

APPENDIX B

Gamma Surveys

B-1: Gamma Walkover Surveys

B-2: Gamma Surveys (Downhole & Spectral)

DuPont Chambers Works FUSRAP – RI/FS Operable Unit 1

Gamma Walkover Survey

Area of Concern 1 – Former Building 845 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 determine whether current standards have been met.

The first two Areas of Concern (AOCs 1 and 2) identified under the FUSRAP have been designated Operable Unit (OU) 1 and are currently undergoing Remedial Investigation. The gamma walkover survey (GWS) summarized in this memorandum was conducted in support of RI activities at OU 1.

2.0 SCOPE OF WORK

Cabrera Services, Inc. (CABRERA), under contract to Roy F. Weston (Weston), 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 will be used to focus subsurface sample location efforts during the intrusive phase of RI data collection activities.

3.0 ONSITE CHARACTERIZATION

3.1 Historical Site Assessment

Area of Concern (AOC) 1 is the site of the former Building 845, which is located in the northwest quadrant of the manufacturing complex, just east of the F Parking Corral Area (see Attachment I). Work in Building 845 consisted of the recovery of uranium from scrap and other by-products and operations continued from 1943 through early 1947. Wastes from these recovery processes were discharged to a wooden trough located north and east of the building

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that ultimately discharged to the Central Drainage Ditch. The building was decontaminated in 1948 and again in 1996. Building 845 was demolished in 1999. The only remaining portions of the building are the concrete slab and elevator shaft, which are covered with approximately four inches of crushed stone.

3.2 Gamma Walkover Survey

The GWS of AOC 1 was carried out on March 18 and 19, 2002 to provide an indication of the areal extent of elevated radiological contaminants of potential concern, specifically Ra-226, U-234, U-235, and U-238. The survey was performed over 100% of reasonably accessible areas within the boundaries of AOC 1 (Attachment I). The survey unit is roughly triangular in shape, covering approximately 12,600 square meters (138,000 square feet). The GWS was extended slightly to the north, beyond the AOC boundaries, due to elevated readings detected along the fenceline/ wooden trough during the survey.

3.2.1 Instrumentation

The GWS was performed using two Bicron G5 Field Instrument for the Detection of Low Energy Radiation (FIDLER) detectors coupled to Ludlum Model 2221 ratemeters with lower level discriminators set just above electronic noise (i.e., open window). FIDLERs are large-area sodium iodide (NaI) detectors sensitive to higher energy gamma radiation but optimized for low-energy gamma radiation detection. These detectors are most reliable in detecting gamma emitters close to the ground surface.

The Model 2221 ratemeters were connected to the TSC-1 data logger components of Trimble Pro XRS Global Positioning System (GPS) receivers and configured such that correlated gamma count rate and geospatial location data were downloaded once per second. The GPS units were operated such that positional accuracy to one meter or less was maintained throughout the survey.

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 $\pm 20\%$ of the average). Both FIDLERs were within tolerance on the day of the GWS. These data are included in Attachment II.

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 day of the GWS. The control charts are included in Attachment II.

3.2.3 *Survey Methodology*

The CABRERA technician, Al Craig, and Weston Supervisor, Robert Massengill, 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 only areas within the AOC 1 boundaries not covered by the GWS were inaccessible due to standing water of greater than three inches depth (western boundary) and stacked railroad ties within the area defined by 96035-96055 Northing and 63845-63855 Easting (Attachment I, Gamma Z-Score Contour Plot). These areas may be incorporated in the next GWS phase at the adjoining AOC 2 (F Corral Parking).

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

As indicated in the Z-score plot (Attachment I), the majority of AOC 1 is within one standard deviation of the average activity. This suggests that there is little variability of radiological constituents over the surface of the survey unit. Detector # 176941 collected 12,576 data points, which showed an average of 6,328 cpm and a standard deviation from the average of 2,343 cpm. Detector #176947 collected 13,240 data points, which showed an average of 6,829 cpm and a standard deviation from the average of 2,626 cpm.

Of primary interest are the areas exhibiting greater than three standard deviations from average activity. These are the red/orange areas, located at the following coordinates:

63897.865343, 95946.635115

63880.657893, 96002.387253

63851.987634, 96057.186363

63843.066233, 96061.951503

63839.545324, 96050.80637

All of these locations are associated with the wooden trough and drainage ditch, with the first three clustered at the junction of the trough with the Central Drainage Ditch. The northernmost of the two isolated occurrences is an area where surface runoff has apparently eroded soils, creating a slight depression where runoff can enter the trough. The southernmost area is a slight depression in the pavement with a thin gravel cover directly over soil.

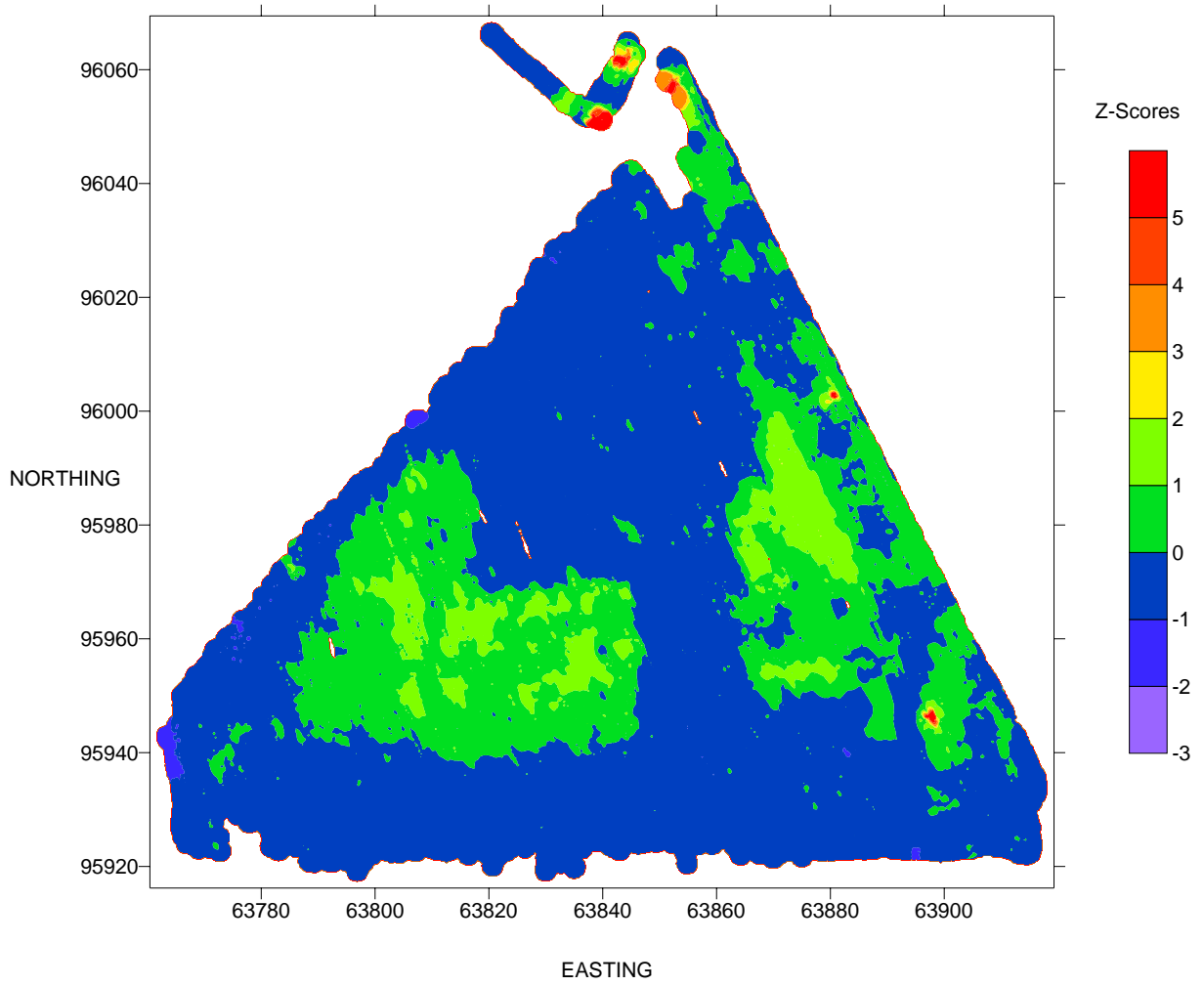
Attachment I
FIGURES
SITE MAP – AOC 1
GAMMA Z-SCORE CONTOUR PLOT

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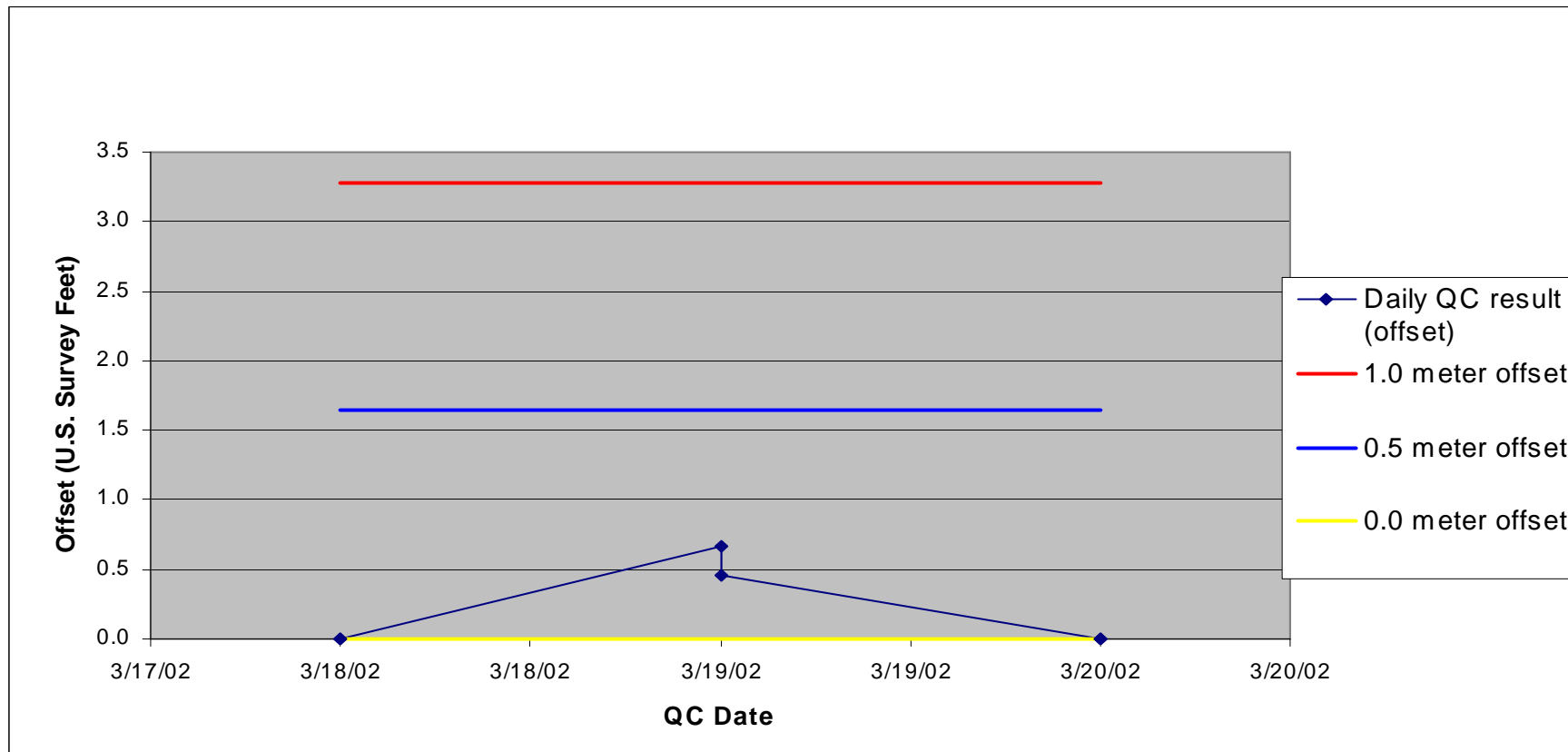
**Building 845 FIDLER GWS
Gamma Z-Score Contour Plot**



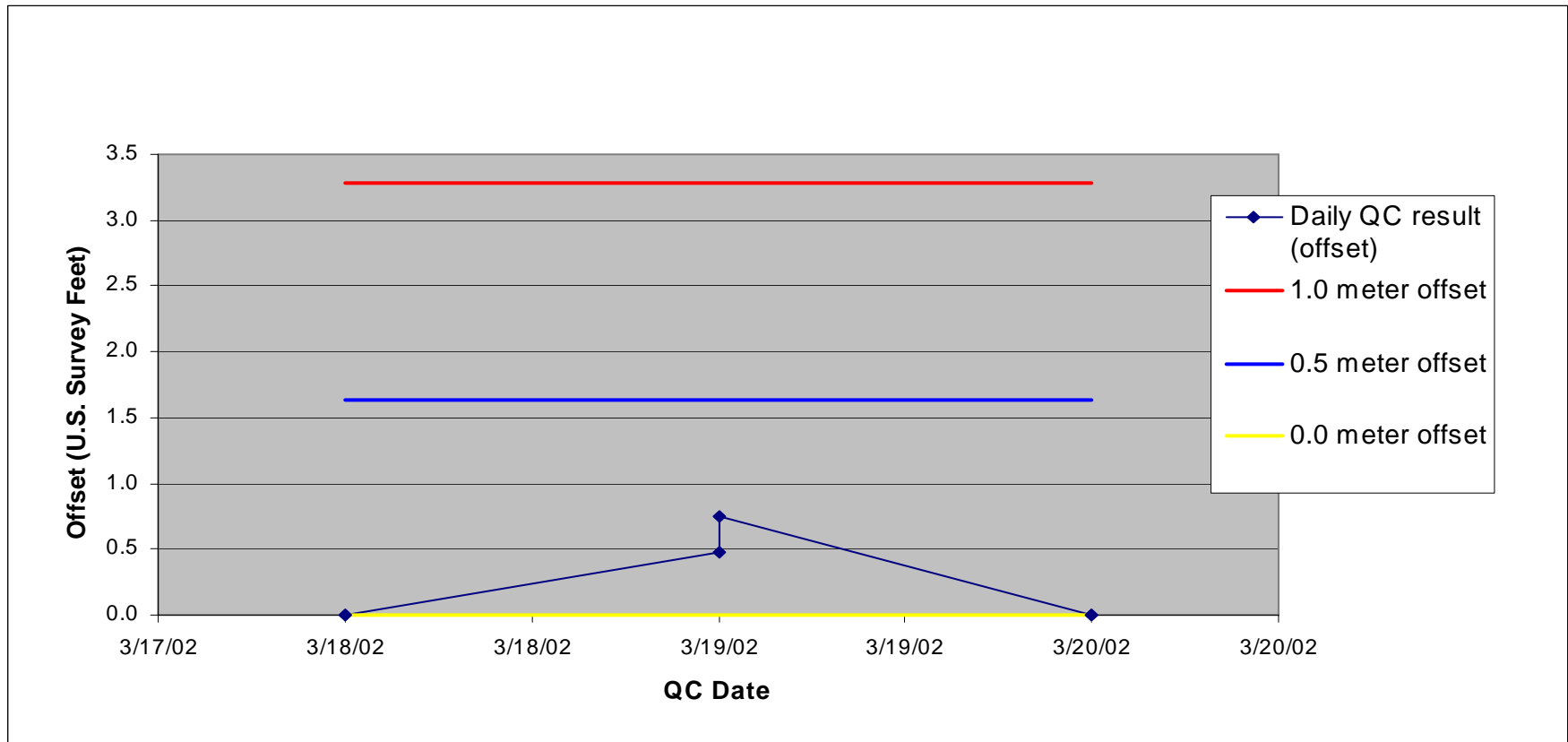
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Attachment II
CONTROL CHARTS

GPS # 1 CONTROL CHART



GPS # 2 CONTROL CHART



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FIDLER RESPONSE CHECK DATA

FIDLER # 1 Serial # 176941

Response to Cd - 109

2221/176941	
QC Daily Nal Background	
Date	Result (cpm)
3/18/2002	n/a
3/18/2002	n/a
3/19/2002	n/a
3/19/2002	n/a

2221/176941	
QC Daily Nal Source	
Result (cpm)	P/F
17727	Pass
17658	Pass
17987	Pass
18127	Pass

2221/176941	
Initial Nal Readings	
Date	Results (cpm)
3/18/2002	17992
3/18/2002	18037
3/18/2002	18133
3/18/2002	17531
3/18/2002	17770
3/18/2002	18234
3/18/2002	17907
3/18/2002	18117
3/18/2002	17791
3/18/2002	17581
	Average
	17909

Response to Co - 57

2221/ #176941	
QC Daily Nal Background	
Date	Result (cpm)
3/18/2002	n/a
3/18/2002	n/a
3/19/2002	n/a
3/19/2002	n/a

2221/ #176941	
QC Daily Nal Source	
Result (cpm)	P/F
17966	Pass
17615	Pass
18018	Pass
17789	Pass

2221/ #176941	
Initial Nal Readings	
Date	Results (cpm)
3/18/2002	18010
3/18/2002	17938
3/18/2002	17876
3/18/2002	17796
3/18/2002	18112
3/18/2002	17619
3/18/2002	18208
3/18/2002	18212
3/18/2002	17895
3/18/2002	18089
	Average
	17976

FIDLER RESPONSE CHECK DATA

FIDLER # 2 Serial # 176947

Response to Cd - 109

2221/176947	
QC Daily Nal Background	
Date	Result (cpm)
3/18/2002	n/a
3/18/2002	n/a
3/19/2002	n/a
3/19/2002	n/a

2221/176947	
QC Daily Nal Source	
Result (cpm)	P/F
18295	Pass
18231	Pass
17998	Pass
18123	Pass

2221/176947	
Initial Nal Readings	
Date	Results (cpm)
3/18/2002	18289
3/18/2002	18185
3/18/2002	17906
3/18/2002	18002
3/18/2002	18199
3/18/2002	18908
3/18/2002	17843
3/18/2002	18004
3/18/2002	18090
3/18/2002	18312
	Average
	18174

Response to Co - 57

2221/ #176941	
QC Daily Nal Background	
Date	Result (cpm)
3/18/2002	n/a
3/18/2002	n/a
3/19/2002	n/a
3/19/2002	n/a

2221/ #176941	
QC Daily Nal Source	
Result (cpm)	P/F
20123	Pass
19941	Pass
20362	Pass
19643	Pass

2221/ #176941	
Initial Nal Readings	
Date	Results (cpm)
3/18/2002	20075
3/18/2002	20230
3/18/2002	19990
3/18/2002	20365
3/18/2002	21206
3/18/2002	20154
3/18/2002	19843
3/18/2002	20318
3/18/2002	19089
3/18/2002	20484
	Average
	20175