REMEDIAL INVESTIGATION REPORT
PHASE 2
FLUOROCHEMICAL (FC) DATA ASSESSMENT REPORT
FOR THE
COTTAGE GROVE, MN SITE

June 2007

Prepared for

3M Company

by

WESTON SOLUTIONS, INC.
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W.O. No. 02181.002.030.0001

Exhibit
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State of Minnesota v. 3M Co.,
Court File No. 27-CV-10-28862

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ES. EXECUTIVE SUMMARY

The 3M Company (3M) Cottage Grove, Minnesota plant (Cottage Grove Site), formerly the 3M Chemolite plant, has been in operation since 1947. The facility currently manufactures a range of products which includes adhesive products, specialty paper, industrial polymers, abrasives, and reflective road sign materials. The facility also engages in research and development of a proprietary nature.

In December 2004, 3M submitted to the Minnesota Pollution Control Agency (MPCA) the *Facility-wide Fluorochemical (FC) Investigation Work Plan* (FC Work Plan) which was prepared by Weston Solutions, Inc. (WESTON®) to voluntarily assess FCs at the Cottage Grove Site. In a letter to 3M dated January 31, 2005, MPCA approved the Work Plan with modifications.

PHASE 1 PROGRAM

During 2005, 3M implemented the FC site-related assessment program (Phase 1 program) of the Cottage Grove Site in accordance with the MPCA approved FC Work Plan. 3M and WESTON presented the results of the assessment activities, data gaps, and recommendations for closing these data gaps to the MPCA and the Minnesota Department of Health (MDH) on March 22, 2006. Subsequently, on April 7, 2006, 3M submitted the *Fluorochemical (FC) Data Assessment Report* (FC Data Assessment Report) to the MPCA. This document contained a summary of the assessment activities, the results of these activities, identification of data needs, and recommendations for the future course of action.

PHASE 2 PROGRAM

Based upon the agreements reached between 3M and MPCA during the March 22, 2006 meeting, 3M proceeded on a voluntary basis to initiate additional fieldwork as part of the Phase 2 FC Assessment Program. In a letter to 3M dated June 13, 2006, the MPCA indicated that the primary objective of the assessment (identifying the presence of FCs in various media) was met. The MPCA requested that 3M submit an addendum to the FC

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Data Assessment Report containing a work plan to further define the extent of FCs at the facility. 3M submitted the *Phase 2 FC Assessment Work Plan* (Phase 2 Work Plan) on August 7, 2006 which incorporated MPCA comments. In accordance with the MPCA-approved Phase 2 Work Plan, the Phase 2 field work was completed in the fall of 2006 and included the following activities:

- Installation and sampling of eight groundwater monitoring wells in the vicinity of the D1/D2, D9, and D5 Areas and the facility wastewater treatment plant (WWTP) ponds.
- Collection of soil samples during the drilling of the eight monitoring wells, 10 soil borings in the D5 and D9 Areas, and six hand auger borings in the vicinity of the Fire Training Area.
- Collection of sediment and surface water samples from the East and West Coves.
- Collection of sediment and surface water samples at 73 locations and porewater samples at 43 locations from the Mississippi River, upstream of the site and downstream to Lake Pepin.
- Performance of a hydraulic capture zone analysis based on the drawdown effects from the plant production wells, PW-5 and PW-6.

CONSENT ORDER

In April 2007, 3M commenced discussions with the MPCA to formalize, under a Settlement Agreement and Consent Order (Consent Order), the process of conducting remedial investigations and response actions to address FCs at the site. The Consent Order became effective on May 22, 2007. It requires that 3M conduct a Remedial Investigation/Feasibility Study (RI/FS) with respect to release or threatened release of FCs at and from the site. In the Consent Order, MPCA states "An RI Report addressing all of the investigative work required under the MPCA approved *Phase 2 FC Assessment Work Plan* shall be submitted to MPCA by June 30, 2007. Upon MPCA approval of the RI Report, the approved RI Report and the April 2006 *Fluorochemical (FC) Data Assessment Report* shall be deemed to meet RI Report requirements ...". Accordingly, pending MPCA approval, this document is the Remedial Investigation Report, and

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together with the April 2006 *Fluorochemical (FC) Data Assessment Report*, meets the RI requirements for the Cottage Grove Site.

It is further stated in the Consent Order that by June 30, 2007, 3M shall submit an FS work plan to address proposed response actions. The FS Work Plan is being submitted concurrently with this RI report as a separate document.

SUMMARY OF OBSERVATIONS

The following is an overview, by media and area, of the findings of the Cottage Grove Site Phase 1 and 2 FC assessments. This overview is presented to provide focus on areas of interest that will be further evaluated as part of the FS process.

Groundwater

In Phase 1, PFOA and PFOS concentrations were detected in groundwater samples from monitoring wells MW-12 downgradient of the D5–Former Solids Burn Pit Area, MW-14 downgradient of the D8–Former Waste Disposal Area, and MW-101 downgradient of the D1–Former HF Tar Neutralization Basin at concentrations ranging from 150 to 1,863 ppb and from 80 to 324 ppb, respectively. It must be noted that PW-6 is downgradient of the D8 Area and is capturing the affected groundwater. The concentration of PFOA detected in production well PW-6 was 155 ppb.

In Phase 2, the following was found:

- **D9 Area** - FCs were detected in groundwater at the D9 Area. PFBA was detected at concentrations ranging from 29.7 to 76.3 ppb. PFOA was detected at 24.6 ppb in MW-107 but was NR at MW-105 and MW-106. PFOS was NR at all three monitoring wells in the D9 Area. Further analyses will be considered to quantify these results so that they may be used in the evaluation of alternatives in the FS. In Phase 1, PFOS was detected at monitoring well MW-13 at a concentration of 16.5 ppb. This well is cross gradient to the D9 Area to the west.

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- **Downgradient of D1/D2 Area, WWTP Ponds, and D5 Area**

  D1 Area

  PFOA was detected in Phase 1 wells MW-101 and MW-102 at concentrations of 150 ppb and 163 ppb, respectively.

  D2 Area

  PFOA was detected in MW-103 and MW-104 downgradient of the D2 Area at concentrations of 619 ppb and 414 ppb, respectively. PFBA was detected in MW-103 at 318 ppb and was NR at MW-104. PFOS was NR in both wells.

  WWTP Ponds

  Downgradient of the WWTP ponds, PFBA was detected in MW-108 at a concentration of 219 ppb. PFOA and PFOS were NR at MW-108.

  D5 Area

  PFOA was detected in Phase 1 well MW-12 at a concentration of 1,863 ppb. During Phase 2, PFOA was detected in MW-109 (shallow) and MW-110 (deep) at concentrations of 199 ppb and 136 ppb, respectively.

- **Hydrological Interpretation** - The area of groundwater capture induced by the pumping of two production wells (PW-5 and PW-6) was estimated by the interpretation of groundwater elevation data by constructing a groundwater elevation contour map. The projected width of capture extends east to MW-12 in the D5 Area, and west to a point midway between PW-5 and the West Cove. The analyses indicate that the pumping of PW-6 serves to capture groundwater from the D5 Area.

  In addition to the hydrological evaluation, the laboratory results for FC analyses of porewater samples from the Mississippi River also support this finding. FC concentrations detected in the porewater locations within the predicted zone of capture (IW-1 to IW-8) indicate concentrations of PFOS, PFOA and PFBA at levels significantly less than the concentrations detected in the D5 Area groundwater (MW-12, MW-109 and MW-110). For example, the maximum FC compound detected in groundwater at the D5 Area was PFOA (1,863 ppb at MW-12 in Phase 1), whereas PFOA was not detected in porewater samples collected from locations IW-7 or IW-8, which are immediately downgradient of the D5 Area. Mississippi River porewater concentrations at locations outside of the projected zone of capture (IW-9 through IW-25) are higher than concentrations detected at locations IW-1 through IW-8 inside the predicted zone of capture.

  The hydrogeological and analytical data collected at the site support the conceptual site model which indicates that groundwater beneath the site flows towards and discharges to the Mississippi River. The capture zone created by

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the pumping of PW-5 and PW-6 intercepts groundwater in the western part of the site before it discharges to the river. On the eastern portion of the site (east of the D5 Area) the groundwater flow is not intercepted and it discharges to the river.

Soil

D1/D2 Area – Former HF Tar Neutralization Basin/Former Sludge Disposal Area

During Phase 1, in the D2 – Former Sludge Disposal Area, FC concentrations up to 12,350 ppb PFOS were found in the sludge, which is located approximately 5 ft to 20 ft bgs. Lower concentrations (ranging from 4.39 to 794 ppb PFOS) were detected in the underlying native soil, which begins at approximately 20 to 25 ft bgs.

In the D1 – Former HF Tar Neutralization Basin Area, FC concentrations up to 4,520 ppb PFOA were detected in the 5 to 30 ft bgs depth range in borings constructed just outside the suspected location of the basin structure and decreased below 30 ft bgs in the native soils (ranging from 53.9 to 375 ppb).

Lower levels of PFOS and PFOA were detected at the deepest interval sampled in the D1 Area at 65 to70 ft bgs and in the D2 Area at 45 to 50 ft bgs. The depth to groundwater in this area is approximately 77 ft bgs.

In Phase 2, Soil samples collected during the installation of monitoring wells MW-104 and MW-105, downgradient of the D2 Area, indicated PFOA and PFOS at significantly lower concentrations than samples collected from within the footprint of the D1 and D2 Areas in Phase 1. FCs were detected up to 66.9 ppb (PFOS at 0-0.5 ft bgs).

D5 Area – Former Solids Burn Pit Area

During Phase 1, in the D5 – Former Solids Burn Pit Area, concentrations of PFOS (up to 2,310 ppb) and PFOA (up to 1,375 ppb) were detected in soil samples to a depth of approximately 15 ft bgs in the one soil boring (SB D501) constructed in this area. Lower concentrations were detected at lower depths, below 15 feet (up to 46.8 ppb PFOS and up to 42.5 ppb PFOA).

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In Phase 2, the following was found:

- The results of Phase 2 soil sampling in the D5 Area indicate that FCs were detected near the stormwater retention basin in the southwest portion of the D5 Area and that higher levels are in a localized area (i.e., 1-2 boring locations). FC concentrations up to 2,650 ppb PFOS were detected in the 5-10 ft bgs sample interval at Phase 2 soil boring D5B02. The highest Phase 2 PFOA concentration for this area also was detected in this soil boring at 200 ppb in the 20-25 ft bgs interval, the deepest interval sampled. PFOS and PFOA are the primary FCs detected in the D5 Area.

- Samples from the remaining four Phase 2 soil borings also indicated detections of PFOS (9.25 to 395 ppb) and PFOA (0.587 to 146 ppb) but at lower concentrations than near the retention basin. The Phase 2 soil borings (D5B01 and D5B03) indicated lower concentrations of FCs than Phase 1 soil boring SB D501, which is in the same area.

- Based on the Phase 2 soil boring logs from five soil borings, there was no definable soil horizons indicative of sludge, ash or other disposed material.

- With the exception of SB-D5B02, FC concentrations decrease with depth and are generally highest between 5 and 15 ft bgs. At SB-D5B02, PFOA was highest at the base of the boring (25 ft bgs) and PFOS was highest at the 5 to 10 ft bgs interval.

D9 Area – Former Sludge Disposal Pit

No investigation was conducted in this area in Phase 1. In Phase 2, the following was found:

- Soil samples collected from the northern and eastern parts of the D9 Area during the installation of MW-106, MW-107, and soil borings SB-D9B01 and SB-D9B04 indicated FC concentrations up to 104,000 ppb PFOS (15-20 ft at MW-107). The soil boring logs indicated waste material was present and organic vapors were recorded at these locations to a maximum depth of 25 feet at SB-D9B01 and 21 feet at SB-DB04. The maximum depth sampled was the 20-25 ft bgs interval at each location. PFOS was detected in this depth interval with concentrations ranging from 1,060 ppb at SB-D9B04 to 57,000 ppb at MW-107.

- The soil boring logs indicated visible waste material was encountered at a maximum depth of approximately 30 ft bgs. Organic vapors were observed at 16 feet down to approximately 79 ft bgs in the MW-106 boring. Visible waste material and organic vapors were not observed at SB-D9B02 and SB-D9B03. Groundwater is present at an average depth of 85 feet which is well below the depth of the encountered waste material.

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Wastewater Treatment Plant Area

In Phase 2, the following was found:

- Soil samples collected during monitoring well MW-108 installation indicated concentrations of PFOS ranging from 12.5 ppb (20-25 ft bgs) to 230 ppb (0.5-5 ft bgs). The PFOS concentrations in soil at MW-108 decrease with depth. Detected PFOA concentrations range from 3.02 ppb (0-0.5ft bgs) to 63.3 ppb (5-10 ft bgs).

Fire Training Area

The FTA is used for fire training and an adjacent area is used as a contractor storage area. In Phase 1, at the Fire Training Area, PFOS was detected at concentrations up to 1,820 ppb primarily in shallow soils to a depth of 5 ft bgs, with significantly lower concentrations detected at lower depths.

In Phase 2, the following was found:

- Soil samples were collected from six hand auger locations. Of the 12 FC compounds analyzed, the primary FCs detected in the Phase 2 program were PFOS and PFOA. The results of the Phase 2 sampling programs indicate that PFOS was detected at location FTA06 (2-3 ft) with a concentration of 2,948 ppb. This sample was collected from a drainage swale south of the lined holding pond. Samples collected from other drainage swales near the lined holding pond (FTA04 and FTA05) indicated PFOS concentrations ranging from 458 ppb (FTA05, 0-1 ft) to 1,026 ppb (FTA04, 0-1 ft).
- PFOS was also detected from a sample (FTA09) collected just off of a concrete pad used for fire training. A concentration of 747 ppb was detected in the 0-1 ft sample. A deeper sample could not be obtained with a hand auger due to large gravel that was encountered.

The FC results from the FTA sampling indicate that:

- Higher FC concentrations are typically found in localized areas of drainage
- The higher concentrations are typically found in the shallow and surficial soils
- Addition of soils and earth disturbance around the new stormwater basin (during construction) has resulted in lower concentrations

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EAST COVE

Based on the physical characterization and the analytical results from the Phase 1 and Phase 2 FC assessments conducted in the two acre East Cove, the following key observations can be made:

Surface Water

- There is a continuous flow of water through the cove due to the Cottage Grove plant cooling water and WWTP discharge, stormwater discharge from the plant and run-off from the cove drainage area during storm events.
- No significant differences in FC concentrations were detected between the Phase 2 surface water samples collected at the East Cove inlet and outlet locations.

Sediment

- Of the 4 FC compounds analyzed during the Phase 1 assessment and the 12 FC compounds analyzed during the Phase 2 assessment, the highest concentrations detected in sediment from the East Cove were PFOS and PFOA.
- A total of three distinct layers were observed in sediment cores collected from the East Cove as observed in 7 probe locations in the lower part of the cove. These layers consisted of a firm top fine granular layer, and middle semi-solid fine silt layer (where a black residue layer was encountered), and a bottom sandy clay layer. The middle layer observed ranged from 2 inches to 2 feet in thickness, appearing to exist in pockets throughout the lower part of East Cove. This black residue layer was encountered at depths of 1.0 to 2.5 feet below the top of the sediment.
- The highest concentrations of PFOS and PFBA (65,450 ppb and 94.6 ppb, respectively) were detected in the middle sediment layer where black residue was observed. The highest concentration of PFOA 1,845 ppb was detected in the bottom sediment layer.

WEST COVE

The West Cove is approximately one acre in size. It receives surface drainage from the Cottage Grove Site Contractor Storage Yard and the Fire Training Area from the northeast and from the area around the Eagle Point municipal sewage treatment plant (STP) to the west. The STP outfall discharges directly to the Mississippi River and does

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not enter the West Cove. The water in the West Cove is generally stagnant and flow velocities were not measurable.

Surface Water

- Surface water and sediment samples collected during Phase 1 and Phase 2 sampling programs indicate the detection of very low concentrations of FCs, primarily PFOA and PFOS.
- PFOS was detected at a concentration of 1.7 ppb (0.5 ft) at the Phase 2 upstream surface water sample location (WC-4). PFOS was also detected at a similar concentration (1.27 ppb) in the upstream Phase 1 surface water sample (WC-1).

Sediment

- PFOS concentrations in the sediment samples ranged from 15.2 ppb (Phase 1, WC-3) to 137 ppb (Phase 2, WC-07). PFOA was also detected in sediment samples ranging from 11.2 ppb (WC-06, 0-6 in) to 15.9 ppb (WC-07, 0-6 in).
- No sludge/waste material or discolored sediment was encountered in West Cove sediments.

MISSISSIPPI RIVER

Porewater Sampling Locations (Porewater, Sediment and Surface Water)

In Phase 2, samples of porewater, sediment and surface water were collected at 43 locations along the shoreline of the river. The higher concentrations of FCs were detected at three general areas for each of the media sampled:

- IW-22 to IW-25 along the eastern portion of the shoreline near the East Cove (approximately 1,000 feet)
- IW-19 transect along the eastern shore near the D1/D2/D9 Areas
- IW-14 transect near the WWTP area

Eastern Portion of the Shoreline

- Near the East Cove area, concentrations of PFOS, PFOA and PFBA were detected in both porewater (up to 206 ppb, 758 ppb and 157 ppb, respectively) and sediment samples (up to 168 ppb, 130 ppb and 53.4 ppb, respectively). In surface water, PFOS concentrations at IW-22 to IW-25 range from 0.0945 to 0.539 ppb. PFOA concentrations range from 0.141 ppb to 0.611 ppb. For

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PFBA, 5 of the 8 samples were NR. Concentrations in the remaining three samples ranged from 1.16 ppb to 6.92 ppb.

Transects

- The detection of FC concentrations in porewater and sediment samples correlate closely and in general decrease with increasing distances from the shoreline (southerly) at the transect locations (IW-19, IW-14 and IW-9). One exception is at IW-19f where porewater concentrations of PFBA decrease beyond IW-19d (300 ft from shore) (1.40 ppb) and increase at IW-19f (500 ft from shore) to a concentration of 118 ppb. Sediment samples from these locations also exhibit a similar trend.

- The highest PFOS concentration detected in surface water was from location IW-13. Other locations where FCs are detected at higher concentrations in porewater and sediment are IW-11, IW-13 and IW-9a. These locations are east of D5 and west of the WWTP pond area.

- At the locations near the West Cove and Fire Training area (IW-1 to IW-7), PFOA and PFOS are the only FC analytes detected in sediment. PFOS was detected at each location and PFOA was detected at IW-3, IW-5 and IW-6. In the porewater samples, PFOS was detected only at IW-1, IW-2 and IW-3. PFOA was detected at IW-1 to IW-6 and not detected at IW-7. Concentrations of FCs in this area (IW-1 to IW-7) were significantly lower than the eastern part of the shoreline.

- The FC concentrations detected in porewater, sediment and surface water in the shoreline area within the zone of capture of production wells PW-6 and PW-5 are either not detected or very low. This indicates that FC concentrations in site groundwater are being captured in the area of PW-5 and PW-6 before they reach the river.

Transect Locations

Sediment and surface water samples were collected from the 3 transects (13 total sampling locations) across the Mississippi River. Also, water samples were collected at the water surface at the five locations along Transect XS-02.

Sediment - The river transect results indicate that PFOS was the only FC compound of the 12 analytes detected in sediment at a maximum concentration of 2.66 ppb (XS-2a).

Surface Water - Surface water sampling results indicate that PFOS was not detected in any of the samples. PFOA was detected in only three samples at a maximum

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concentration of 0.199 ppb (XS-02e). PFBA was not detected in 23 of 30 samples collected at the 13 locations. NRs were reported for the remaining 7 samples.

Longitudinal Locations

Sediment and surface water samples were collected from 17 locations along approximately 40 miles of the Mississippi River from five miles upstream of the Cottage Grove Site and downstream to Lake Pepin.

Sediment - The results indicate that only PFOS and PFOA were detected in sediment samples. PFOA was only detected in the samples at the head of Lake Pepin with concentrations ranging from 0.441 ppb to 1.09 ppb. PFOS was detected with concentrations ranging from 0.142 ppb to 3.16 ppb in 17 of the 26 samples collected. PFBA was ND in 22 of the 26 samples and NR in the remaining four samples.

Surface Water - PFBA and PFOA were the only FCs detected in the longitudinal surface water samples and these concentrations were very low. PFBA was detected in 5 of the 17 samples with concentrations ranging from 0.0530 ppb to 0.0790 ppb. The other 12 samples were all ND. PFOA was detected in three samples with concentrations ranging from 0.0508 ppb to 0.0751 ppb. The other 13 samples were ND and one sample was NR. PFBS, PFHS, and PFOS were either ND or NR.

DEVELOPMENT AND SCREENING OF RESPONSE ACTION ALTERNATIVES

In accordance with the requirements of the Consent Order Section VI and Exhibit A, Section III.E.3, the development and screening of response action alternatives for the Site will be based on the List of Possible Technology Types, presented in the RI Report and FS Work Plan and approved by the MPCA Commissioner.

General response actions have been identified for the Cottage Grove Site based on the information and data provided in this RI. General response actions, response technology type, and associated process options were screened for further evaluation on the basis of technical implementability. The general response action/technology types and process

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options that have been retained as the List of Possible Technology Types from this initial screening are summarized below:

LIST OF POSSIBLE TECHNOLOGY TYPES

Soil

- Removal - Excavation
- Treatment - Thermal
  - Incineration
- Disposal - Landfill
  - New landfill
  - Existing landfill
- Containment - Cap
  - Soil/clay cap
  - Engineered multilayer cap
- Institutional and Site Controls - Access restrictions
  - Deed restrictions
  - Fencing
- No action

Groundwater

- Collection - Groundwater recovery
  - Recovery wells
- Discharge – On-site
- Containment – Cap
  - Soil/clay cap
  - Engineered multilayer cap
- Treatment - Physical
  - Activated carbon
  - Ion exchange resin
  - Reverse osmosis
  - Air stripping
- Institutional and Site Controls
  - Deed restrictions
  - Fencing
  - Monitoring
- No action

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Sediment

- Removal – Excavation/Dredging
- Treatment - Physical
  - Dewatering
  - Surface water diversion
- Treatment - Thermal
  - Incineration
- Disposal - Landfill
  - New landfill
  - Existing landfill
- Containment – In Situ Cap
  - Clean sediment, sand, gravel, geotextile, or liner
- Institutional and Site Controls - Access restrictions
  - Deed restrictions
  - Fencing
- No action

Upon approval of the RI Report and FS Work Plan by MPCA, these technology types and associated process options will be assembled into response action alternatives for screening and further evaluation. The FS Work Plan, which provides a description of the response alternative development, screening, and evaluation process, is being submitted concurrently with this RI Report.

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1. INTRODUCTION

1.1 SITE ASSESSMENT BACKGROUND

The 3M Company (3M) Cottage Grove, Minnesota plant (Cottage Grove Site), formerly the 3M Chemolite plant, has been in operation since 1947. The facility currently manufactures a range of products which includes adhesive products, specialty paper, industrial polymers, abrasives, and reflective road sign materials. The facility also engages in research and development of a proprietary nature.

In December 2004, 3M submitted to the Minnesota Pollution Control Agency (MPCA) the *Facility-wide Fluorochemical (FC) Investigation Work Plan* (FC Work Plan) which was prepared by Weston Solutions, Inc. (WESTON®) to voluntarily assess FCs at the Cottage Grove Site. The Work Plan presented a systematic approach to collect data in various environmental media related to FC manufacturing operations. In a letter to 3M dated January 31, 2005, MPCA approved the Work Plan with modifications.

During 2005, 3M implemented the FC site-related assessment program (Phase 1 program) at the Cottage Grove Site in accordance with the MPCA-approved FC Work Plan. During the course of the FC assessment program, data from the samples collected during Phase 1 were submitted to the MPCA in interim progress reports and addenda. 3M and WESTON presented the results of the assessment activities, data gaps, and recommendations for closing these data gaps to the MPCA and the Minnesota Department of Health (MDH) on March 22, 2006. Subsequently, on April 7, 2006, 3M submitted the *Fluorochemical (FC) Data Assessment Report* (FC Data Assessment Report) to the MPCA. This document contained a summary of the assessment activities, the results of these activities, identification of data needs and recommendations for the future course of action.

Based upon the agreements reached between 3M and MPCA during the March 22, 2006 meeting, 3M proceeded on a voluntary basis to initiate additional fieldwork as part of the Phase 2 FC Assessment Program. Specifically, 3M had proposed installation of

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additional borings and groundwater monitoring wells around the D1/D2, D5, and D9 Areas. The MPCA gave preliminary approval for these borings and wells on May 17, 2006 and discussed the sampling approach with 3M and WESTON on May 22, 2006. Subsequently, 3M provided MPCA with a map on May 26, 2006 depicting the proposed soil boring and groundwater monitoring well locations, which was approved by the MPCA. In accordance with these communications, WESTON performed the additional soil boring and groundwater monitoring well installation in early June 2006.

Also, in May 2006, WESTON collected water level and drawdown data from existing monitoring wells during a planned shutdown of production well PW-6. The data recorded during this activity were used to evaluate the area of groundwater capture resulting from the routine and ongoing pumping of production wells PW-5 and PW-6. The *3M Cottage Grove, MN Fluorochemical (FC) Assessment: Hydraulic Capture Zone Evaluation* was submitted to the MPCA in November 2006 and is included in Appendix A of this report.

In a letter to 3M dated June 13, 2006, the MPCA indicated that the primary objective of the assessment (identifying the presence of FCs in various media) was met. With respect to follow-on activities (Phase 2 assessment activities), the MPCA requested that 3M submit an addendum to the FC Data Assessment Report containing a work plan to further define the extent of FCs in soils, evaluate the groundwater to surface water pathway and conduct additional assessment of the East and West Coves and of the Mississippi River, both near the facility and downstream. The MPCA also requested that the FC analytical parameter list be expanded.

Accordingly, 3M retained WESTON to prepare the Phase 2 Work Plan, perform the assessment work, and present the findings in a Phase 2 FC Data Assessment Report. The Work Plan incorporated the recommendations for additional assessment activities presented in the FC Data Assessment Report and requests made by MPCA in its June 13, 2006 letter to 3M. MPCA also requested a visit to the Cottage Grove Site that was conducted on June 21, 2006. During the visit, MPCA observed the on-site disposal areas, East and West Coves, Mississippi River, and soil boring activities at the D9 Area.

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On July 14, 2006, 3M submitted the *Phase 2 FC Assessment Work Plan* (Phase 2 Work Plan) and met with MPCA on July 25, 2006 to discuss comments on the Work Plan. A revised Work Plan, incorporating changes made in response to the agreements reached during the July 25, 2006 meeting was submitted to the MPCA on August 7, 2006. The Phase 2 field work was completed in the fall of 2006.

A key component in the implementation of the Phase 2 FC Assessment program was the selection of analytical parameters. Samples collected in Phase 1 and in the early part of Phase 2 (prior to the June 13, 2006 MPCA letter to 3M) were analyzed for the following FCs:

- Perfluorooctanoic acid (PFOA)
- Perfluorooctane sulfonate (PFOS)
- Perfluorobutane sulfonate (PFBS)
- Perfluorohexane sulfonate (PFHxS or PFHS)

In their June 13, 2006 letter to 3M, MPCA requested that future sampling include analysis for additional FC compounds. Accordingly, 3M expanded the list of analytes for the Phase 2 work to include the following compounds:

- Perfluorobutanoic acid (PFBA)
- Perfluoropentanoic acid (PFPeA)
- Perfluorohexanoic acid (PFHxA)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorononoic acid (PFNA)
- Perfluorodecanoic acid (PFDA)
- Perfluoroundecanoic acid (PFUnA)
- Perfluorododecanoic acid (PFDoA)

In addition to overall site conditions and potential pathways, the Phase 1 and 2 FC assessment activities addressed historical waste management areas and areas of past FC manufacturing. Three of the historic waste management areas are referred to as the D1 Area (Former HF Tar Neutralization Basin), D2 Area (Former Sludge Disposal Area), and D9 Area (Former Sludge Disposal Pit). In December 2006, at the request of the MPCA, 3M submitted a document entitled "*Interim Remedial Measures Evaluation*". The purpose of the report was to evaluate possible options for interim remedial measures

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(IRMs) in the aforementioned three areas based on the results of the Phase 1 and 2 FC assessment activities and provide the rationale for the initiation of the IRM.

In a letter to 3M dated February 1, 2007, the MPCA approved the *Interim Remedial Measures Evaluation* report for the D1, D2, and D9 Areas, and requested a meeting to clarify the factors and assumptions for the proposed multilayer cap and then have the "final design" for the IRM submitted to the MPCA. At a meeting on February 7, 2007, 3M, WESTON, and the MPCA discussed all of the issues raised in MPCA's February 1, 2007 letter. 3M summarized the discussions and results of the meeting in a letter to MPCA dated February 21, 2007. Subsequently, on March 15, 2007, 3M submitted to the MPCA the *Fluorochemical (FC) Interim Remedial Measures Work Plan for the D1, D2, and D9 Areas*, which addressed and incorporated the items discussed at the February 7, 2007 meeting, including the IRM design.

In April 2007, 3M commenced discussions with the MPCA to formalize, under a Settlement Agreement and Consent Order (Consent Order), the process of conducting remedial investigations and response actions to address FCs at the site. The Consent Order became effective on May 22, 2007. It requires that 3M conduct a Remedial Investigation/Feasibility Study (RI/FS) with respect to release or threatened release of FCs at and from the site. In the Consent Order, MPCA states "An RI Report addressing all of the investigative work required under the MPCA approved *Phase 2 FC Assessment Work Plan* shall be submitted to MPCA by June 30, 2007. Upon MPCA approval of the RI Report, the approved RI Report and the April 2006 *Fluorochemical (FC) Data Assessment Report* shall be deemed to meet RI Report requirements ...". Accordingly, pending MPCA approval, this document is the Remedial Investigation Report, and together with the April 2006 *Fluorochemical (FC) Data Assessment Report*, meets the RI requirements for the Cottage Grove Site.

It is further stated in the Consent Order that by June 30, 2007, 3M shall submit an FS workplan to address proposed response actions. The FS Work Plan is being submitted concurrently with the RI report as a separate document.

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1.2 REPORT ORGANIZATION

This Remedial Investigation Report is organized into the following sections:

- **Section 1 – Introduction.** This section contains the site background and assessment history.
- **Section 2 – Site Setting.** This section contains a description of the site location, area land use and demographics, site topography, geology, and hydrogeology.
- **Section 3 – Summary of Activities.** This section contains a brief summary of the Phase 1 field activities that were described in detail in the April 2006 *Fluorochemical (FC) Data Assessment Report* and a detailed description of the Phase 2 field activities that were conducted in accordance with the MPCA-approved Phase 2 Work Plan from May to September 2006.
- **Section 4 – Results of the Assessment.** This section contains an explanation of the data reduction process, a summary and interpretation of the May 2006 hydraulic study results, and the results of sampling conducted in on-site areas, East and West Coves, and the Mississippi River.
- **Section 5 – Summary of Observations.** Section 5 contains a summary of conclusions based on the results of the entire RI program for the Cottage Grove Site.
- **Section 6 – Development and Screening of Response Action Alternatives.** This section contains a summary of the initial technology evaluation that was performed to prepare the List of Possible Technology Types to address FCs in soil, groundwater and sediments at the Cottage Grove Site. It also contains a condensed discussion on the FS Work Plan (submitted concurrently with this report), which provides a detailed explanation of the FS process that will be followed so that a response action alternative can be selected and implemented at the Cottage Grove Site.
- **Section 7 – References.**

Tables and figures are provided at the end of each section for ease of review.

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2. SITE SETTING

2.1 SITE LOCATION AND DESCRIPTION

The Cottage Grove Site is located approximately three miles southeast of the City of Cottage Grove (see Figure 2-1), Washington County, and is approximately 1700 acres in size. The industrial, developed portion of the site is approximately 200 acres.

Bordering the site to the south is the Mississippi River; to the west is primarily farmland with some residences; to the north is U.S. Highway 61 and farmland with some residences; and to the east are residential areas, a golf course, woodlands, and farmland.

The plant operations and developed portion of the site are located on the southern part of the property adjacent to the river as shown in Figure 2-2. A few groundwater monitoring and production wells exist on the northern portion of the property, but no industrial or production operations occur there. The Eagles Point Wastewater Treatment Plant (WWTP) is located along the Mississippi River west of the developed portion of the site. It is operated by the Metropolitan Council Environmental Services (MCES). Additionally, there is a parcel on the interior portion of the property that is owned by Cogentrix, which operates a cogeneration plant. This electrical power generation plant provides steam to the Cottage Grove Site.

The property is bisected by a railroad right-of-way. An additional railroad right-of-way is located along the bank of the Mississippi River.

2.2 LAND USE AND DEMOGRAPHICS

The Cottage Grove Site is located in Washington County. As indicated in Section 2.1, the area immediately surrounding the facility is comprised predominantly of farmland and woodlands, with some residences primarily to the west and east of the facility, a golf course to the east, and a wastewater treatment plant (Eagles Point) to the west.

In recent years, Washington County has experienced significant economic and population growth. The continued expansion of the Twin Cities metropolitan area has caused a

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spread of developed areas in the region surrounding the 3M plant. Cottage Grove is the nearest city to the 3M facility approximately 3 miles to the northwest.

2.3 TOPOGRAPHY AND DRAINAGE

The Cottage Grove Site is located on a flat to gently undulating bluff overlooking the main channel of the Mississippi River. Relief over most of the property is only on the order of tens of feet, ranging in elevation from a high of 822 feet above mean sea level (msl) on the northern portion to 780 feet msl on the southern portion at the edge of the bluff.

As shown by the topographic contour lines in Figure 2-1, the southern portion of the site has been deeply incised by streams and drainage both east and west of the plant operations area, and along the Mississippi River. The topographic relief is quite steep with land surface elevations ranging from approximately 780 feet msl at the top of the bluff to approximately 700 feet msl at the riverbank. The western drainageway terminates at a cove (West Cove), which flows to the Mississippi River. The eastern drainageway originates from Ravine Lake north of U.S. Highway 61, and flows intermittently following a southerly direction until it approaches the plant operations area where it receives the NPDES-permitted discharges from the plant's wastewater treatment and cooling water system. The drainageway terminates at a cove (East Cove), which discharges to the Mississippi River.

2.4 GEOLOGY

As shown on cross section A-A' (Figure 2-3), the Cottage Grove Site is directly underlain by fill material and unconsolidated glacio-fluvial deposits of probable Quaternary age. The transect used in the cross section is shown in Figure 2-4. In the northern portion of the property, unconsolidated deposits range from a few feet to a few tens of feet in thickness. Groundwater was not observed to be present in the unconsolidated deposits in this area. The unconsolidated deposits increase in thickness from north to south across the site and are over 100 feet thick near the Mississippi River where a buried bedrock valley exists. The bedrock surface closely mimics the present-day topography and the cliff line

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of the bedrock paleo-bluff appears to be located parallel to the Mississippi River. The boring for monitoring well MW-11 encountered talus slope materials at approximately 135 feet below ground surface (bgs) (drill cuttings were identified as Oneota Dolomite) and drilled into the Jordan Sandstone at a depth of 168 feet bgs. Thus, south of the paleo-bluff, unconsolidated glacio-fluvial materials exceed 135 feet in thickness, and at least locally, become important sources of groundwater supply.

An erosional unconformity lies between the base of the unconsolidated deposits and the bedrock beneath the facility. The youngest bedrock in subcrop at the facility is the Shakopee and Oneota formations of the Prairie du Chien Group (early Ordovician age). The Prairie du Chien group is predominantly comprised of fine to medium grained dolomite and sandy dolomite with some inter-bedded quartzite sandstone. Inspection of well completion logs for monitoring and production wells at the facility indicates that the Shakopee and Oneota formations underlie much of the northern portion of the property, through the central plant area south to a paleo-bluff (the boundary of the buried bedrock valley) as shown in Figure 2-3. These features are also shown in Figure 2-5 that presents the bedrock geologic map for the site area.

Underlying the Shakopee and Oneota Formations is the Jordan Sandstone, which is a medium to coarse-grained quartzite sandstone. Several production wells at the site tap this formation for water supply. The St. Lawrence Formation (a confining layer – shale unit) is present at the base of the Jordan Sandstone, approximately 200 feet below the central portion of the site.

2.5 WATER USAGE AND HYDROGEOLOGY

All site production and monitoring wells are completed in the upper water-bearing stratigraphic units at the site. The upper water-bearing units consist of the Prairie du Chien Group, Jordan Sandstone, and unconsolidated deposits. Due to the presence of the paleo-bluff, the Jordan Sandstone and Prairie du Chien Group are hydraulically connected to the unconsolidated deposits near the Mississippi River. Since no aquitard separates the Prairie du Chien and the Jordan sandstone, they are often considered as one

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hydrologic unit. Literature indicates that the underlying St. Lawrence Shale is not considered an aquifer but rather a confining unit due to its low permeability. (Lindholm, et al., 1974).

There are six production wells (PW-1 through PW-6) that supply water for industrial and sanitary purposes at the facility. The six production wells were installed during the period 1947 to 1970. Wells PW-1 through PW-4 are completed in the Jordan Sandstone. Wells PW-5 and PW-6 are completed entirely in the unconsolidated deposits near the Mississippi River.

The groundwater from four of the production wells (PW-2 through PW-5) is blended on a continuous basis in a water supply distribution system for various site needs, including production and sanitation. Bottled water or water treated by granular activated carbon (GAC) is supplied for drinking and the on-site cafeteria. The remaining two production wells are utilized independently on a periodic basis for site-wide fire protection (PW-1) and non-contact cooling for the site incinerator (PW-6). All groundwater coming in contact with production processes is treated after use at the on-site wastewater treatment facility, prior to an NPDES-permitted discharge to the eastern drainageway (East Cove) leading to the Mississippi River. The on-site groundwater obtained for non-contact cooling is supplemented by groundwater from the 3M Woodbury Site located north of the plant which is conveyed to the facility by underground piping. Once utilized for cooling, the non-contact cooling water is discharged to an on-site cooling water pond prior to an NPDES-permitted discharge to the eastern drainageway where it is combined with the wastewater treatment discharge.

Two additional wells (PW-7 and PW-8) are used for water supply on an as needed basis. PW-7 is located at the Trap Range and PW-8 is located adjacent to a guard house at the plant entrance.

In addition to the production wells, the groundwater monitoring well network consists of 31 groundwater monitor wells. Eight monitor wells (MW-1 through MW-8) were installed during a 3M study between 1974 and 1975 in order to maintain an ongoing record of groundwater levels. Monitor well PZ-14 was subsequently added for this

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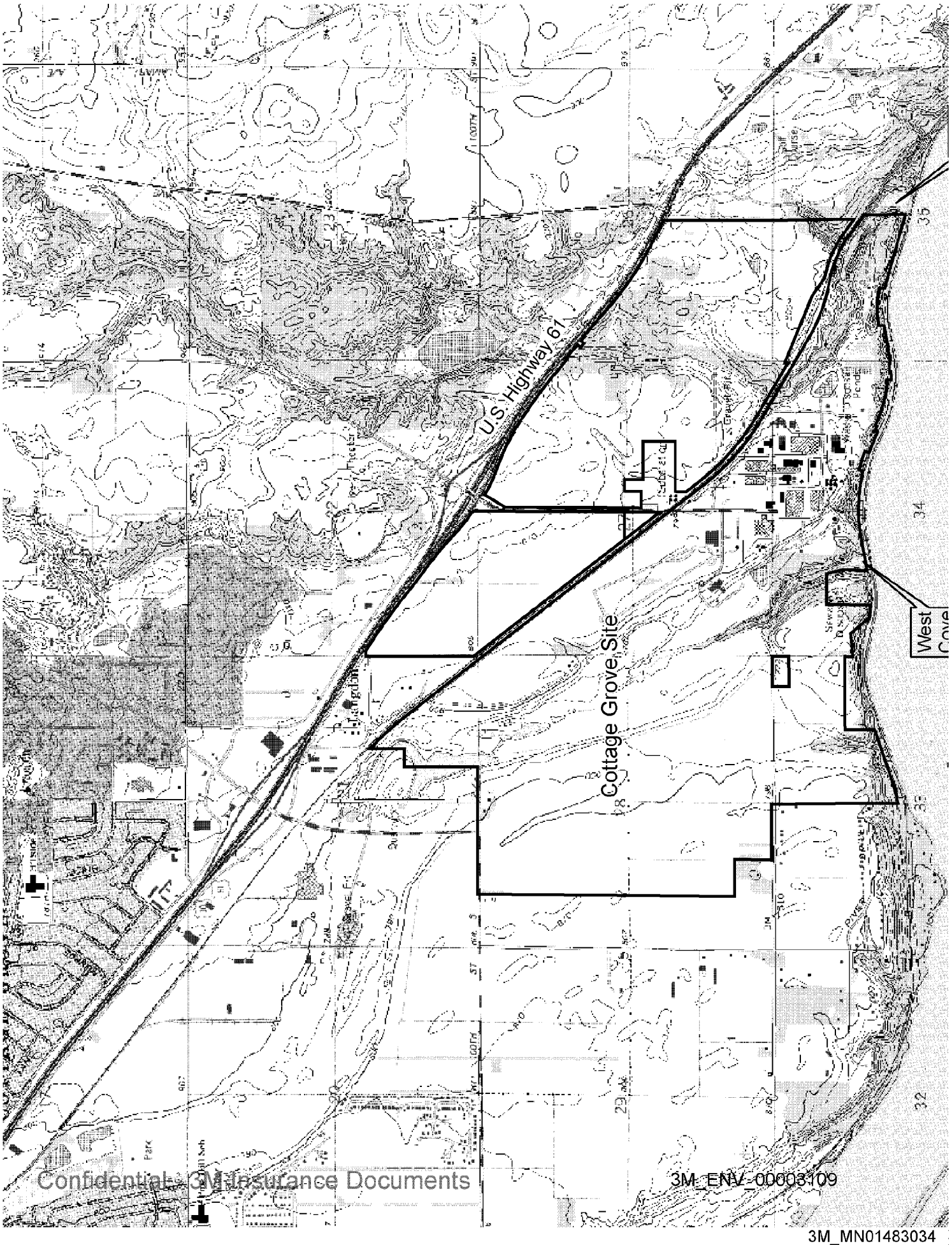
activity. A ninth monitor well (MW-9) was installed on the west side of the plant to monitor groundwater conditions at the former coal storage pile area located north of the incinerator facility. An old production well was identified in 1981 on the east side of the plant near the wastewater treatment facility and was redesignated as monitor well MW-10. During the 1980s, monitor wells MW-11 through MW-16 were installed to monitor several past waste disposal areas and an ammonium sulfate release near the WWTP. In the late 1990s monitor wells MW-17, MW-18, and MW-19 were installed to monitor groundwater conditions at the closed ash/sludge landfill south of the incinerator. Monitor wells MW-101 and MW-102 were installed in 2002 at a former disposal area (D1 Area) to assess the area southeast of the production area. In June 2006, eight additional monitor wells (MW-103 through MW-110) were installed near past waste disposal areas (D1/D2, D5, D9 and the Cottage Grove Site WWTP area) as part of the Phase 2 FC Assessment Program. Figure 2-4 shows the locations of the monitoring and production wells at the facility.

Figure 2-6 depicts the configuration of the water table surface at the plant in May 2006 during conditions when PW-5 and PW-6 were not pumping. Groundwater elevation data indicate a southerly groundwater gradient toward the Mississippi River. The calculated hydraulic gradient is on the order of 0.01 ft/ft Groundwater levels have been measured several times and the water table surface configurations have remained relatively consistent.

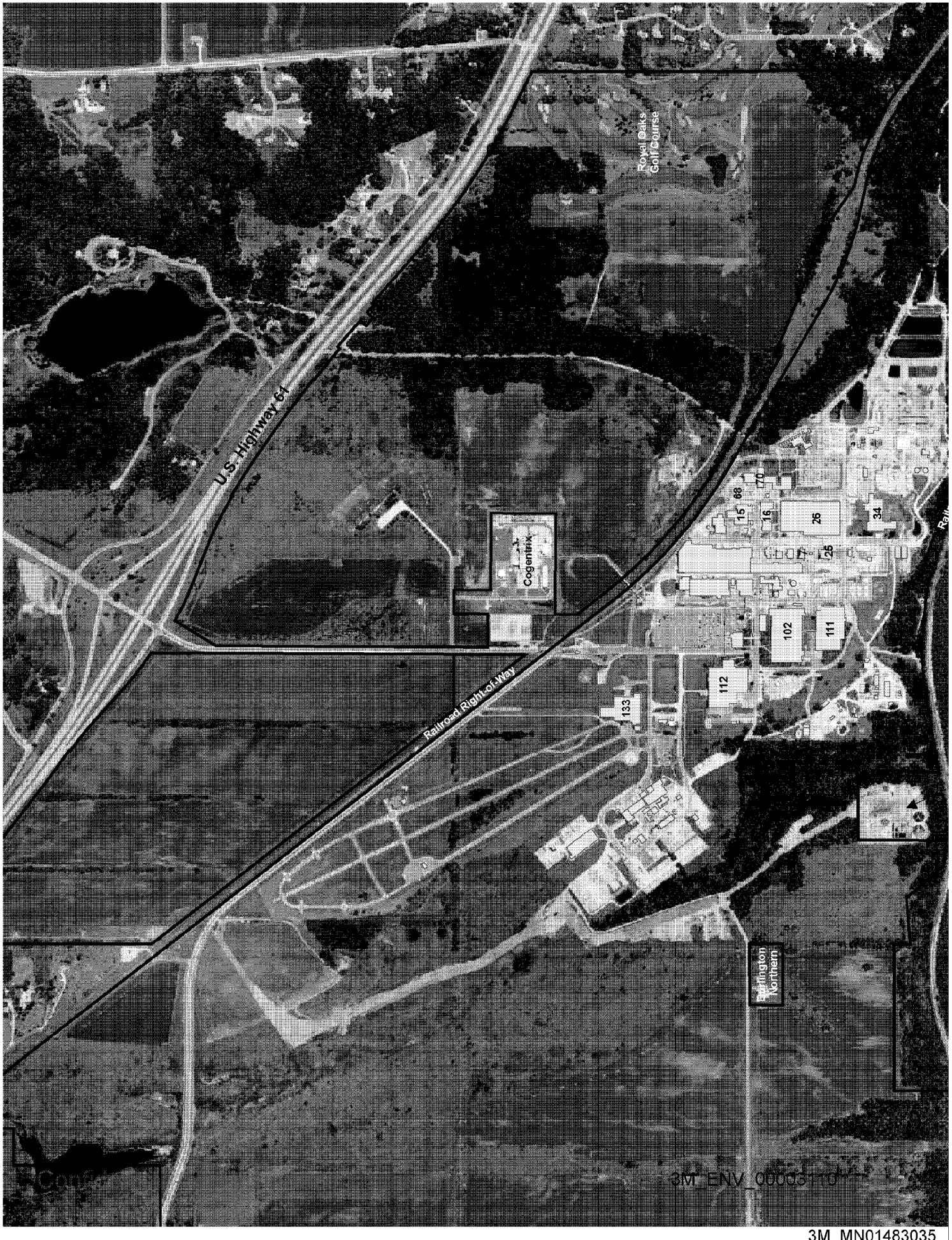
The pumping of the production wells, PW-5 and PW-06, has depressed the groundwater table near these wells with hydraulic gradients directed towards the production wells. In May 2006, as part of the Phase 2 assessment activities, WESTON collected water level and drawdown data from existing monitoring wells during a planned shutdown of production well PW-6. The data recorded during this activity were used to evaluate the area of groundwater capture resulting from the pumping of production wells PW-5 and PW-6. The *3M Cottage Grove, MN Fluorochemical (FC) Assessment: Hydraulic Capture Zone Evaluation* was submitted to the MPCA in November 2006 and is included in Appendix A of this report.

The results of the hydraulic capture zone evaluation are summarized in Section 4.

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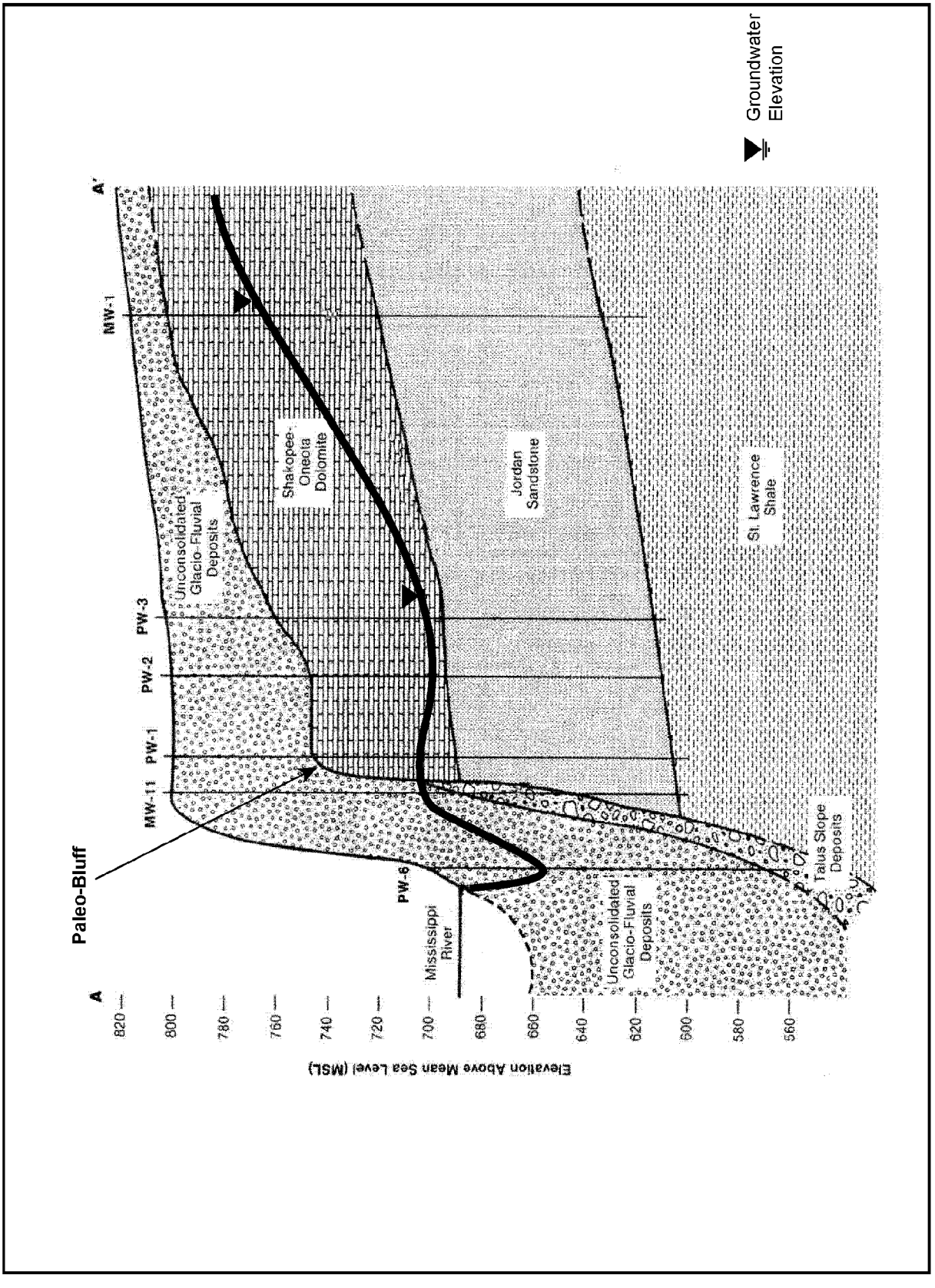
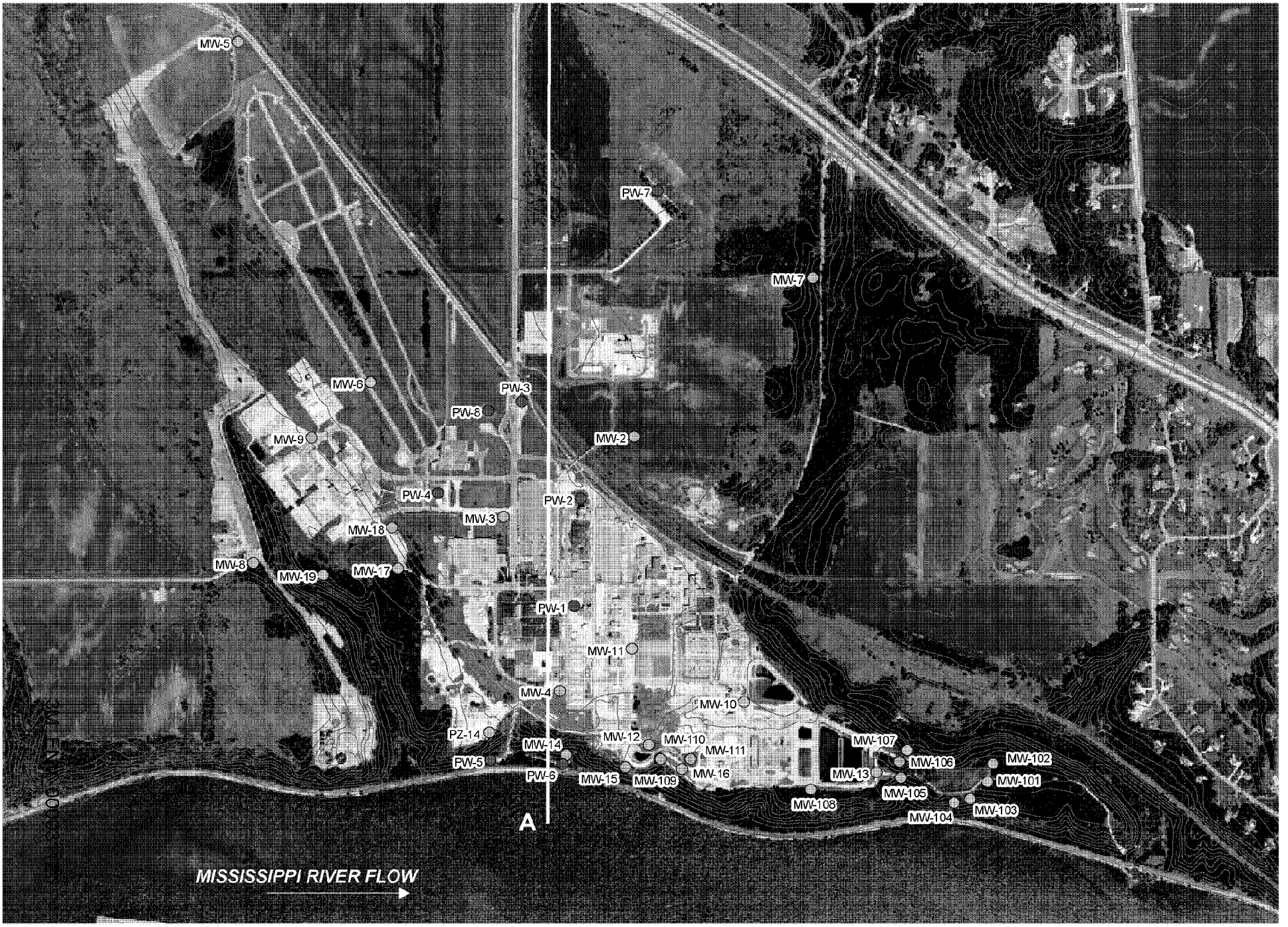


FIGURE 2-3 GENERALIZED STRATIGRAPHIC CROSS SECTION A-A'
COTTAGE GROVE SITE

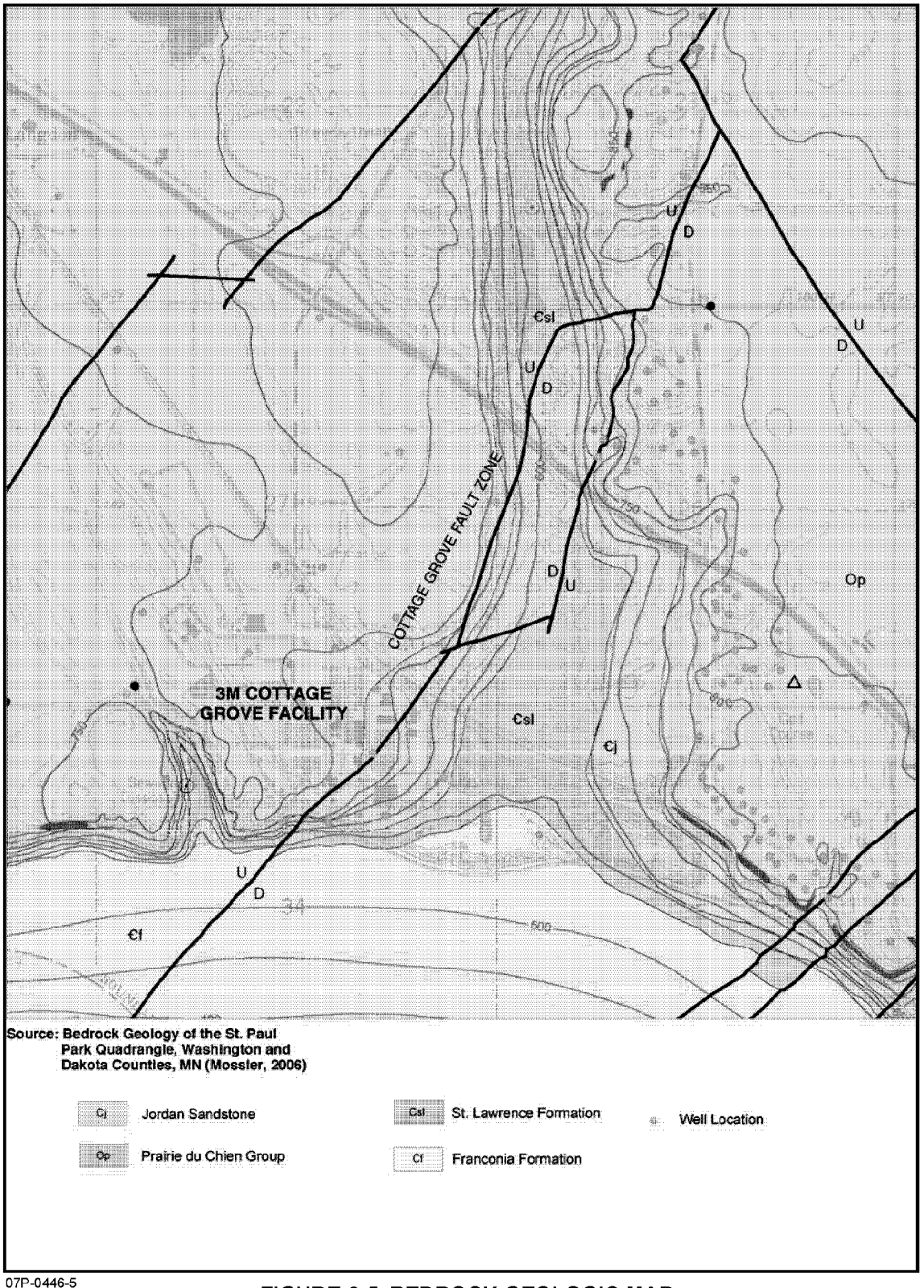
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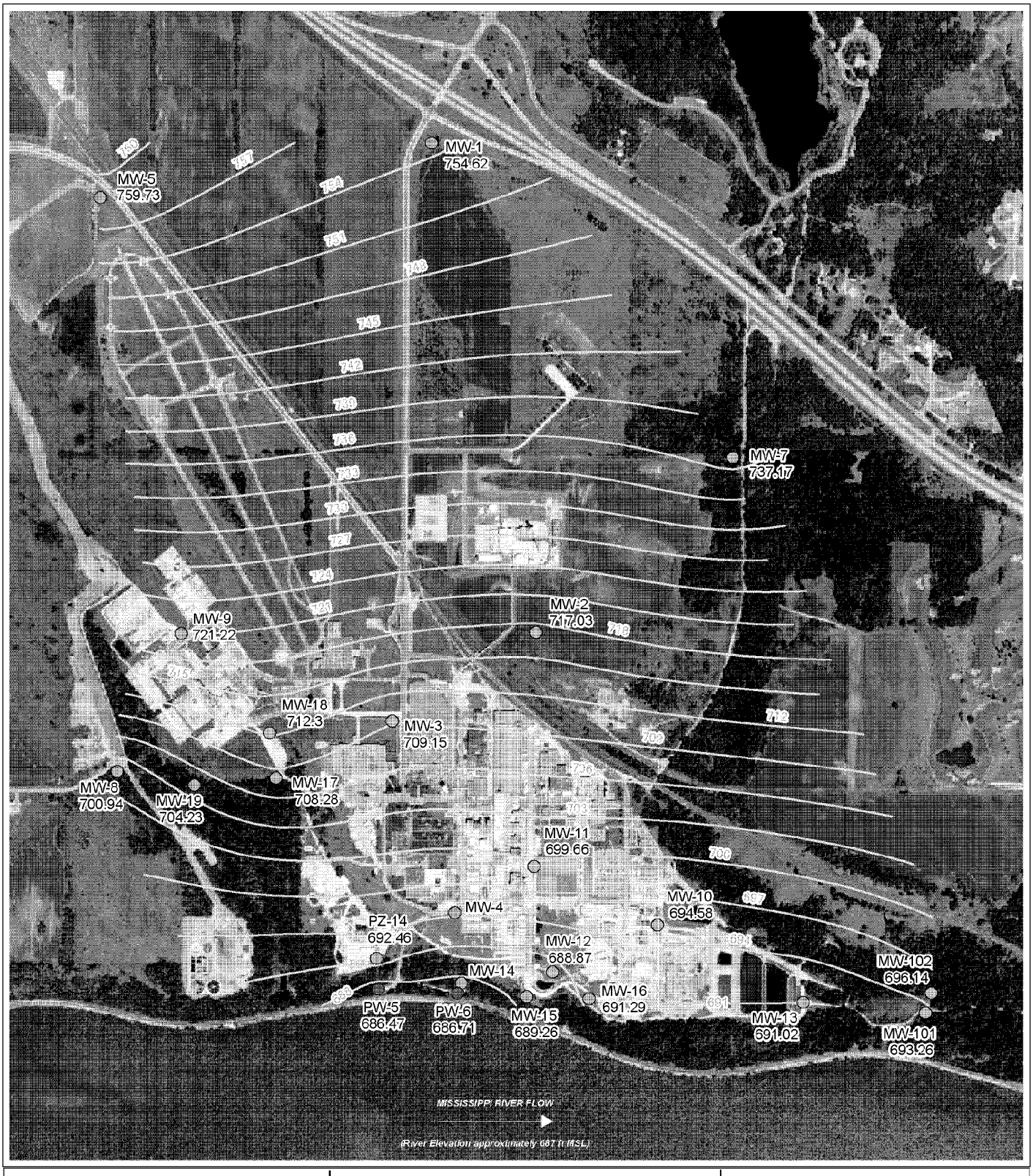
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FIGURE 2-5 BEDROCK GEOLOGIC MAP
COTTAGE GROVE SITE

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Legend:

- Groundwater Elevation Contour (ft MSL)
- Monitoring Well
- Production Well
- 686.47 Groundwater Elevation (ft MSL)

Note: Well Locations are Approximate

0 500 1,000 2,000 Feet

Map Source:
U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office;
National Agricultural Imagery Program (NAIP)
Digital Orthorectified Images (DOQ), Minnesota, 2003

FIGURE 2-6
GROUNDWATER ELEVATION CONTOUR MAP
NON-PUMPING CONDITIONS
8 MAY 2006
COTTAGE GROVE SITE
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File: \\Fswc6\prcj6\Cottage_Grove\mxds\gw_elev_non_pumping.mxd, 27-Jun-07 14:07, rickse

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3. SUMMARY OF ACTIVITIES

Throughout this document, references are made to Phase 1 results as necessary to provide a more complete understanding of the assessment data and groundwater pathways and as a basis for the Phase 2 activities. The complete presentation of Phase 1 information is provided in the Fluorochemical (FC) Data Assessment Report, (WESTON, April 2006), hereafter referred to as the Phase 1 FC Data Assessment Report. A highlights summary of the Phase 1 field activities and results, which formed the basis for the Phase 2 field work, is presented in Subsection 3.1.

3.1 PHASE 1 FIELD ACTIVITIES

The scope of the Phase 1 FC Assessment is summarized in this section since it will be considered in combination with the Phase 2 program, the complete RI program for the Cottage Grove Site, pending MPCA approval.

Activities conducted under the Facility-wide Fluorochemical (FC) Investigation Work Plan (WESTON, 2004), hereafter referred to as the Phase 1 FC Work Plan, were initiated with a file review in January 2005. This review was conducted to collect information on the historic Cottage Grove Site waste generation, waste disposal, or treatment both on-site and off-site. The field assessment commenced in March 2005 and was completed in August 2005. It consisted of the following:

- **Groundwater and Additional Assessment** – In March and May 2005, field data and groundwater samples were collected from 21 existing monitoring wells, six production wells, and two water supply wells at the Cottage Grove Site. One monitoring well (MW-6) could not be sampled due to an obstruction in the well borehole. A sample of water from the tap at Bldg. 116 (cafeteria) was collected after granular activated carbon (GAC) treatment unit.
- Additionally, the four pumping wells at the former 3M Woodbury disposal site (Woodbury Site) and the combined discharge from these wells, which provide non-contact process water for the Cottage Grove Site, were sampled once per month for three months in March, April, and May 2005. At the same time, the discharge from the Cottage Grove Site non-contact process water retention pond also was sampled.

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- **Soil Assessment** – In May 2005, soil assessment work included 16 soil borings installed to depths ranging from 25 to 70 feet below ground surface (ft bgs) and 112 composite soil samples collected at 5-ft intervals from the soil borings.

  In addition, fifty (50) surface soil samples were collected from two shallow depths at 25 locations in drainageways, areas where FCs were handled, and other general site locations.

- **Sediment and Surface Water** – In August 2005, a sediment and surface water assessment was conducted at the Cottage Grove Site and the Mississippi River. Twenty (20) sediment samples and nine surface water samples were collected from the East and West Coves and the Mississippi River. Six sediment samples, co-located with six surface water samples, were collected from the 0-10 cm depth interval at locations upstream, adjacent, and downstream of the facility in the Mississippi River. Sediment samples were collected from three locations in the East and West Coves and upstream of each cove. One surface water sample was collected from each cove. Also, one surface water sample was collected upstream of the East Cove but the drainageway upstream of the West Cove was dry.

- **Fish** - In August 2005, fish sampling was performed at three reaches of the Mississippi River, one upstream, one adjacent to the plant, and one downstream. A total of 62 fish were collected including 11 smallmouth bass, 30 channel catfish and 21 bluegill sunfish. Whole body or filet tissue samples were prepared from the collected specimens for chemical analyses.

- **File Review and Interviews** – A file review and interviews with retired and current employees were conducted to collect information on the historical waste generation, waste disposal, or treatment both on-site and off-site.

All of the samples collected under the Phase 1 FC assessment program were submitted to Exygen Research in State College, Pennsylvania, for analyses of PFOA, PFOS, PFHS, and PFBS. A subset of the soil samples were also selected for grain size distribution and total organic carbon (TOC) analyses. Results of the Phase 1 assessment were reported in the FC Data Assessment Report (WESTON, April 2006), and the primary results which supported the Phase 2 field program, are highlighted in the following subsection.

3.1.1 Results of the Phase 1 FC Assessment and Data Needs

The findings from the file review relative to waste disposal locations utilized by the facility were submitted to the MPCA during a June 10, 2005 meeting. This review indicated that, other than on-site waste disposal, there were three key off-site waste

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disposal areas that received Cottage Grove wastes. These included: the former Oakdale Disposal Site (Oakdale Site), the former Woodbury Site, and the former Washington County Landfill. The Oakdale Site and the Woodbury Site are being assessed by 3M under a related but separate work plan. However, an initial site assessment was performed at the Woodbury Site under the FC Work Plan covered by the Phase 1 Data Assessment Report. The MPCA is addressing the Washington County Landfill under its Closed Landfill Program.

It was found that the facility personnel interviews corroborated information from the file review and provided additional details. A new disposal area was brought up during the personnel interviews was the possible existence and location of a former on-site sludge disposal pit. No documentation of this pit was evident in the file review and it had not been assessed. This former on-site sludge disposal pit was designated as D9 for assessment during Phase 2.

The D8 area had been assessed by a previous removal action in November 1985. It was agreed with MPCA that no further investigation was needed in this area due to the limited site access and proximity to pumping well PW-6.

Groundwater -The highest FC concentrations were detected in groundwater samples from monitoring wells MW-12 downgradient of the D5 – Former Solids Burn Pit Area, MW-14 downgradient of the D8 – Former Waste Disposal Area, and MW-101 downgradient of the D1 – Former HF Tar Neutralization Basin. In these areas, PFOA concentrations ranged from 150 to 1,863 ppb and PFOS from 80 to 324 ppb.

The highest FC concentrations detected in groundwater samples collected from pumping wells were detected at pumping well PW-6 (155 ppb PFOA). PW-6 is downgradient of the MW-14. Groundwater elevation data collected from the monitoring wells in March 2005 show that the influence of the pumping wells is most significant in the central plant area and is reduced with increasing distance from this area.

With respect to groundwater at the Cottage Grove Site, the following data needs were identified:

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- Groundwater quality and movement in the area of the D9 former sludge disposal pit needed to be characterized.
- The potential movement of groundwater to surface water, particularly down gradient of the D5, D1, and D2 Areas, had not been characterized.
- Better definition of the hydraulic influence of pumping wells PW-5 and PW-6.

Soil - The highest concentrations of FCs were found in the D2 and D1 Areas. In the D2 – Former Sludge Disposal Area, the highest FC concentrations (up to 12,350 ppb PFOS) were found in the sludge, which is located approximately 5 to 20 ft bgs. Lower concentrations (ranging from 4.39 to 794 ppb PFOS) were detected in the underlying native soil, which begins at approximately 20 to 25 ft bgs.

In the D1 – Former HF Tar Neutralization Basin Area, the highest FC concentrations (up to 4,520 ppb PFOA) were detected in the 5 to 30 ft bgs depth range in borings constructed just outside the suspected location of the basin structure and decreased below 30 ft bgs in the native soils (ranging from 53.9 to 375 ppb).

In the D5 – Former Solids Burn Pit Area, concentrations of PFOS (up to 2,310 ppb) and PFOA (up to 1,375 ppb) were detected in soil samples to a depth of approximately 15 ft bgs in the one soil boring constructed in this area. Lower concentrations were detected at lower depths (34.5 and 46.8 ppb PFOS and 21.8 and 42.5 ppb PFOA).

At the Fire Training Area (FTA), PFOS was detected in localized areas at concentrations up to 1,820 ppb primarily in shallow soils to a depth of 5 ft bgs, with lower concentrations detected at lower depths.

The following data needs were identified for soils at the Cottage Grove Site:

- D5 – Former Solids Burn Pit Area. This area, which is approximately 2 acres in size, had not been defined with respect to the horizontal extent of FC concentrations. Historic records did not show specific limits or boundaries for this area. Only one boring was located in this area and soil samples from this boring exhibited concentrations of FCs primarily at 0 to 15 ft bgs.
- FTA – Additional soil sampling was needed in the FTA since soil had been disturbed due to construction and to obtain better definitions.

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- D9 - Former Sludge Disposal Pit. This newly identified area had not been assessed or characterized and will be referred to as the D9 Area.

Sediment – FCs were detected in sediment in the coves and Mississippi River. Generally, upstream levels were less than downstream.

PFOA sediment concentrations in the East Cove (11.7 to 28.7 ppb) were comparable to the West Cove (4.11 to 38.7 ppb). PFOS sediment concentrations in the East Cove (24.2 to 267 ppb) are higher than at the West Cove (15.2 to 91.1 ppb). Higher PFOS concentrations were detected in the shallow sediments (0-10 cm) of the East Cove than in the deeper sediments (10-20 cm).

In the Mississippi River, average sediment concentrations at sample location R1, R2, and R4 were not quantified (NQ) or not detected (ND). The average sediment concentrations (8.28 and 13.2 ppb, respectively) of PFOS and PFOA were detected at sample location R3, which is adjacent to the operating plant portion of the property.

The following data needs were identified for the sediment:

- Concentrations of FCs in sediment at depth (below 10 cm)
- Additional on-site area sampling

Surface Water - The average concentrations of FCs in the East Cove water sample were greater than the concentrations detected in the West Cove water sample. In the Mississippi River, PFOA and PFOS concentrations were ND or NQ at the R1 through R4 sampling locations. The only quantifiable concentrations of PFOS and PFOA (0.098 and 0.132 ppb, respectively) in the water samples were detected at downstream location R5. With respect to sediment and surface water, the following data needs were identified:

- Concentrations, if any, of FCs in groundwater entering the river (porewater) as a possible pathway.
- Distribution, if any, of FCs in surface waters and sediment extending across the river and farther upstream and downstream.

Fish - The analytical results indicate that FCs have been detected in fish samples (whole body and filet) collected from three reaches of the Mississippi River in the immediate

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vicinity of the Cottage Grove Site. The FCs were detected in each of the three species sampled: Channel catfish, Bluegill sunfish, and Smallmouth bass.

The following conclusions had been identified for Mississippi River fish:

- The current data set represents one limited round of fish sampling conducted in a finite area in the Mississippi River.

3.1.2 Phase 1 Recommendations

Substantial characterization was completed at the Cottage Grove Site as part of the Phase 1 work conducted in 2005. However, data needs were identified and additional recommendations were made. The recommendations were implemented in the Phase 2 investigation.

3.2 PHASE 2 FIELD PROCEDURES

The Phase 2 FC assessment field activities were conducted in accordance with the FC Work Plan and Health and Safety Plan (HASP) (Appendix B to the Phase 1 FC Work Plan, December 2004) and the "Phase 2 FC Assessment Work Plan", WESTON, July 2006 (revised August 7, 2006). Field procedures were consistent with MPCA site characterization and sampling guidance. Any deviations from the FC Work Plan are identified in the following sections of this Phase 2 Data Assessment Report.

The Phase 2 field activities included:

- Installation and sampling of 8 groundwater monitoring wells in the vicinity of D1/ D2, D9, D5 and the former Cottage Grove Site WWTP ponds.
- Collection of soil samples during the drilling of the monitoring wells, 10 soil boring locations in the D5 and D9 areas and 6 hand auger locations in the vicinity of the Fire Training Area.
- Collection of sediment and surface water samples from the East and West Coves. (East Cove, 7 sediment sample locations and 2 surface water locations. West Cove, 3 sediment sample locations and 2 surface water locations.)
- Collection of samples from the Mississippi River including; porewater samples (43 locations), surface water samples (73 locations) and sediment

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samples (73 locations). Porewater samples were collected at a discrete interval through a temporary well point installed at a depth of 6-inches to 1 foot into the river bottom sediments.

- Performance of a hydraulic capture zone analysis based on the drawdown effects from the plant production wells, PW-5 and PW-6.

Table 3-1 summarizes the sample numbers and types of samples by area. All samples for FC analysis were sent to, and analyzed by, Exygen Research in State College, PA.

3.2.1 Groundwater Monitoring Well Installation

During the period of June 12 and June 19, 2006, eight groundwater monitoring wells (MW-103 through MW-110) were installed at the Cottage Grove Site (Figure 3-1). The rationale and basis for each location is discussed in Subsection 3.3 which describes this Phase 2 effort for the various waste management areas.

The monitoring wells are 2-inch ID with stainless steel screens and low carbon steel risers. The wells were installed using hollow-stem auger and split spoon sampling techniques. Continuous split spoon samples were collected and composited for laboratory analysis over 5 foot intervals to a depth of 25 feet. Below 25 feet, samples were collected every 5 feet to the total depth of the boring for lithologic description only. The borehole was logged by an experienced geologist noting color, texture, moisture content, and any odors or discoloration. The soils were also screened using an organic vapor meter (OVM) and readings were recorded on the soil boring logs.

The monitoring wells were developed during the week of June 26, 2006 and sampled during the week of September 4, 2006 (See Subsection 3.2.2). The new monitoring well elevations and locations were surveyed for horizontal and vertical control. Table 3-2 summarizes the well construction details for all of the Phase 1 and Phase 2 site monitoring wells. The survey information and the soil boring and well construction logs are provided in Appendix B.

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3.2.2 Groundwater Sampling

Groundwater sampling of the newly installed monitoring wells was conducted during the week of September 4, 2006. In accordance with the Phase 2 FC Work Plan, monitoring wells were purged a minimum of three well volumes before sampling was conducted. Temperature, specific conductivity, and pH were measured during the purging process so that representative groundwater samples could be collected after these parameters stabilized. This data was recorded on the well evacuation/sampling forms. Following purging, the wells were allowed to stabilize to minimize the suspended particulate in the sample media. Groundwater samples were collected using disposable polyethylene bailers and poured into sample containers provided by the laboratory. The containers were promptly sealed, labeled, and placed into ice chests. The sample information was entered onto a Chain-of-Custody (COC) that accompanied the samples to the laboratory. The analyses were performed by Exygen Research in State College, Pennsylvania for the twelve FC compounds as defined in Subsection 1.1.

Figure 3-1 shows the groundwater monitoring well locations at the facility and Table 3-3 presents a groundwater sampling summary. A copy of the well evacuation/sampling forms is provided in Appendix C.

3.2.3 Soil Boring and Soil Sampling Activities

In addition to soil samples collected for FC analyses during the monitoring well installation, ten soil borings (D5B01 through D5B06 and D9SB01 through D9SB04) were installed on June 20 and 21, 2006 in the D5 and D9 areas. The locations of the soil borings are shown in Figure 3-1 and the rationale for each boring is described in Subsection 3.3. Composite soil samples were collected at specified intervals to boring termination for descriptive logging and analytical testing. The soil was logged by the on-site WESTON geologist noting color, texture, moisture content, and any odors or discoloration. The soils were also screened using an organic vapor meter (OVM) and readings were recorded on the soil boring logs. A copy of the soil boring logs is provided in Appendix B.

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After descriptive logging, soil samples were collected from 0-3 inches bgs, 0.5-5 ft bgs, and every 5-ft interval to boring termination at each location. This procedure is consistent with the subsurface soil boring and sampling conducted during the previous Phase 1 field work, except that the 0-3 inch bgs surface soil sample was added as part of the soil boring sampling. Soil samples were submitted to Exygen Research in State College, Pennsylvania for analyses of the four FC compounds for soil samples collected in June 2006 and the twelve FC compounds for soil samples collected after June.

3.3 ON-SITE AREAS SAMPLING

This section presents the Phase 2 soil and groundwater FC assessment program by area as defined in the Cottage Grove Site FC Data Assessment Report (WESTON, April 2006).

During the Phase 1 FC assessment program, the highest concentrations of FCs were detected in soils and groundwater primarily in on-site areas where waste residues and sludges were disposed. Some of these areas were further evaluated as part of this Phase 2 assessment to better define the vertical and lateral extent of FCs as will be discussed in the following subsections.

Based on the recommendations presented in the Phase 1 FC Data Assessment Report and discussions with MPCA, further evaluation of the following on-site areas was conducted under this Phase 2 FC assessment program:

- D1/D2 Area – Former HF Tar Neutralization Basin/Former Sludge Disposal Area
- D5 Area – Former Solids Burn Pit Area
- D9 Area - Former Sludge Disposal Pit
- Fire Training Area
- Production wells PW-5 and PW-6 (hydraulic capture zone evaluation)

The Phase 2 FC assessment program for these areas included the installation and sampling of soil borings and monitoring wells as summarized in previous subsections. The locations are shown on Figure 3-1.

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3.3.1 D1/D2 Area – Former HF Tar Neutralization Basin/Former Sludge Disposal Area

The D1 Area was constructed as a concrete-lined basin and was used from the mid 1960s to the early 1970s to neutralize hydrofluoric acid (HF) tars with lime. The area was closed, material removed, and filled with local soils in the early 1970s. The D2 Area, located west of and adjacent to the D1 Area, received sludge or dredged material from the wastewater treatment ponds at the east end of the Cottage Grove Site. The site was closed and covered between 1973 and 1975.

Objectives

The objectives of Phase 2 activities at the D1/D2 Area were:

- To assess the presence of FCs in groundwater and soils immediately downgradient of the D1/D2 Area.
- To characterize the potential movement of this groundwater to the Mississippi River.

Groundwater

WESTON installed two groundwater monitoring wells, MW-103 and MW-104, in the unconsolidated deposits, downgradient of the D1/D2 Area. Both groundwater monitoring wells were installed to a depth of 88 ft bgs into the unconsolidated deposits.

Soil

During well installation activities, a total of 12 composite soil samples were collected for analytical testing from the two soil borings (MW-103 and MW-104) using split spoon samplers continuously to approximately 25 ft bgs. Soil samples were collected from 0-3 inches bgs, 0.5-5 ft bgs, and every 5-ft interval to 25 ft bgs at each boring location. The remaining depth of the boring was logged and screened with an organic vapor meter.

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3.3.2 D5 Area – Former Solids Burn Pit Area

The D5 area, west of the current wastewater treatment operations was used for burning organic solids wastes and disposal of inorganic solid waste generated from plant production operations. Skimmings of sludge from the original wastewater pond were also reportedly placed in this area. The area was covered with 3 to 7 feet of fill and there are no visual ground surface indications of the boundaries of this site.

Objectives

The objectives of Phase 2 activities at the D5 Area were:

- To assess the presence of FCs in groundwater immediately downgradient of the D5 Area.
- To characterize the potential movement of this groundwater to the Mississippi River.
- To further characterize the extent of FCs in soils and residues in this area.

Groundwater

Based on the Phase 2 Work Plan, it was planned to install a single monitoring well to approximately 100 ft bgs, downgradient of the D5 Area. However, during well installation on June 19, 2006, a shallow water-bearing zone was encountered at approximately 40 ft bgs. It was decided to install a shallow monitoring well in this zone in addition to the adjacent deeper monitoring well.

As shown in Figure 3-1, the wells are located between existing monitoring wells MW-15 and MW-16. The two new monitoring wells, MW-109 and MW-110, were installed in unconsolidated deposits to depths of 46.5 and 110 ft bgs, respectively.

Soil

During well installation activities, a total of six composite soil samples were collected for analytical testing from the soil boring at MW-109 using split spoon samplers continuously to approximately 25 ft bgs. The remaining depth of the boring was logged

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and screened with an organic vapor meter. Additionally, in accordance with the Phase 2 Work Plan, six soil borings (D5B01 through D5B06) were installed using a Geoprobe in the D5 Area on June 20, 2006 at the locations shown in Figure 3-1. With the exception of D5B05, the soil borings were installed to a depth of approximately 25 ft bgs. Soil boring D5B05 was installed to refusal at a depth of 10 ft bgs. A total of 33 composite soil samples were collected for descriptive logging and analytical testing. Soil samples were collected from 0-3 inches bgs, 0.5-5 ft bgs, and every 5-ft interval to 25 ft bgs at each boring location.

3.3.3 D9 Area – Former Sludge Disposal Pit

The D9 area was identified during the Phase 1 assessment as a former sludge disposal pit and had not been previously assessed or characterized in the field.

Objectives

The objectives of Phase 2 activities at the D9 Area were:

- To assess the presence of FCs in soil and groundwater at and immediately downgradient of the area.
- To assess groundwater flow direction from this area.
- To characterize the potential movement of this groundwater to the Mississippi River, or north toward the ravine leading to the East Cove.

Groundwater

WESTON installed three groundwater monitoring wells (MW-105, MW-106, and MW-107) in unconsolidated deposits at the D9 Area from June 6 through June 9, 2006. Monitoring wells MW-105, MW-106, and MW-107 were installed to depths of 96.5, 95, and 92 ft bgs, respectively.

Soil

During well installation activities, a total of 18 composite soil samples were collected for analytical testing from the soil borings at MW-105, MW-106, and MW-107 to

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approximately 25 ft bgs. The remaining depth of the boring from 25ft to 99 ft bgs were logged and screened using an organic vapor meter. Additionally, based on the Phase 2 Work Plan, four soil borings (D9B01 through D9B04) were installed in the D9 Area at the locations shown in Figure 3-1. The soil borings were installed to a depth of approximately 25 ft bgs. A total of 24 composite soil samples were collected for descriptive logging and analytical testing. After descriptive logging, soil samples were collected from 0-3 inches bgs, 0.5-5 ft bgs, and every 5-ft interval to 25 ft bgs at each boring location.

3.3.4 Wastewater Treatment Plant Area

WESTON installed an additional groundwater monitoring well, MW-108, into the unconsolidated zone and immediately downgradient of the facility's wastewater treatment plant (WWTP) ponds to provide groundwater data in this area, which had not been previously assessed. MW-108 was installed on June 14 and 15, 2006 to a depth of 103.5 ft bgs. Depth to water at MW-108 is approximately 95 ft bgs. Soil samples were collected from the monitoring well boring to a depth of 25 ft.

3.3.5 Fire Training Area

The Fire Training Area (FTA), located on the western portion of the plant was utilized as early as 1968 to test fire fighting foams. The foams are proprietary 3M products that contain FCs. Prior to 1971, much of the residuals and liquids from the fire fighting exercises discharged to area drainages and then to the drainageway located west of this area. In 1972, an underground storage tank was constructed to collect fluids from the fire fighting activities. In 1981, a lined pond was constructed for containing fluids. The accumulated fluids are pumped into a tanker truck and discharged to the on-site wastewater treatment plant.

Objective

The objective of Phase 2 activities at the Fire Training Area was to further assess the presence and extent of FCs in shallow soils in this area.

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Soil

Additional Phase 2 sampling of shallow soils was performed on September 8, 2006 to confirm the Phase 1 results and to further assess current conditions and concentrations in the 0-5 ft bgs interval. Shallow soil samples were collected at five locations in this area as shown in Figure 3-2. The locations as presented in the Phase 2 FC Work Plan were adjusted in the field to position the borings in areas where surface drainage occurs. The samples were collected using a hand auger with soil samples retrieved at 0-1 ft and 2-3 ft bgs intervals. The samples were sent to Exygen Research in State College, Pennsylvania and analyzed for the 12 FC compounds.

3.3.6 Hydraulic Capture Zone Evaluation

A hydraulic capture zone evaluation was performed on two of the plant production wells PW-5 and PW-6 located along the Mississippi River. The production wells extract groundwater moving toward the river.

Objectives

The objectives of conducting a hydraulic capture zone evaluation at production wells PW-5 and PW-6 were:

- To determine the extent of groundwater capture at these wells using water level data collected during a planned maintenance shutdown of production well PW-6.
- To collect water level data for calculation of hydraulic parameters for the aquifer underlying the facility.

Hydraulic Study

From May 2 to May 8, 2006, WESTON conducted a hydraulic study at the Cottage Grove Site to assess the water level response in facility groundwater monitoring wells to the shutdown of one of the on-site production wells, PW-6. In preparation for the planned temporary shutdown of production well PW-6, WESTON placed transducers with data loggers in eight monitoring wells (MW-4, MW-10, MW-11, MW-12, MW-14, PZ-14,

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MW-15, and MW-16) and two production wells (PW-5 and PW-6). The transducers were programmed to record water level elevations at one or five-minute intervals depending on the well's proximity to PW-6 (i.e., closer wells set at one-minute intervals and more distant wells set at five-minute intervals due to anticipated response times). On May 2, 2006, data logging commenced and at 9:00 am on May 4, production well PW-6 was turned off. It remained off for approximately 24 hours until May 5 when it was turned on again. It remained on for approximately 24 hours. At 9:00 am on May 6, PW-6 was turned off and remained off for the rest of the study period which ended May 8 at 1:00 pm. On May 8, the transducers were removed from the wells. It is important to note that during the study period from May 2 to May 8, 2006 production well PW-5, which is relatively close to well PW-6, cycled on and off numerous times in response to plant water demands.

It was found that the water level in MW-14, which is closest to PW-6, did not change in response to shutdown of PW-6. It is suspected that the lack of response is due to a clogged well screen. Thus, the transducer was moved from MW-14 to MW-17.

A similar lack of response was noted at wells MW-4 and MW-12 and it is suspected that the cause is clogged well screens or collapsed wells. As such, 3M plans to evaluate techniques for rehabilitating or, if necessary, replacing wells MW-4, MW-12, and MW-14.

The recovery and drawdown data collected during the hydraulic study were used to estimate the extent of groundwater capture for production wells PW-5 and PW-6. This evaluation consisted of constructing a groundwater elevation contour map for pumping conditions using water levels collected in site monitor wells on May 3, 2006. The pumping rates for production wells PW-5 and PW-6 were approximately 1400 and 530 gallons per minute (gpm), respectively. Groundwater elevation measurements from production wells PW-5 and PW-6 were not used to construct the contour map since head loss across the well screen and gravel pack cause the measured water level in the pumping well to be lower than the water level in the aquifer immediately outside the pumping well. This produces an erroneously low water level elevation which can cause

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capture zones to be overestimated. An appropriate water level elevation to use for production wells for contouring purposes was determined using the Theis analytical equation (Theis, 1935). Hydraulic parameters input into the Theis equation to calculate drawdown in a pumping well given a specific flow rate, were derived from a recent aquifer testing program performed on-site.

A summary of the findings from the hydraulic study is presented in Section 4 of this report. The complete report was submitted to MPCA in November 2006 and is also presented in Appendix A of this Phase 2 Data Assessment Report.

3.3.7 East and West Coves

As shown in Figure 3-3, the East and West Cove areas are surface water features adjacent to the Mississippi River and are located at the eastern and western ends of the Plant property. The East Cove receives regional surface water drainage and discharge water from the two NPDES-permitted discharges (cooling water and waste water treatment). The West Cove receives surface drainage from the Fire Training Area and the contractor storage yard to the east and north. From the west, surface drainage enters the west cove from the municipal sewage treatment plant area. The sewage treatment plant outfall discharges directly to the Mississippi River.

Objectives

The objectives of Phase 2 activities at the East and West Coves were:

- To physically characterize the extent of the coves and sediments within the coves.
- To further characterize the extent of FCs in the surface water and sediment of the coves.

The assessment activities in the east and west coves were performed in September 2006.

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Physical Characterization Activities

3M provided a detailed topographic map of the site including the East and West Coves which were distinguished by topographic contours. The boundaries were visually verified in the field by WESTON personnel and it was decided that the maps accurately reflect the boundaries of the coves. Therefore, additional surveying of the cove boundaries as planned in the Phase 2 FC Work Plan was not necessary.

In accordance with the Phase 2 FC Work Plan, during the sediment sampling program, efforts were made to estimate the thickness of non-native or potentially impacted sediment in each cove. Polycarbonate tubes were pressed into the sediment by hand at the six Phase 2 sampling locations. A visual description of the recovered material was made and the depth of the sediment encountered at each sampling point was recorded. Location coordinates were recorded for each of the six sediment core locations using a handheld global positioning system (GPS) unit.

Sediment and Surface Water Sampling

In addition to coring to visually delineate the spatial extent of sediment deposits described above, subsamples were collected from selected core samples at locations in the West Cove and locations in the East Cove for FC analyses. The sampling locations are shown in Figures 3-4 and 3-5.

Sediment sampling was performed at three locations in the small (approximately one acre) West Cove. Six locations were sampled in the larger (approximately two acres) East Cove.

A sediment core sample was also collected from the sediment bank or delta at the confluence of the East Cove discharge and the Mississippi River.

Sediment cores were collected using polycarbonate tubes with core catchers to minimize loss of material. Sample collection and handling was performed in accordance with the sediment sampling SOP contained in the Phase 2 FC Work Plan. Sampling intervals from cores obtained at each of the selected locations included subsamples from the zero to 6

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inch sediment horizon and the 6 inch horizon above the native alluvial material underlying recent deposits. This was the interval designed to sample non-native deposition material. In instances where sediment thickness was greater than 3 feet, an additional 6 inch subsample was collected from the middle of the sediment column. A subset of the core sampling locations also included subsamples from native alluvium at the bottom of the core based on field conditions and observations of sediment stratigraphy.

Surface water samples were collected from each cove at the inlet and outlet areas to determine whether FC concentrations increase across the coves due to adsorption-desorption mechanisms. At each location, a discrete water sample was collected at the water surface, 20% and 80% of the total depth. At locations where the water depth was less than two feet, a single depth sample (60% depth) was collected.

Sediment and surface water samples were analyzed for the 12 FC compounds at Exygen Research. In addition to the FC analyses, field measurements were taken at each sample location for temperature, pH, dissolved oxygen (DO), conductivity and water velocity.

3.3.8 Mississippi River

The Mississippi River is the main surface water body along the southern boundary of the site. The river receives surface water discharge from both the East and West Coves and groundwater discharge from the eastern part of the plant. Groundwater is being captured in the western part of the plant by the plant production wells (PW-5 and PW-6).

Objectives

The objectives of Phase 2 activities at the Mississippi River were:

- To assess possible groundwater discharge from the plant site through bottom sediments and into the river.
- To further assess the presence or absence of FCs in surface water and sediment in the river at locations upstream, adjacent, and down stream of the Cottage Grove Site and extending downstream to Lake Pepin.

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- To assess the spatial distribution of FCs in surface water across the Mississippi River in the immediate vicinity of the Cottage Grove Site.

The assessment activities in the Mississippi River were performed in September 2006.

3.3.8.1 Porewater

Porewater was identified as part of this assessment program as a means to evaluate possible groundwater discharge at the surface water/groundwater interface at the bottom of the Mississippi River. Porewater is water contained in the pores of river sediment which is believed to represent groundwater discharging upward to the riverbed. Porewater samples are believed to be more representative of FC concentrations at the groundwater/surface water interface than surface water samples due to dilution.

Porewater Sampling

As shown in Figure 3-6, porewater samples were collected at approximately 43 locations in the Mississippi River along the facility shoreline to assess possible groundwater discharge through bottom sediments into the river. The analytical results from these porewater samples are used to characterize the nature of groundwater discharge pathway along the entire facility property adjacent to the river.

As described in Subsection 3.3.6, the pumping of production wells PW-5 and PW-6 intercepts the flow of groundwater into the river. The effect of these pumping wells should be reflected by the porewater results within the capture zone of the wells.

As shown in Figure 3-6, porewater sampling locations include 25 equally spaced stations along a transect approximately 100 feet from and parallel to the shoreline. In addition, six locations at distances of 25 ft, 50 ft, 200 ft, 300 ft, 400 ft, and 500 ft from the shoreline were established along each of three transects oriented perpendicular to the shoreline.

Porewater samples were collected using stainless steel sampling probes with 0.5 feet of 0.005-inch slotted screen and sufficient riser to extend above the surface of the water. The probes were driven approximately one foot into the sediment so that the screen intercepts a depth of 0.5 feet to 1.0 feet below the top of sediment. The probe was purged

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of water using a peristaltic pump. The total volume of water removed was recorded and the station allowed to recharge. Once the probes sufficiently recharged, they were sampled using the peristaltic pump.

Porewater samples were analyzed for the 12 FC compounds by Exygen Research. In addition to the FC analyses, field measurements were taken for temperature, pH, DO, conductivity and velocity at the time of sampling.

3.3.8.2 Surface Water and Sediment

Porewater Sampling Locations

Surface water and sediment samples were co-located with the porewater samples. Surface water sampling was conducted in accordance with the SOP provided in the Phase 2 FC Work Plan with the following modification. At each of the 43 locations, a discrete water sample was collected at 20% and 80% of the total depth using a peristaltic pump for FC analyses. For example, at a sample location where the water depth is 1 foot, samples would be collected at depths of 0.2 ft and 0.8 ft below water surface. A single depth sample (60% depth) was collected if the water depth was less than two feet. In addition to the FC analyses, field measurements were taken for temperature, pH, DO, and conductivity at the time of sampling.

Sediment samples were collected using a stainless steel corer with a polycarbonate sample tube. Discrete sediment samples were collected from the 0-10 cm and 10-20 cm depth intervals at each of the 43 porewater locations. Five locations were selected for sampling deeper sediment samples (i.e., 50-60 cm). Sediment sampling procedures are described in detail in the sediment sampling SOP provided in the Phase 2 FC Work Plan.

Surface water and sediment samples were analyzed for the 12 FC compounds at the Exygen Research Laboratory.

Longitudinal Series Sampling Locations

As shown in Figure 3-7, surface water and sediment samples were collected from the Mississippi River navigational channel starting at a location six miles upstream from the

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facility (river mile [RM] 824) downstream to the headwaters of Lake Pepin (RM 784). These sample locations are representative of an approximately 40-mile section of the Mississippi River. At the farthest downstream sampling area adjacent to RM 784, three locations were sampled across the width of the river to characterize potential effects of sediment deposition in this area at Lake Pepin.

Surface water sampling was conducted in accordance with the SOP provided in the Phase 2 FC Work Plan with the following modification. At each of the 17 locations, a discrete water sample was collected using a peristaltic pump at 20% and 80% of the total depth. These samples were composited into a single sample for FC analyses. Field measurements were taken for temperature, pH, DO, and conductivity at the time of sampling. Water velocity data was also recorded for each sampling depth at each longitudinal sampling location.

A petite ponar grab sample of surface sediment was collected at each of the 17 longitudinal series sampling locations for FC analysis with the exception of four locations at the headwaters of Lake Pepin (south of Red Wing). At these locations (RM 784 and 785a,b and c) sediment cores were collected to a depth of 3 feet into the sediment. Three discrete samples were collected from each core (top, middle and bottom). Surface water and sediment samples were analyzed for the 12 FC compounds by Exygen Research.

Transect Sampling Locations

Surface water and sediment samples were also collected at three transect locations perpendicular to the flow direction across the width of the Mississippi River: upstream of the plant (XS-1), downstream of the East Cove but upstream of the dam at Hastings (XS-2), and downstream of the Hastings dam (XS-3) as shown in Figure 3-8. The transects were aligned perpendicular to flow. Upstream of the Hastings dam, the two transects consisted of five equally spaced sampling locations (a through e) spanning the river at both locations. The river at the downstream location below the dam is more narrow than the upstream locations and sampling was performed at three locations (a through c) along this transect. A total of 13 locations were sampled along the three transects.

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Surface water sampling was conducted in accordance with the SOP provided in the Phase 2 FC Work Plan with the following modification. At each location, a discrete water sample was collected using a peristaltic pump at 20% and 80% of the total depth. At the middle transect (XS-2) an additional sample was collected from the water surface at the five locations. In addition to the FC analyses, field measurements were taken for temperature, pH, DO, and conductivity at the time of sampling. Water velocity data was also recorded for each sampling depth at each transect sampling location.

A petite ponar grab sample of surface sediment was collected at each of the 13 sampling locations for FC analysis. Surface water and sediment samples were analyzed for the 12 FC compounds by Exygen Research.

3.4 MPCA SPLIT SAMPLES

During the Phase 2 Sampling Program in September 2006, the MPCA requested specific samples be split for their analysis. Water sample bottles were filled by WESTON at the same time as the 3M samples. Sediment samples were collected either with a petite ponar sampler or polycarbonate tubes in a sediment coring device. The samples were split in equal volumes and placed in sample jars provided by MPCA. Table 3-4 summarizes the samples and locations split with MPCA.

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g Well

Monitoring Well Location (Phase 2)

N

W E

0 150 300

WESTON

MONITO



Legend:

- Phase 2 Soil Sampling Location
- Previous SB Sampling Location
- Previous SS Sampling Location (Phase 1)

N W E S

0 62.5 125 Feet

Map Source:
U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office;
National Agricultural Imagery Program (NAIP)
Digital Orthorectified Images (DOQ), Minnesota, 2003

WESTON SOLUTIONS

FIGURE 3-2
FIRE TRAINING AREA
SOIL SAMPLING LOCATIONS
COTTAGE GROVE SITE

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3M_MN01483064



Legend:

- West Cove 1 Acre
- WC-1 Phase 1 Sampling Locations
- Surface Water/Sediment Sampling Location
- Sediment Sampling Location
- Surface Water Sampling Location

N W E S

0 100 200 400 Feet

Map Source:
U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office;
National Agricultural Imagery Program (NAIP)
Digital Orthorectified Images (DOQ), Minnesota, 2003

FIGURE 3-4
SAMPLING LOCATIONS
WEST COVE
COTTAGE GROVE SITE

3M_ENV_00003140

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Legend:

- East Cove 2 Acres
- EC-1 Phase 1 Sampling location
- Surface Water/Sediment Sampling Location
- Sediment Sampling Location

N W E S

0 75 150 300 Feet

Map Source:
U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office; National Agricultural Imagery Program (NAIP) Digital Orthorectified Images (DOQ), Minnesota, 2003

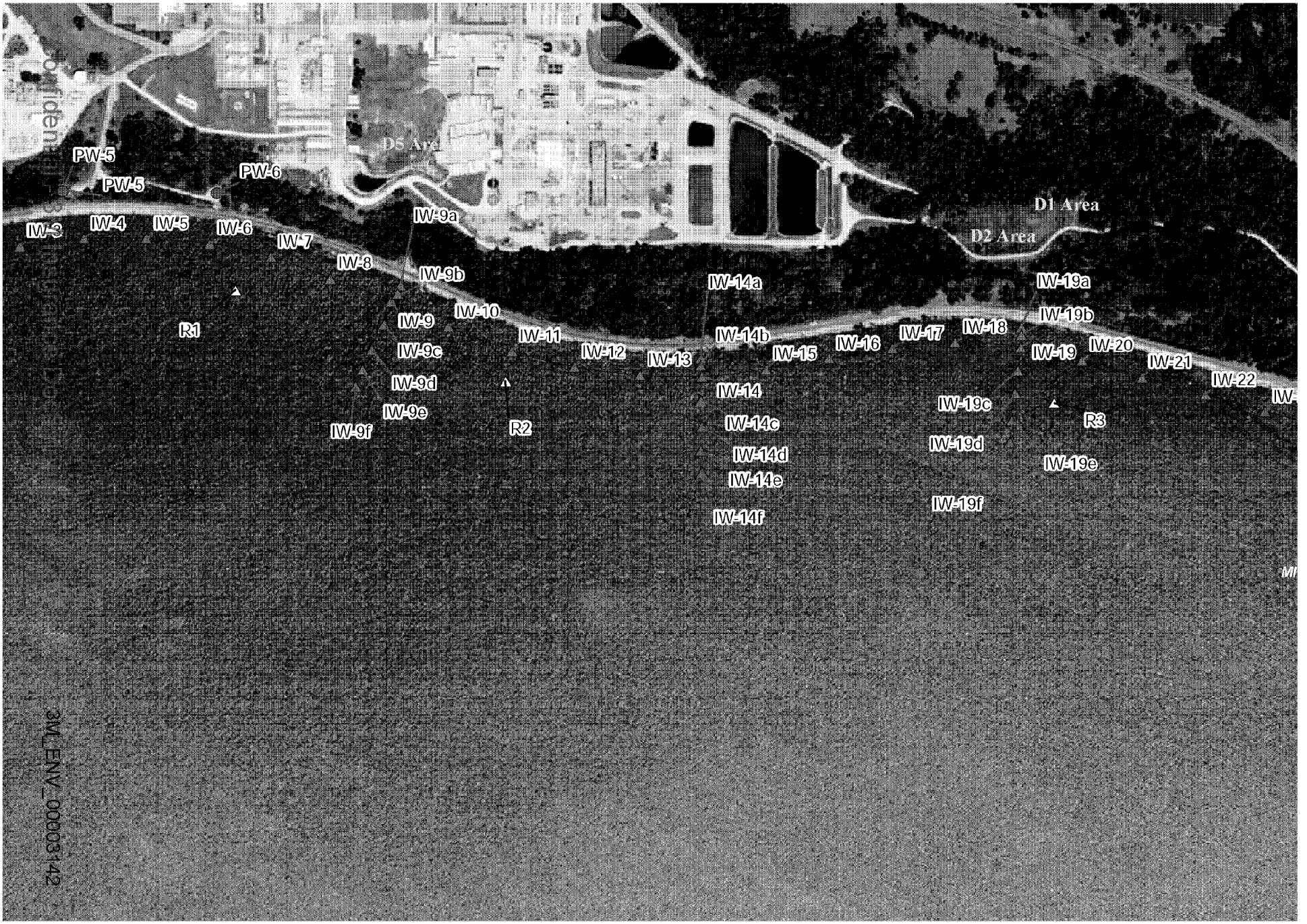
FIGURE 3-5
SAMPLING LOCATIONS
EAST COVE
COTTAGE GROVE SITE

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3M_ENV_00003145

3M_MN01483070

Table 3-1
Total Samples[1] Collected - Phase 1 and Phase 2
Cottage Grove, MN

Areas	Phase	Surface Soil	Subsurface Soil	Groundwater	Sediment	Porewater	Surface Water	Fish
D1 Area	Phase 1	1	44	2				
	Phase 2	0	0	0				
D2 Area	Phase 1	2	34	0				
	Phase 2	2	11	2				
D5 Area	Phase 1	3	9	2				
	Phase 2	7	35	2				
D6 Area	Phase 1	1	2	3				
	Phase 2	0	0	0				
D8 Area	Phase 1	1	6	3				
	Phase 2	0	0	0				
D9 Area	Phase 1	0	0	1				
	Phase 2	7	39	3				
WWTP Area	Phase 1	0	0	0				
	Phase 2	1	6	1				
Fire Training Area	Phase 1	2	19	0				
	Phase 2	7	4	0				
Incinerator Complex	Phase 1	4	4	1				
	Phase 2	0	0	0				
General Plant Area	Phase 1	11	22	16				
	Phase 2	0	0	0				
NE Background Area	Phase 1	1	7	2				
	Phase 2	0	0	0				
NW Background Area	Phase 1	0	6	2				
	Phase 2	0	0	0				
East Cove	Phase 1				7	0	1	0
	Phase 2				21	0	4	0
West Cove	Phase 1				7	0	2	0
	Phase 2				7	0	5	0
Mississippi River	Phase 1				6	0	6	68
	Phase 2				132	43	133	0

[1] Sample counts include duplicate samples collected in the field

Table 3-2

Monitoring Well Construction Details
Cottage Grove Site

Well ID	Reported Well Depth (ft bgs)	Measured Well Depth (ft btoc)	Depth to Water (ft btoc)	Well Diameter (in)	Open Borehole / Screened Interval (ft bgs)	Completed as Open Borehole (O) or Screened (S)
MW-1[a]	200	92.64	67.71	6	NA	O
MW-2[a]	192	92	85.91	6	53-192	O
MW-3	210	196.75	99.4	6	57-210	O
MW-4[a]	200	133.2	108.25	6	75-200	O
MW-5	210	208.7	51.57	6	36-210	O
MW-6[a]	219	103.2	Dry[b]	6	60-219	O
MW-7	146	140.24	55.07	6	51.5-146	O
MW-8	173	172.45	65.45	6	51.5-173	O
MW-9	104	107.95	47.17	4	NA	NA
MW-10	237	241.5	93.73	8	198-237	O
MW-11	200	186.6	102.9	4	180-200	O
MW-12	141	141.03	93.63	4	122-141	S
MW-13	134	134	92.03	4	114-134	S
MW-14	64	59	26.85	4	44-64	S
MW-15	186	186.54	96.08	4	NA	NA
MW-16	140	141.1	93.78	4	NA	NA
MW-17	112	114.36	75.28	4	92-112	S
MW-18	92	93.2	69.07	4	71-91	S
MW-19	120	120	52.33	4	NA	NA
MW-101	100	101.9	94.87	2	90-100	S
MW-102	96	94.67	91.97	2	86-96	S
MW-103	86	86	80.38	2	78-88	S
MW-104	88	88	81.54	2	78-88	S
MW-105	96.5	96.5	89.94	2	86.5-96.5	S
MW-106	95	95	88.6	2	85-95	S
MW-107	91.5	91.5	85.56	2	81.5-91.5	S
MW-108	103.5	103.5	96.88	2	93.5-103.5	S
MW-109	46.5	46.5	43.3	2	36.5-46.5	S
MW-110	110	110	94.86	2	100-110	S
PZ-14	100	187.71	64.26	2	NA	S

[a]Measured depths are significantly shallower than previously recorded total depths suggesting borehole collapse. At MW-6, a sample could not be collected.

[b]Well was dry due to obstruction in borehole.

NA - Not available.

ft bgs – feet below ground surface.

ft btoc – feet below top of casing.

in - inches

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Table 3-3

Groundwater Sampling Summary
Cottage Grove Site

Sampling Location	Well Depth (ft bgs)	Depth to Water (ft toc)	Well Diameter (inches)	Volume Purged (gallons)	Date Sampled
MW-103	86	80.70	2	3.5	9/8/2006
MW-104	88	81.95	2	3	9/8/2006
MW-105	96.5	90.65	2	3.5	9/8/2006
MW-106	95	89.32	2	3	9/8/2006
MW-107	91.5	86.40	2	3	9/8/2006
MW-108	103.5	97.98	2	3	9/7/2006
MW-109	46.5	43.37	2	2	9/7/2006
MW-110	110	96.16	2	7	9/7/2006

ft bgs - feet below ground surface

ft btoc - feet below top of casing

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Table 3-4
Samples Split with MPCA
Cottage Grove Site

Sample Type	Sample Location	Sample Number	Comments
Porewater	IW-6	CGMN-IW-MRIW06	
	IW-9B	CGMN-IW-MRIW09b	
	IW-10	CGMN-IW-MRIW10	
	IW-13	CGMN-IW-MRIW13	
	IW-14B	CGMN-IW-MRIW14b	
	IW-17	CGMN-IW-MRIW17	
	IW-19B	CGMN-IW-MRIW19b	
	IW-20	CGMN-IW-MRIW20	
	IW-25	CGMN-IW-MRIW25	
Porewater Sediment	IW-6	CGMN-SD-MRIW061	0-10 cm
	IW-9B	CGMN-SD-MRIW9b1	0-10 cm
	IW-10	CGMN-SD-MRIW101	0-10 cm
	IW-13	CGMN-SD-MRIW131	0-10 cm
	IW-14B	CGMN-SD-MRIW14b1	0-10 cm
	IW-17	CGMN-SD-MRIW171	0-10 cm
	IW-19B	CGMN-SD-MRIW19b1	0-10 cm
	IW-20	CGMN-SD-MRIW201	0-10 cm
	IW-25	CGMN-SD-MRIW251	0-10 cm
Surface Water Transect	XS-2A	CGMN-SW-MRXS02a0	Water Surface
	XS-2B	CGMN-SW-MRXS02b0	Water Surface
	XS-2C	CGMN-SW-MRXS02c0	Water Surface
	XS-2D	CGMN-SW-MRXS02d0	Water Surface
	XS-2E	CGMN-SW-MRXS02e0	Water Surface
East Cove Sediment	EC-6	CGMN-SD-EC067	top 6" of sed.
	EC-9	CGMN-SD-EC097	top 6" of sed.
	EC-5	CGMN-SD-EC059	bottom 6" of sed.
	EC-10	CGMN-SD-EC109	bottom 6" of sed.
	ECD-1	CGMN-SD-ECD018	bottom 6" of sed.
East Cove Surface Water	EC-04	CGMN-SW-EC040	Water Surface
	EC-11	CGMN-SW-EC110	Water Surface

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3M_MN01483073

4. RESULTS OF THE ASSESSMENT

Throughout this document, references are made to Phase 1 results as necessary to provide a more complete understanding of the assessment data and groundwater pathways. The complete presentation of Phase 1 information is provided in the FC Data Assessment Report, (WESTON, April 2006). A summary of the Phase 1 field activities and results is presented in Subsection 3.1.

The analytical data presented in the following subsections is organized to facilitate a comparison of the data and to be consistent with data presentation in the April 2006 FC Data Assessment Report. In Phase 1, the results of each of the four FCs analytes (PFBS, PFHS, PFOS, and PFOA) were summarized in data tables presented in the text of the Data Assessment Report. Thus, the Phase 2 FC analytical data summary tables presented in the text of this report include PFBS, PFHS, PFOS, and PFOA. PFBA is also included as a recent compound of interest. A complete data summary table including all 12 FC compounds is provided in Appendix D.

In Phase 1, the PFOA and PFOS results were presented on the figures as these were the primary FCs detected in various media sampled. In Phase 2, it was found that PFOA and PFOS continue to be the primary FCs of interest and thus, the figures in this report present PFOA and PFOS data. Again, since PFBA is a recent compound of interest, it is also included. The presentation of results in the text is primarily focused on these same compounds except where further discussion of other FC compounds is warranted.

4.1 SUMMARY OF THE ANALYTICAL DATA QUALITY AND DATA REDUCTION PROCESS

Analytical data for the Phase 2 study was provided following the Good Laboratory Practices (GLP) Protocol P2561. The GLP protocol and the specified analytical methods contain rigorous quality assurance/quality control (QA/QC) provisions including in-phase audits, full documentation, matrix spikes for every sample collected and analyzed, and thorough reviews by the Exygen Quality Assurance Unit (QAU) and external data reviewers. The analytical methods reflect the significant developmental effort that has

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been applied to refine earlier methods to obtain high-quality quantitative analytical data for a suite of fluorochemical compounds at parts per trillion (ppt) limits of quantitation. Where data quality objectives were not met, samples have been re-extracted and reanalyzed by the initial method or an alternate method in an effort to provide quantitative data.

Analytical data for FCs have been reported in Interim Reports from the Exygen laboratory. In instances where quality control (QC) data on matrix spike recoveries associated with a sample result were outside the 70 to 130% range of acceptance (accuracy of ±30%), the data are not reported (NR). The NR designation does not connote either high or low sample concentrations but rather only reflects that analytical conditions did not meet the criteria for field matrix spike recoveries (aqueous samples) or laboratory matrix spikes (solid samples) that would allow the reporting of quantitative data with an assessed accuracy of ±30%. The extent to which data may be absent due to NR designations at locations that are important for the evaluation of remedial alternatives is being evaluated to develop the appropriate cause of action for closing any critical data gaps. Other data reported with non-numerical values include results that are assigned ND because the analyte was not detected at or above the Limit of Quantitation (LOQ).

When water samples were prepared for extraction and analysis, the samples were diluted 1:1 into an organic solvent prior to analysis resulting in dilution by a factor of 2. Because calibration standards were prepared in a pre-mixed water:solvent mixture, calibration standards did not receive the same treatment. As a result, the analytical method target LOQ of 0.025 ng/mL was not attained and the nominal LOQ of 0.050 ng/mL was applied to results from analytical runs that met the method blank QC criteria. In instances where peaks were detected in the method blanks, the blanks were evaluated and the LOQ was determined by the lowest standard and method blank performance that met QC criteria. While LOQs were elevated for certain samples and matrices, data integrity and usability for the intended purpose were not affected.

In addition to each primary sample analysis, a field duplicate (aqueous samples) or laboratory duplicate (solid samples) sample analysis was performed. The primary and

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duplicate results were reduced to a single value in order to simplify reporting. The data reduction process consisted of calculating the average concentration (arithmetic mean) for sets comprised of numeric values. In instances with mixed numeric values and non-numeric values (ND), the numeric values were carried through to represent the media concentrations. It should be noted that the data reduction convention described above is conservative and may result in overestimation of actual concentrations.

4.2 HYDROLOGICAL INTERPRETATION

The purpose of the hydrologic evaluation performed by WESTON at the Cottage Grove Site in May 2006 was to evaluate the area of groundwater capture induced by the pumping of two production wells (PW-05 and PW-06), and calculate aquifer parameters. The area of groundwater capture was estimated by constructing a groundwater elevation contour map using data collected during a period when both production wells were operating.

Six other production wells operate intermittently based on facility water demand. These wells are in the north and northwest part of the site (see Figure 2-4). Although the drawdown effects of these wells has not been evaluated as part of this assessment, groundwater being captured by these wells is upgradient of the manufacturing area and known disposal areas.

The capture zone for PW-05 and PW-06 was interpreted by constructing groundwater flow lines perpendicular to the groundwater elevation contours. The estimated width of capture during periods that production wells PW-05 and PW-06 are both operating is indicated by the flow lines depicted in Figure 4-1. The actual capture zone of these wells will be slightly less since production well PW-05 pumps intermittently and production well PW-06 is shut down periodically for maintenance activities or when the incinerator is not operating. As indicated in Figure 4-1, the area of capture extends east to MW-12 in the D5 Area, and west to a point midway between PW-5 and the West Cove, including the FTA.

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As shown in Figure 4-1, during pumping, the groundwater elevation in the vicinity of the two production wells is several feet below the nominal elevation of the surface water in the Mississippi River. This suggests that the pumping of these two wells induces groundwater beneath the river to flow toward these wells in the immediate area. Despite the proximity of the Mississippi River to the production wells, the riverbed sediments appear to limit the amount of hydraulic communication between surface water and groundwater in this area. Additional data supporting this conclusion was observed in the groundwater elevation data collected from adjacent monitor wells during periods that production well PW-5 was operating. The water level data collected from the adjacent observation wells showed that although a recharge boundary (the river) was encountered during pumping, the water levels in the observation wells did not reach equilibrium and were continuing to decline at the end of the pumping period. This indicates that the leakage rate from the river to the aquifer was less than the discharge rate of the pumping well.

A summary of the computed aquifer parameters using the appropriate analytical methods for site conditions is shown in Table 4-1. As shown in Table 4-1, the geometric mean of the transmissivity values calculated using the Theis drawdown, Cooper-Jacob drawdown, and Theis recovery methods are 15,275 square feet per day (ft^2/day), 17,279 ft^2/day, and 21,228 ft^2/day. These values are indicative of the high permeability of the alluvial sediments that production wells PW-5 and PW-6 are screened within. The geometric mean of the storativity values calculated using the Theis drawdown and Cooper-Jacob methods is 0.0013 and 0.0011, respectively.

Based on this analysis, the pumping at PW-5 and PW-6 is likely capturing groundwater beneath the majority of the central plant area including most of the D5 Area. However, these pumping wells are not capturing groundwater east of MW-12 which is located at the eastern edge of the D5 Area. This capture effectiveness is supported by and consistent with the low detections of FCs in the porewater samples from locations west of MW-12 (see Subsection 4.5.1 and Figures 4-13 to 4-15).

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4.3 ON-SITE AREAS

4.3.1 D1/D2 Area – Former HF Tar Neutralization Basin/Former Sludge Disposal Area

4.3.1.1 Groundwater

Two Phase 2 groundwater monitoring wells (MW-103 and MW-104) were installed and sampled to assess the presence of FCs in groundwater immediately downgradient of the D2 area and to supplement existing Phase 1 groundwater sampling results from monitoring wells MW-101 and MW-102 which are associated with the D1 Area. The Phase 2 well locations in the D2 Area are presented in Figure 3-1. Both Phase 2 wells were installed to a depth of 88 ft bgs in unconsolidated sand and gravel. The average depth to water in the D1/D2 Area is approximately 77 ft bgs. The wells were sampled on September 8, 2006.

The Phase 2 groundwater sampling results at the D1/D2 Areas (as presented in Figure 4-2 and Table 4-2) show PFOA was detected at concentrations of 414 ppb (MW-103) and 619 ppb (MW-104). The higher concentration of 619 ppb was present in MW-104 which is centrally located directly downgradient from the D2 Area.

PFOS analyses of groundwater samples from Phase 2 wells MW-103 and MW-104 indicates the result as NR.

PFBA analyses indicate detected concentrations of 318 ppb (MW-103) and NR (MW-102).

4.3.1.2 Soil

During installation of the two groundwater monitoring wells (MW-103 and MW-104) soil samples were collected and analyzed for the four FC parameters (PFBS, PFHS, PFOS and PFOA) to assess the presence of FCs in soil immediately downgradient of the D2 area and to supplement existing Phase 1 soil sample results collected from soil borings in and around the D1/D2 Area. (PFBA was not analyzed because these samples

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were collected prior to the implementation of the expanded list of analytes.) The Phase 2 soil sample locations are presented in Figure 3-1. Soil samples were collected from Phase 2 monitoring well borings to a depth of 25 feet during the weeks of June 12 and June 19, 2006.

The Phase 2 soil sample results from MW-103 and MW-104, summarized in Table 4-3 and on Figure 4-3, indicate that PFOA was detected at concentrations ranging from 0.321 ppb (0-6 inches, MW-104) to 16.8 ppb (5-10 feet deep, MW-104). At the deepest interval sampled (20-25 feet) the concentration of PFOA is 3.14 ppb at MW-103.

PFOS was detected in soil samples collected from MW-103 and MW-104 at concentrations ranging from 0.247 ppb (15-20 feet, MW-103) to 66.9 ppb (0-6 inches, MW-103). At the deepest interval sampled (20-25 feet) at MW-103, PFOS was not detected. PFOS also was not detected below a depth of 10 feet at MW-104.

PFHS analyses indicate detected concentrations ranging from 0.154 ppb (MW-104, 15-20 feet) to 0.7831 ppb (MW-104, 6 inches to 5 feet interval). PFHS was only detected at the 0-6 inch depth at MW-103 (0.388 ppb) and was not detected below a depth of 20 feet at MW-104.

PFBS was either ND or NR for each of the soil samples collected from MW-103 and MW-104.

4.3.2 D5 Area – Former Solids Burn Pit

4.3.2.1 Groundwater

Two groundwater monitoring wells (MW-109 and MW-110) were installed and sampled to assess the presence of FCs in groundwater downgradient of the D5 Area and to supplement existing Phase 1 groundwater sampling results from monitoring well MW-12. The Phase 2 well locations are presented in Figure 3-1. The Phase 2 wells, MW109 and MW-110, were installed as a shallow and deep well cluster. During the drilling of the deeper well (MW-110) a perched water table was encountered at 36 to 46 feet bgs as a

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result of a silty clay layer which was encountered from 46 to 71 feet bgs. MW-109 was installed to a depth of 46 feet bgs and MW-110 was installed to a depth of 106 feet bgs. Both wells are completed in unconsolidated sand and gravel. The wells were sampled on September 7, 2006.

The Phase 2 groundwater sampling results from MW-109 and MW110 are shown in Figure 4-2 and Table 4-2. PFOA was detected in both wells at concentrations of 136 ppb (MW-110) and 199 ppb (MW-109).

PFOS analyses were NR for MW-109 and 26 ppb for MW-110.

PFBA was detected at a concentration of 23.3 ppb at MW-109 and NR at MW-110.

4.3.2.2 Soil

The Phase 2 soil sample results are comprised of soil samples collected during installation of monitoring wells MW-109, downgradient of the D5 Area and soil borings drilled at 6 locations (SB-D5B01 through SB-D5B06) within the footprint of the D5 Area. Soil samples were collected and analyzed for the four FC parameters (PFBS, PFHS, PFOS and PFOA) to assess the presence of FCs in soil in the vicinity of the D5 Area and to supplement Phase 1 soil sample results collected from soil borings in and around the D5 Area. The Phase 2 soil sample locations are presented in Figure 3-1. The soil results from MW-109 installation are presented on Figure 4-3 and the soil results from the borings are presented on Figure 4-4. Soil samples were collected from the MW-109 well boring and from the six soil borings to a depth of 25 feet with the exception of one location (SB-D5B05) where the boring was terminated at 10 feet due to Geoprobe refusal. The Phase 2 soil sample results are summarized in Table 4-3.

PFOA was detected in the soil samples collected from MW-109 boring downgradient of the D5 Area at concentrations ranging from 1.42 ppb (5-10 feet deep) to 30.7 ppb (20-25 feet). The samples collected from the Phase 2 soil borings in the D5 Area indicated concentrations of PFOA ranging from 0.587 ppb (SBC-D5B05, 0-6 inches) to 200 ppb (SBC-D5B02, 20-25 feet).

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PFOS was detected in the soil samples collected from MW-109 boring downgradient of the D5 Area at concentrations ranging from 9.39 ppb (5-10 feet deep) to 82.2 ppb (0.5-5 feet). The samples collected from the soil borings in the D5 Area indicated concentrations of PFOS ranging from 3.15 ppb (SBC-D5B02, 20-25 feet) to 2,650 ppb (SBC-D5B02, 5-10 feet).

PFHS was detected in the MW-109 boring downgradient of the D5 Area at concentrations ranging from 0.202 ppb (5-10 feet deep) to 1.81 ppb (20-25 feet). The samples collected from the Phase 2 soil borings in D5 Area indicated concentrations of PFHS ranging from 20.1 ppb (SBC-D5B06, 15-20 feet) to 0.215 ppb (SBC-D5B01, 0-6 inches).

PFBS results of samples collected from the MW-109 boring indicated NR for each of the soil samples analyzed. The samples collected from the Phase 2 soil borings in the D5 Area indicated concentrations of PFBS ranging from 0.244 ppb (SBC-D5B02, 15-20 feet) to 1.67 ppb (SBC-D5B06, 5-10 feet).

4.3.3 D9 Area – Former Sludge Disposal Pit

4.3.3.1 Groundwater Sampling Results

Three groundwater monitoring wells (MW-105, MW-106 and MW-107) were installed and sampled to assess the presence of FCs in groundwater in the D9 Area and to supplement existing Phase 1 groundwater sampling results from monitoring well MW-13 which is adjacent to the D9 Area. The Phase 2 well locations are presented in Figure 3-1. The Phase 2 wells; MW-105 (downgradient), MW-106 (in the D9 Area) and MW-107 (upgradient), were installed to depths of 96.5, 95 and 91.5 ft bgs respectively in unconsolidated sand and gravel. The average depth to water in the D9 Area is approximately 85 ft bgs. The wells were sampled on September 8, 2006.

The Phase 2 groundwater sampling results at the D9 Area (MW-105, MW-106 and MW-107) are presented in Table 4-2 and on Figure 4-2.

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PFOA analyses indicate NR for the samples from MW-105 and MW-106. The concentration of PFOA detected in MW-107 is 24.5 ppb.

PFOS analyses indicate NR for the samples from each of the three wells.

PFBA was detected in Phase 2 samples at concentrations of 76.3 ppb, 64.3 ppb and 29.7 ppb at MW-105, MW-106 and MW-107, respectively.

4.3.3.2 Soil Sampling Results

The Phase 2 soil sample results in the D9 Area are comprised of soil samples collected during the installation of three monitoring wells MW-105, MW-106 and MW-107 and four soil borings SB-D9B01, SB-D9B02, SB-D9B03 and SB-D9B04. Soil samples were collected and analyzed for the four FC parameters (PFBS, PFHS, PFOS and PFOA) to assess the presence of FCs in soil in the D9 Area. The Phase 2 sample locations are presented in Figure 3-1. Soil samples were collected from the monitoring well borings and from the soil borings to a depth of 25 feet. The Phase 2 soil sample results are summarized in Table 4-3 and depicted in Figures 4-3 and 4-5.

PFOA was detected in the D9 Area soil samples at concentrations ranging from 0.0620 ppb (SBC-D9B03, 20-25 feet) to 21,800 ppb (SBC-MW106, 20-25 feet). The concentrations detected at MW-106, MW-107, D9B01 and D9B04 range from 13.5 ppb (SBC-MW106, 0-6 inches) to 21,800 ppb (SBC-MW106, 20-25 feet). The sample results from the southeast portion of the D9 Area (SBC-MW-105, SBC-D9B02 and SBC-D9B03) indicated lower concentrations of PFOA ranging from 0.0620 ppb (SBC-D9B03, 20-25 feet) to 205 ppb (SBC-MW105, 5-10 feet).

PFOS was detected in the D9 Area at concentrations ranging from 1.01 ppb (SBC-D9B03, 10-15 feet) to 104,000 ppb (SBC-MW107, 15-20 feet). The concentrations detected at MW-106, MW-107, D9B01 and D9B04 range from 47.6 ppb (SBC-MW106, 0-6 inches) to 104,000 ppb (SBC-MW107, 15-20 feet). The sample results collected from the southeast portion of the D9 Area (MW-105, D9B02 and D9B03) indicated lower

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concentrations of PFOS ranging from 0.672 ppb (SBC-MW105, 20-25 feet) to 318 ppb (SBC-MW105, 5-10 feet).

PFHS was detected in the D9 Area at concentrations ranging from 0.485 ppb (SBC-D9B03 duplicate, 15-20 feet) to 3,470 ppb (SBC-MW106, 20-25 feet). The concentrations detected at MW-106, MW-107, D9B01 and D9B04 range from 1.78 ppb (SBC-MW107, 0-6 inches) to 3,470 ppb (SBC-MW106, 20-25 feet). The sample results from the southeast portion of the D9 Area (MW-105, D9B02 and D9B03) indicated lower concentrations of PFHS ranging from 0.485 ppb (SBC-D9B03 duplicate, 20-25 feet) to 6.05 ppb (SBC-B9B03, 5-10 feet).

PFBS was detected in the D9 Area at concentrations ranging from 0.218 ppb (SBC-D9B03, 20-25 feet) to 139 ppb (SBC-MW106, 20-25 feet).

4.3.4 Wastewater Treatment Plant Area

A Phase 2 monitoring well (MW-108) was installed immediately downgradient of the facility's wastewater treatment plant (WWTP) area to provide soil and groundwater data in this area, which had not previously been assessed. Well MW-108 was installed to a depth of 103.5 ft bgs in unconsolidated deposits. The location of MW-108 is shown on Figure 3-1. The depth to water in MW-108 is approximately 95 ft bgs. The well was sampled on September 8, 2006.

4.3.4.1 Groundwater Sampling Results

The Phase 2 groundwater sampling results downgradient of the WWTP area (MW-108) are shown in Table 4-2 and on Figure 4-2.

PFOA and PFOS analyses indicate NR for the sample from MW-108.

PFBA was detected at a concentration of 219 ppb.

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4.3.4.2 Soil Sampling Results

The Phase 2 soil sample results in the WWTP area are comprised of soil samples collected during the installation MW-108. Soil samples were collected and analyzed for the four FC parameters (PFBS, PFHS, PFOS and PFOA) to assess the presence of FCs in soil in the WWTP area. Soil samples were collected from the monitoring well boring to a depth of 25 ft bgs.

The Phase 2 soil sample results, as summarized in Table 4-3, indicate that FCs were detected at MW-108 at concentrations ranging from 0.295 ppb (PFBS, 20-25 feet) to 230 ppb (PFOS, 5-10 feet). At the lowest interval sampled (20-25 feet), PFOA and PFOS were detected at concentrations of 6.04 ppb and 11.3 ppb respectively. PFHS was detected at the 20-25 feet interval at a concentration of 0.314 ppb. PFBS was not detected below the 15-20 foot interval. The Phase 2 soil analytical results are presented on Figure 4-3.

4.3.5 Fire Training Area

4.3.5.1 Soil Sampling Results

The Phase 2 soil sample results in the Fire Training Area (FTA) are comprised of soil samples collected from 6 hand auger locations (FTA-04 through FTA-09). Samples were collected from 0-1 ft and 2-3 ft at each location with the exception of FTA07 where auger refusal was encountered and a sample could only be collected from the 0-1 ft. Soil samples were collected and analyzed for the twelve FC parameters. The FTA sample locations are presented in Figure 3-2. The Phase 2 soil samples as summarized in Table 4-4 and Figure 4-6 indicate that FCs were detected at concentrations ranging from 0.306 ppb (PFBA, FTA08, 0-1 ft) to 2,948 ppb (PFOS, FTA06, 2-3 feet).

The Phase 1 soil sample results indicate a PFOS concentration of 1,820 ppb at SS FTA02, 0-6" depth, located in the drainage swale south of the FTA. This swale receives surface water drainage from the FTA and surrounding contractor yard area. After the collection of the Phase 1 samples, this area was re-graded and a retention basin was

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constructed to improve storm water management in the area. The storm water overflow structure was constructed with rip rap at the location of the SS FTA02 sample. The Phase 2 samples collected from this location (FTA08) indicated a PFOS concentration of 145 ppb at the 2-3 ft depth. A second sample was collected from the bottom of the retention basin (FTA07) with a similar PFOS result of 144 ppb at the 0-1 ft bgs depth.

A PFOS concentration of 2,948 ppb at FTA06 (2-3 ft bgs) was detected in the FTA during Phase 2. This sample was collected from a drainage swale just south of the holding pond. During Phase 1, PFOS concentrations of 378 ppb and 863 ppb were found in the shallow interval of 0-5 ft at borings FTA02 and FTA03 respectively, with lower concentrations (ranging from 1.35 ppb to 82.2 ppb) at lower depth intervals. The area around FTA03 has also been substantially reworked with the construction of the retention basin.

Phase 2 locations FTA04 and FTA05 were also located south of the holding pond in grassy swales that direct surface runoff from the FTA to the retention basin. Soil sample results indicate PFOS concentrations in this area are consistent with the Phase 1 results collected from FTA02 and FTA03. PFOS concentrations from the 0-1 ft interval at FTA04 and FTA05 are 1,026 ppb and 458 ppb respectively. PFOS concentrations at the 2-3 ft bgs interval were NR. The other FC compounds, i.e., PFOA, PFHS and PFBA, indicate lower concentrations at the 2-3 ft interval showing a decrease in concentration with depth.

A Phase 2 soil sample (FTA09) was collected at the edge of a concrete pad which is currently used for fire training within the FTA. A sample was collected from the 0-1 ft depth. A deeper sample could not be obtained with the hand auger due to large gravel that was encountered. PFOS was detected at a concentration of 747 ppb. Other FC compounds were detected at lower concentrations as indicated on Table 4-4.

4.4 EAST AND WEST COVES

Activities associated with the Phase 2 FC Assessment conducted in the East and West Coves of the Cottage Grove Site occurred on September 13, 14, and 20, 2006. These

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activities were performed to address data gaps identified during the Phase 1 program in the coves and consisted of physical characterization, surface water sampling, and sediment sampling. Results from the Phase 1 program are summarized in Subsection 3.1.

4.4.1 East Cove

Phase 2 assessment activities were conducted in the East Cove on September 13 and 14, 2006. Adjustments and/or clarifications to the field procedures implemented during characterization and sampling activities in the East Cove were as follows:

- A topographical map (Figure 4-7) depicting the boundaries of the East Cove was provided by 3M's civil engineering department. This map accurately reflects the East Cove, as verified in the field by WESTON personnel; therefore, the surface area for the cove was calculated from this map and no additional survey work was performed.
- In accordance with the approved Work Plan, surface water samples were collected at the two locations (East Cove (EC) locations EC-4 and EC-11), identified in Figure 4-8, from the water surface and the 0.6 depth interval, rather than the water surface and the 0.2 and 0.8 depth intervals, due to the shallow water depth (measured to be less than 2 feet deep).
- In accordance with the approved Work Plan, sediment samples were collected from three distinct intervals (top, bottom, and mid core thickness) at six locations (EC-5 through EC-10), identified in Figure 4-9, within the cove. In addition, sediment samples were collected from one location (ECD-1) in a sediment deposit outside the cove footprint. Due to the shallow sediment thickness (i.e. less than 3 feet thick), samples were collected from only the top and bottom intervals.

The depth of the native alluvium could not be determined based on the core samples collected at all six locations within the East Cove footprint; therefore, samples representing the bottom interval were collected from within a distinct sediment stratigraphy observed in the field. This sampling interval deviated slightly from the bottom sediment sampling interval identified in the Work Plan.

4.4.1.1 Physical Characterization

As depicted in Figures 3-3 and 4-7, the East Cove footprint is a 2 acre area that serves as the termination point for a drainageway located to the east of the Cottage Grove Site. It

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should be noted that this footprint varies subject to influxes of surface water and groundwater into the East Cove; therefore this area is approximate. The cove and the associated drainageway are located in a ravine surrounded by a densely wooded area. The drainageway originates from Ravine Lake north of U.S. Highway 61, and follows a southerly direction until it approaches the plant operations area where it receives the NPDES-permitted discharge from the plant's wastewater treatment and cooling water system. This discharge water comprises most of the flow into the East Cove except during periods of heavy rainfall when surface runoff enters the ravine upgradient of the outfall. The drainageway flows into the northwest portion of the East Cove, where it continues a distinct southerly flow line to the southwest portion of the cove. The outlet of the East Cove, located in its southwest corner, then drains under a railroad trestle into the Mississippi River directly downstream of the Cottage Grove Site.

Surface Water Observations

As part of the Phase 2 assessment activities, surface water sampling was conducted from a total of two locations, as depicted in Figure 4-8. Location EC-4 was positioned mid-channel in the inlet and upstream of the East Cove, while EC-11 was positioned mid-channel in the outlet to the Mississippi River. As previously mentioned, water depth at these sampling locations was observed to be shallow, measuring 1.17 ft at inlet location EC-4 and 0.67 ft at outlet location EC-11. Surface water samples were collected at the water surface and at the 0.6 depth interval at both locations.

Water quality in the East Cove was observed to be clear and colorless, with a steady rate of surface water flow occurring from the drainageway in a southerly direction towards the cove outlet. Measurements of the water velocity collected during the Phase 2 activities, as depicted in Figure 4-7, indicated that surface water flowed from the drainageway into the East Cove at a rate of approximately 2.7 feet per second (ft/sec). This velocity was observed to decrease to a rate of approximately 1.1 ft/sec at the cove's outlet into the Mississippi River.

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Sediment Observations

As part of the Phase 2 assessment activities, sediment sampling was conducted from a total of six locations (EC-5 through EC-10) within the East Cove footprint and one location (ECD-01) from a sediment deposit immediately outside the East Cove discharge, as depicted in Figure 4-9. The six East Cove sampling locations were positioned as identified below:

- EC-5: northwest portion of the cove at inlet adjacent to the flow line
- EC-6 and EC-7: transect across the northeast portion of the cove
- EC-8: southwest portion of the cove above outlet and adjacent to flow line
- EC-9 and EC-10: transect across the southeast portion of the cove

In addition to the six sampling points, four other locations were probed with the clear polycarbonate tubes for visual observation and logging:

- EC-5W
- EC-U1
- EC-U2
- EC-U3

Sediment samples were collected from each of the six East Cove locations representing the top, mid, and bottom intervals of the observed sediment thickness. While the top interval at each location represented a consistent depth interval (0 to 6 inches below the top of sediment), the mid and bottom intervals varied in depths. Observations of the sediment cores indicated the presence of three distinct sediment layers as follows:

- Top: tan/brown to black, sand to silty sand, tight consistency.
- Mid: dark grey to black (non-native), fine silty layer with some clay content, light/loose consistency. Note – this layer ranged from 2 inches to 2 feet in thickness dependent upon sample location.
- Bottom: black (non-native) to grey, sand and silty clay, mottled, soft to tight consistency with depth.

A petroleum-like odor and discoloration was noted which primarily occurred in the mid and bottom sampling intervals at each location with the exception of locations EC-U2 and EC-U3.

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As noted above, the mid layer of the sediment cores exhibited loose, semi-solid consistency. This layer varied in depth and thickness at each sample location, appearing to have been deposited in pockets throughout the cove footprint. Up to 2-foot thick deposits of this material were observed in the mid layer of the core samples collected from the East Cove sediment.

Location ECD-01 was positioned directly downstream of the outlet in a sediment deposit along the north bank of the Mississippi River. The sediment core was only able to be advanced to a total depth of 14 inches from the top of sediment. Sediment collected at this location consisted of one layer, a tan and black sand, throughout the core. Sediment samples were collected from this location representing the top and bottom intervals of the observed sediment thickness.

4.4.1.2 Surface Water Sampling Results

The FC results for the surface water samples collected from the East Cove are summarized in Table 4-5. The FC analytical results summarized in Table 4-5 includes: PFOA, PFOS, PFBS, PFHS, and PFBA. A complete data summary table including all 12 FC compounds is provided in Appendix D.

Figure 4-8 depicts the PFOA, PFOS and PFBA surface water concentrations.

No significant concentration differences were found for detected FCs in samples collected from the inlet location EC-4 and the outlet location EC-11. In addition, no significant concentration differences were found for detected FCs in samples collected from the water surface and the 0.6 depth interval. The following is a summary of the range of average concentrations for the five key compounds:

- PFBS: 9.11 to 9.69 ppb
- PFHS: 4.03 to 4.58 ppb
- PFOS: 1.15 to 3.13 ppb
- PFOA: 2.21 to 2.79 ppb
- PFBA: NR

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Due to laboratory QC issues, the analytical results for PFBA were NR for all surface water samples collected from locations EC-4 and EC-11. An additional FC compound detected in the surface water samples at notable average concentrations was PFPeA, which ranged from 9.32 to 9.75 ppb.

4.4.1.3 Sediment Sampling Results

The FC results for the sediment samples collected from the East Cove are summarized in Table 4-6.

The FC analytical results summarized in Table 4-6 includes: PFOA, PFOS, PFBS, PFHS and PFBA. A complete data summary table including all 12 FC compounds is provided in Appendix D.

Figure 4-9 depicts the PFOA, PFOS and PFBA concentrations.

The following is a summary of the range of average concentrations for the five key compounds for the top, mid, and bottom sediment layers sampled within the footprint of the East Cove (EC-5 through EC-10):

	Interval	Within East Cove
PFOS:	top layer:	40 to 1,145 ppb
	mid layer:	1,985 to 65,450 ppb
	bottom layer:	2,850 to 9,150 ppb
PFOA:	top layer:	7.90 to 88.6 ppb
	mid layer:	31.2 to 996 ppb
	bottom layer:	0.764 to 1845 ppb
PFBA:	top layer:	16.3 to 24.8 ppb
	mid layer:	6.05 to 94.6 ppb
	bottom layer:	ND to 30.8 ppb
PFHS:	top layer:	1.13 to 7.87 ppb
	mid layer:	3.24 to 126 ppb
	bottom layer:	ND to 51.6 ppb
PFBS:	top layer:	2.29 to 18.4 ppb
	mid layer:	0.828 to 9.14 ppb
	bottom layer:	ND to 2.03 ppb

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In the top sediment layer, the highest concentrations of FCs were detected at locations EC-8, EC-9, and EC-10 in the southern portion of the East Cove. The lowest concentrations of FCs in the top sediment layer were detected at locations EC-5 and EC-6, in the northwest portion of the cove. An exception to this is location EC-7, in the northeast corner of the cove, which exhibited the lowest PFOA concentration and highest PFOS concentration detected in the top sediment layer.

In the mid sediment layer, the highest concentrations of FCs were detected at locations EC-5 and EC-8, in the western portion of the East Cove, and EC-10, in the southeast corner of the East Cove. The lowest concentrations of FCs in the mid sediment layer were all detected at location EC-7, in the northeast corner of the cove.

In the bottom sediment layer, the highest concentrations of FCs were detected at locations EC-5, EC-8, and EC-9 in the western portion of the East Cove. The lowest concentrations of FCs in the bottom sediment layer were detected at location EC-7 and EC-10, in the eastern portion of the cove. An exception to this is a ND result for PFBS at location EC-5.

It should be noted that the sediment thickness collected from location ECD-11 measured only 14 inches. It consisted of material similar to the top sediment layer observed in the East Cove. The following is a summary of average concentrations for the five FC compounds for the top and bottom sediment samples collected directly downstream the East Cove outlet (ECD-11):

	Interval	Outside East Cove (ECD-11)
PFOS:	top sample:	NR
	bottom sample:	63.6 ppb
PFOA:	top sample:	26.5 ppb
	bottom sample:	11.3 ppb
PFBA:	top sample:	15.4 ppb
	bottom sample:	7.04 ppb
PFHS:	top sample:	1.79 ppb
	bottom sample:	1.11 ppb
PFBS:	top sample:	2.21 ppb
	bottom sample:	0.827 ppb

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In the top and bottom sediment samples of location ECD-11, FC concentrations were either comparable or lower than those detected within the East Cove footprint. Due to laboratory QC issues, the analytical results for PFOS were NR for the top sediment sample collected at location ECD-11.

4.4.2 West Cove

4.4.2.1 Physical Description

The topography in the area of the West Cove and the surveyed boundaries are presented in Figure 4-10. The West Cove is approximately one acre. Water flows intermittently into the cove from surface drainage from the Cottage Grove plant from the north and east and from the municipal wastewater treatment plant to the west. Water discharges through a concrete culvert beneath the railroad tracks at the southeast corner of the cove. At the time of sampling there was no noticeable flow of water into the cove, however water was discharging through the culvert at approximately 0.5 ft/sec. (measured at surface water sampling location WC08). The water level elevation in the cove is indicative of basal groundwater flow. Except during periods of heavy rainfall the water in the cove is still, with heavy algal growth in the summer. Water depths in the cove range from approximately 3 feet at southern edge (WC08) to less than 1 foot to the north (WC04).

During sediment sample collection visual descriptions of sediment were recorded at each location using clear polycarbonate tubes. The sediments throughout the cove are very soft and loose and are represented by three horizons. Black organic rich silt is present ranging in thickness from 6 to 12 inches. A layer of light to dark gray sticky clay underlies the silt layer ranging in thickness from 16 to 19 inches. Beneath the clay layer is a dark brown to black clayey silt layer. This silt layer was encountered at location WC06 at 22 to 30 inches below the surface of the sediment. The total thickness of this silt layer could not be determined with the polycarbonate tubes.

Based on the descriptions of the sediment cores at the sampling locations, the sediments in the West Cove appear to be native sediments and do not exhibit any characteristics representative of waste material (i.e., ash, tars, odors or sheen).

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4.4.2.2 Surface Water Sampling Results

Surface water samples were collected from two locations at the West Cove. One location, WC-4, is in the northern end of the cove (upgradient) and the other location, WC-8, is at the southeastern corner where the water from the West Cove discharges beneath the railroad to the Mississippi River. At WC-4, samples were collected at the water surface and 0.5 feet deep. The samples from WC-8 were collected at the water surface, 0.5 ft and 2 ft deep, as defined in the Work Plan. The results are summarized in Table 4-7 and Figure 4-11.

The FC analysis from WC-4 indicates that PFOS concentrations of 1.03 ppb (water surface) and 1.7 ppb PFOS (0.5 ft) were detected. PFBA was detected at a concentration of 0.325 ppb (water surface) and NR (0.5 ft). PFOA was detected at concentrations of 0.240 ppb (water surface) and 0.284 ppb (0.5 ft). The Phase 1 surface water sample (WC-1) indicated PFOS at a concentration of 1.27 ppb and PFOA at 0.694 ppb.

At location WC-8, PFBA was detected at 1.01 ppb (0.5 ft) 0.803 ppb (2 ft). The water surface sample was NR. PFOS was detected at concentrations of 0.241 ppb (water surface), 0.227 ppb (0.5 ft) and NR at 2 feet.

PFOS was detected at WC-8 with concentrations of 0.241 ppb (water surface) and 0.227 ppb (0.5 ft).

4.4.2.3 Sediment Sampling Results

The West Cove sediment sampling results indicate the detection of FCs at each of the 3 Phase 2 sampling locations. The results are summarized in Table 4-8. Figure 4-12 presents the sample locations and analytical results of three FC compounds (PFOS, PFOA and PFBA) which were detected at higher concentrations than the other FC results. These FC detections range from 4.5 ppb of PFBA at location WC05 (0-6 inch depth) to 137 ppb of PFOS at location WC07 (12-18 inch depth). With the exception of PFOS, the results of the other FC compounds detected are consistent with depth. PFOS concentrations detected at each of the 3 sample locations are slightly higher in the

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subsurface sample compared to the surficial sample (0-6 inch sample depth). At locations WC05 and WC06 the subsurface sample was collected at a depth of 6-12 inches. The subsurface sample at WC07 was collected at a depth of 12-18 inches. The PFOS concentration at the 12-18 inch depth was 137 ppb which is consistent with the 6-12 inch depth interval at location WC05 (126 ppb/108 ppb duplicate) and WC06 (133 ppb). PFOA concentrations range from 11.2 ppb at location WC06 (0-6 inches) to 15.9 ppb at location WC07 (0-6 inches).

4.5 MISSISSIPPI RIVER SAMPLING RESULTS

The Mississippi River FC assessment is an extensive sampling program comprised of sample collection over approximately 40 miles of the river at locations upstream, adjacent to and down stream of the Cottage Grove Site. The types of samples collected are described below:

Porewater: Samples were collected (using a screened well point inserted 6-12 inches into the sediment) to assess possible groundwater discharge from the facility through bottom sediments and into the river. In addition to the porewater samples, sediment and surface water samples were collected at each of these locations. 43 locations were sampled.

Transects: Surface water and sediment samples were collected to assess the spatial distribution of FCs along three transects across the river in the immediate vicinity of the facility. 13 locations were sampled.

Longitudinal: Surface water and sediment samples (referred to as longitudinal samples) were also collected to assess the presence or absence of FCs in the river at locations upstream, adjacent and downstream of the facility to Lake Pepin. 17 locations were sampled.

During the Phase 1 assessment, surface water and sediment samples were collected and analyzed from six locations in the Mississippi River. Porewater samples were not

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collected during the Phase 1 assessment. The Phase 1 samples were analyzed for four FC parameters.

All Phase 2 Mississippi River samples were analyzed for the 12 FC parameters at Exygen Laboratories.

4.5.1 Porewater Locations

4.5.1.1 Porewater Sampling Results

The results of the porewater sampling indicate that FCs were detected at a number of near shore locations in the vicinity of the Cottage Grove Site. The porewater sampling locations are presented in Figure 3-6. A summary of the analytical results are presented in Table 4-9. The results of the analyses for PFOS, PFOA and PFBA are presented in Figures 4-13 to 4-15.

The higher concentrations of these FCs were detected in three specific areas of the river. The IW-14 transect (WWTP area), the IW-19 transect (D1/D2 area) and IW-23 to IW-25 (East Cove area)

PFOS: A PFOS concentration of 206 ppb was detected at IW-25 located just downstream of the mouth of the East Cove (Figure 4-13). Lower concentrations of PFOS were also detected upstream of the mouth of the Cove at IW-23 (15 ppb) and IW-22 (2.4 ppb). In the area of IW-19, off-shore from the D1/D2 area, the higher concentrations of PFOS were detected closest to the shore at IW-19a (47 ppb) and IW-19b (53.1 ppb). IW-19 was NR. Along the IW-19 transect perpendicular to the shoreline; PFOS was detected at a concentration of 1.71 ppb at IW-19f, (500 feet from the shore). In the area of IW-14, off-shore from the WWTP, the higher concentrations of PFOS were detected at IW-14a (31.3 ppb), IW-14b (12.2 ppb) and IW-14 (12.4 ppb). A concentration of 0.0522 ppb was detected at IW-14e. PFOS was not detected or was NR at the other locations along the IW-14 transect further from shore.

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Lower concentrations of PFOS were detected along the IW-9 transect where the highest concentration of 2.69 ppb was detected closest to shore at IW-9a. Detections at other locations along the IW-9 transect ranged from 0.0278 ppb (IW-9e) to 1.09 ppb (IW-9).

PFOS was also detected at low concentrations at and down stream of the West Cove at locations IW-1 to IW-8 ranging in concentration from 0.0270 ppb (IW-8) to 0.652 ppb (IW-2).

PFOA: PFOA was detected in porewater samples collected from IW-24 (758 ppb), located up stream of the mouth of the East Cove and from IW-14a (699 ppb) near the WWTP (Figure 4-14). PFOA was also detected near the East Cove at down stream location IW-25 (129 ppb) and upstream of the mouth of the Cove at IW-23 (78.6 ppb). In the area of IW-19, near the D1/D2 area, the higher concentrations of PFOA were detected closest to the shore at IW-19b (118 ppb), IW-19 (28.9 ppb) and IW-19c (34.3 ppb). At locations farther from shore along the IW-19 transect, concentrations ranged from 0.184 ppb (IW-19d) to 6.84 ppb (IW-19f). PFOA was ND at IW-19e.

In the area of IW-14, near the WWTP, the higher concentrations of PFOA were detected closer to shore at IW-14a (699 ppb), IW-14b (436 ppb), IW-14 (300 ppb) and IW-14c (12.9 ppb). PFOS was not detected at the other locations along the IW-14 transect beyond IW-14c (200 feet from shore). PFOA was also detected at locations east and west of the IW-14 transect at IW-15 (12.2 ppb) and IW-13 (48.5 ppb).

At the IW-9 transect, PFOA was detected at lower concentrations ranging from 0.0541 ppb (IW-9f) to 21.5 (IW-9a). PFOA was ND at IW-9d and NR at IW-9e.

PFOA was also detected at low concentrations near the West Cove and Fire Training Area at locations IW-1 through IW-8. Concentrations in this area range from 0.0327 ppb (IW-5) to 0.120 ppb (IW-3).

PFBA: PFBA was detected in the porewater samples collected from three general areas: The East Cove area (IW-23 to IW-25); near the D1/D2 area (IW-19) and near the WWTP area (IW-14) as shown on Figure 4-15. Concentrations near the East Cove range from 157 ppb (IW-24) upstream of the mouth of the East Cove to 139 ppb (IW-23), also

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upstream. The location downstream of the East Cove (IW-25) indicated a concentration of 23.1 ppb.

Samples collected from the IW-19 transect near the D1/D2 area indicated PFBA concentrations ranging from 172 ppb (IW-19a) 25 feet from shore to 118 ppb (IW-19f), 500 feet from shore. Samples collected along the IW-19 transect closer to shore, at distances of 400 feet (IW-19e) and 300 feet (IW-19d), indicated lesser concentrations (0.108 ppb and 1.40 ppb respectively) of PFBA than the sample collected 500 feet from shore (IW-19f).

In the area of IW-14, near the WWTP, the higher concentrations of PFBA were detected closer to shore at IW-14a (935 ppb), IW-14b (695 ppb), IW-14 (281 ppb) and IW-14c (73.1 ppb). PFBA was detected at lower concentrations (0.178 to 0.282 ppb) at the other locations along the IW-14 transect beyond IW-14c (200 feet from shore). PFBA was also detected at locations east and west of the IW-14 transect at IW-15 (81.1 ppb) and IW-13 (183 ppb).

At the IW-9 transect PFBA was detected at lower concentrations ranging from 0.0898 (IW-9e) to 5.01 ppb (IW-9).

PFBA was also detected at low concentrations near the West Cove and Fire Training Area at locations IW-3 (0.0979 ppb), IW-5 (0.135 ppb) and IW-6 (0.146 ppb). In this area, PFBA was ND at IW-1, IW-7, and IW-8 and was NR at IW-2 and IW-4.

4.5.1.2 Sediment Sampling Results

Sediment samples were collected at each of the porewater sampling locations (Figure 3-6). The samples were collected at various depths as defined in the Work Plan. At most of the locations the sampled intervals were 0-4 inches and 4-8 inches. A third interval was collected at five locations to a maximum depth of 24 inches. A summary of the sediment analytical results are presented in Table 4-10. The results of the sediment analyses for PFOS, PFOA and PFBA are presented in Figures 4-16 to 4-18.

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PFOS: PFOS concentrations were detected at each sampling location from at least one depth interval at concentrations ranging from 0.230 ppb (IW-4, 0-4") to 166 ppb (IW-25, 4-8") as presented on Figure 4-16. The areas where PFOS concentrations in sediment samples were detected generally correlate with the detection of PFOS in the porewater samples.

The highest sediment concentration detected was 166 ppb (IW-25, 4-8") located at the mouth of the East Cove. The porewater sample collected at this location detected PFOS at a concentration of 206 ppb. Sediment samples collected from the other locations near the East Cove detected PFOS concentrations ranging from 7.91 ppb (IW-22, 4-8") to 59.4 ppb (IW-23, 4-8"). A deeper sample was collected in this area at IW-22 from 19.5 to 23.5". A PFOS concentration of 29.1 ppb was detected.

At the IW-19 transect PFOS was detected at IW-19a at concentrations of 79 ppb at 4-8" and 44.3 ppb at 0-4". At IW-19b, PFOS was detected at 34.7 ppb at 4-8" and 6.86 ppb at 0-4". Lower concentrations were detected at distances farther away from the shore. PFOS was detected in IW-19f, 500 feet from the shore, at a concentration of 1.42 ppb (0-4") and 0.937 ppb (4-8")

Similar trends are present at the IW-14 and IW-9 transect locations where higher concentrations are present near the shore and decrease with distance away from the shore. The highest concentration at the IW-14 transect is 74.5 ppb at IW-14a, 0-4" which is 25 feet from the shore. At the IW-9 transect the highest concentration was detected at IW-9a (27 ppb, 0-4") which is also 25 feet from the shore.

PFOA: The areas where PFOA concentrations in sediment samples were detected generally correlate with the detection of PFOA in the porewater samples.

The highest concentration of PFOA in sediment (Figure 4-17) was detected at 341 ppb (IW-14b, 4-8"). The porewater sample from this location indicated a PFOA concentration of 436 ppb.

Samples collected from the locations near the East Cove detected PFOA concentrations ranging from 3.1 ppb (IW-23, 4-8") to 130 ppb (IW-25, 4-8").

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At the IW-19 transect the highest concentration of PFOA was detected at IW-19f located 500 feet from shore at a concentration of 42.7 ppb at 4-8".

At the IW-14 and IW-9 transect locations higher concentrations are present near the shore and decrease with distance away from the shore. The highest concentration at the IW-14 transect is 341 ppb IW-14b, 4-8" which is 50 feet from the shore. At the IW-9 transect the highest concentration was detected at IW-9a (12 ppb, 4-8") which is 25 feet from the shore.

PFBA: The areas where PFBA concentrations in sediment samples were detected also generally correlate with the detection of PFBA in the porewater samples.

The highest concentration of PFBA in sediment was detected at a concentration of 264 ppb (IW-14b, 4-8") (Figure 4-18). The porewater sample from this location indicated a PFBA concentration of 695 ppb.

Samples collected from the locations near the East Cove detected PFBA concentrations ranging from 0.345 ppb (IW-24, 16-20") to 53.4 ppb (IW-23, 4-8"). The concentration at IW-25 at the mouth of the cove is 35.3 ppb (4-8"). Porewater sample results from IW-23, IW-24 and IW-25 indicated PFBA concentrations of 139, 157 and 23.1 ppb respectively.

At the IW-19 transect the highest concentration of PFBA was detected at IW-19a located 25 feet from shore at a concentration of 104 ppb at 4-8". PFBA was detected in the 0-4" sample at concentration of 40.9 ppb. Concentrations of PFBA decrease from this point away from shore until the 500 ft sample location (IW-19f) where the second highest PFBA concentration was detected in the 4-8" sample at a concentration of 70.1 ppb. PFBA was detected in the 0-4" sample at a concentration of 20.4 ppb. The porewater sample results also exhibit a similar trend where PFBA concentrations decrease at distances away from shore up to the 500 ft sample (IW-19f) where PFOA was detected at a concentration of 118 ppb.

At the IW-14 transect the highest PFBA concentration (264 ppb, 4-8") was detected at IW-14b, located 50 feet from shore. At the IW-14c location (200 ft from shore) concentrations of 64.5 and 87.8 ppb were detected at the 0-4" and 4-8" sample intervals

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respectively. However, from IW-14d (300 ft from shore) to IW-14f (500 ft from shore) PFBA was not detected. This trend in PFBA detection in sediment is consistent with the porewater sample results along the IW-14 transect where PFBA concentrations decrease at the 300ft (IW-14d) to 500ft (IW-14f) sampling locations.

At the IW-9 transect locations PFBA concentrations in sediment ranged from 4.15 ppb (IW-9, 4-8") to 2.16 ppb (IW-9b, 14-18"). From IW-9d to IW-9f PFBA was not detected. Likewise, there were no PFBA detections in sediment samples collected from locations upstream (west) of the IW-9 transect. These results are also consistent with the porewater sample results where PFBA was detected at low concentrations near shore at the IW-9 area. At distances away from shore and upstream, PFBA in porewater was either "Not Detected" or detected at concentrations less than 0.510 ppb.

4.5.1.3 Surface Water Sampling Results

Surface water samples were collected at each of the porewater sampling locations. At each location, a discrete water sample was collected using a peristaltic pump at 20% and 80% of the depth of the water. Both samples were analyzed as discrete samples for FC analysis, as defined in the Work Plan. A summary of the analytical results are presented in Table 4-11. The results of the analyses for PFOS, PFOA and PFBA are presented in Figures 4-19 to 4-21.

Generally low FC concentrations were detected in surface water samples at 34 of the 43 sample locations. Near the East Cove at location IW-23, PFBA was detected at concentrations of 6.92 ppb (1.7 ft) and 6.76 ppb (6.7 ft). PFBA was also detected at 17 other locations with higher concentrations reported at IW-09 (1.24 ppb, 2.8 ft), IW-11 (2.58 ppb, 3.4 ft and 1.3 ppb, 13.4 ft), IW-19a (4.28 ppb, 4.4 ft) and IW-19b (2.81 ppb, 0.9 ft and 1.96 ppb, 3.6 ft).

PFOS was detected at 19 locations ranging from 0.0539 ppb (IW-13, 3.8 ft) to 0.539 ppb (IW-22, 4.9 ft).

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PFOA was detected at 30 of the 43 locations at concentrations ranging from 0.0518 ppb (IW-03, 4.5 ft) to 0.611 ppb (IW-22, 1.2 ft).

4.5.2 Transect Locations

4.5.2.1 Sediment Sampling Results

Sediment samples were collected at three transect locations across the Mississippi River. One transect upstream of the Cottage Grove Site (XS-01) and two downstream; XS-02 (above the Hastings dam) and XS-03 (below the Hastings dam). The samples were collected from the top of the sediment layer using a petite ponar grab sampler as defined in the Work Plan. The sediment sampling results for PFOS, PFOA and PFBA are presented in Figure 4-22. A summary of the analytical results are presented in Table 4-12.

PFOS was the only FC compound detected in sediment samples along the three transects. Concentrations of PFOS were detected at each of the 13 sample locations at concentrations ranging from 0.289 ppb (XS-01c) to 2.66 ppb (XS-02a).

4.5.2.2 Surface Water Sampling Results

Surface water samples were also collected at the three transect locations across the Mississippi River. The samples were collected at 20% and 80% of the water depth at each transect. At the middle transect (XS-02) an additional sample was collected from the water surface at each of the five locations, as defined in the Work Plan. A summary of the analytical results are presented in Table 4-13. The results of the analyses for PFOS, PFOA and PFBA are presented in Figure 4-23.

Only PFOA was detected in 3 of the 30 surface water samples collected. The concentrations were 0.0501 ppb (XS-03b, 4 ft), 0.0523 ppb (XS-03c, 14 ft), and 0.199 ppb (XS-02e, 0.0 ft). PFOS and PFHS were not detected in any of the samples.

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4.5.3 Longitudinal Locations

4.5.3.1 Sediment Sampling Results

Sediment samples were collected at seventeen locations along the Mississippi River at locations upstream and downstream to the headwaters of Lake Pepin. At each location the samples were collected from the top of the sediment layer using either a petite ponar grab sampler or clear polycarbonate tubing. At the headwaters of Lake Pepin sediment cores were obtained at four locations (LS-784 a, b & c and LS-785) to a maximum sediment depth of approximately 3 feet. Three discrete samples were collected and analyzed for FCs from each of the four locations. A summary of the sediment analytical results are presented in Table 4-12. The results of the analyses for PFOS, PFOA and PFBA are presented in Figure 4-24.

PFOS and PFOA were the only FCs detected in the sediment. Other FC analytes were either ND or NR at each of the longitudinal sampling locations. PFOS was detected at 12 of the 17 locations. PFOS concentrations at the head of Lake Pepin (location 784) range from 1.22 ppb (LS-784a, 0-0.65 ft) to 3.16 ppb (LS-784c, 1-2 ft). PFOS was not detected in the sediment samples collected from location LS-785 which is the next closest upstream sample location. PFOS was also not detected at locations 791, 797 (duplicate), 803, 815 and 821. The other locations where PFOS was detected range in concentration from 0.983 ppb (LS-809) to 0.142 ppb (LS-806).

PFOA was detected only at location LS-784 a, b and c at the headwaters of Lake Pepin. Detected concentrations from these samples range from 1.09 ppb (LS-784b, 2-2.5 ft) to 0.441 ppb (LS-784a, 0.65-1.3 ft).

4.5.3.2 Surface Water Sampling Results

Surface water samples were collected at the seventeen locations along the Mississippi River at locations upstream and downstream to the headwaters of Lake Pepin. At each location the samples were collected from 20% and 80% of the total water depth and combined as a single composite sample from each location for FC analyses.

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A summary of the analytical results along with the depths of the individual samples are presented in Table 4-13. The results of the analyses for PFOS, PFOA and PFBA are presented in Figure 4-25.

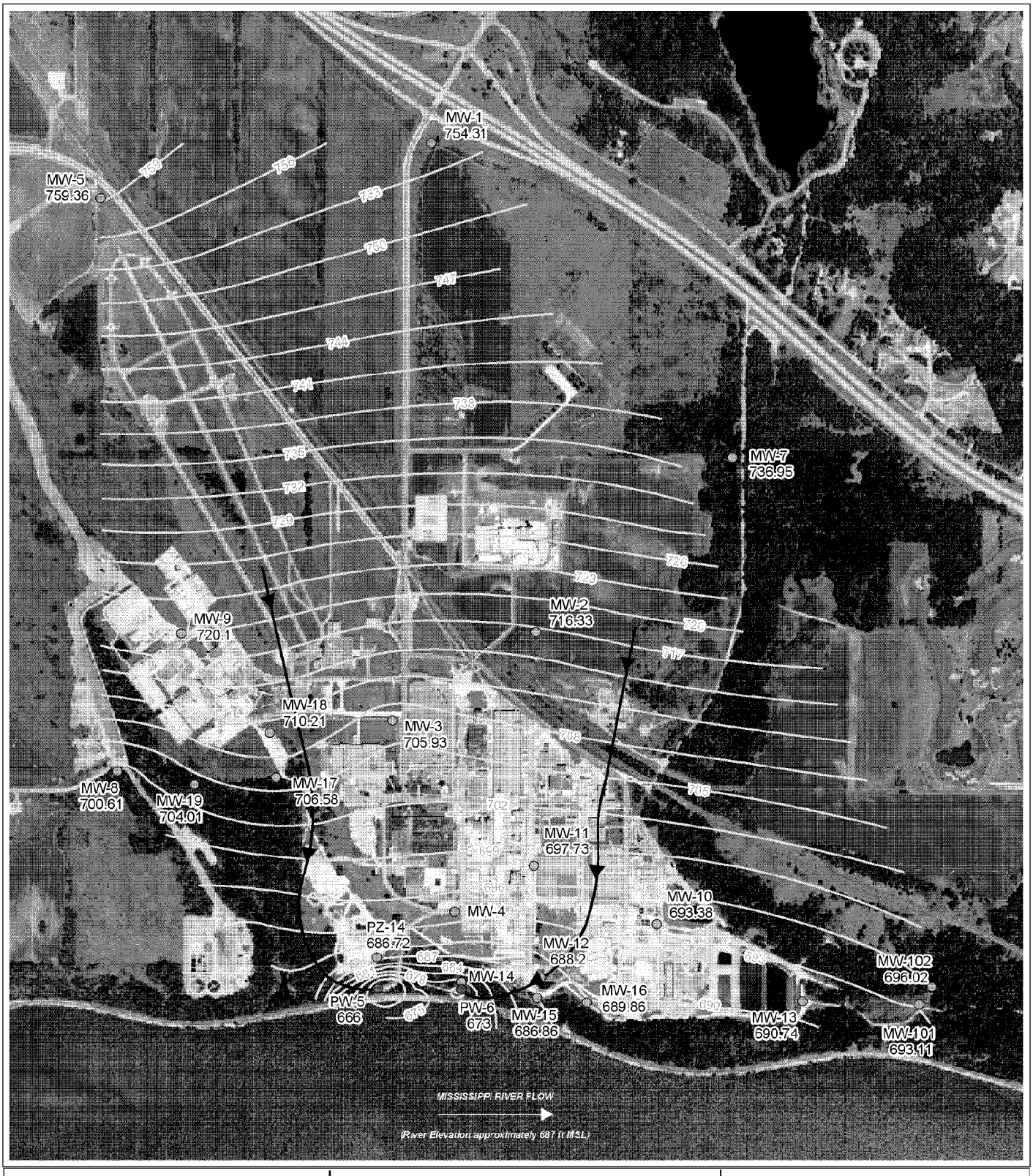
PFBA, PFOA and PFBS were the only FCs detected in the longitudinal surface water samples. PFBA was detected at 7 of the 17 sample locations ranging from 0.0705 ppb (LS-815) to 0.0530 ppb (LS-784c). At the remaining locations PFBA was either ND or NR.

PFOA was detected at 3 locations ranging in concentrations from 0.0751 ppb (LS-785) to 0.0508 ppb (LS-806). At the remaining 13 locations PFOA was either ND or NR.

PFBS was either ND or NR.

The Phase 1 and Phase 2 assessment results as presented in this section are summarized in Section 5—Summary of Observations.

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Legend:

- Groundwater Elevation Contour (ft MSL)
- Monitoring Well
- Production Well
- 686.47 Groundwater Elevation (ft MSL)
- Groundwater Flowline

Note: Well locations are approximate. Water elevations for PW-5 and PW-6 calculated based on aquifer parameters not measurements.

N W E S

0 500 1,000 2,000 Feet

Map Source:
U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office;
National Agricultural Imagery Program (NAIP)
Digital Orthorectified Images (DOQ), Minnesota, 2003

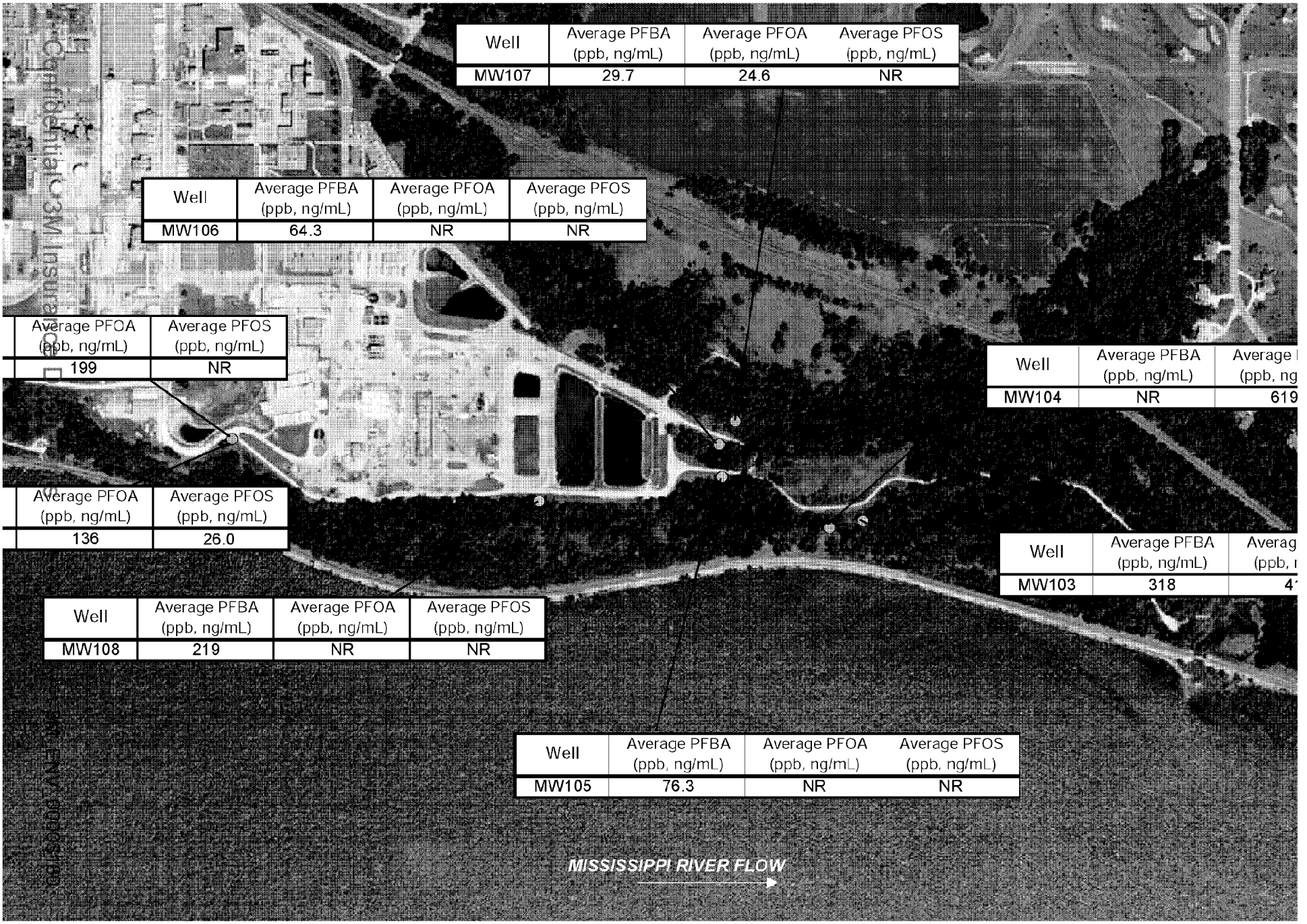
FIGURE 4-1
GROUNDWATER ELEVATION CONTOUR MAP
PUMPING CONDITIONS
3 MAY 2006
COTTAGE GROVE SITE

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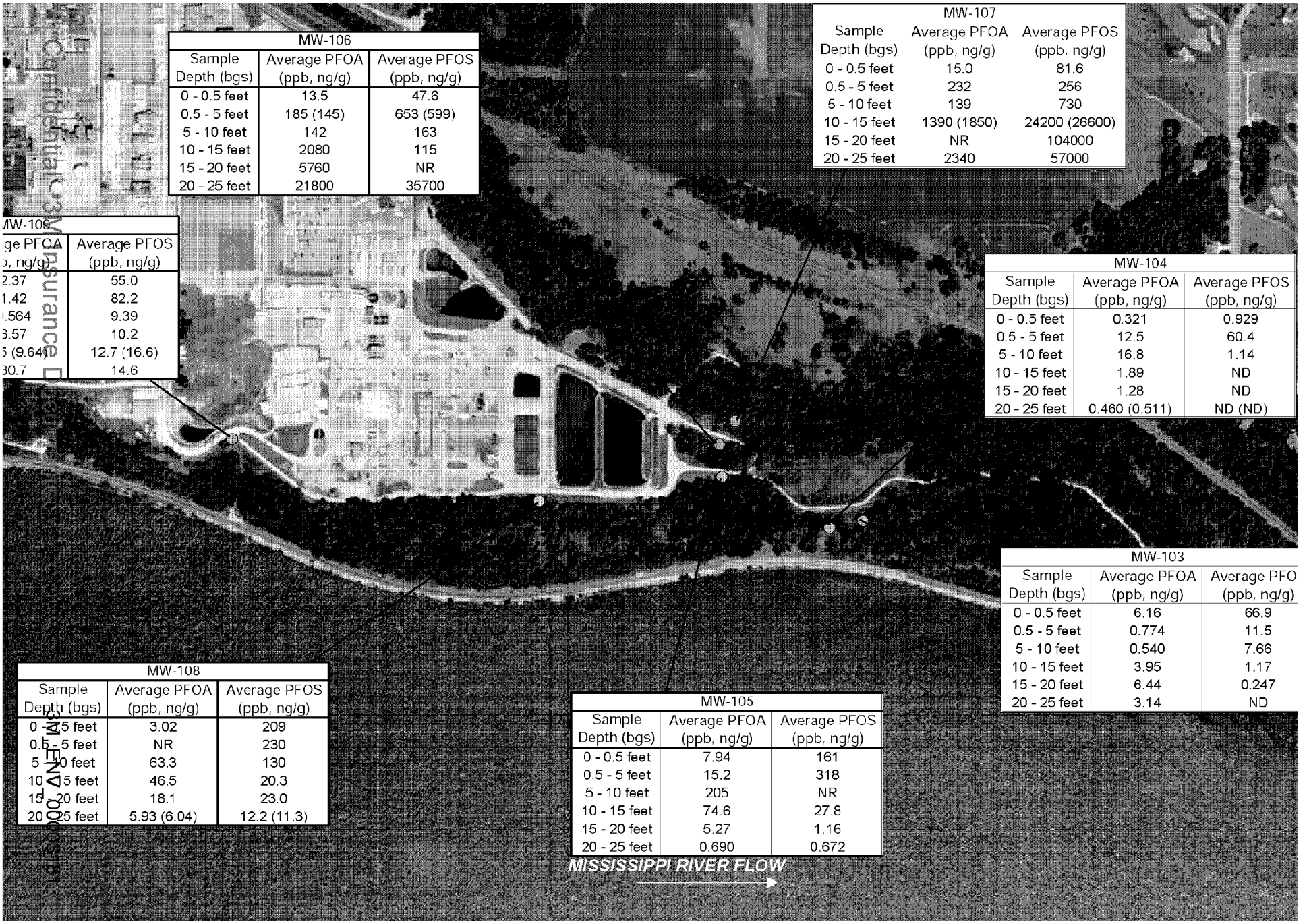
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MW-106		
Sample Depth (bgs)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 0.5 feet	13.5	47.6
0.5 - 5 feet	185 (145)	653 (599)
5 - 10 feet	142	163
10 - 15 feet	2080	115
15 - 20 feet	5760	NR
20 - 25 feet	21800	35700

MW-107		
Sample Depth (bgs)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 0.5 feet	15.0	81.6
0.5 - 5 feet	232	256
5 - 10 feet	139	730
10 - 15 feet	1390 (1850)	24200 (26600)
15 - 20 feet	NR	104000
20 - 25 feet	2340	57000

MW-109	
ge PFOA , ng/g)	Average PFOS (ppb, ng/g)
2.37	55.0
1.42	82.2
.564	9.39
3.57	10.2
5 (9.64)	12.7 (16.6)
30.7	14.6

MW-104		
Sample Depth (bgs)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 0.5 feet	0.321	0.929
0.5 - 5 feet	12.5	60.4
5 - 10 feet	16.8	1.14
10 - 15 feet	1.89	ND
15 - 20 feet	1.28	ND
20 - 25 feet	0.460 (0.511)	ND (ND)

MW-103		
Sample Depth (bgs)	Average PFOA (ppb, ng/g)	Average PFO (ppb, ng/g)
0 - 0.5 feet	6.16	66.9
0.5 - 5 feet	0.774	11.5
5 - 10 feet	0.540	7.66
10 - 15 feet	3.95	1.17
15 - 20 feet	6.44	0.247
20 - 25 feet	3.14	ND

MW-108		
Sample Depth (bgs)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 0.5 feet	3.02	209
0.5 - 5 feet	NR	230
5 - 10 feet	63.3	130
10 - 15 feet	46.5	20.3
15 - 20 feet	18.1	23.0
20 - 25 feet	5.93 (6.04)	12.2 (11.3)

MW-105		
Sample Depth (bgs)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 0.5 feet	7.94	161
0.5 - 5 feet	15.2	318
5 - 10 feet	205	NR
10 - 15 feet	74.6	27.8
15 - 20 feet	5.27	1.16
20 - 25 feet	0.690	0.672

MISSISSIPPI RIVER FLOW

Note: Concentrations in parentheses are field duplicate results

N W E

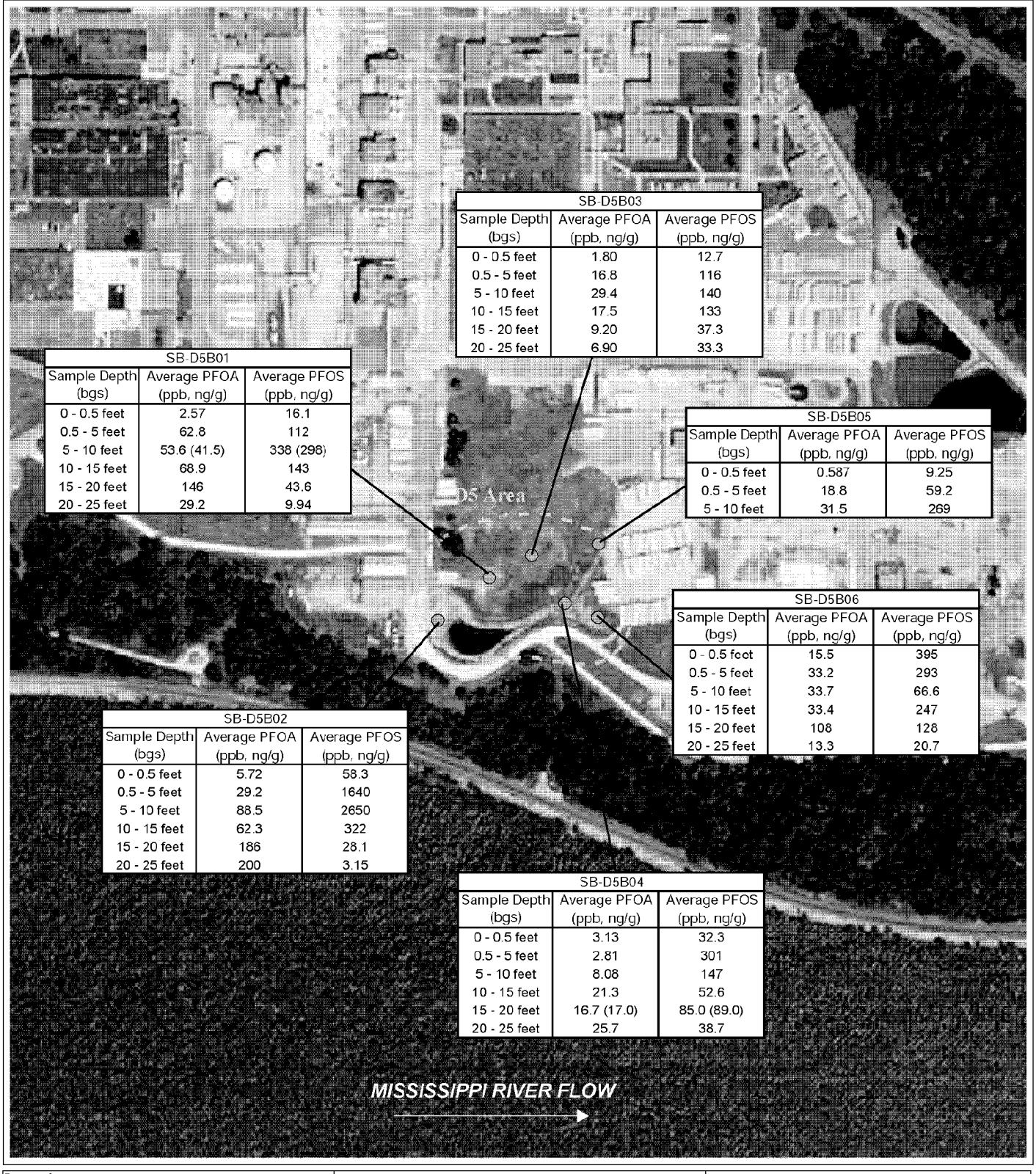
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MONITORING

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SB-D5B03

Sample Depth (bgs)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 0.5 feet	1.80	12.7
0.5 - 5 feet	16.8	116
5 - 10 feet	29.4	140
10 - 15 feet	17.5	133
15 - 20 feet	9.20	37.3
20 - 25 feet	6.90	33.3

SB-D5B01

Sample Depth (bgs)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 0.5 feet	2.57	16.1
0.5 - 5 feet	62.8	112
5 - 10 feet	53.6 (41.5)	338 (298)
10 - 15 feet	68.9	143
15 - 20 feet	146	43.6
20 - 25 feet	29.2	9.94

SB-D5B05

Sample Depth (bgs)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 0.5 feet	0.587	9.25
0.5 - 5 feet	18.8	59.2
5 - 10 feet	31.5	269

SB-D5B06

Sample Depth (bgs)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 0.5 feet	15.5	395
0.5 - 5 feet	33.2	293
5 - 10 feet	33.7	66.6
10 - 15 feet	33.4	247
15 - 20 feet	108	128
20 - 25 feet	13.3	20.7

SB-D5B02

Sample Depth (bgs)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 0.5 feet	5.72	58.3
0.5 - 5 feet	29.2	1640
5 - 10 feet	88.5	2650
10 - 15 feet	62.3	322
15 - 20 feet	186	28.1
20 - 25 feet	200	3.15

SB-D5B04

Sample Depth (bgs)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 0.5 feet	3.13	32.3
0.5 - 5 feet	2.81	301
5 - 10 feet	8.08	147
10 - 15 feet	21.3	52.6
15 - 20 feet	16.7 (17.0)	85.0 (89.0)
20 - 25 feet	25.7	38.7

Legend:

Soil Boring Location

bgs Below ground surface

Note: Concentrations in parentheses are field duplicate results

N W E S

0 150 300 Feet

Map Source:
U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office, National Agricultural Imagery Program (NAIP), Digital Orthorectified Images (DOQ), Minnesota, 2003

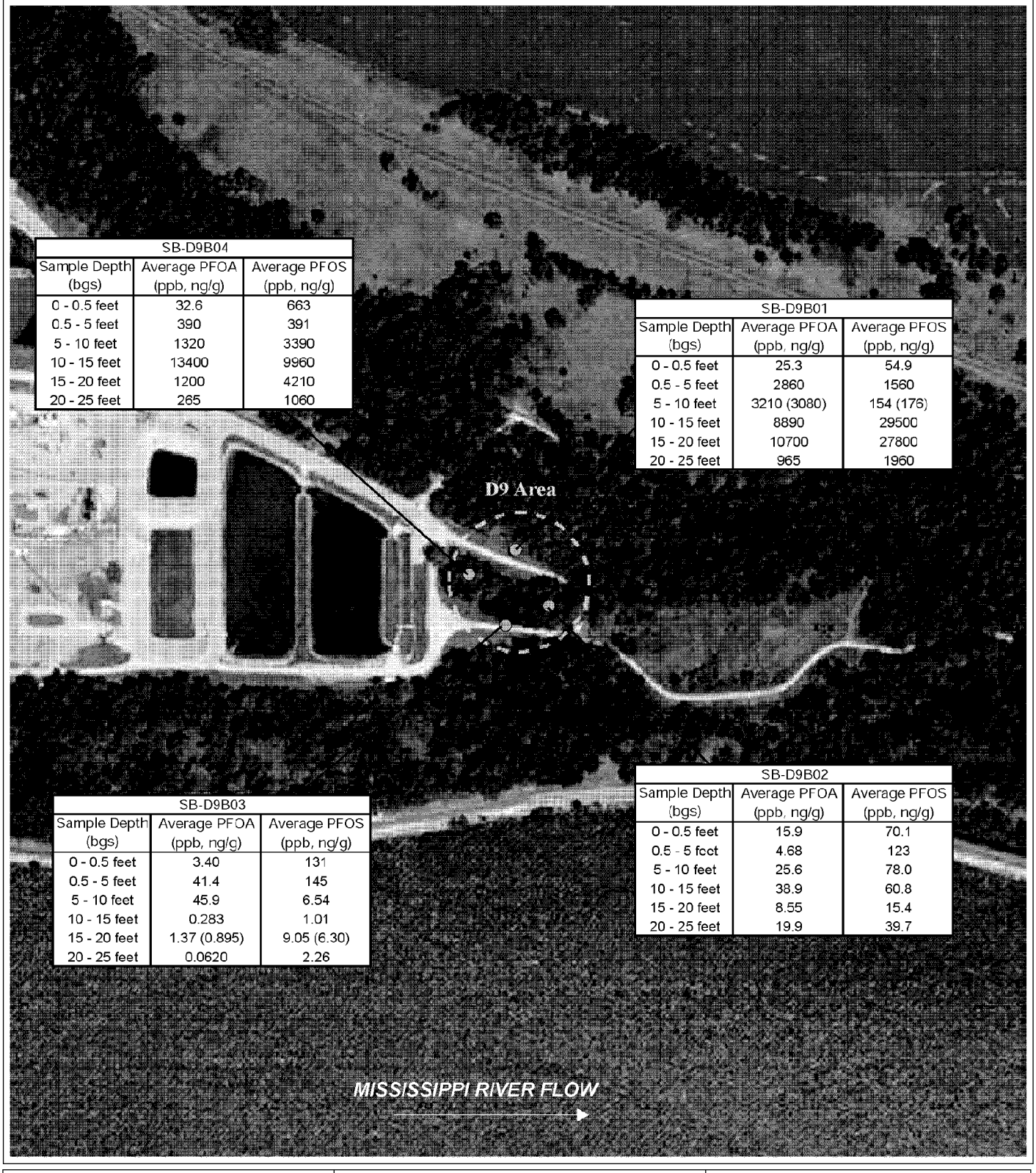
FIGURE 4-4
D5 AREA SOIL BORINGS
PFOA AND PFOS CONCENTRATIONS
JUNE 2006
COTTAGE GROVE SITE

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File: \\Fswc6\proj6\Cottage_Grove\mxds\D5area_sb_PFBS_PFHS_PFOS_PFOA.mxd, 28-Jun-07 14:35, ricksc

3M_MN01483107



Legend:

- Soil Boring Location

bgs Below ground surface

Notes; 1. Concentrations in parentheses are field duplicate results.

2. Since these samples were collected in June 2006, they were analyzed for 4 FCs.

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N W E S

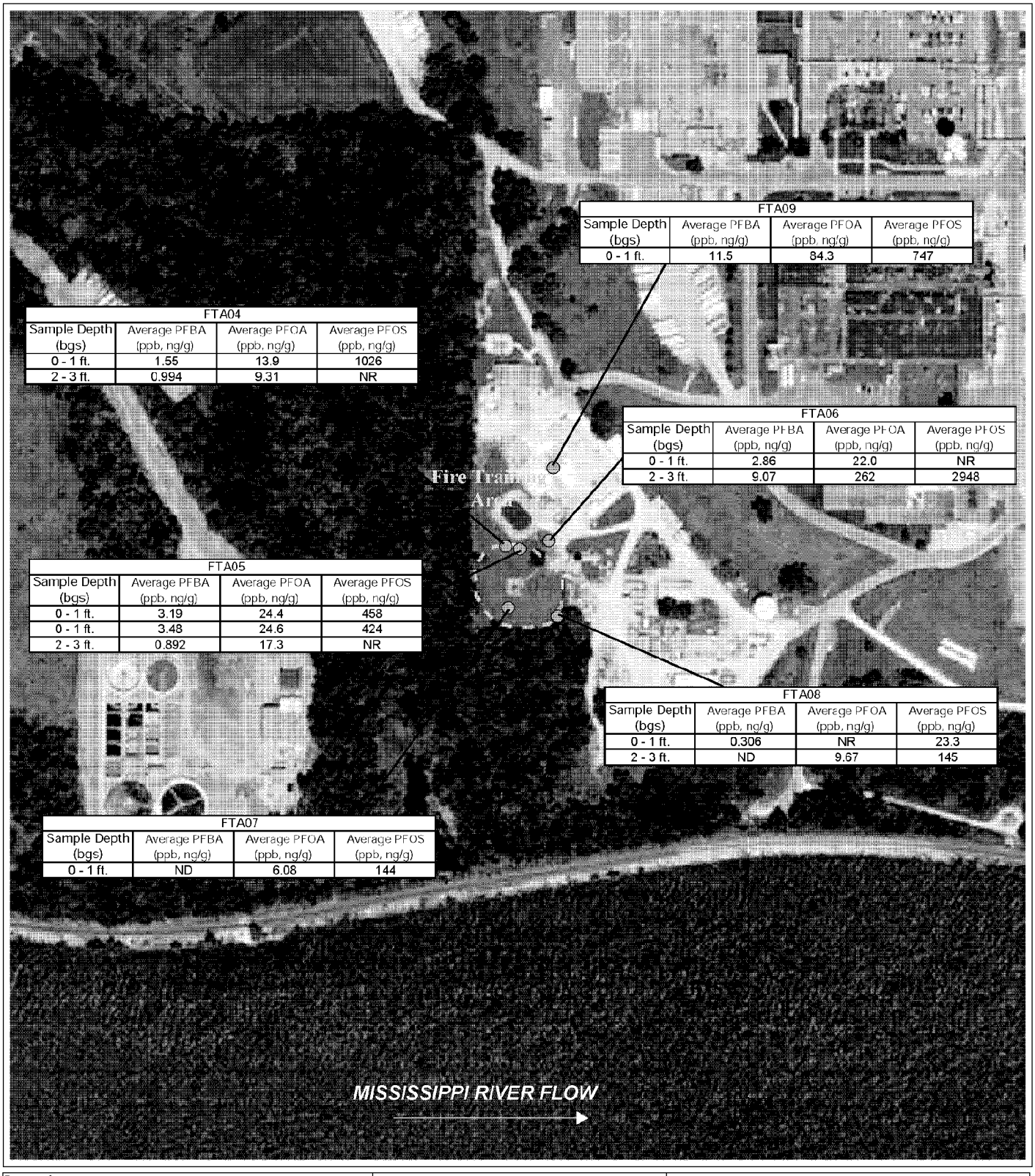
0 150 300 Feet

Map Source:
U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office, National Agricultural Imagery Program (NAIP) Digital Orthorectified Images (DOQ), Minnesota, 2003

FIGURE 4-5
D9 AREA SOIL BORINGS
PFOA AND PFOS CONCENTRATIONS
JUNE 2006
COTTAGE GROVE SITE
3M_ENV_00003183

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3M_MN01483108



Legend:

- Soil Boring Location
- ND — Not detected at or above the acceptable Limit of Quantitation (LOQ)
- NR — Not reported due to quality control failures.
- bgs — Below ground surface
- Note: Concentrations in parentheses are field duplicate results

N W E S

0 150 300 Feet

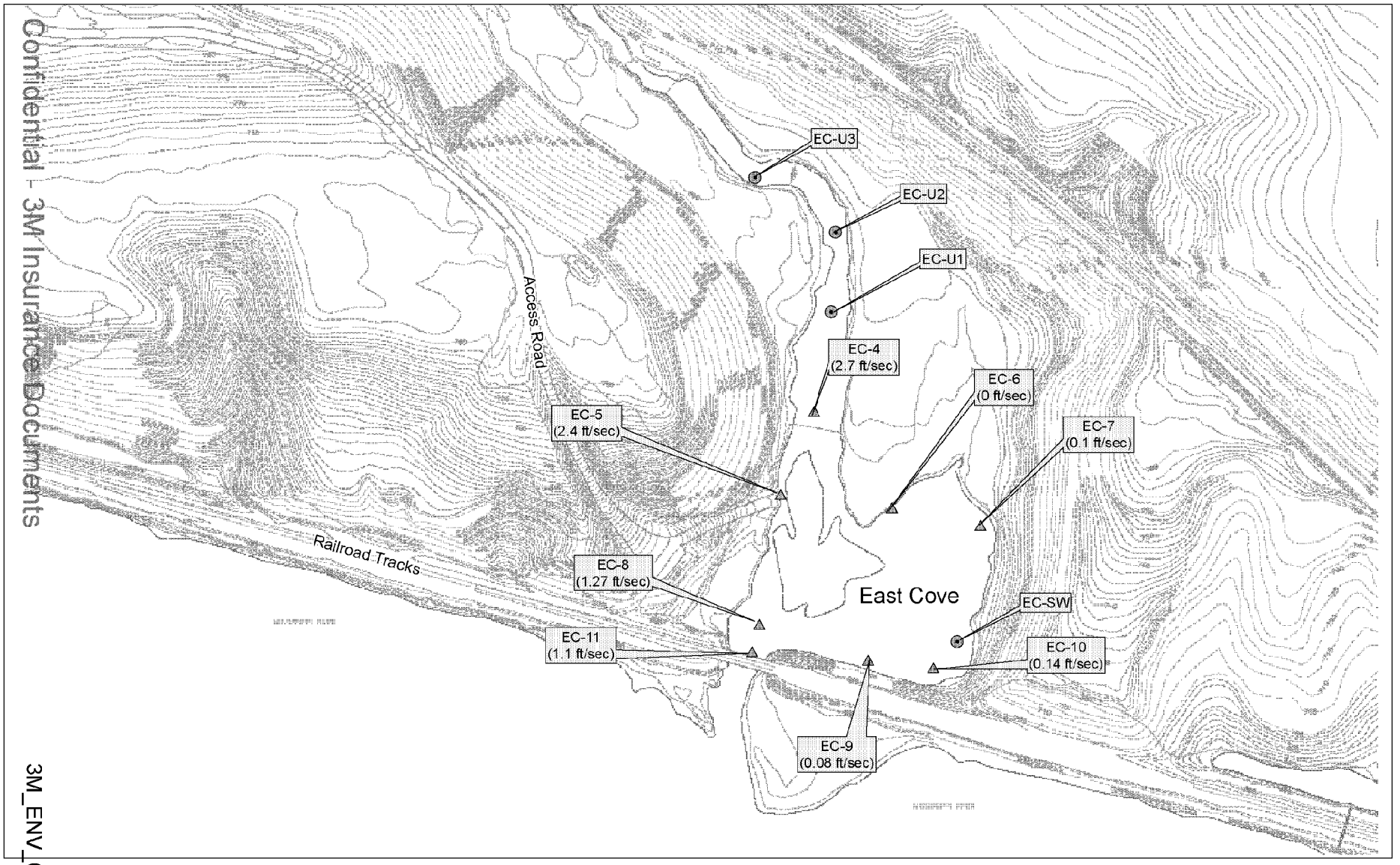
Map Source: U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office, National Agricultural Imagery Program (NAIP) Digital Orthorectified Images (DOQ), Minnesota, 2003

FIGURE 4-6
FIRE TRAINING AREA SOIL
PFBA, PFOA AND PFOS CONCENTRATIONS
SEPTEMBER 2006
COTTAGE GROVE SITE
3M_ENV_00003184

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Legend:

- East Cove Sample Locations (velocity in ft/sec)
- Physical Description Locations
- Access Road
- Tree Line
- Surface Water Boundary

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W
E
S

WESTON SOLUTIONS

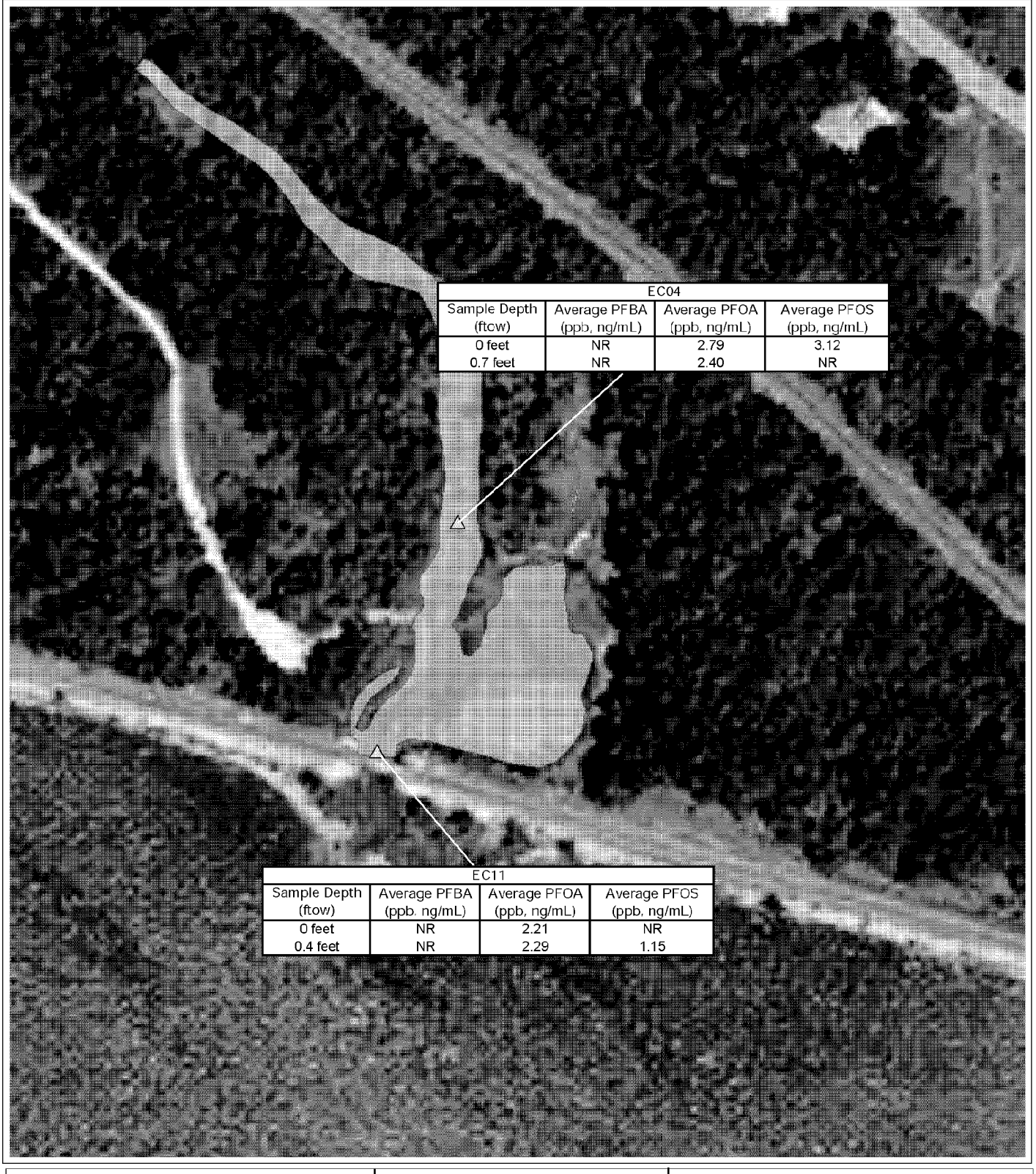
FIGURE 4-7
EAST COVE TOPOGRAPHY AND SURFACE WATER BOUNDARY
COTTAGE GROVE SITE

2162.0109

3M_ENV_00003185

3M_MN01483110

\\Cottage_Grove\mxds\eastcove_landscape_pdf.mxd, 27-Jun-07 14:29, ricksc



Legend:

East Cove

Phase 2 Surface Water Sampling Location

NR Not reported due to quality control failure.

ftow From top of water surface

N W E S

0 75 150 Feet

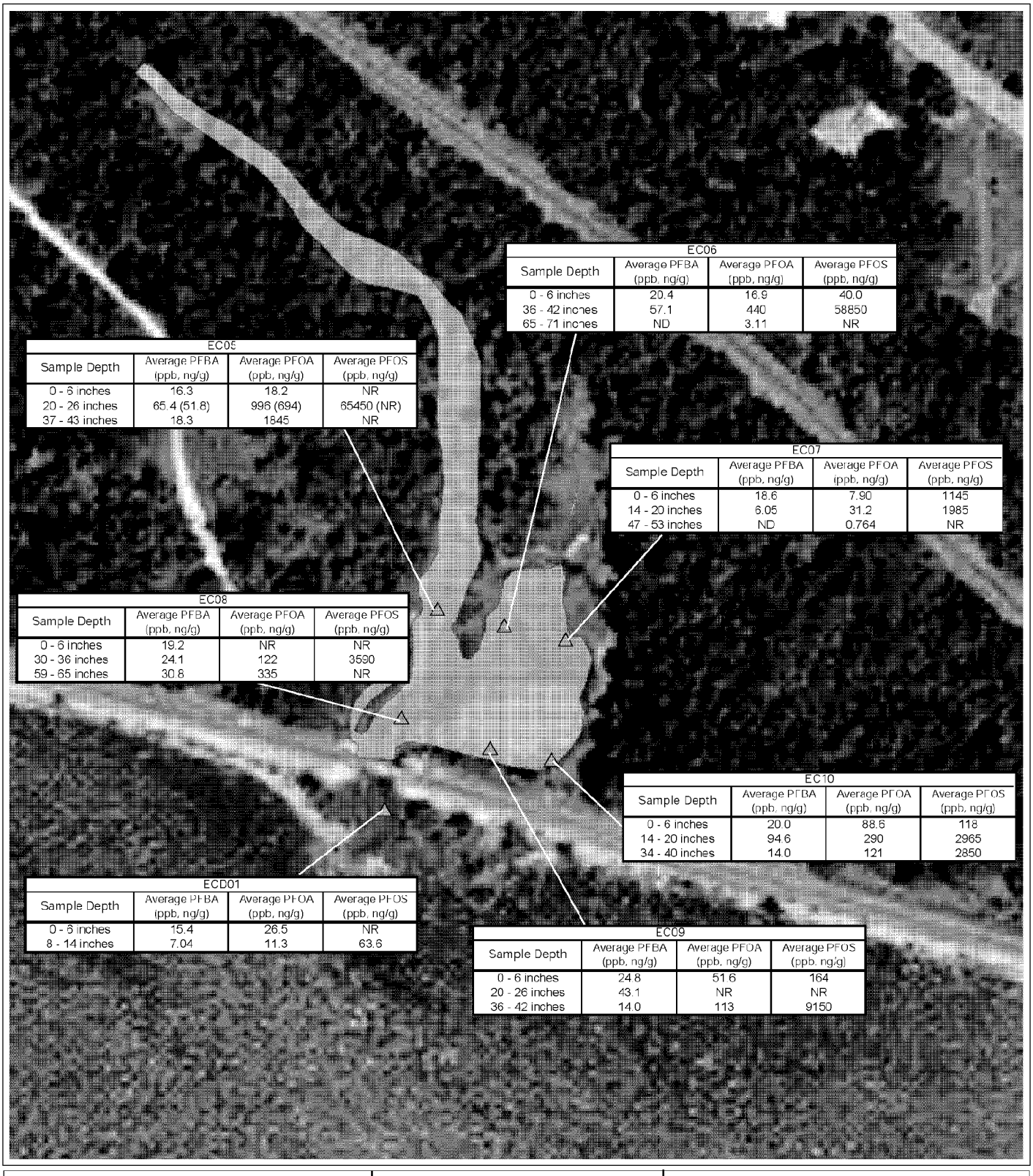
Map Source:
U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office
National Agriculture Imagery Program (NAIP)
Digital Orthorectified Images (DOQ), Minnesota, 2003

FIGURE 4-8
SURFACE WATER
PFBA, PFOA AND PFOS CONCENTRATIONS
EAST COVE
SEPTEMBER 2006
COTTAGE GROVE SITE
3M_ENV_00003186

Confidential - 3M Insurance Documents

File: \\Fswc6\proj6\Cottage_Grove\mxds\surfacewater_eastcove.mxd, 28-Jun-07 14:42, ricksc

3M_MN01483111



EC06			
Sample Depth	Average PFBA (ppb, ng/g)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 6 inches	20.4	16.9	40.0
36 - 42 inches	57.1	440	58850
65 - 71 inches	ND	3.11	NR

EC05			
Sample Depth	Average PFBA (ppb, ng/g)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 6 inches	16.3	18.2	NR
20 - 26 inches	65.4 (51.8)	996 (694)	65450 (NR)
37 - 43 inches	18.3	1845	NR

EC07			
Sample Depth	Average PFBA (ppb, ng/g)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 6 inches	18.6	7.90	1145
14 - 20 inches	6.05	31.2	1985
47 - 53 inches	ND	0.764	NR

EC08			
Sample Depth	Average PFBA (ppb, ng/g)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 6 inches	19.2	NR	NR
30 - 36 inches	24.1	122	3590
59 - 65 inches	30.8	335	NR

EC10			
Sample Depth	Average PFBA (ppb, ng/g)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 6 inches	20.0	88.6	118
14 - 20 inches	94.6	290	2965
34 - 40 inches	14.0	121	2850

ECD01			
Sample Depth	Average PFBA (ppb, ng/g)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 6 inches	15.4	26.5	NR
8 - 14 inches	7.04	11.3	63.6

EC09			
Sample Depth	Average PFBA (ppb, ng/g)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 6 inches	24.8	51.6	164
20 - 26 inches	43.1	NR	NR
36 - 42 inches	14.0	113	9150

Legend:

- East Cove
- Phase 2 Sediment Sampling Location
- NR Not reported due to quality control failure.
- ND Not detected at the Limit of Quantitation (LOQ)
- Note: Concentrations in Parentheses are field duplicate results.

N W E S

WESTON SOLUTIONS

0 75 150 Feet

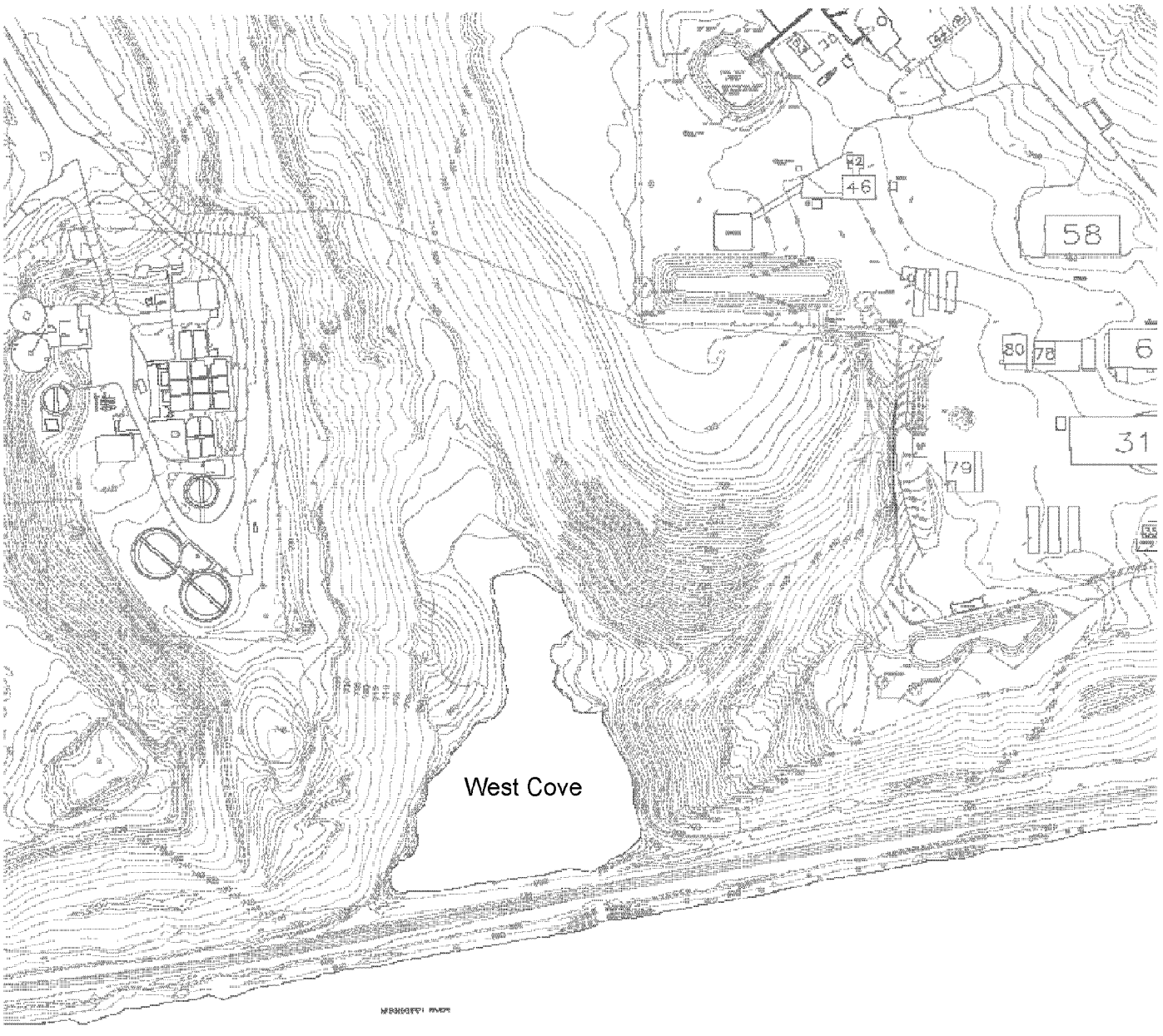
Map Source:
U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office:
National Agriculture Imagery Program (NAIP)
Digital Orthorectified Images (DOQ), Minnesota, 2003

FIGURE 4-9
SEDIMENT
PFBA, PFOA AND PFOS CONCENTRATIONS
EAST COVE
SEPTEMBER 2006
COTTAGE GROVE SITE
3M_ENV_00003187

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File: \\Fswc6\proj3\Cottage_Grove\mxds\sediment_eastcove.mxd, 23-Jun-07 14:45, ricksc

3M_MN01483112



Legend:

Surface Water Boundary

N
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E
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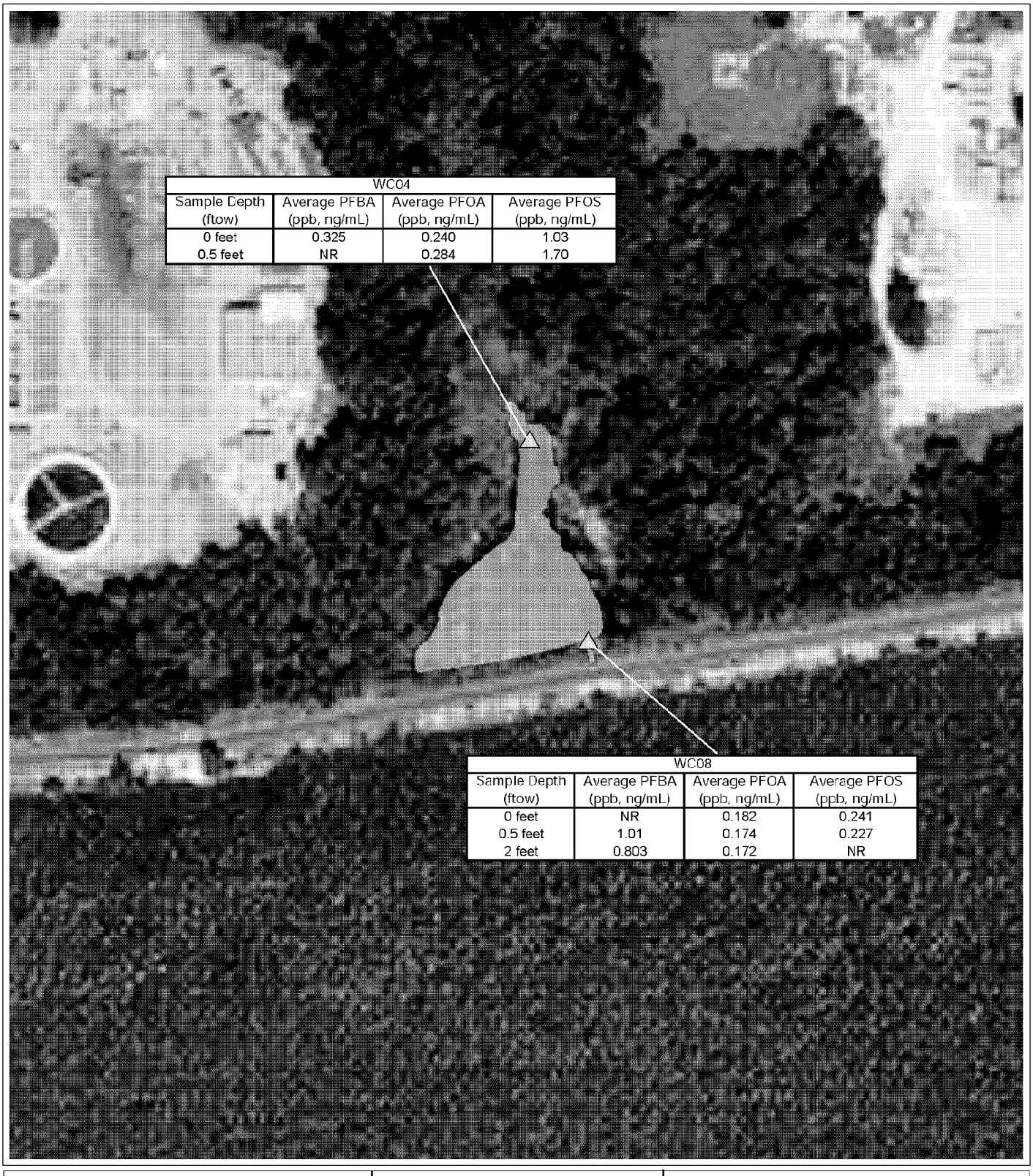
WESTON SOLUTIONS

FIGURE 4-10
WEST COVE TOPOGRAPHY AND
SURFACE WATER BOUNDARY
COTTAGE GROVE SITE

3M_ENV_00003188

Confidential - 3M Insurance Documents

File: \\Fswc5\proj6\Cottage_Grove\mxds\westcove_portrait_pdf.mxd, 27-Jun-07 14:36, ricksc



Legend:

- West Cove
- Phase 2 Surface Water Sampling Location
- NR Not reported due to quality control failure.
- ftow From top of water surface

N W E S

0 75 150 Feet

Map Source:
U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office;
National Agricultural Imagery Program (NAIP)
Digital Orthorectified Images (DOQ), Minnesota, 2003

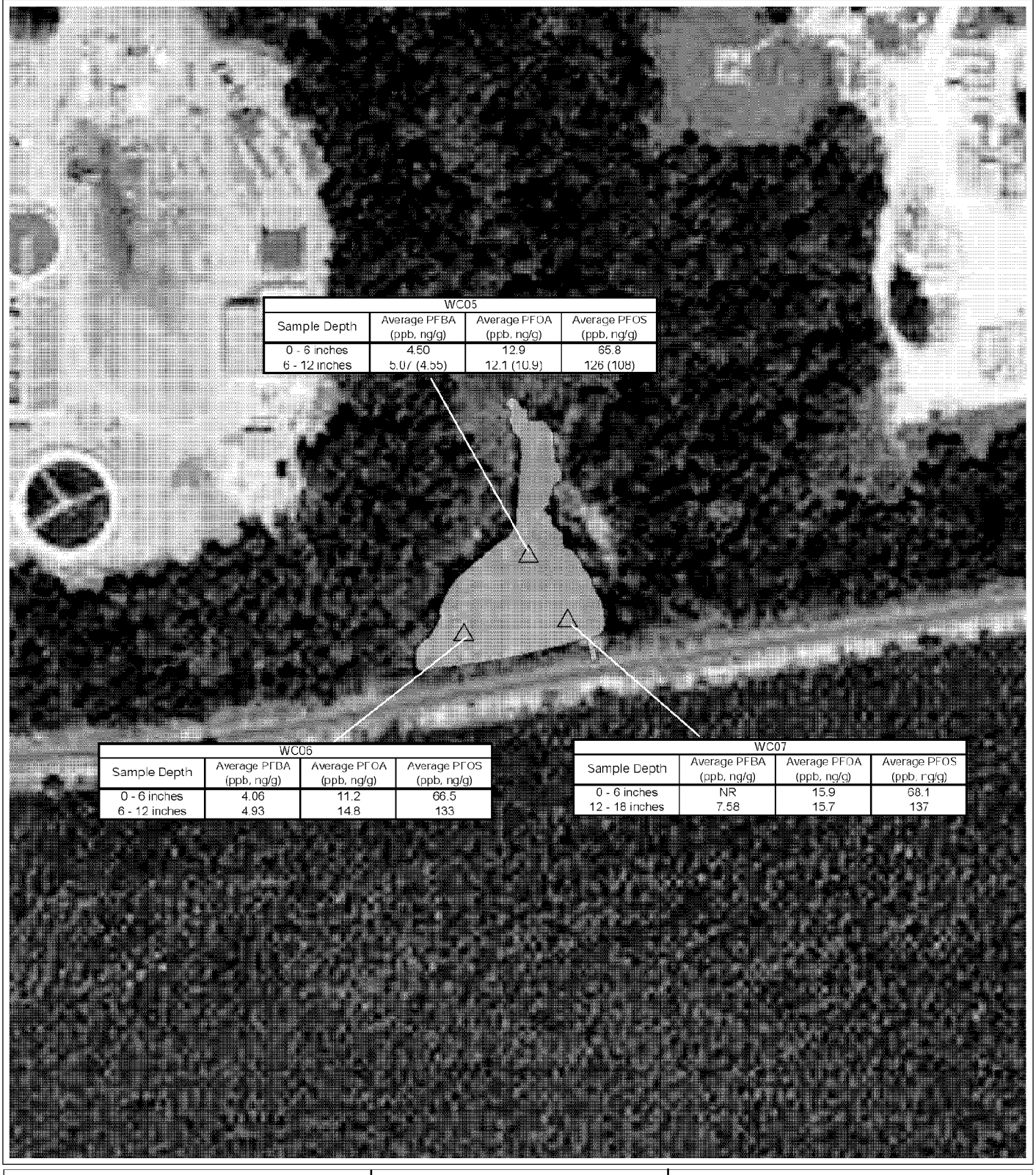
FIGURE 4-11
SURFACE WATER
PFBA, PFOA AND PFOS CONCENTRATIONS
WEST COVE
SEPTEMBER 2006
COTTAGE GROVE SITE

Confidential - 3M Insurance Documents

3M_ENV_00003189

File: \\Fswc3\proj6\Cottage_Grove\mxds\surfacewater_westcove.mxd, 28-Jun-07 14:48, ricksc

3M_MN01483114



WC05			
Sample Depth	Average PFBA (ppb, ng/g)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 6 inches	4.50	12.9	65.8
6 - 12 inches	5.07 (4.55)	12.1 (10.9)	126 (108)

WC06			
Sample Depth	Average PFBA (ppb, ng/g)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 6 inches	4.06	11.2	66.5
6 - 12 inches	4.93	14.8	133

WC07			
Sample Depth	Average PFBA (ppb, ng/g)	Average PFOA (ppb, ng/g)	Average PFOS (ppb, ng/g)
0 - 6 inches	NR	15.9	68.1
12 - 18 inches	7.58	15.7	137

Legend:

- West Cove
- Phase 2 Sediment Sampling Location
- NR Not reported due to quality control failure.
- Note: Concentrations in parentheses are field duplicate results

N W E S

WESTON SOLUTIONS

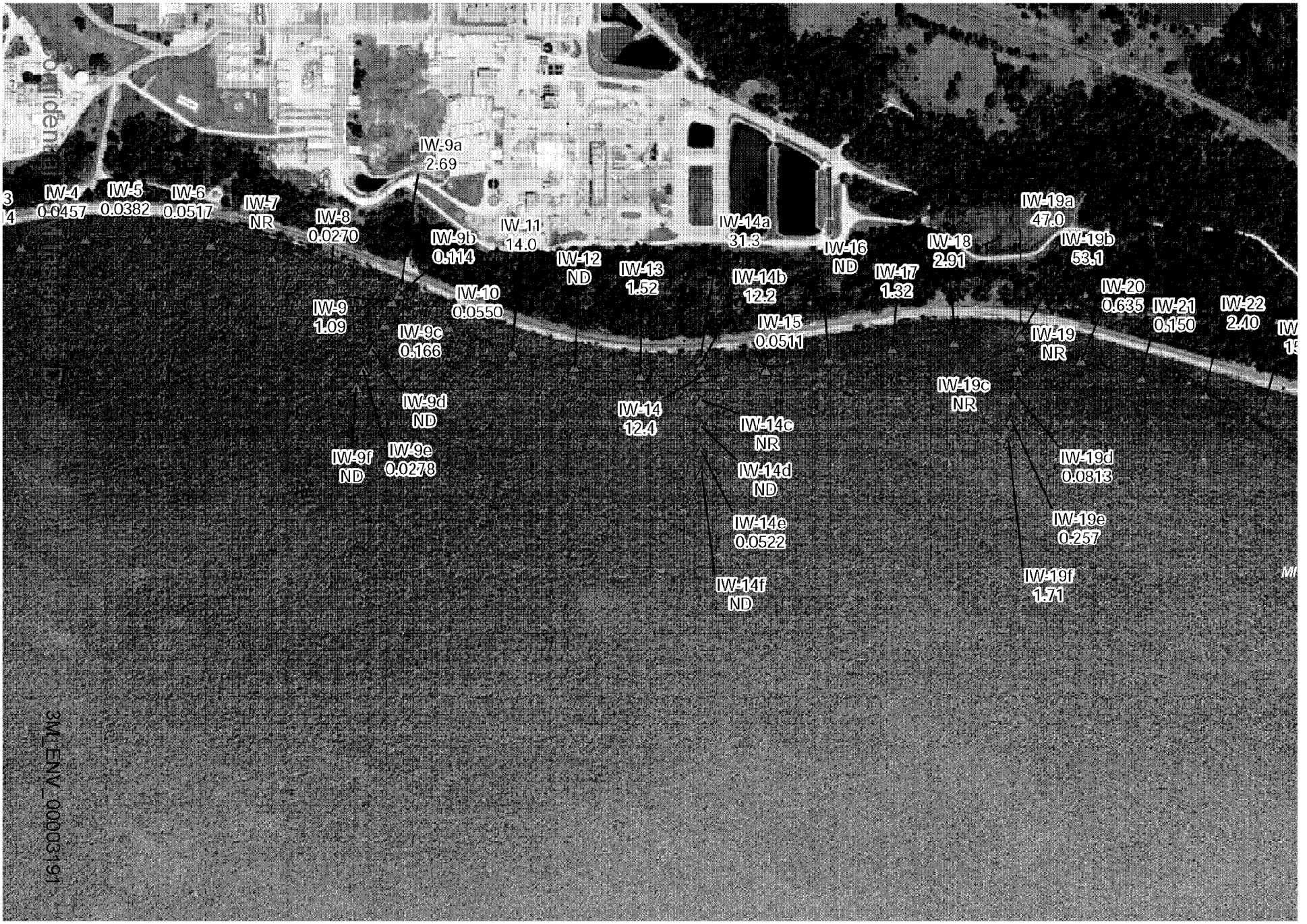
0 75 150 Feet

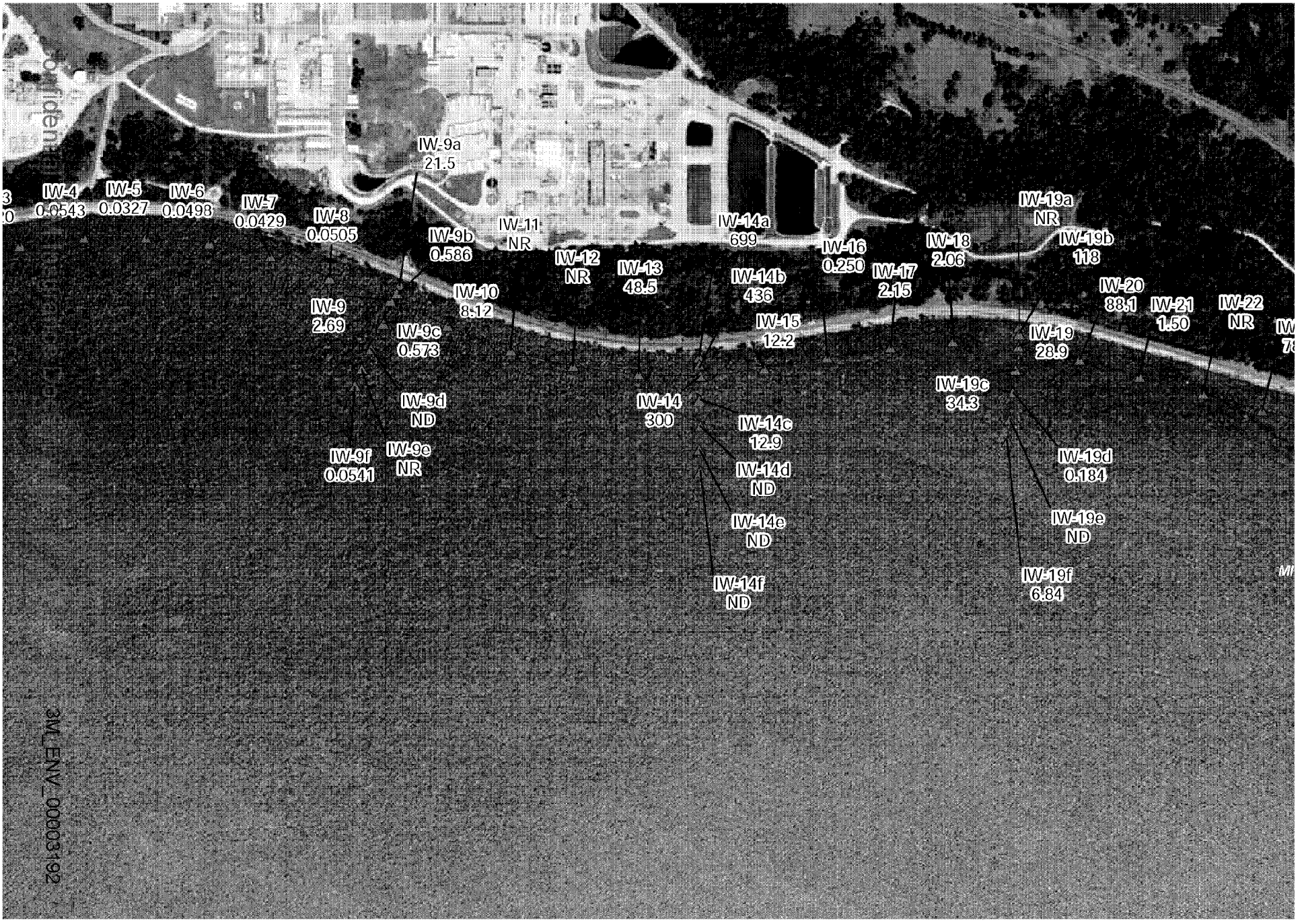
Map Source:
U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office, National Agricultural Imagery Program (NAIP) Digital Orthorectified Images (DOQ), Minnesota, 2003

FIGURE 4-12
SEDIMENT
PFBA, PFOA AND PFOS CONCENTRATIONS
WEST COVE
SEPTEMBER 2006
COTTAGE GROVE SITE
3M_ENV_00003190

Confidential - 3M Insurance Documents

File: \\Fswc6\proj6\Cottage_Grove\mxds\sediment_westcove.mxd, 28-Jun-07 14:50, ricksc


IW-4
0.0457
IW-5
0.0382
IW-6
0.0517
IW-7
NR
IW-8
0.0270
IW-9a
2.69
IW-9b
0.114
IW-11
14.0
IW-12
ND
IW-13
1.52
IW-14a
31.3
IW-16
ND
IW-18
2.91
IW-19a
47.0
IW-19b
53.1
IW-14b
12.2
IW-17
1.32
IW-20
0.635
IW-21
0.150
IW-22
2.40
IW-10
0.0550
IW-9
1.09
IW-9c
0.166
IW-15
0.0511
IW-19
NR
IW-19c
NR
IW-9d
ND
IW-14
12.4
IW-14c
NR
IW-9f
ND
IW-9e
0.0278
IW-14d
ND
IW-19d
0.0813
IW-14e
0.0522
IW-19e
0.257
IW-14f
ND
IW-19f
1.71
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; Location

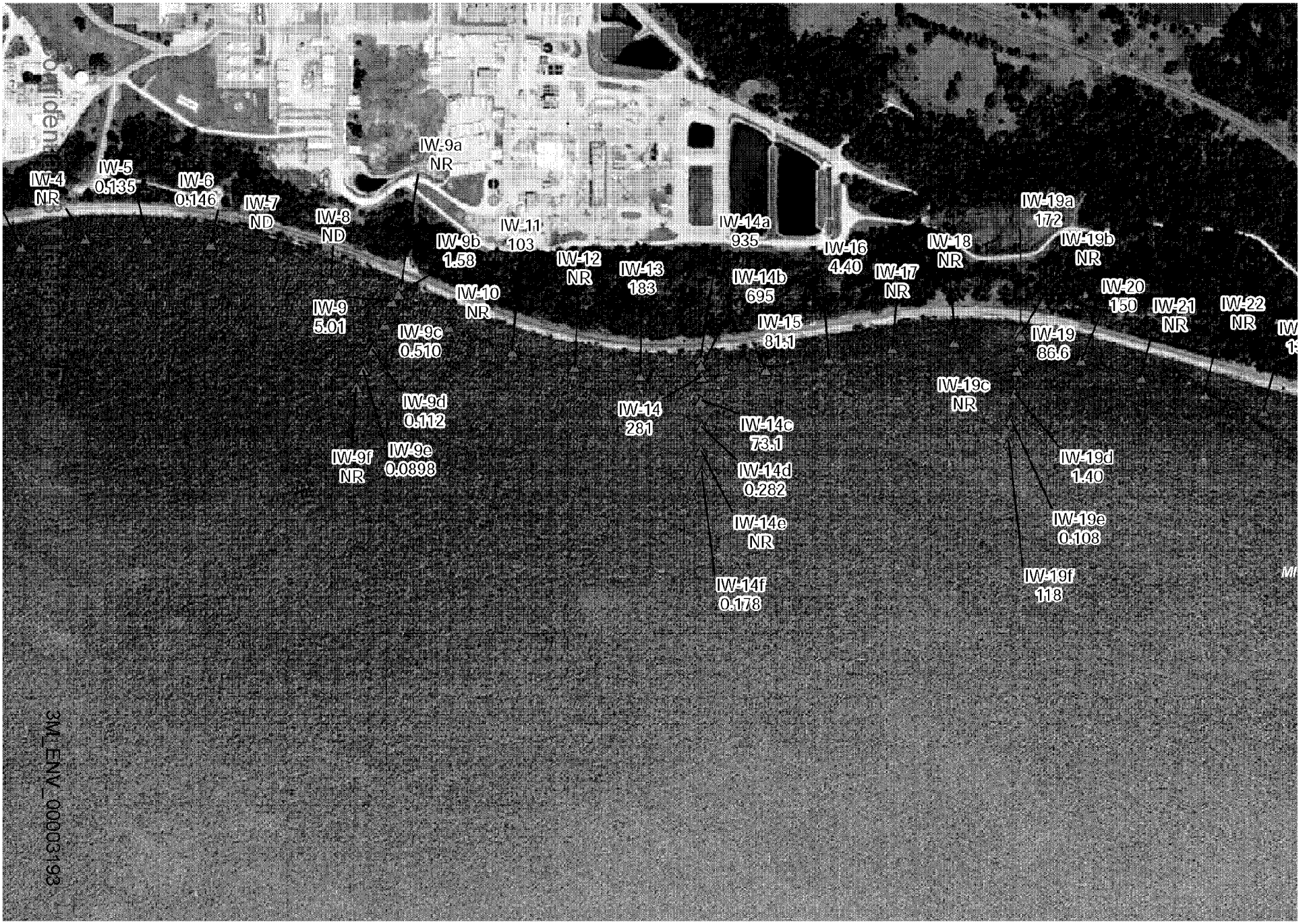
mit of Quantitation (LOQ)

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0 250 500

WESTON

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PC



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3M_MN01483118

ocation

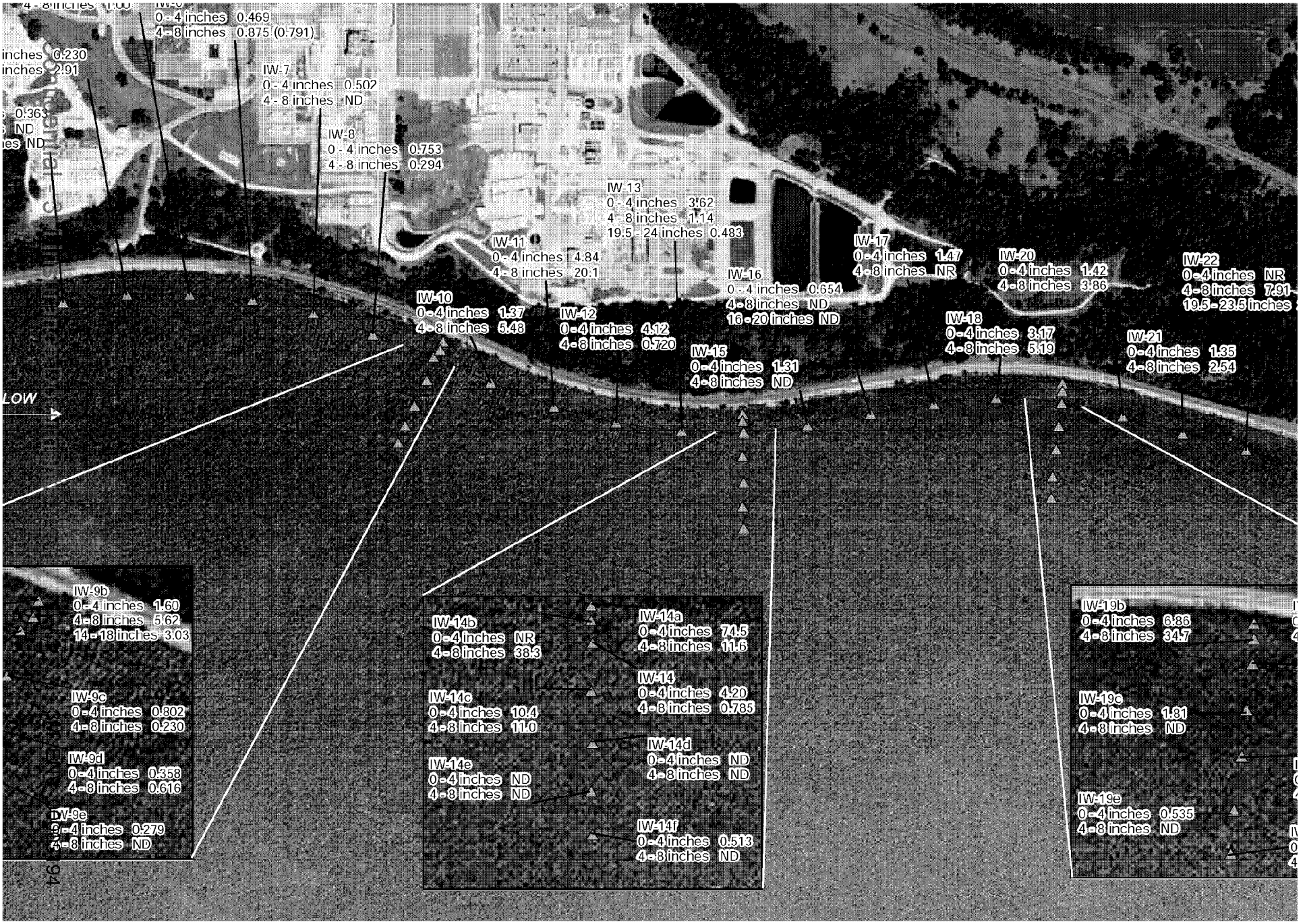
t of Quantitation (LOQ)

N
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0 250 500

WESTON

FI
PO



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Location

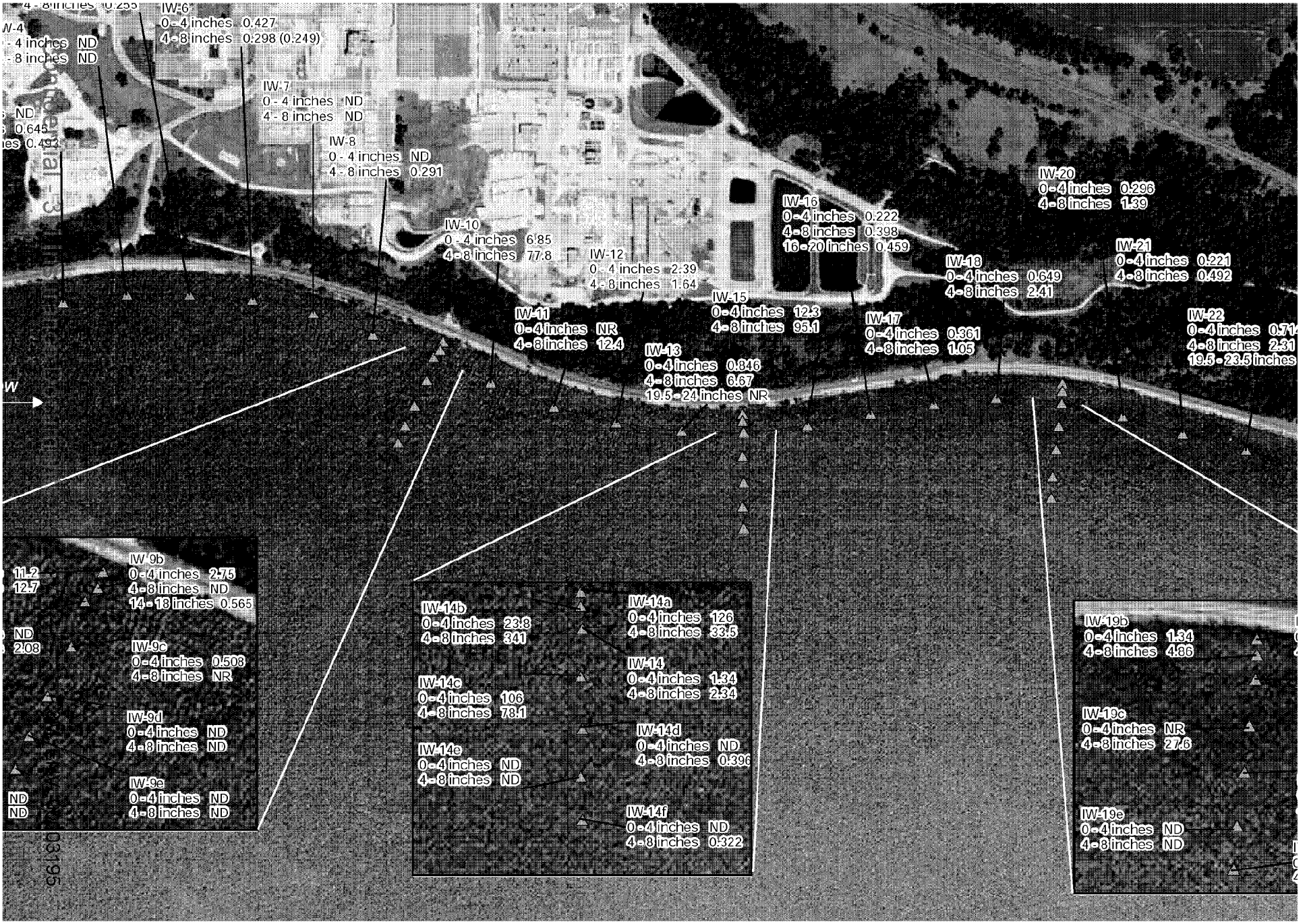
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N

W E

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WESTON



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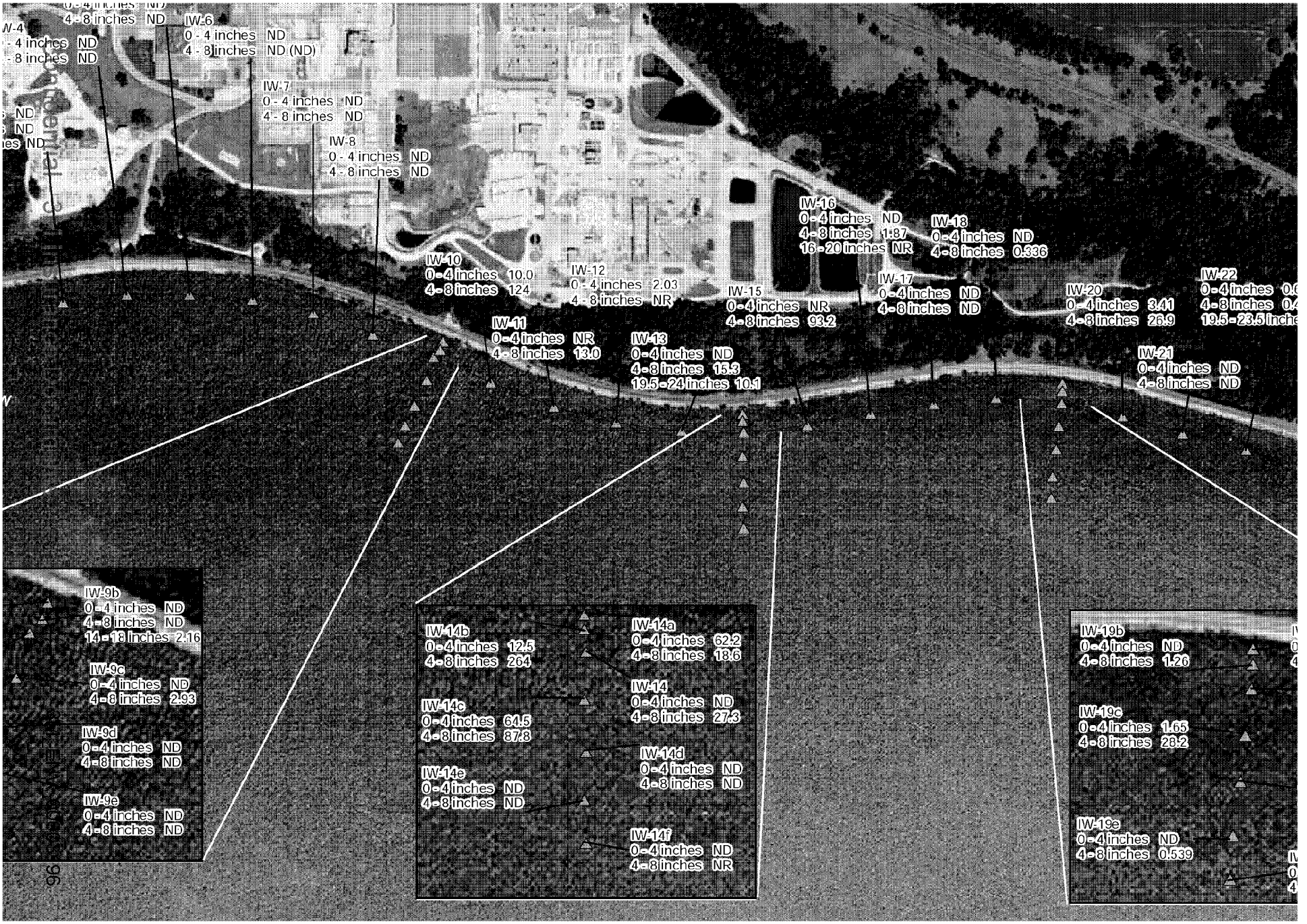
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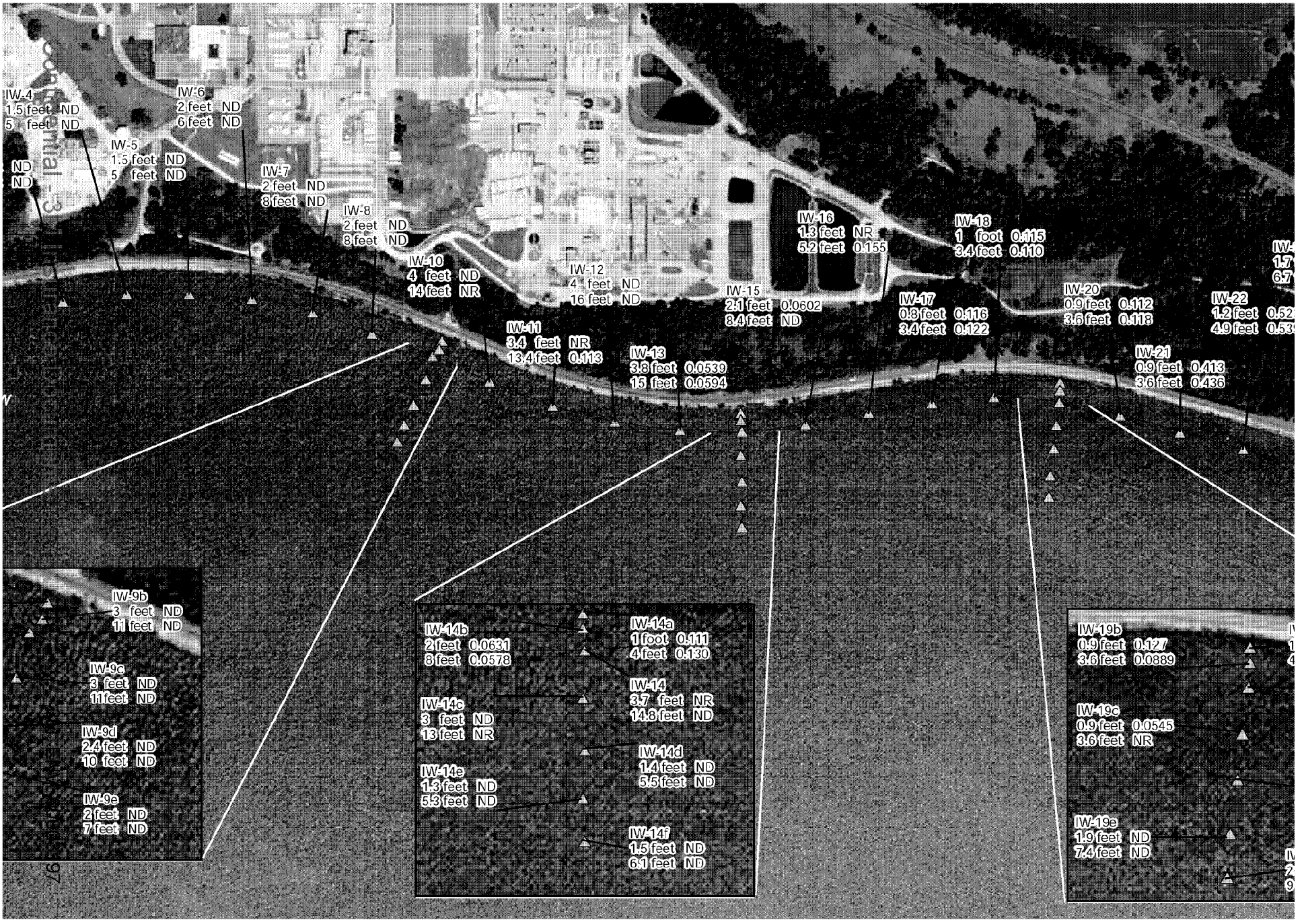


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Location

mit of Quantitation (LOQ)



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3M_MN01483122

oling Location

mit of Quantitation (LOQ)

WESTON

SUB



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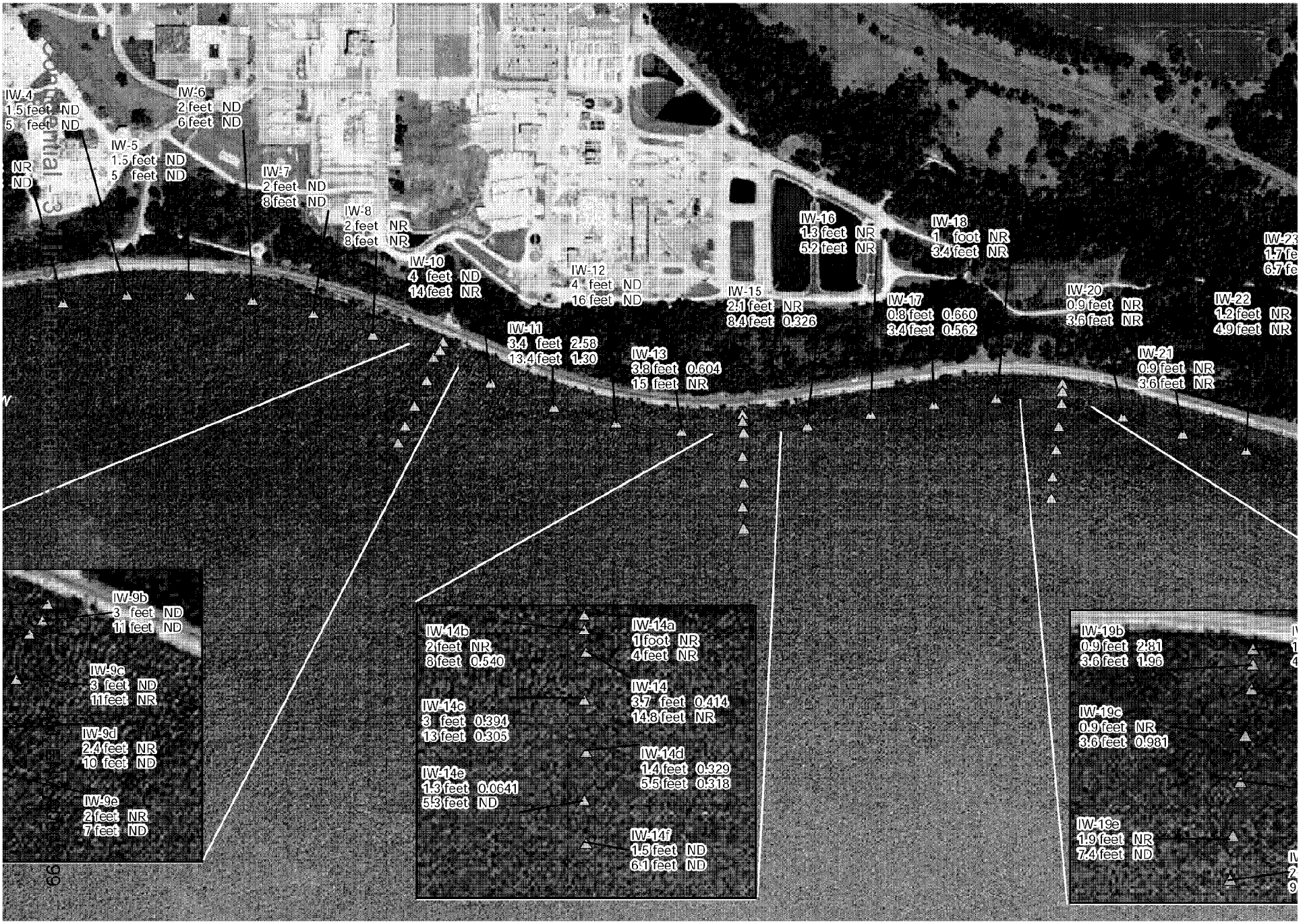
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mit of Quantitation (LOQ)

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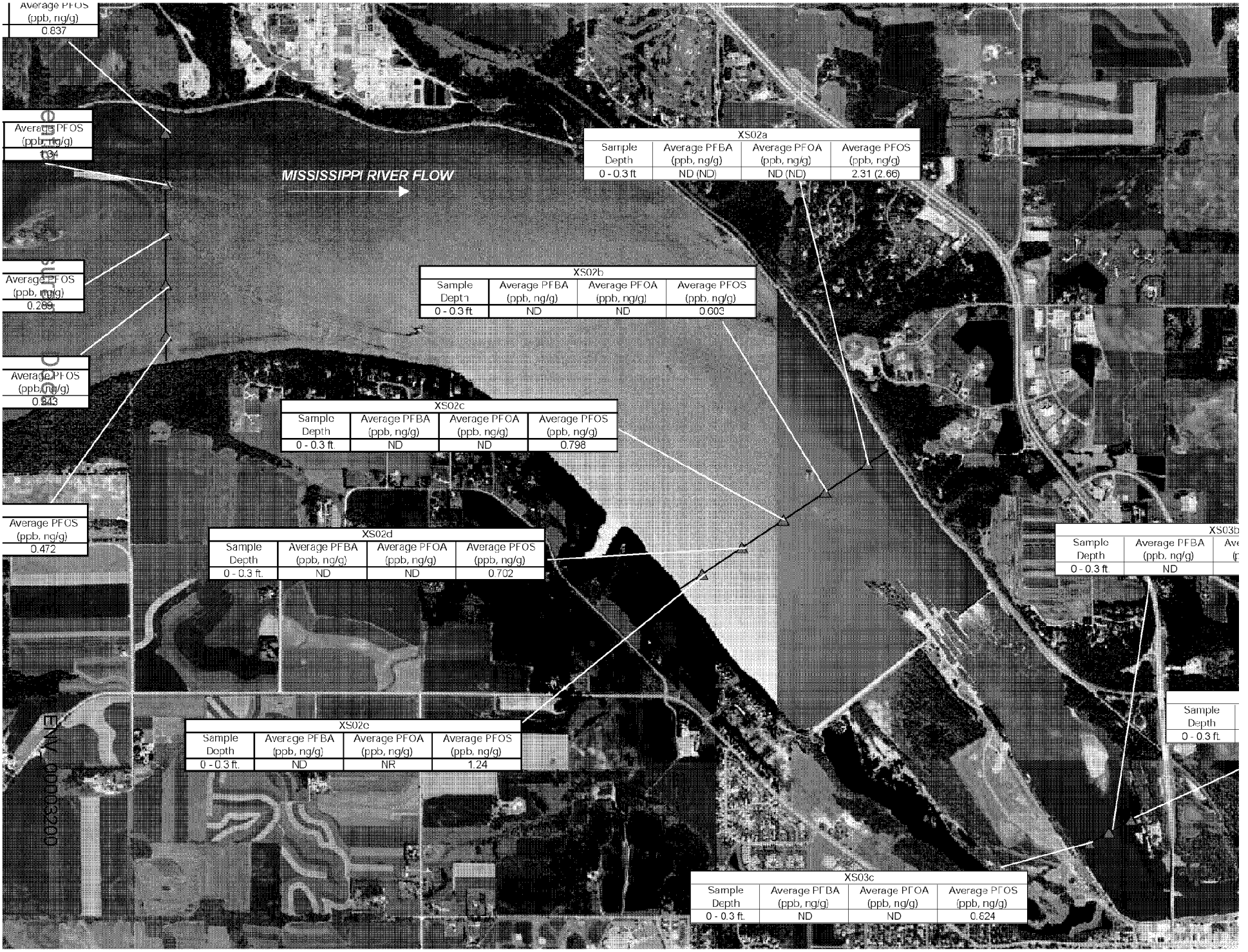
oling Location

mit of Quantitation (LOQ)

WESTON

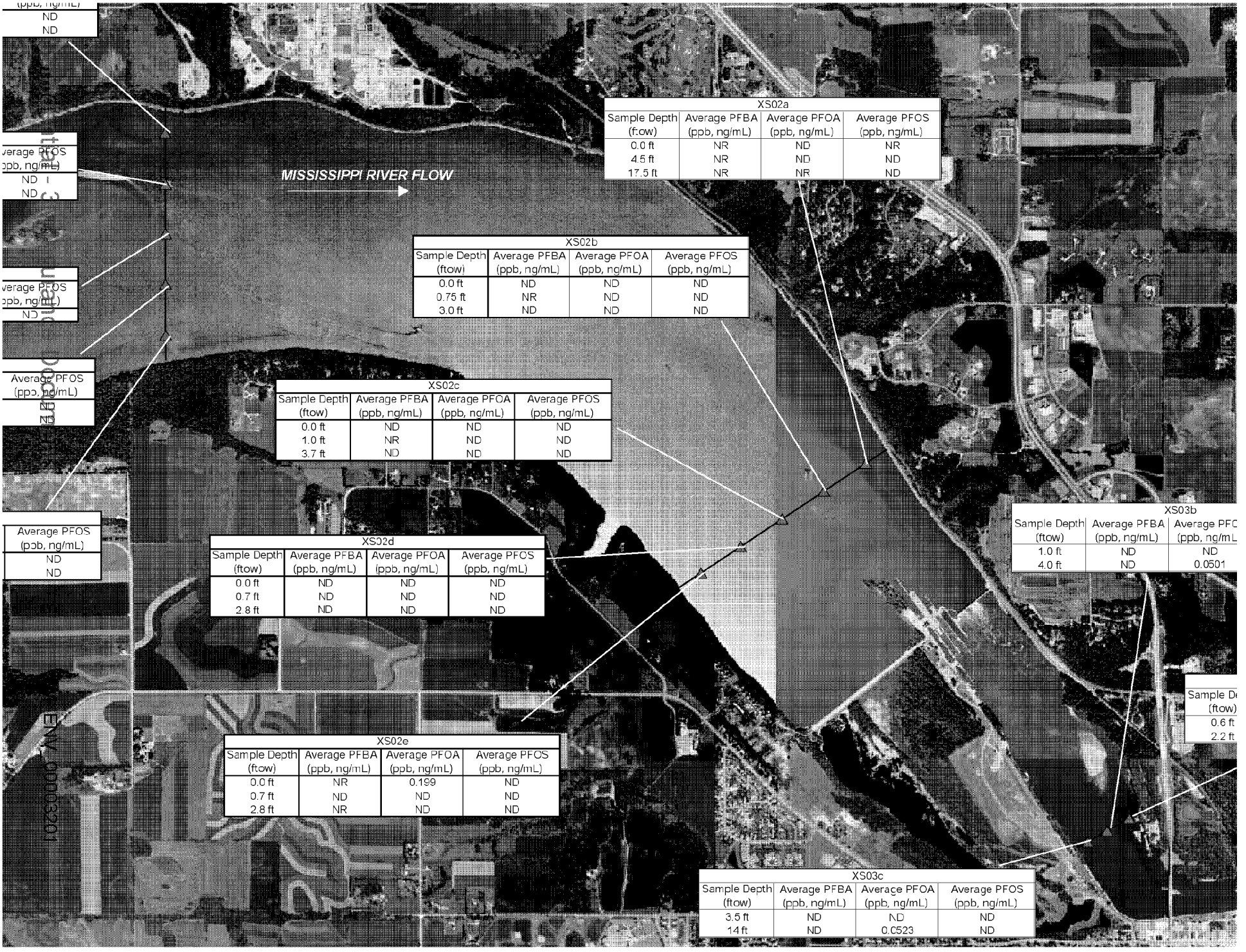
F

SUR



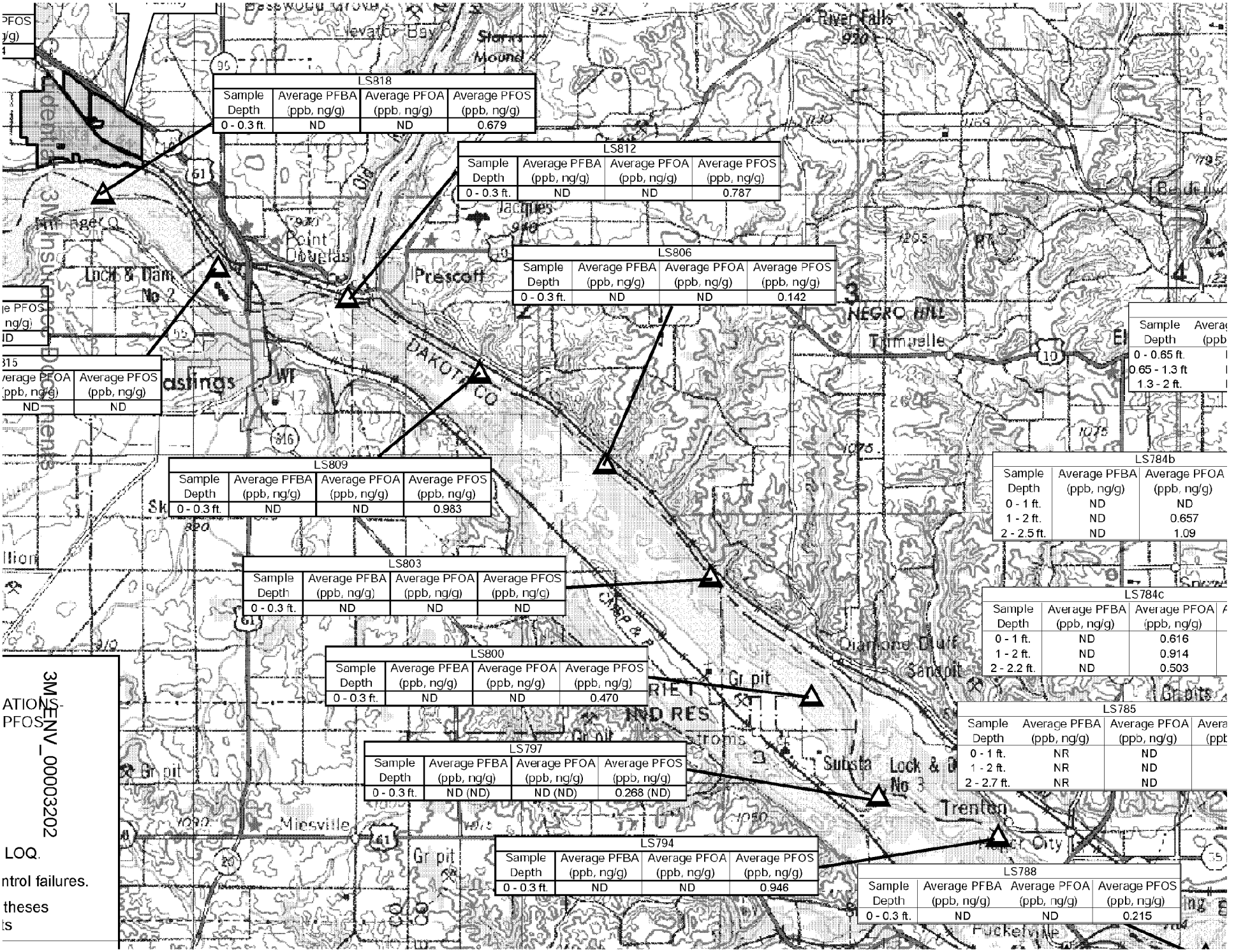
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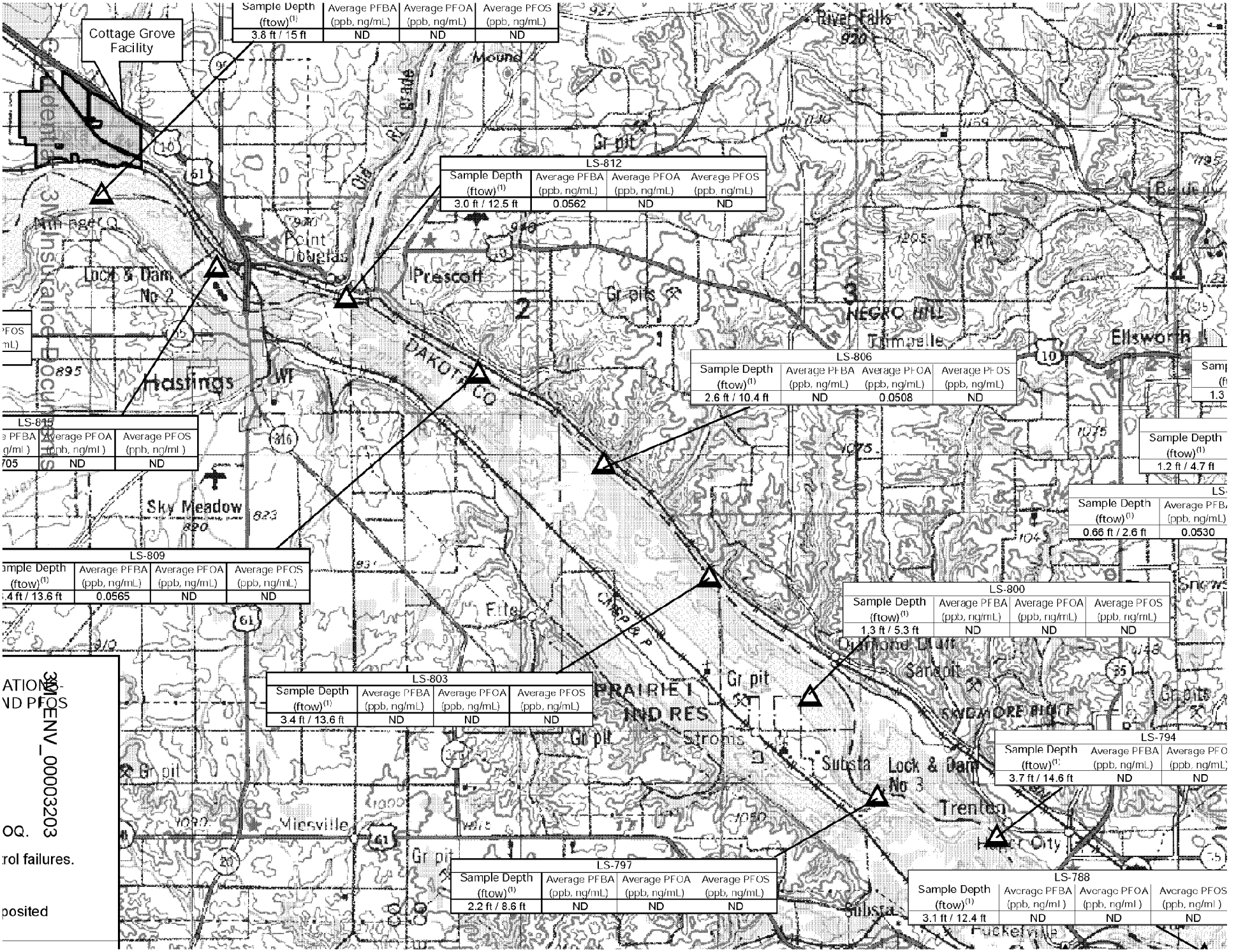


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3M_MN01483126


LS818
Sample Depth | Average PFBA (ppb, ng/g) | Average PFOA (ppb, ng/g) | Average PFOS (ppb, ng/g)
0 - 0.3 ft. | ND | ND | 0.679
LS812
Sample Depth | Average PFBA (ppb, ng/g) | Average PFOA (ppb, ng/g) | Average PFOS (ppb, ng/g)
0 - 0.3 ft. | ND | ND | 0.787
LS806
Sample Depth | Average PFBA (ppb, ng/g) | Average PFOA (ppb, ng/g) | Average PFOS (ppb, ng/g)
0 - 0.3 ft. | ND | ND | 0.142
LS809
Sample Depth | Average PFBA (ppb, ng/g) | Average PFOA (ppb, ng/g) | Average PFOS (ppb, ng/g)
0 - 0.3 ft. | ND | ND | 0.983
LS803
Sample Depth | Average PFBA (ppb, ng/g) | Average PFOA (ppb, ng/g) | Average PFOS (ppb, ng/g)
0 - 0.3 ft. | ND | ND | ND
LS800
Sample Depth | Average PFBA (ppb, ng/g) | Average PFOA (ppb, ng/g) | Average PFOS (ppb, ng/g)
0 - 0.3 ft. | ND | ND | 0.470
LS797
Sample Depth | Average PFBA (ppb, ng/g) | Average PFOA (ppb, ng/g) | Average PFOS (ppb, ng/g)
0 - 0.3 ft. | ND (ND) | ND (ND) | 0.268 (ND)
LS794
Sample Depth | Average PFBA (ppb, ng/g) | Average PFOA (ppb, ng/g) | Average PFOS (ppb, ng/g)
0 - 0.3 ft. | ND | ND | 0.946
LS784b
Sample Depth | Average PFBA (ppb, ng/g) | Average PFOA (ppb, ng/g)
0 - 1 ft. | ND | ND
1 - 2 ft. | ND | 0.657
2 - 2.5 ft. | ND | 1.09
LS784c
Sample Depth | Average PFBA (ppb, ng/g) | Average PFOA (ppb, ng/g)
0 - 1 ft. | ND | 0.616
1 - 2 ft. | ND | 0.914
2 - 2.2 ft. | ND | 0.503
LS785
Sample Depth | Average PFBA (ppb, ng/g) | Average PFOA (ppb, ng/g)
0 - 1 ft. | NR | ND
1 - 2 ft. | NR | ND
2 - 2.7 ft. | NR | ND
LS788
Sample Depth | Average PFBA (ppb, ng/g) | Average PFOA (ppb, ng/g) | Average PFOS (ppb, ng/g)
0 - 0.3 ft. | ND | ND | 0.215
Lock & Dam No 2
Prescott
Hastings
Point Douglas
Jacques
Starrs Mound
River Falls
Elevator Bay
Trimbelle
NEGRO HILL
DAKOTA CO
Diamond Bluff
Sandpit
Gr pit
Maiesville
Trenton
Pickelville
Lock & Dam No 3
3M Inspection Documents
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2162.0126


Cottage Grove Facility
Sample Depth (ftow)[1] | Average PFBA (ppb, ng/mL) | Average PFOA (ppb, ng/mL) | Average PFOS (ppb, ng/mL)
3.8 ft / 15 ft | ND | ND | ND
LS-812
Sample Depth (ftow)[1] | Average PFBA (ppb, ng/mL) | Average PFOA (ppb, ng/mL) | Average PFOS (ppb, ng/mL)
3.0 ft / 12.5 ft | 0.0562 | ND | ND
LS-806
Sample Depth (ftow)[1] | Average PFBA (ppb, ng/mL) | Average PFOA (ppb, ng/mL) | Average PFOS (ppb, ng/mL)
2.6 ft / 10.4 ft | ND | 0.0508 | ND
LS-815
Average PFBA (ppb, ng/mL) | Average PFOA (ppb, ng/mL) | Average PFOS (ppb, ng/mL)
ND | ND
LS-809
Sample Depth (ftow)[1] | Average PFBA (ppb, ng/mL) | Average PFOA (ppb, ng/mL) | Average PFOS (ppb, ng/mL)
13.6 ft | 0.0565 | ND | ND
LS-803
Sample Depth (ftow)[1] | Average PFBA (ppb, ng/mL) | Average PFOA (ppb, ng/mL) | Average PFOS (ppb, ng/mL)
3.4 ft / 13.6 ft | ND | ND | ND
LS-800
Sample Depth (ftow)[1] | Average PFBA (ppb, ng/mL) | Average PFOA (ppb, ng/mL) | Average PFOS (ppb, ng/mL)
1.3 ft / 5.3 ft | ND | ND | ND
LS-794
Sample Depth (ftow)[1] | Average PFBA (ppb, ng/mL) | Average PFO
3.7 ft / 14.6 ft | ND | ND
LS-797
Sample Depth (ftow)[1] | Average PFBA (ppb, ng/mL) | Average PFOA (ppb, ng/mL) | Average PFOS (ppb, ng/mL)
2.2 ft / 8.6 ft | ND | ND | ND
LS-788
Sample Depth (ftow)[1] | Average PFBA (ppb, ng/mL) | Average PFOA (ppb, ng/mL) | Average PFOS (ppb, ng/mL)
3.1 ft / 12.4 ft | ND | ND | ND
Sample Depth (ftow)[1]
1.2 ft / 4.7 ft
Average PFBA (ppb, ng/mL)
0.0530
Cottage Grove
Hastings
Lock & Dam No 2
Point Douglas
Prescott
River Falls
Mound
Ellsworth
Trimbelle
Sky Meadow
Miesville
Farm
Pits
Diamond Bluff
Sand pit
Gr pit
Gr pits
Stroms
Substa
Lock & Dam No 3
Trenton
Hager City
Fuckelville
PRAIRIE I IND RES
SYCAMORE RIDGE
DAKOTA CO
NEGRO HILL
Old Rte
Chippewa R
3M Insurance Documents
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2162.0127

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2162.0128

3M_ENV_00003204

3M_MN01483129

Table 4-1

Summary of Aquifer Parameters
Cottage Grove Site

Well ID	Distance to PW-05 (feet)	Theis Drawdown method		Cooper-Jacob method		Theis recovery method
		Transmissivity ($feet^2$/day)	Storativity	Transmissivity ($feet^2$/day)	Storativity	Transmissivity[1] ($feet^2$/day)
PW-05	0.0	--	--	--	--	16070
PW-06[2]	620.1	21370	5.2E-04	27130	4.0E-04	26110
PW-06[3]	620.1	27480	5.2E-04	18050	7.1E-04	
PZ-14[2]	230.1	8864	2.9E-03	12920	2.2E-03	22800
PZ-14[3]	230.1	10460	3.3E-03	14090	2.3E-03	
Geometric Mean:		15275	1.3.E-03	17279	1.1.E-03	21228

[1] - Recovery period analyzed was from 5/6/06 1:57 PM through 5/7/06 12:52 AM.

[2] - Pumping period 1 (5/7/06 6:20 AM through 5/7/06 9:02 AM).

[3] - Pumping period 2 (5/8/06 06:39 AM through 5/8/06 9:57 AM).

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2162.0129

3M_ENV_00003205

3M_MN01483130

Table 4-2
Groundwater PFBA, PFOA, PFBS, PFHS and PFOS Concentrations
September 2006

Sample ID	Well ID	Average PFBA (ppb, ng/mL)	Average PFOA (ppb, ng/mL)	Average PFBS (ppb, ng/mL)	Average PFHS (ppb, ng/mL)	Average PFOS (ppb, ng/mL)
CGMN-GW-MW103-0-060908	MW103	318	414	6.28	40.0	NR
CGMN-GW-MW104-0-060908	MW104	NR	619	26.1	11.1	NR
CGMN-GW-MW105-0-060908	MW105	76.3	NR	NR	NR	NR
CGMN-GW-MW106-0-060908	MW106	64.3	NR	12.1	7.76	NR
CGMN-GW-MW107-0-060908	MW107	29.7	24.6	23.0	6.47	NR
CGMN-GW-MW108-0-060907	MW108	219	NR	NR	16.4	NR
CGMN-GW-MW109-0-060907	MW109	23.3	199	2.11	NR	NR
CGMN-GW-MW110-0-060907	MW110	NR	136	20.5	15.0	26.0

NR = Not reported due to quality control failures.

Table 4-3
Soil Boring PFBS, PFHS, PFOS and PFOA Concentrations
June 2006

Sample ID	Sample Location	Sample Depth (bgs)	Average PFBS (ppb, ng/g)	Average PFHS (ppb, ng/g)	Average PFOS (ppb, ng/g)	Average PFOA (ppb, ng/g)
CGMN-SB-MW103-0-0000	MW103	0 - 0.5 ft.	ND	0.388	66.9	6.16
CGMN-SBC-MW103-0-0005		0.5 - 5 ft.	ND	ND	11.5	0.774
CGMN-SBC-MW103-0-0050		5 - 10 ft.	NR	ND	7.66	0.540
CGMN-SBC-MW103-0-0100		10 - 15 ft.	ND	ND	1.17	3.95
CGMN-SBC-MW103-0-0150		15 - 20 ft.	ND	ND	0.247	6.44
CGMN-SBC-MW103-0-0200		20 - 25 ft.	ND	ND	ND	3.14
CGMN-SB-MW104-0-0000	MW104	0 - 0.5 ft.	NR	ND	0.929	0.321
CGMN-SBC-MW104-0-0005		0.5 - 5 ft.	NR	0.783	60.4	12.5
CGMN-SBC-MW104-0-0050		5 - 10 ft.	NR	0.447	1.14	16.8
CGMN-SBC-MW104-0-0100		10 - 15 ft.	NR	0.227	ND	1.89
CGMN-SBC-MW104-0-0150		15 - 20 ft.	ND	0.154	ND	1.28
CGMN-SBC-MW104-0-0200		20 - 25 ft.	ND	ND	ND	0.460
CGMN-SBC-MW104-DB-0200		20 - 25 ft.	ND	ND	ND	0.511
CGMN-SB-MW105-0-0000	MW105	0 - 0.5 ft.	NR	1.98	161	7.94
CGMN-SB-MW105-0-0005		0.5 - 5 ft.	NR	1.38	318	15.2
CGMN-SBC-MW105-0-0050		5 - 10 ft.	0.283	NR	NR	205
CGMN-SBC-MW105-0-0100		10 - 15 ft.	0.536	5.81	27.8	74.6
CGMN-SBC-MW105-0-0150		15 - 20 ft.	0.276	0.706	1.16	5.27
CGMN-SBC-MW105-0-0200		20 - 25 ft.	NR	ND	0.672	0.690
CGMN-SB-MW106-0-0000	MW106	0 - 0.5 ft.	0.475	2.00	47.6	13.5
CGMN-SBC-MW106-0-0005		0.5 - 5 ft.	NR	61.8	653	185
CGMN-SBC-MW106-DB-0005		0.5 - 5 ft.	NR	47.7	599	145
CGMN-SBC-MW106-DB-0050 [1]		5 - 10 ft.	NR	21.1	163	142
CGMN-SBC-MW106-0-0100		10 - 15 ft.	NR	70.3	115	2080
CGMN-SBC-MW106-0-0150		15 - 20 ft.	NR	299	NR	5760
CGMN-SBC-MW106-0-0200		20 - 25 ft.	139	3470	35700	21800
CGMN-SB-MW107-0-0000	MW107	0 - 0.5 ft.	0.424	1.78	81.6	15.0
CGMN-SBC-MW107-0-0005		0.5 - 5 ft.	NR	14.5	256	232
CGMN-SBC-MW107-0-0050		5 - 10 ft.	1.75	NR	730	139
CGMN-SBC-MW107-0-0100		10 - 15 ft.	126	221	24200	1390
CGMN-SBC-MW107-DB-0100		10 - 15 ft.	127	NR	26600	1850
CGMN-SBC-MW107-0-0150		15 - 20 ft.	NR	315	104000	NR
CGMN-SBC-MW107-0-0200		20 - 25 ft.	10.1	122	57000	2340
CGMN-SB-MW108-0-0000	MW108	0 - 0.5 ft.	NR	0.475	209	3.02
CGMN-SBC-MW108-0-0005		0.5 - 5 ft.	0.295	0.450	230	NR
CGMN-SBC-MW108-0-0050		5 - 10 ft.	NR	0.787	130	63.3
CGMN-SBC-MW108-0-0100		10 - 15 ft.	NR	1.38	20.3	46.5
CGMN-SBC-MW108-0-0150		15 - 20 ft.	ND	0.789	23.0	18.1
CGMN-SBC-MW108-0-0200		20 - 25 ft.	ND	0.319	12.2	5.93
CGMN-SBC-MW108-DB-0200		20 - 25 ft.	ND	0.314	11.3	6.04
CGMN-SB-MW109-0-0000	MW109	0 - 0.5 ft.	NR	0.516	55.0	2.37
CGMN-SBC-MW109-0-0005		0.5 - 5 ft.	NR	0.409	82.2	1.42
CGMN-SBC-MW109-0-0050		5 - 10 ft.	NR	0.202	9.39	0.564
CGMN-SBC-MW109-0-0100		10 - 15 ft.	NR	0.682	10.2	6.57
CGMN-SBC-MW109-0-0150		15 - 20 ft.	NR	0.892	12.7	7.55
CGMN-SBC-MW109-DB-0150		15 - 20 ft.	NR	0.951	16.6	9.64
CGMN-SBC-MW109-0-0200		20 - 25 ft.	NR	1.81	14.6	30.7

[1] Sample is a primary sample but was incorrectly listed as a field duplicate sample in the laboratory data package

bgs = Below ground surface

ND = Not detected at or above Limit of Quantitation (LOQ) of 0.25 ng/g

NR = Not reported due to quality control failures.

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Table 4-3 (cont.)
Soil Boring PFBS, PFHS, PFOS and PFOA Concentrations
June 2006

Sample ID	Sample Location	Sample Depth (bgs)	Average PFBS (ppb, ng/g)	Average PFHS (ppb, ng/g)	Average PFOS (ppb, ng/g)	Average PFOA (ppb, ng/g)
CGMN-SB-D5B01-0-0000	D5B01	0 - 0.5 ft.	NR	0.215	16.1	2.57
CGMN-SBC-D5B01-0-0005		0.5 - 5 ft.	0.396	1.26	112	62.8
CGMN-SBC-D5B01-0-0050		5 - 10 ft.	NR	1.53	338	53.6
CGMN-SBC -D5B01-DB-0050		5 - 10 ft.	NR	1.12	298	41.5
CGMN-SBC-D5B01-0-0100		10 - 15 ft.	NR	4.09	143	68.9
CGMN-SBC-D5B01-0-0150		15 - 20 ft.	NR	6.00	43.6	146
CGMN-SBC-D5B01-0-0200		20 - 25 ft.	0.283	1.68	9.94	29.2
CGMN-SB-D5B02-0-0000	D5B02	0 - 0.5 ft.	ND	0.438	58.3	5.72
CGMN-SBC-D5B02-0-0005		0.5 - 5 ft.	ND	1.79	1640	29.2
CGMN-SBC-D5B02-0-0050		5 - 10 ft.	0.397	10.7	2650	88.5
CGMN-SBC-D5B02-0-0100		10 - 15 ft.	0.284	6.65	322	62.3
CGMN-SBC-D5B02-0-0150		15 - 20 ft.	0.244	15.3	28.1	186
CGMN-SBC-D5B02-0-0200		20 - 25 ft.	0.269	9.91	3.15	200
CGMN-SB-D5B03-0-0000	D5B03	0 - 0.5 ft.	NR	0.314	12.7	1.80
CGMN-SBC-D5B03-0-0005		0.5 - 5 ft.	0.938	0.422	116	16.8
CGMN-SBC-D5B03-0-0050		5 - 10 ft.	NR	0.272	140	29.4
CGMN-SBC-D5B03-0-0100		10 - 15 ft.	NR	0.683	133	17.5
CGMN-SBC-D5B03-0-0150		15 - 20 ft.	0.467	0.344	37.3	9.20
CGMN-SBC-D5B03-0-0200		20 - 25 ft.	NR	0.382	33.3	6.90
CGMN-SB-D5B04-0-0000	D5B04	0 - 0.5 ft.	NR	0.437	32.3	3.13
CGMN-SBC-D5B04-0-0005		0.5 - 5 ft.	NR	0.592	301	2.81
CGMN-SBC-D5B04-0-0050		5 - 10 ft.	NR	0.673	147	8.08
CGMN-SBC-D5B04-0-0100		10 - 15 ft.	NR	0.815	52.6	21.3
CGMN-SBC-D5B04-0-0150		15 - 20 ft.	NR	0.917	85.0	16.7
CGMN-SBC-D5E04-DB-0150		15 - 20 ft.	NR	0.869	89.0	17.0
CGMN-SBC-D5B04-0-0200		20 - 25 ft.	ND	0.661	38.7	25.7
CGMN-SB-D5B05-0-0000	D5B05	0 - 0.5 ft.	0.912	ND	9.25	0.587
CGMN-SBC-D5B05-0-0005		0.5 - 5 ft.	NR	1.66	59.2	18.8
CGMN-SBC-D5B05-0-0050		5 - 10 ft.	0.487	1.70	269	31.5
CGMN-SB-D5B06-0-0000	D5B06	0 - 0.5 ft.	NR	2.17	395	15.5
CGMN-SBC-D5B06-0-0005		0.5 - 5 ft.	NR	3.71	293	33.2
CGMN-SBC-D5B06-0-0050		5 - 10 ft.	1.67	4.12	66.6	33.7
CGMN-SBC-D5B06-0-0100		10 - 15 ft.	NR	18.45	247	33.4
CGMN-SBC-D5B06-0-0150		15 - 20 ft.	0.262	20.1	128	108
CGMN-SBC-D5B06-0-0200		20 - 25 ft.	ND	0.395	20.7	13.3
CGMN-SB-D9B01-0-0000	D9B01	0 - 0.5 ft.	0.370	NR	54.9	25.3
CGMN-SBC-D9B01-0-0005		0.5 - 5 ft.	1.14	39.0	1560	2860
CGMN-SBC-D9B01-0-0050		5 - 10 ft.	NR	23.2	154	3210
CGMN-SBC-D9E01-DB-0050		5 - 10 ft.	NR	20.5	176	3080
CGMN-SBC-D9B01-0-0100		10 - 15 ft.	NR	418	29500	8890
CGMN-SBC-D9B01-0-0150		15 - 20 ft.	NR	472	27800	10700
CGMN-SBC-D9B01-0-0200		20 - 25 ft.	2.14	29.2	1960	965

bgs = Below ground surface
ND = Not detected at or above Limit of Quantitation (LOQ) of 0.25 ng/g
NR = Not reported due to quality control failures.

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Table 4-3 (cont.)
Soil Boring PFBS, PFHS, PFOS and PFOA Concentrations
June 2006

Sample ID	Sample Location	Sample Depth (bgs)	Average PFBS (ppb, ng/g)	Average PFHS (ppb, ng/g)	Average PFOS (ppb, ng/g)	Average PFOA (ppb, ng/g)
CGMN-SB-D9B02-0-0000	D9B02	0 - 0.5 ft.	NR	1.64	70.1	15.9
CGMN-SBC-D9B02-0-0005		0.5 - 5 ft.	ND	0.935	123	4.68
CGMN-SBC-D9B02-0-0050		5 - 10 ft.	ND	1.91	78.0	25.6
CGMN-SBC-D9B02-0-0100		10 - 15 ft.	ND	2.62	60.8	38.9
CGMN-SBC-D9B02-0-0150		15 - 20 ft.	ND	0.662	15.4	8.55
CGMN-SBC-D9B02-0-0200		20 - 25 ft.	ND	1.46	39.7	19.9
CGMN-SB-D9B03-0-0000	D9B03	0 - 0.5 ft.	NR	0.914	131	3.40
CGMN-SBC-D9B03-0-0005		0.5 - 5 ft.	0.639	2.22	145	41.4
CGMN-SBC-D9B03-0-0050		5 - 10 ft.	NR	6.05	6.54	45.9
CGMN-SBC-D9B03-0-0100		10 - 15 ft.	0.803	0.725	1.01	0.283
CGMN-SBC-D9B03-0-0150		15 - 20 ft.	NR	0.733	9.05	1.37
CGMN-SBC-D9B03-DB-0150		15 - 20 ft.	NR	0.485	6.30	0.895
CGMN-SBC-D9B03-0-0200		20 - 25 ft.	0.218	0.488	2.26	0.0620
CGMN-SB-D9B04-0-0000	D9B04	0 - 0.5 ft.	NR	8.84	663	32.6
CGMN-SBC-D9B04-0-0005		0.5 - 5 ft.	5.85	52.7	391	390
CGMN-SBC-D9B04-0-0050		5 - 10 ft.	NR	17.6	3390	1320
CGMN-SBC-D9B04-0-0100		10 - 15 ft.	NR	150	9960	13400
CGMN-SBC-D9B04-0-0150		15 - 20 ft.	NR	88.9	4210	1200
CGMN-SBC-D9B04-0-0200		20 - 25 ft.	NR	14.0	1060	265

bgs = Below ground surface
ND = Not detected at or above Limit of Quantitation (LOQ) of 0.25 ng/g
NR = Not reported due to quality control failures.

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2162.0133

3M_ENV_00003209

3M_MN01483134

Table 4-4
Fire Training Area Soil PFBA, PFOA, PFBS, PFHS and PFOS Concentrations
September 2006

Sample ID	Sample Location	Sample Depth (bgs)	Average PFBA (ppb, ng/g) Dry Weight	Average PFOA (ppb, ng/g) Dry Weight	Average PFBS (ppb, ng/g) Dry Weight	Average PFHS (ppb, ng/g) Dry Weight	Average PFOS (ppb, ng/g) Dry Weight
CGMN-SS-FTA04-0-0000	FTA04	0 - 1 ft.	1.55	13.9	0.234	62.2	1026
CGMN-SB-FTA04-0-0020		2 - 3 ft.	0.994	9.31	0.224	53.8	NR
CGMN-SS-FTA05-0-0000	FTA05	0 - 1 ft.	3.19	24.4	1.00	48.5	458
CGMN-SS-FTA05-DB-0000		0 - 1 ft.	3.48	24.6	1.41	61.2	424
CGMN-SB-FTA05-0-0020		2 - 3 ft.	0.892	17.3	1.53	31.9	NR
CGMN-SS-FTA06-0-0000	FTA06	0 - 1 ft.	2.86	22.0	4.77	73.0	NR
CGMN-SB-FTA06-0-0020		2 - 3 ft.	9.07	262	24.6	NR	2948
CGMN-SS-FTA07-0-0000	FTA07	0 - 1 ft.	ND	6.08	ND	3.39	144
CGMN-SS-FTA08-0-0000	FTA08	0 - 1 ft.	0.306	NR	ND	1.99	23.3
CGMN-SB-FTA08-0-0020		2 - 3 ft.	ND	9.67	ND	5.98	145
CGMN-SS-FTA09-0-0000	FTA09	0 - 1 ft.	11.5	84.3	6.96	NR	747

ND = Not detected at or above the acceptable LOQ.
NR = Not reported due to quality control failures.
DB = Field duplicate sample.
bgs = Below ground surface

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2162.0134

3M_ENV_00003210

3M_MN01483135

Table 4-5
East Cove Surface Water PFBA, PFOA, PFBS, PFHS and PFOS Concentrations
September 2006

Sample ID	Sample Location	Sample Depth (ftow)	Average PFBA (ppb, ng/mL)	Average PFOA (ppb, ng/mL)	Average PFBS (ppb, ng/mL)	Average PFHS (ppb, ng/mL)	Average PFOS (ppb, ng/mL)
CGMN-SW-EC040-0-060914	EC-4	0 feet	NR	2.79	9.69	4.58	3.12
CGMN-SW-EC044-0-060914		1.67 feet	NR	2.40	9.20	4.03	NR
CGMN-SW-EC110-0-060914	EC-11	0 feet	NR	2.21	9.11	NR	NR
CGMN-SW-EC114-0-060914		0.67 feet	NR	2.29	9.24	4.11	1.15

NR = Not reported due to quality control failures.
ftow = From top of water surface

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2162.0135

3M_ENV_00003211

3M_MN01483136

Table 4-6
East Cove Sediment PFBA, PFOA, PFBS, PFHS and PFOS Concentrations
September 2006

Sample ID	Sample Location	Sample Interval	Average PFBA (ppb, ng/g) Dry Weight	Average PFOA (ppb, ng/g) Dry Weight	Average PFBS (ppb, ng/g) Dry Weight	Average PFHS (ppb, ng/g) Dry Weight	Average PFOS (ppb, ng/g) Dry Weight
CGMN-SD-EC057-0-060913	EC05	0 - 6 inches	16.3	18.2	2.29	1.13	NR
CGMN-SD-EC059-0-060913		20 - 26 inches	65.4	996	1.21	23.6	65450
CGMN-SD-EC059-DB-060913		20 - 26 inches	51.8	694	1.94	32.8	NR
CGMN-SD-EC058-0-060913		37 - 43 inches	18.3	1845	ND	0.612	NR
CGMN-SD-EC067-0-060913	EC06	0 - 6 inches	20.4	16.9	3.02	1.14	40.0
CGMN-SD-EC069-0-060913		36 - 42 inches	57.1	440	NR	49.8	58850
CGMN-SD-EC068-0-060913		65 - 71 inches	ND	3.11	ND	0.758	NR
CGMN-SD-EC077-0-060913	EC07	0 - 6 inches	18.6	7.90	4.18	2.45	1145
CGMN-SD-EC079-0-060913		14 - 20 inches	6.05	31.2	0.828	3.24	1985
CGMN-SD-EC078-0-060913		47 - 53 inches	ND	0.764	ND	ND	NR
CGMN-SD-EC087-0-060913	EC08	0 - 6 inches	19.2	NR	18.4	NR	NR
CGMN-SD-EC089-0-060913		30 - 36 inches	24.1	122	9.14	42.0	3590
CGMN-SD-EC088-0-060913		59 - 65 inches	30.8	335	2.03	49.8	NR
CGMN-SD-EC097-0-060913	EC09	0 - 6 inches	24.8	51.6	2.97	6.63	164
CGMN-SD-EC099-0-060913		20 - 26 inches	43.1	NR	NR	68.6	NR
CGMN-SD-EC098-0-060913		36 - 42 inches	14.0	113	1.78	51.6	9150
CGMN-SD-EC107-0-060913	EC10	0 - 6 inches	20.0	88.6	4.40	7.87	118
CGMN-SD-EC109-0-060913		14 - 20 inches	94.6	290	7.36	126	2965
CGMN-SD-EC108-0-060913		34 - 40 inches	14.0	121	1.85	34.8	2850
CGMN-SD-ECD017-0-060913	ECD01	0 - 6 inches	15.4	26.5	2.21	1.79	NR
CGMN-SD-ECD018-0-060913		8 - 14 inches	7.04	11.3	0.827	1.11	63.6

ND = Not detected at or above the acceptable LOQ.
NR = Not reported due to quality control failures.
DB = Field duplicate sample

Confidential - 3M Insurance Documents

2162.0136

3M_ENV_00003212

3M_MN01483137

Table 4-7
West Cove Surface Water PFBA, PFOA, PFBS, PFHS and PFOS Concentrations
September 2006

Sample ID	Sample Location	Sample Depth (ftow)	Average PFBA (ppb, ng/mL)	Average PFOA (ppb, ng/mL)	Average PFBS (ppb, ng/mL)	Average PFHS (ppb, ng/mL)	Average PFOS (ppb, ng/mL)
CGMN-SW-WC040-0-060920	WC-4	0 feet	0.325	0.240	ND	0.137	1.03
CGMN-SW-WC044-0-060920		0.5 feet	NR	0.284	ND	0.148	1.70
CGMN-SW-WC080-0-060920	WC-8	0 feet	NR	0.182	0.389	0.0936	0.241
CGMN-SW-WC081-0-060920		0.5 feet	1.01	0.174	0.420	NR	0.227
CGMN-SW-WC082-0-060920		2 feet	0.803	0.172	0.304	0.106	NR

ND = Not detected at or above the acceptable LOQ.
NR = Not reported due to quality control failures.
ftow = From top of water surface

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2162.0137

3M_ENV_00003213

3M_MN01483138

Table 4-8
West Cove Sediment PFBA, PFOS, PFBS, PFHS and PFOS Concetrations
September 2006

Sample ID	Sample Location	Sample Interval	Average PFBA (ppb, ng/g) Dry Weight	Average PFOA (ppb, ng/g) Dry Weight	Average PFBS (ppb, ng/g) Dry Weight	Average PFHS (ppb, ng/g) Dry Weight	Average PFOS (ppb, ng/g) Dry Weight
CGMN-SD-WC057-0-060920	WC05	0 - 6 inches	4.50	12.9	ND	3.10	65.8
CGMN-SD-WC058-0-060920		6 - 12 inches	5.07	12.1	ND	2.70	126
CGMN-SD-WC058-DB-060920		6 - 12 inches	4.55	10.9	0.284	2.02	108
CGMN-SD-WC067-0-060920	WC06	0 - 6 inches	4.06	11.2	ND	2.22	66.5
CGMN-SD-WC068-0-060920		6 - 12 inches	4.93	14.8	ND	1.70	133
CGMN-SD-WC077-0-060920	WC07	0 - 6 inches	NR	15.9	ND	2.51	68.1
CGMN-SD-WC078-0-060920		12 - 18 inches	7.58	15.7	ND	3.49	137

ND = Not detected at or above the acceptable LOQ.
NR = Not reported due to quality control failures.
DB = Field duplicate sample

Table 4-9
Porewater PFBA, PFOA, PFBS, PFHS and PFOS Concentrations
September/October 2006

Sample ID	Sample Location	AVG PFBA (ppb, ng/mL)	AVG PFOA (ppb, ng/mL)	AVG PFBS (ppb, ng/mL)	AVG PFHS (ppb, ng/mL)	AVG PFOS (ppb, ng/mL)
CGMN-IW-MRIW01-0-060912	IW01	ND	0.0850	ND	ND	0.0509
CGMN-IW-MRIW02-0-060913	IW02	NR	0.0565	ND	ND	0.652
CGMN-IW-MRIW03-0-060914	IW03	0.0979	0.120	ND	ND	0.114
CGMN-IW-MRIW04-0-060914	IW04	NR	0.0543	ND	ND	0.0457
CGMN-IW-MRIW05-0-060914	IW05	0.135	0.0327	ND	ND	0.0382
CGMN-IW-MRIW06-0-060914	IW06	0.146	0.0498	ND	ND	0.0517
CGMN-IW-MRIW07-0-060913	IW07	ND	0.0429	ND	ND	NR
CGMN-IW-MRIW08-0-060913	IW08	ND	0.0505	ND	ND	0.0270
CGMN-IW-MRIW09-0-060919	IW09	5.01	2.69	NR	NR	1.09
CGMN-IW-MRIW09a-0-061003	IW09a	NR	21.5	0.654	3.18	2.69
CGMN-IW-MRIW09b-0-061003	IW09b	1.58	0.586	NR	NR	0.114
CGMN-IW-MRIW09c-0-061003	IW09c	0.510	0.573	ND	0.0540	0.166
CGMN-IW-MRIW09d-0-061003	IW09d	0.112	ND	ND	ND	ND
CGMN-IW-MRIW09e-0-061003	IW09e	0.0898	NR	ND	ND	0.0278
CGMN-IW-MRIW09f-0-060919	IW09f	NR	0.0541	ND	ND	ND
CGMN-IW-MRIW10-0-061003	IW10	NR	8.12	1.23	0.488	0.0550
CGMN-IW-MRIW11-0-060919	IW11	103	NR	NR	5.65	14.0
CGMN-IW-MRIW12-0-061003	IW12	NR	NR	0.1555	ND	ND
CGMN-IW-MRIW13-0-060921	IW13	183	48.5	NR	2.55	1.52
CGMN-IW-MRIW14-0-060921	IW14	281	300	24.0	8.66	12.4
CGMN-IW-MRIW14a-0-060921	IW14a	935	699	113	27.4	31.3
CGMN-IW-MRIW14b-0-060921	IW14b	695	436	68.2	14.8	12.2
CGMN-IW-MRIW14c-0-060921	IW14c	73.1	12.9	1.81	NR	NR
CGMN-IW-MRIW14d-0-060921	IW14d	0.282	ND	ND	ND	ND
CGMN-IW-MRIW14e-0-060921	IW14e	NR	ND	ND	ND	0.0522
CGMN-IW-MRIW14f-0-060921	IW14f	0.178	ND	ND	ND	ND
CGMN-IW-MRIW15-0-060921	IW15	81.1	12.2	2.01	NR	0.0511
CGMN-IW-MRIW16-0-060915	IW16	4.40	0.250	NR	ND	ND
CGMN-IW-MRIW17-0-060915	IW17	NR	2.15	0.106	0.163	1.32
CGMN-IW-MRIW18-0-060915	IW18	NR	2.06	0.361	0.493	2.91
CGMN-IW-MRIW19-0-060915	IW19	86.6	28.9	NR	1.74	NR
CGMN-IW-MRIW19a-0-060919	IW19a	172	NR	16.8	4.82	47.0
CGMN-IW-MRIW19b-0-060919	IW19b	NR	118	5.69	3.64	53.1
CGMN-IW-MRIW19c-0-060919	IW19c	NR	34.3	4.74	1.26	NR
CGMN-IW-MRIW19d-0-060919	IW19d	1.40	0.184	0.106	0.110	0.0813
CGMN-IW-MRIW19e-0-060919	IW19e	0.108	ND	NR	ND	0.257
CGMN-IW-MRIW19f-0-060919	IW19f	118	6.84	3.14	0.504	1.71
CGMN-IW-MRIW20-0-060915	IW20	150	88.1	NR	6.01	0.635
CGMN-IW-MRIW21-0-060915	IW21	NR	1.50	0.138	0.120	0.150
CGMN-IW-MRIW22-0-060915	IW22	NR	NR	0.283	0.299	2.40
CGMN-IW-MRIW23-0-060915	IW23	139	78.6	7.23	3.15	15.0
CGMN-IW-MRIW24-0-060915	IW24	157	758	16.3	309	NR
CGMN-IW-MRIW25-0-060915	IW25	23.1	129	4.26	3.88	206

ND = Not detected at or above acceptable LOQ.
NR = Not reported due to quality control failures.

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Confidential - 3M Insurance Documents
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Table 4-10
Mississippi River Sediment (Porewater Locations) PFBA, PFOA, PFBS, PFHS and PFOS Concentrations
September 2006

Sample ID	Sample Location	Sample Interval	Average PFBA (ppb, ng/g) Dry Weight	Average PFOA (ppb, ng/g) Dry Weight	Average PFBS (ppb, ng/g) Dry Weight	Average PFHS (ppb, ng/g) Dry Weight	Average PFOS (ppb, ng/g) Dry Weight
CGMN-SD-MRIW011-0-060914	IW01	0 - 4 inches	ND	ND	ND	ND	0.458
CGMN-SD-MRIW012-0-060914		4 - 8 inches	ND	ND	ND	ND	ND
CGMN-SD-MRIW021-0-060914	IW02	0 - 4 inches	ND	ND	ND	ND	0.321
CGMN-SD-MRIW022-0-060914		4 - 8 inches	ND	ND	ND	ND	ND
CGMN-SD-MRIW031-0-060915	IW03	0 - 4 inches	ND	ND	ND	ND	0.363
CGMN-SD-MRIW032-0-060915		4 - 8 inches	ND	0.645	ND	ND	ND
CGMN-SD-MRIW033-0-060915		14 - 18 inches	ND	0.493	ND	ND	ND
CGMN-SD-MRIW041-0-060914	IW04	0 - 4 inches	ND	ND	ND	ND	0.230
CGMN-SD-MRIW042-0-060914		4 - 8 inches	ND	ND	ND	ND	2.91
CGMN-SD-MRIW051-0-060914	IW05	0 - 4 inches	ND	ND	ND	ND	0.320
CGMN-SD-MRIW052-0-060914		4 - 8 inches	ND	0.255	ND	ND	1.00
CGMN-SD-MRIW061-0-060914	IW06	0 - 4 inches	ND	0.427	ND	ND	0.469
CGMN-SD-MRIW062-0-060914		4 - 8 inches	ND	0.298	ND	ND	0.875
CGMN-SD-MRIW062-DB-060914		4 - 8 inches	ND	0.249	ND	ND	0.791
CGMN-SD-MRIW071-0-060914	IW07	0 - 4 inches	ND	ND	ND	ND	0.502
CGMN-SD-MRIW072-0-060914		4 - 8 inches	ND	ND	ND	ND	ND
CGMN-SD-MRIW081-0-060914	IW08	0 - 4 inches	ND	ND	ND	ND	0.753
CGMN-SD-MRIW082-0-060914		4 - 8 inches	ND	0.291	0.238	ND	0.294
CGMN-SD-MRIW091-0-060915	IW09	0 - 4 inches	ND	ND	ND	ND	0.589
CGMN-SD-MRIW092-0-060915		4 - 8 inches	4.15	2.08	ND	ND	NR
CGMN-SD-MRIW09a1-0-060918	IW09a	0 - 4 inches	NR	11.2	0.289	1.08	27.0
CGMN-SD-MRIW09a2-0-060918		4 - 8 inches	2.82	12.7	ND	0.952	18.0
CGMN-SD-MRIW09b1-0-060919	IW09b	0 - 4 inches	ND	2.75	ND	ND	1.60
CGMN-SD-MRIW09b2-0-060919		4 - 8 inches	ND	ND	ND	ND	5.62
CGMN-SD-MRIW09b3-0-060919		14 - 18 inches	2.16	0.565	ND	ND	3.03
CGMN-SD-MRIW09c1-0-060918	IW09c	0 - 4 inches	ND	0.508	ND	ND	0.802
CGMN-SD-MRIW09c2-0-060918		4 - 8 inches	2.93	NR	ND	0.237	0.230
CGMN-SD-MRIW09d1-0-060918	IW09d	0 - 4 inches	ND	ND	ND	ND	0.358
CGMN-SD-MRIW09d2-0-060918		4 - 8 inches	ND	ND	ND	ND	0.616
CGMN-SD-MRIW09e1-0-060918	IW09e	0 - 4 inches	ND	ND	ND	ND	0.279
CGMN-SD-MRIW09e2-0-060918		4 - 8 inches	ND	ND	ND	ND	ND
CGMN-SD-MRIW09f1-0-060918	IW09f	0 - 4 inches	ND	ND	ND	ND	0.737
CGMN-SD-MRIW09f2-0-060918		4 - 8 inches	ND	ND	ND	ND	0.949
CGMN-SD-MRIW101-0-060915	IW10	0 - 4 inches	10.0	6.85	ND	0.332	1.37
CGMN-SD-MRIW102-0-060915		4 - 8 inches	124	77.8	2.28	5.03	5.48
CGMN-SD-MRIW111-0-060915	IW11	0 - 4 inches	NR	NR	1.03	0.582	4.84
CGMN-SD-MRIW112-0-060915		4 - 8 inches	13.0	12.4	5.87	2.45	20.1
CGMN-SD-MRIW121-0-060915	IW12	0 - 4 inches	2.03	2.39	ND	ND	4.12
CGMN-SD-MRIW122-0-060915		4 - 8 inches	NR	1.64	ND	ND	0.720
CGMN-SD-MRIW131-0-060915	IW13	0 - 4 inches	ND	0.846	ND	ND	3.62
CGMN-SD-MRIW132-0-060915		4 - 8 inches	15.3	6.67	0.846	ND	1.14
CGMN-SD-MRIW133-0-060915		19.5 - 24 inches	10.1	NR	0.384	ND	0.483
CGMN-SD-MRIW141-0-060915	IW14	0 - 4 inches	ND	1.34	ND	ND	4.20
CGMN-SD-MRIW142-0-060915		4 - 8 inches	27.3	2.34	1.30	ND	0.785
CGMN-SD-MRIW14a1-0-060919	IW14a	0 - 4 inches	62.2	126	11.1	NR	74.5
CGMN-SD-MRIW14a2-0-060919		4 - 8 inches	18.6	33.5	3.41	1.13	11.6
CGMN-SD-MRIW14b1-0-060919	IW14b	0 - 4 inches	12.5	23.8	1.58	0.693	NR
CGMN-SD-MRIW14b2-0-060919		4 - 8 inches	264	341	29.4	11.5	38.3
CGMN-SD-MRIW14c1-0-060919	IW14c	0 - 4 inches	64.5	106	8.27	4.61	10.4
CGMN-SD-MRIW14c2-0-060919		4 - 8 inches	87.8	78.1	10.5	3.28	11.0
CGMN-SD-MRIW14d1-0-060919	IW14d	0 - 4 inches	ND	ND	ND	ND	ND
CGMN-SD-MRIW14d2-0-060919		4 - 8 inches	ND	0.396	ND	ND	ND
CGMN-SD-MRIW14e1-0-060919	IW14e	0 - 4 inches	ND	ND	ND	ND	ND
CGMN-SD-MRIW14e2-0-060919		4 - 8 inches	ND	ND	ND	ND	ND
CGMN-SD-MRIW14f1-0-060919	IW14f	0 - 4 inches	ND	ND	ND	ND	0.513
CGMN-SD-MRIW14f2-0-060919		4 - 8 inches	NR	0.322	ND	ND	ND

ND = Not detected at or above the acceptable LOQ.
NR = Not reported due to quality control failures.
DB = Field duplicate sample

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Table 4-10 (cont.)
Mississippi River Sediment (Pore Water Locations) PFBA, PFOA, PFBS, PFHS and PFOS Concentrations
September 2006

Sample ID	Sample Location	Sample Interval	Average PFBA (ppb, ng/g) Dry Weight	Average PFOA (ppb, ng/g) Dry Weight	Average PFBS (ppb, ng/g) Dry Weight	Average PFHS (ppb, ng/g) Dry Weight	Average PFOS (ppb, ng/g) Dry Weight
CGMN-SD-MRIW151-0-060915	IW15	0 - 4 inches	NR	12.3	0.446	ND	1.31
CGMN-SD-MRIW152-0-060915		4 - 8 inches	93.2	95.1	NR	3.41	ND
CGMN-SD-MRIW161-0-060915	IW16	0 - 4 inches	ND	0.222	ND	ND	0.654
CGMN-SD-MRIW162-0-060915		4 - 8 inches	1.87	0.398	ND	ND	ND
CGMN-SD-MRIW163-0-060915		16 - 20 inches	NR	0.459	ND	ND	ND
CGMN-SD-MRIW171-0-060915	IW17	0 - 4 inches	ND	0.361	ND	ND	1.47
CGMN-SD-MRIW172-0-060915		4 - 8 inches	ND	1.05	ND	ND	NR
CGMN-SD-MRIW181-0-060915	IW18	0 - 4 inches	ND	0.649	ND	ND	3.17
CGMN-SD-MRIW182-0-060915		4 - 8 inches	0.336	2.41	ND	ND	5.19
CGMN-SD-MRIW191-0-060915	IW19	0 - 4 inches	ND	1.02	ND	ND	3.53
CGMN-SD-MRIW192-0-060915		4 - 8 inches	ND	1.28	ND	ND	NR
CGMN-SD-MRIW19a1-0-060918	IW19a	0 - 4 inches	40.9	9.82	2.25	0.505	44.3
CGMN-SD-MRIW19a2-0-060918		4 - 8 inches	104	26.0	5.54	1.17	79.0
CGMN-SD-MRIW19b1-0-060918	IW19b	0 - 4 inches	ND	1.34	ND	ND	6.86
CGMN-SD-MRIW19b2-0-060918		4 - 8 inches	1.26	4.86	ND	0.612	34.7
CGMN-SD-MRIW19c1-0-060918	IW19c	0 - 4 inches	1.65	NR	ND	ND	1.81
CGMN-SD-MRIW19c2-0-060918		4 - 8 inches	28.2	27.6	0.894	0.869	ND
CGMN-SD-MRIW19d1-0-060918	IW19d	0 - 4 inches	ND	ND	ND	ND	0.295
CGMN-SD-MRIW19d2-0-060918		4 - 8 inches	ND	0.459	ND	ND	ND
CGMN-SD-MRIW19e1-0-060918	IW19e	0 - 4 inches	ND	ND	ND	ND	0.535
CGMN-SD-MRIW19e2-0-060918		4 - 8 inches	0.539	ND	ND	ND	ND
CGMN-SD-MRIW19f1-0-060918	IW19f	0 - 4 inches	20.4	10.7	1.47	0.280	1.42
CGMN-SD-MRIW19f2-0-060918		4 - 8 inches	70.1	42.7	NR	1.89	0.937
CGMN-SD-MRIW201-0-060915	IW20	0 - 4 inches	3.41	0.296	ND	ND	1.42
CGMN-SD-MRIW202-0-060915		4 - 8 inches	26.9	1.39	0.569	ND	3.86
CGMN-SD-MRIW211-0-060915	IW21	0 - 4 inches	ND	0.221	ND	ND	1.35
CGMN-SD-MRIW212-0-060915		4 - 8 inches	ND	0.492	ND	ND	2.54
CGMN-SD-MRIW221-0-060919	IW22	0 - 4 inches	0.609	0.714	0.215	ND	NR
CGMN-SD-MRIW222-0-060919		4 - 8 inches	0.436	2.31	ND	ND	7.91
CGMN-SD-MRIW223-0-060919		19.5 - 23.5 inches	1.71	2.94	ND	0.430	29.1
CGMN-SD-MRIW231-0-060918	IW23	0 - 4 inches	NR	3.10	1.40	0.742	17.4
CGMN-SD-MRIW232-0-060918		4 - 8 inches	53.4	32.0	3.97	1.77	59.4
CGMN-SD-MRIW241-0-060918	IW24	0 - 4 inches	1.22	5.96	0.274	1.55	30.7
CGMN-SD-MRIW242-0-060918		16 - 20 inches	0.345	3.44	ND	0.634	24.0
CGMN-SD-MRIW251-0-060918	IW25	0 - 4 inches	NR	87.0	1.08	5.38	NR
CGMN-SD-MRIW252-0-060918		4 - 8 inches	35.3	130	1.14	6.01	168

ND = Not detected at or above the acceptable LOQ.
NR = Not reported due to quality control failures.

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Table 4-11
Mississippi River Surface Water (Porewater Locations) PFBA, PFOA, PFBS, PFHS and PFOS Concentrations
September/October 2006

Sample ID	Sample Location	Sample Depth (ftow)	Average PFBA (ppb, ng/mL)	Average PFOA (ppb, ng/mL)	Average PFBS (ppb, ng/mL)	Average PFHS (ppb, ng/mL)	Average PFOS (ppb, ng/mL)
CGMN-SW-MRIW011-0-060912	IW01	2 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW012-0-060912		8 feet	ND	ND	ND	ND	ND
CGMNSW-MRIW021-0-060913	IW02	1.5 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW022-0-060913		6.5 feet	NR	ND	NR	ND	ND
CGMN-SW-MRIW031-0-060914	IW03	1.5 feet	NR	ND	NR	ND	ND
CGMN-SW-MRIW032-0-060914		4.5 feet	ND	0.0518	ND	ND	ND
CGMN-SW-MRIW041-0-060914	IW04	1.5 feet	ND	0.0608	ND	ND	ND
CGMN-SW-MRIW042-0-060914		5 feet	ND	0.0551	ND	ND	ND
CGMN-SW-MRIW051-0-060914	IW05	1.5 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW052-0-060914		5 feet	ND	ND	ND	ND	ND
CGMNSW-MRIW061-0-060914	IW06	2 feet	ND	0.0557	ND	ND	ND
CGMN-SW-MRIW062-0-060914		6 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW071-0-060913	IW07	2 feet	ND	ND	NR	ND	ND
CGMN-SW-MRIW072-0-060913		8 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW081-0-060913	IW08	2 feet	NR	ND	NR	ND	ND
CGMN-SW-MRIW082-0-060913		8 feet	NR	ND	NR	ND	ND
CGMN-SW-MRIW091-0-060919	IW09	2.8 feet	1.24	0.192	NR	NR	0.162
CGMN-SW-MRIW092-0-060919		11 feet	NR	0.187	NR	0.104	0.183
CGMN-SW-MRIW09a1-0-061003	IW09a	2 feet	NR	ND	NR	ND	ND
CGMN-SW-MRIW09a2-0-061003		8 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW09b1-0-061003	IW09b	3 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW09b2-0-061003		11 feet	ND	0.530	NR	ND	ND
CGMN-SW-MRIW09c1-0-061003	IW09c	3 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW09c2-0-061003		11 feet	NR	0.543	ND	ND	ND
CGMN-SW-MRIW09d1-0-061003	IW09d	2.4 feet	NR	0.0649	NR	ND	ND
CGMN-SW-MRIW09d2-0-061003		10 feet	ND	NR	NR	ND	ND
CGMN-SW-MRIW09e1-0-061003	IW09e	2 feet	NR	0.0671	ND	ND	ND
CGMN-SW-MRIW09e2-0-061003		7 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW09f1-0-060919	IW09f	1.4 feet	0.405	ND	NR	ND	ND
CGMN-SW-MRIW09f2-0-060919		5.8 feet	0.477	0.0535	0.168	ND	ND
CGMN-SW-MRIW101-0-061003	IW10	4 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW102-0-061003		14 feet	NR	0.0750	NR	NR	NR
CGMN-SW-MRIW111-0-060919	IW11	3.4 feet	2.58	0.323	0.889	NR	NR
CGMN-SW-MRIW112-0-060919		13.4 feet	1.30	NR	NR	NR	0.113
CGMN-SW-MRIW121-0-061003	IW12	4 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW122-0-061003		16 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW131-0-060921	IW13	3.8 feet	0.604	0.0740	NR	NR	0.0539
CGMN-SW-MRIW132-0-060921		15 feet	NR	0.0654	0.216	ND	0.0594
CGMN-SW-MRIW141-0-060921	IW14	3.7 feet	0.414	0.0532	0.159	ND	NR
CGMN-SW-MRIW142-0-060921		14.8 feet	NR	0.0566	NR	NR	ND
CGMN-SW-MRIW14a1-0-060921	IW14a	1 foot	NR	NR	0.371	0.0626	0.111
CGMN-SW-MRIW14a2-0-060921		4 feet	NR	0.760	0.481	0.0763	0.130
CGMN-SW-MRIW14b1-0-060921	IW14b	2 feet	NR	0.195	0.237	ND	0.0631
CGMN-SW-MRIW14b2-0-060921		8 feet	0.540	0.158	0.219	ND	0.0578
CGMN-SW-MRIW14c1-0-060921	IW14c	3 feet	0.394	NR	NR	ND	ND
CGMN-SW-MRIW14c2-0-060921		13 feet	0.305	NR	0.137	NR	NR
CGMN-SW-MRIW14d1-0-060921	IW14d	1.4 feet	0.329	ND	0.129	ND	ND
CGMN-SW-MRIW14d2-0-060921		5.5 feet	0.318	ND	0.135	ND	ND
CGMN-SW-MRIW14e1-0-060921	IW14e	1.3 feet	0.0641	0.0538	NR	ND	ND
CGMN-SW-MRIW14e2-0-060921		5.3 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW14f1-0-060921	IW14f	1.5 feet	ND	ND	NR	ND	ND
CGMN-SW-MRIW14f2-0-060921		6.1 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW151-0-060921	IW15	2.1 feet	NR	0.153	0.198	ND	0.0602
CGMN-SW-MRIW152-0-060921		8.4 feet	0.326	0.0845	0.136	ND	ND
CGMN-SW-MRIW161-0-060915	IW16	1.3 feet	NR	0.198	0.149	ND	NR
CGMN-SW-MRIW162-0-060915		5.2 feet	NR	0.150	NR	0.0591	0.155
CGMN-SW-MRIW171-0-060915	IW17	0.8 feet	0.660	0.144	0.136	ND	0.116
CGMN-SW-MRIW172-0-060915		3.4 feet	0.562	0.145	0.123	ND	0.122
CGMN-SW-MRIW181-0-060915	IW18	0.8 feet	NR	0.149	0.126	ND	0.115
CGMN-SW-MRIW182-0-060915		3.4 feet	NR	0.142	0.117	ND	0.110
CGMN-SW-MRIW191-0-060915	IW19	0.9 feet	NR	0.119	0.113	ND	0.105
CGMN-SW-MRIW192-0-060915		3.5 feet	NR	0.126	NR	NR	0.0966

ND = Not detected at or above the acceptable LOQ listed for each analyte. The assessed accuracy of the ND results associated with LOQs of 0.100 ng/mL is 100% +/- 50%based on the proximity of the 0.100 ng/mL LOQ to the 0.250 ng/mL field spike concentration. The assessed accuracy of other reported results is 100% +/- 30%.
NR = Not reported due to quality control failures.

Confidential - 3M Insurance Documents

Table 4-11
Mississippi River Surface Water (Pore Water Locations) PFBA, PFOA, PFBS, PFHS and PFOS Concentrations
September/October 2006

Sample ID	Sample Location	Sample Depth (ftow)	Average PFBA (ppb, ng/mL)	Average PFOA (ppb, ng/mL)	Average PFBS (ppb, ng/mL)	Average PFHS (ppb, ng/mL)	Average PFOS (ppb, ng/mL)
CGMN-SW-MRIW19a1-0-060919	IW19a	1.1 feet	NR	0.231	NR	0.438	0.214
CGMN-SW-MRIW19a2-0-060919		4.4 feet	4.28	0.246	NR	0.472	0.206
CGMN-SW-MRIW19b1-0-060919	IW19b	0.9 feet	2.81	0.154	NR	0.312	0.127
CGMN-SW-MRIW19b2-0-060919		3.6 feet	1.96	0.129	0.831	0.201	0.0889
CGMN-SW-MRIW19c1-0-060919	IW19c	0.9 feet	NR	0.0699	0.546	0.117	0.0545
CGMN-SW-MRIW19c2-0-060919		3.6 feet	0.981	0.0726	0.413	0.0950	NR
CGMN-SW-MRIW19d1-0-060919	IW19d	1.2 feet	0.0949	ND	ND	ND	ND
CGMN-SW-MRIW19d2-0-060919		4.6 feet	0.117	ND	ND	ND	ND
CGMN-SW-MRIW19e1-0-060919	IW19e	1.9 feet	NR	ND	NR	ND	ND
CGMN-SW-MRIW19e2-0-060919		7.4 feet	ND	ND	ND	ND	ND
CGMN-SW-MRIW19f1-0-060919	IW19f	2.3 feet	0.245	ND	0.0924	ND	ND
CGMN-SW-MRIW19f2-0-060919		9 feet	0.516	NR	NR	NR	ND
CGMN-SW-MRIW201-0-060915	IW20	0.9 feet	NR	0.145	0.180	0.0558	0.112
CGMN-SW-MRIW202-0-060915		3.6 feet	NR	0.154	NR	NR	0.118
CGMN-SW-MRIW211-0-060915	IW21	0.9 feet	NR	0.530	2.27	0.820	0.413
CGMN-SW-MRIW212-0-060915		3.6 feet	NR	0.535	2.28	0.856	0.436
CGMN-SW-MRIW221-0-060915	IW22	1.2 feet	NR	0.611	2.46	0.886	0.523
CGMN-SW-MRIW222-0-060915		4.9 feet	NR	NR	2.35	0.862	0.539
CGMN-SW-MRIW231-0-060915	IW23	1.7 feet	6.92	0.438	NR	0.708	0.323
CGMN-SW-MRIW232-0-060915		6.7 feet	6.76	0.435	1.96	0.694	0.350
CGMN-SW-MRIW241-0-060915	IW24	1 foot	1.16	0.141	0.247	0.0781	0.114
CGMN-SW-MRIW242-0-060915		4 feet	NR	NR	3.05	1.04	0.466
CGMN-SW-MRIW251-0-060915	IW25	0.4 feet	NR	0.163	0.207	0.0661	0.0945
CGMN-SW-MRIW252-0-060915		1.6 feet	NR	0.146	NR	0.0729	0.102

ND = Not detected at or above the acceptable LOQ listed for each analyte. The assessed accuracy of the ND results associated with LOQs of 0.100 ng/mL is 100% +/- 50%based on the proximity of the 0.100 ng/mL LOQ to the 0.250 ng/mL field spike concentration. The assessed accuracy of other reported results is 100% +/- 30%.
NR = Not reported due to quality control failures.

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Table 4-12
Mississippi River Sediment (Longitudinal and Transect Locations) PFBA, PFOA, PFBS, PFHS and PFOS Concentrations
October 2006

Sample ID	Sample Location	Sample Depth	Average PFBA (ppb, ng/g) Dry Weight	Average PFOA (ppb, ng/g) Dry Weight	Average PFBS (ppb, ng/g) Dry Weight	Average PFHS (ppb, ng/g) Dry Weight	Average PFOS (ppb, ng/g) Dry Weight
Longitudinal Sample Locations							
CGMN-SD-MRLS784a4-0-061005	LS-784a	0 - 0.65 ft.	ND	ND	ND	ND	1.22
CGMN-SD-MRLS784a5-0-061005		0.65 - 1.3 ft.	NR	0.441	ND	ND	NR
CGMN-SD-MRLS784a6-0-061005		1.3 - 2 ft.	ND	0.975	ND	ND	2.31
CGMN-SD-MRLS784b4-0-061005	LS-784b	0 - 1 ft.	ND	ND	ND	ND	1.38
CGMN-SD-MRLS784b5-0-061005		1 - 2 ft.	ND	0.657	ND	ND	2.44
CGMN-SD-MRLS784b6-0-061005		2 - 2.5 ft.	ND	1.09	ND	ND	2.08
CGMN-SD-MRLS784c4-0-061005	LS-784c	0 - 1 ft.	ND	0.616	ND	ND	2.39
CGMN-SD-MRLS784c5-0-061005		1 - 2 ft.	ND	0.914	ND	ND	3.16
CGMN-SD-MRLS784c6-0-061005		2 - 2.2 ft.	ND	0.503	ND	ND	1.17
CGMN-SD-MRLS7854-0-061005	LS-785	0 - 1 ft.	NR	ND	ND	ND	ND
CGMN-SD-MRLS7855-0-061005		1 - 2 ft.	NR	ND	ND	ND	ND
CGMN-SD-MRLS7856-0-061005		2 - 2.7 ft.	NR	ND	ND	ND	ND
CGMN-SD-MRLS7880-0-061005	LS-788	0 - 0.3 ft.	ND	ND	ND	ND	0.215
CGMN-SD-MRLS7910-0-061005	LS-791	0 - 0.3 ft.	ND	ND	ND	ND	ND
CGMN-SD-MRLS7940-0-061005	LS-794	0 - 0.3 ft.	ND	ND	ND	ND	0.946
CGMN-SD-MRLS7970-0-061004	LS-797	0 - 0.3 ft.	ND	ND	ND	ND	0.268
CGMN-SD-MRLS7970-DB-061004		0 - 0.3 ft.	ND	ND	ND	ND	ND
CGMN-SD-MRLS8000-0-061004	LS-800	0 - 0.3 ft.	ND	ND	ND	ND	0.470
CGMN-SD-MRLS8030-0-061004	LS-803	0 - 0.3 ft.	ND	ND	ND	ND	ND
CGMN-SD-MRLS8060-0-061004	LS-806	0 - 0.3 ft.	ND	ND	ND	ND	0.142
CGMN-SD-MRLS8090-0-061004	LS-809	0 - 0.3 ft.	ND	ND	ND	ND	0.983
CGMN-SD-MRLS8120-0-061004	LS-812	0 - 0.3 ft.	ND	ND	ND	ND	0.787
CGMN-SD-MRLS8150-0-061004	LS-815	0 - 0.3 ft.	ND	ND	ND	ND	ND
CGMN-SD-MRLS8180-0-061003	LS-818	0 - 0.3 ft.	ND	ND	ND	ND	0.679
CGMN-SD-MRLS8210-0-061003	LS-821	0 - 0.3 ft.	ND	ND	ND	ND	ND
CGMN-SD-MRLS8240-0-061003	LS-824	0 - 0.3 ft.	ND	ND	ND	ND	0.524
Transect Sample Locations							
CGMN-SD-MRXS01a0-0-061003	XS-01a	0 - 0.3 ft.	ND	ND	ND	ND	0.837
CGMN-SD-MRXS01b0-0-061003	XS-01b	0 - 0.3 ft.	ND	ND	ND	ND	1.34
CGMN-SD-MRXS01c0-0-061003	XS-01c	0 - 0.3 ft.	ND	ND	ND	ND	0.289
CGMN-SD-MRXS01d0-0-061003	XS-01d	0 - 0.3 ft.	ND	ND	ND	ND	0.343
CGMN-SD-MRXS01e0-0-061003	XS-01e	0 - 0.3 ft.	ND	ND	ND	ND	0.472
CGMN-SD-MRXS02a0-0-061002	XS-02a	0 - 0.3 ft.	ND	ND	ND	ND	2.31
CGMN-SD-MRXS02a0-DB-061002		0 - 0.3 ft.	ND	ND	ND	ND	2.66
CGMN-SD-MRXS02b0-0-061002	XS-02b	0 - 0.3 ft.	ND	ND	ND	ND	0.603
CGMN-SD-MRXS02c0-0-061002	XS-02c	0 - 0.3 ft.	ND	ND	ND	ND	0.798
CGMN-SD-MRXS02d0-0-061002	XS-02d	0 - 0.3 ft.	ND	ND	ND	ND	0.702
CGMN-SD-MRXS02e0-0-061002	XS-02e	0 - 0.3 ft.	ND	NR	ND	ND	1.24
CGMN-SD-MRXS03a0-0-061004	XS-03a	0 - 0.3 ft.	ND	ND	ND	ND	1.47
CGMN-SD-MRXS03b0-0-061004	XS-03b	0 - 0.3 ft.	ND	ND	ND	ND	0.380
CGMN-SD-MRXS03c0-0-061004	XS-03c	0 - 0.3 ft.	ND	ND	ND	ND	0.824

ND = Not detected at or above the acceptable LOQ.
NR = Not reported due to quality control failures.
DB = Field duplicate sample.

Table 4-13
Mississippi River Surface Water (Longitudinal and Transect Locations) PFBA, PFOA, PFBS, PFHS and PFOS Concentrations
October 2006

Sample ID	Sample Location	Sample Depth (ftow)[1]	Average PFBA (ppb, ng/mL)	Average PFOA (ppb, ng/mL)	Average PFBS (ppb, ng/mL)	Average PFHS (ppb, ng/mL)	Average PFOS (ppb, ng/mL)
Longitudinal Sample Locations							
CGMN-SWC-MRLS784a3-0-061005	LS-784a	1.3 ft / 5.2 ft	0.0790	0.0693	NR	NR	ND
CGMN-SWC-MRLS784b3-0-061005	LS-784b	1.2 ft / 4.7 ft	ND	NR	NR	ND	NR
CGMN-SWC-MRLS784c3-0-061005	LS-784c	0.66 ft / 2.6 ft	0.0530	ND	NR	ND	NR
CGMN-SWC-MRLS7853-0-061005	LS-785	3.0 ft / 12 ft	ND	0.0751	ND	ND	ND
CGMN-SWC-MRLS7883-0-061005	LS-788	3.1 ft / 12.4 ft	ND	ND	ND	ND	ND
CGMN-SWC-MRLS7913-0-061005	LS-791	2.4 ft / 9.6 ft	ND	ND	ND	ND	ND
CGMN-SWC-MRLS7943-0-061005	LS-794	3.7 ft / 14.6 ft	ND	ND	ND	ND	ND
CGMN-SWC-MRLS7973-0-061004	LS-797	2.2 ft / 8.6 ft	ND	ND	ND	ND	ND
CGMN-SWC-MRLS8003-0-061004	LS-800	1.3 ft / 5.3 ft	ND	ND	NR	ND	ND
CGMN-SWC-MRLS8033-0-061004	LS-803	3.4 ft / 13.6 ft	ND	ND	ND	ND	ND
CGMN-SWC-MRLS8063-0-061004	LS-806	2.6 ft / 10.4 ft	ND	0.0508	ND	ND	ND
CGMN-SWC-MRLS8093-0-061004	LS-809	3.4 ft / 13.6 ft	0.0565	ND	NR	ND	ND
CGMN-SWC-MRLS8123-0-061004	LS-812	3.0 ft / 12.5 ft	0.0562	ND	NR	ND	ND
CGMN-SWC-MRLS8153-0-061004	LS-815	3.6 ft / 14.4 ft	0.0705	ND	ND	ND	ND
CGMN-SWC-MRLS8183-0-061003	LS-818	3.8 ft / 15 ft	ND	ND	ND	ND	ND
CGMN-SWC-MRLS8213-0-061003	LS-821	2.2 ft / 8.8 ft	ND	ND	NR	ND	ND
CGMN-SWC-MRLS8243-0-061003	LS-824	2.5 ft / 9.8 ft	ND	ND	ND	ND	ND
Transect Sample Locations							
CGMN-SW-MRXS01a1-0-061003	XS-01a	0.5 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS01a2-0-061003		1.8 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS01b1-0-061003	XS-01b	1.2 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS01b2-0-061003		4.6 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS01c4-0-061003	XS-01c	1.0 ft	ND	NR	ND	NR	ND
CGMN-SW-MRXS01d1-0-061003	XS-01d	1.0 ft	ND	NR	ND	ND	ND
CGMN-SW-MRXS01d2-0-061003		4.0 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS01e1-0-061003	XS-01e	0.9 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS01e2-0-061003		3.7 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS02a0-0-061002	XS-02a	0.0 ft	NR	ND	NR	ND	NR
CGMN-SW-MRXS02a1-0-061002		4.5 ft	NR	ND	ND	ND	ND
CGMN-SW-MRXS02a2-0-061002		17.5 ft	NR	NR	NR	ND	ND
CGMN-SW-MRXS02b0-0-061002	XS-02b	0.0 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS02b1-0-061002		0.75 ft	NR	ND	ND	ND	ND
CGMN-SW-MRXS02b2-0-061002		3.0 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS02c0-0-061002	XS-02c	0.0 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS02c1-0-061002		1.0 ft	NR	ND	ND	ND	ND
CGMN-SW-MRXS02c2-0-061002		3.7 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS02d0-0-061002	XS-02d	0.0 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS02d1-0-061002		0.7 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS02d2-0-061002		2.8 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS02e0-0-061002	XS-02e	0.0 ft	NR	0.199	NR	ND	ND
CGMN-SW-MRXS02e1-0-061002		0.7 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS02e2-0-061002		2.8 ft	NR	ND	ND	ND	ND
CGMN-SW-MRXS03a1-0061004	XS-03a	0.6 ft	ND	ND	NR	ND	ND
CGMN-SW-MRXS03a2-0-061004		2.2 ft	ND	ND	NR	ND	ND
CGMN-SW-MRXS03b1-0-061004	XS-03b	1.0 ft	ND	ND	ND	ND	ND
CGMN-SW-MRXS03b2-0-061004		4.0 ft	ND	0.0501	ND	ND	ND
CGMN-SW-MRXS03c1-0-061004	XS-03c	3.5 ft	ND	ND	NR	ND	ND
CGMN-SW-MRXS03c2-0-061004		14 ft	ND	0.0523	ND	ND	ND

[1] Longitudinal samples were composited from the two depths listed

ftow = From top of water

ND = Not detected at or acceptable LOQ.

NR = Not reported due to quality control failures.

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5. SUMMARY OF OBSERVATIONS

The following sections provide an overview, by media and area, of the findings of the Cottage Grove Site Phase 1 and 2 FC assessments. This overview is presented to provide focus on areas of interest that will be further evaluated as part of the FS process. Detailed information on the Phase 1 activities and results is contained in the *Fluorochemical (FC) Data Assessment Report* (WESTON, April 2006).

5.1 GROUNDWATER

Phase 1

In Phase 1, PFOA and PFOS concentrations were detected in groundwater samples from monitoring wells MW-12 downgradient of the D5–Former Solids Burn Pit Area, MW-14 downgradient of the D8–Former Waste Disposal Area, and MW-101 downgradient of the D1–Former HF Tar Neutralization Basin at concentrations ranging from 150 to 1,863 ppb and from 80 to 324 ppb, respectively. It must be noted that PW-6 is downgradient of the D8 Area and is capturing the affected groundwater. The concentration of PFOA detected in production well PW-6 was 155 ppb.

With respect to groundwater at the Cottage Grove Site, the following data needs were identified for Phase 2:

- Characterization of groundwater quality and movement in the area of the D9 – Former Sludge Disposal Pit.
- Characterization of the potential movement of groundwater to surface water, particularly downgradient of the D8, D5, and D2 Areas.

Phase 2

In Phase 2, the following was found:

- **D9 Area** - FCs were detected in groundwater at the D9 Area. PFBA was detected at concentrations ranging from 29.7 to 76.3 ppb. PFOA was detected at 24.6 ppb in MW-107 but was NR at MW-105 and MW-106. PFOS was NR

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at all three monitoring wells in the D9 Area. Further analyses will be considered to quantify these results so that they may be used in the evaluation of alternatives in the FS. In Phase 1, PFOS was detected at monitoring well MW-13 at a concentration of 16.5 ppb. This well is cross gradient to the D9 Area to the west.

- **Downgradient of D1/D2 Area, WWTP Ponds, and D5 Area**

  D1 Area

  PFOA was detected in Phase 1 wells MW-101 and MW-102 at concentrations of 150 ppb and 163 ppb, respectively.

  D2 Area

  PFOA was detected in MW-103 and MW-104 downgradient of the D2 Area at concentrations of 619 ppb and 414 ppb, respectively. PFBA was detected in MW-103 at 318 ppb and was NR at MW-104. PFOS was NR in both wells.

  WWTP Ponds

  Downgradient of the WWTP ponds, PFBA was detected in MW-108 at a concentration of 219 ppb. PFOA and PFOS were NR at MW-108.

  D5 Area

  PFOA was detected in Phase 1 well MW-12 at a concentration of 1,863 ppb. During Phase 2, PFOA was detected in MW-109 (shallow) and MW-110 (deep) at concentrations of 199 ppb and 136 ppb, respectively.

- **Hydrological Interpretation** - The area of groundwater capture induced by the pumping of two production wells (PW-5 and PW-6) was estimated by the interpretation of groundwater elevation data by constructing a groundwater elevation contour map. The projected width of capture extends east to MW-12 in the D5 Area, and west to a point midway between PW-5 and the West Cove. The analyses indicate that the pumping of PW-6 serves to capture groundwater from the D5 Area.

  In addition to the hydrological evaluation, the laboratory results for FC analyses of porewater samples from the Mississippi River also support this finding. FC concentrations detected in the porewater locations within the predicted zone of capture (IW-1 to IW-8) indicate concentrations of PFOS, PFOA and PFBA at levels significantly less than the concentrations detected in the D5 Area groundwater (MW-12, MW-109 and MW-110). For example, the maximum FC compound detected in groundwater at the D5 Area was PFOA (1,863 ppb at MW-12 in Phase 1), whereas PFOA was not detected in porewater samples collected from locations IW-7 or IW-8, which are immediately downgradient of the D5 Area. Mississippi River porewater concentrations at locations outside of the projected zone of capture (IW-9

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through IW-25) are higher than concentrations detected at locations IW-1 through IW-8 inside the predicted zone of capture (see Figures 4-13 to 4-15).

The hydrogeological and analytical data collected at the site support the conceptual site model which indicates that groundwater beneath the site flows towards and discharges to the Mississippi River. The capture zone created by the pumping of PW-5 and PW-6 intercepts groundwater in the western part of the site before it discharges to the river. On the eastern portion of the site (east of the D5 Area) the groundwater flow is not intercepted and it discharges to the river.

5.2 SOIL

5.2.1 D1/D2 Area – Former HF Tar Neutralization Basin/Former Sludge Disposal Area

Phase 1

In the D2 – Former Sludge Disposal Area, FC concentrations up to 12,350 ppb PFOS were found in the sludge, which is located approximately 5 ft to 20 ft bgs. Lower concentrations (ranging from 4.39 to 794 ppb PFOS) were detected in the underlying native soil, which begins at approximately 20 to 25 ft bgs.

In the D1 – Former HF Tar Neutralization Basin Area, FC concentrations up to 4,520 ppb PFOA were detected in the 5 to 30 ft bgs depth range in borings constructed just outside the suspected location of the basin structure and decreased below 30 ft bgs in the native soils (ranging from 53.9 to 375 ppb).

Lower levels of PFOS and PFOA were detected at the deepest interval sampled in the D1 Area at 65 to70 ft bgs and in the D2 Area at 45 to 50 ft bgs. The depth to groundwater in this area is approximately 77 ft bgs.

Phase 2

Soil samples collected during the installation of Phase 2 monitoring wells MW-104 and MW-105, downgradient of the D2 Area, indicated PFOA and PFOS at significantly lower

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concentrations than samples collected from within the footprint of the D1 and D2 Areas in Phase 1. FCs were detected up to 66.9 ppb (PFOS at 0-0.5 ft bgs).

5.2.2 D5 Area – Former Solids Burn Pit Area

Phase 1

In the D5 – Former Solids Burn Pit Area, concentrations of PFOS (up to 2,310 ppb) and PFOA (up to 1,375 ppb) were detected in soil samples to a depth of approximately 15 ft bgs in the one soil boring (SB D501) constructed in this area. Lower concentrations were detected at lower depths, below 15 feet (up to 46.8 ppb PFOS and up to 42.5 ppb PFOA).

Phase 2

The results of Phase 2 soil sampling in the D5 Area indicate that FCs were detected near the stormwater retention basin in the southwest portion of the D5 Area and that higher levels are in a localized area (i.e., 1-2 boring locations). FC concentrations up to 2,650 ppb PFOS were detected in the 5-10 ft bgs sample interval at Phase 2 soil boring D5B02. The highest Phase 2 PFOA concentration for this area also was detected in this soil boring at 200 ppb in the 20-25 ft bgs interval, the deepest interval sampled. PFOS and PFOA are the primary FCs detected in the D5 Area.

Samples from the remaining four Phase 2 soil borings also indicated detections of PFOS (9.25 to 395 ppb) and PFOA (0.587 to 146 ppb) but at lower concentrations than near the retention basin. The Phase 2 soil borings (D5B01 and D5B03) indicated lower concentrations of FCs than Phase 1 soil boring SB D501, which is in the same area.

Based on the Phase 2 soil boring logs from five soil borings, there was no definable soil horizons indicative of sludge, ash or other disposed material. The soil in the D5 Area is primarily sand with interbedded silt and clay lenses. After disposal activities in the D5 Area were discontinued, the area was reportedly covered with 3 to 7 feet of fill. Based on the boring logs the fill layer could not be distinguished from native sediments. However at SB-D5B05 a white crystalline material was encountered causing the boring to be

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terminated due to Geoprobe refusal. PFOS was detected at the 5-10 ft sample at a concentration of 269 ppb. There were no organic vapor meter (OVM) readings observed at this location. OVM readings were observed at SB-D5B02 near the retention basin. With the exception of SB-D5B02, FC concentrations decrease with depth and are generally highest between 5 and 15 ft bgs. At SB-D5B02, PFOA was highest at the base of the boring (25 ft bgs) and PFOS was highest at the 5 to 10 ft bgs interval.

Depth to groundwater in this area is approximately 90 ft bgs. A perched water table was encountered in one boring, MW-109, at approximately 40 ft bgs.

5.2.3 D9 Area – Former Sludge Disposal Pit

Phase 2

Soil samples collected from the northern and eastern parts of the D9 Area during the installation of MW-106, MW-107, and soil borings SB-D9B01 and SB-D9B04 indicated FC concentrations up to 104,000 ppb PFOS (15-20 ft at MW-107). The soil boring logs indicated waste material was present and organic vapors were recorded at these locations to a maximum depth of 25 feet at SB-D9B01 and 21 feet at SB-DB04. The maximum depth sampled was the 20-25 ft bgs interval at each location. PFOS was detected in this depth interval with concentrations ranging from 1,060 ppb at SB-D9B04 to 57,000 ppb at MW-107.

As described in the boring logs for SB-D9B01 and SB-D9B04, visible waste material was encountered at a maximum depth of approximately 30 ft bgs. Organic vapors were observed at 16 feet down to approximately 79 ft bgs in the MW-106 boring. Visible waste material and organic vapors were not observed at SB-D9B02 and SB-D9B03. Groundwater is present at an average depth of 85 feet which is well below the depth of the encountered waste material.

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5.2.4 Wastewater Treatment Plant Area

Phase 2

Soil samples collected during monitoring well MW-108 installation indicated concentrations of PFOS ranging from 12.5 ppb (20-25 ft bgs) to 230 ppb (0.5-5 ft bgs). The PFOS concentrations in soil at MW-108 decrease with depth. Detected PFOA concentrations range from 3.02 ppb (0-0.5ft bgs) to 63.3 ppb (5-10 ft bgs).

5.2.5 Fire Training Area

The FTA is used for fire training and an adjacent area is used as a contractor storage area.

Phase 1

In Phase 1, at the Fire Training Area, PFOS was detected at concentrations up to 1,820 ppb primarily in shallow soils to a depth of 5 ft bgs, with significantly lower concentrations detected at lower depths.

Phase 2

Phase 2 soil samples were collected from six hand auger locations. Of the 12 FC compounds analyzed, the primary FCs detected in the Phase 2 program were PFOS and PFOA. The results of the Phase 2 sampling programs indicate that PFOS was detected at location FTA06 (2-3 ft) with a concentration of 2,948 ppb. This sample was collected from a drainage swale south of the lined holding pond. During Phase 1, the highest PFOS concentration (1,820 ppb) was detected at SS FTA02. This sample was collected from drainage swale at the southeast corner of the FTA area just prior to the tree line where a natural drainage swale begins. Since the Phase 1 sampling, this area has been re-graded to improve drainage by the construction of the new stormwater runoff detention basin. Phase 2 samples collected from this area (FTA08) indicated lower PFOS concentrations ranging from 23.3 ppb to 145 ppb (0-1 ft).

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Samples collected from other drainage swales near the lined holding pond (FTA04 and FTA05) indicated PFOS concentrations ranging from 458 ppb (FTA05, 0-1 ft) to 1,026 ppb (FTA04, 0-1 ft).

PFOS was also detected from a sample (FTA09) collected just off of a concrete pad used for fire training. A concentration of 747 ppb was detected in the 0-1 ft sample. A deeper sample could not be obtained with a hand auger due to large gravel that was encountered.

The FC results from the FTA sampling indicate that:

- Higher FC concentrations are typically found in localized areas of drainage
- The higher concentrations are typically found in the shallow and surficial soils
- Addition of soils and earth disturbance around the new stormwater basin (during construction) has resulted in lower concentrations

5.3 EAST COVE

Based on the physical characterization and the analytical results from the Phase 1 and Phase 2 FC assessments conducted in the two acre East Cove, the following key observations can be made:

Surface Water

- There is a continuous flow of water through the cove due to the Cottage Grove plant cooling water and WWTP discharge, stormwater discharge from the plant and run-off from the cove drainage area during storm events.
- Of the 4 FC compounds analyzed during the Phase 1 assessment, the highest FC concentrations detected in surface water from the East Cove were PFOS and PFOA.
- Concentrations of PFOS and PFOA detected in surface water samples collected at the East Cove inlet from the Phase 2 assessment were less than those detected from the Phase 1 assessment; however, concentrations of PFHS and PHBS remained consistent.
- No significant differences in FC concentrations were detected between the Phase 2 surface water samples collected at the East Cove inlet and outlet locations.

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- No significant differences in FC concentrations were detected between the water surface and the 0.6 depth surface water samples collected at the Phase 2 East Cove inlet and outlet locations.

Sediment

- Of the 4 FC compounds analyzed during the Phase 1 assessment and the 12 FC compounds analyzed during the Phase 2 assessment, the highest concentrations detected in sediment from the East Cove were PFOS and PFOA.

- A total of three distinct layers were observed in sediment cores collected from the East Cove as observed in 7 probe locations in the lower part of the cove. These layers consisted of a firm top fine granular layer, and middle semi-solid fine silt layer (where a black residue layer was encountered), and a bottom sandy clay layer. The middle layer observed ranged from 2 inches to 2 feet in thickness, appearing to exist in pockets throughout the lower part of East Cove. This black residue layer was encountered at depths of 1.0 to 2.5 feet below the top of the sediment.

- In general, concentrations of FCs, detected in the top layer sediment samples collected from the East Cove are consistent between the Phase 1 and Phase 2 assessments.

- The highest concentrations of PFOS and PFBA (65,450 ppb and 94.6 ppb, respectively) were detected in the middle sediment layer where black residue was observed. The highest concentration of PFOA 1,845 ppb was detected in the bottom sediment layer.

5.4 WEST COVE

The West Cove is approximately one acre in size. It receives surface drainage from the Cottage Grove Site Contractor Storage Yard and the Fire Training Area from the northeast and from the area around the Eagle Point municipal sewage treatment plant (STP) to the west. The STP outfall discharges directly to the Mississippi River and does not enter the West Cove. The water in the West Cove is generally stagnant and flow velocities were not measurable.

Surface Water

- Surface water and sediment samples collected during Phase 1 and Phase 2 sampling programs indicate the detection of very low concentrations of FCs, primarily PFOA and PFOS.

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- PFOS was detected at a concentration of 1.7 ppb (0.5 ft) at the Phase 2 upstream surface water sample location (WC-4). PFOS was also detected at a similar concentration (1.27 ppb) in the upstream Phase 1 surface water sample (WC-1).

- The Phase 2 surface water sample collected from the downstream discharge point (WC-8) indicated a lower PFOS concentration of 0.241 ppb (water surface). PFBA was detected at this location at 1.01 ppb (0.5 ft).

Sediment

- PFOS concentrations in the sediment samples ranged from 15.2 ppb (Phase 1, WC-3) to 137 ppb (Phase 2, WC-07). PFOA was also detected in sediment samples ranging from 11.2 ppb (WC-06, 0-6 in) to 15.9 ppb (WC-07, 0-6 in).

- No sludge/waste material or discolored sediment was encountered in West Cove sediments.

5.5 MISSISSIPPI RIVER

5.5.1 Porewater Sampling Locations (Porewater, Sediment and Surface Water)

At each of the 43 porewater sampling locations along the shoreline of the River, samples of porewater, sediment and surface water were collected and analyzed for the 12 FC compounds. The higher concentrations of these FCs were detected at three general areas for each of the media sampled:

- IW-22 to IW-25 along the eastern portion of the shoreline near the East Cove (approximately 1,000 feet)
- IW-19 transect along the eastern shore near the D1/D2/D9 Areas
- IW-14 transect near the WWTP area

Eastern Portion of the Shoreline

Near the East Cove area, concentrations of PFOS, PFOA and PFBA were detected in both porewater (up to 206 ppb, 758 ppb and 157 ppb, respectively) and sediment samples (up to 168 ppb, 130 ppb and 53.4 ppb, respectively). In surface water, PFOS concentrations at IW-22 to IW-25 range from 0.0945 to 0.539 ppb. PFOA concentrations

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range from 0.141 ppb to 0.611 ppb. For PFBA, 5 of the 8 samples were NR. Concentrations in the remaining three samples ranged from 1.16 ppb to 6.92 ppb.

Transects

The detection of FC concentrations in porewater and sediment samples correlate closely and in general decrease with increasing distances from the shoreline (southerly) at the transect locations (IW-19, IW-14 and IW-9). One exception is at IW-19f where porewater concentrations of PFBA decrease beyond IW-19d (300 ft from shore) (1.40 ppb) and increase at IW-19f (500 ft from shore) to a concentration of 118 ppb. Sediment samples from these locations also exhibit a similar trend.

The highest PFOS concentration detected in surface water was from location IW-13. Other locations where FCs are detected at higher concentrations in porewater and sediment are IW-11, IW-13 and IW-9a. These locations are east of D5 and west of the WWTP pond area.

At the locations near the West Cove and Fire Training area (IW-1 to IW-7), PFOA and PFOS are the only FC analytes detected in sediment. PFOS was detected at each location and PFOA was detected at IW-3, IW-5 and IW-6. In the porewater samples, PFOS was detected only at IW-1, IW-2 and IW-3. PFOA was detected at IW-1 to IW-6 and not detected at IW-7. Concentrations of FCs in this area (IW-1 to IW-7) were significantly lower than the eastern part of the shoreline.

The shoreline area within the zone of capture of production wells PW-6 and PW-5 is discussed in Subsection 4.2. The concentrations detected in porewater, sediment and surface water in this area are either not detected or very low. This indicates that FC concentrations in site groundwater are being captured in the area of PW-5 and PW-6 before they reach the river.

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5.5.2 Transect Locations

Sediment and surface water samples were collected from the 3 transects (13 total sampling locations) across the Mississippi River. Also, water samples were collected at the water surface at the five locations along Transect XS-02.

Sediment

The river transect results indicate that PFOS was the only FC compound of the 12 analytes detected in sediment at a maximum concentration of 2.66 ppb (XS-2a).

Surface Water

Surface water sampling results indicate that PFOS was not detected in any of the samples. PFOA was detected in only three samples at a maximum concentration of 0.199 ppb (XS-02e). PFBA was not detected in 23 of 30 samples collected at the 13 locations. NRs were reported for the remaining 7 samples.

5.5.3 Longitudinal Locations

Sediment and surface water samples were collected from 17 locations along approximately 40 miles of the Mississippi River from five miles upstream of the Cottage Grove Site and downstream to Lake Pepin.

Sediment

The results indicate that only PFOS and PFOA were detected in sediment samples. PFOA was only detected from the samples at the head of Lake Pepin ranging from 0.441 ppb to 1.09 ppb. PFOS was detected in 17 of the 26 samples collected with concentrations ranging from 0.142 ppb to 3.16 ppb. PFBA was ND in 22 of the 26 samples and NR in the remaining four samples.

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Surface Water

PFBA and PFOA were the only FCs detected in the longitudinal surface water samples and these concentrations were very low. PFBA was detected in 5 of the 17 samples with concentrations ranging from 0.0530 ppb to 0.0790 ppb. The other 12 samples were all ND. PFOA was detected in three samples with concentrations ranging from 0.0508 ppb to 0.0751 ppb. The other 13 samples were ND and one sample was NR. PFBS, PFHS, and PFOS were either ND or NR.

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6. DEVELOPMENT AND SCREENING OF RESPONSE ACTION ALTERNATIVES

In accordance with the requirements of the Consent Order Section VI and Exhibit A, Section III.E.3, the development and screening of response action alternatives for the Site will be based on the List of Possible Technology Types, presented in the RI Report and FS Work Plan and approved by the MPCA Commissioner. The following section provides the List of Possible Technology Types for the Site and a description of the process that was used to develop this list.

The FS Work Plan, which is being submitted concurrently with this report, includes a description of how this list will be used to develop response action alternatives, which will be screened for further evaluation. The FS Work Plan also provides an explanation of the screening process and further evaluation of the retained response action alternatives, as well as, a recommendation for implementation of the selected response action alternative and associated conceptual design.

6.1 LIST OF POSSIBLE TECHNOLOGY TYPES

It is important to note that soil, groundwater, and sediment at the Site are being considered as separate operable units. As such, a technology evaluation is provided for each media so that media-specific technologies can be combined into response action alternatives for each media.

General response actions have been identified for the Site based on the information and data provided in this RI. The general response actions, response technology type, and associated process options are presented in Table 6-1 for soil, Table 6-2 for groundwater, and Table 6-3 for sediment along with a brief description of the process option and a screening comment. In their guidance, EPA states "During this screening step, process options and entire technology types are eliminated from further consideration on the basis of technical implementability", (EPA,1988). The general response action/technology

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types and process options that have been retained as the List of Possible Technology Types from this initial screening are summarized below:

LIST OF POSSIBLE TECHNOLOGY TYPES

Soil

- Removal - Excavation
- Treatment - Thermal
  - Incineration
- Disposal - Landfill
  - New landfill
  - Existing landfill
- Containment - Cap
  - Soil/clay cap
  - Engineered multilayer cap
- Institutional and Site Controls - Access restrictions
  - Deed restrictions
  - Fencing
- No action

Groundwater

- Collection - Groundwater recovery
  - Recovery wells
- Discharge – On-site
- Containment – Cap
  - Soil/clay cap
  - Engineered multilayer cap
- Treatment - Physical
  - Activated carbon
  - Ion exchange resin
  - Reverse osmosis
  - Air stripping
- Institutional and Site Controls
  - Deed restrictions
  - Fencing
  - Monitoring
- No action

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Sediment

- Removal – Excavation/Dredging
- Treatment - Physical
  - Dewatering
  - Surface water diversion
- Treatment - Thermal
  - Incineration
- Disposal - Landfill
  - New landfill
  - Existing landfill
- Containment – In Situ Cap
  - Clean sediment, sand, gravel, geotextile, or liner
- Institutional and Site Controls - Access restrictions
  - Deed restrictions
  - Fencing
- No action

Upon approval of the RI Report and FS Work Plan by MPCA, these technology types and associated process options will be assembled into response action alternatives for screening and further evaluation. The FS Work Plan, which provides a description of the response alternative development, screening, and evaluation process, is being submitted concurrently with this RI Report.

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Table 6-1 Initial Screening of Technology and Process Options – Soil

General Response Action	Remedial Technology Types	Process Options	Description	Screening Comments
Removal	Excavation	Excavation	Excavate impacted soil from the site	Retained for further screening
Treatment	Chemical treatment	Oxidation/reduction	Treat impacted soil with a chemical oxidation/reduction technology	Not feasible due to the fact that it is uncertain whether existing technologies would effectively treat/destroy FCs
	Physical	Solidification/ stabilization	Mixing of impacted soil with a stabilizing agent such as cement kiln dust (CKD) to prevent the leaching of constituents	Not feasible due to the fact that it is uncertain that stabilization would reduce leaching of FCs and this technology type would result in a significant volume increase
	Biological	Anaerobic/aerobic	Treat impacted soil with a biological technology to break down constituents using a microbial population	Not feasible as FCs are recalcitrant compounds and to date, there have been no microbial populations identified that can significantly affect the biodegradation of FCs
	Thermal	Incineration	Treat impacted soil by incineration to destroy constituents	Retained for further screening
Disposal	Landfill	New	Dispose impacted soil in a newly constructed/dedicated landfill	Retained for further screening
		Existing	Dispose impacted soil in an existing regulated landfill	Retained for further screening
Containment	Cap	Soil/clay	Installation of soil/clay cover over impacted soil to prevent direct contact and/or reduce infiltration	Retained for further screening
		Engineered cap	Installation of a multilayer engineered cap over impacted soil to prevent direct contact and reduce/eliminate infiltration to impacted soil	Retained for further screening
Institutional and Site Controls	Access restrictions	Deed restrictions	Deed for the Site property would include restrictions on soil disturbance	Retained for further screening
		Fencing	Install fence around site to limit access to impacted soil	Retained for further screening
No Action	None	Not applicable	No action	Retained for a baseline comparison

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Table 6-2 Initial Screening of Technologies and Process Options - Groundwater

General Response Action	Remedial Technology Types	Process Options	Description	Screening Comments
Collection	Groundwater recovery	Groundwater recovery wells	Install wells for extraction of impacted groundwater	Retained for further screening
	Subsurface drain	Interceptor trench	Install subsurface perforated pipe surrounded by porous media to collect impacted groundwater	Not feasible due to the extensive depth (i.e., 80 to 95 ft bgs) to groundwater at the Site.
Discharge	On-site	Local stream	Discharge extracted groundwater to the east cove	Retained for further screening
	Off-site	POTW	Discharge extracted groundwater to the POTW	Due to large volume of water pumped at the site and the potential load to the POTW, this technology is not retained.
Containment	Cap	Soil/clay	Installation of soil/clay cover to reduce infiltration to groundwater	Retained for further screening
		Engineered cap	Installation of a multilayer engineered cap over impacted soil to reduce/eliminate infiltration to groundwater	Retained for further screening
	Vertical barriers	Slurry wall	Trench around impacted groundwater is filled with a soil bentonite slurry to cut off horizontal groundwater flow and contain impacted groundwater	The extensive depth to groundwater at the Site is prohibitive to construction of a slurry wall and there is not a significant aquitard layer to key into; therefore, this technology is not retained
		Sheet piling	Sheets of steel are driven into bedrock around the impacted groundwater area to cut off horizontal groundwater flow and contain impacted groundwater	The extensive depth to groundwater at the Site is prohibitive to installation of sheet piling and there is not a significant aquitard layer to key into; therefore, this technology is not retained

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Table 6-2 Initial Screening of Technologies and Process Options – Groundwater (Continued)

General Response Action	Remedial Technology Types	Process Options	Description	Screening Comments
Treatment	Physical	Carbon adsorption	Adsorption of constituents onto activated carbon by passing impacted groundwater through vessels containing activated carbon	Retained for further screening
		Ion exchange resin	Adsorption of constituents onto ion exchange resin by passing impacted groundwater through vessels containing ionic resin	Groundwater pumped from Site production wells for use in production processes currently is treated after use and prior to discharge by carbon adsorption. However, this technology is being retained as a possible supplementary technology to activated carbon.
		Reverse osmosis	Separation process that uses pressure to force water through a membrane that retains the solute on one side and allows water molecules to pass to the other side.	Groundwater pumped from Site production wells for use in production processes currently is treated after use and prior to discharge by carbon adsorption. However, this technology is being retained as a possible supplementary technology to activated carbon.
		Air stripping	Mix large volumes of air with water in a packed column or tray stripper to promote transfer of constituents to air	Retained for further screening for removal of VOCs
	Chemical	Oxidation/ reduction	Treat impacted groundwater with a chemical oxidation/reduction technology	Not feasible due to the fact that it is uncertain whether existing technologies would effectively treat/destroy FCs
	Biological	Aerobic/ anaerobic	Treat impacted groundwater with a biological technology to break down constituents using a microbial population	Not feasible as FCs are recalcitrant compounds and to date, there have been no microbial populations identified that can significantly affect the biodegradation of FCs
	Off-site	POTW	Extracted groundwater discharged to POTW for treatment	Due to large volume of water pumped at the Site and the potential load to the POTW, this technology is not retained
	In situ	Aeration	Sparging of air down wells into the groundwater to volatilize constituents from the groundwater	Not feasible since FCs do not have Henry's Law Constants in the range acceptable for this technology and do not readily transfer from the water to air phase
		Permeable treatment/ reactive barriers	Downgradient trench filled with adsorptive or reactive media (e.g., activated carbon or zero valent iron) to remove constituents from the groundwater.	Not feasible due to the extensive depth to groundwater at the Site and this technology is of uncertain effectiveness and could require multiple replacement of trench materials over time as they are spent
		Chemical injection	Inject chemicals into the groundwater by means of wells to treat impacted groundwater	Not feasible due to the fact that it is uncertain whether existing technologies would effectively treat/destroy FCs and the proximity to the Mississippi River

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Table 6-2 Initial Screening of Technologies and Process Options – Groundwater (Continued)

General Response Action	Remedial Technology Types	Process Options	Description	Screening Comments
Institutional and Site Controls	Access restrictions	Deed restrictions	Deed for the Site property would include restrictions on installation of groundwater supply wells	Retained for further screening
		Fencing	Install fence around site to limit access to impacted groundwater/surface water ponds	Retained for further screening
	Alternate water supply	Bottled water/public water	Supply alternate water source	This technology is not retained because the groundwater moves towards the river, there are no groundwater issues north of the site, and alternative water supply already is provided for on-site consumption and use.
	Monitoring	Groundwater monitoring	Continue groundwater monitoring	Retained for further screening
No Action	None	Not applicable	No action	Retained for a baseline comparison

POTW - Publicly-owned treatment works

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Table 6-3 Initial Screening of Technologies and Process Options - Sediment

General Response Action	Remedial Technology Types	Process Options	Description	Screening Comments
Removal	Excavation	Excavation	Excavate impacted sediments from the east cove after water is diverted and drained	Retained for further screening
	Dredging	Dredging	Removal of sediments is conducted underwater	Retained for further screening
Treatment	Chemical treatment	Oxidation/reduction	Treat impacted sediment with a chemical oxidation/reduction technology	Not feasible due to the fact that it is uncertain whether existing technologies would effectively treat/destroy FCs
	Physical	Dewatering	Technology used to remove water from sediments	Retained for possible use in combination with an excavation or dredging technology
		Surface water diversion	Technology (such as sheet piling) used to divert a stream so that sediments can be accessed and removed	Retained for possible use in combination with an excavation or dredging technology
		Solidification/ stabilization	Mixing of impacted sediment with a stabilizing agent such as cement kiln dust (CKD) to prevent the leaching of constituents	Not feasible due to the fact that it is uncertain that stabilization would reduce leaching of FCs and this technology type would result in a significant volume increase
	Biological	Anaerobic/aerobic	Treat impacted soil with a biological technology to break down constituents using a microbial population	Not feasible as FCs are recalcitrant compounds and to date, there have been no microbial populations identified that can significantly affect the biodegradation of FCs
	Thermal	Incineration	Treat impacted sediment by incineration to destroy constituents	Retained for further screening

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Table 6-3 Initial Screening of Technologies and Process Options - Sediment (Continued)

General Response Action	Remedial Technology Types	Process Options	Description	Screening Comments
Disposal	Landfill	New	Dispose impacted sediment in a newly constructed/dedicated landfill	Retained for further screening
		Existing	Dispose impacted sediment in an existing regulated landfill	Retained for further screening
Containment	In Situ Cap	Clean sediment, sand, gravel, geotextile, or liner	Subaqueous covering or cap of clean material over impacted sediment that remains in place	Retained for further screening
Institutional and Site Controls	Access restrictions	Deed restrictions	Deed for the Site property would include restrictions on sediment/stream disturbance	Retained for further screening
		Fencing	Install fence around site to limit acess to impacted sediment	Retained for further screening
No Action	None	Not applicable	No action	Retained for a baseline comparison

7. REFERENCES

WESTON, 2006. *Fluorochemical (FC) Data Assessment Report for the 3M Company Cottage Grove, Minnesota Facility.* Prepared by Weston Solutions, Inc. for the 3M Company, April 2006.

USEPA, 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA.* Interim Final, October 1988.

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