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December 19, 2001

Mr. Paul Killian
STS Consultants, Ltd.
1035 Kepler Drive
Green Bay, Wisconsin 54311

Ms. Annette Weissbach
Wisconsin Department of Natural Resources
Northeast Region Headquarters
1125 North Military Avenue
Green Bay, Wisconsin 54303

Reference: *Monitoring Well Location Revisions*
Kewaunee Marsh Arsenic Area
Kewaunee, Wisconsin

KEY RAILROAD DEVELOPMENT, LLC.
File No. R1103004

Dear Annette and Paul:

Enclosed are a revised Table 3 (Page 4) and a revised Figure 5 that illustrate the changes to the monitoring well locations that we talked about at today's meeting. The enclosures have also been e-mailed to Jan Tesch. Please note that I have changed all of the well identification numbers so that they better represent the nesting and depth relationships between wells.

As requested, I forwarded the Work Plan in electronic format to Jan Tesch. The figures were sent as plot files. If you would like to have them in a different format, please let me know.

I would also like to take this opportunity to indicate that two proposed surface water sample locations (SW01-10 and SW01-12) were omitted from Figure 4. There should have been notes on Figure 4 indicating that these sample locations were off the edge of the figure to the north (SW01-10) and to the south (SW01-12.) We were not sure if you based the number of surface water samples in your proposal on Table 3 or on Figure 3, so we thought it was important to note this omission.

If you have any questions, please give me a call.

Sincerely,

KEY RAILROAD DEVELOPMENT, LLC.

Mark A. Bergeon, P.G.
Principal

MAB/mab

Enclosure: Revised Table 3 (4)
Figure 5, Revised 12/19/01

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September 10, 2001

Ms. Annette Weisbach
Wisconsin Department of Natural Resources
Northeast Region Headquarters
1125 North Military Avenue
Green Bay, Wisconsin 54303

Mr. James Killian
Wisconsin Department of Natural Resources
Bureau of Watershed Management-WT/2
101 South Webster Street
Madison, Wisconsin 53703

Mr. Thomas P. McElligott Esq.,
Quarles & Brady
411 East Wisconsin Avenue
Milwaukee, Wisconsin 53202

Reference: *Site Investigation Work Plan*
Carroll D. Besadny Fish and Wildlife Area
Kewaunee Marsh Arsenic Area
Kewaunee, Wisconsin

KEY RAILROAD DEVELOPMENT, LLC.
File No. R1103004

Dear Sir or Madam:

Key Railroad Development, LLC. (KEY Rail) is pleased to submit the *Site Investigation Work Plan* for the arsenic-impacted area of the Carroll D. Besadny Fish and Wildlife Area, in Kewaunee, Wisconsin. KEY Rail has incorporarted comments made by Wisconsin Department of Natural Resources personnel as discussed at our meeting on August 28, 2001. If there are any questions regarding the *Site Investigation Work Plan*, please contact Mr. David P. Heim at (262) 375-4750 or Mr. Mark A. Bergeon (920) 863-3678.

Sincerely,

KEY RAILROAD DEVELOPMENT, LLC.

David P. Heimsen
David P. Heim, P.E., CHMM
Project Engineer

Mark A Bergeon
Mark A. Bergeon, P.G.
Principal

DPH/aef

Enclosure: *Site Investigation Work Plan*

H:\PROJECTS\2001\R1103004\Reports\R1103004.si work plan.wpd

SITE INVESTIGATION WORK PLAN

CARROLL D. BESADNY FISH AND WILDLIFE AREA
KEWAUNEE MARSH ARSENIC AREA
KEWAUNEE, WISCONSIN

September 10, 2001

PREPARED FOR:

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
NORTHEAST REGION HEADQUARTERS
POST OFFICE BOX 10488
GREEN BAY, WISCONSIN 54307

KEY RAILROAD DEVELOPMENT, LLC.

David P. Heim, P.E., CHMM
Project Engineer

Mark A. Bergeon, P.G.
Principal

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1.0 INTRODUCTION

This *Site Investigation Work Plan* was prepared to document the planned scope and procedures to further assess arsenic contamination in soil, sediment, surface water and groundwater in a portion of the Carroll D. Besadny Fish and Wildlife Area.

The site is located in the southwest ¼ of Section 7, Township 23 North, Range 25 East, Town of Pierce, Kewaunee County, Wisconsin. The site is less than a mile north of the City of Kewaunee, and approximately ¼-mile east of County Trunk Highway E, along railroad tracks (Fox Valley & Western, Ltd.). The location of the site is depicted on Figure 1. The remote site location can be accessed from the Kewaunee River or along the railroad tracks (approximately ¼-mile from County Highway E).

The time of the arsenic contaminant release is estimated to be approximately 1943; historical photographs from this time reportedly depict a derailment, with a white powder (believed to be sodium arsenite) spilling from a rail car. Although further evaluation of the photographs appeared to indicate the subject of the photographs maybe a different site, the Wisconsin Department of Natural Resources (WDNR) has assumed that this spill was the source of the contamination at the site. In October 1993, WDNR personnel visited the site and observed the area devoid of vegetation, evidence of deceased waterfowl and some red (granular) and white material on the surface; two soil samples collected during that visit contained arsenic concentrations of 1,100 milligrams per kilogram (mg/kg) and 68,000 mg/kg.

The purpose of the site investigation will be to collect sufficient data to evaluate remedial action options in accordance with NR 722. The site investigation will include:

- Evaluating current arsenic concentrations in soil, sediment, surface water, and groundwater and the current condition of the interim action cover.
- Developing a conceptual site model and evaluating applicable exposure pathways through the analysis of arsenic fate and transport in the marsh/river system.
- Evaluating the influence of the interim action on the movement and stabilization of arsenic in the area.
- Evaluating whether the interim action will function as an effective final remedy.

2.0 BACKGROUND INFORMATION

2.1 Physiography

The site is located in the Lake Michigan Basin, near the banks of the Kewaunee River. The area is marshy, with surficial soils consisting mostly of soft peat and mucky peat, with thicknesses ranging from 15 to 26 feet (STS Consultants, Ltd. (STS), 1995). Ground moraine clay till underlies the peat deposits. These glacial soils are estimated to be approximately 50 to 100 feet thick in this area. Bedrock below Kewaunee County consists of undifferentiated dolomite (Skinner and Borman, 1973). Drainage at the site is generally to the east, toward the Kewaunee River. The ground surface at the marsh is frequently inundated with surface water, especially when the Kewaunee River is flowing at high water levels; low flow conditions occur in the summer.

2.2 Previous Investigation and Interim Action

In 1994, a preliminary assessment was performed by STS for Fox Valley & Western Ltd. This preliminary assessment included 17 soil borings of up to 1½ feet deep. Subsequent additional investigation included collection of surface water samples, groundwater from shallow monitoring wells, sediments, and soil pore water. The WDNR has also conducted sampling of soil, surface water, groundwater and plant and animal tissue at the site in 1996 and 1997.

In 1996, an interim action was performed (pursuant to Consent Order No. 96-LMEE-006, between WDNR and Fox Valley & Western, Ltd.). A cover, consisting of a geotextile and a mixture of wood chips and yard waste, was placed over the areas of the site with the highest arsenic concentrations, to prevent direct contact exposure to arsenic-containing sediments. The area of the cover is approximately 3¼ acres. In addition to the cover, a security fence was installed. The area enclosed by the fence is approximately 15 acres. Figure 2 depicts existing site conditions

Subsequent to interim action cover placement, shallow groundwater monitoring points were constructed near the cover area, and a staff gauge was installed nearby in the Kewaunee River. Groundwater and river elevations were measured, and groundwater samples were collected from the monitoring points. Surface water samples were also collected from the Kewaunee River. Monitoring points MP-1 through MP-4 were installed downgradient of the cover area, within the fence; monitoring points MP-5 and MP-6 were constructed outside the fence, sidegradient of the cover. Groundwater and surface water sample results indicated:

- Arsenic concentrations above the NR 140 enforcement standard (ES) of 50 micrograms per liter (µg/l) were detected at MP-1, MP-2, MP-3 and MP-4 in April and October 1996; at MP-5, the NR 140 ES was not exceeded, but concentrations were greater than the NR 140 preventive action limit (PAL) of 5 µg/l. At MP-6, the April 1996 sample was above the ES, but the October 1996 sample was between the PAL and the ES.

- Arsenic concentrations in surface water samples collected in April, May and June 1996 were above the NR 105 Table 9 Arsenic Human Cancer Criterion of 50 µg/l, but below the NR 105 Table 1 Acute Toxicity Criterion of 339.8 µg/l and the NR 105 Table 5 Chronic Toxicity Criterion of 152.2 µg/l. Arsenic concentrations in samples of river water collected in July and October 1996, and June 1997 were well below NR 105 criterion. In August of 1997, NR 105 criteria for arsenic were revised. The Acute Toxicity Criterion was unchanged, but the Chronic Toxicity Criterion was revised to 148 µg/l, and the Human Cancer Criterion was lowered to 0.185µg/l. Arsenic concentrations in samples collected in August 1997 were below the method of detection. Previous upstream sampling of the river indicates that background concentrations are on the order of 1 to 4 µg/l. These background

concentrations are above the NR 105 Human Cancer Criteria.

WDNR also performed several rounds of sampling of various environmental media. Soil and groundwater samples were collected and analyzed both prior to and subsequent to the interim action. Plant and animal tissue samples were collected, and this data was used to complete a baseline ecological risk assessment for the site. A summary of analytical results from the sampling conducted in 1994 through 1997 is presented in Table 1. Sample locations are shown in Figures 3A, 4A and 5A.

2.3 Previous Groundwater and Surface Water Modeling

Subsequent to the previous investigation, groundwater and surface water modeling of the expected fate and transport of arsenic at the site was performed (STS, 1997). The BIO1D model, which simulates the transport of organic, inorganic and radioactive groundwater constituents, was used. Model input included data collected by both STS and WDNR. "Paired" sediment and water concentrations were not available, so soil concentrations were estimated using isoconcentration contours based on field data. These calculated-paired data were plotted, and curve-fitted using a Langmuir isotherm. The model indicated that the transport of arsenic in the groundwater at the site is very slow, with the model predicting that the maximum concentration of arsenic in the groundwater would reach the Kewaunee River in approximately 2,800 years.

Surface water modeling was performed to simulate the transport of arsenic in storm water. The HydroCAD model, which is based on the United States Department of Agriculture, Soil Conservation Service Technical Release 20 methodology, was utilized for this evaluation. The site was divided into three drainage basins (area north of the cover, cover and the area immediately east of the cover and area south of the cover). Three trials were run of the model for each of the basins (average, high and low water table levels). The HydroCAD model results included estimations of peak flow runoff from various types of storms. An arsenic-water balance was then used to estimate arsenic transported in runoff. An average arsenic concentration and a maximum arsenic concentration were used for each drainage basin. The results indicated that the maximum (worst-case) stormwater arsenic concentration was 28.3 µg/l. Potential downstream Kewaunee River arsenic concentrations were also predicted; the highest downstream arsenic concentration calculated was 15.6 µg/l. A background (upstream) arsenic concentration of 3 µg/l was assumed, based on previous river sampling results.

2.4 Baseline Ecological Risk Assessment

In April 2000, WDNR published its *Baseline Ecological Risk Assessment for the Arsenic Contaminated Wetland Associated with the C. D. Besadny Fish and Wildlife Area and the Kewaunee River* (BERA). The BERA was conducted to determine the present and future risks to wildlife, birds and aquatic resources from exposures to arsenic in site media (soil, sediment, groundwater and surface water) following implementation of the interim action at the site. Table 1 summarizes the results of the BERA. The BERA also documents the degree of uncertainty and quality of the data available in performing the risk assessment and indicates that further investigation of soil, sediment, groundwater and surface water is warranted to determine if the interim action cover is sufficient to protect the environment and public health.

2.5 2001 Wisconsin Department of Natural Sampling Effort

In May and June of 2001, WDNR Bureau of Watershed Management conducted additional investigation at the site. Ten groundwater monitoring wells were installed at the site, and 10 surface water samples and 10 soil/sediment samples were collected. In addition, WDNR installed a continuous water level tracker on the former railroad bridge located adjacent to the site. At the date of the writing of this work plan, soil/sediment analytical results are not available. Sample locations are shown in Figures 3A, 4A and 5A, and analytical results received to date are included in Table 4.

In general, the new surface water data indicates that the actual system of transport of arsenic in this environment is probably more complicated than that assumed by the 1997 modeling. With the exception of two wells, concentrations of arsenic in groundwater samples were generally comparable to, or lower than in the 1994-1997 samples. In one of the two wells that contained higher concentrations, there was very little groundwater present in the well at the time of sampling. The other well was very near one of the sloughs that drain the area to the Kewaunee River, and it may have been influenced by the strong surface water gradient associated with drainage of the slough.

In addition to the sampling, the WDNR personnel installed an automated water level tracker on the nearby former railroad bridge. Water levels at this point were collected nearly continuously (at a rate of one/second), and logged at 15-minute intervals. This data was compared to Kewaunee River level data collected by USGS at a location approximately 6 mile upstream, and also to Lake Michigan level data collected by the National Oceanic and Atmospheric Administration (NOAA). This comparison clearly indicates that the river elevation at this location varies directly with fluctuations in Lake Michigan levels. There is no evident relationship between the USGS-measured river levels and the water levels near the site. This indicates that the hydrology of the marsh at this location is more aptly described by estuarine dynamics than by typical channel flow. In addition, WDNR has moved its level tracker to several groundwater monitoring wells on the site. This data indicates that the estuarine character of water level fluctuations at the site appears to extend westward into the groundwater regime for some distance.

2.6 Fate and Transport of Arsenic

This section is not intended to be an exhaustive survey of the literature of fate and transport of arsenic in surface water and groundwater environments, but a mere mention of some of the co-factors that may be involved in the movement of arsenic through the Kewaunee Marsh system.

Inorganic arsenic may be found in the environment in one of two valence states, trivalent or pentavalent. Of the two, the trivalent form (arsenite) is generally more soluble , and therefore more mobile. Also, arsenite is generally considered to be more environmentally hazardous than the pentavalent form (arsenate). In general, low redox potential (reduced) conditions favor formation of the trivalent form of arsenic. In a marsh environment, dissolved oxygen in surface water is usually relatively low, and anaerobic conditions may often occur. These conditions would tend to favor the formation of arsenite.

Several types of metals and other ions are known to affect the mobility of arsenic in the environment, through sorption, competition for sorption sites, and other mechanisms. For example, arsenite is adsorbed to oxyhydroxides of iron and aluminum, especially in mildly acidic (pH 5 to 7) conditions. Higher pH yielded reductive dissolution of iron oxyhydroxides, and release of sorbed arsenic. Manganese oxyhyroxides can also adsorb arsenate. Sorption of arsenic in the environment can also be affected by organic matter in soil and sediments, and some microbial reduction could also cause formation of arsenite. Arsenic sulfides may be more stable under reducing conditions. Other inorganic species that may affect speciation and mobility of arsenic in the environment include magnesium and calcium.

3.0 SITE INVESTIGATION

The site investigation will consist of a soil/sediment investigation, a surface water investigation, a groundwater investigation, and a site survey/cap evaluation. The site investigation will be performed in accordance with the *Sampling and Analysis Plan* (Appendix 1), the *Data Management Plan* (Appendix 2) and the *Health and Safety Plan* (Appendix 3). The sampling scheme is summarized in Table 2. Sample locations are depicted on Figures 3, 4 and 5.

3.1 Soil/Sediment Investigation

The scope of the soil/sediment investigation will consist of the following:

- Approximately 22 surface wetland sediment samples will be collected using a trowel or shovel. Approximately 10 of these samples will be submitted to the laboratory for phase separation into pore water and sediment solids, for analysis of arsenic to determine partitioning of arsenic at the site between soil and water.

- Approximately 22 soil probes will be advanced to an approximate depth of 5 feet. Samples will be collected using a piston sampler, because of the low solids content expected in the peaty near-surface soils. Approximately 8 of these samples will be submitted for phase separation and analysis.

- Approximately 5 soil borings will be advanced using hollow-stem auger drilling techniques to an approximate depth of 10 feet. A piston sampler will be used, if necessary.

- Approximately 5 soil borings will be advanced using hollow-stem auger techniques to an approximate depth of 15 to 30 feet. In shallow soils, a piston sampler will be used. Standard split-spoon techniques will be used for deeper, mineral soils.

- Soil samples will be collected at the following intervals in the soil borings, to document stratigraphy: uppermost 6 inches and every 2 feet thereafter.

- Laboratory analyses will include arsenic, iron, aluminum, manganese, organic matter (loss on ignition) and percent solids.

SES suggests adding soil pH, Cation Exchange Capacity

- Soil samples collected from intervals at which groundwater monitoring wells are to be screened will be submitted to a soils laboratory for particle-size analysis.

3.2 Surface Water Investigation

The scope of the surface water investigation will consist of the following:

- Collect surface water samples at the locations indicated on Figure 4.

- Surface water samples will be submitted to the laboratory for analysis of hardness, arsenic, iron, aluminum, calcium, magnesium, manganese and sulfate. At approximately one-quarter of the sample locations, duplicate paired samples will be collected. One of these duplicate samples will be field filtered, and the other will remain

unfiltered concentrations will be used to estimate the extent of arsenic transport in suspended solids.

- Field measurements will include pH, conductivity, redox potential (Eh) and temperature.

- To evaluate seasonal variability, an additional five surface water samples will be collected at a time of runoff (probably during spring thaw) from near the interim action cover, two from near the former railroad siding, and two from the two sloughs (for a total of nine) that drain the area between the interim action cover and the river.

- Two stream gauge will be installed in the Kewaunee River. Locations of the stream gauge are shown in Figure 4.

- A continuous-monitoring automated water level tracker will be installed on the former railroad bridge, adjacent to the site. To maintain consistency with the data gathered by WDNR in 2001, readings shall be recorded each second, and logged every 15 minutes. Using this rate of data collection, it is anticipated that this data will have to be downloaded to a laptop computer approximately semi-annually. This rate of data download is based on WDNR's experience in the 2001 sampling discussed in Section 2.5. Download data quaterly during quarterly groundwater sampling events.

3.3 Groundwater Investigation

The scope of the groundwater investigation will consist of the following:

- Install and develop groundwater monitoring wells and piezometers in accordance with NR 141 in selected soil boring locations. Monitoring well locations are shown in Figure 5.

- Sample the wells and piezometers. Analyze groundwater samples for arsenic, iron, aluminum, calcium, magnesium, manganese and sulfate. The majority of samples will be field filtered. However, analogous to the surface water investigation, approximately ¼ of the sample will be duplicated and submitted both for "dissolved" and "total" analysis, as a basis for evaluating transport of suspended solids.

- Measure groundwater levels in the wells and piezometers, to determine horizontal and vertical gradients on the site. Elevation of the Kewaunee River, as measured by the stream gauges, will be recorded on the same date as the groundwater levels.

- An automatic water level tracker, similar to that discussed in Section 3.2, will be installed in two monitoring wells. One of these will be installed in a well on the eastern portion of the site (near the Kewaunee River), and one will be installed in a well in the western portion of the site.

- Perform in-field hydraulic conductivity testing in selected wells and piezometers.

- Groundwater/surface water elevations and groundwater sampling will be conducted on a quarterly basis for one year.

3.4 Survey/Cap Evaluation

3.4 Survey/Cap Evaluation

The scope of the subject site survey/cap evaluation will include the following:

- Verify subject site property boundary and physical features.
- Document the location and surface elevation of each soil boring, and sediment and surface water sample location.
- Document the location and elevation of stream gauges and water level tracker installed in the Kewaunee River.
- Document the location and ground surface and top of casing elevation of each groundwater monitoring well and piezometer.
- Document the location and elevation of approximately 40 points around the perimeter of the interim action cover, and approximately 20 points within the cover area. These points will coincide with those established by STS in its 1997 as-built survey.
- Visually assess of the condition of the cover, including measuring the thickness of the wood chip/yard waste mixture covering the geotextile.

4.0 SITE MODEL AND REMEDIAL ACTION OPTIONS EVALUATION

The site investigation data will be used to develop a site model that will establish the migration and exposure pathways to be further addressed through arsenic fate and transport modeling (to estimate exposure point concentrations).

- Surface water and groundwater modeling will be conducted to approximate potential future impacts on water quality in the Kewaunee River. Modeling should also include predicitions of arsenic concentrations over time within the fenced area of the marsh.

- Consultant's proposals for implementing this Site Investigation Work Plan shall described their proposed groundwateer and surface water models.

Modeled exposure point concentrations will be compared to applicable human health and ecological quality standards, including human health direct contact standards (NR 720 and United States Environmental Protection Agency (USEPA) Preliminary Remediation Goals). Surface water standards that may be applicable include NR 105 Surface Water Quality Criteria and USEPA Ambient Water Quality Criteria for protection of aquatic organisms.

Pursuant to NR 722, remedial action options will be developed and evaluated for applicable human health and environmental exposure pathways. This evaluation will include the review of the available literature for similar sites (similar types of contaminants in freshwater wetlands and surface water environments).

5.0 REPORTING AND SCHEDULE

Following completion of the remedial action options evaluation, a *Site Investigation/Remedial Action Options Report* will be prepared in accordance with NR 716 and NR 722. If applicable, this report will include recommendations for further remedial action at the site, or justification that the interim action will continue to function as an effective final remedy.

The project schedule will be determined by the consultant performing this scope of work. A schedule will be submitted with the consultant's proposal. However, it is anticipated that the majority of the surface soil/sediment and surface water sampling will be performed in the fall of 2001. Because of the soft, organic nature of the soils at the site, some of the surface sediment sampling, and all of the soil boring activities will be performed following freeze-over of the marsh area (sufficient to support drill rigs, vehicles and other necessary equipment). This will probably be between December 2001 and February 2002. Surface water samples SW02-1 through SW02-9 will be collected during spring thaw in 2002. Quarterly groundwater monitoring will continue through 2002. It is anticipated that the *Site Investigation/Remedial Action Options Report* will be completed during the spring of 2003.

6.0 REFERENCES

Skinner, E. L., and Borman, R.G. (1973), Water Resources of Wisconsin - Lake Michigan Basin, United States Geological Survey, Hydrologic Investigations Atlas HA-432.

STS Consultants, Ltd. (1994), Preliminary Assessment Report, Arsenic Spill Site, Kewaunee County, Wisconsin.

STS Consultants, Ltd. (1995) Assessment Report, Kewaunee Marsh Arsenic Impact Site, Kewaunee County, Wisconsin.

STS Consultants, Ltd. (1997) Final Report, Kewaunee Marsh Arsenic Site, Kewaunee, Wisconsin.

United States Environmental Protection Agency (1992), Supplemental Guidance to RAGS: Calculating the Concentration Term, OSWER 9285.7-081.

United States Geological Survey (1978), Kewaunee, Wisconsin Quadrangle 7.5 Minute Series Topographic Map.

Wisconsin Department of Natural Resources (2000), Baseline Ecological Risk Assessment for the Arsenic Contaminated Wetland Associated with the C. D. Besadny Fish and Wildlife Area and the Kewaunee River.

Table 1

Previous Sampling Results

CARROL D. BEDSADNY FISH AND WILDLIFE AREA

Kewaunee Marsh Arsenic Area

Kewaunee, Wisconsin

1. Surface Water

Sample	Date	As (ug/L)	Comment
BKG-1	Nov. 94	35.5	marsh surface water
BKG-2	Nov. 94	398	marsh surface water
BKG-3	Nov. 94	690	marsh surface water
BKG-4	Nov. 94	64.1	marsh surface water
H-1	Nov. 94	19300	marsh surface water
H-2	Nov. 94	5660	marsh surface water
H-3	Nov. 94	148000	marsh surface water
H-4	Nov. 94	920000	marsh surface water
H-5	Nov. 94	24800	marsh surface water
H-6	Nov. 94	19100	marsh surface water
R-1	Feb. 95	< 1.0	river water
R-1A	Mar. 95	< 1.0	river water
R-1B	Mar. 95	< 1.0	river water
R-1C	Mar. 95	< 1.0	river water
R-1D	Apr. 95	2.7	river water
R-1E	Apr. 95	< 1.0	river water
R-2	Feb. 95	4.1	river water
R-3	Feb. 95	1.2	river water
P-1*	Feb. 95	17200	marsh pore water (filtered)
P-2*	Feb. 95	800000	marsh pore water (filtered)
P-3*	Feb. 95	21000	marsh pore water (filtered)
P-4*	Feb. 95	6.6	marsh pore water (filtered)
P-5*	Feb. 95	< 1.0	marsh pore water (filtered)

shown as STS-P-2 on 4A

ID	Date	As (ug/L)	Comment
Water			
wat95-1	Jun-95	3	reference site upstream wetland s. side of Co. Hwy E
wat95-2	Jun-95	500	dug pit s. side of rr tracks, s. of spur
wat95-3	Jun-95	370	SE of dead area, outer pond remnant
wat95-4	Jun-95	62	wildlife pond #6
wat95-5	Jun-95	3400	wildlife pond #12
wat95-6	Jun-95	860	SE of dead area, inner pond remnant

aka known as KM see Janisch memo Dec 5, 1995

ID	Date	As (ug/L)	Comment
wt-01	5/22/96	1	reference site
wt-02	5/22/96	8300	SW of cap, north of tracks
wt-03	5/22/96	1400	S of cap, NE of where spur meets tracks
wt-04	5/22/96	2400	SE of cap, south of STS MP-3
wt-05	5/29/96	430	S slough to river, near ST-05
wt-06	5/22/96	37	south of tracks

ok see Janisch memo 7-18-96

Table 1

Previous Sampling Results

CARROL D. BEDSADNY FISH AND WILDLIFE AREA

Kewaunee Marsh Arsenic Area

Kewaunee, Wisconsin

ID	Date	As (ug/L)	Al(mg/Kg)	Ca (mg/kg)	Fe (mg/kg)	Mg (mg/kg)	S (mg/kg)	Comment
pw-01-01	5/21/96	7.6						south of tracks, towards river (pit water)
pw-01-02	5/21/96	1.4	ND	56	0.65	18		south of tracks, towards river (filtered pit water)
pw-01-03	5/23/96	1.6						sampled two days later (pit water)
pw-02-01	5/21/96	8500						north side of tracks, off spur (pit water)
pw-02-02	5/23/96	9900						sampled two days later (pit water) unfiltered
pw-03-01	5/22/96	2400	1700	93	4.6	35	4.2	NE of cap, between ponds #12 and #6 (filtered pit water)
pw-03-02	5/22/96	1900						NE of cap, between ponds #12 and #6 (filtered pit water)
pw-03-03	5/23/96	3000						NE of cap, between ponds #12 and #6 (filtered pit water)
pw-04-01	9/11/96	3.7						reference site for s. of tracks (it water)

Table 1

Previous Sampling Results

CARROL D. BEDSADNY FISH AND WILDLIFE AREA
Kewaunee Marsh Arsenic Area
Kewaunee, Wisconsin

ID	Date	As (ug/L)	Comment
sw-01-01	5/21/96	1.5	grab from pond 1
sw-02-01	5/21/96	180	s side of tracks, between spur. surface water grab
sw-03-01	5/21/96	360	s side of pond 10
sw-04-01	5/21/96	2.4	grab from kew. river dwnstrm. of rr bridge
swshk-04	4/8/96	8100	sw of cap (near WT-02, unfiltered)
sw-05-01	9/11/96	76	north end of small channel near well gw-09
sw-06-01	9/11/96	60	pond 6
sw-07-01	9/11/96	110	pond 7
sw-08-01	9/11/96	4.6	south end of small channel near well gw-09

Jan sch memo 7-18-96

ID	Date	As (ug/L)	Comment
sts-r1	4/23/96	118	unfiltered sample taken from river bank
sts-r2	5/20/96	108	unfiltered sample taken from river bank
sts-r3	6/18/96	50	unfiltered sample taken from river bank
sts-r4	6/18/96	< 16	unfiltered sample taken from river channel
sts-r5	7/12/96	3.7	unfiltered sample taken from river bank
sts-r6	10/23/96	3.2	unfiltered sample taken from river bank

Sample Site	Date	As (ug/L)	Comments
KMWT-01	Jun-97	< 1.0	Upriver background site
KMWT-02	Jun-97	24	North slough-upper reach at fence
KMWT-03	Jun-97	7	North slough-mouth at juncture with river
KMWT-04	Jun-97	9	South slough-upper reach at fence
KMWT-05	Jun-97	2	South slough-mouth at juncture with river
KMWT-06	Jun-97	1.0	Downstream south of railroad bridge

Sample Site	Date	As (ug/L)	Comments
SW-9	Jun-97	260	Between cap and railroad
SW-10	Jun-97	86	50 ft SE of cap
SW-11	Jun-97	120	50 ft east of cap
SW-12	Jun-97	320	Depressed area in filled Pond 12
SW-13	Jun-97	530	N. of cap, midway between Pond 7 and cap
SW-14	Jun-97	810	30 ft NW of Pond 10
SW-15	Jun-97	26	Collected in Pond 9

All samples unfiltered unless noted

Table 1 (continued)

PREVIOUS SAMPLING RESULTS

CARROL D. BESADNY FISH AND WILDLIFE AREA
Kewaunne Marsh Arsenic Area
Kewaunee, Wisconsin

2. Groundwater

ID	Date	As (ug/L)	Al (ug/L)	Ca (mg/L)	Fe (mg/L)	Mg (mg/L)	S(mg/L)	Comments
gw-01	4/8/96	0.9						south of rr (filtered)
gw-02	4/8/96	0.9						south of rr (filtered)
gw-03	4/8/96	0.9						south of rr (filtered)
gw-05	5/21/96	60						south of rr (filtered)
gw-06-01	5/22/96	89						north of cap (filtered)
gw-06-02	5/22/96	220						north of cap (unfiltered)
gw-07-01	5/22/96	91	ND	100	2.2	40	0.9	NE of cap (filtered)
gw-07-02	5/22/96	65						NE of cap (unfiltered)
gw-08-01	5/22/96	310	31.00	39.00	0.87	16.00		east of cap (filtered)
gw-08-02	5/22/96	220	440.00	38.00	2.10	14.00		east of cap (unfiltered)
gw-09	5/22/96	28						SE of cap (filtered)
gw-10	5/21/96	310						south of cap (filtered)
gw-11	5/21/96	0.7	ND	92	2.7	32	0.8	south of rr (filtered)

		As Concentration	As Concentration	pH	Conductivity	Temp	Redox	DO
ID	Date	Unfiltered	Filtered			(Celsius)	(mV)	mg/L)
sts-mp1	4/23/96	771	763	7.2	282	8.7		
	6/12/96	983	733					
	10/23/96	486	318	6.65	595	10.4	-17	0.5
sts-mp2	4/23/96	837	877	6.58	527	10.1		
	6/12/96	643	436					
	10/23/96	170	65.8	6.64	927	10.2	-181	0.5
sts-mp3	4/23/96	282	333	6.86	640	10.6		
	6/12/96	167	136					
	10/23/96	175	156	6.35	856	10.5	-105	0.5
sts-mp4	4/23/96							
	6/12/96	454	358					
	10/23/96	391	311	6.59	707	11.4	-179	0
sts-mp5	4/23/96	<16	<16					
	6/12/96	12.2	9.9					
	10/23/96	5.1	5.7	6.45	800	10.6	-21	0.5
sts-mp6	4/23/96	67	46					
	6/12/96	393	415					
	10/23/96	48.1	19	6.87	902	10.9	-56	0.5

		pH	Conductivity	Temp	Redox	DO
Well	Date	(Celsius)	(mV)	(mg/L)		
gw-01	10/23/96	6.71	725	10.2	44	1.5
gw-02	10/23/96	6.8	643	9.7	30	0.5
gw-10	10/23/96	6.63	751	9.2	32	1
gw-11	10/23/96	6.54	652	9	25	1

Table 1 (continued)

PREVIOUS SAMPLING RESULTS

CARROL D. BESADNY FISH AND WILDLIFE AREA
Kewaunne Marsh Arsenic Area
Kewaunee, Wisconsin

3. Soil/Sediment

Boring	Date	Depth	As (mg/kg)	Comment
B-1	1994	15-16cm	2	15' below water surface in river channel
B-2	1994	4-6cm	2	4' below water surface in river channel
B-3	1994	0-2cm	5.5	
B-4	1994	0-2cm	4	
B-5	1994	0-2cm	4.1	
B-6	1994	0-2cm	no recovery	
	1994	2-4cm	4.3	
	1994	4-6cm	4.95	
	1994	6-8cm	7.15	
B-7	1994	0-2cm	no recovery	2' below ice on river bank
	1994	2-4cm	4.65	
	1994	4-6cm	16.1	
	1994	6-8cm	0.81	
B-8	1994	0-2cm	no recovery	2' below ice on river bank
	1994	2-4cm	1.7	
B-9	1994	0-2cm	249	
B-10	1994	0-2cm	897	
	1994	2-4cm	290	
	1994	4-6cm	85.6	
B-11	1994	0-2cm	943	
B-12	1994	0-2cm	324	
B-13	1994	0-2cm	3290	
	1994	2-4cm	23.7	
	1994	4-6cm	32.7	
	1994	6-8cm	< 0.72	
B-14	1994	0-2cm	858	
B-15	1994	0-2cm	1660	
B-16	1994	0-2cm	1220	
	1994	2-4cm	390	
	1994	4-6cm	12.2	
	1994	6-8cm	0.93	
B-17	1994	0-2cm	no recovery	
	1994	2-4cm	29	
	1994	4-6cm	15.1	
	1994	6-8cm	1.46	
B-18	1994	0-2cm	1400	
B-19	1994	0-2cm	768	
	1994	2-4cm	874	
	1994	4-6cm	181	
	1994	6-8cm	29.5	

Table 1 (continued)

PREVIOUS SAMPLING RESULTS

CARROL D. BESADNY FISH AND WILDLIFE AREA
Kewaunne Marsh Arsenic Area
Kewaunee, Wisconsin

3. Soil/Sediment

B-20	1994	0-2cm	2440	
B-21	1994	0-2cm	705	
	1994	2-4cm	2.37	
B-22	1994	0-2cm	808	
	1994	2-4cm	411	
	1994	4-6cm	116	
	1994	6-8cm	2.63	
B-23	1994	0-2cm	636	
	1994	2-4cm	17.9	
	1994	4-6cm	< 2.0	
	1994	6-8cm	< 2.1	
B-24	1994	0-2cm	386	
	1994	2-4cm	1.71	
	1994	4-6cm	2.12	
	1994	6-8cm	1.32	
B-25	1994	0-2cm	422	
B-26	1994	0-2cm	3220	
	1994	4-6cm	723	
	1994	6-8cm	2.45	
B-27	1994	0-2cm	1880	
B-28	1994	0-2cm	1470	
B-29	1994	0-2cm	4500	
	1994	2-4cm	360	
	1994	4-6cm	202	
	1994	6-8cm	2.35	
B-30	1994	0-2cm	1240	
B-31	1994	0-2cm	610	
B-32	1994	0-2cm	5480	
	1994	2-4cm	88.9	
	1994	4-6cm	194	
	1994	6-8cm	1.62	
B-33	1994	0-2cm	738	
B-34	1994	0-2cm	2660	
	1994	2-4cm	946	
	1994	4-6cm	1020	
	1994	6-8cm	4.3	
B-35	1994	0-2cm	22.1	
B-36	1994	0-2cm	917	
B-37	1994	0-2cm	4600	
B-38	1994	0-2cm	2030	
	1994	2-4cm	816	
	1994	4-6cm	313	
	1994	6-8cm	4.1	
B-39	1994	0-2cm	10700	
	1994	2-4cm	3980	
	1994	4-6cm	4470	
	1994	6-8cm	852	
B-40	1994	0-2cm	652	

Table 1 (continued)

PREVIOUS SAMPLING RESULTS

CARROL D. BESADNY FISH AND WILDLIFE AREA
Kewaunne Marsh Arsenic Area
Kewaunee, Wisconsin

ID	Date	As (mg/Kg)	% Solids	% Sand	% Silt	% Clay	Comment
soil95-1	1995	4	28.9	27	55	18	reference site upstream wetland s. side of Co. Hwy E (0-8")
soil95-2	1995	91	12.1	62	26	12	dug pit s. side of rr tracks, s. of spur (0-8")
soil95-3	1995	120	14.6	42	48	10	at STS B-9, between pond remnants SW of dead area (0-8")
soil95-4	1995	35	12.1	49	43	8	at STS B-12, NE of dead area (0-8")
soil95-5	1995	440	14.4	53	39	8	at STS B-23, NW of dead area (0-8")
soil95-6	1995	230	13.1	45	49	6	at STS B-10, East of dead area (0-8")

Table 1 (continued)

PREVIOUS SAMPLING RESULTS

CARROL D. BESADNY FISH AND WILDLIFE AREA
Kewaunne Marsh Arsenic Area
Kewaunee, Wisconsin

ID	Date	As (mg/Kg)	Al(mg/Kg)	Sb (mg/Kg)	Ba (mg/Kg)	Be(mg/Kg)	Cd (mg/Kg)	Ca (mg/Kg)	Cr (mg/Kg)	Co (mg/Kg)	Cu (mg/Kg)	Fe(mg/Kg)	Pb (mg/Kg)	Mg (mg/Kg)	Mn (mg/Kg)	Ni(mg/Kg)	K(mg/Kg)	S(mg/Kg)	Se(mg/Kg)	Na(mg/Kg)	Tl(mg/Kg)	V(mg/Kg)	Zn (mg/Kg)	Comments
so-01	5/21/96	219 1	4100 00	2 00	37 00	0 26	0 80	31000 00	5 20	2 00	6 50	6300 00	37 00	4400 00	38 00	15 90	390 00		ND	180 00	ND	10 00	61 00	NW capped area
so-02	5/21/96	39 0																						NW capped area
so-03	5/21/96	42																						N of capped area
so-04	5/21/96	22 2																						NE capped area
so-05	5/21/96	145 9	3300					22000				5400		3400				5581						W of capped area
so-06	5/22/96	204 1	3100					21000				5100		3500				5539						W of capped area
so-07	5/22/96	72 4	4300					23000				6400		3500				5713						SE capped area
so-08-01	5/21/96	6 1																						south of rr tracks
so-08-02	5/21/96	2 8																						south of rr tracks
so-09	5/21/96	8 3	1700 00	2 00	27 00	0 10	ND	44000 00	2 00	0 60	1 30	4000 00	8 00	4100 00	61 00	37 37	85 00		ND	120 00	ND	4 10	11 00	south of rr tracks, between spur
so-10	5/21/96	35 3	2100					40000				4900		4100				4118						inside corner btwn rr tracks and spur
so-11	5/22/96	239 2																						SE capped area
so-12-01	9/10/96	12 17																						in river, 20' d/s of southern inlet (0-16cm)
so-12-02	9/10/96	9 35																						in river, 20' d/s of southern inlet (16-32cm)
so-12-03	9/10/96	4 16																						in river, 20' d/s of southern inlet (32-47cm)
so-13	9/11/96	692																						hot sedge area (shovel core 0-25cm)
so-14	9/11/96	685																						hot cattail area (shovel core 0-25cm)
so-15	9/11/96	4 29																						cattail reference area (shovel core 0-25cm)
so-16-01	9/11/96	17																						in river, 40' off of site, 100' below South channel (0-20cm)
so-16-02	9/11/96	13																						in river, 40' off of site, 100' below South channel (20-49 5cm)
so-17-01	9/11/96	6																						1000' downstream of site (0-20cm)
so-17-02	9/11/96	< 3																						1000' downstream of site (20-60cm)
so-17-03	9/11/96	< 3																						1000' downstream of site (60-69cm)
so-18-01	9/11/96	11																						3300' downstream of site (0-43cm)
so-18-02	9/11/96	15																						3300' downstream of site (43-56cm)
so-18-03	9/11/96	4																						3300' downstream of site (56 83cm)

ID	Date	As (mg/Kg)	Al(mg/Kg)	Sb (mg/Kg)	Ba (mg/Kg)	Be(mg/Kg)	Cd (mg/Kg)	Ca (mg/Kg)	Cr (mg/Kg)	Co (mg/Kg)	Cu (mg/Kg)	Fe(mg/Kg)	Pb (mg/Kg)	Mg (mg/Kg)	Mn (mg/Kg)	Ni(mg/Kg)	K(mg/Kg)	S(mg/Kg)	Se(mg/Kg)	Na(mg/Kg)	Tl(mg/Kg)	V(mg/Kg)	Zn (mg/Kg)	Comments
st-01	5/22/96	2 6	8700	2	48	0 27	0 8	36000	12	4 3	15	10000	26	10000	110	11	640		ND	440	ND	20	50 58	125' S of CTH E, reference site
st-02	5/22/96	150																						S of pond 7, about 250' N of cyclone fence
st-03	5/22/96	220																						60' from NE corner of cap
st-04	5/22/96	220	2600	2	26	0 17	0 6	27000	4 3	1 4	8 3	4700	20	4000	55	5	1100		ND	150	ND	8 6	25 68	E of SE corner of cap
st-05	5/29/96	67																						30' E of GW-09, 7' E of cyclone fence
st-06	5/22/96	2 2																						S side of tracks btwn GW-01 and STS well

TABLE 2

SUMMARY OF BASELINE ECOLOGICAL RISK ASSESSMENT RESULTS

CARROLL D. BESADNY FISH AND WILDLIFE AREA
Kewaunee Marsh Arsenic Area
Kewaunee, Wisconsin

RECEPTOR GROUP	EXPOSURE POINT/AREA OF CONCERN	RELATIVE RISK CHARACTERIZATION
Human Health (Based on NR 105)	River	Low (NearTerm)
		High (Far Term)
	Wetland	Low
Emergent Marsh and Sedge	Wetland	Low
Algal-, Phyto- and Periphyton	Wetland	Low
Fish Community	River	Minimal
	Wetland	Low
Reptiles and Amphibians	Wetland	Moderate to High
Benthic Macroinvertebrates	River	Minimal
	Wetland	Low to Moderate
Surface Water Macroinvertebrates	River	Minimal
	Wetland	Low
Large Mammals	Wetland	Low
Small Mammals	Wetland	Low
Birds	Wetland	Low
Possible NR 105 Criteria - Wildlife and Domestic Animals	Wetland	High
Microbial Community - Decomposers and Detrivores	Wetland	Low to Moderate
Aquatic Life (Based on NR 105)	River	High (Near Term)
	Wetland	Low

TABLE 3

PROPOSED SAMPLING SCHEME SUMMARY

CARROLL D. BESADNY FISH AND WILDLIFE AREA
Kewaunee Marsh Arsenic Area
Kewaunee, Wisconsin

SAMPLE	DEPTH	LOCATION	RATIONALE
SOIL/SEDIMENT SAMPLING			
SURFACE SEDIMENT			
SS01-1*	Surface	Approximately 300 feet west of railroad tracks	Background surface sample
SS01-2*	Surface	Approximately 30 feet north of cover, west side	Indicate surface concentrations near edge of cover
SS01-3	Surface	Approximately 150 feet north of cover, west side	Indicate surface concentrations farther from cover
SS01-4*	Surface	Approximately 30 feet north of cover, center	Indicate surface concentrations near edge of cover
SS01-5	Surface	Approximately 100 feet north of fence	Indicate surface concentrations outside fenced area
SS01-6	Surface	Approximately 300 feet north of cover, east side	Indicate surface concentrations farther from cover
SS01-7*	Surface	Approximately 150 feet north of cover, east side	Indicate surface concentrations farther from cover
SS01-8	Surface	Approximately 30 feet north of cover, east side	Indicate surface concentrations near edge of cover
SS01-9	Surface	Approximately 150 feet northeast of northeast corner of cover	Indicate surface concentrations farther from cover
SS01-10*	Surface	Approximately 150 feet northeast of northesast portion of fence	Indicate surface concentrations outside fenced area
SS01-11	Surface	Approximately 40 feet east of northeast corner of cover	Indicate surface concentrations near edge of cover
SS01-12*	Surface	Approximately 75 feet east of eastern portion of fence	Indicate surface concentrations between fenced area and river
SS01-13	Surface	Approximately 50 feet east of southeast corner of cover	Indicate surface concentrations near edge of cover
SS01-14*	Surface	Approximately 120 feet east of southeast corner of cover	Indicate surface concentrations farther from cover
SS01-15*	Surface	Approximately 50 feet east of southeast portion of fence	Indicate surface concentrations between fenced area and river
SS01-16	Surface	Approximately 180 feet south of southeast corner of cover	Indicate surface concentrations farther from cover
SS01-17*	Surface	Approximately 30 feet south of cover, east side	Indicate surface concentrations near edge of cover
SS01-18	Surface	Approximately 140 feet south of raiload tracks	Indicate surface concentrations outside fenced area
SS01-19*	Surface	Approximately 30 feet south of cover, center	Indicate surface concentrations near edge of cover
SS01-20	Surface	Approximately 150 feet south of cover, center	Indicate surface concentrations farther from cover
SS01-21	Surface	Approximately 30 feet south of cover, west side	Indicate surface concentrations near edge of cover
SS01-22*	Surface	Approximately 100 feet south of cover, west side	Indicate surface concentrations farther from cover
SHALLOW BORINGS			
SB01-1	5 Feet	Approximately 250 feet west of railroad tracks	Background soil sample, boring for well
SB01-2*	5 Feet	Approximately 100 feet north of cover, western portion	Indicate soil concentrations at intermediate distance from cover
SB01-3	5 Feet	Approximately 100 feet north of fence	Indicate soil concentrations outside fence
SB01-4	Surface	Approximately 200 feet north of cover, central portion	Indicate surface concentrations farther from cover
SB01-4*	5 Feet	Approximately 200 feet north of cover, central portion	Indicate soil concentrations farther from cover
SB01-5	5 Feet	Approximately 150 feet north of northeastern corner of cover	Indicate soil concentrations at intermediate distance from cover

Note:

* - Samples are to be submitted to laboratory for phase separation (partition between pore water and soil solids)

TABLE 3 (CONTINUED)

PROPOSED SAMPLING SCHEME SUMMARY

CARROLL D. BESADNY FISH AND WILDLIFE AREA
Kewaunee Marsh Arsenic Area
Kewaunee, Wisconsin

SAMPLE	DEPTH	LOCATION	RATIONALE
SOIL/SEDIMENT SAMPLING			
SHALLOW BORINGS			
SB01-6*	5 Feet	Approximately 50 feet northeast of northeast portion of fence	Indicate soil concentrations between fence and river
SB01-7*	5 Feet	Approximately 250 feet east of northeast portion of fence	Indicate soil concentrations between fence and river
SB01-8	Surface	Approximately 150 feet east of northeastern corner of cover	Indicate soil concentrations between fence and river
SB01-8*	5 Feet	Approximately 150 feet east of northeastern corner of cover	Indicate soil concentrations between fence and river
SB01-9	5 Feet	Approximately 50 feet east of eastern portion of fence	Indicate soil concentrations between fence and river
SB01-10*	5 Feet	Approximately 100 feet east of eastern portion of cover	Indicate soil concentrations between fence and river
SB01-11	5 Feet	Approximately 100 feet east of southeast corner of cover	Indicate soil concentrations between fence and river
SB01-12*	5 Feet	Approximately 80 feet south of cover, eastern portion	Indicate soil concentrations at intermediate distance from cover
SB01-13	5 Feet	Approximately 80 feet east of southeastern portion of fence	Indicate soil concentrations between fence and river
SB01-14	Surface	Approximately 180 feet south of cover, central portion	Indicate soil concentrations farther from cover
SB01-14*	5 Feet	Approximately 180 feet south of cover, central portion	Indicate soil concentrations farther from cover
SB01-15	5 Feet	Approximately 100 feet south of cover, west side	Indicate soil concentrations at intermediate distance from cover
SB01-16	Surface	Southwest of railsiding	Indicate soil concentrations southwest of rail siding
SB01-16	5 Feet	Southwest of railsiding	Indicate soil concentrations southwest of rail siding
SB01-17	Surface	On railroad siding, approximately 260 feet southeast of switch	Indicate soil concentrations within rail siding material
SB01-17	5 Feet	On railroad siding, approximately 260 feet southeast of switch	Indicate soil concentrations within rail siding material
SB01-18	Surface	On railroad siding, approximately 340 feet southeast of switch	Indicate soil concentrations within rail siding material
SB01-18	5 Feet	On railroad siding, approximately 340 feet southeast of switch	Indicate soil concentrations within rail siding material
SB01-19	Surface	East of railroad siding, between two branches	Indicate soil conditions west of railroad, near highest concentrations found
SB01-19	5 Feet	East of railroad siding, between two branches	Indicate soil conditions west of railroad, near highest concentrations found
SB01-20	Surface	East of railroad siding	Indicate soil conditions west of railroad, farther from rail
SB01-20	5 Feet	East of railroad siding	Indicate soil conditions west of railroad, farther from rail
SB01-21	Surface	Approximately 100 feet west of southwest corner of cover	Indicate soil concentrations west of railroad
SB01-21	5 Feet	Approximately 100 feet west of southwest corner of cover	Indicate soil concentrations west of railroad
SB01-22	5 Feet	South of southwest portion of cover	Indicate soil concentrations near edge of cover
INTERMEDIATE BORINGS			
IB01-1	10 Feet	Approximately 250 feet west of railroad tracks	Indicate depth profile of concentrations, background
IB01-2	10 Feet	Approximately 250 feet north of cover, central portion	Indicate depth profile of concentrations
IB01-3	10 Feet	Approximately 100 feet east of eastern portion of cover	Indicate depth profile of concentrations
IB01-4	10 Feet	Approxiamtely 50 feet east of eastern portion of fence	Indicate depth profile of concentrations
IB01-5	10 Feet	Approximately 180 feet south of cover, central portion	Indicate depth profile of concentrations
DEEP BORINGS			
DB01-1	15-30 feet	Approximately 250 feet west of railroad tracks	Indicate depth profile of concentrations, background
DB01-2	15-30 feet	Approximately 250 feet north of cover, central portion	Indicate depth profile of concentrations
DB01-3	15-30 feet	Approximately 100 feet east of eastern portion of cover	Indicate depth profile of concentrations
DB01-4	15-30 feet	Approxiamtely 50 feet east of eastern portion of fence	Indicate depth profile of concentrations
DB01-5	15-30 feet	Approximately 180 feet south of cover, central portion	Indicate depth profile of concentrations

Note:
* - Samples are to be submitted to laboratory for phase separation (partition between pore water and soil solids)

TABLE 3 (CONTINUED)

PROPOSED SAMPLING SCHEME SUMMARY

CARROLL D. BESADNY FISH AND WILDLIFE AREA
Kewaunee Marsh Arsenic Area
Kewaunee, Wisconsin

SAMPLE	LOCATION	RATIONALE
SURFACE WATER SAMPLING		
SW01-1	Kewaunee River bank, approximately 300 yards north of fenced area	Upstream background river water sample
SW01-2	Kewaunee River bank, approximately 200 yards north of fenced area	Upstream background river water sample
SW01-3	Kewaunee River bank, approximately 100 yards north of fenced area	Upstream background river water sample
SW01-4	Kewaunee River bank, near northern end of fenced area	Indicate surface water impacts to river at site
SW01-5	Kewaunee River bank, near central portion of fenced area	Indicate surface water impacts to river at site
SW01-6	Kewaunee River bank, near southern end of fenced area	Indicate surface water impacts to river at site
SW01-7	Kewaunee River bank, approximately 100 yards south of fenced area	Indicate downstream impacts to river
SW01-8	Kewaunee River bank, approximately 200 yards south of fenced area	Indicate downstream impacts to river
SW01-9	Kewaunee River bank, approximately 300 yards south of fenced area	Indicate downstream impacts to river
SW01-10	Standing water in marsh, approximately 300 feet north of fenced area	Background marsh standing water
SW01-11	Standing water in marsh, approximately 300 feet west of railroad tracks	Background marsh standing water
SW01-12	Standing water in marsh, approximately 300 feet south of railroad tracks	Background marsh standing water
SW01-13	Standing water in marsh, approximately 50 feet north of cover	Monitor surface water concentrations between cover and fence
SW01-14	Standing water in marsh, between 50 and 100 feet north of cover	Monitor surface water concentrations between cover and fence
SW01-15	Standing water in marsh, between 100 feet north of cover and fence	Monitor surface water concentrations between cover and fence
SW01-16	Standing water in marsh, approximately 50 feet east of cover	Monitor surface water concentrations between cover and fence
SW01-17	Standing water in marsh, between 50 and 100 feet east of cover	Monitor surface water concentrations between cover and fence
SW01-18	Standing water in marsh, between eastern portion of fence and river	Monitor surface water concentrations between cover and river
SW01-19	Standing water in marsh, approximately 50 feet south of cover	Monitor surface water concentrations between cover and fence
SW01-20	Standing water in marsh, between 50 and 100 feet south of cover	Monitor surface water concentrations between cover and fence
SW01-21	Standing water in marsh, between 100 feet south of cover and fence	Monitor surface water concentrations between cover and fence
SW01-22	North slough draining area between fence and river	Monitor surface water concentrations in drainage slough
SW01-23	South slough drainaing are between fence and river	Monitor surface water concentrations in drainage slough
SW01-24	East of former railroad siding, north of cover	Monitor surface water changes due to seasonal climate
SW01-25	North of cover, east end	Monitor surface water changes due to seasonal climate
SW01-26	South of cover, east end	Monitor surface water changes due to seasonal climate
SW02-1	East of former railroad siding, north of cover	Monitor surface water changes due to seasonal climate
SW02-2	Same location as SW01-21, near former siding, south of cover	Monitor surface water changes due to seasonal climate
SW02-3	Same location as SW01-13, north of cover, central portion	Monitor surface water changes due to seasonal climate
SW02-4	Same location as SW01-25, north of cover, east end	Monitor surface water changes due to seasonal climate
SW02-5	Same location as SW01-16, east of east end of cover	Monitor surface water changes due to seasonal climate
SW02-6	Same location as SW01-26, south of cover, east end	Monitor surface water changes due to seasonal climate
SW02-7	Same location as SW01-27, south of cover, west end	Monitor surface water changes due to seasonal climate
SW02-8	Same location as SW01-22, north slough	Monitor surface water changes due to seasonal climate
SW02-9	Same location as SW01-23, south slough	Monitor surface water changes due to seasonal climate

TABLE 3 (CONTINUED)
REVISED PAGE 4
PROPOSED SAMPLING SCHEME SUMMARY

CARROLL D. BESADNY FISH AND WILDLIFE AREA
Kewaunee Marsh Arsenic Area
Kewaunee, Wisconsin

WELL	DEPTH	LOCATION	RATIONALE
GROUNDWATER SAMPLING			
MW01-1	5 Feet	Approximately 250 feet west of railroad tracks	Background pore water sample, measure vertical gradients
MW01-1i	10 Feet	Approximately 250 feet west of railroad tracks	Background shallow groundwater sample, measure vertical gradients
MW01-1d	15-30 Feet	Approximately 250 feet west of railroad tracks	Background deep groundwater sample, measure vertical gradients
MW01-2	5 Feet	Approximately 250 feet north of cover	Pore water sample between cover and fence
MW01-2i	10 Feet	Approximately 250 feet north of cover	Shallow groundwater sample beween cover and fence
MW01-3	5 Feet	Approximate north edge of cover	Pore water sample at edge of cover, measure vertical gradients
MW01-3i	10 Feet	Approximate north edge of cover	Shallow groundwater sample at edge of cover, measure vertical gradients
MW01-3d	15-30 Feet	Approximate north edge of cover	Deep groundwater sample at edge of cover, measure vertical gradients
MW01-4	5 Feet	Approximate east edge of cover	Pore water sample at edge of cover, measure vertical gradients
MW01-4i	10 Feet	Approximate east edge of cover	Shallow groundwater sample at edge of cover, measure vertical gradients
MW01-4d	15-30 Feet	Approximate east edge of cover	Deep groundwater sample at edge of cover, measure vertical gradients
MW01-5	5 Feet	Approximately 100 feet east of cover	Pore water sample beween cover and fence
MW01-5i	10 Feet	Approximately 100 feet east of cover	Shallow groundwater sample beween cover and fence
MW01-6	5 Feet	Between southeast corner of cover and south drainage slough	Pore water sample beween cover and south drainage slough
MW01-6i	10 Feet	Between southeast corner of cover and south drainage slough	Pore water sample beween cover and south drainage slough
MW01-7	5 Feet	Between fence and river	Pore water sample between fence and river, **measure vertical gradients if MW01-7d can be installed**
MW01-7i	10 Feet	Between fence and river	Shallow groundwater sample between fence and river, **measure vertical gradients if MW01-7d can be installed**
MW01-7d	15-30 Feet	**Between fence and river if this well can be installed by hand**	**Deep groundwater sample between fence and river, measure vertical gradients if this well can be installed by hand**

TABLE 3 (CONTINUED)

PROPOSED SAMPLING SCHEME SUMMARY

CARROLL D. BESADNY FISH AND WILDLIFE AREA
Kewaunee Marsh Arsenic Area
Kewaunee, Wisconsin

WELL	DEPTH	LOCATION	RATIONALE
GROUNDWATER SAMPLING			
MW01-1	5 Feet	Approximately 250 feet west of railroad tracks	Background pore water sample, measure vertical gradients
MW01-2	10 Feet	Approximately 250 feet west of railroad tracks	Background shallow groundwater sample, measure vertical gradients
MW01-3	15-30 Feet	Approximately 250 feet west of railroad tracks	Background deep groundwater sample, measure vertical gradients
MW01-4	5 Feet	Approximately 250 feet north of cover	Pore water sample beween cover and fence, measure vertical gradients
MW01-5	10 Feet	Approximately 250 feet north of cover	Shallow groundwater sample beween cover and fence, measure vertical gradients
MW01-6	15-30 Feet	Approximately 250 feet north of cover	Deep groundwater sample beween cover and fence, measure vertical gradients
MW01-7	5 Feet	Approximately 100 feet east of cover	Pore water sample beween cover and fence, measure vertical gradients
MW01-8	10 Feet	Approximately 100 feet east of cover	Shallow groundwater sample beween cover and fence, measure vertical gradients
MW01-9	15-30 Feet	Approximately 100 feet east of cover	Deep groundwater sample beween cover and fence, measure vertical gradients
MW01-10	5 Feet	Between fence and river	Pore water sample between fence and river, measure vertical gradients
MW01-11	10 Feet	Between fence and river	Shallow groundwater sample between fence and river, measure vertical gradients
MW01-12	15-30 Feet	Between fence and river	Deep groundwater sample between fence and river, measure vertical gradients
MW01-13	5 Feet	Between southeast corner of cover and south drainage slough	Pore water sample beween cover and south drainage slough, measure vertical gradients
MW01-14	10 Feet	Between southeast corner of cover and south drainage slough	Pore water sample beween cover and south drainage slough, measure vertical gradients
MW01-15	15-30 Feet	Between southeast corner of cover and south drainage slough	Pore water sample beween cover and south drainage slough, measure vertical gradients

Revised

Table 4

2001 WDNR Sampling Results Summary

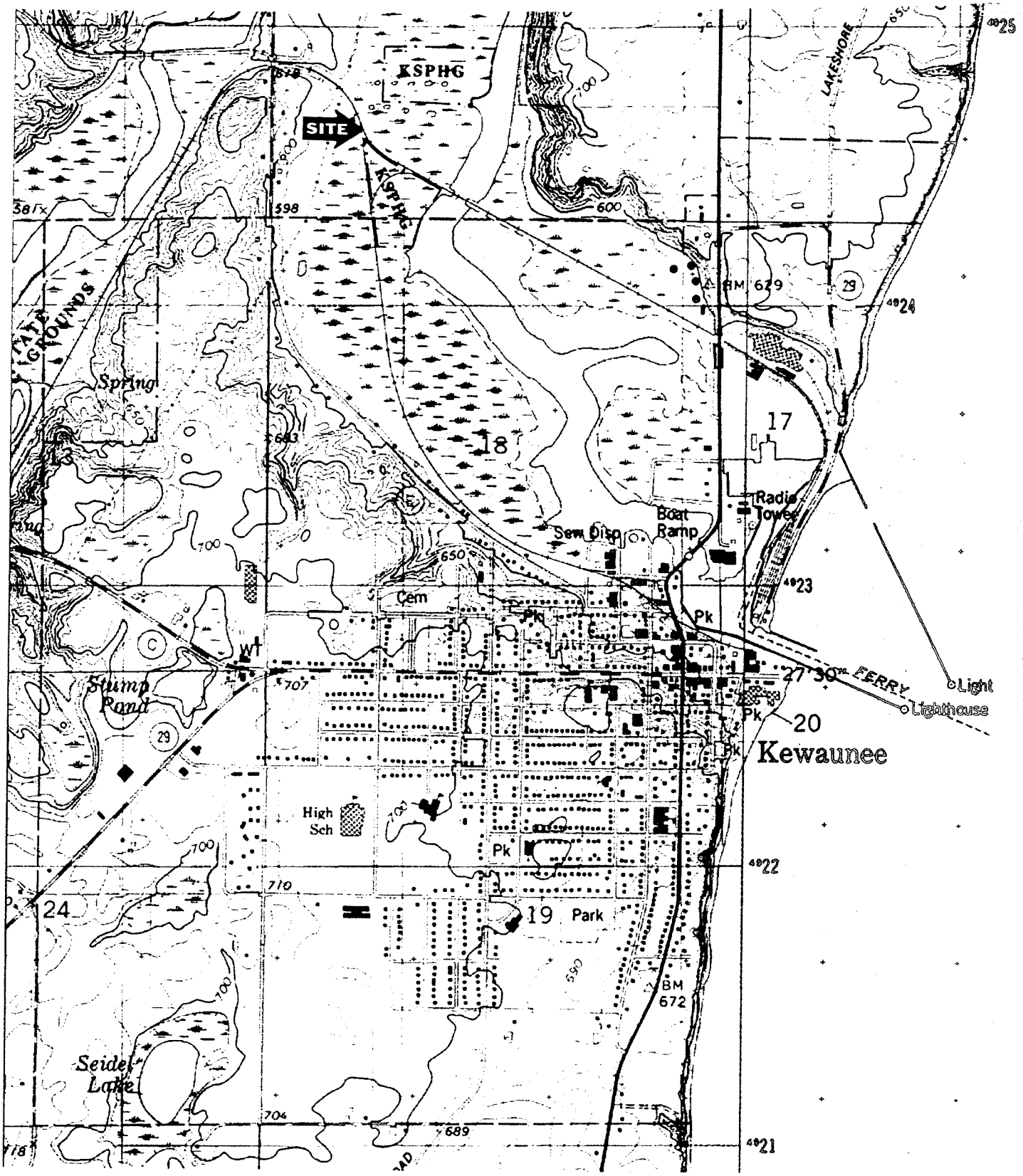
CARROL D. BESADNY FISH AND WILDLIFE AREA
Kewaunee Marsh Arsenic Area
Kewaunee, Wisconsin

1. Surface Water Samples

Sample	Arsenic
	Concentration (ug/l)
SW01-1	98
SW01-2	12
SW01-3	1200
SW01-4	1900
SW01-5	13,000
SW01-6	3100
SW01-7	8200
SW01-8	4600
SW01-9	1400
SW01-10	720

2. Groundwater Samples

Sample	Arsenic
	Concentration (ug/l)
GW0-1	15
GW01-2	150
GW01-3	260
GW01-4	17
GW01-5	130
GW01-6	7000
GW01-7	150
GW01-8	230
GW01-9	7100
GW01-10	3



SOURCE: USGS Kewaunee, Wisconsin Quadrangle Map Topographic Map 1978

DESIGNED BY DPH	DATE 06/06/01
DRAWN BY LMD	SCALE 1" = 2000'
APPROVED BY GLJ	SHEET NO. 1
CADFILE G:\ACAD\R1103004\R1103004.dwg XREF LMAN	

FIGURE 1
SITE LOCATION MAP

C.D. BESADNY FISH AND WILDLIFE AREA
KEWAUNEE, WI

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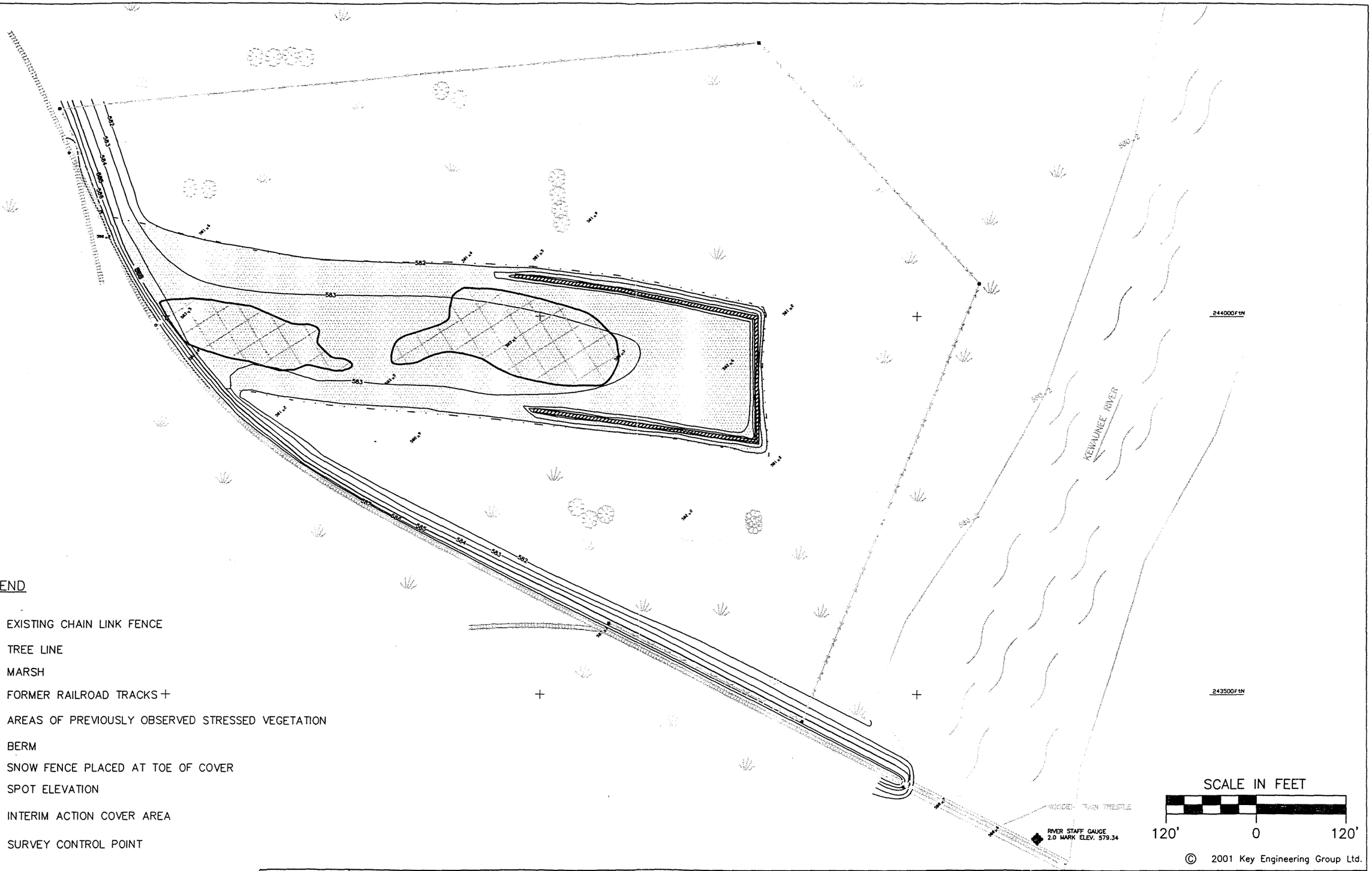

LEGEND

- EXISTING CHAIN LINK FENCE
- TREE LINE
- MARSH
- FORMER RAILROAD TRACKS +
- AREAS OF PREVIOUSLY OBSERVED STRESSED VEGETATION
- BERM
- SNOW FENCE PLACED AT TOE OF COVER
- SPOT ELEVATION
- INTERIM ACTION COVER AREA
- SURVEY CONTROL POINT

DESIGNED BY DPH	DATE 06/06/01
DRAWN BY LMD	SCALE 1" = 120'
APPROVED BY GLJ	SHEET NO. 2
CADFILE G:\ACAD\R1103004\R1103004.dwg XREF LMAN FIGURE 2.lay	

FIGURE 2
EXISTING SITE CONDITIONS

C. D. BESADNY FISH AND WILDLIFE AREA
KEWAUNEE, WISCONSIN

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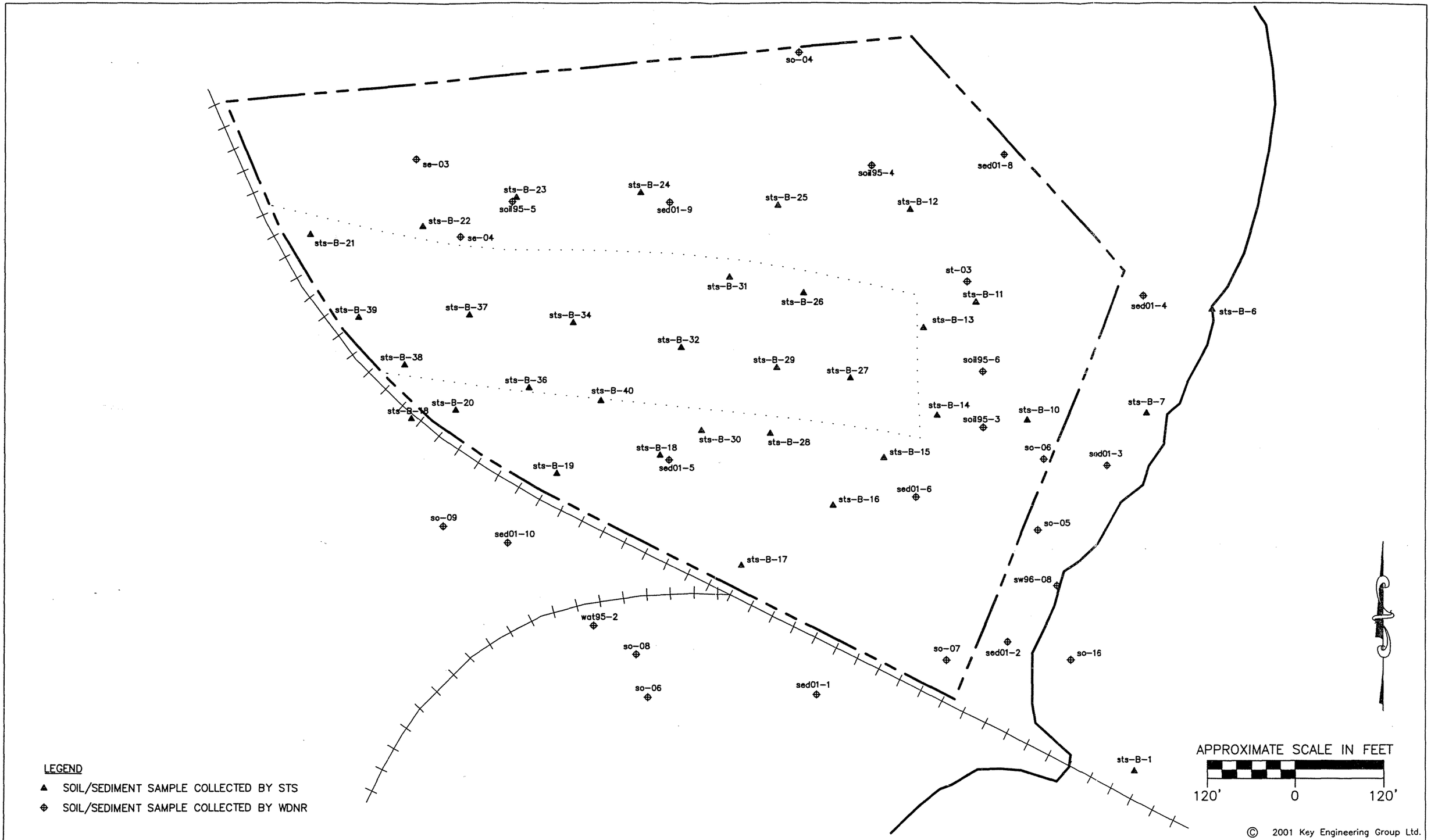

LEGEND

▲ SOIL/SEDIMENT SAMPLE COLLECTED BY STS

⊕ SOIL/SEDIMENT SAMPLE COLLECTED BY WDNR

DESIGNED BY: DPH	DATE: 08/01/01
DRAWN BY: CS	PROJECT: R1103004
APPROVED BY: GLJ	SHEET NO.: 3A
CADFILE G:\ACAD\R1103004\R1103044.dwg XREF LMAN	

FIGURE 3A
PREVIOUS SOIL/SEDIMENT SAMPLING LOCATIONS

C. D. BESADNY FISH AND WILDLIFE AREA
KEWAUNEE, WISCONSIN

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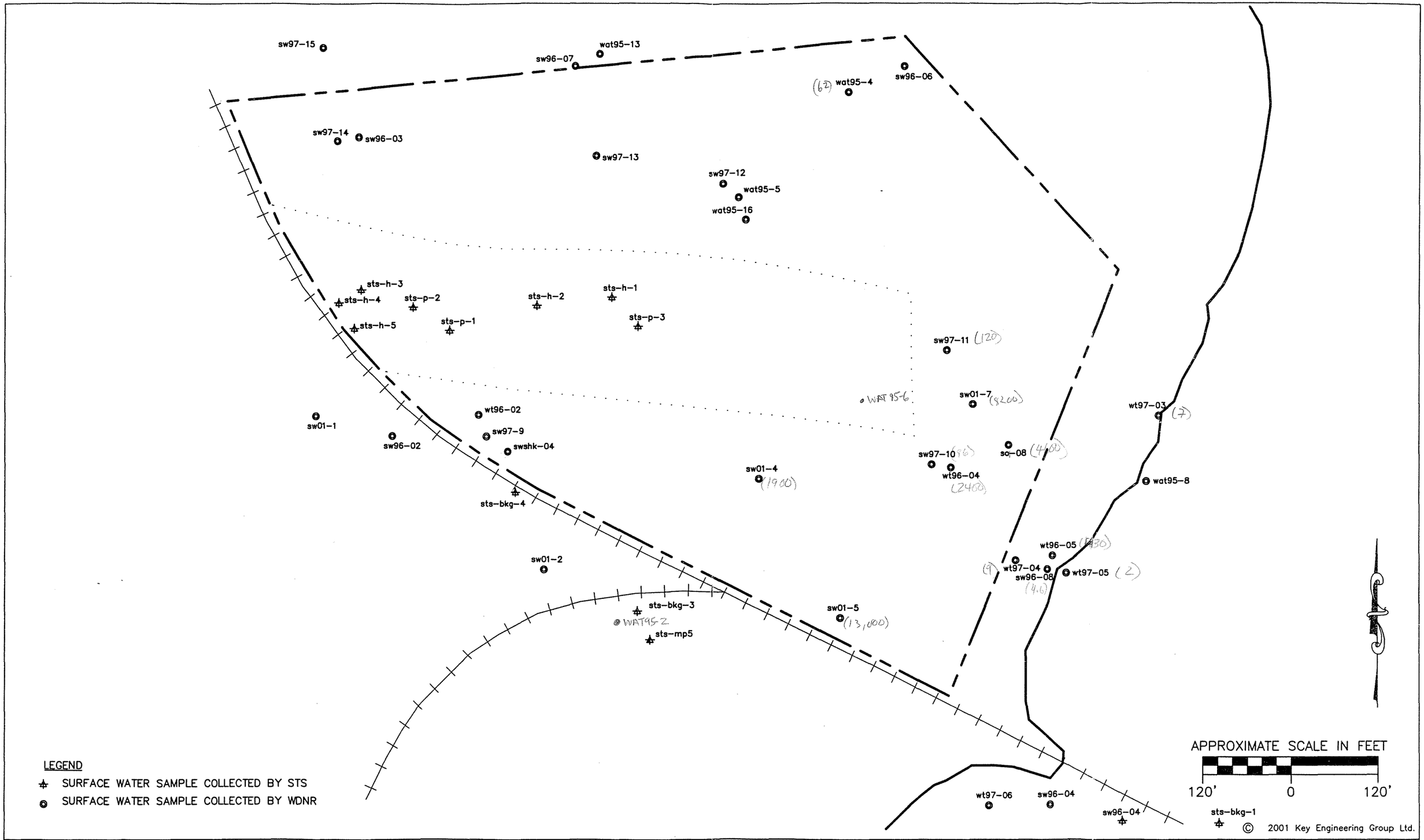

DESIGNED BY DPH	DATE 08/01/01
DRAWN BY CS	PROJECT R1103004
APPROVED BY GLJ	SHEET NO. 4A
CADFILE G:\ACAD\R1103004\R1103044.dwg XREF LMAN	

FIGURE 4A
PREVIOUS SURFACE WATER SAMPLING LOCATIONS

C. D. BESADNY FISH AND WILDLIFE AREA
KEWAUNEE, WISCONSIN

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DESIGNED BY: DPH	DATE: 08/01/01
DRAWN BY: CS	PROJECT: R1103004
APPROVED BY: GLJ	SHEET NO.: 5A
CADFILE G:\ACAD\R1103004\R1103044.dwg XREF LMAN	

FIGURE 5A
PREVIOUS GROUNDWATER SAMPLING LOCATIONS

C. D. BESADNY FISH AND WILDLIFE AREA
KEWAUNEE, WISCONSIN

KEY ENGINEERING GROUP LTD.
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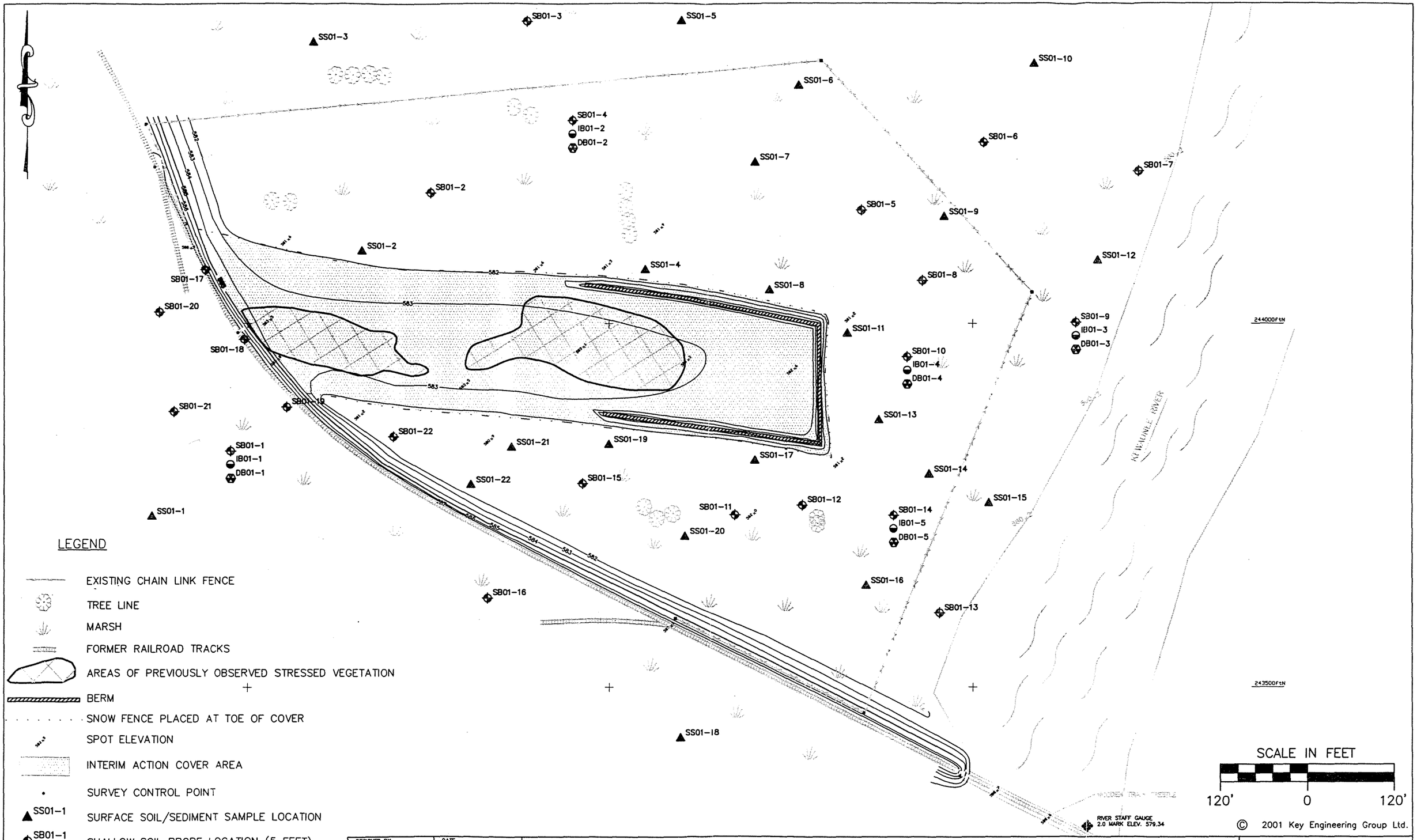

LEGEND

- EXISTING CHAIN LINK FENCE
- TREE LINE
- MARSH
- FORMER RAILROAD TRACKS
- AREAS OF PREVIOUSLY OBSERVED STRESSED VEGETATION
- BERM
- SNOW FENCE PLACED AT TOE OF COVER
- SPOT ELEVATION
- INTERIM ACTION COVER AREA
- SURVEY CONTROL POINT
- SS01-1 SURFACE SOIL/SEDIMENT SAMPLE LOCATION
- SB01-1 SHALLOW SOIL PROBE LOCATION (5 FEET)
- IB01-1 INTERMEDIATE SOIL BORING LOCATION (10 FEET)
- DB01-1 DEEP SOIL BORING LOCATION (15–30 FEET)

SCALE IN FEET

120' 0 120'

DESIGNED BY DPH	DATE 06/06/01
DRAWN BY LMD	SCALE 1" = 120'
APPROVED BY GLJ	SHEET NO. 3
CADFILE G:\ACAD\R1103004\R1103004-3.dwg XREF LMAH FIGURE 3.tdy	

FIGURE 3
PROPOSED SOIL/SEDIMENT SAMPLE LOCATIONS

C.D. BESADNY FISH AND WILDLIFE AREA
KEWAUNEE, WI

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SW01-24
SW02-1
SW01-15
SW01-14
SW01-11
SW02-3
SW01-13
SW01-25
SW02-4
SW01-17
SW02-5
SW01-16
SW02-7
SW01-19
SW01-26
SW02-6
SW01-20
SW02-2
SW01-21
SW01-4
SW02-8
SW01-22
SW01-5
SW01-18
SW02-9
SW01-23
SW01-6
SG-1
SG-2

SW01-1 900' NORTH
SW01-2 600' NORTH
SW01-3 300' NORTH

SW01-7 300' SOUTH
SW01-8 600' SOUTH
SW01-9 900' SOUTH

244000FtN
243500FtN

KEWAUNEE RIVER

RIVER STAFF GAUGE
2.0 MARK ELEV. 579.34

LEGEND

- EXISTING CHAIN LINK FENCE
- TREE LINE
- MARSH
- FORMER RAILROAD TRACKS
- AREAS OF PREVIOUSLY OBSERVED STRESSED VEGETATION
- BERM
- SNOW FENCE PLACED AT TOE OF COVER
- SPOT ELEVATION
- INTERIM ACTION COVER AREA
- SURVEY CONTROL POINT
- SW01-1 SURFACE WATER SAMPLE LOCATION (2001)
- SW02-1 SURFACE WATER SAMPLE LOCATION (2002)
- SG-1 STREAM GAUGE LOCATION

SCALE IN FEET
120' 0 120'

DESIGNED BY DPH	DATE 06/06/01
DRAWN BY LMD	SCALE 1" = 120'
APPROVED BY GLJ	SHEET NO. 4
CADFILE G:\ACAD\R1103004\R1103004.dwg XREF LMAN FIGURE 4.lay	

FIGURE 4
PROPOSED SURFACE WATER SAMPLING LOCATIONS

C.D. BESADNY FISH AND WILDLIFE AREA
KEWAUNEE, WI

KEY ENGINEERING GROUP LTD.
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MW01-2
MW01-2I
MW01-3
MW01-3I
MW01-3d
MW01-4
MW01-4I
MW01-4d
MW01-5
MW01-5I
MW01-6
MW01-6I
MW01-7
MW01-7I
MW01-7d
MW01-1
MW01-1I
MW01-1d

582
583
584
585
586
587
588

244000FtN
243500FtN
KEWAUNEE RIVER
WOODEN TRAIN TRESTLE
RIVER STAFF GAUGE
2.0 MARK ELEV. 579.34

95 soil samples

LEGEND

- EXISTING CHAIN LINK FENCE
- TREE LINE
- MARSH
- FORMER RAILROAD TRACKS
- AREAS OF PREVIOUSLY OBSERVED STRESSED VEGETATION
- BERM
- SNOW FENCE PLACED AT TOE OF COVER
- SPOT ELEVATION
- INTERIM ACTION COVER AREA
- SURVEY CONTROL POINT
- MW01-1 MONITORING WELL LOCATION

SCALE IN FEET
120' 0 120'

DESIGNED BY DPH	DATE 06/06/01
DRAWN BY LMD	SCALE 1" = 120'
APPROVED BY GLJ	SHEET NO. 5
CADFILE G:\ACAD\R1103004\R1103004-3.dwg XREF LMAN FIGURE 5.lay	

FIGURE 5 – REVISED 12/19/01
PROPOSED GROUNDWATER SAMPLING LOCATIONS WITH WELLS

C.D. BESADNY FISH AND WILDLIFE AREA
KEWAUNEE, WI

KEY ENGINEERING GROUP LTD.
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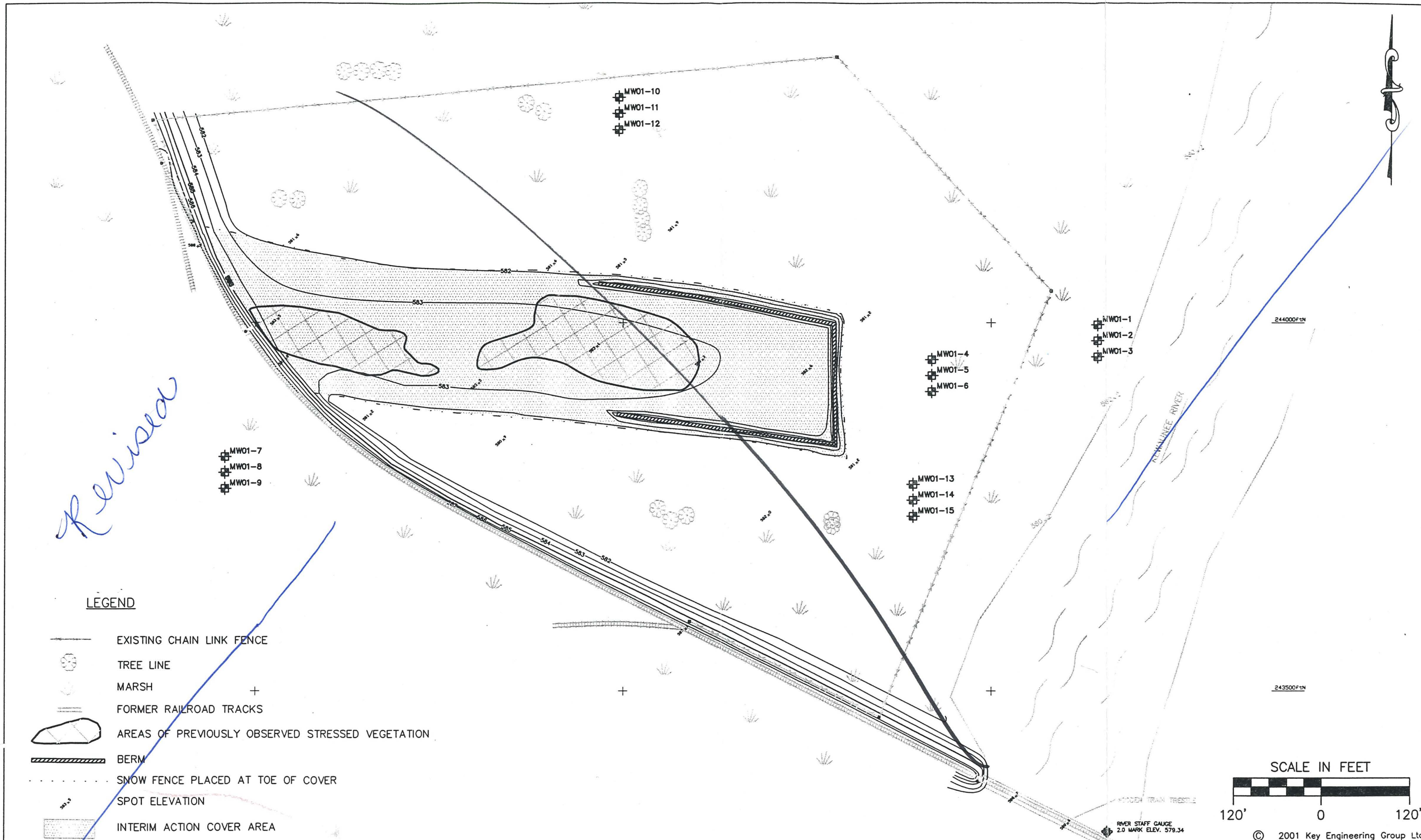

DESIGNED BY DPH	DATE 06/06/01
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APPROVED BY GLJ	SHEET NO. 5
CADFILE G: \ACAD\R1103004\R11030043.dwg XREF LMAN FIGURE 5.lay	

FIGURE 5
PROPOSED GROUNDWATER SAMPLING LOCATIONS WITH WELLS

C.D. BESADNY FISH AND WILDLIFE AREA
KEWAUNEE, WI

KEY ENGINEERING GROUP LTD.
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SAMPLING AND ANALYSIS PLAN

CARROLL D. BESADNY FISH AND WILDLIFE AREA
KEWAUNEE MARSH ARSENIC AREA
KEWAUNEE, WISCONSIN

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LIST OF APPENDICES

1.0 INTRODUCTION

This *Sampling and Analysis Plan (SAP)* identifies the sampling procedures that will be implemented during the site investigation. This *SAP* includes sampling objectives, scope, procedures, equipment, quality control (QC) and documentation, as well as management procedures for investigation derived waste. Contractor may provide an alternative *SAP* or provide proposed alternatives to sections of this *SAP* with their proposals.

2.0 FIELD SAMPLING

This section details the field sampling scope, equipment, procedures, decontamination, QC and documentation protocols.

2.1 Soil/Sediment Investigation

2.1.1 Scope

The scope of the soil/sediment investigation is detailed in Section 4.1 of *Site Investigation Work Plan*. The soil probe and boring locations are depicted on Figure 3 of the work plan. Sample collection and analyses will be consistent with procedures identified in the Wisconsin Administrative Code Chapter NR 700 series of regulations.

2.1.2 Equipment

Equipment and materials to be used during soil investigation will include:

- Drill rig with capability of boring with 4¼ ID hollow stem augers (HSAs)
- Soil probe unit
- Piston sampler
- Field notes form
- Soil boring logs
- Stainless steel bowls and spoons
- Stainless steel trowel or shovel
- Tap water, distilled water, Alconox®
- Steam cleaner
- Sample jars and preservatives
- Munsell Soil Color Chart
- Stakes for marking sample locations
- Chain of custody forms
- Sample labels
- Indelible marking pen
- Coolers and ice
- Camera and film

2.1.3 Procedures

Soil borings will be advanced both with a drilling rig using HSAs, and with a soil probe unit. The probe unit may be either mounted on a vehicle such as a truck, van, or all-terrain vehicle, or a hand unit. Soil samples from drill rig sampling will be collected at 2½-foot intervals with a 2-foot split-spoon sampler, when adequate recovery is possible using this technique. These soil samples will be collected in accordance with American Society of Testing Materials D1586, *Standard Method for Penetration Test and Split-Barrel Sampling of Soil.* For borings performed using a soil probe unit, samples will be collected using standard industry practices, with continuous sampling. In some site soils, particularly in peat deposits near the surface, it may be necessary to collect samples using a piston sampler. Surface soil/sediment samples will be collected by hand, using a stainless steel trowel or shovel.

Immediately after sample collection and description, soil samples selected for laboratory analysis will be placed in a stainless steel bowl, and mixed with a stainless steel spoon. An aliquot of the homogenized soil sample will be placed in the appropriate sample container. For soil and sediment arsenic analysis, no preservative is required. In addition to the sample for chemical analysis, a separate aliquot from the same sample will be packaged for water content testing. The soil samples will then be placed in a cooler with ice.

In addition to analysis for arsenic, several samples will be collected for processing in the laboratory to determine paired pore water-soil solid arsenic concentrations. These samples will be collected in a manner similar to that described above, but it is important that there be no headspace in the sample jar. For these samples, no separate container for moisture content will be required. Before these samples are collected, packaged, and shipped to the laboratory, it is very important that communication with the laboratory be maintained, so that the laboratory knows to expect the samples, and process them accordingly.

The laboratory will separate pore water from soil/sediment solids by centrifuge using *Standard Methods for the Examination of Water and Wastewater* (American Public Health Association, 2001) Proposed Method 8080C, "Extraction of Sediment Pore Water."

A boring log will be maintained for each boring location. Boring logs will include the Standard Penetration Test blow counts; depth and thickness of each soil stratum; a description of each stratum including Munsell color, Unified Soil Classification System classification, soil moisture, plasticity, density or consistency; olfactory observations; sample depth interval and recovery; and the depth at which groundwater is first encountered. For surface soil/sediment samples, soil descriptions will be documented on the field notes form.

2.1.4 Decontamination

The down-hole drilling equipment will be decontaminated prior to mobilization and between boring locations using a high pressure steam cleaner. Decontamination water will be supplied by the drilling contractor, who will obtain if from a potable water source. The split spoon soil sampler, soil mixing bowls, and spoons will be decontaminated between each use. Decontamination will consist of a tap water and detergent (Alconox®) wash, tap water rinse and a distilled water rinse. Decontamination water will not be contained.

2.1.5 Quality Control

Sampling and analytical QC will take the form of duplicate samples, in which two sample aliquots, in separate containers, are submitted to the laboratory for analysis. QC of both the field sampling procedures and the analytical procedures will be measured by the degree of agreement of the analytical results of the two samples. These analytical samples will be collected at a rate of one duplicate per twenty soil samples per analyte.

In addition to the duplicate sampling, field rinsate blanks will be collected to measure the effectiveness of field decontamination between sample intervals. After decontamination of the sampling equipment (split spoon, mixing bowl, and mixing spoon), deionized water will be run over the equipment and collected into sample bottles. These samples will be preserved as prescribed by the analytical method, and analyzed for arsenic. Rinsate samples will be collected at a rate of one rinsate sample per day of field sampling.

As a QC measure on the laboratory's procedure in which pore water and soil/sediment solids are separated, the laboratory will perform analyses of pore water on both filtered and unfiltered aliquots of the pore water removed from three of the sediment samples. The laboratory must follow the methods, instrumentation and QC requirements of the

United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP). The laboratory need not be registered under CLP, but it must meet CLP requirements.

Soil investigation field documentation will undergo a QC review during and after the completion of field activities. Original field forms and photo documentation will be stored in a secure area until completion of the field program. Upon completion of the field program, documentation will be relinquished to the Project Manager.

2.1.6 Documentation

Soil sampling documentation will consist of the following:

- Field Notes Form (Appendix A1-1)
- Soil Boring Log (WDNR Form 4400-122) (Appendix A1-1)
- Borehole Abandonment (WDNR Form 3300-5B) (Appendix A1-1)
- Photographs

2.2 Surface Water Sampling

2.2.1 Scope

The scope of the surface water sampling task is detailed in Section 3.2 of the *Site Investigation Work Plan*. The surface water sampling locations are depicted in Figure 4 of the *Site Investigation Work Plan*.

2.2.2 Equipment

Equipment that will be used to collect surface water samples are a follows:

- Sample containers and preservatives, supplied by the laboratory
- Tube-type drum sampler, capable of collecting water from a column approximately three feet deep.
- Clean pre-filtration jugs
- Peristaltic pump and tubing
- 0.4-um filters
- Field notes form
- Downhole water quality probe, which measures pH, temperature, dissolved oxygen, conductivity and redox potential (Eh)
- Personal protective equipment
- Decontamination supplies
- Stakes for marking sample locations
- Camera and film

2.2.3 Procedures

Surface water samples will be collected both from areas of standing water in the marsh, and from the banks of the Kewaunee River and tributary sloughs in the study area. During collection activities at the river and sloughs, the buddy system will be employed for safety purposes.

Before samples are collected, water quality will be measured at the location, using the downhole water quality probe. The probe will be inserted into the water at the area to be sampled, and readings for pH, temperature, conductivity, dissolved oxygen and redox potential will be recorded.

Surface water samples collected from "casual" standing water in the marsh will be collected by dipping the pre-filtration jug directly into the surface water, and allowing it to fill by gravity. Samples will be field-filtered using a peristaltic pump, placed in the sample container, and preserved. Samples collected from drainage sloughs and from the Kewaunee River will be collected using a tube-type drum sampler ("drum thief"). The advantage of the drum thief is that it can collect a sample from a length water column; not just from the surface, or a particular discrete depth. These samples will also be transferred from the drum sampler into the pre-filtration jug, filtered and preserved.

2.2.4 Decontamination

Equipment expected to require decontamination for this task is the downhole water quality probe, and the peristaltic pump tubing, The pre-filtration jugs, filters, and drum sampler tubes are designed to be disposable. The probe is decontaminated by rinsing it in tap water, then rinsing with distilled water. The tubing for the peristaltic pump will be decontaminated by running approximately 1 gallon of distilled water through the pump between sample locations. Personal protective equipment, namely gloves, will be changed between surface water sampling locations to avoid cross-contamination.

2.2.5 Quality Control

Sampling and analytical QC will include duplicate samples, in which two sample aliquots, in separate containers, are submitted to the laboratory for analysis. QC of both the field sampling procedures and the analytical procedures will be measured by the degree of agreement of the analytical results of the two samples. These analytical samples will be collected at a rate of one duplicate per twenty samples per analyte. In addition to the duplicate samples, a field rinsate blank will be collected of a drum sampler tube, prefiltration jug, and peristaltic pump tubing. This field blank will be collected using a clean, unused tube and jug. Laboratory QC will follow USEPA CLP procedures.

Surface water investigation field documentation will undergo a QC review during and after the completion of field activities. Original field forms and photo documentation will be stored in a secure area until completion of the field program. Upon completion of the field program, documentation will be relinquished to the Project Manager.

2.2.6 Documentation

Surface water sampling documentation will consist of the following:

- Field Notes Form (Appendix A1-1)
- Photographs
- Calibration records for the water quality probe

2.3 Groundwater Monitoring Well Installation

2.3.1 Scope

The scope of the groundwater monitoring well installation task is detailed in Section 3.3 of the *Site Investigation Work*

Plan. The groundwater monitoring well locations are depicted on Figure 5 of the *Site Investigation Work Plan*.

2.3.2 Equipment

Equipment that will be used to install and develop the monitoring wells are as follows:

- Drill rig with capability of boring with 4¼ ID HSAs
- Fiberglass tape of adequate length to reach the bottom of the well
- Field notes form
- Soil boring logs, well construction forms, well development forms
- Tap water, distilled water, Alconox®
- Generator, steam cleaner
- Brush, buckets and plastic
- 2-inch, flush-threaded 0.010-inch slot, Sch. 40 polyvinyl chloride (PVC) well screen, 5 and 10 feet long
- Locking well caps
- High solids bentonite grout
- Bentonite pellets
- Washed, well sorted silica sand, appropriate size grades for filter pack and fine sand filter pack seal
- Flush-mount protective casings
- Keyed-alike locks
- Bailer
- Electric water level indicator
- Camera and film

2.3.3 Procedures

The groundwater monitoring well soil borings will be advanced with a drilling rig using HSAs. Soil samples will be collected at 2½-foot intervals with a 2-foot split-spoon sampler. Soil sampling will be in accordance with the procedures detailed in Section 2.1.

The groundwater monitoring wells will be constructed in general accordance with NR 141. The groundwater monitoring wells will be constructed of schedule 40 PVC. The groundwater monitoring wells will have a 5- or 10-foot length, 0.010-inch machine slotted, PVC well screen.

The annular space seal, filter pack, filter pack seal, ground surface seal and protective cover materials will meet the NR 141 specifications. The annular space between the borehole and the well screen will be backfilled with clean washed sand filter pack to a depth of ½ -foot above the top of the well screen. Placement of the filter pack will be followed by the installation of approximately ½ -foot of fine filter sand. A 1-foot bentonite pellet seal will be placed directly above the sand pack.

A protective casing will be placed over the PVC pipe. The well casing and the protective cover will have a"stickup" of approximately two to three feet above the ground surface.

Each well will be developed to remove sediment produced by construction and to clear out screen slots. The wells will be developed in accordance with NR 141. The wells will be developed utilizing a bailer or pump. For wells that cannot be purged dry, the wells will first be surged and purged. Following well surging and purging, the well will be pumped or bailed until a minimum of ten well volumes is removed or until the well produces sediment free water. For wells that can

be purged dry, development will consist of slowly purging the well dry. To measure the well volume, the depth to the static water level and to the bottom of the well will be measured from the survey reference point (the highest point on the well casing). The water level indicator will be decontaminated between measurements. By using the depth to water, well depth and well radius, the volume of standing water in the well (well volume) will be calculated using the following equation:

$$V = 3.14\ r^2 \times h \times 7.48$$

V= well volume (gallons)
r= well radius (feet)
h= water height (feet)

2.3.4 Decontamination

The down-hole drilling equipment will be decontaminated prior to mobilization and between boring locations using a high pressure steam cleaner. The split spoon soil sampler and development equipment will be decontaminated between each use. Decontamination will consist of a tap water and detergent (Alconox®) wash, tap water rinse and a distilled water rinse. Decontamination water will not be contained.

2.3.5 Quality Control

Groundwater monitoring well installation documentation will undergo a QC review after the completion of field activities. Original field forms and photo documentation will be stored in a secure area until completion of the field program. Upon completion of the field program, documentation will be relinquished to the Project Manager.

2.3.6 Documentation

The drilling and groundwater monitoring well construction and development will be documented in the field by a contractor field scientist using the following field forms:

- Field Notes Form (Appendix A1-1)
- Calibration records for the water quality probe
- Soil Boring Log (WDNR Form 4400-122) (Appendix A1-1)
- Monitoring Well Construction Form (WDNR Form 4400-113A) (Appendix A1-1)
- Monitoring Well Development Form (WDNR Form 4400-113B) (Appendix A1-1)

2.4 Groundwater Sampling

2.4.1 Scope

Each monitoring well will be sampled and analyzed for parameters documented in Section 4.3 of *Site Investigation Work Plan*. Sample collection and analyses will be consistent with procedures identified in the Wisconsin Administrative Code NR 700 series of regulations.

2.4.2 Equipment

Equipment used for groundwater sampling include:

- Disposable or dedicated Teflon or polyethylene bailer
- Electric water level indicator
- Downhole water quality probe, which measures pH, temperature, dissolved oxygen, conductivity and redox potential (Eh)
- Prefiltration jugs
- Peristaltic pump and tubing
- 0.4-um filters
- Field log book and field forms/logs
- Tap water, distilled water, Alconox®
- 5-gallon pails
- Sample containers and preservatives
- Chain of custody
- Sample labels
- Indelible marking pen
- Coolers and ice
- Nylon rope

2.4.3 Procedures

To prevent potential contamination during transportation to the site, sampling equipment will be stored in clean plastic containers or wrapped with aluminum foil. A new sheet of clean plastic sheeting will be used at each sampling location to provide a clean surface on which to place sampling equipment during sample collection activities.

Prior to sampling, each well will be purged of at least three well volumes. Following the well purging process, groundwater samples will be collected with a dedicated or disposable bailer. The time between the completion of purging and sample collection will not exceed 24 hours unless the rate of recovery in the well requires more time for groundwater to collect in the well. All samples requiring preservation will be preserved in the field. Measurements of pH, temperature, conductivity and redox potential will be made at least three times during purging of the well, and at the time that the sample is collected. Barometric pressure, wind speed and direction will be recorded in the field notes. Samples will be placed into prefiltration jugs, and filtered using the peristaltic pump.

2.4.4 Decontamination

The bailer will be decontaminated between wells. Decontamination of the bailer will include an Alconox® and tap water wash, a tap water rinse and distilled water rinse. The decontamination procedure for the downhole water quality probe will not include the soap and water solution, but it will merely be rinsed with tap water, then with distilled water. Peristaltic pump tubing will be decontaminated by running approximately 1 gallon of distilled water through the tubing between samples.

2.4.5 Quality Control

To evaluate the effectiveness of the decontamination process, a field rinsate blank will be collected during the sampling process. The bailer will be cleaned and filled with distilled water and subsequently transferred to a new filtration jug, passed through the peristaltic pump and a filter, into laboratory supplied sample containers. The field blank will be

maintained with the other groundwater samples. Field blanks will be collected at a rate of one rinsate blank per day of groundwater sampling.

In addition to the field rinsate blanks, duplicate groundwater samples will be collected at a rate of one duplicate sample per twenty groundwater samples. The duplicate sample will be submitted for analysis to evaluate the precision of the laboratory analysis.

2.4.6 Documentation

Data collected and field observations made during groundwater sampling will be recorded on the following field documentation forms:

- Field Notes Form (Appendix A1-1)
- Groundwater Monitoring Form (Appendix A1-1)

2.5 Hydraulic Characterization

2.5.1 Scope

Following the installation and development of the monitoring wells, water levels and in-field hydraulic conductivity testing will be performed to determine aquifer hydraulic characteristics. Water levels will be measured in all of the monitoring wells and hydraulic conductivity tests (slug tests or bail down tests) will be performed in select groundwater monitoring wells. The wells to be tested for hydraulic conductivity include:

MW01-01	MW01-02	~~MW01-01~~ 12
MW01-04	MW01-07	MW01-08
MW01-09	MW01-10	MW01-14

These wells were selected to give hydraulic conductivity data on each of the shallow wells, and two each (upgradient and downgradient) for the mid-depth and deepest wells.

2.5.2 Equipment

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9-12 D up

- Solid PVC slug
- Nylon rope
- Stop watch (or watch with a second hand)
- Electric water level indicator
- Water level data logger with pressure transducer
- Field forms/logs
- Tap water, distilled water, Alconox®
- 5-gallon pails and plastic sheeting

2.5.3 Procedures

The depth to groundwater in the wells will be measured with a hand-held electric water level indicator.

Slug testing will involve lowering the pressure transducer into the well to a depth that will allow the solid PVC slug to be lowered into the well without coming into contact with the transducer. The maximum transducer depth will be limited by the settings of the data logger and will be addressed according to the manufacturers operation manual when setting up the test. The rising water level produced by lowering the slug into the well, as well as the falling water level when the slug is removed and the corresponding time, will be digitally recorded by a data logger device. Readings will be recorded until the water level has recovered to approximately 90 percent of the static water level or stabilized.

Bail-down testing will involve purging the well dry with a bailer, measuring the rising water level with a pressure transducer or a water level indicator and recording the time and water level depth during the return of the water level to the static position for at least 2.5 hours.

Reduction of the test data and calculation of the hydraulic conductivity will be performed by the Bower and Rice (1976, 1989) method using the AQTESOLV™ software.

2.5.4 Decontamination

The testing and water level measurement equipment, with the exception of the pressure transducer, will be decontaminated prior to use and at each well location by an Alconox® and tap water wash, a tap water rinse and distilled water rinse. A distilled water rinse only (no soap or tap water) will be used to decontaminate the pressure transducer.

2.5.5 Quality Control

Field documentation will undergo a QC review during the field activities. Original field forms will be reviewed for completeness and accuracy. Original field documentation, computer disks, and data plots will be stored in a secure area until completion of the field program. Upon completion of the field program, documentation will be relinquished to the Project Manager.

2.5.6 Documentation

Data collected and field observations made while performing in-field hydraulic conductivity tests and water level measurements will be recorded on the following field documentation forms:

- Field Notes Form (Appendix A1-1)
- Groundwater Level Data Sheet (Appendix A1-1)
- Slug Test Field Form (Appendix A1-1)

2.6 Survey

2.6.1 Scope

The scope of the survey is detailed in Section 3.4 of the *Site Investigation Work Plan*.

2.6.2 Procedures

The survey will be performed by a Registered Land Surveyor certified in the State of Wisconsin. Horizontal control will be referenced to the NAD 83 system at 0.01-foot accuracy and vertical control to the NAVD88/IGLD1985

referenced to mean sea level at 0.01-foot accuracy.

2.6.3 Quality Control

Survey field documentation will undergo a QC review after the completion of field activities. Original field forms will be stored in a secure area until completion of the field program. Upon completion of the field program, documentation will be relinquished to the Project Manager.

2.6.4 Documentation

The survey will be documented in Autocad electronic format and also in digital flat file format with (x, y, z) coordinates associated with sample point IDs.

4.0 REFERENCES

American Public Health Association (2001), *Standard Methods for the Examination of Water and Wastewater*, 21st Edition.

American Society of Testing and Materials, *Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants*, Designation D421-85.

American Society of Testing and Materials, *Standard Method for Penetration Test and Split-Barrel Sampling of Soil*, Designation D1586-84.

American Society of Testing and Materials, *Test Method for Particle-Size Analysis of Soils*, Designation D-432-63 (Revised 1990).

Wisconsin Department of Natural Resources, *Leaking Underground Storage Tank and Petroleum Analytical and Quality Assurance Guidance*, PUBL-SW-130-93, July 1993.

Wisconsin Department of Natural Resources, Wisconsin Administrative Code, Environmental Protection, *Groundwater Monitoring Well Requirements*, Chapter NR 141.

Wisconsin Department of Natural Resources, Wisconsin Administrative Code, Environmental Protection, *Groundwater Quality*, Chapter NR 140.

Wisconsin Department of Natural Resources, Wisconsin Administrative Code, Environmental Protection, *Investigation and Remediation of Environmental Contamination*, Chapters NR 700 Series.

DATA MANAGEMENT PLAN

CARROLL D. BESADNY FISH AND WILDLIFE AREA
KEWAUNEE MARSH ARSENIC AREA
KEWAUNEE, WISCONSIN

1.0 INTRODUCTION

This *Data Management Plan* was prepared to identify the procedures that will be implemented during the site investigation at the Carroll D. Besadny Fish and Wildlife Area Kewaunee Marsh site to ensure that data collected is recorded, reduced, validated and reported in an appropriate and consistent manner.

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2.0 DATA RECORD KEEPING

2.1 Field Notes Form

The site investigation field activities will be documented on field notes forms. The field notes will provide sufficient data and observations, in as much detail as necessary, to reconstruct events that occurred during the site investigation. Information recorded on the field forms will include site conditions, the sequence and duration of events, field sampling information and field measurements. The field forms will be stored in a secured location when not in use. Each field form will include the name of the field personnel it is assigned to, project name, project start date and project end date. Each field notes form will include the date, start time, weather, names of field personnel and the names of site visitors. All measurements made and samples collected will be recorded in ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed by the person making the entry. All equipment used to make the measurements will be identified.

2.2 Field Forms

Site investigation data will be recorded on the following field forms included in Appendix A1-1 of the *Sampling and Analysis Plan.*

- Soil Boring Log
- Borehole Abandonment Form
- Monitoring Well Construction Form
- Monitoring Well Development Form
- Groundwater Monitoring Well Information Form
- Groundwater Monitoring Form
- Groundwater Level Data Sheet
- Slug Test Form

2.3 Field Audits

Internal audits of field activities will be conducted. The audits will include an evaluation of data record keeping.

2.4 Project File

The original laboratory reports will be assembled by the Project Manager. The laboratory files, along with other relevant records, reports, field notes, photographs, subcontractor reports and data reviews will be maintained in a secured, limited-access area under the custody of the Project Manager.

3.0 FIELD SAMPLE IDENTIFICATION AND LABELING

Each site investigation sample will be identified with a field sample identification number consisting of a sample location, year sampled, and depth interval. Since there have been several environmental sampling events at this site in the past, the year (01 or 02) sampled is included to avoid confusion when sampling results are analyzed as a whole body of data.

3.1 Sample Location Number and Depth Interval

Numerical designation used to identify location and depth interval that the sample was collected. The sample location numbers and designations indicate the type of sample collected. Sample location numbers will include the year of the sampling event, to prevent confusion among the various sampling events that have occurred at this site. Sample designations for this site investigation include:

- SW Surface Water Sample
- MW Monitoring Well (Groundwater)Sample
- SS Surface Sediment Sample
- SB Shallow Soil (5 Feet of Depth) Boring Sample
- IB Intermediate Soil (10 Feet of Depth) Boring Sample
- DB Deep Soil (15 to 30 Feet of Depth) Boring Sample

3.2 Example

The following is an example of a site-specific field sample identification number: IB01-3/ 5.5-7.5 The interpretation of this sample number is as follows: Intermediate Soil boring, collected in 2001, location IB01-3, sample interval 5.5 feet to 7 feet beneath ground surface.

3.3 Sample Label

Each sample will be labeled. The sample label will include the following information:

- Site Name
- Name of Sample
- Date and Time of Collection
- Field Sample Identification Number
- Analysis Required
- Preservation

4.0 DATA REDUCTION AND REPORTING

Field data will be transcribed onto tables for review and validation. Once validated, the data will be compiled and reported in summary tables. Units will also be provided on all summary tables.

Laboratory deliverables will include sample results and quality assurance (QA)/quality control (QC) summaries of blanks, field duplicates, spikes, surrogates and laboratory control samples. Deliverables will also provide the date of sample receipt, extraction date and analysis date. The analytical data will be summarized in a format organized to facilitate data review and evaluation. The data summaries will include any data qualifiers provided by the laboratory. The laboratory data qualifiers may include items such as no detects, concentrations detected below the limit of quantitation and estimated concentrations due to QA/QC results.