To: **John M. Uruskyj CPG**
Remedial Project Manager
GE Corporate Env. Programs

From: **Cabrera Services**

Date: October 28, 2011

RE: Characterization Survey for Area North of Building 3H at the United Nuclear Corporation (UNC) Naval Products facility in New Haven, Connecticut

Background

During a gamma walkover survey (GWS) of a planned laydown area of concrete, asphalt, and soil in a parking lot north of Building 3H, Cabrera Services, Inc. (CABRERA) personnel found an approximate 15 square foot (ft^2) area of elevated gamma activity and collected a composite soil sample from the two most elevated locations. The elevated area is approximately 50 feet north of the Decon Pit. The results of the GWS are displayed in Figure 1. The total uranium result was estimated at 1,284 picocuries per gram (pCi/g) with a measured uranium-235 (^{235}U) result of 45.8 pCi/g and an estimated enrichment of 69%. The project work plans do not currently address the characterization and/or remediation of areas outside of those described in the first paragraph of this document.

The purpose of this document is to provide a description of the means and methods by which CABRERA will characterize the subsurface soils in this area north of Building 3H. This survey will be performed in accordance with all the UNC New Haven Decommissioning project plans, the Cabrera *Accident Prevention Plan*, *Radiation Protection Plan*, and *Nuclear Material Accountability and Control Plan* (CABRERA, 2010) and licensed CABRERA health and safety (CABRERA, 2005) and radiological (CABRERA, 2000) procedures.

Pre-Survey Tasks

Prior to the start of excavation activities CABRERA will complete the following activities:

- Contact Call-Before-You-Dig to mark utilities in the planned excavation areas.
- Provide site-specific safety and radiological training to subcontractor personnel.
- Delineate work zones, haul roads, and on site traffic and access control zones.

Survey Procedures

Gamma Walkover Survey

Outdoor GWS will be performed over 100% of the planned survey area (a total of 1,000 m^2) using a Field Instrument for the Detection of Low Energy Radiation (FIDLER) detector coupled to a Ludlum 2221 ratemeter, or equivalent meter. The detector will be coupled to a Trimble Pro GPS datalogger.

The purpose of the GWS is to identify radiological activity in surface soil and asphalt. These surveys will provide position-correlated gross gamma count rate data that is proportional to the gross gamma fluence rate from these ground-level surfaces. The results of these surveys will be used to identify and locate radioactive materials in soils and asphalt. Areas identified as exceeding criteria (individual data points that exceed three times the standard deviation of the set or Z-score ≥ 3.0-sigma, as explained below) will be used to select locations for biased soil sampling.

The survey will be performed following MARSSIM protocol by walking straight parallel lines at a speed of 0.5-m/s over an area with the detector kept a fixed distance from the ground (≤ 4-in). Survey passes will be approximately 1 meter apart. Data from the ratemeter/scaler will be automatically logged into the GPS unit every second. This system will log the gross gamma reading and position (in State Plane Coordinates) every second. After completion of the survey, the raw data will be downloaded from the GPS and transmitted to a data processing specialist for export into a geospatial software program.

Evaluation of the GWS data includes geospatial imaging for visual trend analysis and calculation of Z-scores for identification of distribution outliers. Z-scores are calculated by comparing each data point against the mean and standard deviation of the data set as a whole. Data will be reviewed for individual data points that exceed three times the standard deviation of the set (or Z-score ≥ 3.0-sigma) calculated by:

$$Z = \frac{(L_{cr}) - (M_{ds})}{(STDEV)}$$

where: Z = Z-score
L_{cr} = Location count rate, in gross cpm
M_{ds} = Mean of the data set, in gross cpm
STDEV= Standard Deviation of the data set

The GWS results will be processed and organized and then reviewed by the Site Radiation Safety Lead. The review will combine observation of individual data points that exceed 3-sigma with any identifiable spatial patterns or trends that might indicate areas of relatively elevated activity, particularly those that correspond to areas where historical data indicate that deeper contamination may exist within the particular excavation unit.

Soil Sampling

The total planned survey area is 1,000 m^2. A total of 11 systematic sampling locations were placed in the parking lot area using MARSSIM guidance. The planned systematic locations are displayed in Figure 2. Per the approved project *FSS Plan* (AAA, 2006), a sample frequency of 22 samples per 2,000 m^2 Class 1 survey unit was calculated for the project. Using this sample frequency, a total number of 11 systematic sampling locations is calculated. Biased samples will be collected at an additional 5 locations based on GWS results and/or professional judgment. This amount of systematic locations, in addition to biased sampling, will provide an accurate depiction of subsurface contamination in the area north of Building 3H and will bound any potential future remedial efforts. Finally, grab sludge samples will be collected from two (2) catch basins in the area north of Building 3H. These areas may have been impacted as a result of historical activities.

The following equipment (or equivalent) will be required for this task.

- Geoprobe® rig and ancillary macrocore sampling rods and equipment (as necessary);
- Downhole Gamma Logging (DGL) with Bicron G1 1"x1" NaI detector;
- Large stainless steel mixing bowls;
- Stainless steel utensil for removal of soil core from soil core rod or hand auger after sample is retrieved and for homogenizing and packaging samples in containers;
- Sample containers and Chain-of-Custody (COC) forms/seals.

Sample results will be used to quantify surface soil contaminant concentrations at discrete locations. If the characterization survey is performed while Cabrera is still onsite performing the current remediation/final status survey project at the UNC site in 2011, the surface and subsurface soil samples will be analyzed in the on-site gamma spectroscopy laboratory for RCOPCs (uranium-235 [^{235}U] and uranium-238 [^{238}U]) and the results will be used to determine the extent of the remediation required (if any). At approximately 5% of all sample locations, field duplicate samples will be collected for QA/QC considerations. Ten percent (10%) of the samples will be sent to GEL Laboratories in Charleston, South Carolina, for gamma spectroscopy analysis for quality assurance purposes. If this characterization survey is performed after the remediation/FSS is completed and Cabrera has to re-mobilize to the site to perform the characterization, all samples will be sent to GEL Laboratories for gamma spectroscopy analysis.

CABRERA will utilize a Geoprobe® direct-push system for all subsurface soil sampling at the UNC site. Due to varying site/drilling conditions, various Geoprobe® systems (both truck and track mounted) may be utilized throughout the sampling effort. If a sample location falls upon a concrete pad, a coring drill may be used to drill through the concrete and access underlying soils. Manual sampling means such as stainless steel hand augers will be employed, as possible, to retrieve subsurface soil samples.

A Geoprobe® is a hydraulically-powered (vehicle or auxiliary engine), percussion/probing machine that relies on a relatively small amount of integrated (vehicle) weight combined with percussion for the advancement of probing tools. Direct-push refers to tools that are "pushed" into the ground without the use of turning to remove soil or to make a path for the tool. Direct push rigs can drive macrocore samplers to obtain continuous soil cores, discrete soil samples, or groundwater samples. Soil sampling will be performed in 5-ft intervals, using steel casings (varying diameters) with dedicated acetate liners. Depth capabilities of direct-push rigs are typically limited by the type of soils encountered. Samples are planned to be collected to a depth of 15 feet below ground surface, depending on the capabilities of the Geoprobe and site conditions.

Samples will be marked to show the sample identification number. Sample identification number and other pertinent data will be recorded on appropriate field data recording sheets. Samples will be collected in accordance with CABRERA's soil collection and COC procedures.

Soil Core Scanning

Sample cores from boreholes will be scanned for beta-gamma activity to identify thin layers of elevated activity. The soil cores will be placed on a table adjacent to the borehole, where the acetate sleeve will be cut open to expose the subsurface soils. A FIDLER detector will be moved over the surface of the soils slowly, with the average count rate for each 1-ft interval recorded on a log sheet. One biased soil sample will be collected from the interval containing the highest observed count rate at each location and analyzed as described in the previous section.

Downhole Gamma Logging

Downhole Gamma Logging (DGL) will be performed at each borehole to provide data regarding the variation in gamma fluence with depth. A one-minute integrated measurement will be performed using a Bicron G1 environmentally encapsulated one inch by one inch sodium iodide (1"x1" NaI) detector. Measurements will be collected at 1-ft intervals. Each borehole will be sleeved with schedule-40, threaded Polyvinyl Chloride (PVC) pipe casing prior to insertion of the probe to prevent cave-in of sidewall soils and capture of the detector at depth. Integrated count rates in units of cpm at each borehole location will be logged on the Field Boring Log sheet.

Radiological release surveys will be performed on equipment and materials used for this effort in accordance with the CABRERA licensed procedures and the *Final Status Survey Plan* (AAA, 2006).

Characterization Survey Report

Upon completion of the survey and receipt of analytical results, a *Characterization Survey Report* will be developed with survey results and provided to the client for review. This report will allow presented in a clear, concise manner to determine if remediation, further surveys/sampling, or no further action is required in the area north of Building 3H.

References

AAA Environmental, et al. 2006. *Final Status Survey Plan for the Former UNC Manufacturing Facility, New Haven, Connecticut.* Report No. 2002020/G-6315. Submitted to UNC Naval Products, Old Saybrook, Connecticut. AAA Environmental, Inc and Integrated Environmental Management. September. 2006.

CABRERA, 2000. Cabrera Services, Inc.; Cabrera *Radiation Safety Program*; January 2000.

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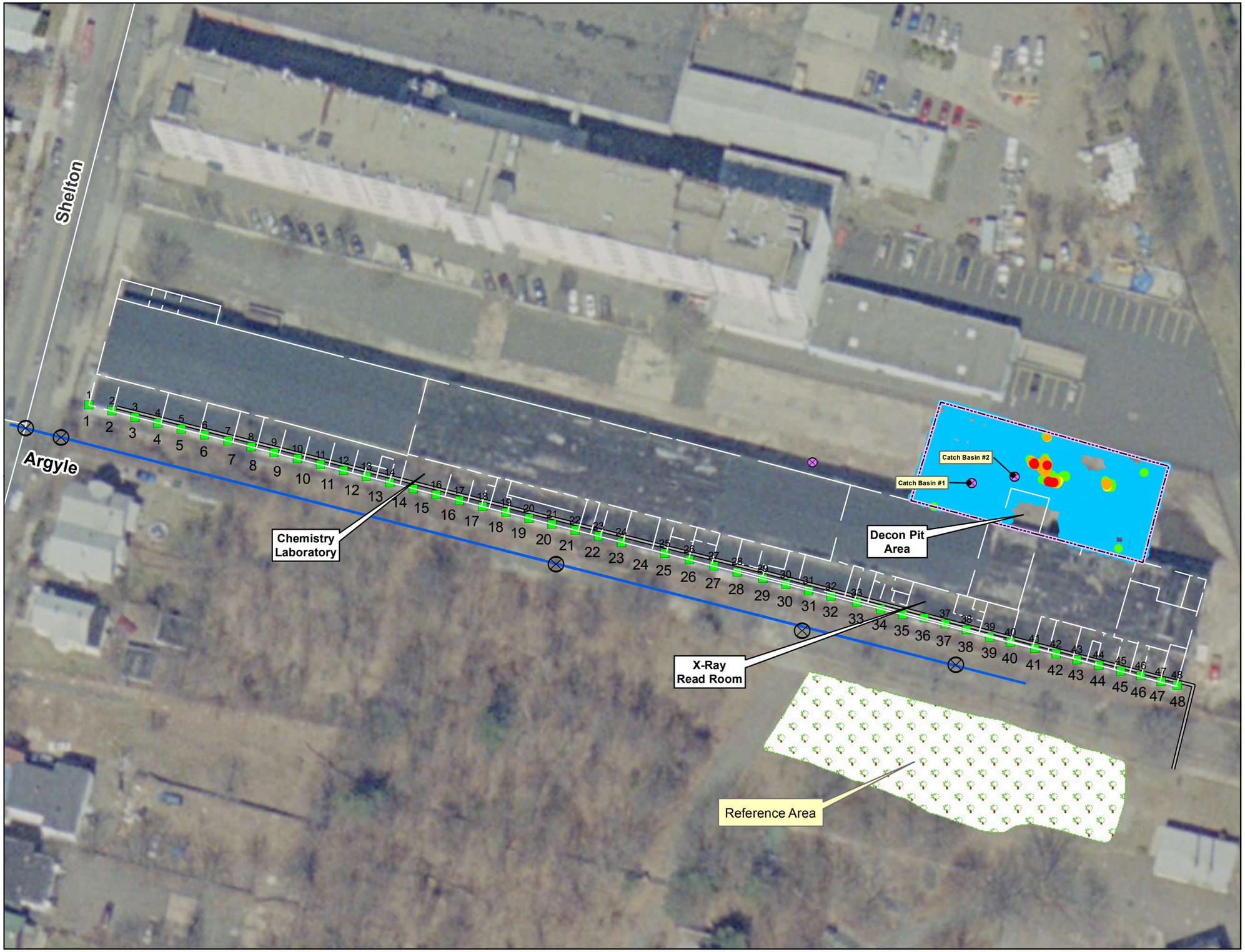

N
W E
S

Legend

CPM

- 4,549 - 5,000
- 5,001 - 10,000
- 10,001 - 15,000
- 15,001 - 20,000
- 20,001 - 100,000
- 100,001 - 366,822

- **Catch Basin**
- **Columns**
- **Manhole Locations**
- **Walls**
- **Sewer Line**
- **South Trench**
- **Laydown Area (SU)**

0 15 30 60 90 120 Feet

Gamma Walkove Survey Laydown Area

UNC New Haven Site

Date: Sept 2011
Project #: New Haven
File Name: Basemap
Prepared By: B. Pangelova

Figure 1

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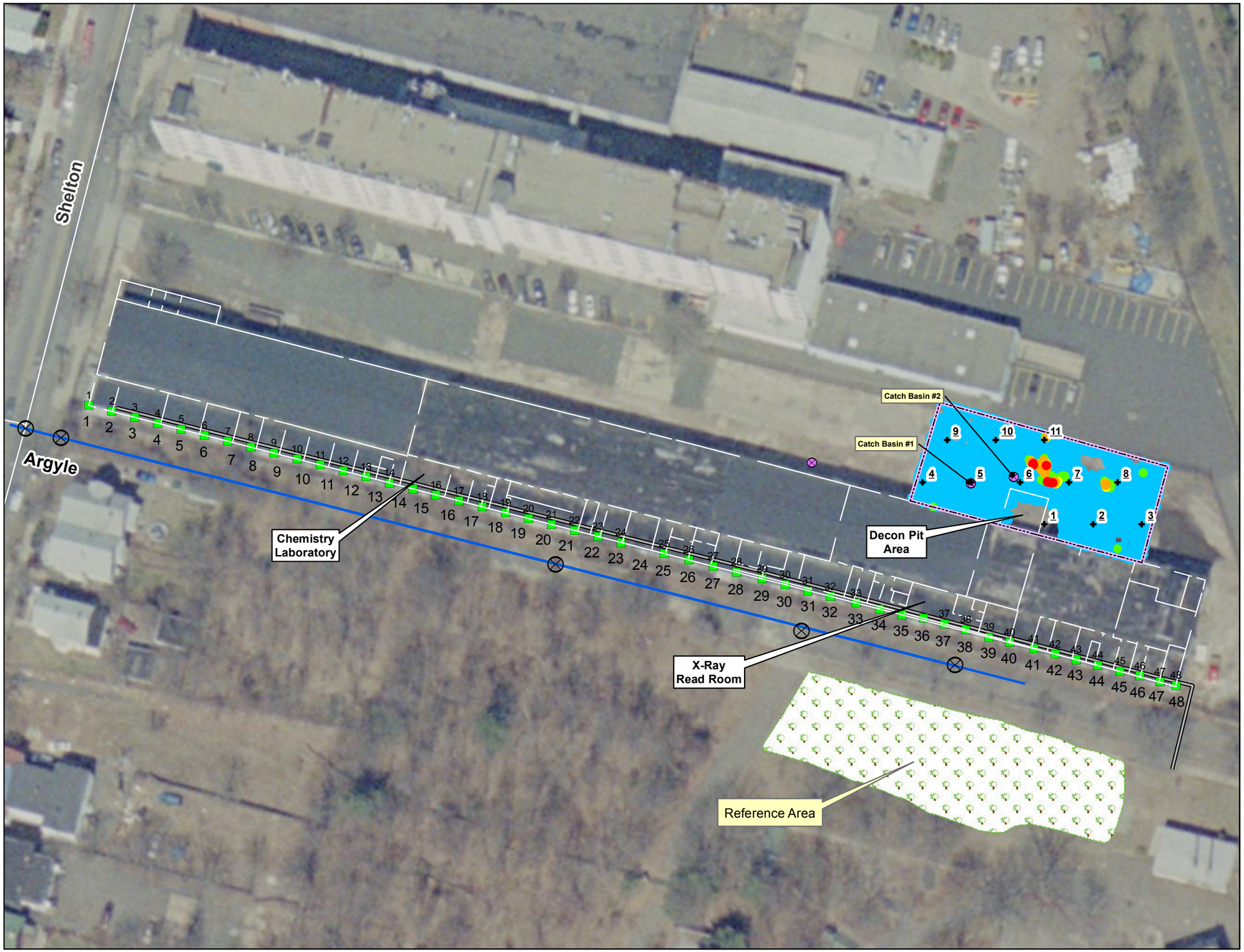
RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION



N
W E
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Legend

- Sample Locations
- CATCH_BASIN_all

CPM

- 4,549 - 5,000
- 5,001 - 10,000
- 10,001 - 15,000
- 15,001 - 20,000
- 20,001 - 100,000
- 100,001 - 366,822

- **Catch Basin**
- **Columns**
- **Manhole Locations**
- **Walls**
- **Sewer Line**
- **South Trench**
- **Laydown Area (SU)**

0 15 30 60 90 120 Feet

Gamma Walkover Survey and Sample Locations Laydown Area

UNC NEW HAVEN SITE

Date: Sept 2011
Project #: New Haven
File Name: Basemap
Prepared By: B. Pangelova

Figure 2

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