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Hazardous Waste
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Phase II RFI Workplan
Alcoa - Badin Works
Badin, North Carolina

ALCOA

Prepared For:

Alcoa Inc.
Badin Works
Badin, North Carolina
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RFI OVERVIEW

The RFI investigated 14 Solid Waste Management Units (SWMUs) and two Areas of Concern (AOCs). RFI soil, groundwater, surface water, and sediment data were collected and screened against background concentrations and highly conservative risk screening values. These screening values include:

Soils

- Region III residential and industrial Risk-Based Concentrations (RBCs) for soil.
- Soil Screening Levels (SSLs) to evaluate the potential for leaching from soil to groundwater. The SSLs were default values published by USEPA and default values calculated based on North Carolina's equation in the December 1996 document "Draft North Carolina Risk Analysis Framework".

Groundwater

- North Carolina Standards, as promulgated in 15A NCAC 2L
- Federal Maximum Contaminant Levels (MCLs)

Surface Water

- North Carolina Standards, as promulgated in 15A NCAC 2B
- Federal Ambient Water Quality Criteria

Sediments

- Region III residential and industrial RBCs for soil

Constituents detected at concentrations exceeding the conservative screening values were identified as Constituents of Interest (COIs) and retained for further evaluation (e.g. further risk assessment, further investigation, or interim measures). Based on further evaluation of the COIs, data gaps were identified for four SWMUs:

- SWMU No. 3 Old Brick Landfill
- SWMU No. 35: Old Waste Oil Storage Area
- SWMU No. 44: Pine Tree Grove Area
- SWMU No. 46: West SPL Area

In addition to the four preceding SWMUs, data gaps were also identified for groundwater beneath the north end of the plant (North End). Groundwater beneath the North End is being evaluated during the RFI using the "SWMU-Area Concept" and not on an individual SWMU basis. The SWMU-Area Concept is being used because SWMUs in the North End are all located within the same contiguous infilled valley, have similar groundwater COIs (e.g cyanide and fluoride), and the COIs are not traceable to any individual SWMU.

With respect to total cyanide, the primary COI at the site, Alcoa has taken a conservative approach in the risk screening process by screening both total and free cyanide analytical results against values that are based on the toxicity of free cyanide. The Region III RBC table explicitly states that the industrial and residential RBCs for soils are based on free cyanide (not total cyanide). Total cyanide analysis includes complexed forms of cyanide (e.g. iron cyanide), which are considered less bioavailable and therefore less toxic than free cyanide. Furthermore, the federal MCL for cyanide (see 40 CFR 141.62) specifically states "cyanide (as free cyanide)." Finally, back calculation of the NC 2L Standard for cyanide indicates that it is based on a free cyanide RfD. For conservatism, the screening tables presented within this Work Plan shows the results of screening both total and free cyanide concentrations against values that are based on free cyanide. However, the decision to further investigate is largely driven by the comparison of risk screening values to the free cyanide concentrations in site media.

SWMU NO. 3 OLD BRICK LANDFILL

Description

The Old Brick Landfill is 0.75 miles northeast of the main plant site. It was used from 1915 through 1960 for disposal of Spent Pot Lining (SPL) and furnace brick originating from aluminum smelting operations. This unit was subjected to voluntary work by Alcoa in 1987 (covered with 12-inches of compacted clay and upslope ditch to divert storm water) and 1996/1997 (improvements to diversion channel to divert surface water run-on and cover repairs). The surface of the landfill is steep and slopes toward Badin Lake.

RFI Findings

Groundwater samples were collected from monitoring wells OBL-MW-1 through OBL-MW-5 during the 1999/2000 RFI activities. The samples were analyzed for a broad list of analytes including inorganics, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs). Table 1 in Attachment A provides a list of constituents detected in the samples from the Old Brick Landfill monitoring wells and identifies those found at concentrations exceeding the conservative risk-based screening values. As indicated on the table, total and free (weak acid dissociable and microdiffusion) cyanide were detected at concentrations exceeding the NC 2L Standard and USEPA MCL.

Figure 1 in Attachment B shows the cyanide analytical results and identifies the wells where cyanide concentrations are greater than the screening values. Total cyanide concentrations exceed the screening values in OBL-MW-2, OBL-MW-3, and OBL-MW-4. Free cyanide exceeds the screening values in OBL-MW-2.

Groundwater beneath the Landfill discharges to Badin Lake. Neither total nor free cyanide were detected in surface water samples collected in 1996 by Woodward-Clyde Consultants at the Old Brick Landfill shoreline.

Proposed Phase II Scope of Work

The objective of the Phase II activities at SWMU No. 3 is to delineate free cyanide to the southeast of OBL-MW-2. Total cyanide exceeds the screening values in three monitoring wells. However, as discussed previously, the basis for the NC 2L Standard and Federal MCL for cyanide is free cyanide. The only well where the concentration of free cyanide exceeds the groundwater screening value is at OBL-MW-2. Therefore, the Phase II RFI scope of work at this SWMU focuses on delineating the free cyanide extent detected at OBL-MW-2.

One groundwater monitoring well will be installed to the southeast of OBL-MW-2. The approximate location of the monitoring well is illustrated on Figure 1. The monitoring well location will be adjusted in the field as necessary given the steep terrain to permit access to a safe, suitable drilling site. The monitoring well will be installed to an estimated depth of 85 feet below ground surface (ft-bgs) into bedrock. The anticipated screened interval is approximately 525 to 535 ft-msl, which corresponds to the screened interval for OBL-MW-2. Upon reaching the top of bedrock, rock coring will be performed in the boring to assess for fractures that may be influencing groundwater flow direction.

The monitoring well will consist of 2-inch PVC well screen and riser. It will be completed at surface with a steel protective casing and concrete pad. The well will developed and sampled for free (microdiffusion and weak acid dissociable) cyanide.

SWMU NO. 35: OLD WASTE OIL STORAGE AREA

Description

Alcoa used the area from the 1920's to the early 1970's to store containers of waste motor oils, lubricating oils, and transformer oils. The area is triangular in shape and measures approximately 110 feet by 50 feet (largest dimensions).

RFI Findings

Soil samples were collected from the three test pits and three test borings shown on Figure 2. The test pit samples (collected in 1996) were analyzed for total and free (amenable) cyanide and fluoride. The test boring samples (collected in 1999/2000) were analyzed for VOCs, SVOCs, total cyanide, free (weak acid dissociable) cyanide, total fluoride, metals (arsenic, barium, cadmium, chromium, lead, and selenium), and PCBs. Table 2 provides a list of constituents detected in soil and provides a comparison with the conservative risk-based screening values. As indicated on the table, inorganic and organic constituents were detected at concentrations exceeding the conservative risk-based screening values, with PCBs aroclor 1248 exceeding both industrial and residential values.

As indicated on Figure 2 the highest concentration of the PCBs is detected at boring S35-TB-01 in a surface soil sample. Other organic and inorganic constituents exceeding the screening values are generally co-located with the PCBs detections.

PCBs and PAHs were not detected in a monitoring well (MW-27) downgradient of this SWMU.

Proposed Phase II Scope of Work

Although a site-specific risk assessment is likely to show acceptable risks, Alcoa is proposing further investigation of SWMU No. 35. The objective of the investigation is to further delineate the PCBs detected in surface and subsurface soil during the initial phase of the RFI.

Field screening of soil samples will be conducted to delineate the horizontal and vertical extent of PCBs in the surface and subsurface at SWMU No. 35. The field screening kit will be customized to report the combined concentration of aroclor 1248 and 1260, the only two PCBs detected at the SWMU. The PCBs field screening results will be confirmed with 10 percent fixed laboratory analysis. In addition to PCBs, the confirmatory samples will be analyzed for PAHs, total cyanide, weak acid dissociable cyanide, and fluoride.

Initially, soil borings will be advanced at the five locations illustrated on Figure 2 using a Hollow Stem Auger Drilling rig. Soil samples will be collected at surface (0-2 ft-bgs), 2-4 ft-bgs, and 4-6 ft-bgs, and 6-8 ft-bgs ahead of the lead auger using a split-spoon sampler. Sampling will be terminated upon reaching the water table (expected at 8 ft-bgs). Upon retrieval, the split-spoon samples will be screened for PCBs (aroclor 1248 and 1260) using a Strategic Diagnostics Inc. (SDI) EnSys RisC immunoassay kit or equivalent method. The detection limit for the immunoassay will be 2 parts per million (ppm), which is less than the industrial risk-based concentration of 2.9 ppm. Based on the screening results at the initial five locations, additional test borings may be installed (either inside or outside the initial ring of borings) to further delineate the PCBs. The general horizontal field screening delineation target will be 2 ppm PCBs (aroclor 1248 and 1260). The general vertical delineation target will also be 2 ppm; however, the soil delineation of PCBs will be terminated at the water table.

Following delineation, Alcoa will evaluate the data to assess whether interim measures are warranted at SWMU No. 35. In addition to the PCBs, this approach is expected to address other constituents (e.g. PAHs), present in soil within the footprint of the PCBs.

SWMU NO. 44: PINE TREE GROVE AREA

Description

The Pine Tree Grove Area (PTGA) is located near the North End of the Badin facility adjacent to Badin Lake. The North End is characterized by a natural east-west trending valley that was progressively filled over the period between 1916 and 1968. The PTGA is a former prong of Badin Lake, which was filled beginning between 1938 and 1951. Filling was completed between 1959 and 1961. A comparison of 1916 and 1989 topographic maps has allowed delineation of the former valley and estimation of fill thickness. The filling resulted in raising the topographic elevation of the valley by approximately 15 feet in the PTGA.

RFI Findings

Pre-RFI Geophysical work in 1996 identified electromagnetic anomalies indicative of SPL at SWMU No. 44. Geraghty & Miller collected seven soil samples from SWMU No. 44 in 1996 at the locations and depths shown on Figure 3. Samples were analyzed for total cyanide, free (amenable) cyanide, and fluoride and confirmed the presence of SPL. As shown on the figure, all samples were collected at depths of 5 feet or deeper. Table 3 lists all constituents detected in the soil samples. As indicated on the table, fluoride is the only constituent detected at concentrations exceeding the conservative risk-based screening values.

Proposed Phase II Scope of Work

The data gap at this SWMU is the lack of surface soil analytical data. The objective of RFI Phase II is to fill the surface soil analytical data gap. Five surface soil samples will be collected from SWMU No. 44 at the locations illustrated on Figure 3. The surface soil samples will be laboratory analyzed for total cyanide, free (weak acid dissociable) cyanide, fluoride, VOCs, SVOCs, and metals (arsenic, barium, cadmium, chromium, lead, and selenium). These data will be subjected to the risk-based screening process to assess whether there are any COIs in surface soils at this SWMU.

SWMU NO. 46: WEST SPL AREA

Description

Alcoa identified this area as a potentially receiving SPL through a review of historical photos. The photos indicated piles of fill material staged in the area between 1964 and 1977. Although not included in the RFI Work Plan, Alcoa decided to subject this area to RFI activities to assess the potential for SPL and determine whether it warranted SWMU status.

RFI Scope of Work and Findings

Thirteen test pits were advanced at the locations illustrated on Figure 4 to visually inspect for SPL. Six subsurface soil samples were collected and submitted for laboratory analysis of VOCs, SVOCs, metals (arsenic, barium, cadmium, chromium, lead, and selenium), total cyanide, weak acid dissociable cyanide, and fluoride. Subsurface soil samples collected within the SWMU boundary were comprised of suspected SPL. Table 2 shows the constituents detected at concentrations exceeding the conservative risk-based screening values. As indicated on the table, total cyanide and five PAHs exceed the conservative risk-based screening values. The total cyanide and PAH concentrations are provided on Figure 4. Based on the visual observations and analytical confirmation, it was concluded that this area was used in the past for SPL disposal. A new SWMU notification was submitted to NCDENR on November 22, 1999.

Proposed Phase II Scope of Work

There are four data gaps to be filled at SWMU No. 46. These are:

- The location of the west, northwest, and southwest SWMU boundary
- Surface soil analytical data
- Groundwater analytical data downgradient of the SWMU
- Groundwater flow direction in the vicinity of the SWMU

Three additional test pits will be installed at the locations illustrated on Figure 4 to further delineate the SWMU's west, northwest, and southwest boundary. One soil sample will be collected from each test pit at a location outside the SWMU boundary to confirm the SWMU limits as determined by visual inspection for SPL. The sample will be collected from the end-wall of the test pit at the approximate depth of observed SPL, but outside the SWMU boundary. Three surface soil samples will be collected from the SWMU surface to provide data needed to evaluate the direct contact pathways. The surface and test pit soil samples will be analyzed for the parameters detected in subsurface soil at concentrations greater than the screening values (total cyanide and PAHs). In addition, the samples will be analyzed for free (weak acid dissociable) cyanide and fluoride, which are potential SPL COIs.

Two groundwater monitoring wells will be installed at the locations illustrated on Figure 4. One well will be installed upgradient and one downgradient of the SWMU. The wells will be constructed of 2-inch PVC well screen and casing and will be completed at the surface with a steel protective casing and concrete pad. The well screen will be set to straddle the water table. The wells will be developed and sampled for total cyanide, free (weak acid dissociable and microdiffusion) cyanide, fluoride, and PAHs. The parameter list is based on the detection of these constituents in subsurface soil at the SWMU. Groundwater elevations will be measured in the newly installed monitoring wells and existing monitoring wells MW-1 and MW-7 to assess flow direction in the vicinity of the SWMU.

NORTH END OF PLANT GROUNDWATER

Description

As discussed in the approved RFI Work Plan, groundwater beneath the North End is being addressed using the "SWMU-Area" concept. North End groundwater is presented using the SWMU-Area concept because of similar COIs, the co-mingling of plumes in the contiguous infilled valley, which makes the COIs not traceable to any individual SWMU.

RFI Scope of Work and Findings

Groundwater samples were collected from 27 monitoring wells in the North End of the plant. The samples were analyzed for a broad list of analytes that included inorganic compounds, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs). In accordance with the RFI Work Plan, the "most contaminated well" in the north end of the plant (MW-6) was analyzed for Appendix IX parameters. Table 5 provides a list of constituents detected in the samples from North End monitoring wells and identifies those found at concentrations exceeding the conservative risk-based screening values. As indicated on the

screening table, metals (antimony, arsenic, and thallium), cyanide (total and free), fluoride, and trichloroethene were detected at concentrations exceeding the conservative screening values.

The most prevalent constituents are total and free cyanide and fluoride (Figures 5 through 7). As indicated on these figures, the constituent plume has two lobes, one oriented east-west (parallel to a line formed by MW-6, MW-27, and MW-25) and one oriented northeast-southwest (parallel to the line formed by MW-4, MW-9, and MW-16). The east-west lobe corresponds with the infilled valley. The northeast-southwest lobe corresponds to the regional and local dominant saprolite/bedrock fracture orientation. Trichloroethene is found at concentrations exceeding the NC 2L Standard in wells MW-4, MW-9, and MW-16, which are screened in saprolite/weathered bedrock (Figure 8). As part of the expanded appendix IX sampling, antimony and thallium were analyzed for in MW-6. These metals were detected in the sample from MW-6 at concentrations exceeding the federal MCL.

Groundwater flows toward and discharges to Badin Lake. Surface water samples collected in Badin Lake by Woodward-Clyde (1996) show cyanide, fluoride, and arsenic as either not detected or detected at concentrations less than the conservative screening values. As a result, there is no need for further sampling of these COIs.

Proposed Phase II Scope of Work

Data gaps for north end groundwater are centered around (1) the detection of trichloroethene at concentrations exceeding the NC 2L Standards and (2) the detection of antimony and thallium in MW-6 at concentrations greater than the federal MCL.

Trichloroethene is present in North End monitoring well MW-16 at a concentration greater than the NC 2L Standard. There are no receptors to the groundwater beneath the North End. The Badin Works does not use groundwater for any purpose and potential residential groundwater well users are upgradient of the plant. The only potential complete exposure pathway with facility groundwater is after it enters and mixes with Badin Lake surface water. As a result, the objective of the Phase II scope of work related to trichloroethene is to obtain surface water analytical data needed to evaluate the effect of groundwater discharge on Badin Lake water quality.

One surface water sample will be collected at the location illustrated on Figure 8 and will be laboratory analyzed for TCE. The basis for the sample location is (1) the occurrence of TCE in MW-4, MW-9, and MW-16 and (2) the major fracture orientation mapped during the RFI (northeast).

Antimony and thallium were analyzed during the initial RFI phase in only MW-6. As a result, there is no down-gradient data to evaluate whether concentrations in groundwater diminish to less than the federal MCLs prior to reaching Badin Lake. In addition, there are no background concentrations for these parameters.

The Phase II investigation of the antimony and thallium detections will consist of collecting groundwater samples from four monitoring wells. The monitoring wells will include MW-6

(resampling of the "most contaminated well"), MW-7 (background well), MW-16 (perimeter well), and MW-25 (perimeter well). The groundwater samples will be analyzed for total and dissolved antimony, total and dissolved thallium, and total suspended solids.

Table 1
Groundwater Sceening Table
SWMU No. 3
Alcoa Badin, NC Works RFI

Constituent	Number Detected	Number Analyzed	Units	Minimum Detection	Maximum Detection	North Carolina Standard	USEPA MCL	NC Standard	USEPA MCL
Metals									
Arsenic, Total	1	6	mg/l[a]	0.013	0.013	0.05	0.05		
Arsenic, Dissolved	1	6	mg/l	0.011	0.011	0.05	0.05		
Barium, Dissolved	3	6	mg/l	0.27	0.4	2	2		
Chromium, Total	1	6	mg/l	0.019	0.019	0.05	NA		
Chromium, Dissolved	1	6	mg/l	0.019	0.019	0.05	NA		
Other Parameters									
Cyanide, Microdiffusion	7	11	mg/l	0.0054	0.573	0.154	0.2	✓	✓
Cyanide, Total	7	11	mg/l	0.16	1.1	0.154	0.2	✓	✓
Cyanide, Weak Acid Dissociable	6	11	mg/l	0.03	0.58	0.154	0.2	✓	✓
Flouride	1	6	mg/l	0.93	0.93	2	4		
SVOCs [b]									
None Detected									
VOCs [c]									
None Detected									

[a] mg/l = milligrams per liter

[b] SVOCs = Semi-Volatile Organic Compounds

[c] VOCs = Volatile Organic Compounds

✓ = Maximum concentration of constituent exceeds screening value

Table 2
Soil Screening Table
SWMU No 35 (Old Waste Oil Storage Area)
Alcoa Badin, NC Works RFI

Parameter	Units	Number of Detects	Number Analyzed	Minimum Detection	Maximum Detection	USEPA Region III Industrial RBC[a]	USEPA Region III Residential RBC	USEPA SSL[b]DAF[c] = 20	North Carolina SSL DAF = 20	Ind. RBC	Res. RBC	USEPA SSL DAF = 2	NC SSL DAF = 20
Metals													
Arsenic	mg/kg[d]	7	7	7.1	16.2	3.8	0.43	29	29	✓	✓		
Barium	mg/kg	7	7	34.5	216	140000	5500	1600	1648				
Cadmium	mg/kg	3	7	0.31	0.99	2000	78	8	8				
Chromium	mg/kg	7	7	6.8	26.5	6100	230	38	38				
Lead	mg/kg	7	7	20.4	270	400	400		267				✓
Selenium	mg/kg	3	7	0.63	1.4	10000	390	5	5				
Other													
Cyanide (amenable)	mg/kg	2	3	0.6	4.1	41000	1600	40	31				
Cyanide (weak acid dissociable)	mg/kg	4	7	0.83	54.2	41000	1600	40	31			✓	✓
Cyanide (total)	mg/kg	9	10	1.1	331	41000	1600	40	31			✓	✓
Fluoride	mg/kg	10	10	7	7370	120000	4700				✓		
Pesticides/Herbicides													
None Detected													
PCBs[e]													
Aroclor 1248	mg/kg	4	6	0.065	110	2.9	0.32			✓	✓		
Aroclor 1260	mg/kg	1	6	0.086	0.086	2.9	0.32						
SVOCs[f]													
Acenaphthene	mg/kg	1	8	2.9	2.9	120000	4700	570	11.6				
Benzo(a)anthracene	mg/kg	4	8	3.1	7.5	7.8	0.87	2	0.4		✓	✓	✓
Benzo(a)pyrene	mg/kg	6	8	0.49	5.6	0.78	0.087	8	0.1	✓	✓		✓
Benzo(b)fluoranthene	mg/kg	6	8	0.55	8	7.8	0.87	5	1.2	✓	✓	✓	✓
Benzo(g,h,i)perylene	mg/kg	6	8	1	4.4	61000	2300	4200	6720				
Benzo(k)fluoranthene	mg/kg	4	8	3.1	7.5	78	8.7	49	11.6				
bis(2-Ethylhexyl) phthalate	mg/kg	2	7	0.5	6.6	410	46	3600	906				
Chrysene	mg/kg	4	8	4	8.1	780	87	160	39.8				

Table 2
Soil Screening Table
SWMU No 35 (Old Waste Oil Storage Area)
Alcoa Badin, NC Works RFI

Parameter	Units	Number of Detects	Number Analyzed	Minimum Detection	Maximum Detection	USEPA Region III Industrial RBC[a]	USEPA Region III Residential RBC	USEPA SSL[b] DAF[c] = 20	North Carolina SSL DAF = 20	Ind. RBC	Res. RBC	USEPA SSL DAF = 2	NC SSL DAF = 20
Dibenz(a,h)anthracene	mg/kg	1	8	0.99	0.99	0.78	0.087	2	0.357	✓	✓		✓
Fluoranthene	mg/kg	5	8	0.71	11	82000	3100	4300	600				
Indeno(1,2,3-cd)pyrene	mg/kg	6	8	0.52	3.9	7.8	0.87	14	3.26		✓		✓
Phenanthrene	mg/kg	5	8	0.41	7.1	61000	2300	4200	59.6				
Pyrene	mg/kg	5	8	3.5	8.8	61000	2300	4200	442				
VOCs [g]													
Acetonitrile	mg/kg	1	7	0.14	0.14	12264	469.286						
2-Butanone	mg/kg	3	7	0.031	0.058	1200000	47000		0.8				
Acetone	mg/kg	5	7	0.037	0.34 E	200000	7800	16	2.81				
Bromomethane	mg/kg	1	7	0.021	0.021	2900	110	0.2					
Carbon disulfide	mg/kg	3	7	0.019	0.12	200000	7800	32	4.94				
Chloromethane	mg/kg	1	7	0.15	0.15	440	49		0.0125				✓
Toluene	mg/kg	1	8	0.0086	0.0086	410000	16000	12	8.1				
Trichloroethene	mg/kg	2	7	0.014	0.025	520	58	0.06	0.02				✓

Notes:

[a] RBC = Risk-Based Concentration

[b] SSL = Soil Screening Level

[c] DAF = Diluation Attenuation Factor

[d] mg/kg = milligrams per kilogram

[e] PCBs = Polychlorinated Biphenyls

[f] SVOCs = Semi-Volatile Organic Compounds

[g] VOCs = Volatile Organic Compounds

✓ = Maximum concentration of constituent exceeds screening value

All arsenic concentrations are less than background concentrations.

Table 3
Soil Screening Table
SWMU No. 44 (Pine Tree Grove Area)
Alcoa Badin, NC Works RFI

Parameter	Units	Number of Detects	Number Analyzed	Minimum Detection	Maximum Detection	USEPA Region III Industrial RBC[a]	USEPA Region III Residential RBC	USEPA SSL[b]DAF[c] = 20	North Carolina SSL DAF = 20	Ind. RBC	Res. RBC	USEPA SSL DAF = 2	NC SSL DAF = 20
Cyanide (amenable)	mg/kg [d]	2	7	0.19	10.7	41000	1600	40	31				
Cyanide (total)	mg/kg	7	7	0.52	10.9	41000	1600	40	31				
Fluoride	mg/kg	7	7	570	14600	120000	4700				✓		

Notes:

[a] RBC = Risk-Based Concentration

[b] SSL = Soil Screening Level

[c] DAF = Dilution Attenuation Factor

[d] mg/kg = milligrams per kilogram

✓ = Maximum concentration of constituent exceeds screening value

Table 4
Soil Screening Table
SWMU No. 46 (West SPL Area)
Alcoa Badin, NC Works RFI

Parameter	Units	Number of Detects	Number Analyzed	Minimum Detection	Maximum Detection	USEPA Region III Industrial RBC[a]	USEPA Region III Residential RBC	USEPA SSL[b] DAF[c] = 20	North Carolina SSL DAF = 20	Ind. RBC	Res. RBC	USEPA SSL DAF = 20	NC SSL DAF = 20
Metals													
Arsenic	mg/kg [d]	6	6	9.7	19.4	3.8	0.43	29	29	✓	✓		
Barium	mg/kg	6	6	71.3	143	140000	5500	1600	1648				
Cadmium	mg/kg	2	6	0.38	0.49	2000	78	8	8				
Chromium	mg/kg	6	6	17.6	29.7	6100	230	38	38				
Lead	mg/kg	6	6	14.8	85.2	1000	400		267				
Selenium	mg/kg	1	6	0.76	0.76	10000	390	5	5				
Other													
Cyanide (weak acid dissociable)	mg/kg	6	6	2.5	13.9	41000	1600	40	31				
Cyanide (total)	mg/kg	6	6	11.5	76.8	41000	1600	40	31			✓	✓
Fluoride	mg/kg	6	6	562	1770	120000	4700						
Pesticides/Herbicides													
None Detected													
SVOCs [f]													
Benzo(a)anthracene	mg/kg	2	6	0.89	0.9	7.8	0.87	2	0.4		✓		✓
Benzo(a)pyrene	mg/kg	2	6	1	1.6	0.78	0.087	8	0.1	✓	✓		✓
Benzo(b)fluoranthene	mg/kg	2	6	1.2	1.6	7.8	0.87	5	1		✓		✓
Benzo(g,h,i)perylene	mg/kg	2	6	0.75	1.5	61000	2300	4200	6720				
Benzo(k)fluoranthene	mg/kg	2	6	0.86	1.1	78	8.7	49	11.6				
Chrysene	mg/kg	2	6	1.2	1.2	780	87	160	39.8				
Dibenz(a,h)anthracene	mg/kg	1	6	0.5	0.5	0.78	0.087	2	0.357		✓		✓
Fluoranthene	mg/kg	2	6	0.93	1.4	82000	3100	4300	600				
Indeno(1,2,3-cd)pyrene	mg/kg	2	6	0.64	1.1	7.8	0.87	14	3.26		✓		
p-Cresol	mg/kg	1	6	2.6	2.6	10000	390						
Phenanthrene	mg/kg	2	6	0.62	0.85	61000	2300	4200	59.6				
Phenol	mg/kg	1	6	1	1	1200000	47000	100	1.4				
Pyrene	mg/kg	2	6	1	1.3	61000	2300	4200	442				

Table 4
Soil Screening Table
SWMU No. 46 (West SPL Area)
Alcoa Badin, NC Works RFI

Parameter	Units	Number of Detects	Number Analyzed	Minimum Detection	Maximum Detection	USEPA Region III Industrial RBC[a]	USEPA Region III Residential RBC	USEPA SSL[b] DAF[c] = 20	North Carolina SSL DAF = 20	Ind. RBC	Res. RBC	USEPA SSL DAF = 2	NC SSL DAF = 20
VOCs [f]													
Acetonitrile	mg/kg	1	7	0.23 J [g]	0.23 J	12264	469						
2-Butanone	mg/kg	1	6	0.091	0.091	1200000	47000		0.8				
Acetone	mg/kg	7	7	0.052	0.7	200000	7800	16	2.81				
Carbon disulfide	mg/kg	2	6	0.013	0.022	200000	7800	32	4.94				

Notes:

[a] RBC = Risk-Based Concentration
[b] SSL = Soil Screening Level
[c] DAF = Diluation Attenuation Factor
[d] mg/kg = milligrams per kilogram
[e] SVOCs = Semi-Volatile Organic Compounds
[f] VOCs = Volatile Organic Compounds
[g] J = Estimated Value
✓ = Maximum concentration of constituent exceeds screening value
All arsenic concentrations are less than background concentrations.

Table 5
Groundwater Screening Table
North End of Plant
Alcoa Badin, NC Works RFI

Constituent	Number Detected	Number Analyzed	Units	Minimum Detection	Maximum Detection	North Carolina Standard	USEPA MCL	NC Standard	USEPA MCL
Metals									
Antimony, Dissolved	2	2	mg/l [(a)]	0.012	0.012	NA	0.006		✓
Antimony, Total	1	2	mg/l	0.0085	0.0085	NA	0.006		✓
Arsenic, Dissolved	12	28	mg/l	0.0056	0.14	0.05	0.05	✓	✓
Arsenic, Total	8	28	mg/l	0.0088	0.14	0.05	0.05	✓	✓
Barium, Dissolved	28	31	mg/l	0.24	0.79	2	2		
Barium, Total	2	29	mg/l	0.46	0.48	2	2		
Chromium, Dissolved	4	28	mg/l	0.0052	0.011	0.05	NA		
Chromium, Total	2	28	mg/l	0.0054	0.0067	0.05	NA		
Cobalt, Dissolved	2	2	mg/l	0.19	0.2	NA	NA		
Cobalt, Total	2	2	mg/l	0.19	0.2	NA	NA		
Copper, Dissolved	2	2	mg/l	0.19	0.22	1	NA		
Copper, Total	2	2	mg/l	0.21	0.22	1	NA		
Lead, Dissolved	1	28	mg/l	0.0032	0.0032	1.015	NA		
Lead, Total	2	28	mg/l	0.0034	0.0037	0.015	NA		
Mercury, Dissolved	1	2	mg/l	0.00024	0.00024	0.0011	0.002		
Selenium, Total	4	28	mg/l	0.005	0.0091	0.05	0.05		
Selenuim, Dissolved	5	28	mg/l	0.0053	0.008	NA	NA		
Thallium, Dissolved	1	2	mg/l	0.012	0.012	NA	0.002		✓
Vanadium, Dissolved	2	2	mg/l	0.12	0.13	NA	NA		
Vanadium, Total	2	2	mg/l	0.13	0.13	NA	NA		
Other Parameters									
Diesel Range Organics	1	1	mg/l	0.089	0.089	NA	NA		

Table 5
Groundwater Screening Table
North End of Plant
Alcoa Badin, NC Works RFI

Constituent	Number Detected	Number Analyzed	Units	Minimum Detection	Maximum Detection	North Carolina Standard	USEPA MCL	NC Standard	USEPA MCL
Cyanide, Free	29	41	mg/l	0.0053	0.57	0.154	0.2	✓	✓
Cyanide, Total	31	41	mg/l	0.014	52.4	0.154	0.2	✓	✓
Cyanide, Weak Acid Dissociable	28	41	mg/l	0.024	4.5	0.154	0.2	✓	✓
Fluoride	23	28	mg/l	0.1	3700	2	4	✓	✓
SVOCs [b]									
Non Detected									
VOCs [c]									
1,1-Dichloroethene	1	28	mg/l	0.0012	0.0012	0.007	0.007		
Acetone	1	28	mg/l	0.037	0.037	0.7	NA		
Trichloroethene	3	28	mg/l	0.024	0.19	0.0028	0.005	✓	✓

[a] mg/l = milligrams per liter

[b] SVOCs = Semi-Volatile Organic Compounds

[c] VOCs = Volatile Organic Compounds

✓ = Maximum concentration of constituent exceeds screening value

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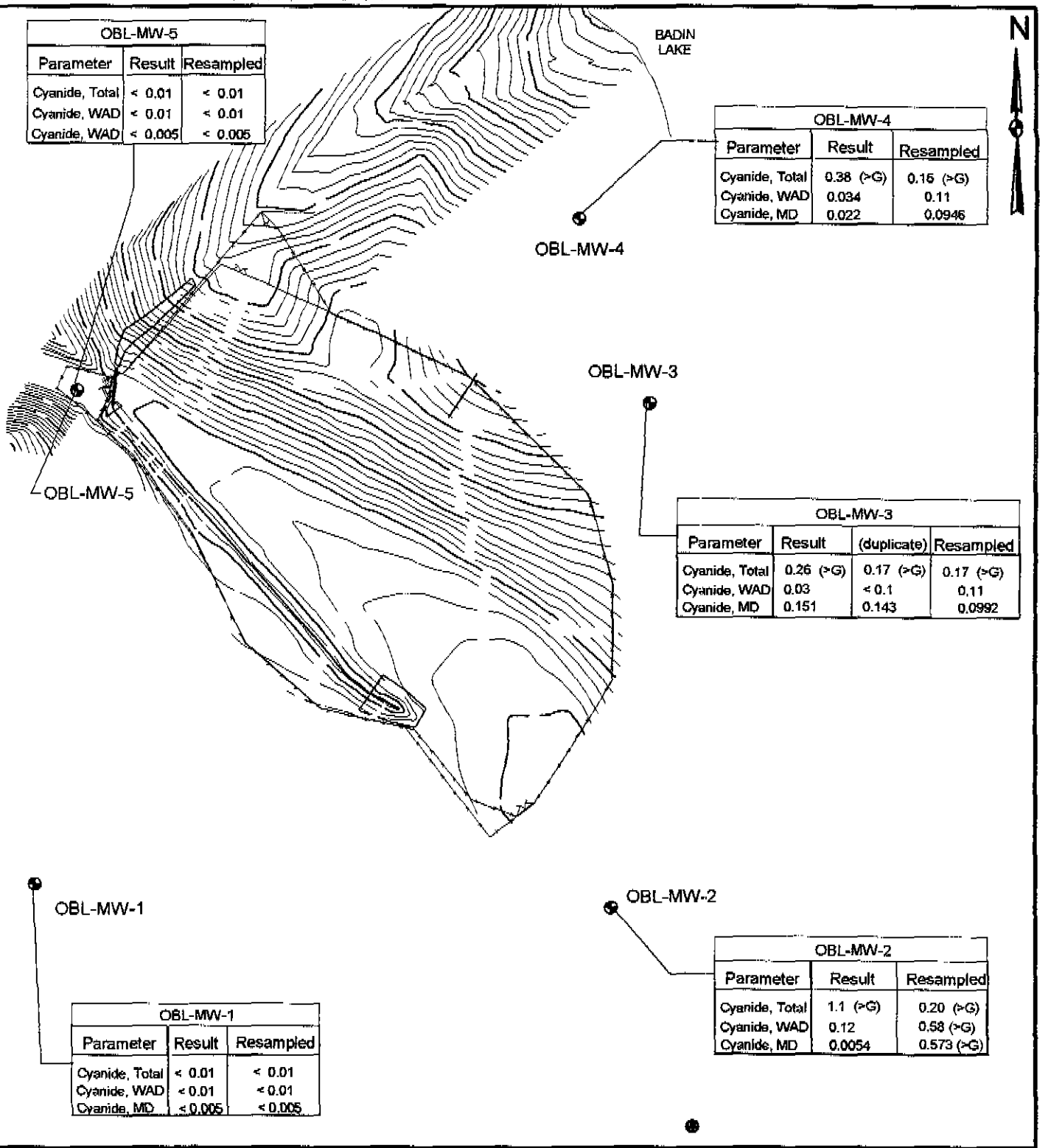


OBL-MW-5		
Parameter	Result	Resampled
Cyanide, Total	< 0.01	< 0.01
Cyanide, WAD	< 0.01	< 0.01
Cyanide, WAD	< 0.005	< 0.005

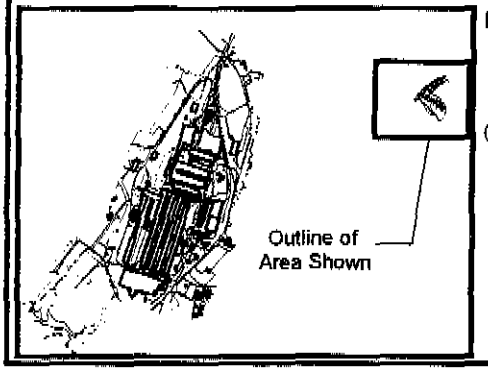
OBL-MW-4		
Parameter	Result	Resampled
Cyanide, Total	0.38 (>G)	0.16 (>G)
Cyanide, WAD	0.034	0.11
Cyanide, MD	0.022	0.0946

OBL-MW-3			
Parameter	Result	(duplicate)	Resampled
Cyanide, Total	0.26 (>G)	0.17 (>G)	0.17 (>G)
Cyanide, WAD	0.03	< 0.1	0.11
Cyanide, MD	0.151	0.143	0.0992

OBL-MW-2		
Parameter	Result	Resampled
Cyanide, Total	1.1 (>G)	0.20 (>G)
Cyanide, WAD	0.12	0.58 (>G)
Cyanide, MD	0.0054	0.573 (>G)

OBL-MW-1		
Parameter	Result	Resampled
Cyanide, Total	< 0.01	< 0.01
Cyanide, WAD	< 0.01	< 0.01
Cyanide, MD	< 0.005	< 0.005

120 0 120 Feet



LEGEND:

- Proposed Monitoring Well Location
- Monitoring Well Location
- (>G) Result exceeds North Carolina Groundwater standard

Notes:

1. All analytical results are in mg/l.
2. Resampling event occurred on January 8, 2000
3. "WAD"=Weak Acid Dissociable "MD"=Microdiffusion

SWMU No. 3: Old Brick Landfill Monitoring Well Locations

Alcoa-Badin Works
Badin, North Carolina

PROJECT: 120006	BY: M.W.	Figure 1
DATE: 4/5/00	CHECKED: MEP	

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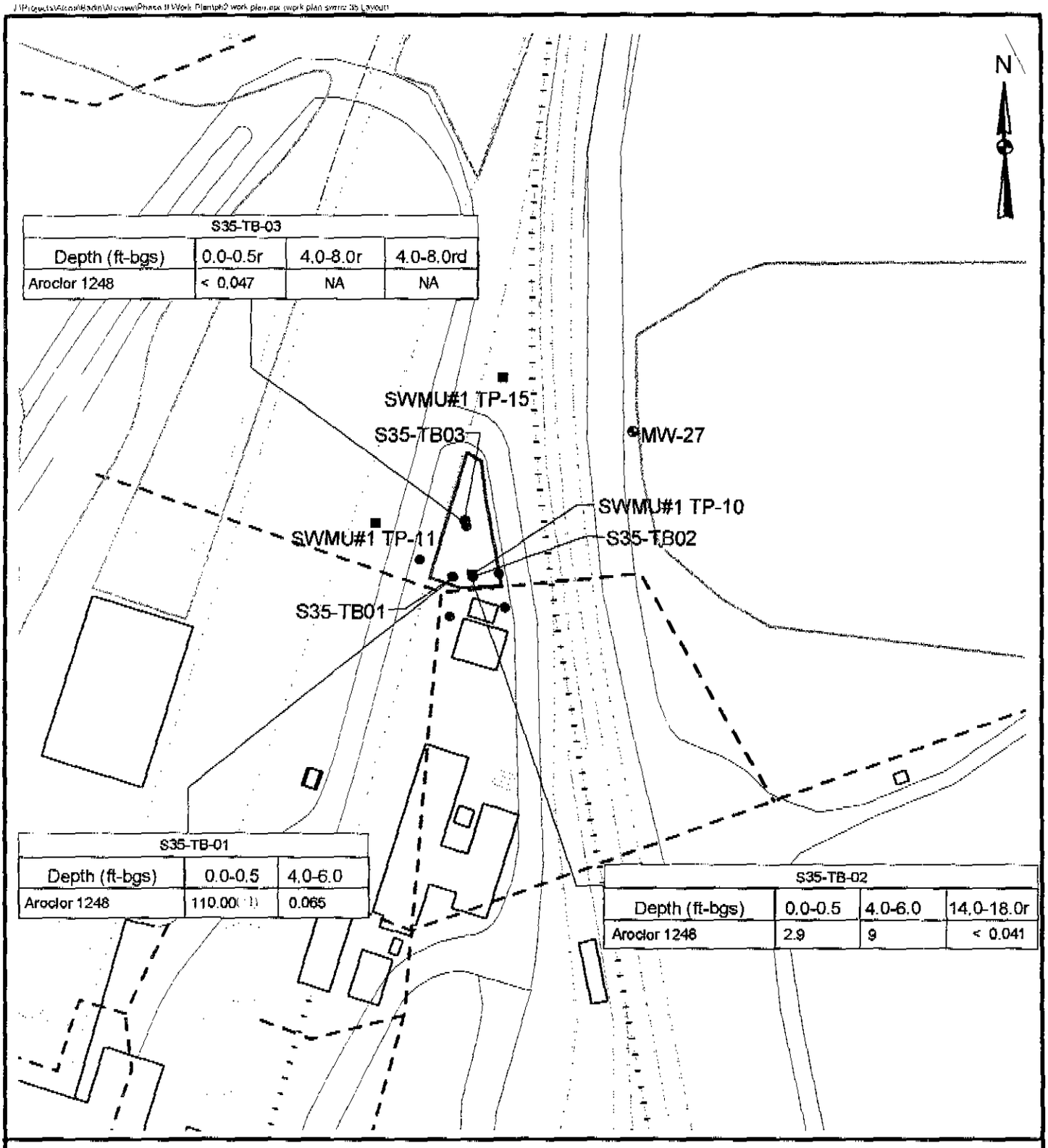
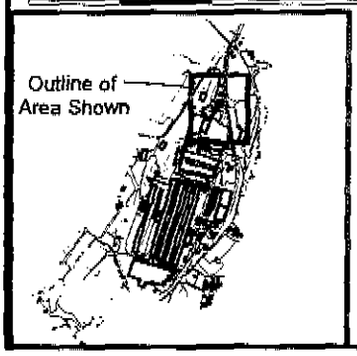


S35-TB-03			
Depth (ft-bgs)	0.0-0.5r	4.0-8.0r	4.0-8.0rd
Aroclor 1248	< 0.047	NA	NA

S35-TB-01		
Depth (ft-bgs)	0.0-0.5	4.0-6.0
Aroclor 1248	110.00 (1)	0.065

S35-TB-02			
Depth (ft-bgs)	0.0-0.5	4.0-6.0	14.0-18.0r
Aroclor 1248	2.9	9	< 0.041

100 0 100 Feet



LEGEND:

- Proposed Surface and Shallow Subsurface Sample Location
- Historical Soil Sample Location (1996)
- 1999 RFI Soil Sample Location
- Existing Monitoring Well Location
- SWMU #35 Boundary
- Run-On Diversion (SWMU #33)
- U.G. Conveyance Line (SWMU #25)
- SWMU Boundaries
- (1) Results exceed Industrial RBCs

Note:
All analytical results are in mg/kg.

SWMU No. 35: Old Waste oil Storage Area
Soil Analytical Results and
Proposed Sample Locations

Alcoa-Badin Works
Badin, North Carolina

PROJECT: 120006	BY: M.W.	Figure 2
DATE: 4/5/00	CHECKED: MEP	

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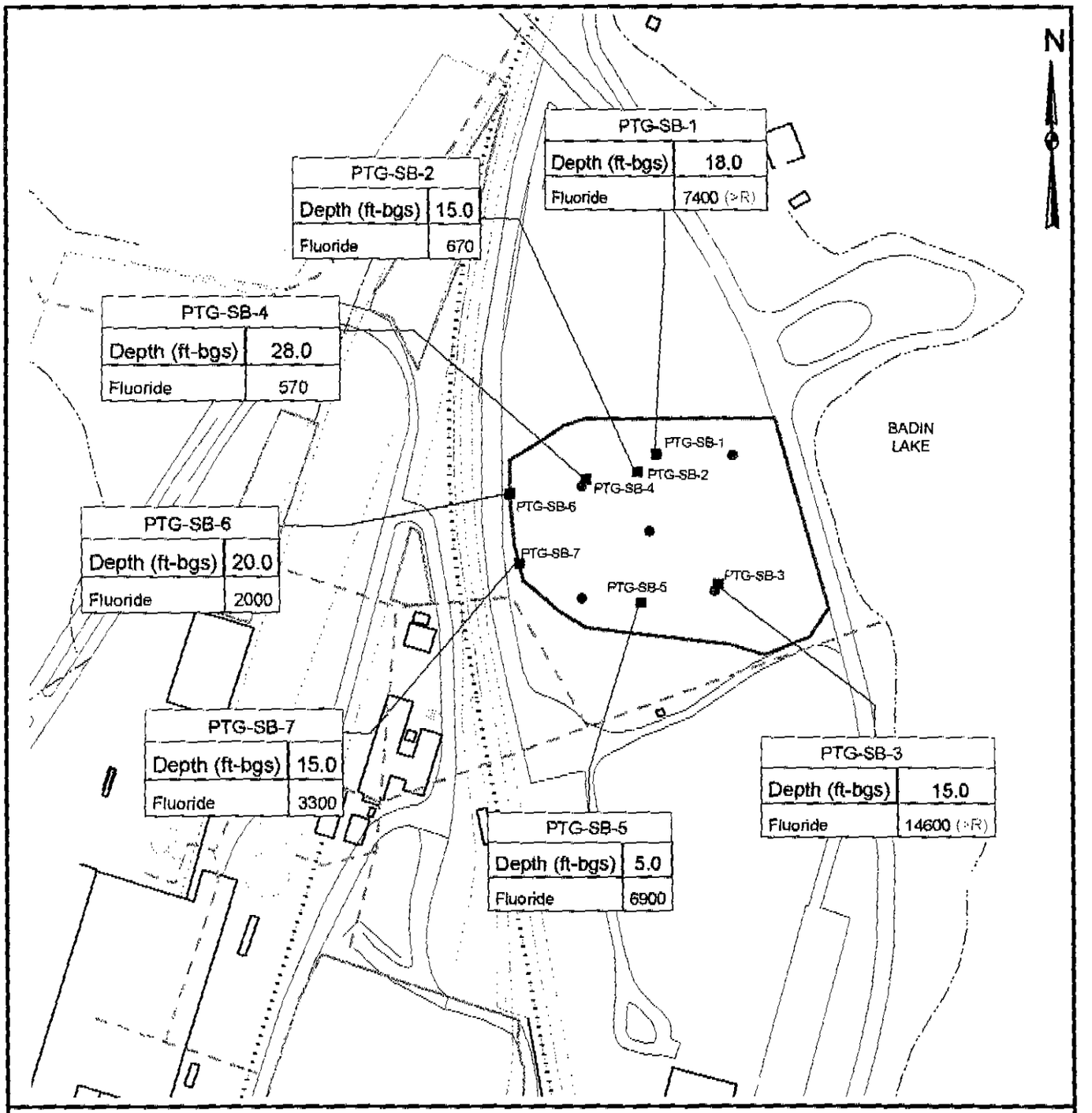

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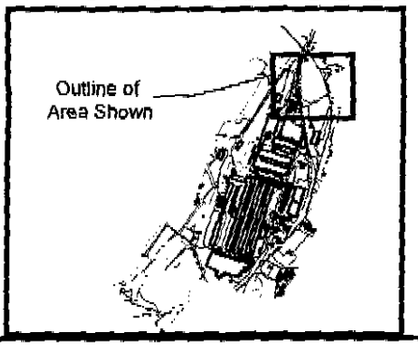

LEGEND:

- ● Proposed Surface Soil Sample Location
- ■ Historical Soil Sample (1996)
- SWMU #44 Boundary
- Run-On Diversion (SWMU #33)
- U.G. Conveyance Line (SWMU #25)
- SWMU Boundaries

(>R) Results exceed Residential RBC.

Note:
All analytical results are in mg/kg.

SWMU No. 44: Pine Tree Grove Area Soil Analytical Results and Proposed Sample Locations

Alcoa-Badin Works
Badin, North Carolina

PROJECT: 120006	BY: M.W.	Figure 3
DATE: 4/5/00	CHECKED: MEP	

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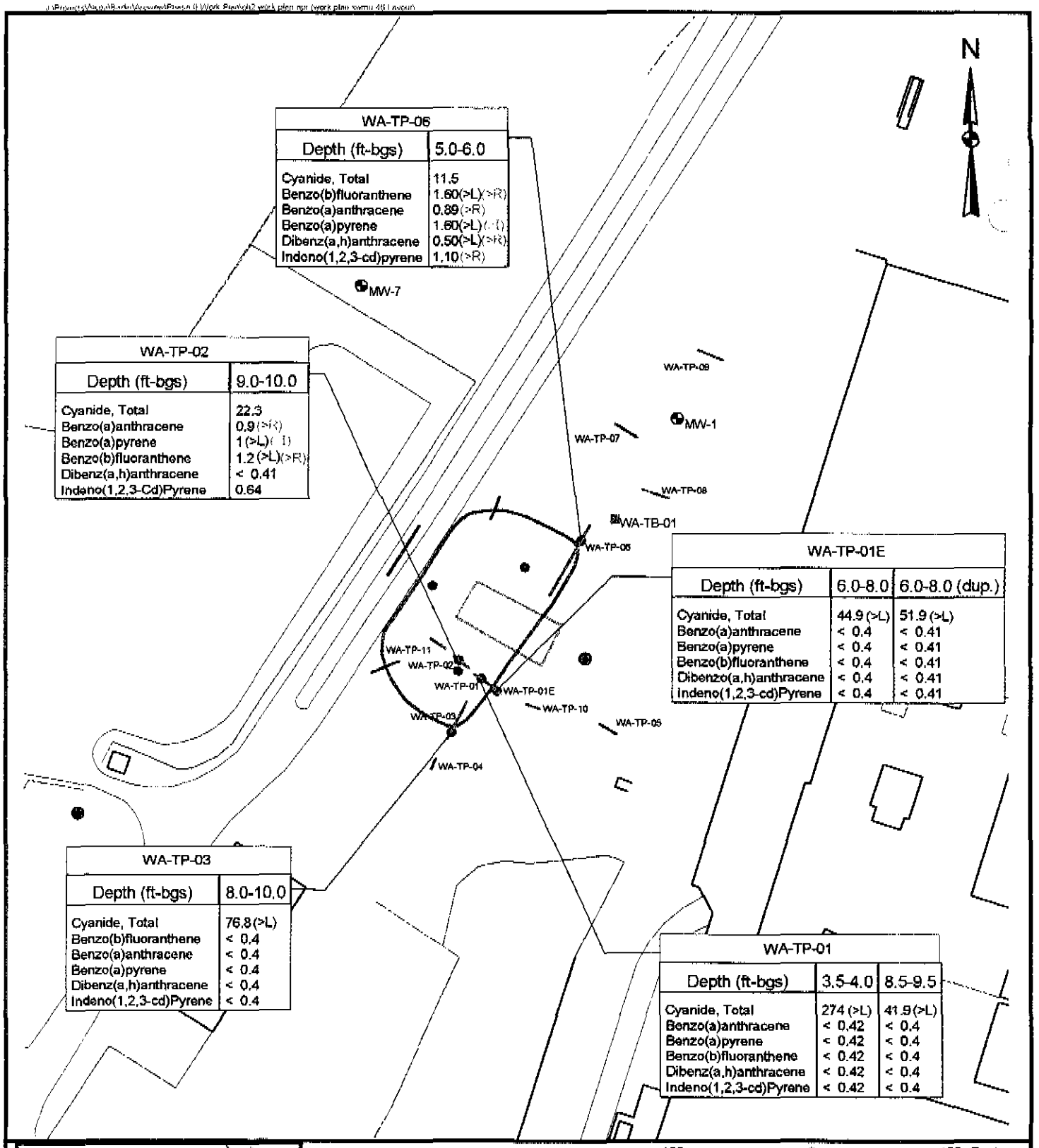


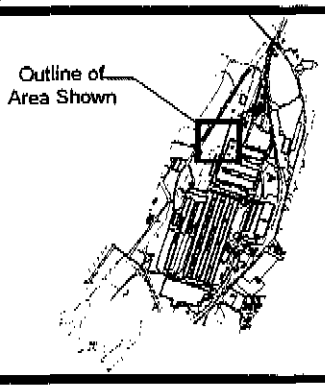
WA-TP-06	
Depth (ft-bgs)	5.0-6.0
Cyanide, Total	11.5
Benzo(b)fluoranthene	1.60(>L)(>R)
Benzo(a)anthracene	0.89(>R)
Benzo(a)pyrene	1.60(>L)(>I)
Dibenz(a,h)anthracene	0.50(>L)(>R)
Indeno(1,2,3-cd)pyrene	1.10(>R)

WA-TP-02	
Depth (ft-bgs)	9.0-10.0
Cyanide, Total	22.3
Benzo(a)anthracene	0.9(>R)
Benzo(a)pyrene	1(>L)(>I)
Benzo(b)fluoranthene	1.2(>L)(>R)
Dibenz(a,h)anthracene	< 0.41
Indeno(1,2,3-Cd)Pyrene	0.64

WA-TP-01E		
Depth (ft-bgs)	6.0-8.0	6.0-8.0 (dup.)
Cyanide, Total	44.9 (>L)	51.9 (>L)
Benzo(a)anthracene	< 0.4	< 0.41
Benzo(a)pyrene	< 0.4	< 0.41
Benzo(b)fluoranthene	< 0.4	< 0.41
Dibenzo(a,h)anthracene	< 0.4	< 0.41
Indeno(1,2,3-cd)Pyrene	< 0.4	< 0.41

WA-TP-03	
Depth (ft-bgs)	8.0-10.0
Cyanide, Total	76.8(>L)
Benzo(b)fluoranthene	< 0.4
Benzo(a)anthracene	< 0.4
Benzo(a)pyrene	< 0.4
Dibenz(a,h)anthracene	< 0.4
Indeno(1,2,3-cd)Pyrene	< 0.4

WA-TP-01		
Depth (ft-bgs)	3.5-4.0	8.5-9.5
Cyanide, Total	274 (>L)	41.9(>L)
Benzo(a)anthracene	< 0.42	< 0.4
Benzo(a)pyrene	< 0.42	< 0.4
Benzo(b)fluoranthene	< 0.42	< 0.4
Dibenz(a,h)anthracene	< 0.42	< 0.4
Indeno(1,2,3-cd)Pyrene	< 0.42	< 0.4



LEGEND:
- Proposed Test Pit Location
- Proposed Surface Soil Sample Location
- Proposed Monitoring Well Location
- Soil Sample Locations
- Test Boring Location
- Existing Monitoring Well Location
- SWMU #46 Boundary
- SWMU Boundary
- Test Pit Location
- (>L) Results exceed SSLs
- (>R) Results exceed Residential RBCs
- (>I) Results exceed Industrial RBCs

Notes:
All analytical results are in mg/kg.
Arsenic concentrations are less than Background values.

100 0 100 Feet

SWMU No. 46: West SPL Area
Soil Analytical Results and
Proposed Soil and Groundwater Sample Locations

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Badin, North Carolina

PROJECT: 120006	BY: M.W.	Figure 4
DATE: 4/5/00	CHECKED: MEP	

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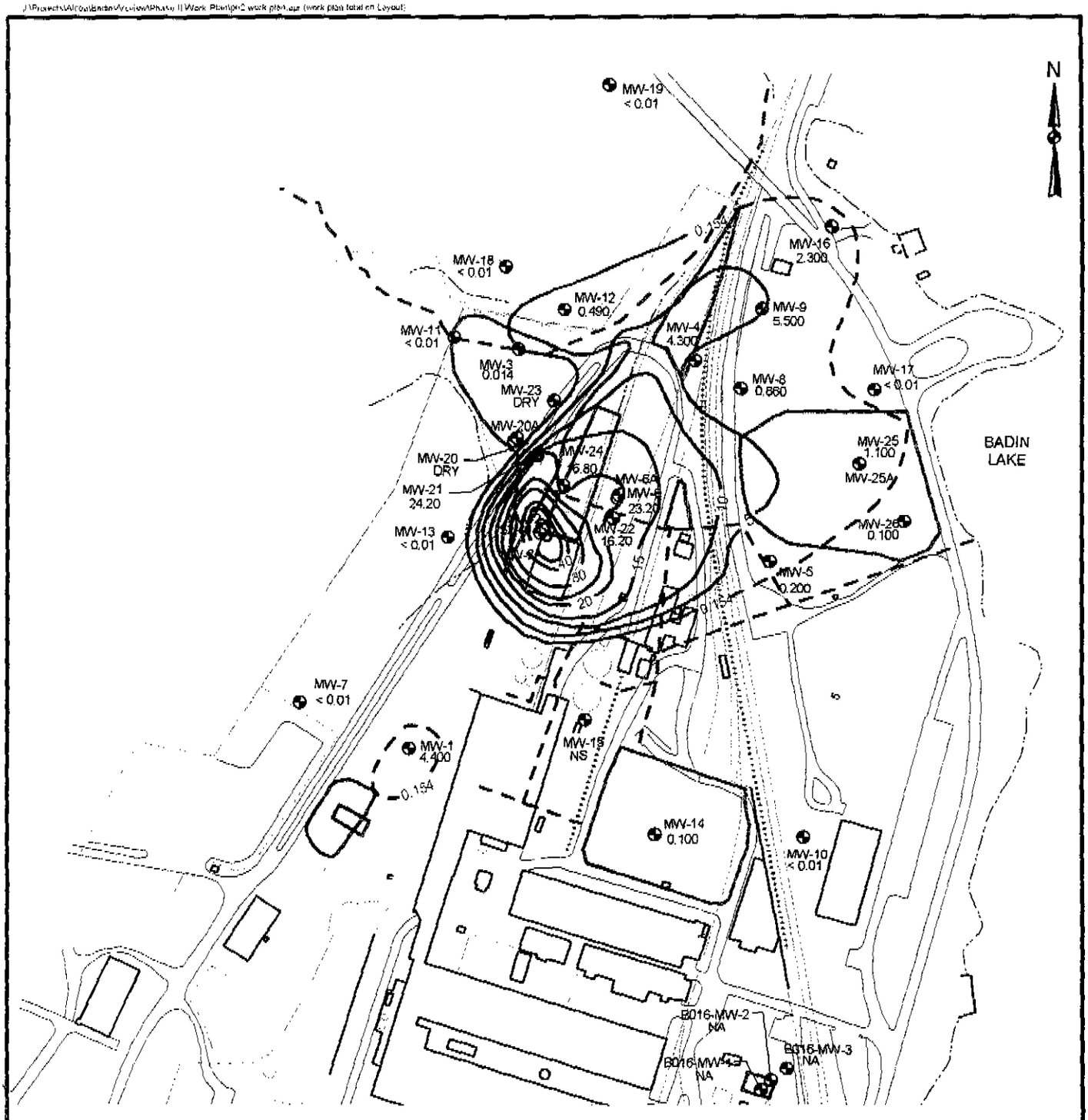

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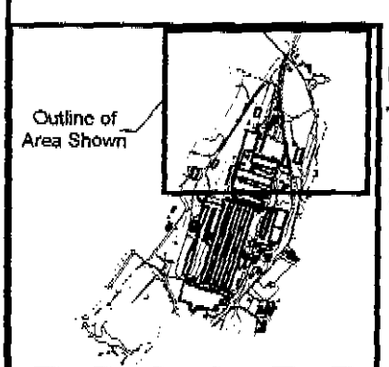

LEGEND:

- Total Cyanide Isoconcentration Contour [mg/l]
- Monitoring Well Location
- Run-On Diversion (SWMU #33)
- U.G. Conveyance Line (SWMU #25)
- SWMU Boundary

Note:
All analytical results are in mg/l.

North End
Total Cyanide Isoconcentration Contours

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Badin, North Carolina

PROJECT: 120006	BY: M.W.	Figure 5
DATE: 4/5/00	CHECKED: MEP	

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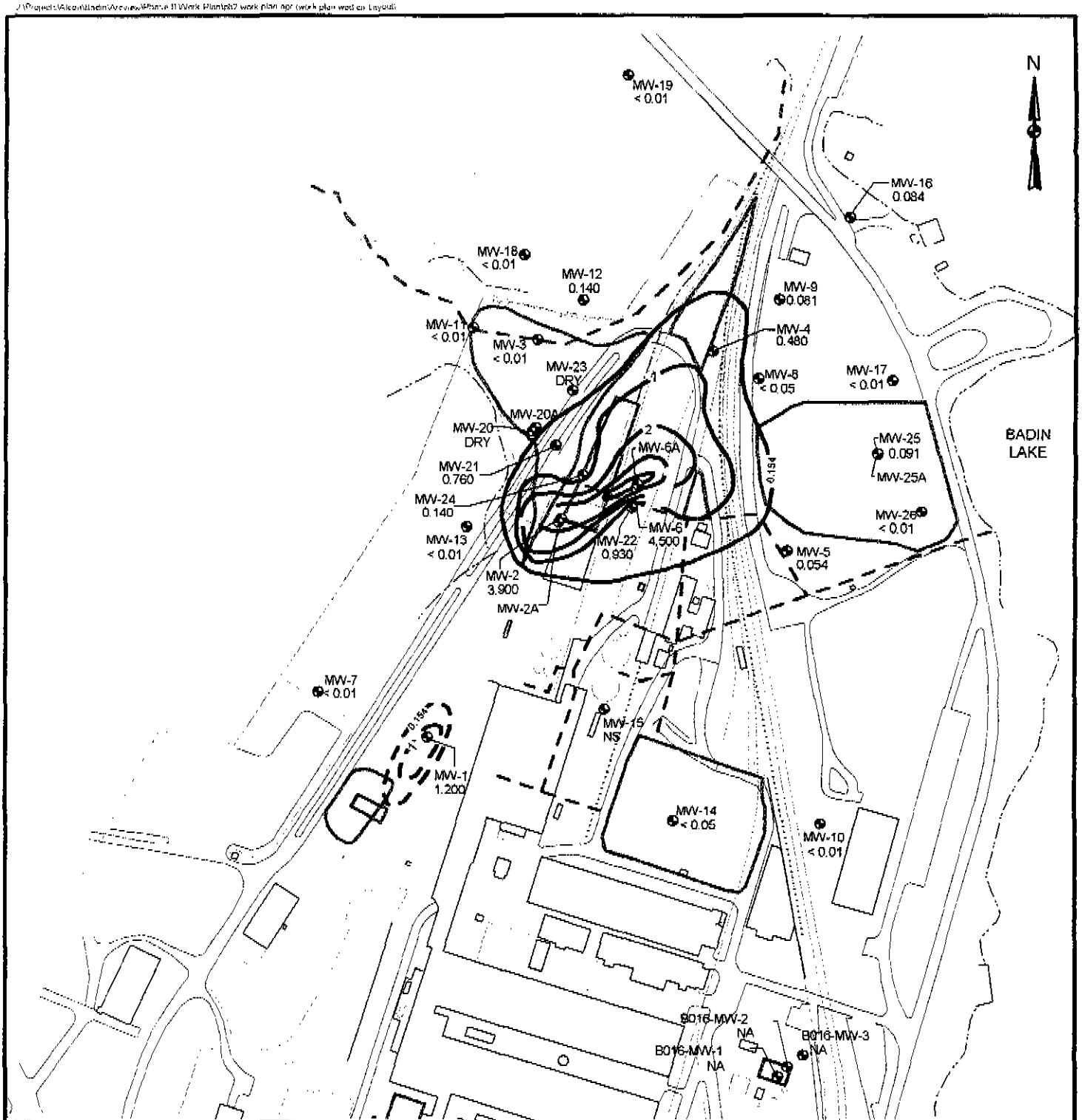

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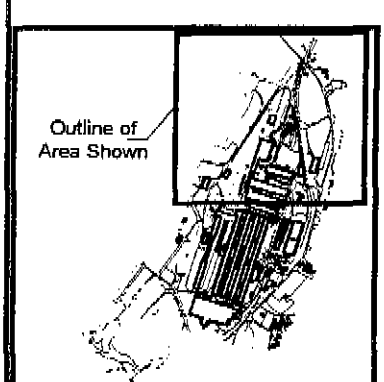

LEGEND:

- Monitoring Well Location
- WAD Cyanide Isoconcentration Contour [mg/l]
- Run-On Diversion (SWMU #33)
- U.G. Conveyance Line (SWMU #25)
- SWMU Boundaries

Note:
All analytical results are mg/l.

North End
Weak Acid Dissociable Cyanide
Isoconcentration Contours

Alcoa-Badin Works
Badin, North Carolina

PROJECT: 120006	BY: M.W.	Figure 6
DATE: 4/5/00	CHECKED: MEP	

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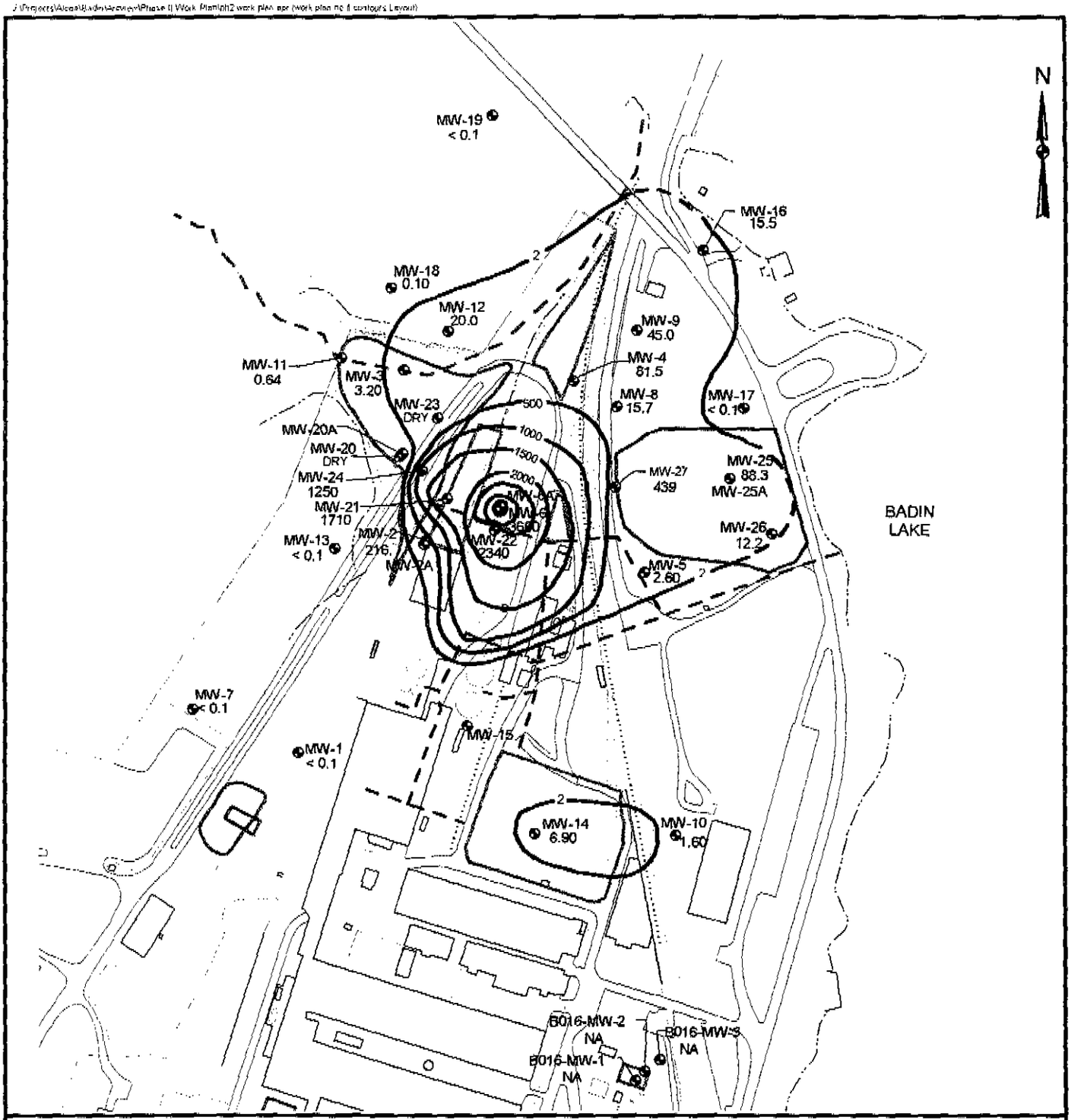

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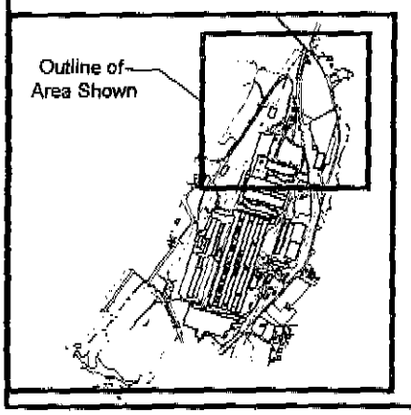

Legend:

- Fluoride Isoconcentration Contours [mg/l]
- Monitoring Well Location
- Run-On Diversion (SWMU #33)
- U.G. Conveyance Line (SWMU #25)
- SWMU Boundary

Note:
All analytical results are in mg/l.

North End

Fluoride Isoconcentration Contours

Alcoa-Badin Works
Badin, North Carolina

PROJECT: 120006	BY: M.W.	Figure 7
DATE: 4/5/00	CHECKED: MEP	

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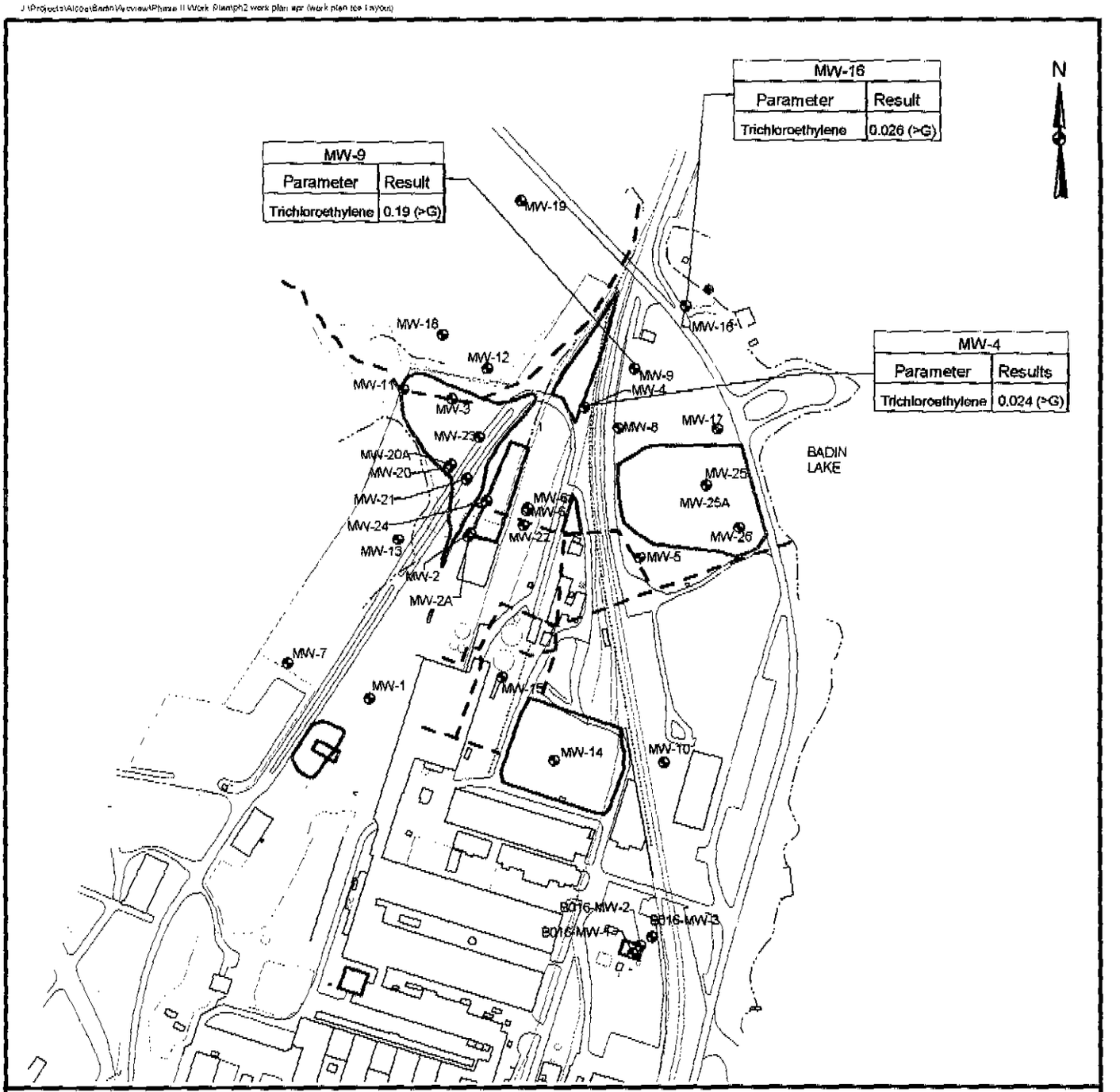

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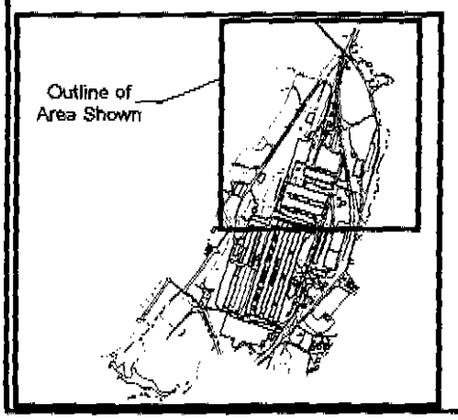

LEGEND:

- Proposed Surface Water Sample Location
- Monitoring Well Location
- Run-On Diversion (SWMU #33)
- U.G. Conveyance Line (SWMU #25)
- SWMU Boundaries
- (>G) Results exceed North Carolina Groundwater Standards

Note:
All analytical results are mg/l.

North End
Trichloroethylene Analytical Results

Alcoa-Badin Works
Badin, North Carolina

PROJECT: 120006	BY: M.W.	Figure 8
DATE: 4/5/00	CHECKED: MEP	

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