, no PSD permits have been required for any emission source at the Facility.

3.7 NOISE

The noise environment near the NFS Erwin Facility is typical of a rural location. Major noise emission sources within the Facility include various alarm systems, fixed plant equipment (e.g., pumps, blowers), and heavy equipment (tractor trailers, front-end loaders, back-hoes, etc.). The primary source of noise at the Facility boundary is from traffic, with other sources occasionally audible above background. During shift changes, the Facility traffic may be a significant contributor to noise levels in the area. The State of Tennessee and Unicoi County have not established specific numerical environmental noise standards applicable to the Facility.

3.8 HISTORIC AND CULTURAL RESOURCES

No pre-historic or historic archaeological sites have been identified on the NFS Erwin Facility. The National Register of Historic Places (NRHP) lists three sites in the Town of Erwin located in Unicoi County (NPS 2020). One is the Clarksville Iron Furnace on Tennessee State Highway 107 in the Cherokee National Forest, approximately 10 miles west of the Facility. The Clinchfield Depot located at the junction of Nolichucky Avenue and Union Street. The A.R. Brown house located at 241 South Main Avenue. The depot and the A.R. Brown house are both approximately 1 mile from the Facility.

3.9 VISUAL/SCENIC RESOURCES

The following changes have been made to the Facility since the 1980s:

- Decommissioning of portions of the Facility that started in the mid-1980s;
- Construction of the AREVA NP (BLEU Complex) Facility on the southwest side of the Facility in August 2002;
- Security wall around the perimeter of the Facility started in 2007 and completed in 2012;
- Modernization of ammonia stripping tower (2012);
- Replaced exit/entry access control point (2012);
- Redesign and installation of the main stack (2014);
- Replacement of fan house (2014);
- Decommissioning of the BLEU Complex (2018);
- Decommissioning of the northern burial ground area and surface water impoundments (2018);
- Relocation of the meteorological tower (2020);
- Addition of a new office building (2020); and,
- Relocation and modernization of Versatile Automated Gamma Assay System (VAGAS) in 2021.

The protection and preservation of scenic and environmental resources on the Facility and surrounding community are part of all construction projects.

3.10 DEMOGRAPHY AND SOCIOECONOMIC

The NFS Erwin Facility is located approximately fifty (50) miles north-northeast of Asheville, North Carolina and twenty (20) miles south of Johnson City, Tennessee. The Facility is located near the southwest boundary of the Town of Erwin, Tennessee, which has a population of 5,918 people (USCB 2019). The current population of the Town of Erwin represents an approximately 2.8 percent decrease from the estimated 2010 population of 6,091 (USCB 2019).

Table 11 (Johnson City MSA Employment Statistics) provides employment and economic information from the Johnson City Metropolitan Statistical Area (MSA).

Table 11. Johnson City MSA Employment Statistics

Regional Economic Area	May 2021
Civilian labor force	91,100
Employment	87,200
Unemployment	4,000
Unemployment Rate	4.4

Source:
United States Department of Labor, Bureau of Labor, Statistics, May 2021

Region of Interest (ROI) for the NFS Erwin Facility includes four Tennessee Counties: Carter, Sullivan, Unicoi, and Washington. The ROI economic data for 2019 is presented in **Table 12** (2019 ROI Economic Data). For comparison, the median household income for the State of Tennessee is $53,320 and 13.9% of the population is below the poverty level.

Table 12. 2019 ROI Economic Data

Location	Median Household Income (2015-2019)	Persons Below Poverty Level
Unicoi County	41,890	15.8
Carter County	38,092	19.3
Washington County	48,334	15.8
Sullivan County	46,684	15.1

Source:
US Census Bureau, Census 2019 QuickFacts

Table 13 (NFS Employee Distribution by Residence) represents the distribution of NFS employees among the ROI counties in April 2007.

Table 13. NFS Employee Distribution by Residence

County	Number	Percent of Employment by NFS
Carter	95	12.72%
Sullivan	76	10.17%
Unicoi	199	26.64%
Washington	320	42.84%
Total in ROI	690	92.37
Total Employees	747	100

Source:
NFS Department of Human Resources July 2021

Table 14 (Population Distribution and Percent Employment by NFS in Region of Interest) provides the population breakdown by County and the NFS current employment percent in each of the Counties. The total population in the ROI is 361,997 (USCB 2019). NFS provides for approximately 0.19% of the regional employment. Unicoi County has the largest percentage, at 1.11%.

Table 14. Population Distribution and Percent Employment by NFS in Region of Interest

County	Number	Percent of Employment by NFS
Carter	56,391	0.17%
Sullivan	158,348	0.05%
Unicoi	17,883	1.11%
Washington	129,375	0.25%
Total in ROI	361,997	0.19%

Source:
U.S. Census Bureau, Census 2019 QuickFacts

Table 15 (Selected Demographic Characteristics for the NFS ROI) summarizes certain demographic characteristics for the ROI. The data was obtained from the U.S. Census Bureau (USCB 2019).

Table 15. Selected Demographic Characteristics for the NFS ROI

NFS Characteristics	Carter County (%)	Sullivan County (%)	Unicoi County (%)	Washington County (%)	Total ROI (%)
White	98.95	93.42	99.50	93.13	95.80
Black or African America	0.00	2.63	0.00	6.25	3.19
Hispanic or Latino (of any race)	1.05	2.63	0.00	0.31	0.58
American Indian and Alaska Native	0.00	0.00	0.00	0.00	0.00
Asian	0.00	1.32	0.50	0.00	0.29
Native Hawaiian and other Pacific Islander	0.00	0.00	0.00	0.00	0.00
Two or more races	0.00	0.00	0.00	0.31	0.14
Median household money income [c]	$38,092	$46,684	$41,890	$48,334	$43,750 [b]
Total 2019 Population [c]	56,391	158,348	17,883	129,375	361,997

Notes:
[a] Totals may add up to more than the total population (100%), because individuals may report more than one race.
[b] Average median household money income for the ROI counties.
Source:
[c] U.S. Census Bureau, Census 2019 QuickFacts

3.11 PUBLIC AND OCCUPATIONAL HEALTH

3.11.1 Background Radiation Exposures

All residents in the vicinity of the NFS Erwin Facility are exposed to background radiation from a variety of natural and man-made sources. The major sources of background radiation exposure in the vicinity of the Facility are shown in **Table 16** (Background Sources of Radiation Exposure).

Table 16. Background Sources of Radiation Exposure

Source	CEDE (mrem/yr)
Cosmic radiation	27
External terrestrial radiation	28
Internal terrestrial radiation	39
Radon in homes	200
Diagnostic X-rays and nuclear medicine	52
Weapons test fallout	<1

Source	CEDE (mrem/yr)
Air travel	1
Consumer and industrial products	10
Total	358

Note:
CEDE = Committed effective dose equivalent
Source:
NCRP 93

3.11.2 Background Radioactivity

NFS' routine radiological surveillance program includes determining the local background level of radioactivity in media that could potentially be affected by Facility operations. **Table 17** (Alpha Background Radiation and Alpha Radioactivity in Vicinity of NFS) presents data for background monitoring locations from NFS' surveillance program.

Table 17. Alpha Background Radiation and Alpha Radioactivity in Vicinity of the NFS Erwin Facility

Station	Media	Background Level	
Asheville Highway	Ambient air	3.12×10^{-6}	pCi/l
	Soil	45.32	pCi/g
	Vegetation	3.95	pCi/g
Martin Creek Upstream	Water	0.517	pCi/l
	Sediment	15.27	pCi/g
Nolichucky River Upstream	Water	1.53	pCi/l
	Sediment	21.53	pCi/g
Groundwater (Well 52)	Water	0.63[a]	pCi/l

Note:
[a] Gross alpha data 2009-2016. From 2017 to present radiological data is isotopic data.
Source:
NFS Environmental Data Management System

3.12 WASTE MANAGEMENT

3.12.1 Liquid Waste

Liquid waste is treated, measured, and sampled. When all parameters are in accordance with the NPDES Permit and 10 CFR 20 the waste effluent is released. The processes are described in Section 2.1.2.

3.12.2 Solid Waste

- Non-Radiological/Non-Hazardous - Non-Radiological/Non-Hazardous solid waste (such as waste oil and paper) is shipped off-site for treatment, recycling and /or disposal at appropriate facilities.
- Radioactive Solid Waste - The disposal and storage of radioactive solid waste is described in Section 2.1.2.

3.12.3 Hazardous and Mixed Waste

- Hazardous Waste - The disposal and storage of hazardous solid waste is described in Section 2.1.2 (Non-Radiological/Hazardous Waste).
- Mixed Waste - The disposal and storage of mixed solid waste is described in Section 2.1.2.

4.0 Environmental Impact of Proposed Action and Alternative

4.1 LAND USE IMPACTS

Land use on-site (as described in **Table 3**) is not anticipated to change significantly in the near future if NFS' SNM-124 license is amended. All major operations will continue to be conducted within the Facility's Protected Area, with the exception of certain environmental remediation projects. The proposed license amendment will not impact land use at the Facility.

Off-site land use will not be affected by continued licensed operation or the license amendment. Emissions, both chemical and radiological, to air and water have been shown to have an insignificant effect on local air and water quality.

The alternative to license amendment would not impact land usage at the Facility. However, because the work would have to be conducted elsewhere, not amending the license would likely require land use impacts at another site resulting from construction and start-up activities, since other currently available licensable facilities are limited.

4.2 TRANSPORTATION IMPACTS

The transportation of radioactive material to and from the Facility is not anticipated to change due to license amendment. The quantities and types of materials will not significantly change. The transportation route is not projected to be impacted due the amendment.

The alternative to the SNM-124 license amendment would result in the transportation of authorized special nuclear materials to an alternative site which could result in some impacts to transportation routes.

4.3 GEOLOGY AND SOIL IMPACTS

License amendment will not negatively impact the geology or seismology of the NFS Erwin Facility. No major land use changes exist that will adversely affect geology or soil on the Facility.

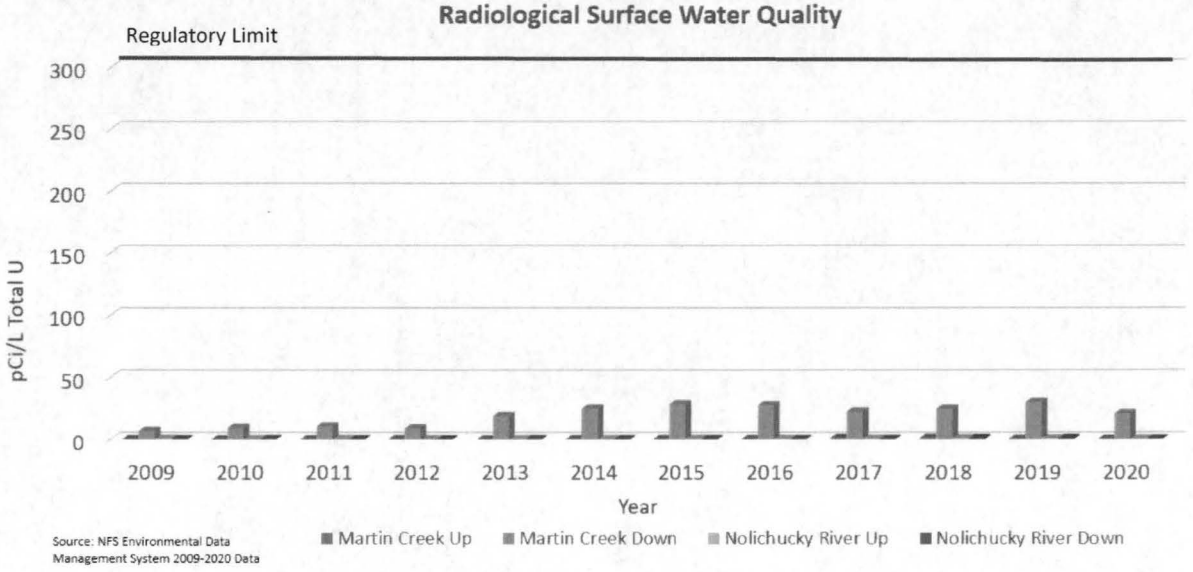
The alternative of not amending the SNM-124 license to include the Uranium Purification and Conversion Services will result in the work having to be conducted elsewhere, resulting in potential impacts to geology and soil from construction, since other currently available licensable facilities are limited.

4.4 WATER RESOURCES IMPACTS

Background radiological concentrations are compared with downstream concentrations, which are measured against the regulatory limit of 300 pCi/l in 10 CFR Part 20. The comparison is shown in **Figure 5** (Radiological Surface Water Quality). The data in **Figure 5** consist of total uranium concentrations in Martin Creek Upstream, Martin Creek Downstream, Nolichucky River Upstream and Nolichucky River Downstream for years 2009-2020. The data indicate that the radiological concentrations in surface water are below the 300 pCi/l limit with the highest concentration of 30 pCi/l (Martin Creek Downstream) being an order of magnitude less that the regulatory limit.

The 2009 Environmental Report identified no significant chemical impacts to surface water from the NFS Erwin Facility, as compared to Federal and State Drinking Water standards. Collection of surface water chemical data was terminated in 2003, because the statistical background of this data demonstrated no significant trends or changes due to plant operation.

Figure 5
Radiological Surface Water Quality



Operations at the NFS Erwin Facility resulted in the presence of radionuclides and organic constituents in the groundwater beneath the Facility. The primary sources of contamination were: i) three unlined surface impoundments (formerly Ponds 1, 2, and 3), ii) the "Pond 4" disposal area and iii) radiological burial grounds, all of which were located in the northern portion of the Facility (GMI 1996) in an area referred to as the "North Site". For remediation purposes, the primary groundwater contaminants of concern (COCs) include tetrachloroethylene (PCE), uranium (U), and technetium (Tc-99). Bioremediation of PCE has created byproduct contaminants including trichloroethylene (TCE), 1,2-dichloroethylene (1,2-DCE), and vinyl chloride (VCI). NFS has completed corrective actions involving the excavation, transport, and removal of over 5 million cubic feet of contaminated soil and debris to remove PCE, Tc-99, and uranium sources at the North Site. In 2018, NFS obtained NRC concurrence that final status survey requirements were achieved at the North Site for subsurface and surface soil. NFS is currently continuing corrective actions to address the residual groundwater contamination remaining now that the main contributing sources have been excavated and removed.

There are no known users of the groundwater between the NFS Erwin Facility and the Nolichucky River. Groundwater collected in monitoring wells on the down-gradient (Plant west) boundary indicates that TCE, PCE, 1,2-DCE and VCI periodically exceed drinking water standards at one or more locations near the western boundary. NFS is actively working to remediate the off-site plumes and has achieved significant plume reductions. The goal of groundwater remediation is to meet the EPAs drinking water MCLs for all the COCs.

PCE levels are measured above MCLs in wells near the down-gradient boundary of the Facility. Groundwater modeling has shown that contamination from the Facility should have no impact on the local drinking water supply well. The Erwin Utilities' "Railroad Well," located approximately one mile

northeast of, and cross-gradient from, the Facility is the local drinking water supply well for a portion of the Town of Erwin that includes the NFS Erwin Facility. The capture zone for this water supply well does not appear to intersect the simulated contaminant plume from the Facility. Uranium monitoring indicates that uranium does not appear to be migrating off-site and that source removal actions and groundwater bioremediation has had a significant impact on shrinking the uranium plumes at the North Site.

4.5 ECOLOGICAL RESOURCES IMPACTS

License amendment will not result in significant land use changes at the NFS Erwin Facility or adversely impact plant or animal communities. More specifically, there will be no impacts to state or federal listed threatened or endangered species habitats.

Process water discharges (from the NFS WWTF) are only to the Nolichucky River. Since the NFS discharges are consistently in compliance with its NPDES permit, and since the input represents less than 1% of the flow volume of the river, the potential ecological impact is minimal. The proposed license amendment will not increase the potential for negative ecological impacts from process water discharge.

Storm water discharges enter the off-site environment at Banner Spring Branch and Martin Creek. These discharges have no process water content and no potential for significant radiological or chemical effect on the ecology of the creek or spring. Stormwater associated with the proposed action will be managed in the same way as other stormwater at the Facility and will discharge to Martin Creek.

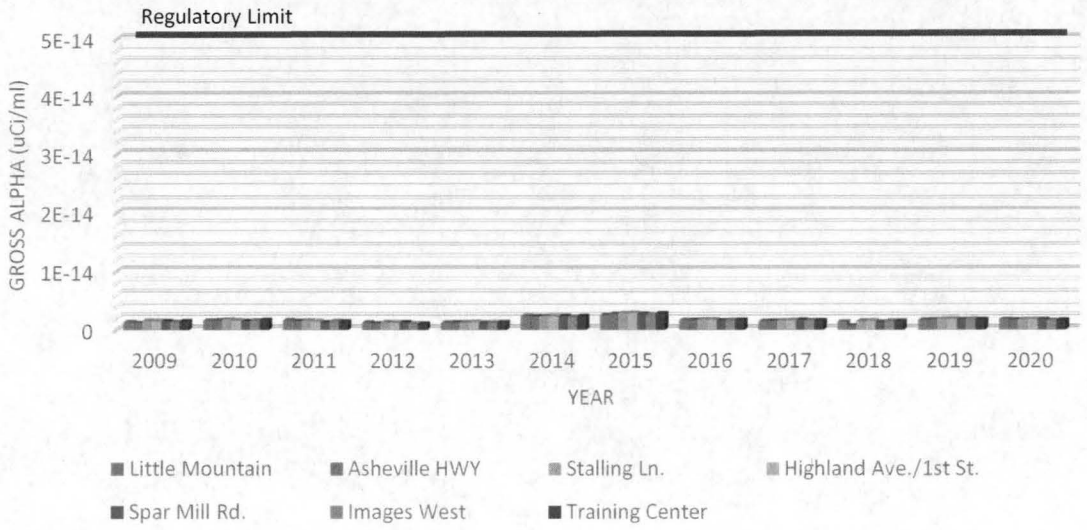
The alternative of not amending the SNM-124 license to include the Uranium Purification and Conversion Services will result in the work having to be conducted elsewhere, resulting in potential impacts to ecological resources from construction at another location, since other currently available licensable facilities are limited.

4.6 AIR QUALITY IMPACTS

The radiological air quality impact is depicted in **Figure 6** (2009-2020 Off-site Radiological Ambient Air Quality). **Figure 6** shows monitoring results for both the background location (Asheville Highway) and the off-site locations in the near vicinity of the NFS Erwin Facility. As depicted by **Figure 6**, the radioactivity levels at the designed monitoring stations are less than the internal NFS average action level of 5.0 E^{-15} uCi/ml and the 10 CFR 20 regulatory limit of 5 E^{-14} microcurie per milliliter (uCi/ml). As shown by **Figure 6** the effluent concentrations in the vicinity of the Facility are typically a factor lower than the regulatory limit. NFS emissions, including those anticipated from this proposed license amendment, do not result in a significant adverse impact to air quality within the vicinity of the Facility.

NFS is not a "major source" of air contaminants (radiological or non-radiological). In addition, many of NFS' emissions are further reduced by the use of effluent control equipment, which minimizes the amount of air contaminants that reach the environment. As demonstrated by **Table 21** (Permitted and Actual Emissions of Criteria and Hazardous Air Pollutants), NFS' actual emissions of air contaminants are significantly less than its permitted emissions. Accordingly, NFS' emissions of non-radiological air contaminants do not have a significant impact on local air quality.

Figure 6
2009-2020 Average Off-site Radiological Ambient Air Quality



Source:
NFS Environmental Data Management System

4.7 NOISE IMPACTS

The amendment of the SNM-124 license for the proposed action will not increase noise levels associated with the construction and operation of the new U-Metals Utilities Building. It is anticipated that noise levels during construction will be similar to the current noise levels of ongoing operations and remedial activities occurring at the NFS Erwin Facility. However, the alternative to license amendment is likely to increase noise levels at an alternative site as a result of construction and operation of a new facility, since other currently available licensable facilities are limited.

4.8 HISTORIC AND CULTURAL IMPACTS

Under the license amendment alternative, operations at the NFS Erwin Facility would continue essentially as they are today with respect to historic and cultural resources. Relatively minor construction is anticipated within previously disturbed areas at the Facility and no additional impacts to undisturbed areas are anticipated.

The effects considered include those resulting directly from land disturbance during construction, visual intrusion on the settings or environmental context of historical structures, visual and audio intrusions on Native American sacred sites, reduced access to Native American traditional use areas, unauthorized artifact collection, and vandalism.

No current or potential impacts to potentially significant pre-historic, historic, or cultural resources have been identified by NFS.

Under the alternative to license amendment, a new facility would likely have to be constructed at an alternative location, since other currently available licensable facilities are limited. The presence of

historic and cultural resources at an alternative site would have to be evaluated and, if present, could be potentially impacted.

4.9 VISUAL/SCENIC RESOURCES IMPACTS

The license amendment will have no impact on visual/scenic resources. New construction will occur within previously developed areas of the NFS Erwin Facility and will be comparable in character to existing infrastructure at the Facility. As such, any construction resulting from license amendment will not significantly alter views from surrounding areas. Since the development of the 2009 ER, the main discharge stack was replaced within the protected area in 2014. The location and height of the new stack did not change, however, the diameter of the new stack (54") is slightly smaller than the previous stack (60"). Otherwise, no other changes that have occurred since 2009 have presented any significant or adverse change to the visual character of the surrounding community. The alternative of no license amendment could potentially impact visual and scenic resources at an alternative site depending on the specific site characteristics.

4.10 SOCIOECONOMIC IMPACTS

Employment at the NFS Erwin Facility has remained relatively steady since 2009 as shown in **Table 18** (NFS Annual Employment).

Table 18. NFS Annual Employment

Year	No of Employees
2009	809
2010	762
2011	748
2012	731
2013	708
2014	705
2015	714
2016	706
2017	707
2018	703
2019	719
2020	732
2021	734

Notes:
Totals do not include temporary and part-time workers
2009-2020 is as of Dec. 31
2021 data is as of July 31

The projected 2021 employment is approximately 756 individuals. The unemployment rates for the ROI from April 2020 to April 2021 are described in **Table 19** (ROI Unemployment Rate).

Table 19. ROI Unemployment Rate

ROI	April 2020 (%)	April 2021 (%)	Change (%)
Carter County	12.4	4.6	-7.8
Sullivan County	14.4	4.7	-9.7
Unicoi County	13.0	5.9	-7.1
Washington County	13.2	3.9	-9.3

Sources:
Tennessee Department of Labor & Workforce Development, July 2021
These rates likely reflect the impact of the COVID-19 pandemic, however, NFS employment was not impacted by the pandemic.

The average per capita income in Tennessee in 2019 was $29,859. **Table 20** (2015-2019 ROI Per Capita Income) shows the per capita income in 2019 dollars for the ROI. The average NFS 2021 salary is $96,100 (with benefits) or $73,350 (without benefits), which greatly exceeds the ROI per capita income. This demonstrates NFS' positive influence on the socioeconomics of the ROI.

Table 20. 2015-2019 ROI Per Capita Income (in 2019 dollars)

Counties	Income
Carter	$23,205
Sullivan	$28,429
Unicoi	$23,455
Washington	$29,656

Source:
U.S. Census Bureau Quick Facts 2019

Under the "No Amendment Alternative," the potential exists for a portion of the current 734 NFS employees to lose their jobs, as the only confirmed operational activity would be fuel production. This would further increase the unemployment rate as well as negatively impacting the tax revenues in the ROI. The Counties within the ROI would experience negative socioeconomic impacts due to NFS downsizing.

4.11 ENVIRONMENTAL JUSTICE

NFS, in accordance with the NRC's Environmental Justice Strategy (NRC 1995) and Executive Order 12898 (EXO 1994), has evaluated whether any of its programs, policies and activities have disproportionately high and adverse effects on low-income and minority populations.

4.11.1 Local Minority and Low-Income Population Information

The local minority and low-income populations in Carter, Sullivan, Unicoi, and Washington Counties and demographic characterizations are shown in **Table 15**. The total minority population in the ROI represents 27.4% of the total population. The area surrounding the NFS Erwin Facility is predominately non-minority. NFS provides approximately 0.19% of the regional employment within the ROI. **Table 12** identifies Carter County (19.3%), Unicoi County (15.8%), and Washington County (15.8%) with the highest percent of individuals living below the poverty level. Washington County population is the most positively influenced by the NFS employment trends.

Review of the above socioeconomic data and land use information demonstrates that no disproportionate adverse economic impact to the minorities or low-income population in the ROI will occur from this license amendment.

4.11.2 Evaluation of Disproportional Impacts

Any impacts to the communities surrounding the NFS Erwin Facility would most likely be the result of hazardous and/or radioactive air emissions or accidents. No significant adverse human health or environmental impacts have been identified by NFS as being associated with its activities. In addition, NFS facilities are designed with extensive safeguards to prevent accidents, and should an accident occur, no acute health impacts would be expected to result. Because the area surrounding the Facility is predominately non-minority and is not low-income, significant adverse human health or environmental impacts, if any, would not disproportionately affect minority or low-income populations.

4.12 PUBLIC AND OCCUPATIONAL HEALTH IMPACTS

4.12.1 Non-radiological Impacts

Air

No routine monitoring is currently required for non-radiological constituents. However, **Table 21** (Permitted and Actual Emissions of Criteria and Hazardous Air Pollutants) estimates the NFS contribution of pollutants to ambient air. **Table 21** demonstrates that the estimated concentrations comply with applicable guidelines, regulations, and permits.

Table 21. Permitted and Actual Emissions of Criteria and Hazardous Air Pollutants

Pollutant	Emission Limitations (tons/yr)	
	Actual	Allowable
Particulate	0.339	16.98
Sulfur dioxide	0.0204	10.25
Carbon monoxide	2.921	14.62
Volatile organic compounds	2.8	12.39
Nitrogen oxides	15.554	45.90
Hydrogen chloride	0.467	1.43
Mercury	0.00002	0.00002
Ammonia	17.466	74.31
Nitric Acid	0.361	0.363

Note:

Air permit monitoring for the following attributes is no longer required: Hydrogen Fluoride, Vinyl Chloride, Tetrachloroethylene, Trichloroethylene, and Bis-2-ethylhexylphthalate.

"Actual" values are based upon calculations provided to the State of Tennessee as part of the air permit applications.

Source:

2021 NFS Air Permits

Surface Water

Three (3) surface water bodies that are potentially affected by Facility operations are: Banner Spring Branch, Martin Creek and Nolichucky River. Historical data associated with these water bodies has identified (2009 Environmental Report) that water quality and sampling data are below National Primary Drinking Water Standards and demonstrate no significant trends or changes due to Facility operations. The chemical monitoring of these water bodies was discontinued during the second half of 2003, because the statistical background of this data demonstrated no significant trends or changes due to plant operation.

Soil and Vegetation

No routine monitoring of soil and vegetation is conducted for chemical parameters.

Groundwater

NFS has conducted groundwater investigations, remedial actions on groundwater, and routine monitoring since 1990 in conjunction with its Resource Conservation and Recovery Act (RCRA) Part B Hazardous and Solid Waste Amendment (HSWA) Permit. Routine monitoring is performed for AOC groundwater which is mainly focused on the down-gradient border of the Facility property. As part of the routine groundwater monitoring program required by SNM-124, 13 wells are routinely sampled and analyzed for radiological parameters on either a quarterly or monthly basis. Additional wells (the number varies from ~25-125 in any given year) are monitored annually by the groundwater remediation contractor to determine the effectiveness of groundwater remedial actions across the Facility. A summary of this monitoring and remediation progress is shared and discussed with TDEC Hazardous Waste Management Division at the annual facility action plan workshop and additionally is captured in a Facility Action Plan (FAP) document that is updated and submitted after the annual meeting.

4.12.2 Radiological Impacts

Pathway Assessment: Air, Soil Vegetation, Sediment, and Surface Water

Tables 22A-22F present the annual average environmental surveillance program data for 2009-2020: **Table 22A** (2009-2020 Environmental Air Average Gross Alpha Radioactivity), **Table 22B** (Stream Sediment Average Radioactivity 2009-2020), **Table 22C** (Soil Average Radioactivity 2009-2020), **Table 22D** (Vegetation Average Radioactivity 2009-2020), **Table 22E** (Martin Creek Downstream Average Radioactivity 2009-2020) and **Table 22F** (Nolichucky River Downstream Average Radioactivity 2009-2020). There are no impacts above criteria to the air, stream sediment, soil, vegetation or surface waters as indicated in the tables below. These tables do not include data associated with samples collected within the Plant Protected Area, which are not representative of off-site conditions.

Table 22A. 2009-2020 Environmental Air Average Gross Radioactivity

Sampler Station/ Location	2009 (uCi/ml)	2010 (uCi/ml)	2011 (uCi/ml)	2012 (uCi/ml)	2013 (uCi/ml)	2014 (uCi/ml)	2015 (uCi/ml)	2016 (uCi/ml)	2017 (uCi/ml)	2018 (uCi/ml)	2019 (uCi/ml)	2020 (uCi/ml)
171-Perimeter W	1.61E-15	1.82E-15	1.70E-15	1.31E-15	1.24E-15	2.12E-15	2.55E-15	1.68E-15	1.51E-15	1.37E-15	1.67E-15	1.75E-15
174-Perimeter E #1	1.57E-15	1.62E-15	1.48E-15	1.27E-15	1.45E-15	2.45E-15	2.71E-15	1.78E-15	1.55E-15	1.28E-15	1.88E-15	1.76E-15
322-Little Mountain	1.30E-15	1.57E-15	1.62E-15	1.22E-15	1.20E-15	2.38E-15	2.50E-15	1.61E-15	1.43E-15	1.37E-15	1.65E-15	1.78E-15
323-Banner Hill Road	1.46E-15	1.61E-15	1.67E-15	1.33E-15	1.45E-15	2.42E-15	2.58E-15	1.68E-15	1.54E-15	1.56E-15	1.90E-15	1.76E-15
324-Asheville Hwy.	1.17E-15	1.60E-15	1.45E-15	1.10E-15	1.23E-15	2.27E-15	2.67E-15	1.65E-15	1.51E-15	6.65E-16	1.75E-15	1.66E-15
372-Parking Lot Entrance	1.49E-15	1.81E-15	1.70E-15	1.40E-15	1.16E-15	2.44E-15	2.79E-15	1.64E-15	1.51E-15	1.50E-15	2.02E-15	1.65E-15
381-BH Road/Stalling	1.66E-15	1.77E-15	1.49E-15	1.30E-15	1.29E-15	2.47E-15	2.82E-15	1.59E-15	1.48E-15	1.34E-15	1.94E-15	1.65E-15

Notes:

Air Sampler 170 was removed from service at the end of 2014.

Air Sampler 172 was removed from service at the end of 1st half of 2016.

Air Sampler 218 was removed from service at the end of 2012.

Table 22B. Stream Sediment Average Radioactivity 2009-2020

Year	Martin Creek Down Linear Park			Martin Creek RR Trestle			Martin Creek Upstream			Nolichucky River Downstream			Nolichucky River Upstream		
	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)
2009	11.36	13.46	2.23	12.30	15.70	4.16	6.20	7.27	0.63	27.43	25.15	2.22	6.51	17.38	1.30
2010	14.08	22.58	2.29	16.19	13.31	4.17	6.82	10.26	1.02	12.18	18.90	2.14	8.25	17.50	2.16
2011	9.88	16.28	2.75	10.20	9.58	3.05	9.30	7.71	0.89	9.57	18.18	1.75	6.85	22.15	1.03
2012	20.33	20.73	2.28	5.66	7.62	0.86	14.91	21.58	1.46	13.43	39.93	1.28	15.56	17.63	1.07
2013	13.98	18.58	2.90	4.18	6.34	0.82	7.12	5.61	0.87	16.69	20.63	1.89	9.70	17.93	1.31
2014	18.85	19.43	2.05	9.14	12.38	0.88	7.33	12.74	0.77	16.81	20.90	1.41	9.88	20.25	1.04
2015	18.70	27.00	4.09	6.79	6.58	1.62	6.16	9.89	1.00	10.02	20.87	1.55	8.42	16.10	1.38
2016	16.66	23.10	2.09	3.72	7.92	1.45	3.90	6.59	0.92	18.60	22.50	2.19	11.90	17.60	1.48
2017	21.78	18.48	3.37	7.28	9.80	1.03	12.63	9.19	1.23	18.73	23.86	1.22	15.83	21.08	1.19
2018	14.50	17.20	1.84	6.17	8.48	0.95	6.65	9.78	1.00	13.33	19.80	1.13	11.95	17.68	1.28
2019	14.41	12.37	1.18	11.63	7.51	1.09	6.35	9.43	0.54	16.65	19.05	1.11	14.84	20.83	0.81
2020	7.83	9.55	2.03	7.59	9.54	2.25	4.30	6.35	1.03	10.47	18.45	1.24	9.52	14.38	0.98

Note:

Total U = U-233/234 + U-235/236 + U-238

Source:

NFS Environmental Database Management System (EDMS) 2021

Table 22C. Soil Average Radioactivity 2009-2020

Year	Asheville Highway			Banner Hill Road			Burial Ground			First Street			Little Mountain		
	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)
2009	22.50	29.80	2.30	19.20	21.93	3.15	19.63	25.45	4.14	16.68	18.93	2.88	14.18	21.40	3.02
2010	15.59	22.80	1.54	22.25	21.50	3.34	21.93	28.90	3.73	18.20	17.48	2.73	15.40	11.48	3.17
2011	14.48	22.70	1.30	22.33	16.74	3.10	19.83	22.03	4.23	17.18	17.58	2.68	15.70	12.94	3.07
2012	25.43	31.13	0.97	24.48	24.20	3.30	25.95	26.73	3.71	24.13	21.28	2.19	17.53	16.56	3.04
2013	23.73	29.95	1.53	21.35	28.35	3.17	21.85	45.85	3.19	18.25	16.73	2.71	24.95	17.61	3.75
2014	23.38	29.63	1.55	27.98	27.65	4.10	20.65	71.53	2.48	22.90	26.03	2.26	23.55	16.73	3.71
2015	21.00	28.75	1.76	28.05	29.88	3.87	26.20	59.15	6.56	20.83	17.90	2.52	18.05	20.70	4.07
2016	22.30	36.78	2.41	26.25	18.20	3.46	36.95	39.15	8.85	21.75	19.05	2.69	20.93	14.88	3.90
2017	29.33	38.60	1.97	28.93	22.43	3.46	26.70	28.25	6.22	33.43	25.00	2.67	24.13	13.58	3.64
2018	28.00	41.88	2.36	27.35	25.13	3.59	23.83	54.88	5.31	23.00	20.00	2.37	22.13	15.83	2.93
2019	25.73	31.20	1.48	28.73	19.58	2.27	26.35	32.65	4.37	22.05	21.75	1.92	21.88	13.78	2.73
2020	20.50	31.33	1.95	21.95	18.45	2.88	22.10	33.53	5.51	20.53	17.65	2.38	22.30	13.45	3.48

Note:

Total U = U-233/234 + U-235/236 + U-238

Source:

NFS EDMS 2021

Table 22D. Vegetation Average Radioactivity 2009-2020

Year	Asheville Highway			Banner Hill Road			Burial Ground			First Street			Little Mountain		
	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)
2009	1.06	16.06	0.22	1.41	14.66	0.16	3.53	15.05	0.07	2.37	34.53	0.28	2.66	17.98	0.14
2010	1.13	12.15	0.29	1.16	18.04	0.36	2.36	24.85	0.40	2.87	15.42	0.65	4.24	16.57	0.36
2011	2.21	14.25	0.29	1.45	15.05	0.18	4.70	15.98	1.08	1.20	15.49	0.26	3.37	17.88	0.56
2012	5.25	18.39	0.21	15.58	34.74	0.17	1.95	22.27	0.45	8.57	26.08	0.15	2.06	18.20	0.10
2013	1.85	12.33	0.13	6.24	25.88	0.52	5.02	23.08	0.44	4.97	18.42	0.34	1.78	20.19	0.13
2014	0.53	9.89	0.25	4.61	29.78	0.59	4.41	25.28	0.75	9.96	30.13	0.58	2.10	20.75	0.14
2015	2.98	15.00	0.46	7.12	20.73	1.16	5.85	27.48	1.05	3.28	23.93	0.65	4.36	23.03	0.29
2016	1.43	27.52	0.60	3.09	22.18	1.04	5.94	17.28	0.86	1.88	28.93	0.80	1.96	19.46	0.49
2017	1.91	23.98	0.22	5.52	34.35	0.50	4.24	19.17	0.66	4.01	30.53	0.32	4.11	19.49	0.28
2018	1.39	21.22	0.54	8.25	24.15	0.65	5.97	25.58	1.74	9.62	36.08	0.45	3.97	22.70	0.57
2019	2.46	15.93	0.20	4.04	23.40	0.44	4.11	23.50	0.74	3.38	26.28	0.25	0.25	16.20	0.12
2020	1.93	20.60	0.14	3.66	24.70	0.33	4.08	20.53	1.13	2.93	29.63	0.29	1.61	12.12	0.09

Note:

Total U = U-233/234 + U-235/236 + U-238

Source:

NFS EDMS 2021

Table 22E. Martin Creek Downstream – Average Radioactivity 2009-2020

Year	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/l)
2009	3.83	2.74	3.51
2010	6.04	3.49	4.75
2011	6.21	3.41	5.36
2012	5.17	2.89	4.57
2013	9.96	3.82	9.45
2014	14.49	4.85	12.49
2015	16.51	5.91	14.33
2016	17.45	4.85	13.80
2017	13.77	4.40	11.28
2018	15.57	5.45	12.40
2019	16.87	5.32	15.03
2020	12.01	5.73	10.49

Notes:
Total U = U-233/234 + U-235/236 + U-238
Based on water samples taken in Martin Creek.
Source:
NFS EDMS 2021

Table 22F. 2009-2020 Nolichucky River Downstream - Environmental Monitoring Data

Year	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Total U (pCi/g)
2009	0.79	2.53	0.17
2010	1.95	2.27	0.20
2011	0.43	1.46	0.13
2012	0.51	1.26	0.08
2013	0.73	2.22	0.20
2014	0.23	1.68	0.19
2015	0.09	1.24	0.25
2016	0.14	0.99	0.22
2017	0.21	1.28	0.23
2018	1.21	1.98	0.42
2019	1.50	2.26	0.41
2020	0.90	2.71	0.19

Note:
Total U = U-233/234 + U-235/236 + U-238
Source:
NFS EDMS 2021

Pathway Assessment: Groundwater

NFS maintains a large array of groundwater monitoring wells. The primary function of these wells is to allow monitoring for COCs including uranium contamination, which is the major radiological constituent of interest for NFS. Some of these wells are included specifically to comply with license requirements to monitor the groundwater in the vicinity of previous activity sites involving contamination sources which have been excavated, packaged, and shipped for disposal.

Other wells are in place to monitor the conditions of groundwater both on- and off-site.

Public and Occupational Exposure: Public Radiation Exposure

As required by NRC regulations, NFS strives to ensure that all releases, emissions, etc., of radioactive material remain "As Low As is Reasonably Achievable" (ALARA). The measured off-site air quality (discussed in Section 4.2) confirms the success of these efforts and that off-site exposure to the public from Facility radiological emissions is minimal. However, in order to document compliance with federal and state standards for exposure to members of the public, NFS routinely prepares formal estimates of the exposure. **Table 23** (Radiation Exposure to Members of the Public) shows the results for the period 2008 through 2020, as compared to the permissible public exposure limit.

Radiation exposure to members of the public is estimated using local wind speed and direction frequency information, combined with effluent release data. The data are used in standard atmospheric dispersion modeling techniques to estimate the exposures to members of the public. These calculated exposures, based on site-specific data, confirm that exposures to the "maximally exposed individual" consistently remain at only a small fraction of the allowable exposure limit.

Table 23. Radiation Exposure to Members of the Public

Year	CEDE (mrem) [a]	Percent of Limit [b]
2008	3.0E-3	0.01
2009	4.9E-3	0.02
2010	6.5E-3	0.03
2011	1.1E-2	0.04
2012	5.9E-3	0.02
2013	7.9E-3	0.03
2014	4.6E-3	0.02
2015	6.4E-3	0.03
2016	6.6E-3	0.03
2017	3.9E-3	0.02
2018	4.1E-3	0.02
2019	3.0E-3	0.01
2020	6.0E-3	0.02

Notes:

[a] CEDE: Committed Effective Dose Equivalent in mrem from gaseous effluent in the maximally exposed individual

[b] 40 CFR, Part 190, Subpart B, Limit=25 mrem/yr.

Source:

NFS Biannual Effluent Monitoring Report 2008-2020

Amendment of the SNM-124 license will continue efforts to ensure that public exposure remains ALARA and within NRC's limits.

Public and Occupational Exposure: Potential Impact for Accidents

NFS recognizes the potential for accidents, the probability of any of them occurring is low due to engineered safety factors incorporated into the process design. NFS process designs incorporate sufficient safety controls to ensure that any accident sequence (radiological or chemical) resulting in high or intermediate consequences meet the performance requirements specified in 10 CFR Part 70.61.

In conjunction with the NFS Emergency Plan, a detailed analysis of eight (8) potential accident scenarios has been evaluated. While NFS has classified these scenarios as potential, the probability of any of them

occurring is low, due to safety factors incorporated into the design of all radiological material related process equipment and systems.

Based on the review of potential accidents, actual environmental releases, and the comprehensive safety programs in place to prevent and minimize the effect of accidents, the probability and potential consequences of any reasonably foreseen significant site-related accident with off-site consequences are both estimated to be low.

Amendment of the SNM-124 license would not significantly impact public safety.

4.13 WASTE MANAGEMENT

Waste management at the NFS Erwin Facility is conducted as stated in Section 2.1.2 Radioactive Waste Management, Liquid Waste Storage, Radioactive Solid Waste Management, Mix Waste Management, Non-Radioactive Hazardous Waste, and Non-Radioactive/Non-Hazardous Waste. The amendment of the license would not significantly increase the quantities or types of waste generated at the Facility.

The alternative to license amendment would not decrease the volume of waste generated and but would only shift the generation of waste to an alternative facility.

5.0 Mitigation Measures

Mitigation measures are designed into all process operations and evaluated prior to implementation. NFS strives to control all emissions at the source and to the degree possible to mitigate uncontrolled releases. NFS' goal is to maintain occupational and public exposure to radioactive material to "As Low As is Reasonably Achievable" (ALARA). The ALARA goal is detailed in Section 4.12 (Public and Occupational Health Impacts).

NFS recognizes the potential for accidents. The probability of any accident occurring is low due to engineered safety factors incorporated into the process designs.

No disproportionate impacts are expected to occur therefore, no additional mitigative measures are anticipated other than those NFS currently has proposed associated with the Proposed Action as described in Section 1.

6.0 Environmental Measurements and Monitoring Programs

The NFS environmental monitoring program is a comprehensive program that encompasses on-site and off-site environmental surveillance (see Section 4.0). Environmental media monitoring includes air, surface water, sediment, soil, vegetation, and groundwater. **Figure 7** (Environmental Air Sample Locations) and **Figure 8** (Surface Water Sample Locations) shows the locations where samples of these media type are taken.

6.1 RADIOLOGICAL MONITORING

The radiological monitoring program is described in Section 4.0.

6.2 PHYSIOCHEMICAL MONITORING

6.2.1 Air

Ambient concentrations of atmospheric chemical pollutants near the NFS Erwin Facility are not routinely measured. The primary NFS emission source of criteria pollutants is the industrial boiler. The secondary emission source is chemical processing. **Table 22** (Permitted and Actual Emissions of Criteria and Hazardous Air Pollutants) presents the currently permitted maximum (allowable) and average actual emissions of chemical pollutants based on permit application information.

6.2.2 Surface Water

The NFS WWTF discharges water to the Nolichucky River from Outfall 001. **Table 24** (NPDES Outfall Monitoring Data) provides effluent quality data for the NFS WWTF outfall for the period 2009 through 2020. This data indicates discharges from the WWTF consistently comply with the limitations imposed by the NFS NPDES permit.

Table 24. NPDES Outfall Monitoring Data

Effluent Characteristic	Mg/l (except as noted)	
	Average [a]	Maximum
COD	181.3	370
TSS	10.01	38
Ammonia (N)	11.38	29
Nitrate/Nitrite	39.38	213.4
Fluoride, Total	2.39	20
Cadmium, Total	0.0008	0.005
Copper, Total	0.007	0.06
Lead, Total	0.0046	0.066
Mercury, Total	0.0002	0.0079
Silver, Total	0.002	0.023
pH	7.8	9

Notes:

[a] For some constituents, the calculated average is an estimated quantity, which consists of detected values and reported non-detected samples. The average was determined by using the quantitation limit when non-detects occurred; thus, the actual concentrations were probably lower.

Source:

2009-2020 NFS Discharge Monitoring Reports. Where less than values occurred, the absolute value was reported.

NFS NPDES Industrial Storm Water Permit monitors storm water runoff. Compliance storm water sampling is conducted annually, as shown in **Table 25** (NFS 2009 – 2020 Storm Water Data). The annual monitoring data identifies nitrate as nitrogen and magnesium in storm water at concentrations above the monitoring State Benchmark concentrations. These two attributes have exceeded the cut-off concentration limit since February 1998. An investigation into the elevated nitrate as nitrogen and magnesium attributes identified that they are natural occurring in surface water and ground water at levels above the NPDES State Benchmark concentration limits. The aluminum and copper contributors are unidentified.

Table 25. NFS 2009-2020 Storm Water Data

Parameter	Outfall A Average (mg/l)	Outfall B Average (mg/l) (except as noted)
Chemical Oxygen Demand	53.84	58.89
pH	7.7	7.4
Total Suspended Solids	37.94	43.2
Nitrate + Nitrite, Nitrogen	11.38	0.73
Ammonia	0.287	0.455
Magnesium, Total Recoverable	2.29	1.84
Aluminum, Total Recoverable	0.381	0.548
Iron, Total Recoverable	0.438	0.764
Cadmium, Total Recoverable	0.001	0.001
Cyanide, Total	0.0018	0.0018
Lead, Total Recoverable	0.0029	0.0047
Mercury, Total Recoverable	0.0001	0.0001
Selenium, Total Recoverable	0.0075	0.005
Silver, Total Recoverable	0.0008	0.0008
Copper, Total Recoverable	0.0136	0.0216
Gross Alpha (pCi/l)	16.21	25.15
Gross Beta (pCi/l)	9.95	10.39
Isotopic U-234 (pCi/l)	9.28	18.79
Isotopic U-235 (pCi/l)	0.479	0.77
Isotopic U-238 (pCi/l)	1.2	0.437
Temperature (°F)	59.7	60

Notes:

Source: NFS Annual Storm Water Monitoring Reports 2009-2020. Where less than values occurred, the absolute value was reported.
Radiological analysis is not a storm water permit requirement.
Chemical attribute sampling was reduced in 2016 to only include: pH, NO3/NO2, NH3, Mg, Al, Fe, & Cu.

6.23 Soil and Vegetation

No routine monitoring of soil and vegetation is conducted for chemical parameters.

6.2.4 Groundwater

NFS has been conducting extensive groundwater investigations since 1990 in conjunction with its HSWA Permit and as part of its ongoing efforts to decommission inactive parts of the Facility. There are 13 wells routinely sampled and analyzed for various parameters on either quarterly or monthly basis. Additional wells (the number varies from ~25-125 in any given year) are monitored annually by the groundwater remediation contractor to determine the effectiveness of groundwater remedial actions across the Facility. The results of this monitoring are shared and discussed with both the TDEC and NRC. This monitoring is being done pursuant to requirements of the RCRA Part B HSWA permit. The analytical results are routinely reviewed by the agencies.

6.3 ECOLOGICAL MONITORING

The ecology within the vicinity of the NFS Erwin Facility is described in Section 3.0. The radiological monitoring of air, water, vegetation, sediment, and soil as discussed in Section 4.0; and the chemical monitoring of process water discharges and storm water runoff are the key to preserving the ecological health within the vicinity of the Facility. The monitoring programs have not indicated adverse effects to the ecological system.

Figure 7. Environmental Air Sample Locations

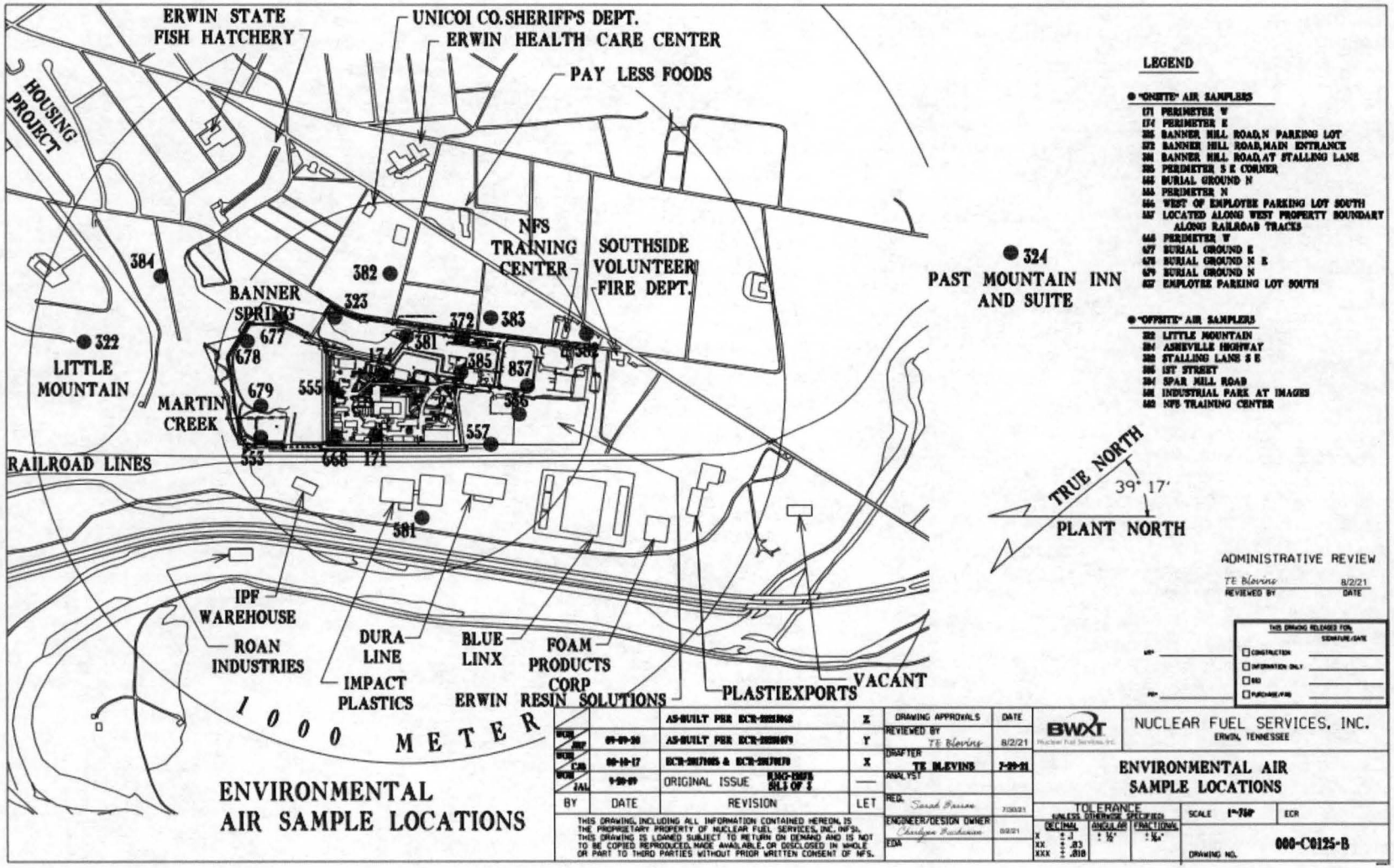
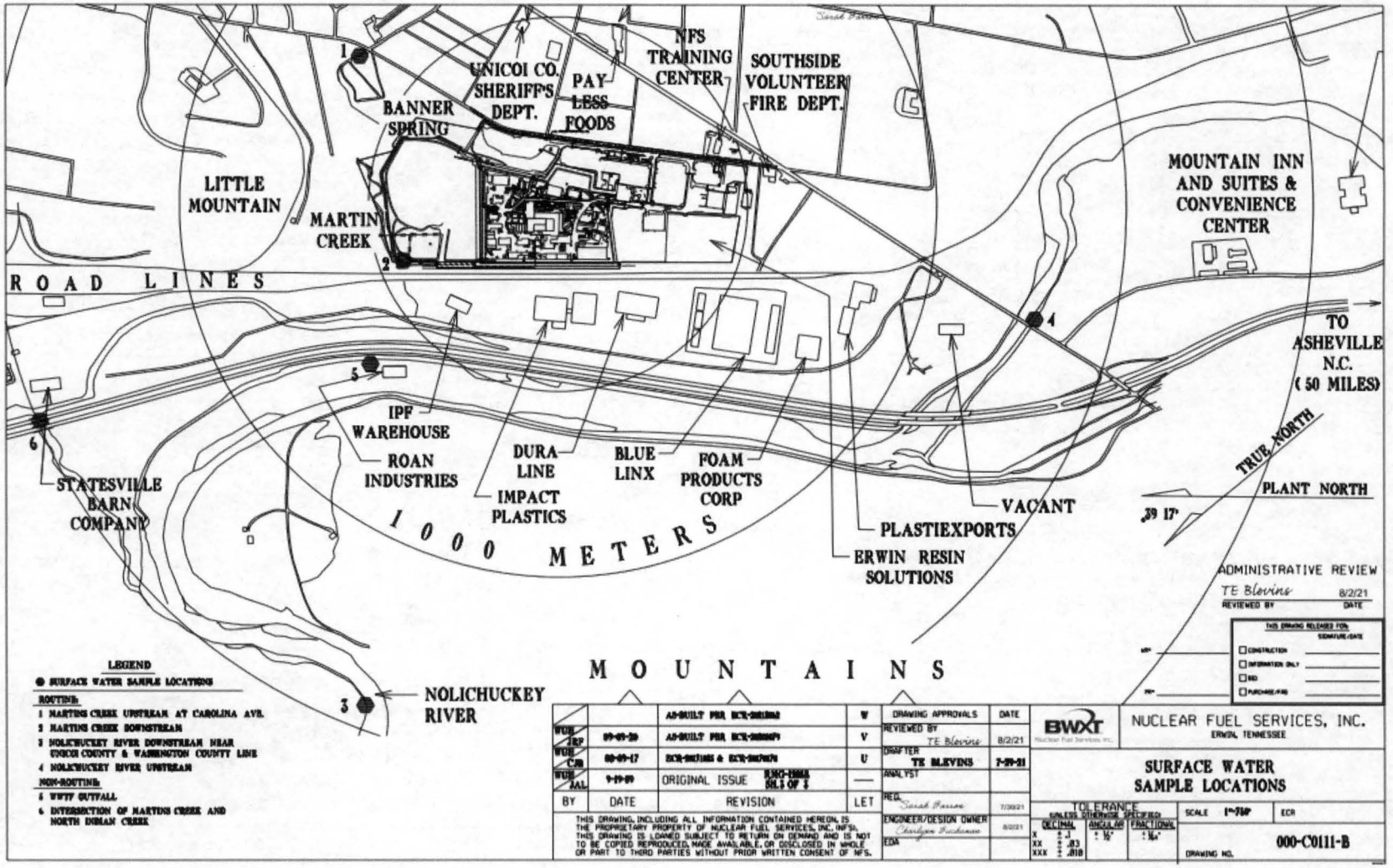


Figure 8. Surface Water Sample Locations



7.0 Summary of Environmental Consequences

7.1 ADVERSE IMPACTS

Section 4.0 of this report comprehensively describes the direct and indirect environmental impacts of the NFS Erwin Facility's operation, and the environmental justice related impacts. The data indicate that NFS' conduct of licensed activities has, and is expected to continue to have, no significant adverse impact on the people, air, land, water, flora, and fauna surrounding the NFS Erwin Facility.

The potential for significant adverse impacts is considered only for the "No License Amendment" action, because not amending the license would likely require land use impacts at another site resulting from construction and start-up activities, since the work would have to be conducted elsewhere and currently available licensable facilities are limited. The potential significant adverse impacts from this scenario are:

1. Land Use – The proposed license amendment and the activities that have occurred since 2009 have not and will not result in significant adverse impacts to land use. Not amending the license would likely require land use impacts at another site resulting from construction and start-up activities.
2. Transportation - The proposed license amendment and the activities that have occurred since 2009 have not and will not result in significant adverse impacts to transportation routes. The alternative to amending the license would result in the transportation of authorized special nuclear materials to an alternative site which could potentially result in new impacts to transportation routes.
3. Geology and Soils – The proposed license amendment and the activities that have occurred since 2009 have not and will not result in significant adverse impacts to geology and soils. Conducting the Uranium Purification and Conversion Services elsewhere could result in potential impacts to geology and soils from new construction, since other currently available licensable facilities are limited.
4. Water Resources – The proposed license amendment and the activities that have occurred since 2009 have not and will not result in significant adverse impacts to water resources. The construction and operation of a new licensable facility could potentially result in new impacts to water resources.
5. Ecological Resources - The proposed license amendment and the activities that have occurred since 2009 have not and will not result in significant adverse impacts to ecological resources. Conducting the Uranium Purification and Conversion Services elsewhere could result in potential impacts to ecological resources from new construction.
6. Air Quality - The proposed license amendment and the activities that have occurred since 2009 have not and will not result in significant adverse impacts to air quality.
7. Noise - The proposed license amendment and the activities that have occurred since 2009 have not and will not result in significant adverse impacts to noise. The alternative to license amendment is likely to increase noise levels at an alternative site as a result of construction and operation of a new facility.
8. Historic and Cultural Resources - The proposed license amendment and the activities that have occurred since 2009 have not and will not result in significant adverse impacts to historic and cultural resources. Under the alternative to license amendment, a new facility would likely have

to be constructed at an alternative location, since other currently available licensable facilities are limited. The presence of historic and cultural resources at an alternative site would have to be evaluated and, if present, could be potentially impacted.

9. Visual/Scenic Resources - The proposed license amendment and the activities that have occurred since 2009 have not and will not result in significant adverse impacts to visual and scenic resources. The alternative of no license amendment could potentially impact visual and scenic resources at an alternative site depending on the specific site characteristics. Since the development of the 2009 ER, the main discharge stack was relocated within the protected area in 2014. However, the new stack is the same size and height as the previous stack. Otherwise, no other changes that have occurred since 2009 have presented any significant or adverse change to the visual character of the surrounding community.
10. Socioeconomic - Under the "No Amendment Alternative," the potential exists for a portion of the current 734 NFS employees to lose their jobs, as the only confirmed operational activity would be naval fuel production. This would further increase the unemployment rate as well as negatively impacting the tax revenues in the ROI. The Counties within the ROI would experience negative socioeconomic impacts due to NFS downsizing.
11. Environmental Justice – The socioeconomic data and land use information provided in this report demonstrate that no disproportionate adverse economic impact to the minorities or low-income population in the ROI will occur from this license amendment. If the construction and operation of a new facility is relocated to a new site, then there is a potential for environmental justice impacts associated with a new site.
12. Public and Occupational Health Impacts - The proposed license amendment and the activities that have occurred since 2009 have not and will not result in significant adverse impacts to public and occupational health. NFS conducts a robust and comprehensive monitoring program in consultation with the TDEC as outlined in Section 6.0 of this report. All results of the monitoring program comply with or are below acceptable standards.
13. Waste Management - The amendment of the license would not significantly increase the quantities or types of waste generated at the NFS Erwin Facility. The alternative to license amendment would not decrease the volume of waste generated and would only shift the generation of waste to an alternative facility.

In addition, further negative impacts resulting from the non-approval of the license amendment are the counter-productivity of the nuclear material processing objectives of the U.S. Government and the negative effects to the U.S. Department of Energy.

7.2 BENEFICIAL IMPACTS

The beneficial impacts of NFS' licensed activities are:

1. The average per capita income in Tennessee in 2019 was $29,859. The average NFS 2021 salary is $96,100 (with benefits) or $73,350 (without benefits), which greatly exceeds the ROI per capita income. This demonstrates NFS' positive influence on the socioeconomics of the ROI.
2. Furthermore, NFS provides approximately 0.19% of the regional employment within the ROI. The highest percent of individuals living below the poverty level for each County is Carter County

(19.3%), Unicoi County (15.8%), and Washington County (15.8%). Washington County population is the most positively influenced by the NFS employment trends.

3. The decommissioning and remediation of the BLEU Complex and the northern burial ground area including the surface water impoundments in 2018 has improved the environmental characterization of the NFS Erwin Facility.
4. Nuclear fuel production for the U.S. Department of Energy; and,
5. Supporting the nuclear material processing objectives of the U.S. Government.

8.0 List of References

ARCADIS 2021 Arcadis U.S., Inc., *Martin Creek Flood Study Summary*, May 13, 2021.

BLS 2021 U.S. Department of Labor, Bureau of Labor Statistics, *Johnson City MSA Economy at a Glance*, May 2021, https://www.bls.gov/regions/southeast/tn_johnsoncity_msa.htm (July 2021).

DOE 1996 U.S. Department of Energy, *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement,* DOE/EIS-0240, Volume I, (Washington, DC), June 1996.

DOWR 2021 Tennessee Department of Environment and Conservation, Department of Water Resources, *Wellhead / Source Water Protection Request (Email Communication),* July 20, 2021.

EPA 2021 Environmental Protection Agency, *Tennessee Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*, June 30, 2021, https://www3.epa.gov/airquality/greenbook/anayo_tn.html (July 2021).

Erwin 1995 City of Erwin, *City of Erwin Zoning Map*, September 26, 1995.

EXO 1994 Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.

FEMA 2008 Federal Emergency Management Agency, *Flood Insurance Rate Map (Map Number 47171C0068C),* September 3, 2008.

GMI 1996 Geraghty & Miller, Inc., *Final Project Report – Groundwater Flow and Constituent Transport Modeling at the Nuclear Fuel Services, Inc. Facility, Erwin, Tennessee,* April 25, 1996.

Google 2019 Google Earth Pro v7.3.3.7786 (32-bit), *NFS Site, Erwin, TN*, October 17, 2019.

ISA 2007 Nuclear Fuel Services, Inc, *Integrated Safety Analysis*, 2007.

NFS 1984 Nuclear Fuel Services, Inc., *Environmental Report for the Erwin Plant* located in Erwin, Tennessee, July, 1984.

NFS 1995a Nuclear Fuel Services, Inc., *RCRA Facility Investigation Report for SWMU3 at Nuclear Fuel Services, Inc., Erwin, Tennessee,* December 1995.

NFS 1995b Nuclear Fuel Services, Inc., *RCRA Facility Investigation Report for SWMUs 13 and 14 at Nuclear Fuel Services, Inc.,* December 1995.

NFS 1996 Nuclear Fuel Services, Inc, *Applicant's Environmental Report for Renewal of Special Nuclear Material License No. SNM-124*, December 1996.

NFS 1996b Grimaud, G., NFS Engineering Section Manager, "*Seismic Loading from the Southern Building Code,*" request for information to support DOE EIS, Erwin, TN, February 16, 1996.

NFS 2001d Nuclear Fuel Services, Inc., *Technical Basis – Dose Factors and Action Levels for WWTF Radioactive Liquid Effluents, Rev 0*, Document #21T-01-0728, July 11, 2001.

NFS 2009 Nuclear Fuel Services, Inc., *Environmental Report for Renewal of Special Nuclear Material License No. SNM-124, Docket No. 70-143; SNM License 124*, May 2009.

NFS 2020 Nuclear Fuel Services, Inc., 2009-2020 Storm Water Discharge Data, 2020.

NFS 2021a Nuclear Fuel Services, Inc., Environmental Database Management System (EDMS), 2021

NFS 2021b Nuclear Fuel Services, Inc., Emergency Plan, Revision 27, November 2021.

NOAA 2019 National Oceanic and Atmospheric Administration, *Comparative Climatic Data*, https://www.ncdc.noaa.gov/ghcn/comparative-climatic-data (July 2021).

NOAA 2021a National Oceanic and Atmospheric Administration, Climate Normals, https://www.ncei.noaa.gov/access/us-climate-normals/ (July 2021).

NOAA 2021b National Oceanic and Atmospheric Administration, National Centers for Environmental Information, Storm Events Database, https://www.ncdc.noaa.gov/stormevents/ (July 2021).

NPS 2020 National Park Service, *National Register of Historic Places* (last update September 2020), https://www.nps.gov/maps/full.html?mapId=7ad17cc9-b808-4ff8-a2f9-a99909164466 (July 2020).

NRC 1991 United States Nuclear Regulatory Commission, *Environmental Assessment for Renewal of Special Nuclear Materials License No. SNM-124*, Docket No. 70-143, NRC, August, 1991.

NRC 1991a United States Nuclear Regulatory Commission 1991, referencing *Climates of the States*. Dale Research Company for the National Oceanic and Atmospheric Administration. 1978, Vol. 1, Detroit, Michigan.

NRC 1991b United States Nuclear Regulatory Commission 1991b, referencing U.S. Nuclear Regulatory Commission, Office of Nuclear Materials Safety and Safeguards, Div. of Fuel Cycle and Material Safety, *Environmental Impact Appraisal of the Nuclear Fuel Services, Inc., Erwin, Tennessee*, (Washington, D.C.) January 1978.

NRC 1991d United States Nuclear Regulatory Commission 1991, referencing "*Groundwater Resources of East Tennessee*." Tennessee Division of Geology, Bulletin 58, Nashville, Tennessee. DeBuchananne, D.G. and R.M. Richardson, 1956 and "*Geology & Manganese Deposits of Northeast Tennessee,*" Tennessee Division of Geology, Bulletin 52, Nashville, TN. King, P.B. H.W. Ferguson, L.C. Craig and J. Rodger, 1944.

NRC 1991e — United States Nuclear Regulatory Commission 1991, referencing Eyre, F.J. (ed.). *Forest Cover Types of the United States and Canada*. 1980 Society of American Foresters, (Washington, D.C), 148.

NRC 1991f — United States Nuclear Regulatory Commission 1991, referencing Braum, E.L. (1950) *Deciduous Forests of Eastern North America.* Free Press, (New York), 556.

NRC 1991g — United States Nuclear Regulatory Commission 1991, referencing Simpson, G.G. 1964. *Species Density of North America Recent Mammals*, Systematic Zoology 12:57-73, 1964.

NRC 1991h — United States Nuclear Regulatory Commission 1991, referencing Cook, R.E. 1969. *Variation in Species Density of North American Birds*, in Systematic Zoology, 18:63-84, 1969.

NRC 1995 — United States Nuclear Regulatory Commission, *Environmental Justice Strategy*, March 1995.

NCRP 93 — National Council on Radiation Protection and Measurements, *Ionizing Radiation Exposure of the Population of the U.S.,* Pergamon Press, Elmsford, NY, 1993.

TNC 2019 — Tennessee Comptroller Digital Parcel and CAMA Data for Unicoi County, February 4, 2019.

TNNHP 2021 — Tennessee Department of Environment and Conservation, Division of Natural Areas, Natural Heritage Program, *Rare Species Database Review*, August 20, 2021.

TDEC 2019 — Tennessee Department of Environment and Conservation, *Chapter 0400-40-04 - Use Classifications For Surface Waters*, 2019. https://publications.tnsosfiles.com/rules/0400/0400-40/0400-40-04.20190911.pdf (July 2021).

TDEC 2021 — Tennessee Department of Environment and Conservation, *TN Water Well Desktop Application [3.0-PUBLIC]*, https://tdeconline.tn.gov/tdecwaterwells/ (July 16, 2021).

TNDOL 2021 — Tennessee Department of Labor and Workforce Development, *Unemployment Rates*, April 2021, https://www.tn.gov/workforce/tennessee-economic-data-/labor-force-statistics/unemployment-rates.html (July 2021).

TWRA 2016 — Tennessee Wildlife Resources Agency, *Rules and Regulation for In Need of Management, Threatened, and Endangered Species*, June 2016, https://www.tn.gov/content/dam/tn/twra/documents/wildlife/1660-01-32-threatened-endangered-species-rule.pdf (July 2021).

USCB 2019 — U.S. Census Bureau, *QuickFacts* https://www.census.gov/quickfacts/fact/table/US/PST045219 (July 2021).

USDA 1985 — U.S. Department of Agriculture, Soil Conservation Service, *Soil Survey of Unicoi County*, Tennessee, 1985.

USDA 2017 U.S. Department of Agriculture, National Agricultural Statistics Service, *2017 Quick Stats – Unicoi County*, https://quickstats.nass.usda.gov/?source_desc=CENSUS#22587508-FB7C-329B-A950-CD5F337174DF (July 16, 2021).

USFWS 2021 U.S. Fish and Wildlife Service, *List of Threatened and Endangered Species, Consultation Code: 04ET1000-2021-SLI-1007*, July 15, 2021.

USGS 2018 U.S. Geological Survey, *2018 Long-term National Seismic Hazard Map*, 2018. https://www.usgs.gov/media/images/2018-long-term-national-seismic-hazard-map (July 2021).

USGS 2021 U.S. Geological Survey, *National Water Information System: USGS 03465500 Nolichucky River at Embreeville*, *https://waterdata.usgs.gov/nwis/inventory/?site_no=03465500&agency_cd=USGS* (July 2021).

UT 2018 University of Tennessee Extension, *Contribution of Agriculture to the Unicoi County Economy*, https://extension.tennessee.edu/publications/Documents/W634.pdf (July 2021).