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3. FINDINGS FOR SUBJECT PROPERTY

This section contains the history and current use of the property, including a description of activities at the former LFs and MAFs, followed by the environmental setting of the 446 MS deployment area, and discussions of hazardous substances. Detailed site-specific data are found in tabular format in Appendix C, Site-specific Characteristics.

3.1. HISTORY AND CURRENT USE

Regional land use in the 446 MS is generally rural and sparsely populated, consisting of small communities surrounded by agricultural areas. Agricultural land is primarily used for growing grains, sugar beets, soybeans, flaxseed, sunflowers, potatoes, hay, and other crops.

The Air Force purchased the property for the LFs and MAFs in the mid-1960s. The MM III system at Grand Forks included 150 LFs with one missile per LF, and 15 MAFs with one MAF per flight of 10 LFs. The 446 MS included 5 flights, with each flight composed of 10 LFs and a MAF, which were connected through the HICS. Section 1.2 further explains the squadron organization. Flight-specific maps are provided in Appendix B. These maps were scanned from the original Mylar® sheets created in the mid-1960s and overlaid on a current base map of the area. The original Mylar® sheets and additional maps included in the real property files can be accessed at the Real Estate Office, 319 CES/CERR, or the USACE Omaha District, Real Estate office.

3.1.1. Launch Facilities Prior To Dismantlement

An LF consisted of a launcher and associated launcher equipment building (LEB). All facilities were enclosed within a security fence, except a buried antenna (a grid of copper wires covered in non-polychlorinated biphenyls (PCB) plastic, approximately 400 feet by 400 feet, buried 4 to 8 feet deep) that was adjacent to each LF. The fenced sites average about 1.4 acres in size, but the Air Force owns a total of approximately 10 acres at each LF. Figure 3.1-1 shows a schematic of a typical LF prior to dismantlement. The LF launch tube was approximately 80 feet deep, of which the top 28 feet comprised the headworks. Including concrete and steel, the headworks was approximately 25 feet wide and 33 feet deep. The launch tube was 12 feet in diameter below the headworks. Figure 3.1-2 contains LF photographs. The top photo shows LF N-33, which was retained after dismantlement with its surface features intact for use as an historic site (see Section 5.11). The lower photo shows LF K-04 as a typical LF with all structures removed and the ground surface graded.

Dismantlement included demolishing the headworks of each LF silo and destroying the access shaft in the LEB. Prior to demolition, various regulated and hazardous materials (such as diesel fuel and sodium chromate solution) were removed from the facilities. Some recoverable material (e.g., steel, copper, aluminum, and the remaining mechanical equipment) was salvaged by the dismantlement contractor.

All underground storage tanks (UST) at the LFs were removed for salvage or closed in place in accordance with applicable North Dakota regulations. All LFs had an older deep-buried, 11,000-gallon UST; this UST was closed in place in accordance with North Dakota requirements. Most LFs with deep-buried tanks closed in place also had a new 4,000-gallon, double-walled shallow-buried UST that was removed for salvage (see Section 3.5).

The LEB blast door was welded shut, the upper level of the access shaft demolished, and the remainder filled with rubble. The dismantlement technique included explosive demolition of the headworks to the depth of the launcher equipment room (LER) floor (approximately 21 feet). This depth complied with START protocols that required explosive demolition to at least 6 meters (19.5 feet) or mechanical demolition to at least 8 meters (26.0 feet). For explosive demolition, everything above the floor of the LER, including the launcher closure door, was removed for salvage or became rubble. Concentric holes were drilled vertically in the concrete of the headworks for emplacement of explosives.

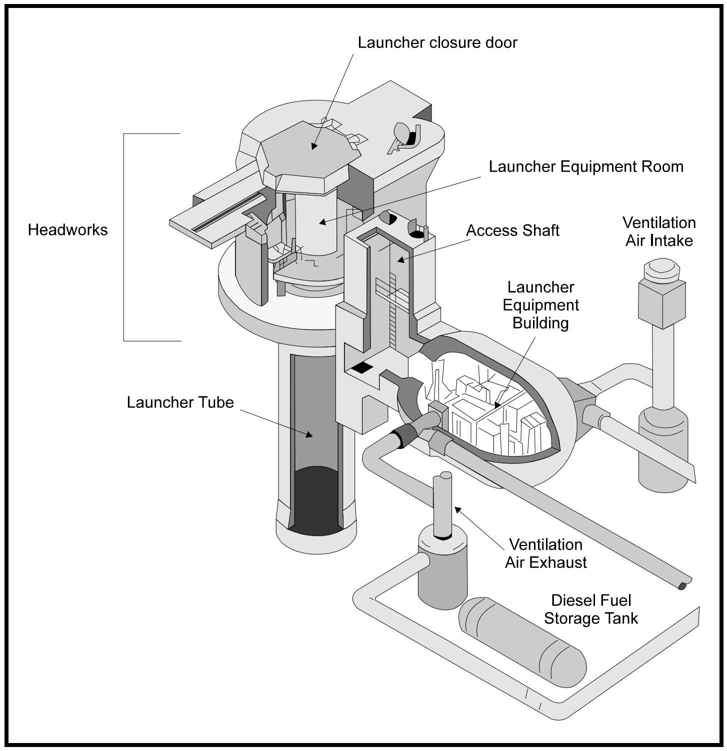

Figure 3.1-1. Launch Facility Schematic

To limit environmental impacts, the Air Force produced specifications for explosive demolition that prescribed maximum noise levels, ground attenuation, and debris criteria. The dismantlement contractor was required to use the minimum amount of explosives necessary to implode the concrete and steel into the launch tube. The demolition of each LF was designed to preclude the ejection of large pieces of debris outward from the launch tube. The rubble from the demolition was pushed into the launch tube along with fill material. A contractor then placed a steel-reinforced, 2-foot thick, 14-foot diameter, concrete cap over the launch tube, at a depth of approximately 28 feet. A 40-millimeter polymer liner was placed above the cap (at a depth of approximately 4 to 6 ft below ground level) to limit water incursion into the tube. A 90-day observation/verification period followed the demolition of the headworks. After the observation period, the remaining excavations were filled with rubble and gravel, backfilled, compacted, and contoured to leave a slightly mounded gravel surface to meld with existing gravel contours.

The cathodic protection system control was removed during the dismantlement and the wells were closed. The former antenna field (a pair of antenna wire arrays buried between 4 and 8 feet below the surface) was left in place at dismantlement. The HICS, which connects the LFs and MAFs, has marker posts that define the path of the cable. The HICS was abandoned in place, and the marker posts removed at the landowner’s discretion. Various power companies own the transformer pole and service connections to the LFs and are gradually removing them.

View of LF N-33 (Surface Features Intact)

View of Typical LF After Surface Grading, Showing K-04

Figure 3.1-2. Photographs of Launch Facilities

The Air Force and the dismantlement contractor have not disturbed the real property owned by the power companies. Azimuth markers were removed only at a landowner's request. The markers were buried in place unless the landowner requested removal; the Air Force excavated and removed the markers requested and buried them as launch tube fill. The fence around the site remains in place.

3.1.2. Missile Alert Facilities Prior To Dismantlement

The MAFs are located within a fenced area averaging about four acres; the Air Force actually owns approximately 20 acres at each facility. Located outside the security fence is a buried antenna (approximately 400 feet by 400 feet), and a dual-celled sewage lagoon that has been closed. Figure 3.1-3 shows the layout of a typical MAF, while Figure 3.1-4 includes photographs of a typical MAF.

Dismantlement of the MAFs included removing hazardous materials from the facilities, and retrieving salvageable materials, such as scrap metal. The sewage lagoon at each MAF was sampled and closed in accordance with federal and state regulations. Water wells located at the MAFs were not used since the quality of well water was inadequate. Rural water was delivered from local water suppliers to the MAFs. The water wells were closed in accordance with state requirements.

The dismantlement contractor was allowed to salvage items from the launch control center (LCC) and launch control equipment building (LCEB) after the Air Force removal operations were completed. Reusable components of the outside radio antennas were salvaged and other antenna components were used as rubble. After salvage operations, the blast door to the LCC and the LCEB door were welded shut. The elevator, elevator structure, controls, motor, and all structural steel stairs, platforms, and supports were removed from the elevator shaft. These items were removed through the service door. The vestibule in front of the LCC door and the entire elevator shaft and vestibule before the LCEB blast door were filled with rubble, sand, gravel, and dirt, and compacted to within one to two feet of the top of the shaft. A reinforced concrete cap was placed over the shaft to prevent settlement and to deny access to the abandoned LCC structure. Air intakes and exhaust ducts were filled and sealed with a 2-foot cap of reinforced concrete.

The MAFs had four to six fuel tanks used for diesel fuel, gasoline, or heating oil. The tanks ranged in size from 500 gallons to 15,000 gallons, and were usually USTs. Some smaller "day" tanks were also found within the facilities. Each MAF also had a 40,000-gallon, deep-buried tank formerly used to store distilled water. All of the tanks at the MAFs were older tanks that were removed or closed in place in accordance with state and federal regulations (see Section 3.5 for additional information on closure of these tanks). A 7,000-gallon tank for potable water remains for future reuse.

The cathodic protection system control was removed during the dismantlement and the wells were closed. The antenna located outside the fenced area is a grid of wires, buried three to four feet deep, which was left in place.

The MAF waste disposal system processed sewage from the launch control support building (LCSB) and LCC. Wastewater was discharged to the two-celled sewage lagoon by gravity flow drain lines and pumps. The sewage lagoon was located outside the security fence.

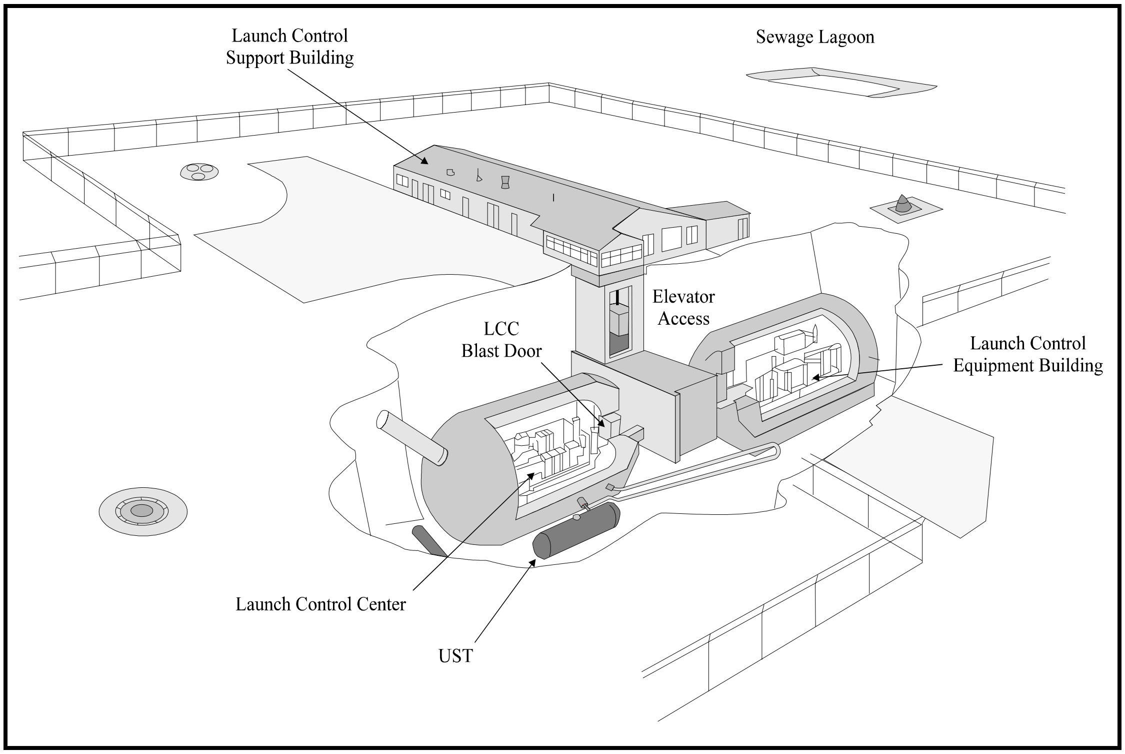

Figure 3.1-3. Missile Alert Facility Schematic

Solids in the lagoon were oxidized by bacterial action into an inert sludge, and sewage water was lost through evaporation. The lagoon contents, both liquids and sludge, were sampled prior to dismantlement. The liquids were properly handled, which included discharging sufficiently clean wastewater to surface waters, based on test results. Sludge disposal was dependent on test results. The dismantlement contractor drained the lagoons, leveled and graded the lagoons and berms for proper drainage, and stabilized and seeded the site with grasses specified by North Dakota regulations (NDCC Chapter 63-01.1-09).

The MAF buildings have not been demolished, but were left as a part of the real property. The MAF sites, including buildings and the surrounding fence, are being disposed of as described under the LF property disposition.

3.2. ENVIRONMENTAL SETTING

This section describes the climate, geology and soils, water resources, wetlands and prairie potholes, and floodplains in the deployment area of the 446 MS. Site-specific information on these features is provided in the EBSs for each LF and MAF.

3.2.1. Climate

The deployment area is located in the northern Great Plains near the geographic center of North America. The area is in a humid continental climate regime characterized by cool to warm summers and a large range of mean temperatures.

View of Former MAF A-0

View of Graded Sewage Lagoon at Former MAF A-0

Figure 3.1-4. Photographs of a Typical Missile Alert Facility

Mean daily maximum temperatures in the area range from the low teens (degrees Fahrenheit (°F)) in January to the low 80s°F in July and August. Mean daily minimum temperatures range from near -5°F in January to the high 50s°F in mid-summer. Extreme temperatures during cold arctic air masses have reached near -40°F in the region. Extreme high temperatures have reached near 105°F.

Mean precipitation in the area is about 20 inches per year, and is fairly evenly distributed across the 12 months, with a maximum in late spring and early summer at about 2.5 to 3.0 inches per month. Wind blows predominantly from the north in the winter and from the south during the summer. Mean wind speeds range from 7 to 9 knots (8 to 10 miles per hour (mph)) during most months.

3.2.2. Geology and Soils

The 446 MS deployment area lies within the physiographic province known as the Central Lowlands. The deployment area can be further separated into two physiographic subregions: the Red River Valley and the Drift Prairie (see Figure 3.2-1). The physiography of the deployment area varies from a nearly level lake plain in the Red River Valley, to rolling hills and small depressions in the Drift Prairie.

Sand, silt, and clay deposits from former glacial Lake Agassiz formed a broad, nearly level lake plain in most of Pembina County, the northeastern corner of Cavalier County, and the eastern half of Walsh County. At the western edge of the former Lake Agassiz, a series of beaches formed as the level of the lake varied over time. These beaches consist of sand, silt, and gravel deposited along a series of ridges and swales occurring from eastern Cavalier County to central Grand Forks County (USDA, 1972; USDA, 1977a, USDA, 1981; USDA, 1990a). West of these beaches, the Pembina Escarpment divides the Red River Valley (the lake bed of the former Lake Agassiz) from the Drift Prairie. The Drift Prairie is an area of glacial till (unsorted deposits of gravel, sand, silt, and clay) forming rolling hills, ridges, broad hills, and small, undrained depressions. Most LFs and MAFs in the 446 MS are located in the Drift Prairie, but a few LFs of Flight C are located in the Red River Valley.

Subsurface site reports from the construction of LFs and MAFs contain information on geologic layers to a depth of 1,000 feet (USAF, 1963). Surface layers generally consist of glacial till with layers of clay, silt, and sand to a depth of 20 to around 130 feet.

In some areas, this layer of glacial till extends to only 7 to 10 feet. In other areas, the glacial till extends as deep as 160 to 200 feet. The Pierre Shale underlies the glacial till at all sites in the 446 MS, except C-22 and C-23. The Pierre Shale is underlain by Colorado Shale and Limestone from about 400 feet to around 900 feet. The Dakota Shale and Sandstone is below the Colorado group. In some areas, Ordovician Limestone and Dolomite is encountered at a depth of 900 to 950 feet. Bedrock (Pierre Shale in most cases) is generally encountered at a depth of about 30 to 80 feet; however, at some LFs, it is found as shallow as 7 to 9 feet.

The 446 MS is located in portions of Pembina, Cavalier, Walsh, and Ramsey Counties. LFs and MAFs occur primarily in six soil series: Barnes, Buse, Cresbard, Hamerly, Svea, and Tonka, and in 16 other series to a lesser extent. Appendix C, Table C-1, lists the properties of soils occurring within the 446 MS.

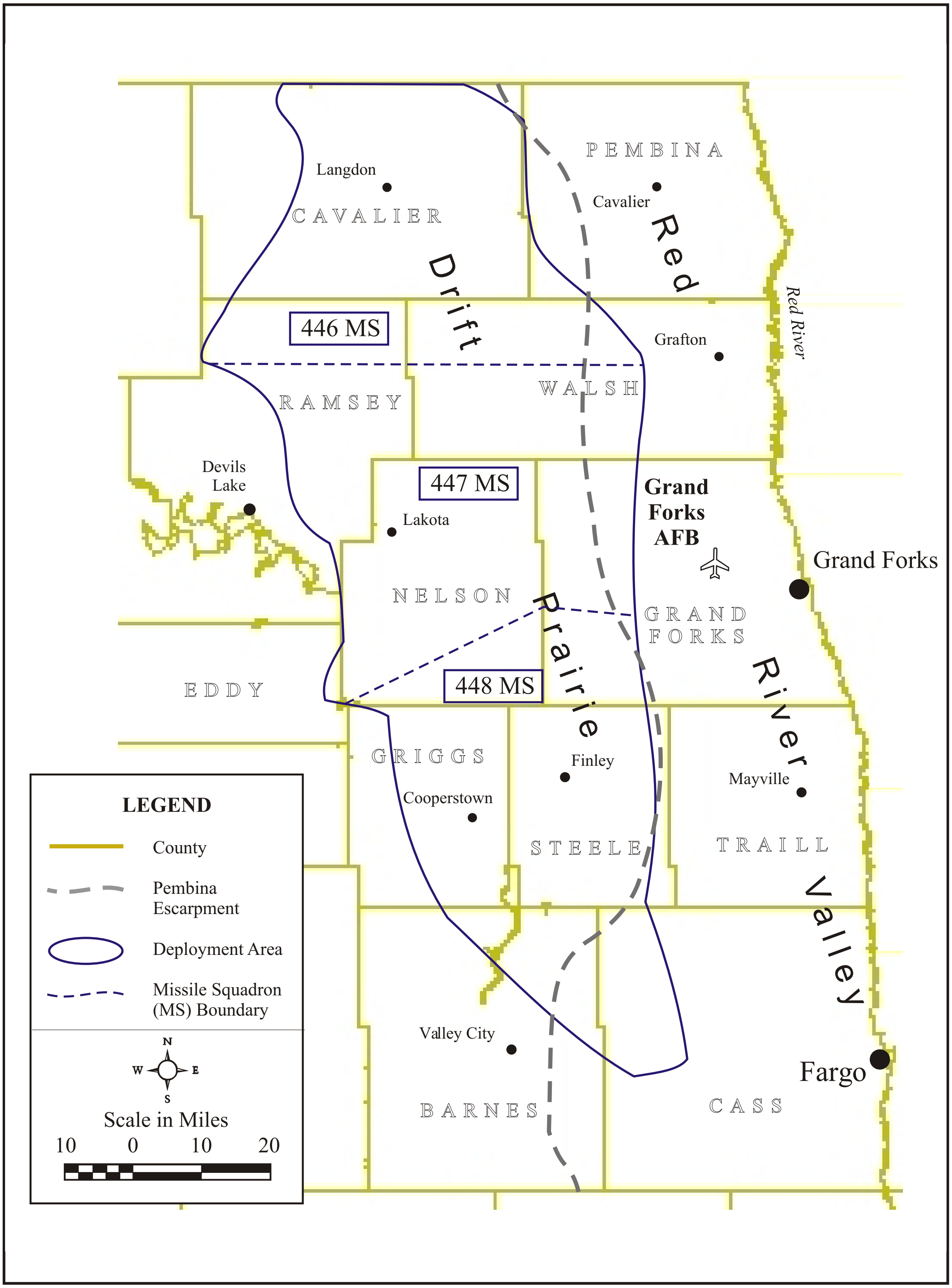

Figure 3.2-1. Physiographic Regions of the Deployment Area

These soils formed in areas affected by glaciation. The Barnes, Cavour, Cresbard, Easby, Hamerly, Parnell, Svea, Tonka, Vallers, Waukon, and Wyard soils formed in various locations on till plains. The Binford, Brantford, and Gilby soils developed on glacial lake beaches. The Divide, Renshaw, and Vang soils developed on glacial outwash plains. The Glyndon and Tiffany soils formed in glacial lake plains. Walsh soils developed in alluvial valley plains and on alluvial fans. Lamoure soils formed in floodplains.

These soils have a surface layer of loam and subsurface layers of clay, clay loam, or silty clay. Seven of these soils have sandy or gravelly subsurface layers. Permeability is generally moderate near the surface, and ranges from very slow to very rapid in the subsoil. Hydrologic groups vary from B to D (moderate to very slow water transmission within the soil). Many of the soils have a seasonally high water table. Five of these soils have a seasonally high water table either above the surface or within one foot of the surface. Eight of these soils have a seasonally high water table within one to six feet of the surface, while nine do not have a seasonally high water table within six feet of the surface. Six of the soil series are hydric soils, and nine additional series have hydric soil inclusions within them. The presence of hydric soils is one of the three criteria for wetland determination. The Lamoure soil (located only at LF C-29) experiences occasional brief flooding from March to October. No other soils at LFs in the 446 MS experience flooding.

Most of the soils have a low to moderate shrink-swell potential at the surface and a moderate to high potential in subsurface layers. Runoff ranges from ponded (occasional standing water) in flat areas to rapid flow in areas of higher slope. Slopes are generally between 0 and 3 percent, with slopes at some sites ranging from 3 to 6 percent. One LF in Walsh County is situated on a 6 to 9 percent slope.

The hazard of erosion by water is slight to moderate. The hazard of wind erosion ranges from slight to moderate for most of the soils, to high for Binford and Tiffany soils.

3.2.3. Water Resources

Water in the deployment area is provided primarily by rural water systems (i.e., water is piped to locations from municipal water sources). Private and public groundwater wells also exist within the deployment area. Most water in northeastern North Dakota is derived from well systems, typically within Glacial Drift Aquifers (USAF, 1999a). Water quality in the deployment area varies substantially for both surface water and groundwater. Generally, groundwater is too saline for domestic use, while surface waters are suitable for domestic use during periods of medium to high flow. Water with less than 500 milligrams per liter (mg/L) of total dissolved solids (TDS) is considered safe for most domestic uses.

Water at MAFs A-0, B-0, D-0, and E-0 was provided by rural water systems; a well at Cavalier Air Station provided water to C-0. Rural water system lines have been left in place for the potential new owners of the MAF sites. The two water tanks at the MAFs remain in place and could also be used by future owners to store water. Although water wells exist at the MAFs, the wells had not been used for drinking water for many years due to water quality problems (primarily high TDS levels). These water wells were closed in accordance with State guidelines (Vetter, 2001). The well depths vary from approximately 150 feet to 1,300 feet.

The LFs were unoccupied except during maintenance activities or missile component removal or emplacement, so no water wells were installed at the sites.

Because of the PCB coatings on the access shaft and ventilation shafts at the LFs and the potential to leach into shallow groundwater, no shallow drinking water wells can be installed at these sites. There are also deep-buried USTs that may have a PCB coating remaining at the LFs and MAFs (see Section 3.3 for a further discussion of this issue).

3.2.3.1. Surface Water

Northeastern North Dakota lies in the Central Lowlands physiographic region, which is primarily drained by the Red River of the North (USGS subregion 0902). This river drains 39,800 square miles of the United States, including 29,900 square miles of North Dakota All of the deployment area is located within this drainage. Figure 3.2-2 shows surface water features and drainage basin divides within the 446 MS deployment area.

The Red River of the North forms in southeastern North Dakota, where the Otter Tail and Bois de Sioux Rivers combine. North of this confluence, the Red River of the North forms the boundary between North Dakota and Minnesota, and therefore lies east of the deployment area.

The primary tributaries in the 446 MS generally flow easterly, and include the Pembina, Park, and Forest Rivers. The tributaries start in the Drift Prairie, where there is poor drainage, and flow through deeply incised valleys entering the Red River Valley, then develop nearly flat slopes in the lowlands before merging with the Red River of the North. The 446 MS lies west of the flood-prone area along the Red River of the North.

The Red River of the North subregion is divided into numerous hydrologic units, each of which is identified by a unique hydrologic unit catalog (HUC) number. The LFs and MAFs of the 446 MS are located in four hydrologic units:

- The Pembina River (HUC 09020313) starts in Cavalier County and enters the Red River of the North near Pembina in Pembina County, draining an area of 2,020 square miles. Its waters are used for fish and wildlife propagation, stock watering, municipal domestic water, recreation, and irrigation. The Tongue River is included within this HUC.
- The Park River (HUC 09020310) also starts in Cavalier County, and enters the Red River of the North southeast of Herrick in Walsh County. It drains 1,080 square miles. It is used for stock watering, municipal supply, recreation, and irrigation.
- The Forest River (HUC 09020308) starts in Walsh County and is 120 miles long, draining an area of 875 square miles and entering the Red River northeast of Warsaw. Its waters are used for fish and wildlife propagation, stock watering, municipal domestic water, and irrigation
- The Devils Lake basin (HUC 09020201) is located in Ramsey and northwestern Nelson Counties. This basin, covering an area of 3,580 square miles, is closed (runoff is retained within the basin and does not contribute to a river system). The Edmore Coulee is the major drainage in the Devils Lake basin lying within the 446 MS. Water is used for stock watering and wildlife production.

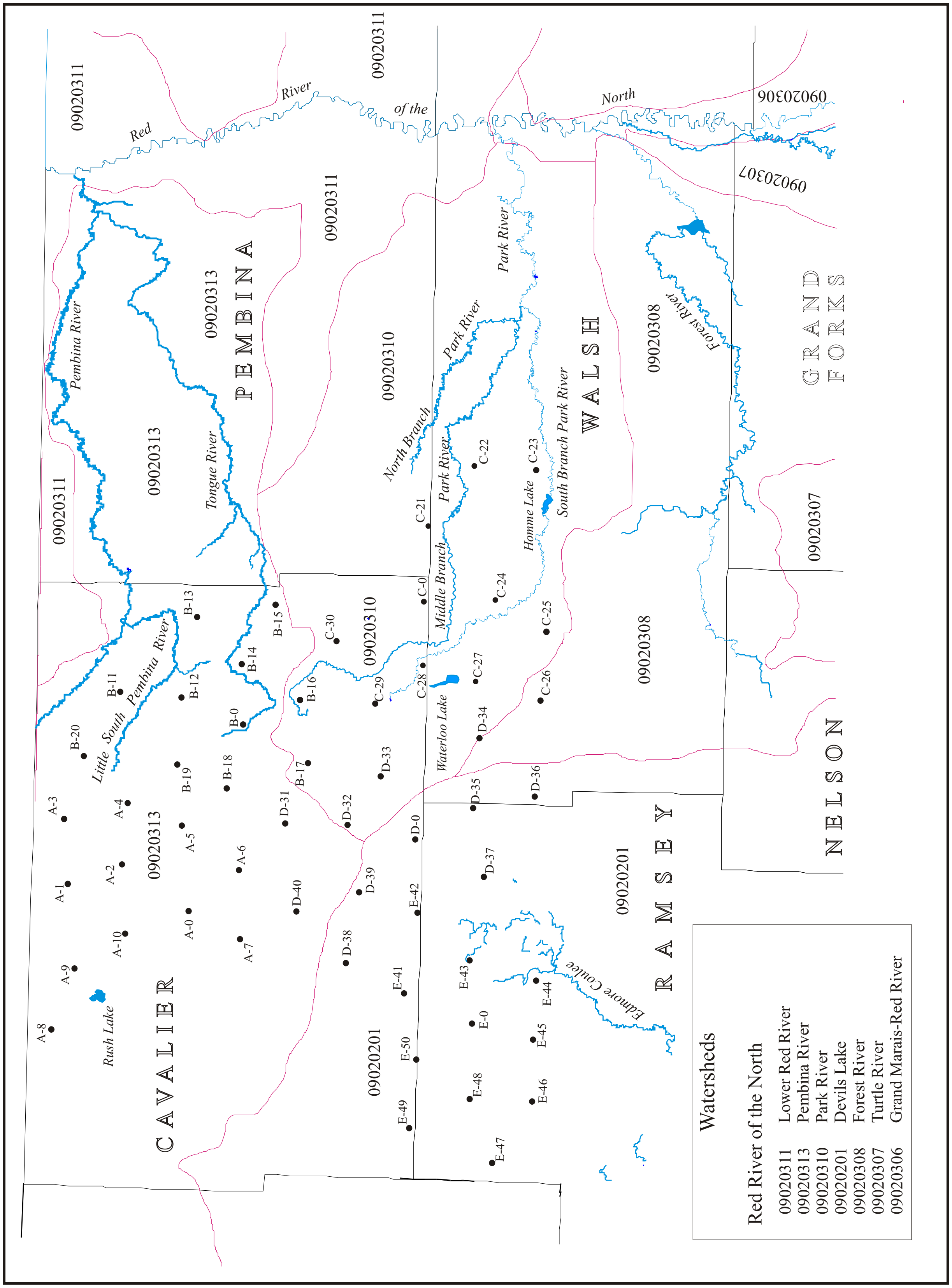

Figure 3.2-2. Surface Water in the 446th Missile Squadron

Small lakes are found throughout the deployment area of the 446 MS. Larger lakes include Rush Lake, Waterloo Lake, and Homme Lake. Numerous small reservoirs are also present in the region, typically ranging from about 50 to 400 acres.

According to the National Water Quality Inventory Report (NDDH, 2000), North Dakota reports that 69 percent of its surveyed rivers and streams have good water quality, which is defined as fully supporting aquatic life. Within the Red River Basin, 59 percent of the rivers and streams had good water quality. The leading sources of contaminants in rivers and streams are agriculture, the removal of streamside vegetation (which leads to siltation), and municipal sewage treatment plants. Natural conditions, such as low flows, also contribute to violations of standards.

Good water quality was found in 97 percent of the lakes surveyed. The leading sources of pollution in lakes are agricultural activities, municipal sewage treatment plants, and urban runoff/storm sewers.

The U.S. Public Health Service (USPHS) has established drinking water limits for chloride and sulfate content. Water with less than 500 milligrams per liter (mg/L) of TDS is considered safe for most domestic uses. Most of the rivers in northeastern North Dakota have average dissolved solids of less than 500 mg/L during medium to high flows, with water suitable for domestic use. During low flow periods, the rivers are generally too saline for domestic use. The Red River of the North has bicarbonate-type water and an average dissolved solid content of 330 mg/L. The Park River has sulfate-type water, with high calcium and magnesium content, and a TDS content of less than 1,000 mg/L. The Forest River has high calcium and magnesium content, with a TDS content of less than 1,000 mg/L. The Pembina River has bicarbonate type water with high calcium and magnesium content, and a TDS content of about 460 mg/L.

3.2.3.2. Groundwater

Two types of aquifers—bedrock and glacial drift—provide groundwater in northeastern North Dakota. The 446 MS is situated near shallow glacial-drift aquifers and shallower areas of the Pierre Aquifer. None of the LFs are located within one mile of a glacial-drift aquifer. The Dakota Aquifer is the major bedrock aquifer, but it is not widely used due to moderate salinity. Recharge of this aquifer occurs to the west of the deployment area. Limited quantities of water are found in the Pierre Aquifer, which is situated in Pierre Shale. Small, scattered aquifers in glacial drift provide groundwater to some areas.

The Pierre Aquifer consists of shale, marlstone, and claystone, and underlies much of the 446 MS. The aquifer is overlain by glacial drift or soil. Depth to the Pierre Shale ranges from 10 feet to greater than 130 feet. Recharge occurs throughout much of the deployment area from precipitation, snowmelt, or prairie potholes. Small amounts of water are yielded from fractures within the shale, generally at depths of 20 to 200 feet. This aquifer is used by some farms and municipalities, but is not a major groundwater source in the region.

Glacial-drift aquifers are scattered throughout most of the glaciated part of North Dakota and are the most important sources of groundwater in the state. These aquifers are composed of clay, silt, sand, and gravel. While these aquifers often yield little or no water in clay layers, yields can be high when glaciofluvial deposits of sand and gravel are present. These aquifers are generally shallow, from several feet to around 150 feet deep. Recharge is also from precipitation, snowmelt, or prairie potholes. The average recharge area is 10 to 20 square miles, with some small aquifers only having a recharge area of 3 to 4 square miles. Major glacial drift aquifers include the following:

- The Icelandic Aquifer is more than 20 miles long, as much as 9 miles wide, and underlies about 82 square miles. The aquifer consists mostly of very fine to medium sand interbedded with silt and clay. The aquifer is unconfined at the top and underlain by clay but generally becomes finer grained with increasing depth from west to east. Recharge is mainly from precipitation that is received on the surface of the aquifer. Water from this aquifer is predominantly very hard, fresh, and a calcium magnesium bicarbonate type that is be acceptable for most domestic and public uses (USGS, 1977).
- The Pembina Delta Aquifer is about 71 square miles in area and consists of clay, silt, sand, and gravel. Recharge to the Pembina Delta Aquifer is mainly from precipitation that is received in the immediate area; however, precipitation must percolate through several tens of feet of sediment before reaching the water table in much of the area. Groundwater in the Pembina Delta Aquifer is considered very hard, with a high dissolved calcium and magnesium content. Iron in the groundwater often exceeds drinking water standards. The Pembina Delta Aquifer is tapped for livestock, irrigation, and some domestic use (USGS, 1977).
- The Munich Aquifer underlies about 30 square miles and consists of shaly sand and gravel interbedded with clay and silt. The aquifer ranges in thickness from 0 to nearly 200 feet; the thicker part is confined beneath about 20 to 50 feet of glacial till. Recharge to the Munich Aquifer is derived primarily from local precipitation, which must percolate through the till, so maximum water levels are not attained until late fall or early winter. Some recharge may be by underflow from the Pierre Formation. Groundwater from the Munich Aquifer is predominantly very hard, slightly saline, and is a sodium sulfate type with a rather high concentration of iron. Concentrations of iron, sulfate, and TDS exceed drinking water standards. Discharge by wells is small, and is used by local farms (USGS, 1977).

Groundwater from the Dakota, Pierre Shale, and glacial-drift aquifers is generally hard and of the calcium bicarbonate or calcium sulfate type. It contains chemical constituents (such as sulfates or high salinity) that limit its use for domestic or industrial use, including irrigation. High concentrations of sodium and magnesium are found locally. The best quality water from these aquifers is found at higher elevations, where the TDS is less than 1,000 mg/L. In Pembina, Walsh, and Grand Forks Counties, these aquifers are contaminated by upward seepage from the Dakota Aquifer (NDGS, 1973b).

Water in the Pierre Aquifer is of the sodium chloride or sodium sulfate type, and the TDS content ranges from 700 mg/L to 12,500 mg/L. This water also exceeds the limits set by the U.S. Public Health Service for chloride and sulfate content.

3.2.4. Wetlands and Prairie Potholes

Wetlands are defined by the USACE (1987) as “those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." Wetlands are diverse ecosystems that provide natural flood control by storing spring runoff and heavy summer rains, replenish groundwater supplies, remove water pollutants, filter and use nutrients, provide a source of water for livestock and, in dry years, are valuable for crop and forage production. They provide habitat for many plant and animal species, including economically valuable waterfowl and 45 percent of the nation's endangered species. North Dakota has lost 49 percent of its original wetlands (NDDH, 2000).

Numerous prairie potholes exist throughout northeastern North Dakota. Prairie potholes tend to be seasonal water bodies that generally are not large or deep enough to maintain a fish population (other than small minnows, for example), and which are often associated with wetlands and lakes. Formed by glaciation, they are often found in large numbers grouped together. Prairie potholes typically fill with snowmelt and gradually dry out, although many are associated with surficial aquifers and retain water throughout the year. Some prairie potholes are characterized as ephemeral wetlands.[1]

Prairie potholes are prime waterfowl production (nesting) areas, and also provide habitat for waterfowl and other species during migratory seasons. Many areas within eastern North Dakota have been set aside to preserve wetland habitats. These areas range from 40 to 3,000 acres, and are managed to support migrating and nesting waterfowl, sustain native wildlife, and provide the public with outdoor recreational areas for hunting, trapping, bird watching, and other wildlife-oriented activities. The number and size of prairie potholes in North Dakota has increased over the past five years due to increased precipitation (Larson, 1995; HPRCC, 2003).

Appendix B provides maps showing streams and other surface waters in the 446 MS deployment area, but the types of other surface waters (wetland, prairie pothole, or pond) are not differentiated.

In the 446 MS, no fenced areas in MAFs or LFs are located within wetlands, although 10 sites have wetlands adjacent to or within the Air Force property boundaries; one of the 10 is categorized as an ephemeral wetland basin (USAF, 1999a; USEPA, 2003). The MAF sewage lagoons were formerly classified as wetlands but have since been closed. No closure permits were required from the USACE because the lagoons were not within a naturally occurring basin, connected to another wetland by an intermittent stream, or more than one-third acre (USAF, 1999a). Table C-2 lists wetlands within 1,000 feet of missile sites. Detailed information on wetlands near MAFs or LFs is provided in the site-specific EBSs (Section 3.2.5); regional and site maps showing wetlands are found within Appendix A of each site-specific EBS.

3.2.5. Floodplains

The 446 MS deployment area is not located within the 100-year floodplain of the Red River of the North or other perennial rivers in the deployment area (USAF, 1999a).

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[1] Ephemeral wetlands are depressional wetlands that temporarily hold water in the spring and early summer or after heavy rains. Periodically, these wetlands dry up, often in mid to late summer. They are isolated without a permanent inlet or outlet, but may overflow in times of high water. Ephemeral wetlands are free of fish, which allows for the successful breeding of certain amphibians and invertebrates (USEPA, 2003).

3.3. HAZARDOUS MATERIALS AND WASTES

A material is hazardous when, because of its quantity, concentration, or physical, chemical, or infectious characteristics, it may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness, or pose a substantial present or potential hazard to human health or the environment. Hazardous materials used at the LFs and MAFs (and not addressed under other sections in this EBS) include oils and lubricants, cleaning solvents, ethylene glycol, sodium chromate solution (only at the LFs), lead-acid batteries, and mercury switches. These materials, and any wastes generated from their use and handling, have been removed from the LFs and MAFs. The only hazardous material remaining in the 446 MS sites is liquid propane, contained in two aboveground storage tanks (AST) located at each MAF (A-0, B-0, C-0, D-0, and E-0). The propane was used to heat the LCSB facilities during cold weather; these tanks and their contents have been left for the future owner of the property.

Under a Site Investigation program, sampling was performed at each site to determine if contamination due to the use or storage of these hazardous materials occurred. The following subsections provide a discussion of soil sampling conducted at the LFs and MAFs, the sampling of sewage lagoons at the MAFs, and groundwater sampling that was completed at five LF sites.

3.3.1. Soil and Coating Sampling at LFs

Soil sampling was conducted at all LFs at Grand Forks AFB, ND. A total of 79 samples were collected in the 446 MS. Soils samples were collected and analyzed for target analyte list (TAL) metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium (total), cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, silver, selenium, sodium, vanadium, thallium, and zinc), total petroleum hydrocarbons (TPH) (including diesel range organics (DRO) and gasoline range organics (GRO)). Results of these samples were compared to regulatory limits or risk-based health standards, where applicable. North Dakota has issued guidelines for TPH, setting the cleanup action level at 100 parts per million (ppm) (NDDH, 2001).

All sample results for TAL metals were below applicable regulatory limits (USAF, 1999d).

Testing for TPH indicated GRO above the North Dakota standard of 100 ppm at one site (E-44), with a reading of 200 ppm. Sample results for DRO were above the North Dakota standard of 100 ppm at four sites within the 446 MS: 230 ppm at C-24; 370 ppm at C-26, 560 ppm at C-27, and 24,000 ppm at E-44 (USAF, 2001a; USAF, 2000a; USAF, 1999b). Other sampling indicated that DRO were detected above cleanup action level guidelines at sites B-0 and D-0 (Klaus, 2001). Results are provided in Table C-3. Under NDDH Health Guidelines for petroleum hydrocarbon cleanup, the method selected for cleaning sites with contaminated soils is based on hydrogeologic conditions at the site, the potential for impacting population and groundwater used by wells or utilities, the presence of free product, potential impacts from vapors, and the future use of the land (NDDH, 2001). Based on the sample results and site factors, Grand Forks AFB personnel coordinated with staff from NDDH to determine a suitable action to address the contaminated sites. The NDDH gave its approval for the Air Force to blend the organically contaminated soil on site by excavating and spreading the soil near the surface to facilitate degradation of the organic contamination (Koop, 2001). Remediation at all identified sites has been completed in accordance with NDDH guidelines (Vetter, 2003).

Samples for analyzing PCBs were collected at LFs from waterproof coatings on ventilation shafts and access shafts, adjacent soils, and groundwater in ventilation shaft excavation. These are discussed in Section 3.14.

For other hazardous waste, North Dakota has followed federal regulations for land disposal, as found in 40 *Code of Federal Regulations* (CFR) 268. North Dakota and Federal regulations require testing of contaminated soil to determine the presence of hazardous waste. USEPA Region 8 has not established standards or remediation goals for contaminated soil.

3.3.2. Soil, Sludge, and Wastewater Sampling at MAFs

Soil and sludge samples were collected and analyzed at all five MAFs. Samples were analyzed for TAL metals, and none exceeded regulatory limits (USAF, 1999d).

Wastewater from sewage lagoons at all MAFs was sampled for oil and grease and TAL metals. All sample results were below regulatory limits.

3.3.3. Groundwater Sampling at LFs

The Environmental Impact Statement (EIS) on the Dismantlement of the MM III Missile System at Grand Forks AFB identified the potential for PCB contamination of groundwater due to leaching from buried coatings on ventilation and access shafts. The impact to groundwater was determined to be insignificant in the EIS (USAF, 1999a).

Groundwater modeling was performed using the Method of Characterization computer model. The Air Force submitted an application to the USEPA Region 8 for in-situ risk-based disposal of PCB bulk product waste as allowed under 40 CFR 761.62(c). Based on USEPA Region 8 comments on modeling results (regarding some of the selected physical parameters) in the EIS, the Air Force performed additional environmental modeling that evaluated a range in parameters to determine the sensitivity of the analysis. Results of the modeling were documented in a memorandum and submitted to USEPA Region 8, which approved in-situ risk-based disposal for the missile silos (USAF, 2001c). In order to extend the approval to allow destruction of the remaining silos, the Air Force needed to resolve all modeling issues. The Air Force agreed to collect field samples to provide inputs to the computer models, and to install groundwater monitoring wells (GMW) and sample for PCBs at five LFs. The USEPA Region 8 provided approval to demolish all of the remaining missile silos.

The Air Force developed a Groundwater Monitoring Plan for the 446 MS, providing rationale for site selection, identifying the well locations, and outlining the methods for sampling the wells. The Plan was submitted to USEPA Region 8 and approved in April 2001. Under the Plan, the Air Force would sample the sites for two years to monitor the potential presence of PCBs. Groundwater monitoring wells were installed at LFs B-13, C-21, C-22, C-28, and D-34, which were selected as a representative sample of LFs in the 446 MS. Three GMWs were installed at each site (one at a perceived upgradient location, one at the perceived downgradient location, and one for determining groundwater flow direction). The sampling is discussed in Section 3.14; results are presented in Table C-4.

3.4. INSTALLATION RESTORATION PROGRAM

The DoD implements CERCLA through its Defense Environmental Restoration Program (AFI 32-7020), which requires installations to identify, confirm, quantify, and remediate contamination associated with past hazardous material disposal sites. CERCLA, as amended by the *Superfund Amendments and Reauthorization Act* (SARA) (42 U.S.C. Sec. 9601, *et seq*.) provides Federal agencies with the authority to inventory, investigate, and clean up uncontrolled or abandoned hazardous waste sites. Areas that may be contaminated by hazardous materials or wastes through spills or leaks caused by DoD activities are being investigated and cleaned up through the Installation Restoration Program (IRP). There are no IRP sites associated with the LFs or MAFs.

3.5. STORAGE TANKS

Storage tanks can be aboveground or underground and can be associated with pipelines, hydrant fueling systems, or transfer systems. There were no known fuel pipelines, hydrant fueling, or transfer systems associated with the fuel systems of the LFs or MAFs. There were piping lines that connected the fuel storage tanks to dispensing systems or generators. All aboveground lines were removed. Buried lines were drained and closed in place (Vetter, 2001).

Numerous ASTs and USTs were used at the LFs and MAFs for fuel and water. Fuel storage tanks are closely regulated and must meet stringent guidelines for spill and leak protection as a result of historic problems with leaking tanks and fuel spills throughout the nation.

Prior to site dismantlement, tanks included deep-buried USTs at the LFs (30-35 feet deep) and MAFs (40-45 feet deep), shallow-buried USTs (ranging from about 3 to 10 feet deep) at the MAFs and LFs, and day tanks that were located within the LCEB at the MAFs and LEB at the LFs. Depending on their use, the tanks contained diesel heating fuel, diesel vehicle fuel, motor gasoline (MOGAS), or water. Some of the buried fuel tanks contained diesel fuel to run back-up power generators. Because they were used as a fuel source for the emergency generators, the USTs were deferred from federal regulation and the requirements under the North Dakota Storage Tank Regulations (1, Chapter 10) for release detection requirements. However, the tanks were still regulated for the December 1998 deadline for corrosion and spill or overfill protection, as well as proper closure. A 30-day notification was given to the State before UST removal or closure. The status of tanks installed at the MAFs and LFs is identified in Table 3.5-1.

At the MAFs, the deep-buried 15,000-gallon diesel fuel tank near the LCC and the 40,000-gallon demineralized water tank under the LCSB were left in place. The diesel tank was closed in accordance with state guidelines (cleaned and filled with sand). The water tanks were abandoned in place, as they are not regulated. The two propane tanks behind the garage have been left for the future owner of the property. All other tanks were removed.

The 1,000-gallon shallow-buried (3 to 4 feet to the top of the tank) diesel fuel tanks were removed from an area to the right of the gate, and the MOGAS tanks were removed. The 3,700-gallon shallow-buried heating oil tanks were removed.

Table 3.5-1 MAF and LF Storage Tank Status			
Size (Gallons)	**Location**	**Contents**	**Status**
40,000	Deep – MAF	Water	Abandoned
15,000	Deep – MAF	DF-2	Closed in Place
11,000	Deep – LF	DF-2	Closed in Place
4,000	Deep – LF	DF-2	Closed in Place
7,000	Shallow – MAF	Water	Abandoned
4,000	Shallow – MAF	DF-2	Removed
1,000	Shallow – MAF	DF-2	Removed
1,500	Shallow – MAF	MOGAS	Removed
1,000	Shallow – MAF	DF-2	Removed
500	Shallow – MAF	DF-1/DF-2	Removed
100	Day Tank – MAF	DF-2	Removed
100	Day Tank – LF	DF-2	Removed
480 (approx.)	Temporary Tank - LF and MAF	DF-2	Removed

DF = diesel fuel; MOGAS = motor gasoline
Source: Vetter, 2001

The 100-gallon diesel fuel tanks were removed from the LCEB and the 5-gallon diesel fuel tanks were removed from the LCSB; both of these were aboveground tanks.

At the LFs, the deep-buried 11,000-gallon USTs were closed in place in accordance with all applicable regulations (triple-rinsed and filled with an inert material (sand)); they were temporarily replaced with double-walled fiberglass USTs (4,000 gallons and 6 feet in diameter), including interstitial monitoring equipment. All of the piping was replaced at the same time, and the system tightness tested. The soils at all sites with these new USTs were examined, and cleaned if necessary, when the previous USTs were closed in place. Prior to site demolition, these shallow-buried 4,000-gallon USTs were removed in accordance with State requirements. The Air Force prepared tank closure reports (USAF, 2000c), which noted any soil contamination at the site (see Table C-4).

3.6. OIL/WATER SEPARATORS

There were no oil/water separators associated with the LFs or MAFs.

3.7. PESTICIDES

Pesticides are a group of biological or chemical materials that includes herbicides and insecticides. Pesticides vary greatly in toxicity, and can pose a threat to human health and safety and the environment, if improperly managed. Pesticides vary greatly in their persistence in the environment. Factors that influence the persistence of pesticides include soil type (coarse soil types allow more leaching), adsorption (clay and organic matter favor strong adsorption), solubility of the pesticide, and degradation rates (dependent on the chemical, sunlight, temperature, soil pH, soil moisture, and microbial activity). Pesticides were used at the MAFs and LFs and are still used by many adjacent private land owners.

Herbicides were used at regular intervals between the early 1960s and the late 1990s to control weed and plant growth. Arsenal®, a non-selective herbicide, was used in 1996 at the LFs and MAFs on a biannual basis, at a rate of 200 pounds (lbs) per site. Arsenal® is a systemic herbicide that is directly absorbed through the roots of the plant. Previous usage included Sprakil®, Weed Blast®, Pramitol® 25E, and Bromocil® 2-4-D. Herbicides were typically applied during late spring and early summer at rates below the maximum prescribed by the manufacturer. In addition, the herbicide Rodeo® was occasionally used to control aquatic vegetation, specifically cattails, at various locations. The sites are also mowed occasionally to control noxious weeds.

As part of the MM III Dismantlement EIS, a computer model, *Groundwater Loading Effects on Agricultural Management Systems* (GLEAMS), was used to evaluate the potential impact of residues from three pesticide ingredients (Imazapyr, Tebuthiuron, and Prometon). The other active ingredients (Diuron, Bromocil, and 2,4-D) persist less than two years. Results from the model showed that most pesticide residues are almost completely degraded within one year of application. Within the top 90 centimeters (cm) (36 inches) of soil, Imazapyr would degrade to less than 0.01 ppm (about 0.005 ppm in the top 1 cm [0.4 inches]) after two years. Tebuthiuron would degrade to about 0.07 ppm in the top 90 cm of soil after two years, and Prometon would degrade to about 0.35 ppm in the top 90 cm of soil after two years. There are no Federal or North Dakota regulatory limits on pesticide residues in soil. The modeling predicted that no leaching would occur below 36 inches and that three percent or less of the residue would run off into surface water. Any potential runoff would be substantially diluted in streamflow and would not exceed or even approach the maximum contaminant level (MCL) for drinking water (USAF, 1999a). Previous sampling in response to adjacent landowner complaints generally failed to detect pesticides, even though pesticide applications had been conducted within the previous months.

In recent years, Grand Forks AFB decreased herbicide use as part of a mandated reduction in overall pesticide usage. Less toxic and persistent herbicides were used, since spills or runoff of herbicides can damage crops in the fields that often surround the LFs and MAFs. Recent spot treatments have been used sporadically to supplement mowing for noxious weed control. Since these treatments involved smaller treatment areas and lower application rates than the previously modeled applications, they would also be predicted to result in negligible pesticide residues after one year. Few complaints over the past years were registered with the Air Force regarding herbicide damage to crops surrounding the LFs or MAFs. Table 3.7-1 provides information on herbicides used at the LFs and MAFs.

3.8. MEDICAL OR BIOHAZARDOUS WASTE

The LF sites were unoccupied, and were visited only during maintenance activities. Any medical waste generated at the site was returned to Grand Forks AFB for proper disposal. Air Force personnel temporarily lived at the MAFs and occasionally generated medical waste. All waste generated at the site was removed to Grand Forks AFB for disposal. There were no biohazardous wastes associated with the LFs or MAFs. Consequently, there is no risk of exposure to medical or biohazardous wastes at the dismantled sites.

Table 3.7-1
Herbicides Used at LFs and MAFs

Years	Product Name	Active Ingredient	CAS Number	Action	Amount	Concentration
1996-1997	Arsenal®	Imazapyr	081334-34-1	NS[1] Herbicide	200 lbs/site biannually	0.5%
1995	Sprakil®	Tebuthiuron	34014-18-1	NS Herbicide	200 lbs/site biannually	1.0%
		Diuron	330-54-1			3.0%
1993-1994	Weed Blast®	Bromocil	314-40-9	NS Herbicide	200 lbs/site biannually	4.0%
		Diuron	330-54-1			4.0%
1990-1992	Pramitol® 25E	Prometon	1610-18-0	NS Herbicide	200 lbs/acre annually	5.0%
1989-1990[2]	Arsenal®	Imazapyr	081334-34-1	NS Herbicide	Unknown	Unknown
	Weed Blast®	Bromocil	314-40-9			
		Diuron	330-54-1			
1985-1986[2]	Bromocil®	Bromocil	314-40-9	NS Herbicide	Unknown	Unknown
	2,4-D	2,4-D	94-75-7			

[1] Non-selective
[2] Records for these years cannot be located; herbicides used in these years are based on interviews with Pest Management personnel.
Source: USAF, 1999a

3.9. ORDNANCE

Security forces were present at the MAFs to protect the facility as well as the surrounding LFs within the MAF's flight and adjacent flights. All weapons and ordnance used to protect the sites have been removed from the MAFs.

Each LF contained munitions that served as actuators for ballistic gas generators designed to remove the launcher closure door in the event of a launch. These munitions were removed before each site was demolished. Ordnance associated with the MM missiles was removed early in the deactivation process. There are no remaining munitions at the LFs or MAFs.

3.10. RADIOACTIVE WASTES

Reentry systems (RS), stored within the launch tube at LFs during missile deployment, were tightly sealed and designed to prevent leaks of radioactive material, and all have been removed from the LFs. Radioactive material within the warheads continuously emitted ionizing radiation in the form of alpha and beta particles, gamma rays and X-rays, and neutrons, measurable at a very low rate (below background levels) at a distance of three feet from the RS, and undetectable at a distance of 10 feet (NCRP, 1987). The steel liner of the LF was not irradiated above background levels to any significant degree from the presence of the RS in the launch tube, and any trace of latent radioactivity would have quickly dissipated to natural background levels after removal of the RS. The soil outside the launch tubes would not retain any latent radioactivity. Leaks of radioactive materials are not known to have occurred at Grand Forks AFB or in the deployment area (Rudolf, 1998). There is no risk of radiation exposure caused by past use of the site.

3.11. SOLID WASTE

Solid waste generated during operations at the LFs or MAFs was collected and returned to Grand Forks AFB for proper disposal. During dismantlement activities, any solid waste generated (except construction rubble) was collected and disposed off-site by a government contractor. Construction rubble generated at a site was placed down the launch tube at the LFs or the elevator shaft at the MAFs; the tube and shaft were subsequently sealed during dismantlement activities. North Dakota considers each site to be an inert solid waste site due to the demolition debris, and required the placement of a 40-millimeter-thick polymer liner 4 to 6 feet below grade level at the demolished LF sites (see Figure 3.1-2). No excavation or drilling can occur within the mounded area (over the launch tube) at these sites, although plowing around the periphery can occur.

3.12. WASTEWATER TREATMENT, COLLECTION, AND DISCHARGE

There were no wastewater treatment, collection, or discharge points associated with the LFs, since the sites were not occupied.

At each MAF a system was designed to treat, collect, and discharge wastewater. Sewage was collected and pumped to a dual-celled lagoon. The sewage lagoon sludge was landfarmed by removing the sludge, setting it aside, and grading the lagoon area. The sludge was then spread over the soil and mixed in with the top six inches of soil (USAF, 1999a; Koop, 2001). At the time of sampling, the primary lagoon had been cleaned out and no sludge remained for sampling. Seven sludge samples were collected from the secondary lagoon. One of the seven samples detected fecal coliform, but it was well below regulatory limits. Sludge samples for priority pollutant metals (PPM), molybdenum, ammonia, nitrate, nitrite, percent solids, and total nitrogen, phosphorus, and potassium were all below regulatory limits according to 40 CFR 503. Surface water samples for PPM, molybdenum, phosphorus, potassium, biochemical oxygen demand, total suspended solids, oil and grease, and pH were all below regulatory limits (USAF, 1999d).

The lagoon cells were closed in accordance with State requirements. Any remaining sewage sludge was stockpiled at one location, then the lagoon was graded out level with the surrounding land and the sludge was spread over the top 6 inches of soil. The disturbed area was then seeded with native grasses. At MAF E-0, improper grading during closeout resulted in nitrogen levels above the regulatory limit, and alfalfa was planted to balance the soil nitrogen (a USEPA-approved method). Subsequent soil sampling found nitrogen levels below the regulatory limit, and USEPA determined that no further remediation was needed (Koop, 2004). Details are found in the site-specific EBS for MAF E-0, in Volume II of this document.

3.13. ASBESTOS

At the LFs, the only item known to contain asbestos was the exhaust system for the diesel electric unit (DEU), which was removed as part of site dismantlement. The coatings found on some buried structures (such as the LEB access shaft) at the LFs may contain asbestos. None of the tanks at the LF tested positive for asbestos (Vetter, 2001). Any asbestos at the LFs was buried as part of the subsurface structure (disposed of in place, on site).

At the MAFs, the DEU exhaust systems in the LCSB and LCEB contain asbestos insulation under a metal sheet covering. MAFs may also contain asbestos at the elbows and joints of water pipe insulation on the heating system (asbestos sampling indicated that molded pipe joints on the heating system contained non-friable asbestos). Additional sources of asbestos at the MAFs include floor tiling (at the LCSB and the LCC), and vinyl base mastic and vinyl floor tiling in a closet at the LCSB (Hustad, 1997; Rudolf, 1998). The external coatings of the buried 15,000-gallon UST closed in place at the MAFs may contain asbestos.

3.14. POLYCHLORINATED BIPHENYLS

Liquid PCBs are a synthetic molecular additive formerly used in lubricating oils to enhance cooling characteristics. They were typically found in electrical transformers, fluorescent light ballasts, and machinery gear case oils, and were also used as a plasticizing agent and in waterproof coatings (e.g., at the LF underground structures). PCBs were used in the United States from 1929 to 1979 and are regulated by the *Toxic Substances Control Act* (TSCA) (15 U.S.C. Sec. 2601, *et seq*). PCBs are not regulated by CERCLA unless there is a release.

All equipment (e.g., electric filters, panels, and capacitors) that potentially contained PCBs was removed during the environmental safing process during the missile system dismantlement. Unless clearly identified as non-PCB, ballasts were handled as potentially containing PCBs. At the MAFs, light ballasts that potentially contained PCBs at the LCSB were removed and replaced only because of failure; some remaining ballasts may contain PCBs. All light ballasts were removed from the LFs.

The in-situ disposal of solid PCB occurred when debris from the implosion of LFs was left in place. The USAF and the USEPA addressed the issue of PCBs in non-liquid form during closure of the MM II facilities at Ellsworth AFB, South Dakota, and Whiteman AFB, Missouri. In November 1995, the two agencies entered into a Federal Facility Compliance Agreement (FFCA), a formalized plan to address PCBs in non-liquid form (including their potential inclusion within the HICS coatings) during closure of the MM II facilities. Subsequent to the FFCA, USEPA developed regulations pertaining to disposal of PCB bulk product waste (40 CFR 761.62(c)), which established a cleanup criterion of 100 ppm for a low occupancy site with an impermeable cap and restricted access (fenced site).

The Air Force and NDDH determined that PCB issues regarding the Grand Forks AFB MM III sites would be resolved with USEPA Region 8, rather than as specified in the FFCA. As noted in Section 3.3.3, the Air Force submitted an application to the USEPA Region 8 for in-situ risk-based disposal of PCB bulk product waste, as allowed under 40 CFR 761.62(c). The Air Force and USEPA Region 8 agreed that the Air Force would further evaluate potential levels of PCBs in the 446 MS, the first squadron scheduled for demolition.

Prior to the deactivation of each squadron, samples for PCBs were collected from UST coatings and adjacent soils. Testing revealed a PCB coating on some tanks at MAFs (Eggleston, 1997). The heating oil tanks (TK-106) and generator tanks (TK-107) were removed at the MAFs; all tested positive for PCBs (Hustad, 1998). Soil samples taken from around the tanks found PCBs at low levels, ranging from non-detectible amounts to 14 ppm (USAF, 1994b, 1995, 1996a, 1996b).

Sampling was also conducted in 1998 after deactivation. Sample results from waterproof coatings on access and ventilation shafts ranged from non-detect to 0.38 ppm (see Table C-6), with higher readings from ventilation shaft coatings. Adjacent soil samples collected at three LFs (A-03, D-32, and E-48) ranged from 0.81 to 7.9 ppm. Sump pump outfalls were sampled for PCBs at all LFs, and concentrations ranged from 0.021 to 3.8 ppm. All of the sample findings were well below the 100 ppm criterion for PCBs in soil.

PCBs can potentially leach into groundwater, where the drinking water criterion is 0.5 ppb. To investigate this possibility, groundwater monitoring is being conducted at 5 selected sites within the 446 MS, as discussed in see Section 3.3.3. Filtered[2] groundwater samples were used for comparison to drinking water MCLs. PCBs were not detected at four of the five LFs being monitored in the 446 MS. PCB (Arachlor 1254) was detected in one sample collected in June 2005 at LF C-22, at a level of 1 microgram per liter (μg/L). This sample was collected in sediment near the former vent shaft where PCB coatings were applied, and was not dissolved in the groundwater (filtered samples for groundwater were non-detect). Downgradient well samples did not detect PCBs. Groundwater monitoring will continue until June 2007 to confirm current sampling (USAF, 2005).

The coating on the deep-buried 15,000-gallon diesel fuel UST that was closed in place at each MAF might contain PCBs (Vetter, 2001). Within the entire MM III deployment area of Grand Forks AFB, only one deep-buried 11,000-gallon UST (at LF F-09 within the 447 MS) was tested for PCBs and none was detected.

The electric power suppliers in the deployment area were contacted to determine whether there had been any instances of insulating oil leakage and, if so, whether these transformers were suspected of being PCB transformers or PCB-contaminated[3]. The electric power suppliers have an easement with property owners for crossing private or Air Force lands (Nordham, 2001). The suppliers have full responsibility for all of their transformers. When the Air Force relinquishes the sites, the licenses between the Air Force and the electric suppliers will be terminated. Electric service is currently maintained at the MAFs; the future owners would become responsible for future electric service costs upon conveyance of the facility. Following is a summary of transformer status in the deployment area.

- Cavalier Electric Cooperative has no known PCB transformers in their service area; however, all transformers have not been tested. Transformers at the missile sites were tested in the summer of 2001 (Mickleson, 2001). There had been no PCB contaminant spills recorded within their system in the last five years.
- Cass County Electric Cooperative has removed all transformers at missile sites within its service area. There have been no PCB contaminant spills within the last five years within their system. If PCBs were found in the oil, the equipment was removed from service and refilled with PCB-free oil (Schmidt, 2001; Holmly, 2003).

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[2] An unfiltered water sample may contain sediment and debris, while a filtered sample has been passed through a series of very fine screens and contains only water. The MCLs apply only to filtered samples. All samples were collected in accordance with USEPA methodology.

[3] According to 40 CFR 761.3, a "PCB-contaminated transformer" contains between 50 and 500 ppm of PCBs, while a "PCB transformer" contains greater than 500 ppm. A transformer containing less than 50 ppm is considered a "non-PCB transformer."

- Nodak Electric Cooperative has no known PCB transformers in their service area; the pole-type transformers at the missile sites do not contain PCBs. There have been no PCB spills recorded within their system in the last eight years, and their transformers at missile sites have been removed (Rodgers, 2003). Nodak's service area includes the area served by the former Sheyenne Valley Electric Cooperative.
- Otter Tail Power Company has removed most transformers and other equipment at missile sites within its service area; remaining equipment will be removed during scheduled maintenance, and no PCB-containing transformers remain (Van Voorhis, 2003). There have been no PCB contaminant spills recorded within their system in the last seven years (Graumann, 2003).

3.15. RADON

Radon is a naturally occurring odorless, colorless gas with radioactive qualities that may be harmful to human health. The region can present a risk of exposure from naturally occurring radon. Subsurface areas are a concern for radon gas to build up if structures are inadequately ventilated. The USEPA-recommended action level is 4 picocuries per liter (pCi/l); readings at Grand Forks AFB have ranged from about 4 to 20 pCi/l (Koop, 2001).

The LCC and LCEB at the MAFs were hermetically sealed areas with filtration units for nuclear, biological, and chemical elements. The LCSB did not contain a basement; subsurface areas are a concern for radon gas buildup if the areas are inadequately ventilated. No radon monitoring was conducted at the MAFs because the protected ventilation of the subsurface structures (Rudolf, 2001) was adequate to prevent radon buildup. Radon exposure at the LFs is negligible because of adequate ventilation on the surface.

3.16. LEAD-BASED PAINT

Lead-based paint was used on interior and exterior surfaces in buildings constructed prior to 1978. The subsurface facilities within the deployment area, including the LCEB and the LCC, were originally painted with paint containing red-lead pigment. At the LF, the interior of the launcher and LEB contain LBP. Although the lead content of the particular paint used is unknown, the paint used at the LFs and MAFs is conservatively assumed to contain 20 percent lead by weight (industrial paints contain 15 to 18 percent lead by weight (DuPont, 1990; Westinghouse Electric Corporation, 1990)). Other heavy metals, such as chromium and mercury, are also likely to be in the paint. (As discussed previously, soil test results for chromium, cadmium, mercury, zinc, and nickel were all below regulatory limits.) Subsurface structures potentially coated with LBP were buried in place. During Rivet Minuteman Integrated Life Extension (MILE) activities, portions of the original paint were chipped off exterior and interior surfaces at the LFs and left on the topside surface of each site (Hustad, 1997). The highest value for random samples for lead taken within the fence line of LF B-17 had a value of 260 ppm (USAF, 1999d); this concentration is below health criteria levels of 1,200 ppm for residential areas (TSCA Section 403).

Any LBP in the LCSB was removed prior to dismantlement. The only LBP remaining at the MAF is inaccessible below grade in the former LCC (Vetter, 2001). Traces of LBP may remain around door posts and jambs within the LCSB, but would be below the contaminant regulatory level of 5.0 mg/l (Koop, 2001).