Sampling Protocol
Groundwater Monitoring
For
West Newton Chute Dredged Material Transfer Project

SAMPLING PROTOCOL FOR AMBROUGH SLOUGH
GROUND WATER MONITORING WELLS

SAMPLING PROTOCOL FOR WEST NEWTON CHUTE GROUND WATER MONITORING WELLS

1.0 INTRODUCTION

This document defines procedures to be used for ground water quality measurements and for collecting and handling ground water and surface water samples obtained for the West Newton Chute Dredged Material Disposal Project in Wabasha County near Kellogg, Minnesota. Deviations from these procedures may be required by unforeseen circumstances that develop during the program. Such deviations will be approved by the Corps of Engineers representative in advance of sampling. When approvals cannot be obtained in advance, deviations from the established procedures will be evaluated as soon as possible after sampling and needs for re-sampling will be evaluated. Deviations from the specified procedures will be clearly noted on the sampling information form (SIF) used for the sampling of each well and will be included in the Sampling and Analysis Report (final) as described below.

2.0 ADVANCE PREPARATION FOR SAMPLING

Selection of analytical parameters, field measurement and sampling techniques, equipment selection and other quality assurance measures are based on the sampling objectives presented in the Scope of Work.

2.1 Selection Of Analytical Parameters

Analytical parameters were selected based on regulatory requirements and a review of site history. Samples will be collected and analyzed for the parameters in **Table 1** at 14 residential wells, 3 monitoring wells and 2 surface water sites according to the schedule in **Table 2**.

2.2 Detection Limits

Minimum detection levels are shown in **Table 1**. In all cases, these detection limits are at or below applicable action levels.

2.3 Quality Assurance For Field Procedures

Particular care will be exercised to avoid the following common ways in which cross contamination or background contamination may compromise ground water samples:

- improper storage or transportation of equipment
- contaminating the equipment or sample bottles on site by setting them on or near potential contamination sources such as uncovered ground, a contaminated vehicle, or vehicle exhaust
- handling bottles or equipment with dirty hands or gloves
- inadequate cleaning of well purging or sampling devices

Special care will be exercised to prevent cross-contamination of sampling equipment, sampling bottles, or anything else that could potentially compromise the integrity of samples. Field methods quality assurance verification procedures are described in Section 4.4, "Field Blanks, Replicates and Split Samples". Field personnel will work under the assumption that contamination exists in land surface soil and vegetation near sampling points, wash water, etc. Therefore, exposure to these media will be minimized by taking at least the following precautions:

- minimizing the amount of rinse water left on washed materials
- minimizing the time sampling containers are exposed to airborne dust or volatile contaminants in ambient air
- placing equipment on clean, ground-covering materials instead of on the land surface

Clean gloves made of appropriately inert material will be worn by all field crew. Gloves will be kept clean while handling sampling-related materials. The gloves will be replaced by a new pair when soiled and between each sampling site.

2.4 Sampling Containers And Preservatives

Laboratory-supplied sampling containers and preservatives to be used for samples from all wells are shown in Table 3. The Contractor is responsible for ensuring that all sample collection containers are appropriate for the analysis and detection levels required. Chemical preservatives will be added in the laboratory before samples are collected.

2.5 Purging And Sampling Equipment

The contractor shall **provide a list of the well purging and sampling equipment** to be used during the project. The list shall include the following:

- two-inch nominal diameter stainless steel positive displacement submersible bladder or Grundfos or similar pumps: [provide manufacturer name, model name/number and optional equipment used]
- pump discharge lines: [new, decontaminated] Teflon
- regulators and compressed nitrogen tanks other equipment such as bailers, rope, other pumps, generators, air compressors, etc.

The contractor shall provide the government representative equipment descriptions and specification details as well as maintenance schedules prior to initiating field work.

2.6 Decontamination, Storage And Transport Of Equipment

New pump tubing will be used the first time each well is sampled. Tubing will then be dedicated to a single well for subsequent sampling events. Between sampling events, the tubing will be stored in a sealed, chemically inert plastic bag. The bag will be labeled with the well name and stored in a secure, clean location.

The Contractor will provide a plan for the decontamination of pump bladders along with the proposal. The Contractor may choose to discard bladders after use at each well; dedicate, label, and store pump bladders in the same manner as tubing for each well; or decontaminate the bladder by circulating decontamination fluids through the pump as described below.

All sampling-related equipment including filtration devices, personal protection gear and materials coming into contact with actual sampling equipment or with sampling personnel will be decontaminated. If using sampling pumps and tubing that are permanently installed or dedicated to individual wells, they are exempt from field decontamination. Decontamination will be performed before, between and after working at each sampling point. All equipment will be handled in a manner that will minimize cross-contamination between wells and avoid introducing surface or ambient air contamination into a well. Equipment used during purging or sampling will be thoroughly cleaned prior to use in each individual well even when the wells are located close to each other. After cleaning, the equipment will be visibly inspected to detect sticky residues or other substances that may survive normal cleaning. If inspection reveals that decontamination was insufficient, additional measures will be implemented as needed and documented.

Decontamination procedures will be specific to the contractors sampling plan. The Contractor is required to provide decontamination schedule and procedures with the proposal. In general equipment will be decontaminated in the following manner:

A. Equipment that does not contact sample water or the inside of the well

1. clean (inside and out where possible) with a hot water pressure washer filled with clean water
2. clean (inside and out) with an Alconox/clean-water solution - applied with a scrub brush where practical
3. rinse with clean control water
4. inspect for remaining particles or surface film and repeat cleaning and rinse procedures if necessary

B. The following steps shall be used for equipment that contacts sample water or the inside of the well:

1. clean (inside and out where possible) with an Alconox/clean-water solution - applied with a scrub -brush made of inert materials
2. rinse with clean control water
3. inspect for remaining particles or surface film and repeat cleaning and rinse procedures if necessary
4. rinse with an inorganic desorbing agent
5. rinse with clean control water
6. rinse thoroughly with laboratory controlled deionized water
7. shake off remaining water and allow to air dry

The internal surfaces of pumps and tubing that cannot be adequately cleaned by the above methods alone will also be cleaned by circulating decontamination fluids through them. The fluids will be circulated through this equipment in the order shown above under "B". Special care will be exercised to ensure that the "rinse" fluids will be circulated in sufficient quantities to completely flush out contaminants, detergents and desorbing agents.

When transporting or storing equipment after cleaning, the equipment will be protected in a manner that minimizes the potential for contamination. Sampling pumps will be totally enclosed in a clean case capped at both ends. If the case is used to transport used pumps, the case will undergo the same decontamination process as the pump before being used again. The tubing will be placed in a clean, inert plastic bag.

2.7 Selection Of Sample Collection Techniques

Sample collection techniques as detailed in this document have been tailored to the goals of this sampling event and the individual characteristics of this site. The techniques described herein are scientifically sound and widely used in this industry.

2.8 Order Of Sampling

Wells will be sampled in a logical order. All wells of one type will be sampled before the next set or well type is sampled. Example: All monitoring wells will be sampled before the residential wells are sampled.

3.0 PRELIMINARY FIELD WORK

The following procedures will be implemented to ensure representativeness of samples collected by methods in Section 4, "Sample Collection".

3.1 Field Inspections And Field Decisions

Before purging or sampling, all wells will be inspected to verify that the annular seal is intact at the surface. The well depths at each well will be measured on the first sampling visit to verify the integrity of the wells. Well depths will be measured with the same instrument used to measure the water level, however, a weight may be attached to the measurement device for sounding the well bottom. This sounding device will also be decontaminated in the same manner as specified for making water-level measurements (Section 3.3). The well depth will be recorded to the nearest 0. 1 feet prior to purging the well. In addition, the condition of any relevant facts regarding the general physical condition of the well, the surrounding soil and vegetation or other objects in the immediate vicinity of the well will be inspected. Any unusual condition including the presence of wind-blown dust or odor in the ambient air will be recorded on the attached Sampling Information Form (SIF). Details will be noted in the field sampling log and summarized in the Sampling and Analysis report. More specifically, any hint of odor or free product in the well will be noted on the SIF and in the Sampling and Analysis Report. If any condition that may interfere with obtaining representative analytical results is discovered, the condition will be rectified before sampling of the dissolved phase of well water proceeds. The decision and exact change of procedure will be recorded on the SIF and reported in the Sampling and Analysis Report in a manner that clearly indicates which data sets may have been affected by the change in protocol.

3.2 Detection Of Immiscible Layers

The Government representative shall be notified as soon as possible if immiscible layers of contaminants (free product "floaters" or "sinkers") are suspected or seen or if odors or an oil sheen are observed in the well or sampling equipment. Any detection of an immiscible shall be documented in detail.

3.3 Water-Level Measurements

Water level measurements are required for the monitoring wells during each sampling round. Water level measurements are not required for the residential wells.

Prior to any well evacuation or sampling, the initial static water level of the monitoring well will be measured and recorded. The measurements shall be taken from the top of the 2-inch riser pipe to the water level for each monitoring

well. This is done to facilitate selection of the proper pump intake depths for purging and sampling and calculation of the ground water flow direction.

During initial static water level measurement, a minimum of two water level measurements will be made at each well. If there is poor agreement between the first and second static water level measurements (i.e., a difference of more than 0.05 feet), data will be re-evaluated for measurement errors, unsuspected pumping that may be causing transient changes in gradient, etc. If the disagreement cannot be rectified, a third static water level measurement will be made at each questionable sampling point to assess the true water level, verify non-steady state conditions, etc.

Water level probes will be decontaminated by triple-rinsing with clean water and drying with clean Kim Wipes or equivalent tissue before use in each well. Water levels will be measured with an electric water-level sensor probe that has been calibrated within the last month and recorded to the nearest 0. 1 foot. The electric water-level sensor probe, will be lowered down the well until the probe indicates contact with the water surface.

The depth-to-water will be referenced from the top of the 2-inch riser pipe on each of the monitoring wells. When reporting absolute water level elevation, this measurement will be converted to water level elevation (MSL) from the surveyed elevation of the top of riser pipe. The attached water-level data form will be completed for all wells where water level measurements are made. Data will be entered in all applicable columns on this form.

3.4 Field Water-Quality Measurements

Specific conductance, pH, temperature, turbidity and dissolved oxygen will be measured in the field immediately before sample collection. Calibration information and all measurements will be recorded on the attached Well Purging - Field Water-Quality Measurements Form. Measurement conditions and the steady-state value for each field water-quality parameter will also be noted on the SIF.

All measurements except for turbidity, unless measured in situ, will be taken within a closed flow cell designed to allow measurement of these parameters while minimizing changes in temperature, pressure, and dissolved gases from the in situ aquifer environment. The flow cell requires the following characteristics:

- Air tight fittings for installation of all probes.
- Intake is connected directly to the pump discharge line or tap discharge line.
- A discharge line at least 3 feet long that is connected to the flow cell with an air tight connection.
- A maximum volume of no greater than five times the per minute volumetric rate of inflow to the cell to maintain measurement sensitivity to temporal changes in water quality.
- A minimum volume of 500 ml to provide enough thermal mass to minimize external temperature effects.
- The flow cell will be shielded from strong winds and on hot days it will be shielded from direct sunlight.

The operation of the probes will be as follows:

1. The flow of ground water through the flow cell will be maintained as continuous and steady as practical throughout the measurement period.

2. Discharge velocities through the flow cell are kept low to prevent streaming potential problems with probes.

3. All probes will be fully immersed without touching the sides of the air tight, non-metallic flow cell.

4. All probes will be allowed to equilibrate with fresh well water for five minutes before recording measurements.

Specific procedural details for measurement of individual field water quality parameters are specified below. General care, maintenance, calibration procedures, and operation of each measurement device will also follow manufacturers specifications as detailed in the instruction/owner's manual for each device. These procedures shall be documented and provided to the Government representative for inclusion in the final report. Where there are differences in procedures as defined in this document compared to manuals accompanying measurement devices, the more stringent procedures shall be documented and followed.

Specific Conductance

The conductivity meter will be calibrated each day using a traceable standard potassium chloride reference solution before taking measurements at the first site. Calibration shall be near the range of suspected readings. The expected range of specific conductance for this study is 200 to 600 us/cm. Linearity of the probe should be checked with a second standard. A post calibration will be completed following the days sampling. Records of the pre-and post calibrations shall be included with the daily data. The conductivity cell will be inspected to be sure it is in good condition with no chips in the coating.

The conductivity standard calibration solution will be labeled to show the date of preparation, check-marked to show the number of times used and replaced at regular intervals of no more than three months or 10 uses, which ever comes first. The probe will be fully immersed but will not be allowed to touch the non-metallic container. This reading will be compared with the chart value for the standard reference solution at the temperature of the solution. All readings must be corrected (temperature) to show the specific conductance (SC). It should be noted if the instrument electronically corrects for temperature. If the instrument does not correct for temperature the specific conductance (electrical conductance (EC) corrected to 25 degrees Celsius) will be calculated from the EC and the water temperature. The SC value will be taken from the conversion table provided in the EC meter instruction manual and recorded. The SC (not EC) will be used to determine when stabilization is reached. Both the electrical conductivity (EC) and temperature corrected specific conductance (SC) shall be recorded in micro-Mhos/cm, as well as the sample temperature in degrees Celsius. All readings shall be recorded on the appropriate field forms in micro-Mhos/cm to three significant digits.

Temperature

At the beginning of each day of field operations, the temperature probe will be inspected. Prior to initialization, at the midpoint, and at the completion of the sampling program the temperature probe shall be placed in a well mixed water bath and compared to a mercury thermometer capable of being read to the nearest 0. 1 degrees Celsius to assure it is in good operating condition. During monitoring the measured ground water temperature will be recorded to the nearest 0.1 degrees Celsius.

pH

Personnel using pH measuring equipment will read the manufacturer's instruction manual carefully before recording any measurements. Special care will be taken to protect the fragile glass bulb on the end of the pH electrode. Careful

handling includes all steps from the manner in which the cap is taken off the electrode and includes keeping the electrode tip moist between sampling points.

Before sampling is begun for the day, the pH meter will be calibrated by a two-point calibration method. Periodic checks using a single buffer during the day are recommended. The single buffer calibration will normally be accomplished using a pH = 7 buffer for natural waters. At the completion of the days monitoring the pH meter will be post calibrated using the two-point calibration method.

For the two-point calibration method, two buffers with pH values representative of the range of values expected in the field will be used to check the slope (span) of the meter. Typically, a pair of buffers with pH = 7 and 10 will be used for the two-point calibration.

Because the pH of buffer solutions vary with temperature, the actual pH (e.g., pH = 7.07 vs. 7.00) of the buffer solution at its current temperature will be used for calibration. The actual pH of the buffer at its temperature of measurement will be determined from manufacturer documentation accompanying the buffer. The exact pH of the buffer solutions at 2- to 5-degree intervals for the range of buffer temperatures expected will be recorded in indelible ink on the buffer solution bottles. Only fresh buffer solutions will be used. Care will be taken not to dilute or contaminate the buffer solutions. Buffer solutions will be discarded after the tenth calibration or four weeks after the first use of the solution, whichever occurs first. pH meter calibration will be performed as follows:

1. The pH meter's temperature compensation control will be set to the current temperature of the buffer solution.
2. The pH meter electrode will be rinsed with distilled water and the excess water will be shaken off.
3. The electrode will then be stirred and left immersed in the buffer container until it stabilizes.
4. While immersed in the first buffer solution, the calibration control will be adjusted until the display matches the known pH of the buffer.
5. Steps 2 and 3 will then be repeated to prepare for the second buffer. 6. Step 4 will be repeated for the second buffer.
7. If measurement of the second buffer does not give a satisfactory reading the slope control will be adjusted.
8. Steps 2-7 will be repeated until both buffer solutions yield satisfactory readings (within approximately 0.02 pH units of the actual value on both ends of the measured scale).
9. In the field, step 2 will be repeated at each well before measuring the pH of well water.

After allowing the pH probe to equilibrate with a continuously replenished supply of fresh aquifer water for a minimum of five minutes, the first pH measurement will be recorded.

Dissolved Oxygen

Personnel using dissolved oxygen measuring equipment will read the manufacturer's instruction manual carefully before making dissolved oxygen measurements. Special care will be taken to store the probe in a humid environment and to otherwise protect the delicate membrane on the end of the probe. The membrane will be replaced every two to four weeks. The dissolved oxygen meter will be calibrated at prior to sampling and at the completion of sampling each day according to manufacturer's specifications. When dissolved oxygen readings less than or equal to approximately 1.0 mg/L are expected, the meter will be calibrated in a mode (if available) that enhances accuracy at low concentrations. The calibration method will be recorded on the Well Purging - Field Water Quality Measurements Form. Measurements will be taken as follows:

1. The membrane at the tip of the probe will be checked visually to verify that it is in good condition.
2. A submersible stirring device will be operated adjacent to the membrane during dissolved oxygen measurements if a flow cell is not in use.
3. After allowing the dissolved oxygen probe to equilibrate with a continuously replenished supply of fresh aquifer water for a minimum of five minutes, the first measurement will be recorded.

Readings should appear stable on the display to be considered valid. If non-stable readings are recorded, they will be footnoted when recorded and the non-stable measurement conditions will also be clearly stated in the final Sampling and Analysis Report. Readings will be reported to the nearest hundredth of a mg/L dissolved oxygen. Pre and post calibration data shall be included with the data recorded during the days sampling.

Turbidity

Turbidity meter calibration and measurement techniques will follow manufacturer recommendations except where they conflict with statements in this paragraph. Measurements will be made inside a glass or transparent plastic bottle filled directly from well discharge in the same manner as samples are collected. Measurements will be taken immediately after filling the container to minimize bias due to particulate settling.

3.5 Well Purging And Stabilization

Monitoring Wells

Before a well is sampled for the dissolved phase, it will be evacuated to ensure that samples contain fresh formation water. While the well is being purged, water quality parameters described above in Section 3.4, "Field Water-Quality Measurements", and the quantity of water evacuated will be recorded on the Well Purging - Field Water Quality Measurements Form.

A purging rate that will result in a minimum of drawdown while still allowing the well to be purged in a reasonable length of time will be used and recorded on the SIF. However, the maximum purging rate will be 0.5 gallons per minute. There is expected to be no significant drawdown if purged at the 0.5 gallons per minute. Care will be taken to avoid any significant amount of cascading or turbulence in the well.

Wells that do not have extremely slow recharge rates will be purged and sampled as described below. Purging will be conducted in a manner that, to the extent practical, removes all the "old" water in the well so it is replaced by fresh ground water from outside the well installation.

1. The well will be purged by withdrawing water from within two feet of the top of the water column.
2. Repeated vertical adjustment of the purging equipment intake may be necessary if the water level drops.
3. Positive displacement submersible bladder or Grundfos or similar type pumps will be used for both purging and sampling.
4. Sampling will immediately follow purging.
5. Well evacuation will be continuous between purging and sampling.
6. The same pump will be used for both purging and sampling at each individual well.

7. Neither air lift pumps or any other method device that significantly aerates well water or otherwise creates significant turbulence will be used at any time during the purging or sampling of wells.

Field water quality parameters will be measured for stabilization after each water-column volume is purged. One water-column volume is defined here as equal to the volume of a cylinder with a height (h) equal to that of the Static Water Column inside the well and a diameter (d) equal to the diameter of the well casing (Volume = $\prod(d/2)^2$ h). The following target criteria for three consecutive measurements (one water-column volume apart) will be used to demonstrate stabilization:

- pH +/- 0.04 units temperature
- +/- 0. 1 degrees Celsius
- specific conductance (temperature corrected EC) +/- 5%
- dissolved oxygen +/-0.5 mg/L

Samples for laboratory analysis will be collected only after a minimum of three water-column volumes have been purged and stabilization of field water-quality parameters has been demonstrated by meeting the target criteria defined in the preceding paragraph. If field parameters do not stabilize after approximately five water-column volumes, then field staff will check operator procedures, equipment functioning and well construction information for potential problems. In particular, field staff will re-evaluate whether or not water is being withdrawn from the appropriate depth to effectively evacuate the well. If all the checks produce no new insight, a decision might be made to collect samples after five water-column volumes have been purged even if field measurements have not stabilized. Before authorizing the laboratory to analyze samples, the meaningfulness and value of completing laboratory analysis of the sampling suite will be evaluated by reviewing the results of field measurements, well construction data, site hydrogeology, etc. Where such data is presented, it will be clearly documented that stabilization was not achieved; at a minimum, this fact will be reported on the SIF and in the Sampling and Analysis Report.

Residential Wells

The residential wells will be sampled at an exterior tap on residences determined by the Corps. Generally sampling procedure is the same only the volume of water in the system will need to be estimated to ensure three well or system volumes have been pumped before stabilization readings are taken and samples obtained.

Surface Water Samples

Surface water samples will be grab samples. Purging is not applicable.

4.0 SAMPLE COLLECTION

This section describes procedures for setting the sampling pump and collecting ground water samples. Field data for these items will be recorded on the SIF for each sampling point.

4.1 Pump Setting

The contractor shall use a positive displacement submersible bladder, Grundfos, or similar type pump(s) for sample collection. The Contractor shall identify the pump used for each well by providing its type and model number in all

reports. If well recovery is so slow that a satisfactory water column height (for normal pump operation) is not reached in a reasonable amount of time, a zero submergence bladder pump or Teflon bailer will be used for sample collection. The SIF will show what type of pump or bailer was used to sample each well. If any device other than the one described above is used, it will be reported as a protocol exception. Alternative pumps or bailers used must be identified and justified in the Contractors proposal and approved by the Corps prior to contract award.

Following purging. the water level will be checked with a clean measurement device. The pump intake will be adjusted, if necessary, so it is set inside the screened interval (if possible)at approximately two feet below the water surface inside the well to collect samples. The water level measurement will be compared to the static water level and the pump intake setting. This comparison will be used to verify that drawdown is minimal at the purge rate and that the pump intake is located approximately two feet below the top of the water column. Note for alternate scenario where static water level is sufficiently above the top of the screen: the sampling pump intake should be set at approximately two feet above the top of the screen and at least two feet below the top of the water column.

The same pump will be used for sampling as was used for purging. Pumping will be continuous and sampling will immediately follow purging. If pumping is not continuous it will be noted on the SIF. The sample collection pumping rate will be less than or equal to the purging rate. The purging and sampling rate will be no more than 0.5 gallons per minute. High volume wells may require the use of a "packer" or simultaneous pumping to effectively purge the deep wells.

Any final rinse water remaining in any portion of the sampling pump or discharge lines will be completely purged with fresh well water before filling sampling containers. To insure this, at least two tubing-volumes will be purged from discharge lines before sample collection begins.

4.2 Sample Filtration

Table 2 identifies which sample containers will be filled with sample water that has been filtered in the field. Sample filtration will be completed as follows:

1. The filter holder and new filter will be thoroughly pre-rinsed with laboratory-controlled deionized or distilled water before use.
2. The new filters will be flushed with fresh sample water before collecting samples.
3. The filter will be connected directly to the well sampling pump discharge line using positive pressure to force the sample through the filter.(if practible)
4. From the filter, the flow will be routed directly into the sample collection container.
5. A 0.45 micron pore size filter will be used.
6. The flow rate will not exceed 0.5 gallons per minute.
7. Agitation and aeration of the sample will be minimized.
8. Teflon tubing will be used for the pump and filter discharge lines.

4.3 Filling Sample Containers

Table 2 summarizes the sample container type, filling method, preservation method and holding time for each analytical parameter set. To clarify and supplement the summary in Table 2, the manner in which containers will be filled is

described below in subsections of 4.3. Individually prepared bottles will not be opened until they are to be filled with water samples. Special care will be taken to ensure that the procedures listed below are followed:

1. The area surrounding the wellhead will be kept as clean as practical to minimize the potential for contamination of samples.

2. Care will be exercised to minimize the potential for airborne contamination of sample water during collection. If vehicles or generators are left running during sample collection, containers will be filled upwind from engine exhaust sources. If conditions are dusty, an effort will be made to shield the sample collection area from windborne contamination.

3. A clean and dry sheet of relatively inert plastic shall be placed on the ground surface in the wellhead area. If materials used in the sampling process must be put down, they will be placed on a clean portion of the plastic sheet instead of the ground surface.

4. A clean pair of gloves will be put on at the onset of sampling activities at each new sampling point.

5. Sampling personnel will keep their hands as clean as practical and replace gloves if they become soiled while performing sampling activities.

6. Sampling personnel will not touch the inside of sampling containers, inside of bottle caps or rim of sample containers. If contact occurs, sample containers will be replaced.

At the well, bottles will be labeled and chain-of-custody sections will be filled out by the field personnel according to procedures described below in Section 5: "Documentation of Sampling Event". To prevent a mix up with sample bottle identification, no sampling-point specific information such as "well name" will be filled out in advance. Chain of custody information will be completed before leaving the sampling point. Laboratory-prepared bottles will be used to assure quality control.

The order of filling bottles with water to be analyzed will be as follows:

1. major and minor ions
2. nitrates
3. trace metals
4. "miscellaneous" parameters
5. non-volatile organics

Methods for filling sample containers for individual analyses are described below.

The sample water discharge point at the end of the tube will be held as close as possible to the sample container without allowing the sample tubing to contact the container. At a minimum, sampling personnel will use their body to shield the sampling container from wind and airborne dust while filling. When strong winds, heavy rain, or dusty conditions are present, additional measures will be implemented to guard against background interference.

Nitrate

Sample containers for nitrate analysis will be prepared in advance by the laboratories with H_2SO_4 as a preservative. The containers will be filled approximately 95% full with unfiltered water. Containers will not be rinsed or overfilled at anytime in the field. Samples will be checked with pH paper in the field to verify that the pH has been lowered to less than or equal to pH = 2.

Trace Metals

Sample containers for general trace metals analysis will be prepared in advance by the laboratories with $HN0_3$ as a preservative. This will insure that samples will be acidified as soon as they are collected. Containers will be filled approximately 95% full. Containers will not be rinsed or overfilled at anytime in the field.

Monitoring Wells

Two samples, one filtered and one unfiltered, will be collected for general trace metals analysis. The sample bottles will be clearly labeled as "filtered" and "unfiltered." **Analysis of the filtered samples will be conducted for the monitoring well samples**. All filtrations will use positive pressure through a 0.45 micron filter. Unfiltered (whole) water samples will be placed in cold storage until project completion or until directed by the Corps.

Residential Wells

Unfiltered (whole water) samples will be collected for the residential wells. The whole water samples will be analyzed for the residential wells.

Surface Water

Unfiltered samples will be collected and analyzed for the surface water sites during each monitoring trip.

General

All filtered sample water will be filtered through a 0.45 micron pore size filter unit before filling the laboratory prepared bottle. New filters will be used for each sample.

If sample water is too turbid to field filter and a protocol exception has been pre-approved by the Corps of Engineers, it will be collected in a new unacidified container, put on ice, and immediately delivered to the laboratory for filtration and acidification. Unacidified metals sample bottles will be filled completely.

Whether filtered or not, samples for metals analysis will be collected in a manner that minimizes turbulence and aeration and then acidified immediately as described above. Plastic containers will be used for sample collection. The acid will be produced/controlled within the applicable QA/QC program to ensure that it is pure enough (e.g., Ultrex or pure acid diluted with triple distilled water) with regards to metals to avoid a false positive analytical result.

Non-Volatile Organics

As defined here,"non-volatile organics" (meaning organic compounds that are not highly volatile) include the following sets of parameters: base-neutral/acid extractable organics, phthalate esters, polychlorinated biphenyls (PCB's), phenols, polyaromatic hydrocarbons, chlorinated herbicides, organochlorinated pesticides and PCB's, and organophosphorus pesticides. Sample containers used for non-volatile organics analysis will not be rinsed in the field or allowed to overflow excessively during sample collection. Containers will be filled completely.

4.4 Field Blanks, Replicate And Split Samples

Sample blanks, will be collected to detect background or method contamination. Replicate samples and split samples will be collected to evaluate variability in analytical methods. QA/QC samples will be collected at sampling points suspected to have relatively higher levels of contamination to provide meaningful information duplicate sample evaluation. All QA/QC samples will be collected in the same type of container as the corresponding primary samples. All QA/QC samples will be assigned identification aliases on the sample bottle label and on the chain of custody sheet to avoid alerting laboratories that the sample is a blank or replicate sample. The true identity of the QA/QC samples will be recorded in the field sampling log.

The collection schedule for QA/QC samples will be as follows:

1. one field methods (equipment) blank every other sampling trip
2. at least one replicate set for every ten sets of samples collected
3. at least one surrogate spike for each ten sets of samples collected

For each type of QA/QC sample, containers will be prepared and submitted for the following analyses:

1. field methods (equipment) blank: trace metals, non-volatile organics
2. replicates: all analytical parameters
3. surrogate spikes: all analytical parameters

Field Blank Samples

Field equipment/methods blanks will be collected in the field for trace metals and non-volatile organics. Sample containers used for each blank will be the same as for the actual analysis of sample water for these parameter groups. All containers shall be pre-cleaned within the laboratory's QA/QC program in the same manner as primary sample bottles. The sample blank containers will be filled in the field. Laboratory controlled, organic free water will be used to fill all organic blank samples. Trace metals blanks will be filled with laboratory prepared, triply distilled water. The same preservatives will be added to both the methods blank and the primary samples. An effort should be made to have the blank sample water contact all the interfaces and preservatives that the sample water will contact.

Field Replicate Samples

Field replicate samples of actual ground water will be collected and analyzed for the same parameters as the primary samples are analyzed for. Replicate samples will be collected for 10% of the primary samples collected. Replicate samples will be collected by sequentially filling all containers as close together in time as practical with a sampling stream that is as steady and continuous as practical. The sequence number (first, second, etc.) and time filled will be listed in the field notebook. The time that each individual container was filled will be listed on the container and on the Sample

Identification - field chain of Custody Record in the same manner as primary samples. One field replicate sample set will be collected for every ten primary sampling sets.

Field Split Samples

Field split samples of actual ground water will be collected and analyzed for the same parameters the primary samples are analyzed for. Split samples will be collected for approximately 10% of the primary samples by filling the subsample containers from a single homogeneous sample water at the same time. **Field split samples will be delivered to a laboratory specified by the Corps.**

5.0 DOCUMENTATION OF SAMPLING EVENT

This sampling protocol includes the use of the attatched forms; they are designed for documentation of field activities and collection of field data. They also provide a means to verify whether or not this protocol was followed during a number of key steps in the ground water sampling event. To fully implement the protocol verification facility of these forms, all entries on both sides of the forms will be completed before leaving the sampling point. This includes filling in all blanks and circling or checking all choices, e.g., "yes" or "no" choices on the following forms:

1. Water-level Data Form
2. Well Purging/Field Water Quality Measurements Form
3. Ground Water Sampling Information Form
4. Sample Identification - Field Chain of Custody Record (SI-FCCR)

The following exceptions are allowed on all forms:

- Columns with blank headings don't require an entry.
- Ditto marks or continuation arrows may be used in any column to indicate "same as above"; N/A or a horizontal line may be used to indicate "not applicable."
- "Comment" fields may be filled in with a horizontal line to imply that nothing that could impact data or the validity of data was observed.
- The Project Name/# and Organization performing the work can be entered in advance.
- The IGWIS fields "Facility ID" and Station ID" can be filled out after leaving the sampling point.

Other exceptions include the following:

- Forms 1,2, and 4: only rows needed to document required tests, measurements, calibration, etc., will be filled.
- Form 2: Only include field water quality parameters called for in the sampling protocol
- Form 4 (SI-FCCR): the entire header block (upper one-sixth of the form) may be filled

out in advance except for the "hazardous materials expected" field.

5.1 Sample Identification

The attached Sample Identification - Field Chain of Custody Record (SI-FCCR) or a similar form will be completed as described above in Section 5.0, "Documentation of Sampling Event". All primary and QA/QC samples collected at a

given sampling point over a discrete interval of time will be assigned the same sample event ID #. This number is used to link that set of containers together and associate them with all of the information contained on the SIF.

The SI-FCCR will be at least a two-part (carbonless copy) form. When samples are transferred to an analytical laboratory, the laboratory will receive only the laboratory part(s) of the form. Information from the "Sampling Point", "Location", "Field Sample Event ID #', "Sample Type" and "Time" columns does not transfer to the laboratory part(s) of the form and, therefore, will not be disclosed to the laboratory.

Each Sample Identification - Field Chain of Custody Record (SI-FCCR) will contain a unique record number printed in the upper margin on the right side of the form. The container's row # appended to the record # on the form uniquely identifies each sample container (unique container ID #). In the case of a multi-container set, such as a set of three associated VOC vials - the set is uniquely identified.

Each sample container will be labeled with the following information using a waterproof marker on firmly affixed, water-resistant labels:

- unique container ID #
- sample collection Date
- sample collection Time
- initials of person collecting sample
- analyses required on pre-printed label
- preservation method specified on pre-printed label when preserved at lab
- sampling organization name on a pre-printed label

Container information will be entered at the sampling point at the time of sample collection with the following exceptions. For containers receiving preservatives in advance, "analyses required" and "preservation method" will be entered onto labels by laboratory staff. For containers receiving preservatives in the field, "preservation method" will be entered at the time individual containers are filled.

5.2 Chain Of Custody

A chain-of-custody record (SI-FCCR) will be initiated in the field at the time of sampling; a copy will accompany each set of samples (cooler) shipped to any laboratory.

Each time responsibility for custody of the samples changes, the new and previous custodians will sign the record and denote the date and time. A copy of the signed record will be made by the receiving laboratory. The final signed SI-FCCR will be submitted with analytical results in the Sampling and Analysis Report.

Field Chain of Custody Documentation

All signatures related to sample custody will be made in ink on the SI-FCCR in a timely fashion. One or more signatures will be entered to identify the person or persons who are collecting the samples. Each time the custody of a sample or group of samples is transferred, a signature, date and time will be entered to document the transfer. The signatures, date and time will be entered at the time of transfer; the row # will be used to define which bottles were transferred. A sample will be considered to be in custody if it is in any one of the following states:

1. in actual physical possession
2. in view, after being in physical possession
3. in physical possession and locked up so that no one can tamper with it
4. in a secured area, restricted to authorized personnel

A secured area such as a locked storage shed or locked vehicle specified in the "comments" column, may be used for temporary storage. When using such an area, the time, date, and location of the secured area will be recorded in the "relinquished by" space. The time at which an individual regains custody will then be recorded in the "received by" space.

Chain of Custody During Shipping and Transfer of Samples

When samples are shipped, the person sealing the shipping container will enter the time, date and their signature on the SI-FCCR. The laboratory part of the SI-FCCR will be enclosed in the container; the top page (first part) will be retained for the project manager's file. A post office receipt, bill of lading, or similar document from the shipper will be retained as part of the permanent chain-of-custody documentation.

One or more custody seals will be affixed over the opening of the shipping container in a manner that precludes opening the container without breaking the seal(s). The laboratory will be instructed to note whether or not the container seal(s) are intact and sign in the appropriate blank on the SI-FCCR at the time of receipt. They will also be instructed to keep a copy and return the original form to the Corp of Engineers with the analysis results.

5.3 Field Sampling Log

A daily field log of sampling activities will be kept by the leader of the field sampling crew. This record or log will supplement information entered on the SIF. At a minimum, the log will contain a record of the following items:

- list of field personnel present
- field conditions as described below in Section 5.5, "Field Conditions"
- a summary of how samples were transferred/transported to laboratories
- description of exceptions to this protocol including specification of which samples may have been impacted by exception(s) (see below)
- For each well sampled:
  - -the unique SI-FCCR # used to identify samples
  - -well name and Minnesota unique well number
  - -date and time that sampling began and ended
  - -list of primary and QA/QC samples sent to each laboratory
  - -any alias cross-reference list for QA/QC samples

5.4 Exceptions To Sampling Protocol

This protocol defines the procedures to be, followed during this sampling event. Exceptions to this protocol will be noted on the SIF and detailed in the Field Sampling Log (see above). The section titled "Exceptions to Protocol" in the Sampling and Analysis Report will include the following details for each exception:

- the reason for the exception
- the identification of all samples and individual parameters that may have been impacted either in terms of the quantitative or legal integrity of their reported values
- the significance of the potential impacts to the integrity of each parameter for each sample

If there has been any potentially significant impact on sample integrity, then the potential impact for each parameter for each sample affected will be footnoted whenever the results are reported or referred to in the Sampling and Analysis Report.

5.5 Field Conditions

Field conditions during the sampling event will be recorded on the SIF (using the "comment" field on the reverse side, if necessary). The Sampling and Analysis Report will include a statement regarding the likelihood that any unusual field conditions had a significant impact on the integrity of results. Field conditions reported will include but not be limited to the following:

- air temperature
- wind speed
- precipitation/moisture
- ambient odors
- airborne dust

6.0 SAMPLE PRESERVATION, HANDLING AND TRANSPORT

This section describes procedures that will be followed between the time samples are collected and the time they are either shipped or delivered to an analytical laboratory.

6.1 Sample Preservation

Samples will be preserved as shown in Table 3. All Chemical preservatives, added to containers in the laboratory or field will be produced and controlled within the laboratory's QA/QC program. Field supplies of preservatives and sample containers with pre-dosed preservatives will be discarded and replaced with fresh preservatives no later than 14 days after receipt from the laboratory.

All samples will be thermally preserved in the field immediately after sample collection by placing the samples in an insulated ice chest containing uncontaminated Blue Ice. (Regular ice may be used if blue ice is unavailable. If so, particular care will be taken to assure that paper work and sample labels are not damaged by water. The regular ice will be placed inside uncontaminated leak-proof plastic containers and the chain of custody record will be placed inside a Zip Lock bag.) The ice chest temperature will be checked by measuring the temperature of the water within the temperature blank container and recorded just before transporting samples and upon receipt at the laboratory, to verify whether or not samples are kept refrigerated at approximately 4 degrees C.

6.2 Sample Handling And Transport

All ice chests shipped will be accompanied by an SI-FCCR form and contain a complete address and return address both inside and out. The samples will be kept at approximately 4 degrees C during transport to laboratories. Before transporting samples, field personnel will perform the following tasks:

1. Verify that laboratory personnel will be present to receive samples when they arrive.
2. Verify that laboratory personnel understand chain of custody and sample storage/preservation requirements.
3. Check labeling and documentation to ensure sample identity will be clear to laboratory personnel.
4. Hand deliver or ship samples in a manner that ensures samples will remain cool (about 4 degrees Celsius) until received by laboratory personnel.
5. Maintain the chain-of-custody according to procedures described above.

TABLE 1 – WATER ANALYSIS

WATER QUALITY TESTING AND REPORTING PROTOCOL				
PARAMETER	TESTING METHOD	CITATION	TESTING METHOD OR PROJECT PQL*	APPROX. NUMBER OF SAMPLES
Fecal Coliform	Membrane filtration (MF) SM Method 9222	APHA 1995		81
Alkalinity	EPA 310.1 or 310.2		10 mg/l as $CaCO_3$	117
Hardness	EPA 130.1 or 130.2		10 mg/l as $CaCO_3$	117
Nitrate+Nitrite Nitrogen	EPA 353.1 or 353.3	EPA 1983	0.1 mg/l	117
Nitrite Nitrogen	EPA 354.1	EPA 1983	0.1 mg/l	117
Nitrate Nitrogen	CALC.		1 ug/l	117
Arsenic	EPA 206.2	EPA 1986	0.1 ug/l	117
Cadmium	EPA 213.2	EPA 1986	1 ug/l	117
Chromium	EPA 218.2	EPA 1986	1 ug/l	117
Copper	EPA 220.2	EPA 1986	1 ug/l	117
Lead	EPA 239.2	EPA 1986	1 ug/l	117
Nickel	EPA 249.2	EPA 1986	1 ug/l	117
Zinc	EPA 289.2	EPA 1986	1 ug/l	117
Iron	EPA 236.2		1 ug/l	117
Manganese	EPA 243.2		1 ug/l	117
PCB's and CHLORINATED PESTICIDES**				
Total PCB's (Arochlors 1016, 1221, 1232, 1242, 1248, 1254, 1260)	SW-846 3520/8080	EPA 1986	2 ug/l	12
Aldrin	SW-846 3520/8080	EPA 1986	0.04 ug/l	12
Alpha BHC	SW-846 3520/8080	EPA 1986	0.03 ug/l	12
Beta BHC	SW-846 3520/8080	EPA 1986	0.06 ug/l	12
Delta BHC	SW-846 3520/8080	EPA 1986	0.09 ug/l	12
Gamma BHC (Lindane)	SW-846 3520/8080	EPA 1986	0.04 ug/l	12
Heptachlor	SW-846 3520/8080	EPA 1986	0.03 ug/l	12
Heptachlor Epoxide	SW-846 3520/8080	EPA 1986	0.83 ug/l	12
4,4 DDD	SW-846 3520/8080	EPA 1986	0.11 ug/l	12
4,4 DDE	SW-846 3520/8080	EPA 1986	0.04 ug/l	12
4,4 DDT	SW-846 3520/8080	EPA 1986	0.12 ug/l	12

Dieldrin	SW-846 3520/8080	EPA 1986	0.02 ug/l	12
Endrin	SW-846 3520/8080	EPA 1986	0.06 ug/l	12
Chlordane	SW-846 3520/8080	EPA 1986	0.14 ug/l	12
Methoxychlor	SW-846 3520/8080	EPA 1986	0.5 ug/l	12
Endosulfan I	SW-846 3520/8080	EPA 1986	0.14 ug/l	12
Endosulfan II	SW-846 3520/8080	EPA 1986	0.04 ug/l	12
Endosulfan sulfate	SW-846 3520/8080	EPA 1986	0.66 ug/l	12
Endrin Aldehyde	SW-846 3520/8080	EPA 1986	0.23 ug/l	12
Toxaphene	SW-846 3520/8080	EPA 1986	2 ug/l	12
FIELD MEASUREMENTS				
PH	EPA 150.1	EPA 1983	0.1 st. units	Site dependent
Temperature	EPA 170.1	EPA 1983	0.1 deg. C	Site dependent
Specific Conductance	EPA 120.1	EPA 1983	1 us/cm	Site dependent
Dissolved Oxygen	EPA 360.1	EPA 1983	0.1 mg/l	Site dependent
Turbidity	EPA 180.1	EPA 1983	1 ntu	Site dependent

* Detection limits refer to final analyte concentrations, including back calculations, and do not refer to the basic instrument detection limits. All detection limits are minimum acceptable levels.

** Florosil column cleanup, method 3620, followed by sulfur cleanup, method 3660, may be required to remove interferences.

Table 2. Sampling Schedule

SCHEDULE	Phase 1 Pre-Project			Phase 2 (Time from onset of dredging in days)						Phase 3 (after completion of dredging-days)		
PARAMETERS	1	2	3	3	17	31	45	59	73	30	60	90
MONITORING WELLS (2)												
Basic Parameters[1]	X	X	X	X	X	X	X	X	X	X	X	X
Nit., Alk., Hardness	X	X	X	X	X	X	X	X	X	X	X	X
Metals	X	X	X	X	X	X	X	X	X	X	X	X
Fecal Coliform												
PCB's, Pesticides												
STAINLESS STEEL WELL (1)												
Basic Parameters[1]	X	X	X	X	X	X	X	X	X	X	X	X
Nit., Alk., Hardness	X	X	X	X	X	X	X	X	X	X	X	X
Metals	X	X	X	X	X	X	X	X	X	X	X	X
Fecal Coliform	X	X	X	X	X	X	X	X	X	X	X	X
PCB's, Pesticides	X	X	X	X	X	X	X	X	X	X	X	X
RESIDENTIAL WELLS (11)												
Basic Parameters[1]	X	X	X									
Nit., Alk., Hardness	X	X	X									
Metals	X	X	X									
Fecal Coliform	X	X	X									
PCB's, Pesticides												
RESIDENTIAL WELLS (3)												
Basic Parameters[1]	X	X	X	X	X	X	X	X	X	X	X	X
Nit., Alk., Hardness	X	X	X	X	X	X	X	X	X	X	X	X
Metals	X	X	X	X	X	X	X	X	X	X	X	X
Fecal Coliform	X	X	X	X	X	X	X	X	X	X	X	X
PCB's, Pesticides												
RIVER AND CARRIAGE WATER												
Basic Parameters[1]				X	X	X	X	X	X			
Nit., Alk., Hardness				X	X	X	X	X	X			
Metals				X	X	X	X	X	X			
Fecal Coliform												
PCB's, Pesticides												

1 – Basic parameters are water temperature, specific conductance, pH, dissolved oxygen, and turbidity.

Table 3: Sample Containers, Filling Method, Preservation and Holding Times

Table 3 Sample Containers, Filling Methods, Preservation, and Holding Time				
PARAMETER	BOTTLE Volume/type	FILL METHOD	PRESERVATION	HOLDING TIME
Nitrate	250 ml P	Leave head space	H_2SO_4/pH<2 Lab, cool	28 days
Trace Metals (unfiltered)	500 ml P	Leave head space	HNO_3/pH<2 Lab, cool	6 months
Trace Metals (filtered)	500 ml P	Filter (0.45 micron) No head space	HNO_3/pH<2 Lab, cool	6 months
Non-volatile organics (pesticides & pcb's)	2x1L AG	No head space	Cool	7 days extraction 40 days analysis

(1) PARAMETER NAMES/GROUPS

Some of these parameter names {e.g., "trace metals"} actually represent a set of several or many individual analytes. Specific analytes for each parameter/bottle type are listed in Table 1.

(2) BOTTLE TYPE

L: liters; AG: amber glass bottle fitted withTeflon lined cap

ml: milliliters; P: polyethylene;

(3) FILL METHOD

No head space - fill container completely; container will not be rinsed; overfilling will be minimized.

Leave head space - fill container about 90 to 95% full - do not allow preservative (if present) to be diluted by overfilling container.

Filter [0.45 micron] - filter in-line with positive pressure through a filter with 0.45 micron pore size.

(4) PRESERVATION

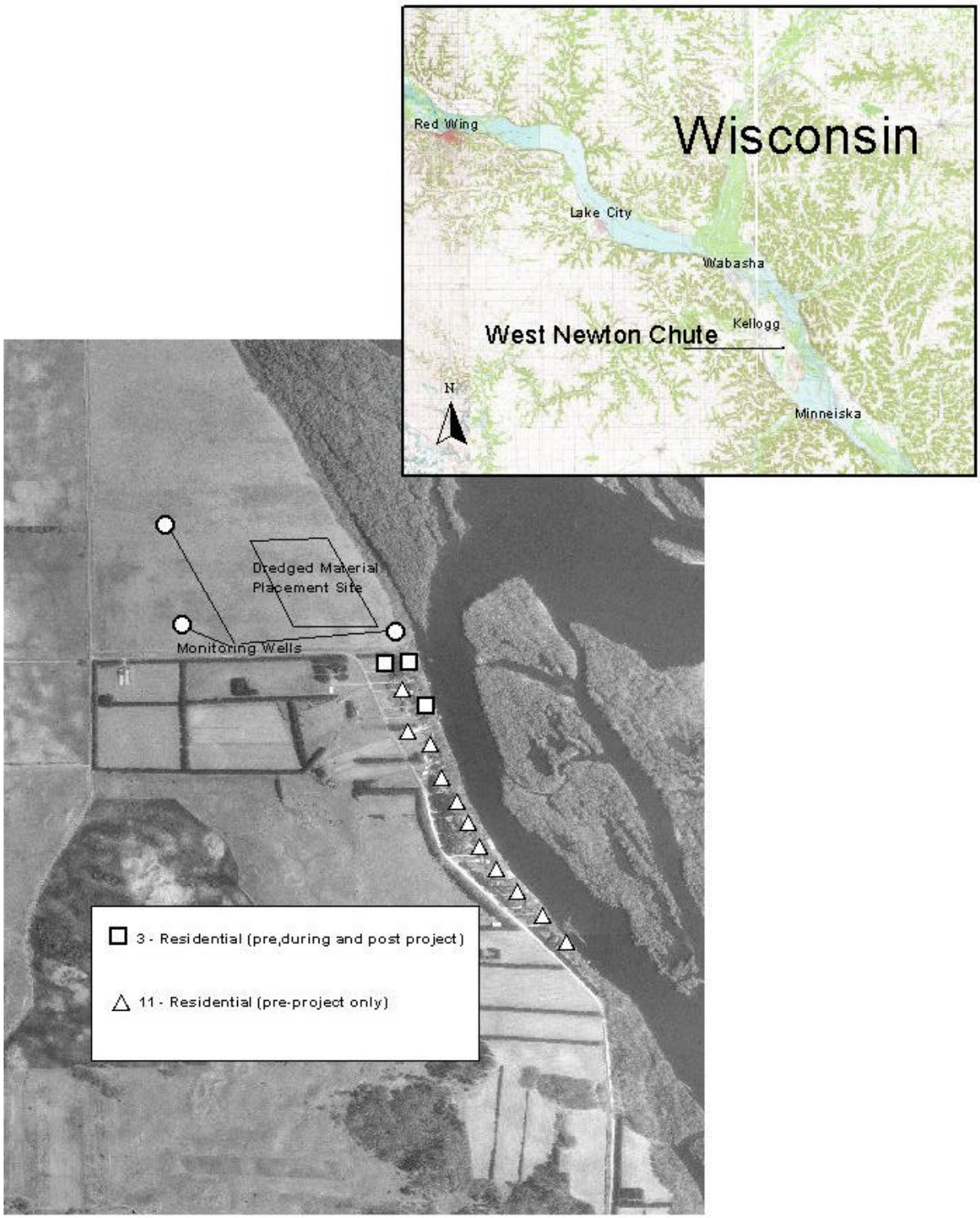
Cool - place container inside sealed Zip-Lock bag; place in cooler with sufficient ice to quickly bring temperature down to 4 degrees C and hold at approximately 4 degrees C until received by laboratory personnel.

H_2SO_4/pH<2 - add a predetermined amount of high-purity H_2SO_4, to sample to bring the sample pH down to 2 or less.

HNO_3/pH<2 - add a predetermined amount of high-purity HNO_3, to sample to bring the sample pH down to 2 or less.

Lab - preservative added to container in laboratory before going into the field.

Figure 1. Map of approximate locations of residential and monitoring wells



7.

SAMPLE IDENTIFICATION - FIELD CHAIN OF CUSTODY RECORD

Sheet ____ of ____

Project Name/# _____ Sample Collection Date: ___/___/___ (Month / day / year)

Report to: _____

Gen. Location City: _____ County: _____

Organization: _____ Tel# _____

Shipped by : _____ tel# _____

Sample Medium: _____ (Ground water, surface water, etc.?) _____ (Grab or composite?)

Shipped to: (specify laboratory and address) _____

Hazardous Materials Suspected (Y, N) _____

Row #	Sampling Point (Common Well Name)	Location (Site/Facility Name)	Field Sample Event ID# (Date plus military time preferred: yymmddhhmm)	Sample Type (Primary, Replicate, Split, Field Ambient Air Blank, Field Methods Blank, Trip Blank; code or abbreviate)	Time (time sample bottle was filled)	Sample Containers Volume	#	Filtration (if filtered, enter:) Time	filter Pore Size	Preservation (1. HCl, 2. HNO3, 3. NaOH, 4. H2SO4, 5. K2Cr2O7, 6. Ice only, 7. Other (specify), 8. Not preserved) Time	Method	Analyses Required (specify fraction & parameters; NF = no lab filtration - analyze total sample; LF = filter in lab - dissolved phase only; S = analyze solids/particulates only; O = Other (specify)) Fraction	Parameter(s)/method	Row #
1														1
2														2
3														3
4														4
5														5
6														6
7														7
8														8
9														9
10														10
11														11
12														12

Sampling Personnel (name and organization) _____

Row/ ID#(s)	Relinquished by (signature in ink)	Received by (signature in ink)	Date	Time	Comments

Sampling Personnel:

Shipping Method/Carrier _____ Shipping Receipt attached (Y, N) Comments _____

Chain of Custody maintained through 1) sealing for shipment or 2) delivery to lab: (Y, N) (signed) _____ Date _____ Time _____

Lab Personnel:

Custody Seals intact at lab? (Y, N, N/A) Sample Temp. _____ ° C. Verified for lab by (signed) _____ Date _____ Time _____

Sample Destruction Authorized by _____ Destroyed by _____ Date _____

Form GWS #5-A
Revised 10-13-94

Note: the field sample container identification # is defined by appending the appropriate row # to the chain of custody record # on this form. Use this numbering convention to label (identify) all containers.

WELL PURGING - FIELD WATER QUALITY MEASUREMENTS FORM* Side 1 of 2*; Sheet ____ of ____

Location (Site/Facility Name) _____ (MN Unique Well #) _____ Sampling Point (common name) _____

Project Name/# _____ Date _____ Facility ID (for IGWIS data entry only) _____

Field Personnel _____ Station ID (for IGWIS data entry only) _____

Sampling Organization _____ Purging Device (type of pump, bailer, etc):* _____

Submersible pump with direct line to Flow Cell used for all measurements? (Y, N)* Pump Intake or Bailer set at (ft. below MP)

Time (24 hour clock)	DTW below MP (ft.)	Purge Rate (specify units below) ( )	Cumulative Volume Purged (specify units below) ( )	Water Column Volumes Purged	Temp. (°C)	Electrical Conductivity (µMhos/cm)	Specific Conductance (µMhos/cm)	pH	Eh (mv)	DO (mg/l)	Turbidity (NTU)	Comments (At appropriate time enter "static water level", "purging began"; describe sample appearance, odor) (alternately, list sampling point when recording data for multiple sampling points)

CALIBRATION									
Date ☞									
Time (24 hour clock) ☞									
Calibration: Summary Comments* ☞	1 or 2 pt.	k =		Buffers		Type			

Field Measurements protocol followed with no exceptions (Y, N)* Form completed by _____ Date _____ Form GWS #3 Revised 1-12-95

* Side 2 of this form contains room for supporting documentation including protocol exceptions

WELL PURGING - FIELD WATER QUALITY MEASUREMENTS FORM

(Reverse Side)

Location (Site/Facility Name) _____ Sampling Point (common name) _____

Project Name/# _____ _____

CALIBRATION	Temp. (°C)	Electrical Conductivity (µMhos/cm)	Specific Conductance (µMhos/cm)	pH	Eh (mv)	DO (mg/l)	Turbidity (NTU)	GUIDANCE REMARKS	Comments
DATE									
TIME (24 hour clock)									
TYPE OF CALIBRATION								e.g., standard KCL solution, Zobels solution, in air/water etc.	
LIST 1ST STANDARD								e.g., pH = 7.02 @ 25 °C, KCL solution = 1000 µMhos/cm	
INSTRUMENT READING								actual reading from instrument	
CALIBRATED TO +/-?								difference between calibrated instrument display and standard	
LIST 2ND STANDARD								eg., repeat calibration with 2nd buffer or by alternate method	
INSTRUMENT READING								"	
CALIBRATED TO +/-?									
CORRECTION FACTOR								e.g., cell constant, "k"	
CALIB. SUCCESSFUL?								Enter YES or NO	
SATISFIES PROTOCOL?								Did calibration meet criteria in the sampling protocol ? (Y or N)	
CALIBRATION BY								Signature or Initials	
INSTRUMENT ID#								serial # or other ID #	
LOCATION								specify "field", "lab", "office", etc.	

Well Purging Equipment (more details): _____

List/Describe Field Instruments: _____

Discussion of Protocol Exceptions: _____

_____

Other Comments: _____

Form completed by _____ Date _____

Form GWS #3R
Revised 1-18-95

GROUND WATER SAMPLING INFORMATION FORM*

Side 1 of 2*

General Information

Location (Site/Facility Name) _____ Sampling Point (common name) _____

Project Name/# _____ Type (mon. well, spring, etc.) _____

Field Personnel _____ Field Sample (Event) ID#* _____

Sampling Organization _____ Facility ID (for IGWIS data entry) _____

Weather ☼ ? _____ Station ID (for IGWIS data entry) _____

Sampling Station (Well) Details

Read from left to right ☞

Well Depth (ft. below MP) _____ Casing Diameter (inches) _____ Open Interval (depth below GS) top -- bottom _____ - _____ (0.1 ft.)

Static Depth to Water (below MP) _____ (0.01 ft.) Static DTW (ft. below GS) _____ (0.1 ft.) Date _____ Time _____

Water Column Length (L) (ft.) _____ One WC Volume (cu. ft.) _____ One WC Volume (gals) _____

Condition: Securely Locked? Y or N Station (Well) Damaged? Y or N Surface Contamination (visible)? Y or N

Purging

Read from left to right ☞

PID/FID Reading @ Wellhead* Concentration _____ ppm Background Conc. _____ ppm

Free Product (circle: LNAPL or DNAPL)* Detected/Sampled? Y or N / Y or N Appearance ☕ _____

Well Purging Equipment Pump, bailer? _____ Type* _____

Purging Date/Time Start ⌚ _____ / _____ Finish ⌚ _____ / _____

Pump/Bailer Intake Set at Feet below MP _____ Avg. Purge Rate _____ gpm

Amt. Purged before Sampling Gals./WC Volumes _____ / _____ Purge Protocol of ___ WCV's met? Y or N

Field Water-Quality Measurements and Observations

Date/Time Measurements Began _____ / _____ Purge Rate for Measurements (gpm) _____

Submersible Pump with direct line to Flow Cell used for all Field Water Quality Measurements? Y or N

All Field Measurement Instruments Calibrated according to Protocol? Y or N

All Field Water Quality Parameters Stabilized according to Protocol Criteria just before filling sample containers? Y or N

The Measurements below Represent: (1) stabilization, (2) sample water collected, (3) both 1 and 2, (4) other*: _____

Sample Appearance: ☕ _____ Odor: _____

Field Measurement	Value	Time (24 hour)	Comments*
Temperature	°C		
Electrical Conductivity	µMhos/cm		= meter reading x magnitude x k
Specific Conductance	µMhos/cm		EC corrected to 25 ° C
pH	Standard Units		
Dissolved Oxygen	mg/l		
Eh	mV		
Turbidity	NTU		

Sample Collection

Sampling Device (type of pump/bailer)* _____ Sample Medium (well water, LNAPL, etc.)* _____

Permanently Installed Pump? Y or N Dedicated Equipment? Y or N Used Same Equip. for Purge? Y or N

Pump Intake/Bailer Set at (ft. below MP) _____ Interval Samples Represent (ft. below GS) Top = _____ / Bottom = _____

Date/Time Sampling Began _____ Date/Time Sampling Finished _____

Depth to Water (ft. below MP) _____ Depth to Water (ft. below MP) _____

QC Samples Collected? Y or N (see reverse*) Sample Withdrawal Rate _____ gpm

All Field Protocols were followed with no exceptions (Y, N); Enter Protocol Codes* 1.___ 2.___

Remarks (1)* (include protocol exceptions) _____

Form Completed by _____ ✍ (sign in ink) Date _____

Form GWS #4
Revised 1-12-95

* Side 2 of this form contains definitions of abbreviations, protocol codes, additional room for equipment specification, QC sample description and other comments

GROUND WATER SAMPLING INFORMATION FORM*
(Reverse side)

Sheet ____ of ____
Side 2 of 2

ABBREVIATIONS

ft.	feet	MP	Measuring Point	GS	Ground Surface
DTW	Depth to Water	WC	Water Column	cu. ft.	cubic feet
Y	Yes (circle if appropriate)	N	No (circle if appropriate)	gals	gallons
PID	Photo Ionization detector	FID	Flame Ionization detector	ppm	parts per million
gpm	gallons per minute	Amt.	amount	k	cell constant
EC	Electrical Conductivity	LNAPL	light non-aqueus phase liquid (floater)	DNAPL	dense non-aqueus phase liquid (sinker)

GENERAL INFORMATION

The "Field Sample (Event) ID#" should be constructed from the date and time that the first sample container of a purposefully associated set of sample containers is filled. This set of samples would normally be collected very closely together in time and include containers for a number of analytical parameters and QC samples. QC samples are normally assigned temporary aliases (see below) For example, if the first of a set of containers is filled at 1:30 PM on December 19, 1992, the Field Sample Event ID# for all containers in the set should be 9212191330.

WELL INFORMATION

The water column length (L) is calculated by subtracting the depth to water (DTW) from the well depth. L = well depth - DTW. However, both of these distances must be referenced to the same datum: either from the measuring point (MP) or from ground surface (GS). This form was designed with the assumption that both the well depth and static water level values are referenced to the MP.

For convenience, a blank was included to also enter depth to water below GS in case the well depth referenced to the MP is unknown or cannot be measured directly. In addition, this value will indicate where the static water level is relative to the open (screened) interval which is referenced to GS. For the calculation of L in this case, the "stick up", the distance from the MP to GS, needs to be looked up or measured in the field. If the MP is above GS, then the stick up is a positive number for this calculation. Enter the stick up distance here _____ft. (to the nearest 0.1 ft.). DTW (from GS) = DTW (from MP) - stick up; L = well depth (from GS) - DTW (from GS).

One water column volume = $\pi r^2 L$. The units conversion from cubic feet to gallons is as follows: πr^2 [ft.^{2}] L [ft.] [7.48 gallons/ft3]. r = well radius in feet (since well specifications are normally given as diameter in inches, the diameter must be converted from inches to feet and then divided by one-half to yield r, in feet). Examples of well diameter/gallons per ft. of WC: 1"/0.041 gals; 2"/0.163; 4"/0.653; 6"/1.47; 8"/2.61.

PURGING

Measure the concentration of organic vapors inside the well immediately after removing the wellhead cap. On the front side of this form, circle whether a PID or a FID was used, then enter wellhead and ambient background readings. Here specify the calibration gas_____, lamp voltage_____ make & model # of the instrument here_____ If free product was detected, describe appearance, thickness, etc. (free product samples collected? (Y , N)):_____.
Supplemental description of purging equipment:_____.

FIELD WATER QUALITY MEASUREMENTS AND OBSERVATIONS

If a flow cell was not used, describe how measurements were taken (note whether or not measurements were taken down hole):
_____.
Other Comments and Observations_____.

SAMPLE COLLECTION

Sampling equipment details (Mfgr., Model#, tubing, etc.):_____.

Quality Control Samples

Fictional sampling point name(s) and field sample event ID#(s) (aliases) can be used for QC samples on sample labels and chain of custody sheets to distinguish them from primary samples without tipping off laboratories. List aliases here to document their association with primary sample identifiers on front side of sheet. Name(s)/ID#(s) _____.
Indicate total # of QC samples collected: Replicates _____ Splits _____ Trip blanks _____ Field ambient air blanks ____ Field methods blanks ____.

Protocol codes: 1.

Indicate the type of sampling protocol followed by selecting from codes (A-F) below and entering it on the front of this form. Specify the name of the agency_____ and the name of the agency program _____ that approved the protocol. If none, write "none."
A) A slightly modified agency program standard sampling protocol, approved as a site-specific protocol
B) An unmodified or slightly modified agency program standard sampling protocol, approved as a non site-specific protocol
C) A non site-specific protocol approved by an agency
D) A detailed but non agency-approved, site-specific sampling protocol with adequate QA/QC procedures was followed;
E) A detailed but non agency-approved sampling protocol without adequate QA/QC procedures was followed;
F) None of the above protocol conditions were known to be met (comment):_____.

Protocol codes: 2

A) Sampling observed by _____(agency) to meet all field protocols except as noted below: (agency signature)_____;
B) Sampling observed by "neutral" observer (signature)_____approved by _____(agency) to meet all field protocols except as noted below;
(list the agency that approved observer)
C) Neither A or B applies (comment):_____.

PROTOCOL EXCEPTIONS

List/discuss protocol exceptions for sampling-related field work(attach additional sheets if necessary): _____

OTHER REMARKS(2) _____

Form GWS #4R

* Other forms normally used to support this form include GWS #1 for Purging & WQ Measurements, GWS #3 for Sample ID/Chain of Custody, GWS#4 for Water Levels. Revised 09-07-94

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