DuPont Chambers Works FUSRAP – RI/FS Operable Unit (OU) 3
Gamma Walkover Survey
Area of Concern (AOC) 4 – Historical Lagoon Area A and
Area of Concern (AOC) 6 – East Area

1.0 INTRODUCTION

The DuPont Chambers Works site is an approximately 700-acre active chemical plant located in Pennsville and Carneys Point Townships on the southeastern shore of the Delaware River, north of the I-295 Delaware Memorial Bridge, and adjacent to the residential community of Deepwater, NJ. The plant is owned and operated by E.I. DuPont de Nemours & Company (DuPont). DuPont has maintained chemical manufacturing operations on this site and the adjoining Carneys Point site since 1892.

Operations involving uranium were conducted at the Chambers Works site between 1942 and 1947 in support of the Manhattan Engineer District. Buildings involved in uranium processing were surveyed and decontaminated and turned back over to DuPont in 1949 under criteria current at the time. These areas are currently being evaluated under the Formerly Utilized Sites Remedial Action Program (FUSRAP) to identify any residual radioactive contamination in order to ensure that current cleanup standards are met.

The Areas of Concern (AOCs) 4 and 6, identified under the FUSRAP, have been designated Operable Unit (OU) 3 and are currently undergoing Remedial Investigation (RI). The gamma walkover survey (GWS) summarized in this memorandum was conducted in support of OU 3 RI activities.

2.0 SCOPE OF WORK

Cabrera Services, Inc. (CABRERA) was tasked to perform a GWS of the subject area, identify areas of elevated gamma readings, and prepare a summary report (i.e. this technical memorandum). The results of the GWS were to be used to focus subsurface sample location efforts during the intrusive phase of RI data collection activities.

3.0 ON-SITE CHARACTERIZATION

3.1 Historical Site Assessment

AOC 4

Historical Lagoon A was located in the northern portion of the site, bounded by the Delaware River to the north, Plant No. 1 Road to the south, Kinetic Road to the west, and Boundary Road to the east. Lagoon A was later separated into three settling basins; Settling Basins “A”, “B”, and “C”. The number and size of these basins varied significantly over time during the operation of the plant. Historically, Lagoon A received wastewater from Chambers Works manufacturing areas, including that generated by MED operations. The CDD provided the conduit for this wastewater discharged from the MED operational areas to the lagoon. As the lagoon was filled in over time it is reported that building debris and contaminated soil from MED operational buildings were disposed of in AOC 4 (CABRERA, 2006c). This included the area of DuPont’s Solid Waste Management Unit 5 (SWMU 5) also referred to as the North Burial Area,

AOC 4 was used for the management of chemical process wastes prior to the commencement of MED activities at Chambers Works. In the early 1920s, a lagoon was formed by the installation of a sluiced dam at the mouth of Whopping John Creek to form a 50-acre impoundment basin on the swampy ground between Chambers Works and Carneys Point Works. The lagoon was used as a settling basin for process wastewater. DuPont added quick lime and lime waste runoff to reduce the acidity of the wastewater before discharging it to the Delaware River. Extensive land filling activities occurred around the lagoon in the 1930s and 1940s. Air photos from 1940 and 1942 show fill areas on all sides of the lagoon (EA, 2003).

After MED activities began at Chambers Works, AOC 4 was modified as discussed below to facilitate the management of MED-related wastes. During the MED era, the lagoon consisted of the impounded basin (about 50 acres) on marsh land between the Dye Works and Carneys Point Works. The Process Water Ditch System carried liquid wastes from the operations units into the basin, where solids were allowed to settle before the liquids were sluiced into the river. By-product waste lime run-off from the neoprene operation was disposed into a ditch near the basin to help neutralize the acidity of the waste waters (DuPont, 1984).

No uranium-production activities took place in the Lagoon Area. Wastewater from MED operations in the Blue Products area (OU 1) and the East Area (OU 3) was directed through the Process Water Ditch System to the lagoon (Weston, 2001). Presumably, waste liquors from filtration processes were directed to the Process Water Ditch System and entered the lagoon.

A review of historical aerial photographs of AOC 4 indicates that the lagoon complex was gradually filled in from all sides after MED activities ceased at Chambers Works. Historical records indicate that in 1948 Building 708 (located in OU 1) was decommissioned. In 1953, the building was removed along with several feet of underlying earth and the building debris was reportedly disposed of in the Lagoon A area (BNI, 1985). In the 1940s the area at the northern end of the lagoon and along the Delaware River, was marshland. This area began to be used as a landfill area for waste and debris. This area is designated as DuPont's Solid Waste Management Unit 5 (SWMU 5).

AOC 6

The East Area was used to manufacture fluorinated hydrocarbons and fluorolube under contract with MED. The East Area includes the East Burial Area, which also received demolition debris and discarded equipment from MED projects conducted in the Blue Products area of Chambers Works. This burial area was located adjacent to and north of East Road.

AOC 6 was used for management of chemical process wastes prior to the commencement of MED activities at Chambers Works. Historical aerial photographs indicate that the East Area was used as a landfill beginning about 1940 (CABRERA, 2006). The MED Construction Completion Report indicated that the site, originally swampland, had been

backfilled with chemical refuse and used as a landfill prior to MED use. During MED construction activities it was necessary to remove the refuse to a depth of about three feet and then cover the area with earth fill to provide earthen cover (USACE, 1946).

After MED activities began at Chambers Works, AOC 6 was modified to facilitate the management of MED-related wastes. During the MED operations, AOC 6 was known as the East Area. MED contracted DuPont to construct a 30-building complex on 21 acres of DuPont-owned land in the East Area (BNI, 1985). The aerial photo in Figure 1-12 shows MED operations in the East Area in 1944. The area extended into a refuse swamp and required 35,000 cubic yards of backfill to make it suitable for construction. In the complex that was built DuPont produced fluorinated solvents and fluorinated lubricants under contract to MED. Uranium processing did not take place in the East Area.

DuPont purchased the buildings of the East Area from the U.S. government in 1949. Following the war, some buildings in this area were dismantled while others were converted for industrial use by the Petroleum Laboratory, the Technical Laboratory Annex, "Ponsol" Colors Stores, and the Industrial Hygiene Laboratory (DuPont, 1984). When the equipment from Building 845 in OU 1 was removed, it was either buried in the East Burial Area or sent to the Lake Ontario Ordnance Works in Lewiston, NY for disposal (BNI, 1985).

The Industrial Hygiene Department developed several new programs in 1955, one involving the use and handling of radioisotopes by DuPont. Radium and radioactive isotopes were used as technical tools in procedures such as making density and liquid-level measurements, tracing molecular actions, and testing substances (Safety Department History in DuPont, 1984).

DuPont used the East Burial Area for disposal of its radioactive waste on three occasions in 1964, 1969, and 1970. DuPont was permitted by the State of New Jersey for the disposal of these wastes. Two letters were cited from the NJDEP permitting disposal of Carbon-14 in drums within a previously delineated burial site located within Chambers Works (Weston, 2001). It was also reported that DuPont buried radioactive material in two small areas of Landfill 'A' (NJDEP, 1988). In addition, various chemical wastes and small amounts of New Jersey-approved low-level radioactive material were reported to have been stored in the East Burial Area (BNI, 1985), presently located under East Road.

3.2 Gamma Walkover Survey

The GWS identifies areas of elevated radiological activity, and consist of measuring gamma radiation emanating from subsurface materials with an appropriate detector.

3.2.1 Instrumentation

The surveys conducted for the sitewide RI were performed using a pair of Bicron® G-5 Field Instrument for Detection of Low Energy Radiation (FIDLER) detectors. The FIDLER probe is a large area, NaI scintillation detector optimized for the detection of low-energy X-ray and gamma radiation detection. The detection sensitivity of this instrument to the refined natural uranium contaminant was estimated using a standard

industry approach, as presented in the project Quality Assurance Project Plan (QAPP) (CABRERA, 2003c). The approximate detection sensitivity of the FIDLER is 5 pCi/g of total uranium when contamination is at the surface and 75 pCi/g when four inches of cover material is present. Each FIDLER was coupled to Ludlum Model 2221 ratemeter/scalars and Trimble ProXRS GPS units.

3.2.2 Quality Control Measures

Quality control measures were completed on both the FIDLERs and GPS units. Prior to commencing the GWS, the FIDLERs collected ten (10) readings from two different radiation sources, Cadmium 109 (Cd-109) and Cobalt 57 (Co-57) to establish a control for each unit to determine on a daily basis if the instruments were working within tolerance (i.e., within ± 20% of the average). Both FIDLERs were within tolerance on the days of the GWS.

The GPS system used the North American Datum 1983 (NAD83), New Jersey East 2900 for the horizontal coordinate system. The GPS systems were also referenced to a set location (a baseline reading) and compared to this location on the day of the GWS. Ten separate readings were collected at this location and control charts generated for each GPS unit (#1 and #2). On the day of the survey, each GPS unit collected a location reading from this established position prior to and after the GWS. These location readings were compared to the baseline location reading and an off-set calculated. If the off-set was one meter or greater, the GPS unit would have been removed from use. Calculated off-sets for both units were less than one meter on the days of the GWS.

3.2.3 Survey Methodology

The GWS technicians walked side-by-side in successive, parallel, one-meter-wide paths (i.e., grid columns) to complete the GWS of the survey unit. To accomplish this and achieve 100% coverage, surveyors adhered to the following protocol:

- Each two-meter wide grid column was delineated by use of small stake flags, which were moved at the completion of each grid column.
- Each surveyor completed a linear pass along each survey path, while moving the detector in a serpentine manner perpendicular to the travel path. The detector was maintained as close to the land surface as practically achievable. In most cases, this kept the detector within approximately four inches of the ground surface.
- While walking the survey paths, the surveyors visually observed the GPS signal reception status. In the event of GPS signal loss, the surveyors paused until signal was regained.
- Travel velocity was maintained at approximately 0.5 meters per second.

The audible indicator was turned to the "on" position, providing the technician real-time identification of areas exhibiting elevated radioactivity. Areas where elevated readings were observed were further investigated by collecting additional measurements prior to continuing the survey path.

For OU3, AOC 6, the GWS was intended to focus on the ten specific areas of interest identified within the Field Sampling Plan (FSP) (CABRERA, 2004C). As the survey

progressed, some areas were omitted based on real time data analysis, while others were extended in an attempt to delineate the horizontal extent of potential contamination. In areas where DuPont had stored inoperable vehicles and equipment, surveys were conducted by positioning the FIDLER detector as close to and under these vehicles and containers as was practical. These adjustments provided satisfactory results, causing no significant disruption to the intended survey patterns.

3.2.4 Data Processing

Upon fieldwork completion, collated data were imported into a three-dimensional contouring software package (Surfer, Version 7.0). Project data included spatial coordinates (plotted on the X and Y-axes) and gamma readings (plotted on the Z-axis). The software generated a spatially interpolated contour map depicting the gamma count rate Z-scores. The Z-score is the number of standard deviations above (i.e., +) or below (i.e., -) the average within the survey unit.

Prior to posting gamma data to the contour maps, the data were qualitatively reviewed for positional accuracy. No position points failed verification for this GWS, therefore all data were used to develop contours. Posted data indicating sharp variation from surrounding data points (i.e., sharp, non-gradient color change) was examined to determine the cause of the variability. It should be noted that, while performing the GWS, variations in count rate occur in relatively small steps. Even upon encountering a small localized area of very elevated activity, the data trends up in incremental steps. As such, data spikes due to instrument errors are easily discerned during data analysis, since they have no surrounding data supporting the expected trending pattern. No such anomalous spikes were noted in this data set.

4.0 RESULTS

At the completion of the GWS for OU 3, data stored in the GPS unit were transferred to a field computer for initial processing using Pathfinder™ software. The gamma count rate measurements were post-processed using Surfer™ v8.0 surface mapping software. Summary statistics were developed for each data set. Gamma count rates were evaluated and compared to the mean count rate for the survey area. Z-scores, which represent the number of standard deviations the recorded result lies from the mean, were calculated based on the following formula:

$$Z - Score = \frac{CountRate - Mean}{StdDeviation}$$

A Z-score (Zx) of 1 means that there is an approximately 84.1% confidence level that the Zx value exists as a statistical outlier from the normally distributed data population. Zx scores of 2 and 3 indicate confidence levels of 97.7% and 99.9%, respectively, that the Zx value exists as a statistical outlier from the normally distributed data population

Biased samples were selected at all locations where the gamma readings were greater than 3 times the standard deviation above the average of the GWS measurements.

Contour maps of the resulting Z score values were plotted over site base maps referenced to New Jersey State Plane coordinates for each AOC.