US Army Corps of Engineers®
Buffalo District
BUILDING STRONG®

Preliminary Assessment Report

Niagara Falls Storage Site–Vicinity Property H Prime

Niagara County, New York

December 2016
Formerly Utilized Sites Remedial Action Program

NFSS_01.09_0004_a

This page is intentionally left blank.

CONTENTS

FIGURES

TABLES

ACRONYMS

AEC	Atomic Energy Commission
BTV	background threshold value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMSA	contaminated material storage area
cm	centimeter
Co	cobalt
Cs	cesium
CWM	Chemical Waste Management, Inc.
DERP–FUDS	Defense Environmental Restoration Program–Formerly Used Defense Sites
DoD	Department of Defense
DOE	Department of Energy
EPA	Environmental Protection Agency
FUSRAP	Formerly Utilized Sites Remedial Action Program
GSA	General Services Administration
IWCS	interim waste containment structure
KAPL	Knolls Atomic Power Laboratory
KOA	Kampground of America
LOOW	Lake Ontario Ordnance Works
LWBZ	lower water-bearing zone
MED	Manhattan Engineer District
NFSS	Niagara Falls Storage Site
NRC	Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
PA	Preliminary Assessment
pCi/g	picocuries per gram
pCi/L	picocuries per liter
Pu	plutonium
Ra	radium
Sr	strontium
Th	thorium
TNT	trinitrotoluene
μR/hr	microRoentgens per hour
U	uranium
USACE	United States Army Corps of Engineers
UTL	upper tolerance level
UWBZ	upper water-bearing zone
VPs	Vicinity Properties
VP–H’	Vicinity Property H-Prime

This page is left intentionally blank.

EXECUTIVE SUMMARY

This report is a Preliminary Assessment (PA) of the Niagara Falls Storage Site (NFSS) Vicinity Property H Prime (VP-H'), in Porter, New York. The NFSS and associated vicinity properties are within the original boundary of the former Lake Ontario Ordnance Works (LOOW), a portion of which was used in support of the Manhattan Engineer District (MED) and U.S. Atomic Energy Commission (AEC) activities, such as storage of radioactive residues and wastes from uranium ore processing.

The U.S. Department of Energy (DOE) designated VP-H' for cleanup in 1984 under the Formerly Utilized Sites Remedial Action Program (FUSRAP). This program was initiated in 1974 to identify, investigate, and if necessary, clean up or control sites throughout the U.S. that had been contaminated as a result of MED or early AEC activities. Both the MED and the AEC were predecessors of the DOE. The DOE removed residual radioactive contamination from VP-H' in 1984 and certified that radiological conditions on this property conformed to the cleanup guidelines in 1991.

In 2010, DOE performed a desktop review of the remediation documentation and current land use at NFSS vicinity properties in response to stakeholder concerns. The DOE and its contractor remediated all FUSRAP material at the completed sites, including VP-H', to meet DOE guidelines for unrestricted use. The resulting report concluded that if undiscovered contamination was identified, the DOE would refer the property to the U.S. Army Corps of Engineers (USACE) for investigation and possible remediation through a memorandum of understanding between DOE and USACE regarding program administration and execution of FUSRAP.

In 2004–2005, USACE, Buffalo District, conducted intrusive work on VP-H' under the Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP–FUDS) program to remove a contaminated material storage area (CMSA) pad. During this field work, USACE performed radiological screening for health and safety reasons and found elevated radioactivity. In response, the DOE issued a letter to USACE in September 2014 authorizing an assessment[1] (and remediation, if necessary) of VP-H' due to the following conditions:

- Measured gamma activity in 2005 at levels up to eight times higher than background in the areas of potential contamination that USACE delineated. These measurements indicated that gamma sources were on the property at levels that may exceed guidelines.

- The radium (Ra)-226 and total uranium concentrations in USACE sample CMSA 7-0 exceeded the numerical guidelines established for the DOE remediation work at the NFSS and VP-H'. The sample appeared to represent FUSRAP-eligible waste because it

[1] A Memorandum of Understanding (March 1999) between the USACE and the DOE allows DOE to transfer sites to USACE under FUSRAP, is provided in Appendix A.

contained less uranium than Ra-226, which was consistent with uranium-processing residues at this location (i.e., the radionuclides were not in secular equilibrium).

- The Ra-226 concentration in the sample CMSA Pad 8-0 exceeded the Ra-226 guideline for surface soil.

Under FUSRAP, Congress has limited the Corps of Engineers' authority to addressing only potential contamination associated with MED activities during the early atomic energy program.

Based on the findings of this PA, USACE recommends that VP-H' undergo further investigation, in accordance with CERCLA, beginning with a remedial investigation to determine the nature and extent of AEC-related contamination and the associated risks to human health and the environment. There is evidence of an unpermitted release of the constituents of concern into the environment associated with the Nation's early atomic energy program at VP-H'. Further action under FUSRAP will address potential contamination throughout the property, to include surface soil, subsurface soil, process pipelines, groundwater, surface water, and sediment.

1. INTRODUCTION

The United States Army Corps of Engineers (USACE), in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and the National Oil and Hazardous Substance Pollution Contingency Plan, performed a Preliminary Assessment (PA) of Vicinity Property H' (VP-H') at the Niagara Falls Storage Site (NFSS). The purpose of this PA was to review information to determine the need for further USACE action under the Formerly Utilized Sites Remedial Action Program (FUSRAP) to ensure the protection of human health and the environment. The scope of the assessment included a review of existing information on the site from previous remediation and investigations.

Beginning in 1944, the Manhattan Engineer District (MED) and its successor, the Atomic Energy Commission (AEC), used portions of the Lake Ontario Ordnance Works (LOOW) (presently referred to as the NFSS and vicinity properties [VPs]) near Lewiston, New York (Figure 1), for storage of radioactive wastes. These wastes were primarily residues from uranium processing operations; however, they also included contaminated rubble and scrap from decommissioning activities, biological and miscellaneous wastes from the University of Rochester, and low-level fission-product waste from contaminated-liquid evaporators at the Knolls Atomic Power Laboratory (KAPL). The LOOW discontinued receipt of radioactive waste in 1954, and after the Hooker Chemical Company conducted cleanup activities, 525 hectares (1,297 acres) of the original 612 hectare (1,512 acre) site became surplus. The General Services Administration (GSA) eventually sold this property to various private, commercial, and governmental agencies.

From 1970 to 1971 and again from 1981 to 1984, contractors for the AEC and Department of Energy (DOE) conducted radiological surveys of the 525 hectares (1,297 acres) comprising the vicinity (off-site) properties. The Oak Ridge Associated Universities (ORAU) performed the latter surveys at the DOE's request to determine if any of these properties contained residual contamination above current federal guideline levels. During 1983 and 1984, Bechtel National, Inc., the project management contractor for FUSRAP, conducted additional characterization surveys where appropriate to define more accurately the boundaries of contamination on 11 properties ORAU identified. These properties were Vicinity Properties A, H', L, M, N/N' South, Q, R, S, U, V, and X. Figure 1 shows the locations of these properties relative to the NFSS. Battelle Columbus Laboratories also conducted surveys in 1979 and 1980 and identified extensive contamination in the western and central drainage ditches. This report will focus on VP-H', currently owned by Chemical Waste Management, Inc. (CWM). Figure 2 shows the location of VP-H' in relation to the Town of Lewiston and Town of Porter boundary and also includes individual parcel boundaries of the surrounding properties and site drainage features.

2. SITE LOCATION AND DESCRIPTION

2.1 VICINITY PROPERTY H PRIME

The property is rectangular in shape (approximately 180 meters [m] by 90 m [600 feet [ft] x 300ft]) and occupies an area of approximately 1.6 hectares (4 acres). It is bounded on three sides by roads–Wesson Road on the west, M Street on the south, and 5th Street on the east. The northern boundary is an out-of-service railroad track. The property is owned by CWM, which restricts access to VP-H'. There are no buildings on the site, but there are several small concrete pads or foundations on the eastern section. A portion of an unused railroad spur crosses the northern corner of the property.

The VP and surrounding area are generally flat. Most of the site is overgrown with pasture grass and northern shrub. Maple, ash, and oak trees dominate the wooded areas. Cattail-marsh grass is dominant within drainage swales and low-lying areas with standing surface water. A variety of mammals, amphibians, reptiles, fish, and bird species utilize the area within 1.6 km (0.5 mile) radius of the site.

Surface soil consists of generally dry, clayey silt with some fine sand that had been graded during past Department of Defense (DoD) operations. The VP is underlain by approximately 9 to 18 m (30 to 60 ft) of unconsolidated glacial deposits that overlie shale bedrock of the Queenston formation. There are eight distinct stratigraphic layers under the LOOW: fill material, alluvium, upper glacial till (or brown clay till), middle silt till, glaciolacustrine clay, glaciofluvial sand and gravel, red lodgment till, and Queenston shale bedrock.

Groundwater in the near-surface stratigraphy occurs in low-permeability unconsolidated deposits, and the water-table surface generally conforms to the local topography. Groundwater at the site occurs at approximately 1.5 to 3 m (5 to 10 ft) below ground surface (bgs). Regional groundwater flow is primarily to the northwest toward the Niagara River, although creeks and drainage ditches influence localized groundwater flow patterns. The discontinuous nature of saturated lenses restricts lateral groundwater flow (USACE, 2007b).

Before SCA Chemical Services, Inc., (site owner prior to CWM) acquired the VP-H' land, as excessed property, the New York State Commissioner of Health prepared a letter outlining the land-use restrictions that would apply to the property for the state to approve the land transfer (DOE, 1982b). The state imposed restrictions with the objective of protecting public health and safety and to "minimize danger to life and property from radiation hazards." The restrictions indicate that the property cannot be used for residential purposes, schools, or hospitals, but it can be used for industrial or commercial activities. If the New York State Department of Health deemed it appropriate, these restrictions could be lifted (Wallow, 1980).

2.2 NIAGARA FALLS STORAGE SITE

The NFSS proper and associated VPs occupy approximately 607 hectares (1,500 acres) of the original 3,035 hectares (7,500 acres) LOOW, the former trinitrotoluene (TNT) manufacturing facility built during the 1940s. In 1944, the MED took over the LOOW to store radioactive residues and materials leftover from the development of the atomic bomb. By 1948, the federal

government had sold 2,428 hectare (6,000 acres) of the original 3,035 hectares (7,500 acres), leaving 611 hectare (1,511 acres) under newly formed AEC control. The DoD determined that all but 86 hectares (212 acres) of the 611 hectare (1511 acre) site were excess beginning in 1955. The GSA later disposed of the excess acreage at various times. In 1974, the Town of Lewiston acquired an additional area of approximately 9 hectares (22 acres), including the original sewage treatment plant facilities (VP-X), leaving the NFSS the remaining 77 hectares (191 acres).

In 1974, FUSRAP was initiated to address contamination at sites formerly used for MED and early AEC operations that were not addressed by other programs. In the 1980s, the DOE and its contractor, Bechtel National, Inc., performed remedial actions at the NFSS and its vicinity properties. The NFSS vicinity properties are radioactively contaminated areas adjacent to or near the NFSS that were once part of the former LOOW and designated by the DOE as radiologically impacted by past government activities. The interim waste containment structure (IWCS) is the dominant site feature, occupying approximately 4 hectares (10 acres) in the southwest portion of the NFSS; the DOE built it on the location of the former fresh water treatment plant and the R-10 pile (uranium extraction residues). During the 1980s, the DOE consolidated radioactive wastes and contaminated materials from the NFSS and its vicinity properties into the IWCS, which it engineered to retard radon emissions, infiltration from precipitation, and migration of contamination to groundwater.

The DOE completed remediation of 23 of the 26 designated VPs before Congress transferred cleanup responsibilities under FUSRAP to the U.S. Army Corps of Engineers in 1997. The USACE, Buffalo District, is responsible for remediating the remaining three VPs (E, E', and G) and the NFSS proper under FUSRAP. Additionally, USACE received a letter from the DOE in 2014 referring both VP-X and VP-H' to USACE for assessment and, if needed, remediation under FUSRAP. This report will document the preliminary assessment of VP-H' as the first step in the CERCLA process. The 2014 DOE referral letter for VP-H' is included as Appendix A to this report.

2.3 OWNER-OPERATOR INFORMATION

The VP lies within two hectares (five acres) of land owned by CWM. There are no buildings or structures on this portion of the property and it is currently not used by CWM.

2.4 REGIONAL INFORMATION

- **Surrounding Land Use**
  There are approximately 380 private residences within the original 3,035 hectare (7,500 acre) land parcel of the former LOOW. Most are along Creek Road, the western section of Cain Road, Balmer Road, and Pletcher Road in the former 2,023 hectare (5,000 acre) buffer zone. The largest residential area is along Balmer Road and includes a mobile home park, Youngstown Mobile Park, consisting of approximately 92 units on Balmer Road, west of the former LOOW. The Lewiston-Porter Central School District property is approximately 2.4 km (1.5 miles) to the west and Modern Landfill is located within 1 km (0.6 miles) to the southwest of VP-H'. A 5.3 hectare (13 acre) Kampground of America (KOA) opens seasonally April through mid-October on the south side of Pletcher Road in the south-central portion of the former LOOW acreage. The KOA campground also

includes a centrally located sewage disposal area. The Shrine of Fatima, attracting thousands of visitors each year, is on the north side of Swann Road, within the former LOOW 2,023 hectare (5,000 acre) buffer (there are also several small farms in the area).

- **Population**
  According to 2008 U.S. Bureau of the Census data, the population of Niagara County was 214,464. The majority of the population in Niagara County surrounding VP-H' resides in the Towns of Lewiston (2,628), Niagara (8,404), Porter (6,699), and the City of Niagara Falls (52,326). Figure 3 shows an updated population distribution surrounding the NFSS, which USACE, Buffalo District, generated using LandScan 2013 Global Population Data from Oak Ridge National Laboratory; this included data for the United States and Canada.

- **Meteorology**
  Western New York, where the VP-H' is located, has a humid, continental climate characterized by warm summers and long, cold winters. The mean annual temperature is 8.8 degrees Celsius (°C) (48 degrees Fahrenheit [°F]) with mean seasonal temperatures ranging between –3.9°C and 24.4°C (25°F and 76°F). Mean annual precipitation is approximately 74 cm (29 inches (in]), distributed evenly throughout the year. Snowfall, predominantly falling between November and March, averages approximately 130 centimeters (cm) (51 inches [in]) per year. Wind data for the region indicated predominantly southwest winds with average monthly wind speeds ranging from 16.1 to 22.5 kilometers per hour (10 to 14 miles per hour).

2.5 OPERATIONAL HISTORY AND WASTE CHARACTERISTICS

There is no evidence of contaminated waste burial on VP-H', through documentation review or site investigation. Although, the DOE suspects that before 1954, radioactive material was stored on this property and that waste incineration operations were performed on a pad in the eastern portion of the site. A 1958 aerial photograph of VP-H' is provided in Figure 4.

There are reports that incineration of the combustible portion of KAPL waste occurred on VP-H' on a pad along the east boundary adjacent to VP-E' (DOE, 2013). A report titled "Background and Resurvey Recommendations for the Atomic Energy Commission Portion of the Lake Ontario Ordnance Works" presents the most comprehensive overview of the NFSS VPs' operating history and land use (DOE, 1982b). This document states that the Hooker Electrochemical Company, under instructions from the AEC, incinerated KAPL material on a concrete pad. An excerpt from the report is as follows:

> *Based on studies and experimental contaminated-waste burning conducted on an open cement pad at the Lake Ontario Ordnance Works it was discovered that significant volume reduction of combustible wastes could be attained ...The Atomic Energy Commission instructed Hooker Electrochemical Company to burn low-level (5 milli-roentgens/hour or less) crates and barrel the ashes for shipment to Oak Ridge…The burning was to be done on cement pad or in the incinerator (Building 419) Hooker suggested using loose cinder block concrete outdoor fireplace erected on an existing concrete pad metal backstop used for*

indoor pistol practice was modified to contain fan-operated water scrubbing arrangement to remove particulate matter that might be carried up the stack…It is possible that the pad used for burning the combustible wastes was the change house south of the locomotive shop on Castle Garden Road where Oak Ridge National Laboratory discovered cesium 137 in the soil...No plutonium-bearing waste or unmarked waste was to be burned. Ashes in crates sent from the Knolls Atomic Power Laboratory were to be buried onsite [sic] *because they were uncontaminated. It is not clear why this uncontaminated waste was sent to the Ordnance Works…*

The eastern half of this plot was decontaminated in 1972 through the removal of scrap from a concrete pad. The plot had several areas with radiation levels between 20 and 40 microroentgens/hour in the eastern half…There is no evidence of contaminated scrap burial. However, the concrete pad is suspected to be the site of waste incineration operations...

A 1978 aerial survey the DOE conducted over the entire LOOW did not identify any anomalous gamma radiation levels on VP-H'. A preliminary assessment was performed over properties VP-H' and VP-E' in 1982 (DOE, 1982a), and the DOE followed that up with a comprehensive assessment of VP-H' in 1983 (ORAU, 1983b). It analyzed soil and sediment samples for cesium (Cs)-137, uranium (U)-235, U-238, and other gamma emitters. Several samples in the vicinity of the pads contained high Cs-137 concentrations (13.8 picocuries per gram [pCi/g] to 33 pCi/g); these were consequently analyzed for strontium (Sr)-90 because the presence of elevated Cs-137 was an indicator of possible KAPL or University of Rochester waste. The DOE also analyzed a sample that had high radium (Ra)-226 and U-238 levels for plutonium (Pu)-239 (results 0.3 ± 0.26 pCi/g) and cobalt (Co)-60 (results 13.3 pCi/g). Results for cesium, strontium, and plutonium were below the DOE established guidelines. However, results of a walk-over gamma scan and analysis of biased surface soil samples indicated numerous isolated areas of Ra-226 in the soils well in excess of the 5 pCi/g cleanup criterion. Several samples also contained U-238 concentrations greater than cleanup criteria. The DOE subsequently remediated the areas on VP-H' (DOE, 1986).

The DOE contractor, ORAU, performed a verification survey over VP-H' in 1983 and 1984 (ORAU, 1989). Contact exposure rates in the area of a black cinder material ranged as high as 84 microRoentgens per hour (μR/hr) (i.e. suspected incineration wastes). A sample of this material contained 220 pCi/g of Ra-226 and 37 pCi/g of U-238. After additional excavation, subsequent survey results indicated the area conformed to the DOE FUSRAP cleanup criteria. Information reviewed for VP-H' indicates a low potential for remaining KAPL waste. At the time of the verification, the DOE concluded that all concentrations were within its guidelines for the NFSS VPs.

2.6 PREVIOUS INVESTIGATIONS/REMEDIATION

1970s

During October 1970 and June 1971, radiological surveys of the approximately 526 hectares (1,300 acres) formerly held by AEC indicated that about 2.6 hectares (6.5 acres) exceeded the

AEC exposure criterion of 50 μR/hr. The AEC decontaminated areas by removing soil that exceeded the criteria of 50 μR/hr (including background). As a result of this survey, the AEC removed 15,000 to 20,000 cubic yards of contaminated soil and debris from the VPs and transported it to the NFSS in 1972 (AEC, 1973 and ORNL, 1979). Specifically on VP-H', the eastern half of this plot was decontaminated through the removal of contaminated scrap from a concrete pad. Preremediation surveys of the soils on the remaining portion of VP-H' had several areas with radiation levels between 20 and 50 μR/hr. Decontamination of the elevated areas on VP-H' required the removal of 1–3 ft of soil in an approximate 35,000 square foot area, and the area was not backfilled (AEC, 1973). The AEC listed post-decontamination radium soil concentrations as less than 1 pCi/g. There was no evidence of contaminated scrap burial based on visual inspections. However, the concrete pad was used for waste incineration along the eastern boundary of the site (DOE, 1980 and 2013). Figure 5 shows the locations of radiation survey measurements collected by the AEC prior to remediation on VP-H'. Figure 6 shows the area of VP-H' that the AEC excavated due to elevated dose-rate survey measurements and its post remedial-action survey locations.

In April 1972, following a review of the AEC's survey data, the Commissioner of Health, New York State Department of Health placed land-use restrictions on all the excessed properties due to the residual radioactive contamination (Wallo, 1980).

In October 1978, the DOE conducted another follow-up low-level aerial survey using a helicopter for more sensitive readings (EG&G, 1978). The survey did not indicate the presence of any significant gamma radiation on VP-H'. The DOE also performed a mobile ground scanning to confirm the areas identified by the aerial survey (ORNL, 1979), which confirmed earlier AEC findings of above background levels along M Street (VP-H' southern boundary), Wesson Road (VP-H' western boundary), and 5th Street (VP-H' eastern boundary).

1982

The Radiological Site Assessment Program of ORAU performed a preliminary survey of VP-H' in June 1982. It found numerous "hot spots" on VP-H' that had a surface contact exposure rate ranging from 23 to 600 μR/hr, and bias soil samples collected identified Ra-226 as the predominant contaminant of concern. The report concluded that areas on VP-H' would likely exceed DOE cleanup goals (5 pCi/g for Ra-226 in surface soil) based on the qualitative data collected by the dose rate measurements. Figure 7 shows the locations of the 1982 dose rate survey locations. The report on this investigation recommended further characterization and remediation (DOE, 1982a).

As recommended, the DOE contractor, Bechtel National, Inc., performed additional characterization through the end of June and into July of 1982 and a summary of the results were published by the DOE in a report titled "Comprehensive Radiological Survey of Vicinity Property H'" (DOE, 1983). Figure 8 shows the locations of various sampling performed during the comprehensive radiological survey. Radiological information collected during this investigation included:

- Direct radiation exposure rates and surface beta-gamma dose rates

- Locations of elevated surface soil contamination
- Concentrations of radionuclides in surface and subsurface soil
- Concentrations of radionuclides in groundwater
- Contamination levels on pads previously used for storage or incineration of contaminated wastes

Comprehensive survey results were:

The DOE contractor, Bechtel National, Inc., analyzed soil and sediment samples using gamma spectrometry for Ra-226, Cs-137, U-235, U-238, and other gamma emitters. It analyzed several samples with high Cs-137 concentrations for Sr-90 since the presence of high Cs-137 indicated possible wastes from KAPL or the University of Rochester. It also analyzed a sample that had high Ra-226 and U-238 levels for Pu-239. It analyzed water samples for gross alpha and gross beta concentrations and performed an isotopic analysis on water samples exceeding the U.S. Environmental Protection Agency (EPA) drinking water standard for gross activity.

Direct radiation levels measured on site identified numerous small isolated areas with elevated surface radiation levels. Gamma exposure rates at contact and 1 m above the surface at these locations ranged from 18 to 365 μR/hr and 12 to 33 μR/hr, respectively. Contact beta-gamma dose rates ranged from 110 to 5,580 μR/hr. Soil sampling did not reduce exposure rates at most locations. At many points, exposure rates actually increased following sampling. These results indicated that contamination at some locations extended greater than 15 cm (6 inches) below the surface and was diffused rather than in discrete particles. Direct radiation levels at grid line intersections on VP-H' were generally higher on the southeastern and eastern portion of the site and along "M" Street and 5th Street.

Surface soil sampling at grid intersections found concentrations of Ra-226 ranging from 0.51 to 15.7 pCi/g, and approximately half of the samples collected contained Ra-226 concentrations above baseline soil samples (baseline samples were collected off site, in unimpacted areas, for comparison purposes to represent background concentrations for the surrounding area). The contractor collected 21 bias samples from locations of elevated contact radiation; all showed Ra-226 above baseline levels. The highest Ra-226 concentration was 1,750 pCi/g and consisted of a black material resembling an ash residue from incineration. Other samples contained elevated U-238 (highest was 1,480 pCi/g), and some samples contained elevated levels of Cs-137 (highest 27.1 pCi/g and 33 pCi/g with corresponding Sr-90 concentrations of 9.71 pCi/g and 1.29 pCi/g, respectively). Only one sample contained detectable levels of Co-60 at 13.3 pCi/g.

The DOE contractor also used a ground penetrating radar on VP-H' and found evidence of old building foundations or concrete pads. The contractor noted other anomalies at several locations on the southeastern portion of the property, indicating the possibility of small buried objects or small subsurface deposits of electrically "active" material. These anomalies were at a depth of approximately 0.6 to 1.7m (2–5.5ft) below the surface.

The DOE contractor collected subsurface soils from 15 locations on VP-H'. The Ra-226 concentrations from these locations indicated that the soil contamination was primarily in the upper 0.5 m (1.6 ft) of soil. The highest levels of Ra-226 were 24.8 pCi/g and U-238 at 101 pCi/g.

Most of the groundwater samples obtained from boreholes contained elevated gross alpha and gross beta concentrations. The gross alpha and gross beta concentrations in the highest sample were 788 picocuries per liter (pCi/L) and 363 pCi/L, respectively. The contractor's report noted that high concentrations of dissolved solids may have adversely affected the detection sensitivities of the gross alpha procedures. During this investigation, the contractor did not analyze U-238 in groundwater samples.

The DOE contractor collected three surface water samples from standing water on VP-H'. All locations had gross alpha and gross beta concentrations above baseline levels. One location contained gross alpha at 30 pCi/L, well above the EPA drinking water criteria of 15 pCi/L. The other water sample locations did not exceed the EPA drinking water criteria. The contractor collected sediment samples from drainage ditches on VP-H', but they did not contain radionuclides significantly different from the levels in baseline soils.

Results of this comprehensive survey found numerous isolated areas of surface soil contamination. The major contaminant was Ra-226; however, several areas of high uranium contamination were also noted. Bechtel National, Inc., representatives also identified cesium-137, Sr-90, and Co-60 in some of the samples, but the concentrations were well below the guideline levels. The contractor estimated it would need to remove approximately 2,150 m^3 of soil on VP-H' to bring the property into compliance with the DOE criteria for unrestricted use. This accounted for 71 percent of the estimated total volume of soil that needed to be remediated from all of the NFSS VPs as part of this 1984 cleanup (DOE, 1984).

During remediation at VP-H', the DOE used the following guideline limits for radium-226 (the principal contaminant at NFSS), thorium (Th)-230, Th-232 and Ra-228 in soil: 5 pCi/g above background averaged over 100 m^2 (1,076 ft^2) for the first 15 cm (6 in) thick layer of soil and 15 pCi/g above background averaged over 100 m^2 (1,076 ft^2) for any 15 cm (6 in) thick layer below the first (up to 1.5 m deep). During surveys performed by the DOE in the early 1980s, the guideline for total uranium was 75 pCi/g above background. However, based on a study site-specific to the NFSS, conducted by Argonne National Laboratory, the DOE established remedial action guidelines of 90 pCi/g for total uranium (DOE, 1992). The remedial actions described in the following section were completed during the time frame when the total uranium DOE remediation guideline was set at 75 pCi/g (DOE, 1992).

1984

In 1984, after the 1983 characterization of VP-H', the DOE remediated portions of the property. A report released by the DOE in 1986 titled "Post-Remedial Action Report for the Niagara Falls Storage Site Vicinity Properties 1983–1984" outlined the remedial actions conducted on each of the NFSS VPs, including VP-H' (DOE, 1986c).

After Bechtel National, Inc., completed remedial action on VP-H', it conducted a radiological survey to ensure that radiological conditions on the property complied with remedial action guidelines before backfilling it with clean fill. Surveys included gamma radiation walk-over surveys and sampling at grid intersections across the property (6.1-m [20-ft] spacing). The soil sampling performed during the DOE post-remedial action determined that the property had met the remedial action guidelines. Five soil samples exceeded the guideline used for remediation, but nearby concentrations indicated when background was subtracted from the average results, the average met the remediation guideline. The highest near-surface result collected from 336 samples for Ra-226 was 58.8 pCi/g; the average Ra-226 concentration was 1.9 pCi/g. There were 17 individual samples that exceeded 5 pCi/g of Ra-226 after the remedial action. Figure 9 shows the areas of excavation conducted on VP-H' during this field work plus the post-remedial action sample locations.

1986

In 1986, the DOE contractor ORAU characterized areas of elevated radioactivity, post-remediation, on some vicinity properties (including VP-H'). Samples of ash and cinders from the locations of elevated contact radiations on properties H' contained Ra-226 concentrations of 220 pCi/g and 27 pCi/g of U-238. Concentrations in these samples were about 10 percent or less of the Ra-226 concentrations, compared to U-238, suggesting that the materials are not of natural origin; ORAU recommended additional cleanup on these areas (DOE, 1986a). Excavation of this area was effective in removing the material (DOE, 1989). Figure 9 also depicts a location where a small area of elevated material was found and subsequently removed after the initial remedial action. This location was outlined in the 1986 DOE report (DOE 1986a), where it was identified as a "hot spot" and "black cinder (not slag)."

1989

In December 1989, ORAU released a report titled "Verification of 1983 and 1984 Remedial Actions Niagara Falls Storage Site Vicinity Properties," which was a third party verification of the effectiveness of the DOE remedial actions conducted at the VPs (ORAU, 1989). The ORAU performed verification activities at 11 vicinity properties to confirm that surveys, sampling, analyses, and associated project documents provided an accurate and complete description of the remedial actions and conditions of the VPs and thereby confirmed that remedial actions had been effective in meeting established criteria. Figure 10 shows the post-remedial action verification sample locations on VP-H' that were collected in 1989.

As part of the verification, ORAU reviewed drawings and the post-remedial action reports to determine where past remediation had occurred. It obtained from the DOE soil samples that had been collected during the post-remedial action survey; ORAU selected a subset at random for its laboratory to reanalyze for radionuclides of interest (Ra-226, U-238 and Th-232) so as to confirm the accuracy of the original analysis. Additionally, ORAU representatives visited the VPs and performed visual inspections, gamma scans, direct measurements, and surface (0–15 cm [0–6 inches]) and subsurface sampling on representative portions of the excavated areas. They also collected background locations to provide baseline concentrations of radionuclides for comparison purposes.

On VP-H', there were three isolated areas with elevated direct radiation levels. All three were within the area originally identified in the ORAU characterization report. One area was due to small chips of material which caused gamma readings up to 40 μR/hr (removal of chips reduced contact exposure rates). One location was due to slag material, which exhibited naturally occurring radionuclide ratios, and no cleanup was performed. The third location was adjacent to a remediated area on "M" Street, which had exposure rates ranging up to 84 μR/hr; this activity was associated with a black cinder-like material that contained 220 pCi/g of Ra-226 and 37 pCi/g of U-238. This location was excavated, and the material was removed from VP-H'. Follow-up sampling showed remaining concentrations within the guidelines for VPs at NFSS.

2004

The contaminated material storage area (CMSA) pad was a storage pad (approximately 175 ft x 175 ft) on the southeast corner of VP-H' that consisted of compacted stone on top of a geo-textile liner; USACE constructed it in 2000 as part of a removal action of TNT-contaminated pipelines. The CMSA pad was designed to securely hold TNT-contaminated material awaiting disposal; it was no longer needed once the waste material was removed. In turn, USACE began its scheduled removal of the CMSA pad at the beginning of November 2004. The USACE conducted this field work to remove the CMSA pad under the Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP–FUDS) program to address environmental impacts due to government activities on the LOOW property.

The contractor for USACE completed the CMSA pad removal in 2004. During the removal, the contractor removed both the compacted stone and the liner under the pad. After removing the stone and geo-textile, the contractor collected six grab samples of soil using dedicated sample equipment for each specific location. The contractor disposed of the CMSA pad stone as approved by the Corps of Engineers team and the New York State Department of Environmental Conservation (NYSDEC).

The Corps performed radiological monitoring for health, safety, and disposal purposes during the CMSA pad removal. As part of the health and safety monitoring during the CMSA pad excavation process, USACE performed gamma walk-over surveys and identified a small area of subsurface soil below the former pad exhibiting radiological readings above background. The gamma walk-over, conducted with a 2x2 sodium iodide detector, did not identify the need to adjust health and safety procedures, but the Corps conducted limited soil sampling for confirmation purposes.

In turn, the Corps' contractor collected two biased soil samples and confirmed the results of the gamma walk-overs with Ra-226 concentrations of 16 pCi/g and 836 pCi/g with U-238 concentrations of 46 pCi/g and 88.2 pCi/g, respectively. It collected and analyzed a third bias sample as representative of radiologically unimpacted soil. A 2005 CMSA fact sheet, included in Appendix C, summarizes the soil sample results (USACE, 2005). Figure 11 shows the location of soil samples the Corps' contractor collected under DERP–FUDS during the CMSA pad removal and the location of the only groundwater well located on VP-H'. Tables 1 and 2 contain the data from soil samples collected at the CMSA pad during its removal in 2004.

After the CMSA pad stone and original geo-textile liners were removed, the site was restored with clean backfill from a local vendor, and the site was reseeded. The areas USACE identified as exhibiting elevated gamma walk-over and radiological sample results had a new geo-textile liner placed on top prior to backfilling and reseeding. In 2005, USACE communicated the radiological findings to the DOE.

2.7 POTENTIAL CONSTITUENTS OF CONCERN

Under FUSRAP, the DOE conducted an extensive characterization program for radionuclides in the residues at the NFSS and its VPs. The residues were generated by processing uranium ores and contained radionuclides in the U-238, U-235, and Th-232 decay series. Other materials stored at VP-H' contained additional contaminants such as fission products, including Sr-90, Cs-137, and transuranic radionuclides (including isotopes of plutonium). Records indicate that MED and AEC had stored KAPL wastes and incinerated combustibles on the NFSS property and on the southeast corner of VP-H' (DOE, 2013).

Under FUSRAP, neither the U.S. Department of Energy nor the U.S. Army Corps of Engineers is authorized to remediate waste that resulted from non-FUSRAP-eligible activities. Indicators that waste may not be eligible under FUSRAP include:

- The waste was brought to or used at the site before or after the 1940s to 1960s time frame.
- The waste was not related to MED/AEC activity (i.e., activities conducted by DoD).
- The waste has characteristics unlike known FUSRAP wastes for a given site (based on site specific knowledge of MED/AEC activities).

Based on these criteria, wastes ineligible for remediation under FUSRAP are the pseudowollastonite and metal separation slag. Other materials to be evaluated for eligibility under FUSRAP are related to the University of Rochester and Knolls Atomic Power Lab/Separations Process Research Unit (KAPL/SPRU).

3. SOIL EXPOSURE AND AIR PATHWAYS

3.1 PHYSICAL CONDITIONS

Surface soil on the NFSS and VPs consists of generally dry, clayey silt with some fine sand that had been graded during past DoD operations. The NFSS and VPs' are underlain by approximately 9 to 18 m (30 to 60 ft) of unconsolidated glacial deposits that overlie shale bedrock of the Queenston formation. Eight distinct stratigraphic layers have been identified under the LOOW: fill material, alluvium, upper glacial till, middle silt till, glaciolacustrine clay, glaciolacustrine silt and sand, lodgment till, and bedrock.

3.2 SOIL EXPOSURE AND AIR PATHWAYS

The potential receptors for VP-H', based on current land-use, could be an on-site construction or maintenance worker and a youth trespasser. A site worker is possible since VP-H' is a portion of the larger CWM property, which is currently operating as a chemical waste landfill. The youth trespasser scenario is unlikely due to the presence of perimeter fencing and other physical security measures on the CWM property. A future worker may come in contact with environmental media during site investigation activities on VP-H'. Schools, residential areas, and other commercial businesses are found within a mile of the site.

As explained in Section 2.6, VP-H' was previously investigated and remediated by both the AEC in 1972 and the DOE in 1984. During the DOE's post-remedial action sampling of VP-H', there were individual soil sampling results that exceeded the DOE cleanup guidelines, which met its objectives when averaged over a 100 m^2 (1,076 ft^2) area. For example, during the post-remedial action survey, the DOE found Ra-226 in soil as high as 58.8 pCi/g (DOE, 1986c), but the remedial action guidelines for Ra-226 (5 pCi/g) at the NFSS VPs is based on an average concentration over a 100 m^2 (1,076 ft^2) area and to a depth of 15 cm (6 in); therefore, the DOE considered the cleanup complete as per its guidelines.

In 2004, USACE removed the CMSA pad and, when performing gamma walk-over surveys, found areas of elevated gamma activity. The USACE contractor under DERP–FUDS collected samples; soil below the former CMSA pad contained elevated Ra-226 (highest result of 836 pCi/g). Since the property was previously closed out as a NFSS vicinity property, it was not eligible to be further characterized under FUSRAP. The areas identified as radiologically impacted were subsequently covered in a geo-textile material after sampling was performed, and the entire CMSA Pad area was backfilled with 15 cm (6 in) of clean top soil and seeded for grass. The USACE collected sample results during the DERP–FUDS field work and sent them to the DOE as part of the Memorandum of Understanding between the agencies.

Analytical results from the samples USACE collected in 2004 were compared to project-specific human health screening levels (Table 1 and 2). Screening levels are conservatively selected values used to identify areas of a site which may require further attention or evaluation. Results that are lower than screening levels would not pose a risk to human health or the environment. Screening levels are not cleanup standards and do not represent action levels that trigger remedial action. All soil samples from the CMSA pad removal were compared to the following screening values:

1) Background Threshold Value (BTV)
The background threshold value (BTV) was determined using the soil background data set from the NFSS Remedial Investigation Report (USACE, 2007c). The NFSS background screening criteria values are defined to be the lesser of the 95 percent upper tolerance limit (UTL) or the maximum value in the background dataset. This is identified as the BTV. The results from soil samples collected from VP-H' were compared to the soil BTVs. This is presented in Tables 1 and 2.

2) Screening values for protection of human health

Soil from the 2004 CMSA Pad sampling was compared to surface soil screening levels that would allow a U. S. Nuclear Regulatory Commission (NRC) licensed site to be decommissioned; the screening levels that allow decommissioning are those that result in less than a 25 mrem/year radiological dose to a member of the public using the site for any purposes, including farming. Although VP-H' is not an NRC licensed site, these screening values are considered appropriately protective of human health. These screening values are found in the NRC document NUREG-1757 (NRC, 2006). NUREG-1757 provides guidance on compliance with radiological criteria for NRC license termination in 10 Code of Federal Regulations 20, Subpart E. These surface soil screening values were developed by the NRC in order to streamline the decommissioning process. The use of these screening values are overly protective to human health because actual exposures to soil on VP-H' would be much lower than the intense and chronic exposure assumed in developing these screening values. Since these screening values are applied in addition to background (i.e. do not include background concentrations), average background levels from NFSS remedial investigation background sampling were added to these values for comparative purposes. In other words, average background levels of sediment from the NFSS remedial investigation data set were added to the dose-based screening values before comparing to soil at VP-H'.

3) DOE Remediation Cleanup Guidelines

A final point of screening was to compare the CMSA pad results to the surface and subsurface cleanup guidelines that were established by the DOE during the 1980's remedial action that took place on the NFSS and its vicinity properties (including VP-H').

Based on this screening methodology there were samples which exceeded the background threshold value, dose based screening level, and the DOE surface and subsurface cleanup guidelines. All data and screening criteria is presented in Tables 1 and 2.

3.3 SOIL EXPOSURE AND AIR PATHWAYS CONCLUSIONS

In conclusion, there is potential for the presence of MED/AEC-related waste on VP-H' based on sample results of surface and subsurface soil and from field radiological instruments found during post-remedial action. These subsurface soil samples were compared to site specific screening values in Tables 1 and 2 of this report. The USACE identified this unpermitted release to the environment in 2004, and further evaluation may be warranted to determine the nature and extent of radiological impacts to soil on this property.

4. GROUNDWATER PATHWAYS

4.1 HYDROGEOLOGIC SETTING

Within 30.5 m (100 feet) of the ground surface, there are two water-bearing zones at the NFSS and surrounding vicinity. The upper water-bearing zone (UWBZ) is near the surface brown clay unit. The lower water-bearing zone (LWBZ) is associated with the Queenston Formation and the unconsolidated materials immediately above the bedrock (red silt and sand and gravel units). The gray clay unit acts as an aquitard between the UWBZ and the LWBZ. Groundwater in the

UWBZ occurs at approximately 1.5 to 3 m (5 to 10 ft) bgs and exhibits a water-table surface that generally conforms to the local topography.

Regional groundwater flow is primarily to the northwest toward the Niagara River, although creeks and drainage ditches influence localized groundwater flow patterns. Lateral groundwater flow in the low-permeability glacial deposits is locally enhanced by discontinuous saturated lenses that do not promote large-scale transport of contaminants (USACE, 2007b).

4.2 GROUNDWATER PATHWAYS

The surrounding area land use consists primarily of an active chemical waste landfill. The Lewiston–Porter Central School District property is approximately 1.5 miles northwest of VP-H', and a public campground is approximately 0.5 miles southwest of VP-H'. A hydroponic greenhouse stands on a former farm field immediately south of the NFSS (south of Pletcher Road). There are also many residences in the area; the nearest residences are on Pletcher Road approximately .8km (0.5 miles) west-southwest of the NFSS (USACE, 2007).

For several decades, almost all Niagara County residents have used a public water supply from the upper Niagara River. (Niagara County Department of Health [NCDOH], 2006). Before installation of the public water supply, groundwater from private wells was the primary source of drinking water near the LOOW property. In 2005, the Niagara County Department of Health commenced a private water well project in the towns of Lewiston and Porter (NCDOH, 2006). The purpose of this project was to identify the water quality of active wells within a project area of the LOOW property. This included portions of Niagara County north of Route 104 and west of Ransomville Road (excluding the Village of Lewiston). The county distributed questionnaires to 219 residents it believed had private wells within the project area; only 159 residents returned surveys. Based on the information provided, there were 117 private wells; 11 are actively used as a source of drinking water; 8 are used for other non-potable activities; 20 were abandoned, and 78 individuals reported the wells were not in use. Figure 12 shows the population and drinking wells located within ¼ mile, ½ mile, 1 mile, 2 miles, 3 miles, and 4 miles from VP-H'.

The DOE performed limited subsurface water sampling for radionuclides during the 1984 VP-H' site characterization (DOE, 1984). During this site characterization, the DOE sampled subsurface water from all deep boreholes, where it was available. Every water sample collected contained elevated gross alpha and beta concentrations. The highest gross alpha concentration was 799 pCi/L, and the highest gross beta concentration was 363 pCi/L. The samples also contained high concentrations of dissolved solids, which may have adversely affected the detection sensitivities for the laboratory procedures.

There is currently one groundwater well, C1-2-BP1, installed on VP-H' (Figure 11). This well was installed during the 2000 Phase II Remedial Investigation at the LOOW and has not been sampled for radionuclides. During the LOOW investigation, six monitoring wells were installed within "Area 2" to assess potential impact of subsurface constituents to groundwater (these wells are located north of VP-H' and on VP-H). One well, C1-2-MW-BP1, was placed up gradient of "Area 2" as part of a series of wells that surrounded the area of concern (USACE, 2002).

4.3 GROUNDWATER PATHWAYS CONCLUSIONS

Groundwater in a well USACE installed during its DERP–FUDS investigation on VP-H' has not been sampled for radionuclides and the exposure pathway remains uncharacterized. The DOE collected subsurface water samples in 1984; all locations exhibited elevated results for the parameters analyzed. However, groundwater on VP-H' is not used as a drinking water source, as explained in the previous section. Further evaluation may be warranted to determine the native water quality on the site and the nature and extent of impacts to groundwater on this property.

5. SURFACE WATER PATHWAYS

5.1 HYDRAULIC SETTING

Topography associated with the NFSS and its VPs is characterized by relatively level grade surface and a number of concrete foundations and structures associated with past site activities. During heavy rain events, the clayey soils promote overland flow to surface depressions into two low-lying ditches on site. During a June 2015 site visit, USACE observed surface water on a majority of the eastern portion of the site (Appendix B). Cattail-marsh grass is dominant within drainage swales and low-lying areas with standing surface water. Figure 2 contains surface water features on VP-H' along with nearby site drainage.

Direct infiltration of surface water to the shallow groundwater can normally contribute to the migration of contaminants. However, the overall low permeability of surface and subsurface soils at the site inhibits surface water infiltration into the shallow groundwater. In addition, vegetation typically inhibits the erosion of soil particles, and very few areas at the site are devoid of ground surface grass and brush vegetation. This dense vegetation also promotes soil-moisture evapotranspiration that additionally reduces surface contaminant migration to groundwater.

5.2 SURFACE WATER PATHWAYS

During the 1984 characterization of VP-H', the DOE collected two surface water samples from two drainage ditches and one sample from standing water on the ground surface. The sample collected from standing water on VP-H' contained a gross alpha concentration of 30 pCi/L, a gross beta concentration of 33.8 pCi/L, and 0.16 pCi/L of Ra-226. The other two surface water samples from the drainage ditches had gross alpha and gross beta concentrations above the baseline levels but well within the EPA drinking water criteria of 15 pCi/L and 50 pCi/L respectively (DOE, 1984). The location of surface water samples collected by the DOE is shown on Figure 8; the DOE subsequently excavated some of those locations during the remedial action of VP-H' in 1984, as shown in Figure 9.

After the 1984 surface water sampling (Figure 8), the DOE remediated VP-H' (Figure 9) and subsequently resurveyed it to verify the remedial actions met the objectives (Figure 10). It did not conduct further sampling of surface water during this verification survey, and some of the locations previously sampled for surface water during the comprehensive areas were included in the excavation boundary during the remedial action (Reference Figure 8 and 9).

In June 2015, USACE conducted a site visit to VP-H' to determine current site use and conditions (Appendix B). During this visit, USACE representatives observed large areas of standing water, which can also be seen on recent aerial photographs (Figure 2 and Figure 11). This surface water was not identified in historical DOE reports and could be due to changing site topography after the remediation occurred in the 1980s.

5.3 SURFACE WATER PATHWAYS CONCLUSIONS

During the comprehensive radiological characterization completed in the 1980s, the DOE contractor, Bechtel National, Inc., only collected three surface water samples on VP-H' for radiological analysis. Bechtel collected them during the initial DOE site characterization in 1984; they exhibited elevated gross alpha and gross beta concentrations above the baseline levels for that investigation. Surface water from standing water on VP-H' contained higher concentrations compared to the surface water from drainage ditches on the property. Since the DOE's soil remediation in the 1980s, surface water on VP-H' has increased as observed during the USACE 2015 site visit (Appendix B and Figures 2 and 9). Further characterization of the drainage ditches and surface water on VP-H' may be warranted to quantify any remaining risk from past remediation and to confirm that remedial action objectives were met based on current site conditions.

6. SUMMARY AND CONCLUSION

Based on the review of existing information on the VP-H' at the NFSS, USACE has determined there is no imminent threat to human health or the environment. However, surface soils, subsurface soils, concrete slabs/foundations, sediment, surface water, and groundwater may have residual impacts from past storage and processing (burning) of FUSRAP material. The USACE, Buffalo District, recommends that VP-H' undergo further investigation, in accordance with CERCLA, beginning with a remedial investigation to determine the nature and extent of AEC-related contamination and the associated risks to human health and the environment.

7. **REFERENCES**

AEC (U.S. Atomic Energy Commission), 1973. *Radiation Survey and Decontamination Report of the Lake Ontario Ordnance Works Site.* January 1973.

Department of Energy (DOE), 1979. ORNL/TM-7004, *Results of Ground Level Radiation Measurements in Support of the 1978 Aerial Survey of the Lake Ontario Ordnance Works, Lewiston, New York,* September 1979.

DOE, 1980. *A Background Report and Evaluation of Resurvey Requirements for the Former Atomic Energy Commission Portion of the Lake Ontario Ordnance Works.* August 1980.

DOE, 1982a. *Preliminary Report on Survey of Off-Site Properties H' and E' Lake Ontario Ordnance Works.* June 1982.

DOE, 1982b. *Background and Resurvey Recommendations for the Atomic Energy Commission Portion of the Lake Ontario Ordnance Works*. November 1982.

DOE, 1983. *Comprehensive Radiological Survey, Off-Site Property H', Niagara Falls Storage Site, Lewiston, New York.* June 1983.

DOE, 1984. *Addendum to Action Description Memorandum Niagara Falls Storage Site. Proposed Interim Remedial Actions for FY 1983–85 Accelerated Program.* July 1984.

DOE, 1986a. Letter – *Additional Information – Verification of NFSS Vicinity Properties.* April 1986.

DOE, 1986b. Letter – *Additional Cleanup for 1983–84 Vicinity Properties.* May 1986.

DOE, 1986c. *Post-Remedial Action Report for the NFSS Vicinity Properties 1983 and 1984.* December 1986.

DOE, 1992. *Certification Docket for the Remedial Action Performed at the Niagara Falls Storage Site Vicinity Properties in Lewiston, New York, From 1983 through 1986.* July 1992.

DOE, 2010. *Niagara Falls Storage Site Vicinity Properties, New York: Review of Radiological Conditions at Six Vicinity Properties and Two Drainage Ditches.* October 2010.

DOE, 2012. *Evaluation of Final Radiological Conditions at Areas of the Niagara Falls Storage Site Remediated under the Formerly Utilized Sites Remedial Action Program.* Waste Management Conference. February 26 – March 1, 2012. Paper Number: 12184

DOE, 2013. *Assessment of Historical Knolls Atomic Power Laboratory Waste Storage Locations Niagara Falls Storage Site, FUSRAP Site, Lewiston, New York.* May 2013.

EG&G Energy Measurements Group, 1973. *Aerial Radiological Measuring Survey of the Lake Ontario Ordnance Works and Vicinity in June 1972.* August 1973.

EG&G Energy Measurements Group, 1978. *Summary Report Aerial Radiological Survey Lake Ontario Ordnance Works, Lewiston, New York,* October 1978.

Niagara County Department of Health, 2006. *Summary Report for the Private Water Well Project, Towns of Lewiston and Porter, Niagara County, New York*. March 2006.

Oak Ridge National Laboratory (ORNL), 1979. *Results of Ground Level Radiation Measurements in Support of 1978 Aerial Survey of the Lake Ontario Ordnance Works, Lewiston, New York.* September 1979.

ORAU, 1989. *Verification of 1983 and 1984 Remedial Actions Niagara Falls Storage Site Vicinity Properties Lewiston, New York.* December 1989.

U.S. Army Corps of Engineers (USACE), 2002. *Report of the Results for the Phase II Remedial Investigation at the Lake Ontario Ordnance Works (LOOW) Niagara County, New York, Volume I of III.* February 2002.

USACE, 2004. *Radiological Report–TNT Investigation at the Lake Ontario Ordnance Works, Waste Water Treatment Plant.* March 2004.

USACE, 2005. *DERP–FUDS Fact Sheet – Former Lake Ontario Ordnance Works, Niagara County, New York. Contaminated Material Storage Area (CMSA) Pad.* May 2005.

USACE, 2007a. *Radiological Investigation of Underground Utility Lines on the former Lake Ontario Ordnance Works Property.* October 2007.

USACE, 2007b. *Groundwater Flow and Contaminant Transport Modeling*. December 2007.

USACE, 2007c. *Remedial Investigation Report.* December 2007.

USACE, 2008. *Report of Results for the Remedial Investigations of Underground Utility Lines, Formerly Used by the Department of Defense, Lake Ontario Ordnance Works, Niagara County, New York.* Prepared by EA. September 2008.

USACE, 2011. *Final Report for Phase IV Remedial Investigation/Feasibility Study at Formerly Used Defense Site The Former Lake Ontario Ordnance Works, Niagara County, New York.* April 2011.

USACE, 2012. *Completion Report for Mitigation of Safety Hazards at the Lake Ontario Ordnance Works, Office of Economic Adjustment, Waste Water Treatment Plant.* March 2012.

USACE, 2014. *Feasibility Study, Waste Water Treatment Plant at the Former Lake Ontario Ordnance Works Site, Lewiston, New York.* June 2014.

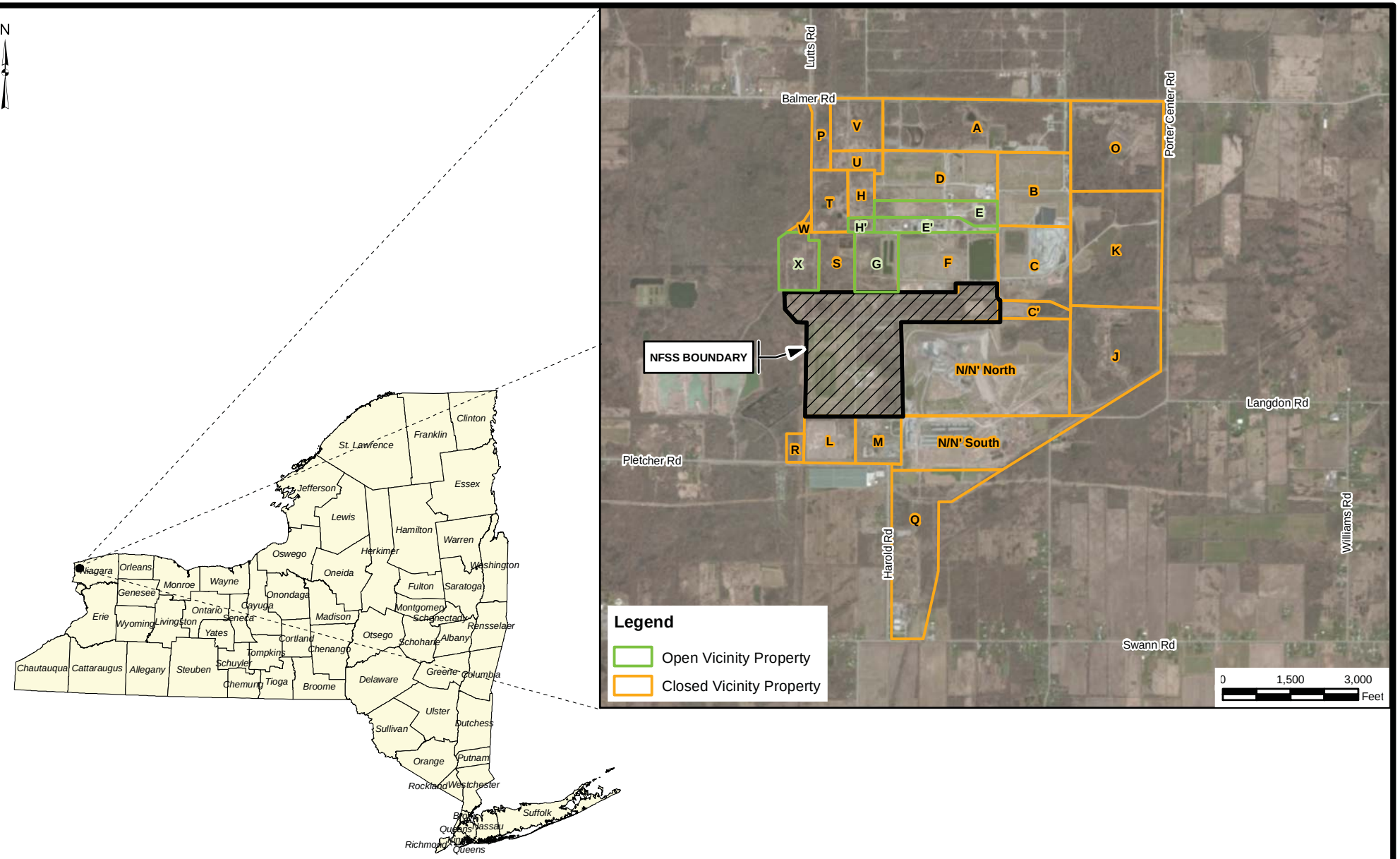
U.S. Nuclear Regulatory Commission (USNRC), 2006. *NUREG-1757 Consolidated Decommissioning Guidance: Characterization, Survey and Determination of Radiological Criteria, Vol. 2, Rev.1*. September 2006.

Wallo, A., 1980. *Correspondence from Andrew Wallo, The Aerospace Corporation, to William E. Mott, DOE, attached April 1972 NYDOH Commissioner's land use restrictions on 1,511 acres of former LOOW.* August 1980.

FIGURES

(This space intentionally left blank)

Document Path: K:\NFSSP\GIS\ArcMap\VicinityProperty\230715_VicinityProperty.mxd



U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS BUFFALO, NY	SITE LOCATION MAP	
Document Name: 230715_VicinityProperty.mxd Drawn By: H5TDESPM Date Saved: 24 Jul 2015 Time Saved: 2:33:38 PM	NIAGARA FALLS STORAGE SITE LEWISTON, NEW YORK	FIGURE 1

Legend

- Site Boundary
- Drainage Ditch
- Surface Water Feature
- Parcel Boundary (2010 Niagara County)
- Town Boundary

0 150 300 600 Feet

US Army Corps of Engineers Buffalo District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

SITE DRAINAGE FEATURES

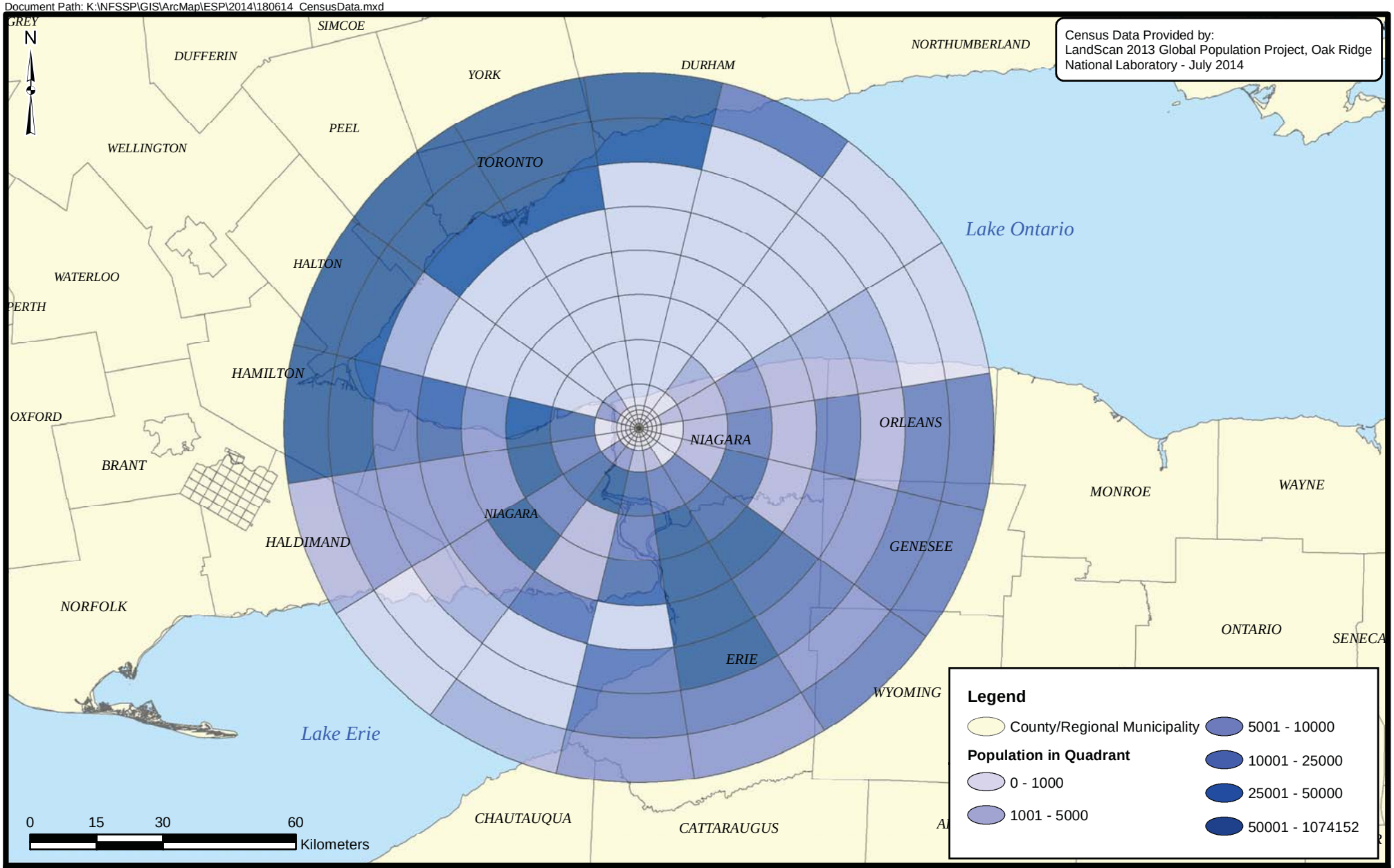
Name: 100815SiteDrainage.mxd
Drawn By: H5TDESPM
Date Saved: 21 Oct 2015
Time Saved: 2:05:02 PM

VICINITY PROPERTY H'
NIAGARA FALLS STORAGE SITE
LEWISTON-PORTER, NEW YORK

FIGURE 2

Document Path: K:\NFSSP\GIS\ArcMap\VicinityProperty\VP_H'\100815SiteDrainage.mxd

Document Path: K:\NFSSP\GIS\ArcMap\ESP\2014\180614_CensusData.mxd



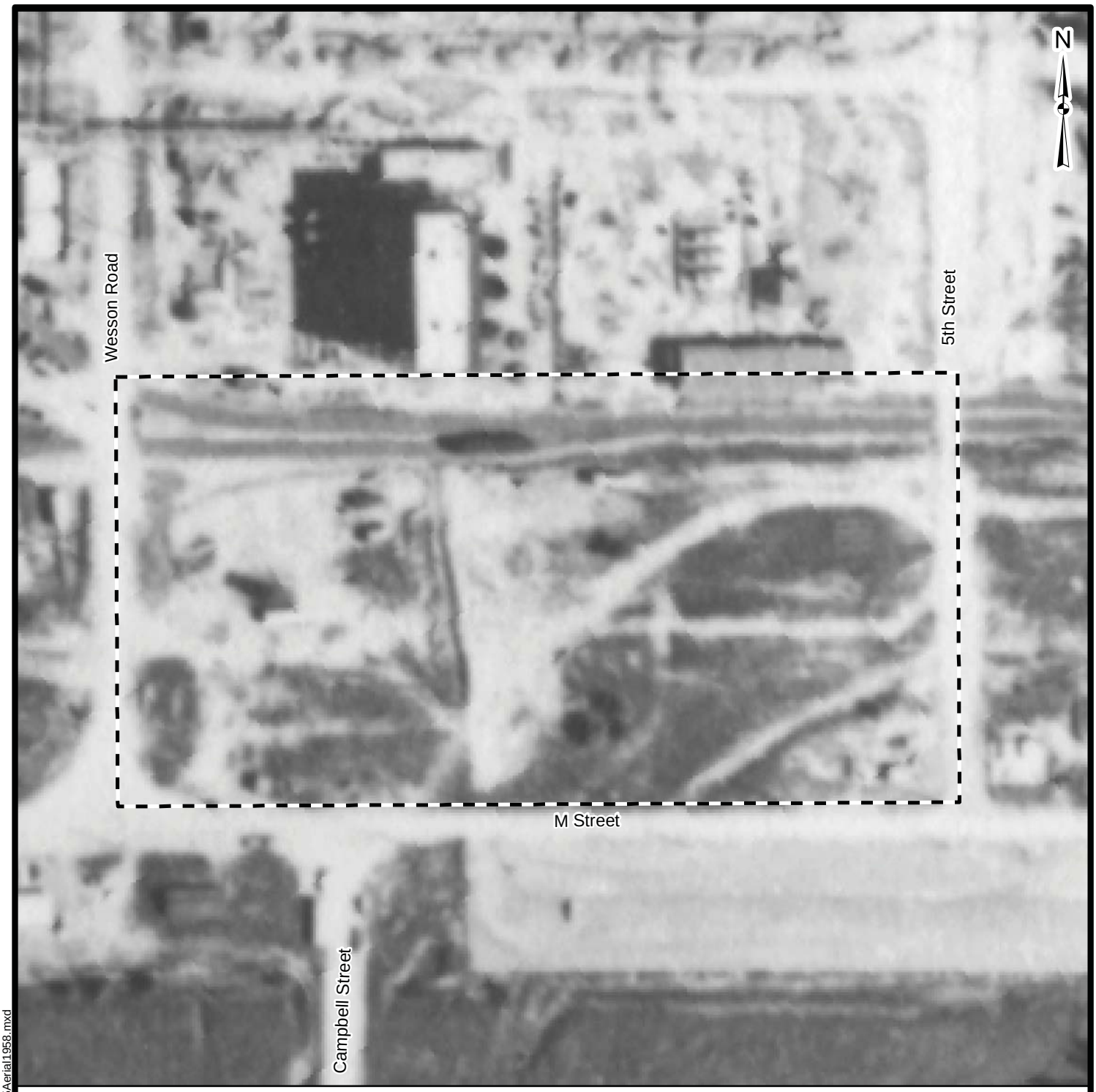
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

CENSUS DATA

Document Name: 180614_CensusData.mxd
Drawn By: H5TDESPM
Date Saved: 25 Jun 2015
Time Saved: 1:48:47 PM

NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK

FIGURE 3



Legend

Site Boundary

0 50 100 200
Feet

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

US Army Corps of Engineers
Buffalo District

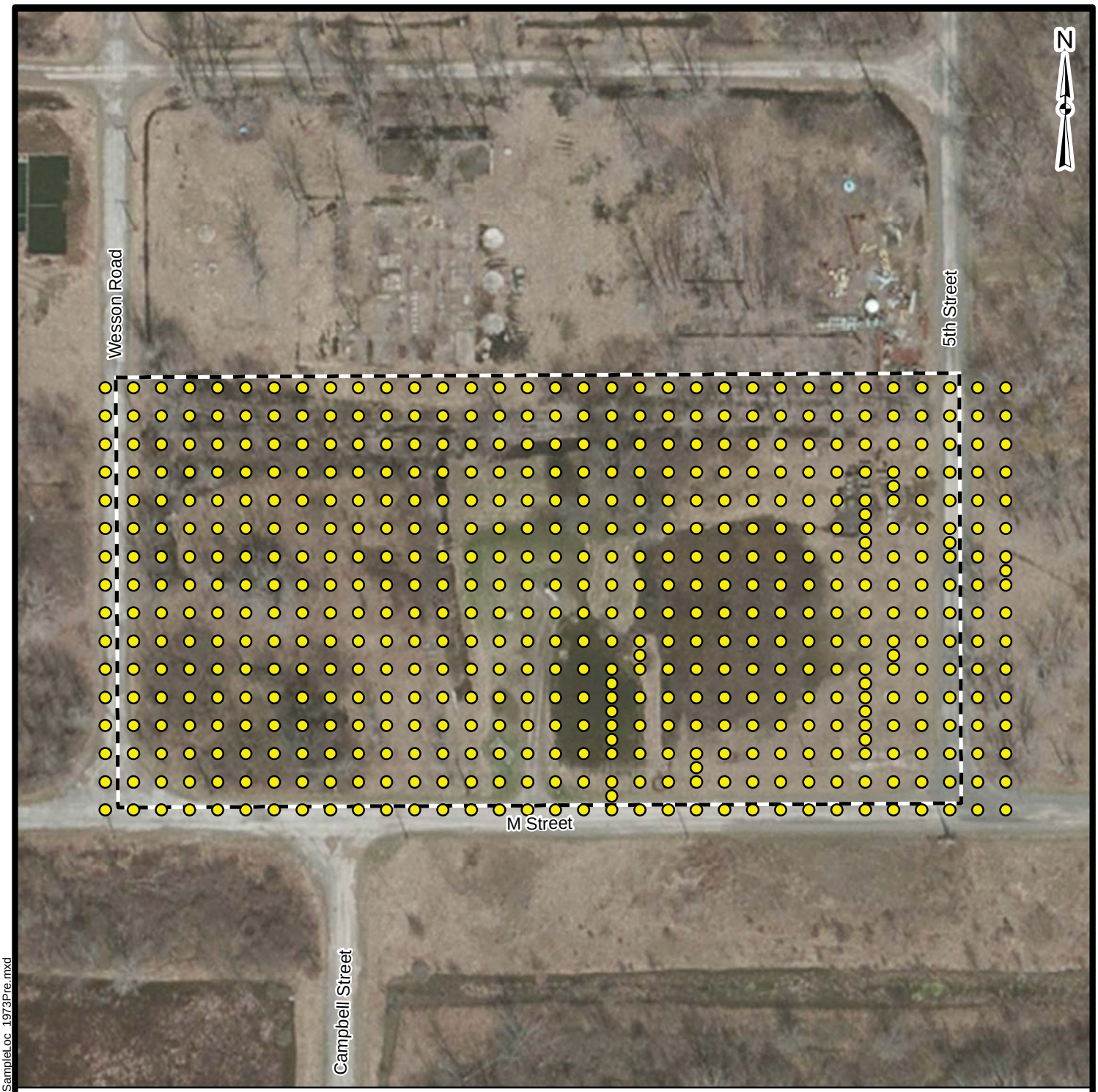
1958 AERIAL PHOTOGRAPH

Name: 100815Aerial1958.mxd
Drawn By: H5TDESPM
Date Saved: 21 Oct 2015
Time Saved: 11:47:08 AM

VICINITY PROPERTY H'
NIAGARA FALLS STORAGE SITE
LEWISTON-PORTER, NEW YORK

FIGURE 4

Document Path: K:\NFSSP\GIS\ArcMap\VicinityProperty\VP H'\100815Aerial1958.mxd



Legend

- 1973 Radiation Survey Scan Location
- Site Boundary

0 50 100 200 Feet

US Army Corps of Engineers Buffalo District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

DEPARTMENT OF ENERGY 1973 PRE-EXCAVATION RADIATION SURVEY LOCATIONS

Name: 100815SampleLoc_1973Pre.mxd
Drawn By: H5TDESPM
Date Saved: 21 Oct 2015
Time Saved: 1:37:07 PM

VICINITY PROPERTY H'
NIAGARA FALLS STORAGE SITE
LEWISTON-PORTER, NEW YORK

FIGURE 5

Document Path: K:\NFSSP\GIS\ArcMap\VicinityProperty\VP H'\100815SampleLoc 1973Pre.mxd

Legend

- 1973 Radiation Survey Scan Location
- Area of Excavation (1973)
- Site Boundary

0 50 100 200 Feet

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

US Army Corps of Engineers
Buffalo District

DEPARTMENT OF ENERGY 1973 POST-EXCAVATION RADIATION SURVEY LOCATIONS

Name: 100815SampleLoc_1973Post.mxd
Drawn By: H5TDESPM
Date Saved: 10 Aug 2015
Time Saved: 1:17:29 PM

VICINITY PROPERTY H'
NIAGARA FALLS STORAGE SITE
LEWISTON-PORTER, NEW YORK

FIGURE 6

Document Path: K:\NFSSP\GIS\ArcMap\VicinityProperty\VP H'\100815SampleLoc 1973Post.mxd

Legend

- 1982 Radiation Survey Scan Location
- Area of Excavation (1973)
- Site Boundary

0 50 100 200 Feet

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

US Army Corps of Engineers
Buffalo District

DEPARTMENT OF ENERGY 1982 RADIATION SURVEY LOCATIONS

Name: 100815SampleLoc_1982.mxd
Drawn By: H5TDESPM
Date Saved: 21 Oct 2015
Time Saved: 11:51:18 AM

VICINITY PROPERTY H'
NIAGARA FALLS STORAGE SITE
LEWISTON-PORTER, NEW YORK

FIGURE 7

Document Path: K:\NFSSP\GIS\ArcMap\VicinityProperty\VP H'\100815SampleLoc 1982.mxd

Legend

- Groundwater Sample Location
- Soil Boring
- Survey Scan Location
- Surface Soil Sample
- Surface Water/Sediment Sample
- Surface Water Sample
- Site Boundary

0 50 100 200 Feet

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

US Army Corps of Engineers
Buffalo District

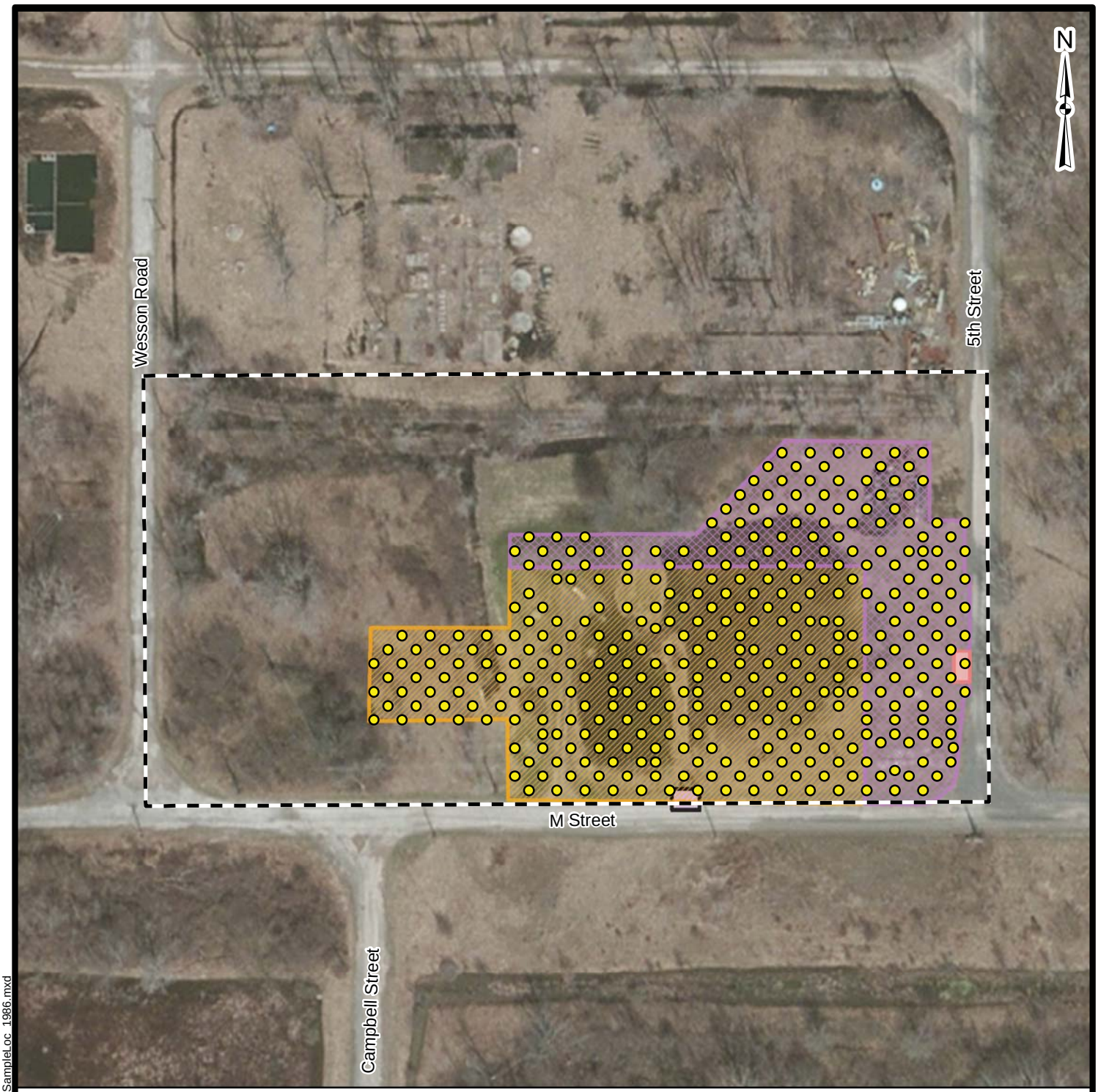
DEPARTMENT OF ENERGY 1984 COMPREHENSIVE RADIOLOGICAL SURVEY

Name: 100815SampleLoc_1984.mxd
Drawn By: H5TDESPM
Date Saved: 21 Oct 2015
Time Saved: 11:56:35 AM

VICINITY PROPERTY H'
NIAGARA FALLS STORAGE SITE
LEWISTON-PORTER, NEW YORK

FIGURE 8

Document Path: K:\NFSSP\GIS\ArcMap\VicinityProperty\VP_H'\100815SampleLoc_1984.mxd



Legend

- 1986 Surface Soil Sample Location
- Site Boundary

Area of Excavation (1984)

- Excavation 1.1 ft Depth
- Excavation 2.5 ft Depth
- Excavation 5.5 ft Depth

- Area of Excavation (1986 - Black Cinder)

0 50 100 200 Feet

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

US Army Corps of Engineers
Buffalo District

DEPARTMENT OF ENERGY 1986 POST-REMEDIAL ACTION SAMPLING LOCATIONS

Name: 100815SampleLoc_1986.mxd
Drawn By: H5TDESPM
Date Saved: 21 Oct 2015
Time Saved: 1:53:51 PM

VICINITY PROPERTY H'
NIAGARA FALLS STORAGE SITE
LEWISTON-PORTER, NEW YORK

FIGURE 9

Document Path: K:\NFSSP\GIS\ArcMap\VicinityProperty\VP_H'\100815SampleLoc_1986.mxd

Legend

- 1989 Soil Sample Location
- Site Boundary

Area of Excavation (1984)

- Excavation 1.1 ft Depth
- Excavation 2.5 ft Depth
- Excavation 5.5 ft Depth

0 50 100 200 Feet

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

US Army Corps of Engineers
Buffalo District

DEPARTMENT OF ENERGY 1989 POST-REMEDIAL ACTION VERIFICATION SAMPLING LOCATIONS

Name: 100815SampleLoc_1989.mxd
Drawn By: H5TDESPM
Date Saved: 10 Aug 2015
Time Saved: 1:56:27 PM

VICINITY PROPERTY H'
NIAGARA FALLS STORAGE SITE
LEWISTON-PORTER, NEW YORK

FIGURE 10

Document Path: K:\NFSSP\GIS\ArcMap\VicinityProperty\VP_H'\100815SampleLoc_1989.mxd

Legend

- Monitoring Well (Installed in 2000)
- 2004 Soil Sample Location
- Site Boundary

0 50 100 200 Feet

US Army Corps of Engineers Buffalo District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

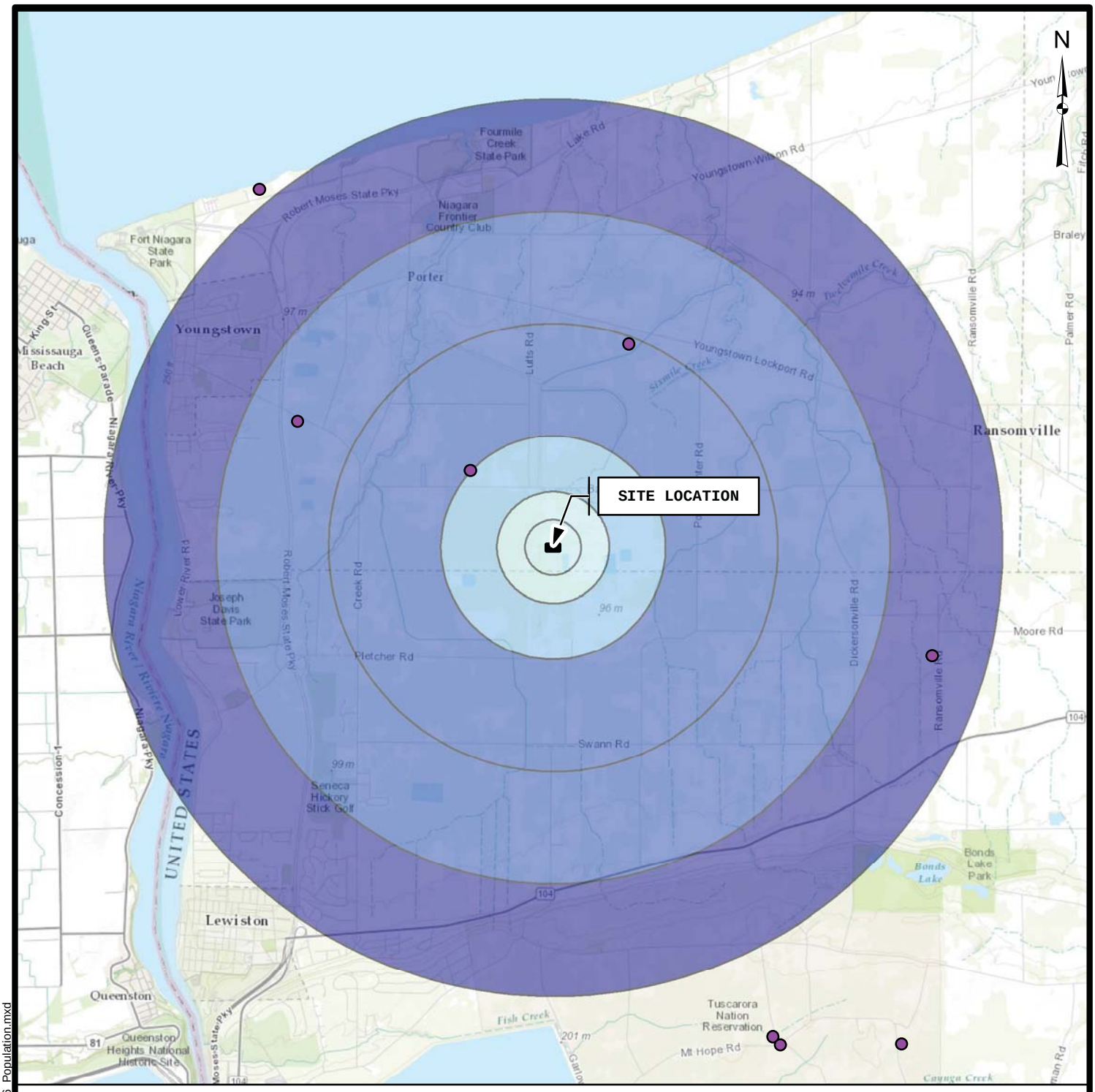
USACE 2000 MONITORING WELL AND 2004 LOOW CMSA PAD REMOVAL SOIL SAMPLE LOCATION

Name: 100815SampleLoc_2004.mxd
Drawn By: H5TDESPM
Date Saved: 21 Oct 2015
Time Saved: 1:57:42 PM

VICINITY PROPERTY H'
NIAGARA FALLS STORAGE SITE
LEWISTON-PORTER, NEW YORK

FIGURE 11

Document Path: K:\NFSSP\GIS\ArcMap\VicinityProperty\VP H'\100815SampleLoc 2004.mxd



Legend

- VP H' Site Boundary
- Water Well Location

Population

- 0
- < 100
- 100 - 1,000
- 1,000 - 5,000
- > 5,000

Notes:
1) Census Data Provided by: LandScan 2013 Global Population Project, Oak Ridge National Laboratory - July 2014
2) Water Well Locations provided by NYSDEC - November 2015.

0 0.625 1.25 2.5 Miles

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

US Army Corps of Engineers
Buffalo District

WATER WELL LOCATIONS AND POPULATION SURROUNDING VICINITY PROPERTY H'

Name: 040216_Population.mxd
Drawn By: H5TDESPM
Date Saved: 04 Feb 2016
Time Saved: 11:37:53 AM

VICINITY PROPERTY H'
NIAGARA FALLS STORAGE SITE
LEWISTON-PORTER, NEW YORK

FIGURE 12

Document Path: K:\NFSSP\GIS\ArcMap\VicinityProperty\VP_H'\040216_Population.mxd

TABLES

(This space intentionally left blank)

Table 1
Radionuclides Data - Confirmation Samples
USACE - CMSA Pad Removal 2004

Sample Name		LOOW-CMSAPad-1-0				LOOW-CMSAPad-2-0				LOOW-CMSAPad-3-0				Data Comparison					
Laboratory ID		4K08008-01				4K08008-02				4K08008-03									
Date Sampled		11/8/2004				11/8/2004				11/8/2004									
Constituent	unit	Result	Detect? (Yes or No)	UNC	MDA	Result	Detect? (Yes or No)	UNC	MDA	Result	Detect? (Yes or No)	UNC	MDA	BTV	DBSL**	Average Background	DBSL+BKG	DOE Surface Clean Up Guideline	DOE Subsurface Clean Up Guideline
Potassium 40	pCi/g	19.90	Yes	1.17	0.06	15.30	Yes	0.92	0.05	220.50	Yes	1.25	0.06	-	-	-	-	-	-
Thallium 208	pCi/g	0.35	Yes	0.04	0.01	0.27	Yes	0.03	0.01	0.37	Yes	0.04	0.01	-	-	-	-	-	-
Bismuth 212	pCi/g	0.72	Yes	0.22	0.06	0.62	Yes	0.16	0.04	0.84	Yes	0.21	0.06	-	-	-	-	-	-
Lead 212	pCi/g	1.00	Yes	1.55	0.01	0.79	Yes	1.54	0.01	1.02	Yes	2.12	0.01	-	-	-	-	-	-
Bismuth 214	pCi/g	0.76	Yes	0.08	0.02	0.66	Yes	0.06	0.01	0.73	Yes	0.08	0.02	-	-	-	-	-	-
Lead 214	pCi/g	0.83	Yes	0.09	0.02	0.66	Yes	0.06	0.01	0.76	Yes	0.07	0.02	-	-	-	-	-	-
Actinium 228	pCi/g	1.09	Yes	27.60	0.03	0.78	Yes	26.60	0.02	1.14	Yes	37.30	0.02	-	-	-	-	-	-
Protactinium 234 meta-stable	pCi/g	2.76	Yes	2.29	1.10	2.45	Yes	1.92	0.92	0.97	No	2.43	1.25	-	-	-	-	-	-
Thorium 234	pCi/g	2.31	Yes	1.06	0.42	2.66	Yes	0.37	0.39	1.18	Yes	0.71	0.48	-	-	-	-	-	-
Uranium 235	pCi/g	0.24	Yes	0.04	0.01	0.04	Yes	0.03	0.01	**0.11**	Yes	0.03	0.01	0.08	8.00	0.08	8.08	2.00	-
Gross Alpha	pCi/g	10.00	Yes	2.60	4.60	5.22	Yes	2.00	3.90	5.04	Yes	1.80	3.60	-	-	-	-	-	-
Gross Beta	pCi/g	46.70	Yes	4.57	8.02	39.20	Yes	3.76	6.60	34.30	Yes	3.27	5.71	-	-	-	-	-	-
Radium 226	pCi/g	0.56	Yes	0.11	0.03	0.80	Yes	0.13	0.01	1.19	Yes	0.26	0.10	1.20	0.70	0.81	1.51	5.00	15.00
Radium 228	pCi/g	1.09	Yes	27.60	0.03	0.78	Yes	26.60	0.02	1.14	Yes	37.30	0.02						
Thorium 228	pCi/g	0.90	Yes	0.18	0.05	0.60	Yes	0.14	0.07	1.10	Yes	0.20	0.07	1.64	4.70	1.11	5.81	-	-
Thorium 230	pCi/g	1.08	Yes	0.20	0.03	0.82	Yes	0.17	0.02	1.21	Yes	0.22	0.02	1.39	1.80	0.89	2.69	5.00	15.00
Thorium 232	pCi/g	0.85	Yes	0.17	0.05	0.63	Yes	0.14	0.05	1.02	Yes	0.20	0.05	1.24	1.10	0.91	2.01	5.00	15.00
Uranium 234	pCi/g	**2.62**	Yes	0.45	0.01	1.12	Yes	0.21	0.02	0.88	Yes	0.17	0.04	1.66	13.00	0.80	13.80	44.00	-
Uranium 235	pCi/g	**0.18**	Yes	0.06	0.03	**0.08**	Yes	0.04	0.01	0.05	Yes	0.03	0.01	0.08	8.00	0.08	8.08	2.00	-
Uranium 238	pCi/g	**2.58**	Yes	0.44	0.01	**1.34**	Yes	0.24	0.01	0.81	Yes	0.16	0.01	1.34	14.00	0.80	14.80	44.00	-
Total Uranium	pCi/g	**5.38**	-	-	-	2.54	-	-	-	1.74	-	-	-	3.08	-	1.67	-	90.00	90.00

LEGEND	Comment
Red	Result is above both dose based screening level plus the average background (DBSL+BKG) and one of the DOE clean-up guidelines.
Grey	Result is above both dose based screening level plus the average background (DBSL+BKG)
Bold	Bold font indicates that the value exceeds 95% UTL (BTV) and/or Dose Based Screening
*	The VP-H' background screening criteria values are defined to be the lesser of the 95% upper tolerance limit (UTL) or the maximum value in the soil background dataset from the NFSS Remedial Investigation. This is identified as the Background Threshold Value (BTV).
* *	Dose Based Screening Level - US Nuclear Regulatory Commission. Consolidated Decommissioning Guidance: Characterization, Survey and Determination of Radiological Criteria. NUREG-1757, Vol.2,Rev.1. September 2006.
Itallic	For LOOW-CMSAPad-8-0 resutls for Ra-226, Th-232, U-234, U-235, U-238 and Total Uranium were estimated using other radionuclide results from gamma spectroscopy. The U-235 by gamma spectroscopy for LOOW-CMSAPad-8-0 is assumed to be the same as the result for the U-235, since there was no alpha spectroscopy data. Note: The Total U value for LOOW-CMSAPad-7-0 is calculated using gamma spec and alpha spec data.

Note: Soil results from VP-H' collected at the CMSA pad were compared to surface soil screening levels which would allow a United States Nuclear Regulatory Commission (NRC) licensed site to be decommissioned for unrestricted use at less than a 25 mrem/year radiological dose. Although the VP-H' is not an NRC licensed site, these screening values are considered appropriately protective of human health. These screening values are found in the NRC document NUREG-1757 (NRC 2006).

Unc. = Result Uncertanity
MDA = Minium Detectable Activity
BKG = Average Background
BTV = Backgorund Threshold Value*
DBSL = Dose Based Screening Level**

Table 1 - Continued
Radionuclides Data - Confirmation Samples
USACE - CMSA Pad Removal 2004

Sample Name		LOOW-CMSAPad-4-0				LOOW-CMSAPad-5-0				LOOW-CMSAPad-6-0				LOOW-CMSAPad-Dup1				Data Comparison					
Laboratory ID		4K08008-04				4K08008-05				4K08008-06				4K08008-07									
Date Sampled		11/8/2004				11/8/2004				11/8/2004				11/8/2004									
Constituent	unit	Result	Detect? (Yes or No)	UNC	MDA	Result	Detect? (Yes or No)	UNC	MDA	Result	Detect? (Yes or No)	UNC	MDA					BTV	DBSL**	Average Background	DBSL+BKG	DOE Surface Clean Up Guideline	DOE Subsurface Clean Up Guideline
Potassium 40	pCi/g	23.00	Yes	1.37	0.07	18.10	Yes	1.12	0.07	19.30	Yes	1.16	0.07	20.50	Yes	1.22	0.05	-	-	-	-	-	-
Thallium 208	pCi/g	0.39	Yes	0.05	0.01	0.29	Yes	0.04	0.01	0.30	Yes	0.04	0.01	0.34	Yes	0.04	0.01	-	-	-	-	-	-
Bismuth 212	pCi/g	0.96	Yes	0.22	0.06	0.70	Yes	0.18	0.05	0.70	Yes	0.22	0.06	0.73	Yes	0.20	0.06	-	-	-	-	-	-
Lead 212	pCi/g	1.17	Yes	2.56	0.02	0.87	Yes	6.16	0.01	0.88	Yes	6.46	0.01	1.01	Yes	7.69	0.02	-	-	-	-	-	-
Bismuth 214	pCi/g	0.76	Yes	0.09	0.02	0.74	Yes	0.09	0.02	0.76	Yes	0.08	0.02	0.75	Yes	0.08	0.02	-	-	-	-	-	-
Lead 214	pCi/g	0.79	Yes	0.08	0.02	0.80	Yes	0.07	0.02	0.83	Yes	0.07	0.02	0.75	Yes	0.07	0.02	-	-	-	-	-	-
Actinium 228	pCi/g	1.25	Yes	43.60	0.03	0.93	Yes	249.00	0.03	0.99	Yes	288.00	0.03	1.14	Yes	351.00	0.03	-	-	-	-	-	-
Protactinium 234 meta-stable	pCi/g	2.57	Yes	2.53	1.23	-0.89	No	8.87	1.30	0.27	No	2.30	1.20	1.73	Yes	2.11	1.05	-	-	-	-	-	-
Thorium 234	pCi/g	3.76	Yes	1.58	0.58	2.19	Yes	0.68	0.42	2.43	Yes	0.65	0.46	2.42	Yes	0.63	0.61	-	-	-	-	-	-
Uranium 235	pCi/g	0.28	Yes	0.04	0.01	0.04	Yes	0.03	0.01	0.03	Yes	0.03	0.01	0.12	Yes	0.03	0.01	0.08	8.00	0.08	8.08	2.00	-
Gross Alpha	pCi/g	7.50	Yes	2.00	3.60	9.04	Yes	2.20	3.90	5.84	Yes	1.80	3.30	5.21	Yes	1.70	3.30	-	-	-	-	-	-
Gross Beta	pCi/g	42.50	Yes	3.50	5.73	34.40	Yes	3.46	6.15	30.20	Yes	2.85	4.94	31.20	Yes	2.80	4.78	-	-	-	-	-	-
Radium 226	pCi/g	**1.28**	Yes	0.22	0.05	0.93	Yes	0.15	0.05	0.92	Yes	0.13	0.05	0.71	Yes	0.11	0.02	1.20	0.70	0.81	1.51	5.00	15.00
Radium 228	pCi/g	1.25	Yes	43.60	0.03	0.93	Yes	249.00	0.03	0.99	Yes	288.00	0.03	1.14	Yes	351.00	0.03						
Thorium 228	pCi/g	1.40	Yes	0.26	0.06	0.70	Yes	0.17	0.10	1.10	Yes	0.22	0.07	0.80	Yes	0.17	0.07	1.64	4.70	1.11	5.81	-	-
Thorium 230	pCi/g	1.34	Yes	0.26	0.04	1.06	Yes	0.22	0.04	**1.66**	Yes	0.30	0.02	1.09	Yes	0.21	0.06	1.39	1.80	0.89	2.69	5.00	15.00
Thorium 232	pCi/g	1.06	Yes	0.22	0.05	0.70	Yes	0.17	0.08	0.96	Yes	0.20	0.02	0.96	Yes	0.19	0.06	1.24	1.10	0.91	2.01	5.00	15.00
Uranium 234	pCi/g	**3.26**	Yes	0.53	0.01	1.23	Yes	0.23	0.02	1.51	Yes	0.27	0.02	0.91	Yes	0.17	0.01	1.66	13.00	0.80	13.80	44.00	-
Uranium 235	pCi/g	0.22	Yes	0.07	0.03	**0.12**	Yes	0.05	0.01	**0.10**	Yes	0.04	0.01	0.06	Yes	0.03	0.02	0.08	8.00	0.08	8.08	2.00	-
Uranium 238	pCi/g	**2.87**	Yes	0.47	0.02	1.32	Yes	0.24	0.02	**1.50**	Yes	0.27	0.01	0.78	Yes	0.15	0.01	1.34	14.00	0.80	14.80	44.00	-
Total Uranium	pCi/g	***6.35***	-	-	-	*2.67*	-	-	-	***3.11***	-	-	-	*1.75*	-	-	-	3.08	-	1.67	-	90.00	90.00

LEGEND	Comment
Red	Result is above both dose based screening level plus the average background (DBSL+BKG) and one of the DOE clean-up guidelines.
Grey	Result is above both dose based screening level plus the average background (DBSL+BKG)
Bold	Bold font indicates that the value exceeds 95% UTL (BTV) and/or Dose Based Screening
*	The VP-H' background screening criteria values are defined to be the lesser of the 95% upper tolerance limit (UTL) or the maximum value in the soil background dataset from the NFSS Remedial Investigation. This is identified as the Background Threshold Value (BTV).
* *	Dose Based Screening Level - US Nuclear Regulatory Commission. Consolidated Decommissioning Guidance: Characterization, Survey and Determination of Radiological Criteria. NUREG-1757, Vol.2,Rev.1. September 2006.
Itallic	For LOOW-CMSAPad-8-0 resutls for Ra-226, Th-232, U-234, U-235, U-238 and Total Uranium were estimated using other radionuclide results from gamma spectroscopy. The U-235 by gamma spectroscopy for LOOW-CMSAPad-8-0 is assumed to be the same as the result for the U-235, since there was no alpha spectroscopy data. Note: The Total U value for LOOW-CMSAPad-7-0 is calculated using gamma spec and alpha spec data.

Note: Soil results from VP-H' collected at the CMSA pad were compared to surface soil screening levels which would allow a United States Nuclear Regulatory Commission (NRC) licensed site to be decommissioned for unrestricted use at less than a 25 mrem/year radiological dose. Although the VP-H' is not an NRC licensed site, these screening values are considered appropriately protective of human health. These screening values are found in the NRC document NUREG-1757 (NRC 2006).

Unc. = Result Uncertainty
MDA = Minium Detectable Activity
BKG = Average Background
BTV = Backgorund Threshold Value*
DBSL = Dose Based Screening Level**

Table 2
Radionuclides Data - Bias Samples
USACE - CMSA Pad Removal 2004

Sample Name		LOOW-CMSAPad-7-0				LOOW-CMSAPad-8-0				Data Comparison					
Laboratory ID		4K08009-01				4K10020-08									
Date Sampled		11/8/2005				11/10/2004									
Analyte	units	Result	Detect? (Yes or No)	UNC	MDA	Result	Detect? (Yes or No)	UNC	MDA	BTV*	DBSL**	Average Background	DBSL+BKG	DOE Surface Clean Up Guideline	DOE Subsurface Clean Up Guideline
Potassium 40	pCi/g	16.40	Yes	4.47	1.38	18.10	Yes	1.26	0.19	-	-	-	-	-	-
Thallium 208	pCi/g	-0.59	No	0.58	0.22	0.32	Yes	0.04	0.01	-	-	-	-	-	-
Bismuth 212	pCi/g	24.70	Yes	3.60	1.43	0.43	Yes	0.40	0.13	-	-	-	-	-	-
Lead 212	pCi/g	1.11	Yes	4.86	0.27	0.88	Yes	0.09	0.03	-	-	-	-	-	-
Bismuth 214	pCi/g	265.00	Yes	10.90	0.35	15.60	Yes	0.67	0.03	-	-	-	-	-	-
Lead 214	pCi/g	286.00	Yes	11.70	0.43	16.00	Yes	0.68	0.04	-	-	-	-	-	-
Actinium 228	pCi/g	2.19	Yes	30.40	0.78	1.13	Yes	0.17	0.06	-	-	-	-	-	-
Protactinium 234 meta-stable	pCi/g	316.00	Yes	70.60	17.70	22.90	Yes	5.92	1.92	-	-	-	-	-	-
Thorium 234	pCi/g	141.00	Yes	29.20	10.90	15.10	Yes	3.63	1.14	-	-	-	-	-	-
Uranium 235 (Gamma Spec.)	pCi/g	**2.74**	Yes	0.94	0.45	**2.13**	Yes	0.12	0.03	0.08	8.00	0.08	8.08	2	-
Radium 226	pCi/g	**836.00**	Yes	46.60	0.05	***16.00***	-	-	-	1.2	0.7	0.806	1.51	5	15
Thorium 228	pCi/g	**2.30**	Yes	0.36	0.06	-	-	-	-	1.64	4.7	1.108	5.81	-	-
Thorium 230	pCi/g	**394.00**	Yes	47.70	0.01	-	-	-	-	1.39	1.8	0.888	2.69	5	15
Thorium 232	pCi/g	**15.00**	Yes	1.90	0.05	***1.13***	-	-	-	1.24	1.1	0.908	2.01	5	15
Uranium 234	pCi/g	**42.20**	Yes	7.84	0.03	***22.90***	-	-	-	1.66	13	0.798	13.80	44	-
Uranium 235 (Alpha Spec.)	pCi/g	**3.66**	Yes	0.80	0.09	***2.13***	-	-	-	0.08	8.00	0.08	8.08	2	-
Uranium 238	pCi/g	**42.30**	Yes	7.86	0.07	***22.90***	-	-	-	1.34	14	0.796	14.80	44	-
Total Uranium	pCi/g	**88.16**	-	-	-	***47.93***	-	-	-	3.08	-	1.674	-	90	90

LEGEND	Comment
Red	Result is above both dose based screening level plus the average background (DBSL+BKG) and one of the DOE clean-up guidelines.
Grey	Result is above both dose based screening level plus the average background (DBSL+BKG)
Bold	Bold font indicates that the value exceeds 95% UTL (BTV) and/or Dose Based Screening Value
*	The VP-H' background screening criteria values are defined to be the lesser of the 95% upper tolerance limit (UTL) or the maximum value in the soil background dataset from the NFSS Remedial Investigation. This is identified as the Background Threshold Value (BTV).
* *	Dose Based Screening Level - US Nuclear Regulatory Commission. Consolidated Decommissioning Guidance: Characterization, Survey and Determination of Radiological Criteria. NUREG-1757, Vol.2,Rev.1. September 2006.
Itallic	For LOOW-CMSAPad-8-0 resutls for Ra-226, Th-232, U-234, U-235, U-238 and Total Uranium were estimated using other radionuclide results from gamma spectroscopy. The U-235 by gamma spectroscopy for LOOW-CMSAPad-8-0 is assumed to be the same as the result for the U-235, since there was no alpha spectroscopy data. Note: The Total U value for LOOW-CMSAPad-7-0 is calculated using gamma spec and alpha spec data.

Note: Soil results from VP-H' collected at the CMSA pad were compared to surface soil screening levels which would allow a United States Nuclear Regulatory Commission (NRC) licensed site to be decommissioned for unrestricted use at less than a 25 mrem/year radiological dose. Although the VP-H' is not an NRC licensed site, these screening values are considered appropriately protective of human health. These screening values are found in the NRC document NUREG-1757 (NRC 2006).

Unc. = Result Uncertanity
MDA = Minium Detectable Activity
BKG = Average Background
BTV = Backgorund Threshold Value*
DBSL = Dose Based Screening Level**

Appendix A–Department of Energy VP H Prime FUSRAP Referral Letter

(This space intentionally left blank)

Department of Energy
Washington, DC 20585

September 22, 2014

[redacted]

[redacted]

The U.S. Army Corps of Engineers (USACE) notified the U.S. Department of Energy (DOE) by letter dated August 17, 2005, that USACE had identified unassessed radiological contamination on Vicinity Property H Prime (VP-H') at the Niagara Falls Storage Site (NFSS) near Lewiston, New York. USACE requested that DOE review records of the cleanup of this property to determine if investigation and cleanup was required.

The NFSS and associated vicinity properties are within the original boundary of the former Lake Ontario Ordnance Works, a portion of which was used in support of Manhattan Engineer District and U.S. Atomic Energy Commission activities. DOE designated VP-H' for cleanup under the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1984. DOE removed assessed residual radioactive contamination from this property in 1984 to the extent necessary to comply with remedial action guidelines established for the site. In 1991, DOE certified that radiological conditions on VP-H' conformed to the cleanup standards and listed the property as a completed FUSRAP site.

DOE has reviewed records of site characterization, remediation, and verification, as well as the information provided by USACE and has found that:

- DOE identified numerous small sources during the verification survey in the area of the Contaminated Material Storage Area (CMSA) pads. Several individual biased samples exceeded the cleanup guideline for radium-226, but the average radium-226 concentration was less than the guideline.

- Radioactive slag was found in the area. This material was used extensively in Niagara County for road base and railroad ballast. Officials of the New York Department of Environmental Conservation indicated that their agency was responsible for managing it. If slag was found co-mingled with FUSRAP-eligible waste, it would be removed and disposed of along with FUSRAP waste.

- USACE measured gamma activity in 2005 at levels up to 8 times higher than background in the areas of potential contamination that USACE delineated. These measurements indicated that gamma sources were on the property at levels that may exceed guidelines.

- The radium-226 and total uranium concentrations in USACE sample CMSA 7-0 exceeded the numerical guidelines established for the DOE remediation work at the site. The sample appeared to represent FUSRAP-eligible waste because it contained less uranium than radium-226, which was consistent with uranium-processing residues at this location.

- The radium-226 concentration in sample CMSA Pad 8-0 exceeded the radium-226 guideline for surface soil.

- The USACE measurements did not provide the information needed to determine if average concentrations of radium-226 and uranium exceeded the cleanup criteria for VP-H'.

Article III.B.1.b. of the *Memorandum of Understanding Between the U.S. Department Of Energy and the U.S. Army Corps of Engineers Regarding Program Administration and Execution of the Formerly Utilized Sites Remedial Action Program (FUSRAP)* (MOU) stipulates that for sites remediated by DOE before 1997 (i.e., "completed" sites), DOE "Shall request USACE to conduct additional FUSRAP cleanup in a manner consistent with those procedures described in Article III section D, FUSRAP ELIGIBILITY (NEW SITES)."

DOE concludes that unassessed contamination exceeding cleanup guidelines might remain on VP-H'. Therefore, in accordance with Article III.B.1.b. of the MOU, DOE refers NFSS VP-H' to USACE for assessment and, if needed, remediation.

Article III.D.1.a of the MOU provides that DOE "Shall perform historical research and provide a FUSRAP eligibility determination, with historical references, as to whether a site was used for activities which supported the Nation's early atomic energy program." NFSS VP-H' was previously found to be eligible and was remediated under FUSRAP, and the site was included on the list of Completed FUSRAP Sites in Attachment A of the MOU.

In accordance with MOU Article I.F.13, if USACE concurs that evaluation and, if needed, remediation is required, the status of NFSS VP-H' will change to "active," and all appropriate provisions of the MOU shall apply.

We appreciate USACE's assistance and will continue to work cooperatively with your staff in carrying out the terms of the MOU. [redacted] if you need f urther information in this matter.

Sincerely,

[redacted]

Director
Office of Legacy Management

cc:

[redacted]

File: LM 0010.05 (rc grand junction)

Appendix B–Site Visit Photographs

(This space intentionally left blank)


N
5
6
3
4
2
1
Legend
Site Boundary
Photograph Location and Direction
0 35 70 140
Feet
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY
SITE VISIT PHOTOGRAPH
LOCATIONS
Document Name: 220615_SitePhotos.mxd
Drawn By: HSTDESPM
Date Saved: 22 Jun 2015
Time Saved: 12:45:27 PM
VICINITY PROPERTY H'
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK
FIGURE 1

Appendix B - Photo 1–Southeast Corner of VP–H’ (View Looking Northwest, across former CMSA Pad)

Appendix B - Photo 2–Southern Boundary of VP–H’ (View Looking North)

Appendix B - Photo 3–Center of VP–H' Near Groundwater Well (View Looking Southeast)

Appendix B - Photo 4–Southwest Corner of VP–H’ (View Looking Northeast)

Appendix B - Photo 5–Northwest Corner of VP–H’ (View Looking South–Southeast)

Appendix B - Photo 6–Northeast Corner of VP–H’ (View Looking South–Southwest)

Appendix C–CMSA Pad Fact Sheet

(This space intentionally left blank)

US Army Corps of Engineers®
Buffalo District

DERP-FUDS Fact Sheet

Former Lake Ontario Ordnance Works
Niagara County, New York

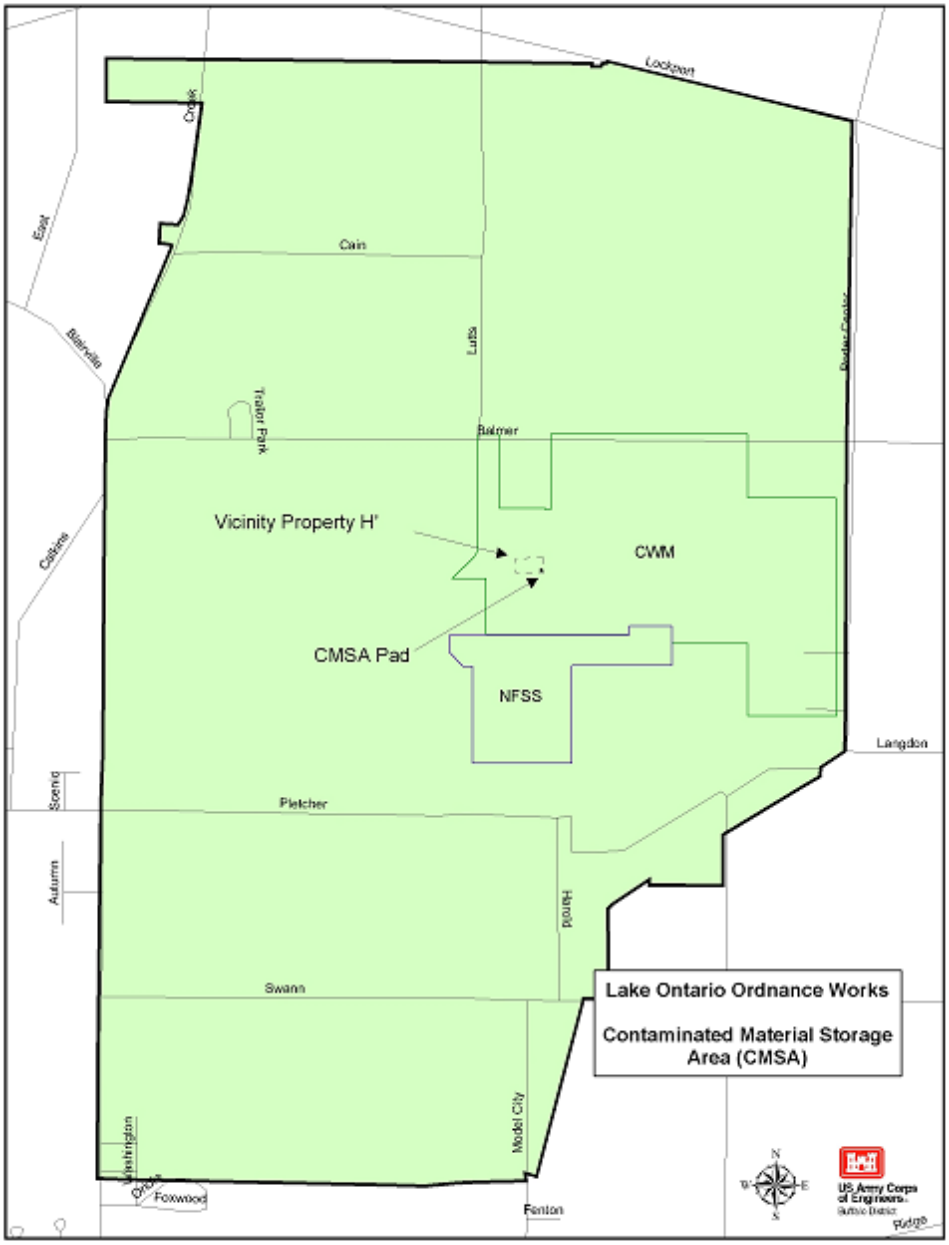
Contaminated Material Storage Area (CMSA) Pad

May 2005

This fact sheet was compiled to present information about the radiological findings on the CMSA pad at the former Lake Ontario Ordnance Works (LOOW) located in Niagara County, New York.

Brief Site Description and History

The former LOOW is a 7,500-acre Defense Environmental Restoration Program, Formerly Used Defense Site (DERP-FUDS) located in the towns of Lewiston and Porter, New York. The former LOOW was built for the purpose of manufacturing trinitrotoluene (TNT) during World War II. The TNT production, production support, and storage areas were constructed on approximately 2,500 acres. The remaining 5,000 acres, located to the west of the production area, were left undeveloped. The TNT plant was decommissioned in July 1943 due to excess production at other TNT plants after only nine months of operation. In 1945, the 5,000 acres outside the production areas were declared excess and transferred to the General Service Administration (GSA) for resale to private landowners.



Since the 1940s, the government and private landowners have used the 2,500-acre former TNT production and storage area for various activities, including: borane fuel plants (Air Force Plant [AFP]-68), a Navy Interim Pilot

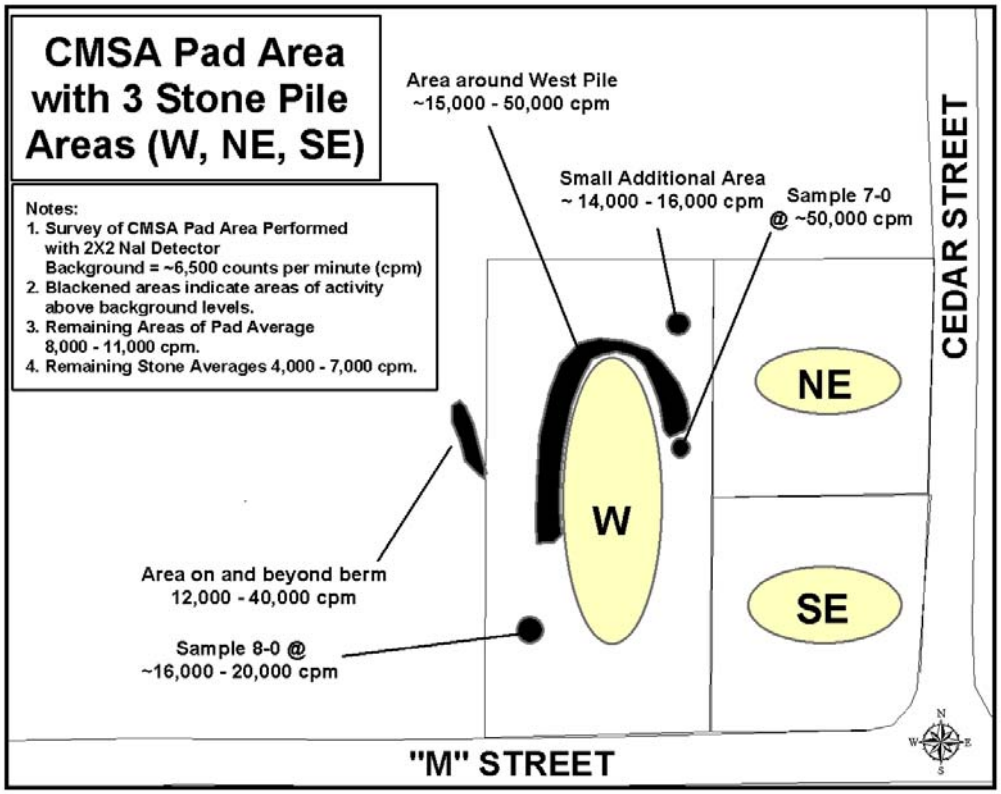
Production Plan (IPPP), jet engine testing facilities (AFP-38), a Nike missile facility, chemical and radioactive waste storage facilities (Niagara Falls Storage Site [NFSS]), municipal and hazardous waste landfills, and the testing of experimental communications equipment. As Department of Defense (DOD) operations decreased, the property was sold. Environmental investigations have confirmed Department of Defense-related contamination in several areas. Current owners of the site include local and federal governments, residential and agricultural areas, and private corporations. The Manhattan Engineer District and its successor, the Atomic Energy Commission (AEC), have used portions of the former LOOW for storage of radioactive wastes from approximately 1944 to the present. These wastes were primarily residues from uranium processing operations. The wastes were consolidated onto a 191-acre portion of the site currently owned by the Department of Energy. This facility is known as the Niagara Falls Storage Site (NFSS), and is being addressed under the Formerly Utilized Sites Remedial Action Program (FUSRAP).

CMSA Pad Description

The CMSA is a storage pad, consisting of compacted stone, that the Corps constructed in 2000 as part of a removal action of TNT contaminated pipelines, once used in the TNT production process. The CMSA pad purpose was to securely hold TNT-contaminated material awaiting disposal but has since become outdated and is no longer needed. In turn, the Corps began its scheduled removal of the CMSA at the beginning of November 2004.

The CMSA pad is located on the portion of the LOOW site that is currently owned by Chemical Waste Management, Inc. (CWM). The Corps has been working only under the DERP-FUDS program on this parcel to address chemical contamination (such as TNT) from historical Department of Defense activities. This property is also a former vicinity property (VP-H') of the Niagara Falls Storage site, which was remediated for radiological contamination and certified closed by the Department of Energy in the early 1980s. Specifically, the site is located in the west - southwest portion of the CWM property, near the border with NFSS and property owned by the Town of Lewiston, also known as the former Wastewater Treatment Plant.

Due to it's location within the CWM fence line and security, and lack of current CWM operations, the CMSA pad does not pose a current threat to human health or the environment, as access to the area is restricted to the public.



CMSA Pad Radiological Findings

Although the Corps, under the DERP-FUDS program, has no authority to characterize or remediate radiological material, monitoring is permitted for health, safety and disposal purposes[1]. As part of the health and safety monitoring during the CMSA pad excavation process, the

[1] Health and safety practices used on this program are the same stringent practices adhered to by the FUSRAP.

Corps identified a small area, of subsurface soil below the former pad, exhibiting radiological readings above background. The gamma walkover, conducted with a 2x2 NaI detector, did not identify the need to adjust health and safety procedures[2] but some limited soil sampling was conducted for confirmatory purposes. Gamma walkover results can be found in the above figure.

In turn, two biased soil samples, labeled 7-0 and 8-0, were collected and confirmed the results of the gamma walkovers; health and safety practices were adequate. A third sample, labeled 6-0, was collected and analyzed as representative of radiologically un-impacted soil. Sample 6-0 and 7-0 were analyzed via gamma and alpha spectroscopy. Sample 8-0 was analyzed by gamma spectroscopy only. Soil sample results are summarized in the below table.

Sample	Th-230	Th-232	Ra-226	Total Uranium
	Results in pCi/g			
CMSA Pad 7-0	394	15	836	88.2
CMSA Pad 8-0	Not Reported	1.1	16	46
CMSA Pad 6-0	1.7	1	0.9	3.1

Sample descriptions:

CMSA Pad 7-0 - Sample located on the Northeast side of the West stone pile.
CMSA Pad 8-0 - Sample located on the Northwest side of the West stone pile
CMSA Pad 6-0 - Sample is representative of radiologically unimpacted soils.

CMSA Pad Path Forward

The removal of the CMSA pad is complete and the stone, comprising the CMSA pad, has been disposed, as approved by the Corps' technical team and the New York State Department of Environmental Conservation (NYSDEC). The former CMSA Pad area was covered with geotextile and backfilled with approximately 6 inches of backfill material.

In addition, the Corps has communicated radiological findings to the Department of Energy (DOE), as the CMSA pad is on a vicinity property of the Niagara Falls Storage site that was investigated and closed by the DOE in the 1980s.

[2] Based on the information collected to date and considering the low levels of radiological contamination, health and safety practices, administered under a Radiation Protection Plan, were adequate for this work. For example, the materials sampled at the CMSA pad were of a granular nature and integrated with the clay. Unless the pad was very dry when the initial development of the CMSA pad was performed, the potential for inhalation of these materials is minimal as they are not fine particulates.

Where can I get more information?

The USACE Buffalo District has established an administrative record for this site. This record contains reports of past investigations and other pertinent site data. As new information becomes available, it will be added to the record. This record is available for viewing by the public at the following sites:

Lewiston Public Library ● 305 South Eighth Street ● Lewiston, New York

Youngstown Free Library ● 240 Lockport Street ● Youngstown, New York

U.S. Army Corps of Engineers (USACE) ● 1776 Niagara Street ● Buffalo, New York

To get more information about LOOW or other DERP-FUDS issues, or to be added to the program's mailing list, contact:

U.S. Army Corps of Engineers, Buffalo District
Public Affairs Office
1776 Niagara Street
Buffalo, NY 14207
(716) 879-4410

You may also call the district toll-free telephone number:

1-800-833-6390
or e-mail at
derpfuds@usace.army.mil

The USACE Buffalo District Web page is: **http://www.lrb.usace.army.mil/derpfuds/loow.**