N60508.AR.000884
NAS WHITING FIELD
5090.3a

DIFFUSION-SAMPLER AND OIL ANALYSIS DATA INVESTIGATION OF CONTAMINATED GROUNDWATER DISCHARGE TO THE CLEAR CREEK FLOOD PLAIN NAS WHITING FIELD FL

6/19/1998

U S GEOLOGICAL SURVEY

DIFFUSION-SAMPLER AND OIL-ANALYSIS DATA: INVESTIGATION OF CONTAMINATED GROUND-WATER DISCHARGE TO THE CLEAR CREEK FLOOD PLAIN, NAS WHITING FIELD, FLORIDA, MARCH 1998

By Don A. Vroblesky, Paul M. Bradley
U.S. Geological Survey, Columbia, South Carolina

and Cliff Casey
Southern Division Naval Facilities Engineering Command, Charleston, South Carolina

June 19, 1998

ABSTRACT

Water-to-vapor diffusion samplers in stream-bed and saturated flood-plain sediments along a reach of Clear Creek, NAS Whiting Field, Milton, Florida, March 1998, showed the presence of benzene, toluene, 1,1-dichloroethene, *cis* 1,2-dichloroethene, and 1,2-dichloroethane. An oily sheen was observed leaching from stream banks and from fine-grained stream-bed sediment in part of the flood plain. The sheen was collected and analyzed by gas chromatography. A substantial amount of iron flocculent was observed in surface-water bodies in another part of the flood plain.

INTRODUCTION

The Naval Air Station (NAS) Whiting Field at Milton, Florida (fig. 1), is approximately 20 miles northeast of Pensacola. The NAS, in operation since 1943, is used for airplane and helicopter flight instruction. Prior to establishment of hazardous waste management and recycling plans, waste streams associated with the operation and maintenance of aircraft were disposed onsite. Wastes were either placed in disposal pits or waste oil bowsers, and sometimes were used for firefighting training.

Operations that generated waste streams included paint stripping, painting, washing, and upkeep of aircraft engines. The waste streams included stripping compounds, cleaning solvents, paint wastes, alkaline cleaners, detergents, oil, and hydraulic fluids. In the 1970's, NAS Whiting Field began generating waste streams that included waste oil, mineral spirits, methyl ethyl ketone (MEK), isopropyl alcohol, mixed paint thinners, and aircraft cleaning solution. Other wastes that may have been dumped into onsite disposal areas include waste oils, gasoline, aviation gasoline (AVGAS), tank bottom sludges, polychlorinated biphenyl (PCB)-containing transformer fluids, and paint stripping wastewater (Brown and Root Environmental, 1998). The site activities resulted in ground-water contamination.

Clear Creek is a stream along the eastern boundary of NAS Whiting Field. An investigation of the Clear Creek flood plain in the vicinity of a wastewater-treatment plant showed that high concentrations (>10,000 mg/L) of total petroleum hydrocarbons were present in flood-plain sediments (ABB Environmental Services, Inc., 1993). In addition, 55-gallon drums with unknown contents were found at four locations in the flood plain (fig. 2). Preliminary digital ground-water modeling results suggested that this reach of Clear Creek (fig. 2) may be the discharge point for ground water contaminated with volatile organic compounds (VOC's) (Cliff Casey, unpublished data, 1998).

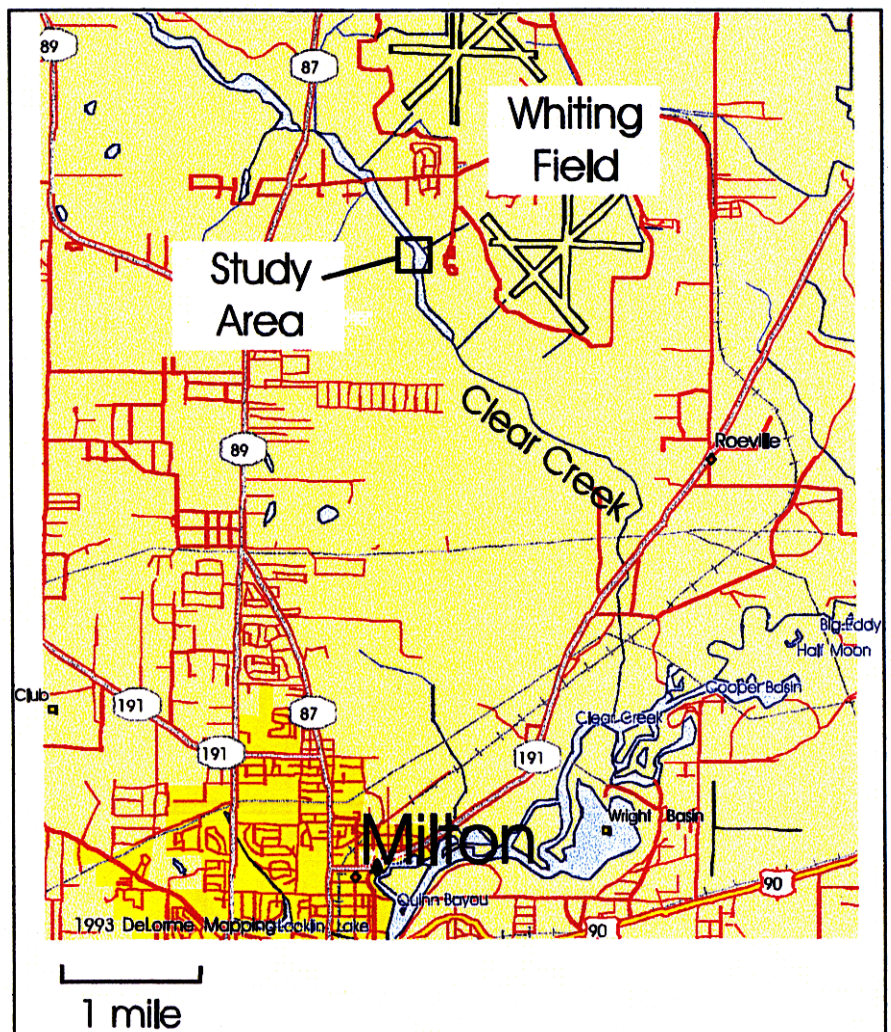


Figure 1. Location of study area.

00178 BOLY

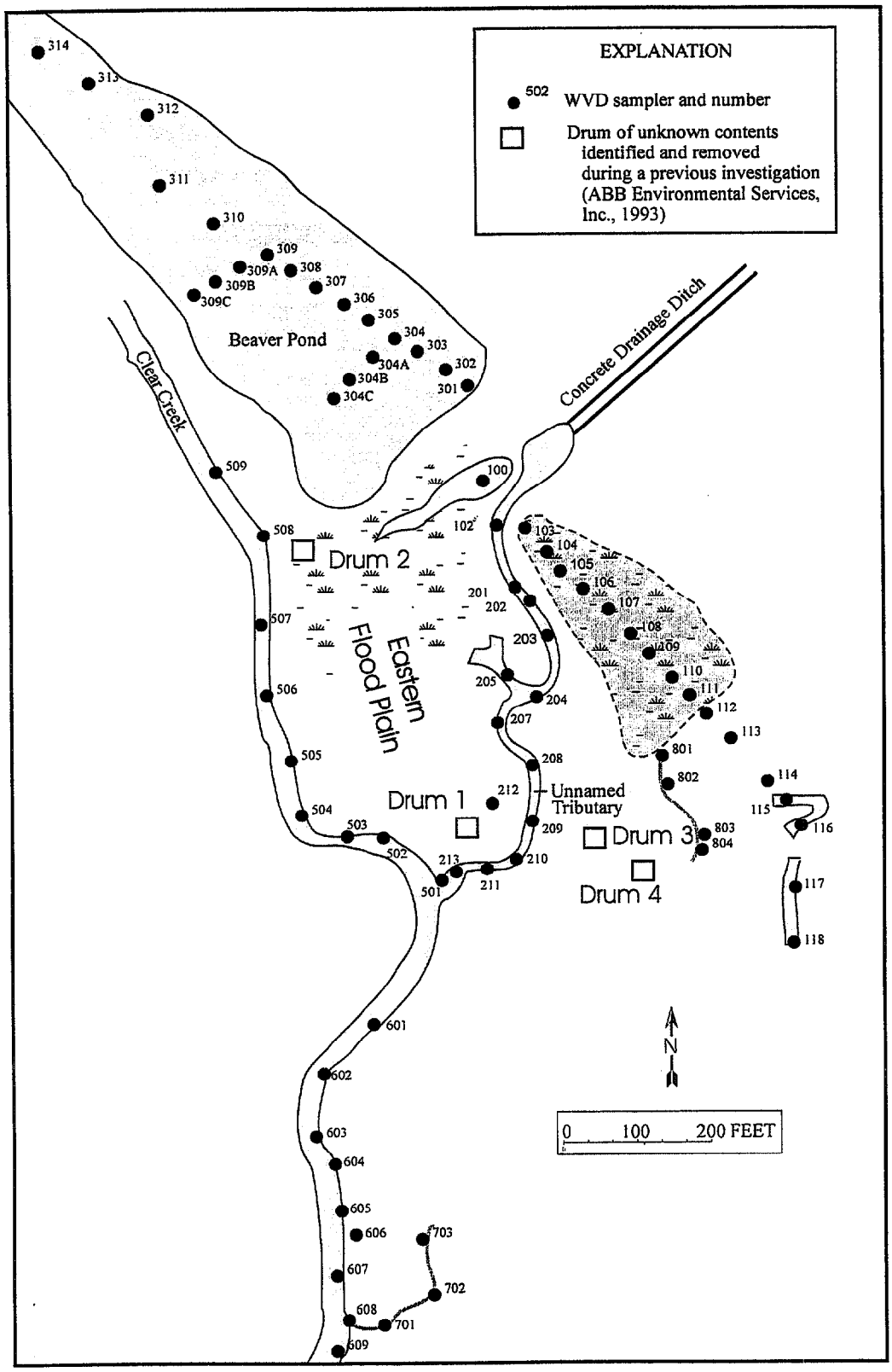


Figure 2. Locations of water-to-vapor diffusion (WVD) samplers used in this investigation and sites where drums were identified and removed during a previous investigation, NAS Whiting Field, Florida.

In 1998, the Southern Division Naval Facilities Command requested the U.S. Geological Survey to conduct a stream-bed survey using diffusion samplers beneath Clear Creek and the associated flood plain. as a means of elucidating the extent of contamination. The study area for this investigation is a portion of Clear Creek (fig. 3) and its associated flood plain on the eastern side of the creek, in the southwestern part of NAS Whiting Field. The eastern flood plain includes a beaver pond, and other areas of marsh or open water (fig. 2). Surface water in the flood plain (fig. 4) is derived primarily from ground-water and from the concrete ditch (fig. 2) that discharges water from the western end of Whiting Field runways.

Figure 3. Clear Creek, NAS Whiting Field, Florida, March 1988.

The purpose of this report is to present data from a stream-bed diffusion-sampler survey in Clear Creek and the adjacent flood plain. The survey was to provide information to assist in delineating the area where VOC-contaminated ground water is discharging. The investigation utilized water-to-vapor diffusion samplers at 73 sites. The investigation concentrated on a 1,500-ft reach of Clear Creek and selected areas on the eastern Clear Creek flood plain.

METHODS

Passive water-to-vapor diffusion (WVD) samplers were used to examine VOC concentrations beneath the Clear Creek flood plain. The WVD samplers consisted of 30-mL (milliliter) glass serum vials enclosed in sealable polyethylene bags.

Preparation of the WVD samplers involved placing a clean, uncapped vial in the polyethylene bag, removing excess air from the bag, and then sealing the bag. The vial was arranged in the bag so that one smooth layer of polyethylene tightly covered the opening of the vial, thereby creating a membrane permeable to VOCs, but not to water (Vroblesky and others, 1991). Strapping tape was used around the outside of the bag to wrap the polyethylene firmly against the vial. Care was taken to ensure that no tape covered the opening or the neck of the tube. Several WVD samplers contained no detectable VOCs, indicating that the strapping tape and polyethylene bag did not contribute detectable amounts of VOCs to the analyses.

Figure 4. Clear Creek flood plain (site 103), NAS Whiting Field, Florida, March 1998.

The serum vial and bag were then placed inside another sealable polyethylene bag. The second bag was sealed using the same approach as the inner bag. The outer bag was used to reduce abrasion of the inner bag, to prevent residual carryover of contamination by keeping the inner bag from contacting contaminated soil, and to

optimize the integrity of the bottle crimp by eliminating sand from bottle threads. The outer bag was removed immediately prior to capping the vials during sample retrieval. The WVD sampler, which then consisted of an uncapped serum vial enclosed in two sealable polyethylene bags, was taped to a wire survey flag.

The diffusion samplers were installed by using a coring hand auger to excavate a hole approximately 5 to 12 inches (0.15 to 0.3 m) deep in the bed sediment beneath surface water in Clear Creek and the adjacent flood plain. A WVD sampler with the attached flagging was placed in the hole (fig. 5), and the hole was backfilled with the removed sediment.

Figure 5. Water-to-vapor diffusion samplers installed beneath tributary in Clear Creek flood plain, NAS Whiting Field, Florida, March, 1998.

WVD samplers were installed and subsequently recovered from 73 sites. Eighteen of the samplers were installed in Clear Creek, near the eastern side of the creek. Twenty samplers were installed in the beaver pond (fig. 2), and the remainder were installed in bog areas or tributaries to Clear Creek. The WVD samplers were installed on March 20, 1998 and recovered on March 30, 1998. The samplers were removed by slowly pulling the wire survey flags, with the attached diffusion samplers, out of the bottom sediment. Immediately upon removal from the bottom sediment, the outer polyethylene bag of each sampler was cut open, leaving the inner polyethylene bag intact. A Teflon-coated butyl-rubber stopper was crimped onto the mouth of the serum vial over the inner polyethylene bag (the polyethylene was between the glass vial and the Teflon septum stopper).

Approximately 10 percent of the samplers were collected as replicates. Replicates consisted of two WVD samplers buried in the same hole and recovered at the same time. In general, the replicates showed good correlation. Benzene was detected in both the sample and replicate at site 203 (20.2 and 11.7 nmol/20 mL, respectively).

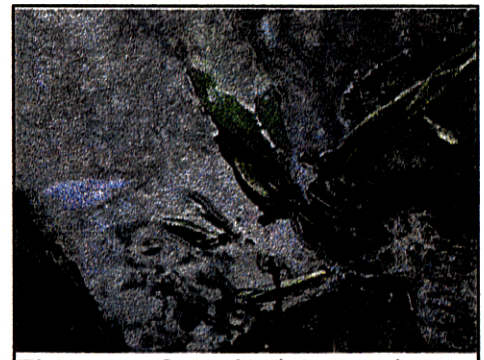


Figure 6. Organic sheen on the water surface leaching from the shoreline and from fine-grained bottom sediment near site 205, Clear Creek flood plain, NAS Whiting Field, Florida, March 1998.

The recovered samplers were stored chilled until analysis using gas chromatography. Chromatogram peaks were analyzed for 1,1-dichloroethene (1,1-DCE), *cis* 1,2-dichloroethene (c-DCE), 1,2-dichloroethane (1,2-DCA), benzene (Benz), toluene (Tol), trichloroethene (TCE), 1,1,2-trichloroethene (1,1,2-TCA), and tetrachloroethene (PCE). Detection limits were 0.5 nanomoles of target compound per 20 milliliters of head space in the serum vials (<0.5 nmol/20 mL).

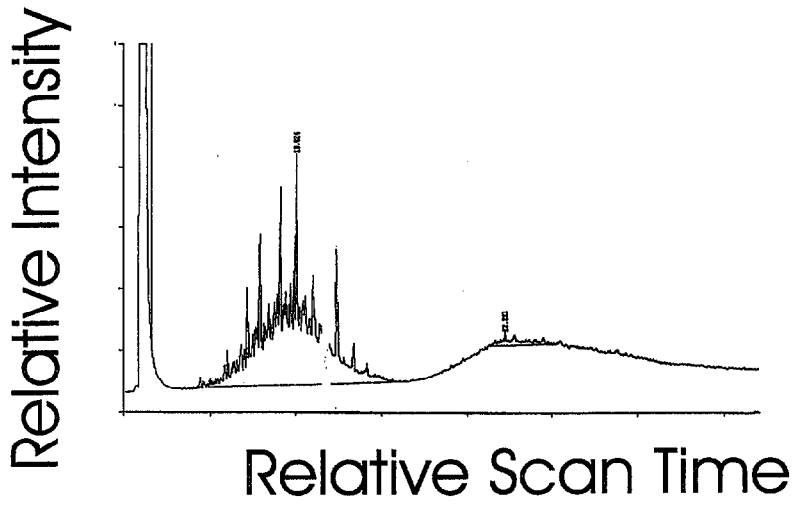
RESULTS

Among WVD samplers collected from 73 sites in Clear Creek and the adjacent flood plain, samplers from 28 of the sites contained detectable concentrations of at least one target compound (table 1). The highest concentrations of detected compounds were 187.2 nmol/20 mL of 1,2-dichloroethane and 119.5 nmol/20 mL of *cis* 1,2-dichloroethene.

Sites 204, 205, and 207 were at or near areas where a organic sheen was leaching from shoreline and fine-grained bottom sediments (fig. 6). A chromatogram of the sheen, obtained using gas chromatography, is shown in figure 7A. The early-eluting peaks of selected typical chromatograms are shown for comparison (fig. 7B). The WVD samplers at those sites, however, were buried below, rather than within, the stream-bed sediments and showed only moderate or undetectable concentrations of benzene (table 1).

Substantial iron flocculent was observed in surface-water bodies near sites 210 and 212, in approximately the same area where a 55-gallon drum of unknown content was found during a previous investigation (ABB Environmental Services, Inc., 1993)(fig. 2). No detectable concentrations of target compounds were found in WVD samplers from sites 210 and 212; however, both aromatic and chlorinated compounds were found in nearby samplers 209 and 211 (table 1). The areal distributions of target contaminants in WVD samplers are shown in figures 8 - 12.

A.



B.

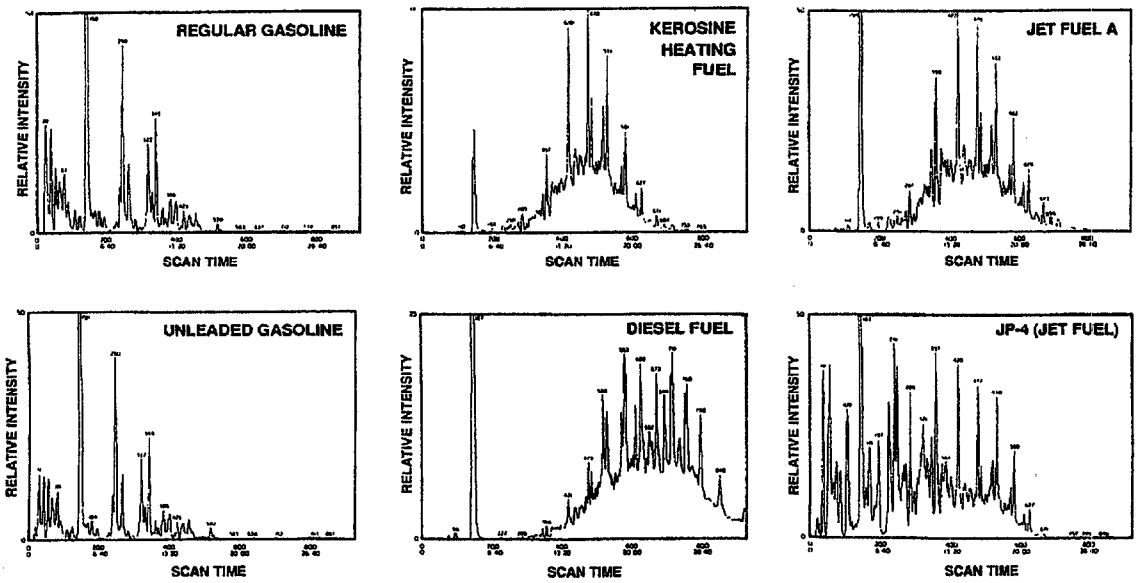


Figure 7. (A) Chromatogram of sheen from site 207, NAS Whiting Field, Florida, March 1998, and (B) the early-eluting peaks of selected typical chromatograms for comparison (Nielsen, 1991).

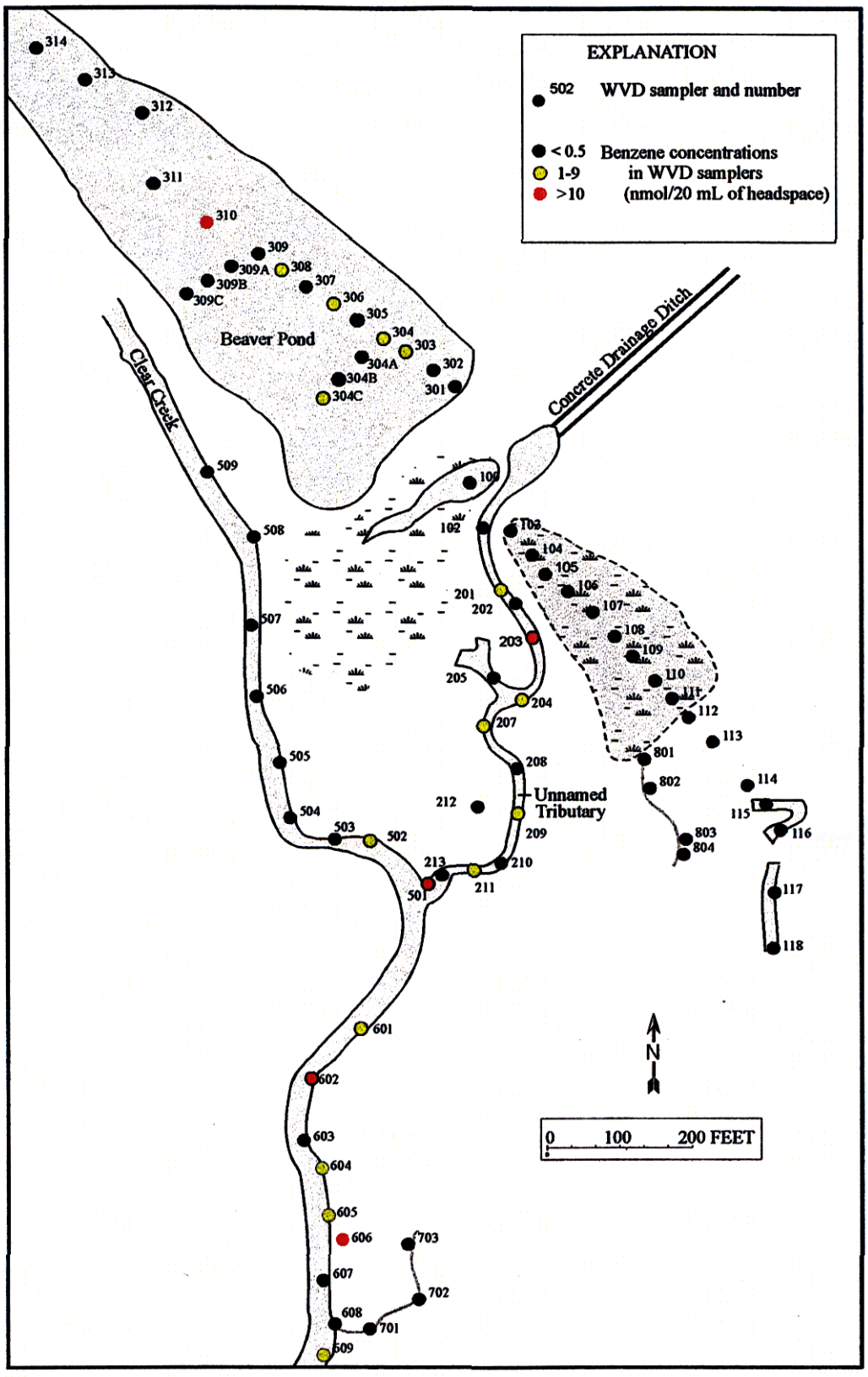


Figure 8. Benzene concentrations in water-to-vapor diffusion (WVD) samplers from Clear Creek and the eastern flood plain, NAS Whiting Field, Florida, March 1998.

00178803Y

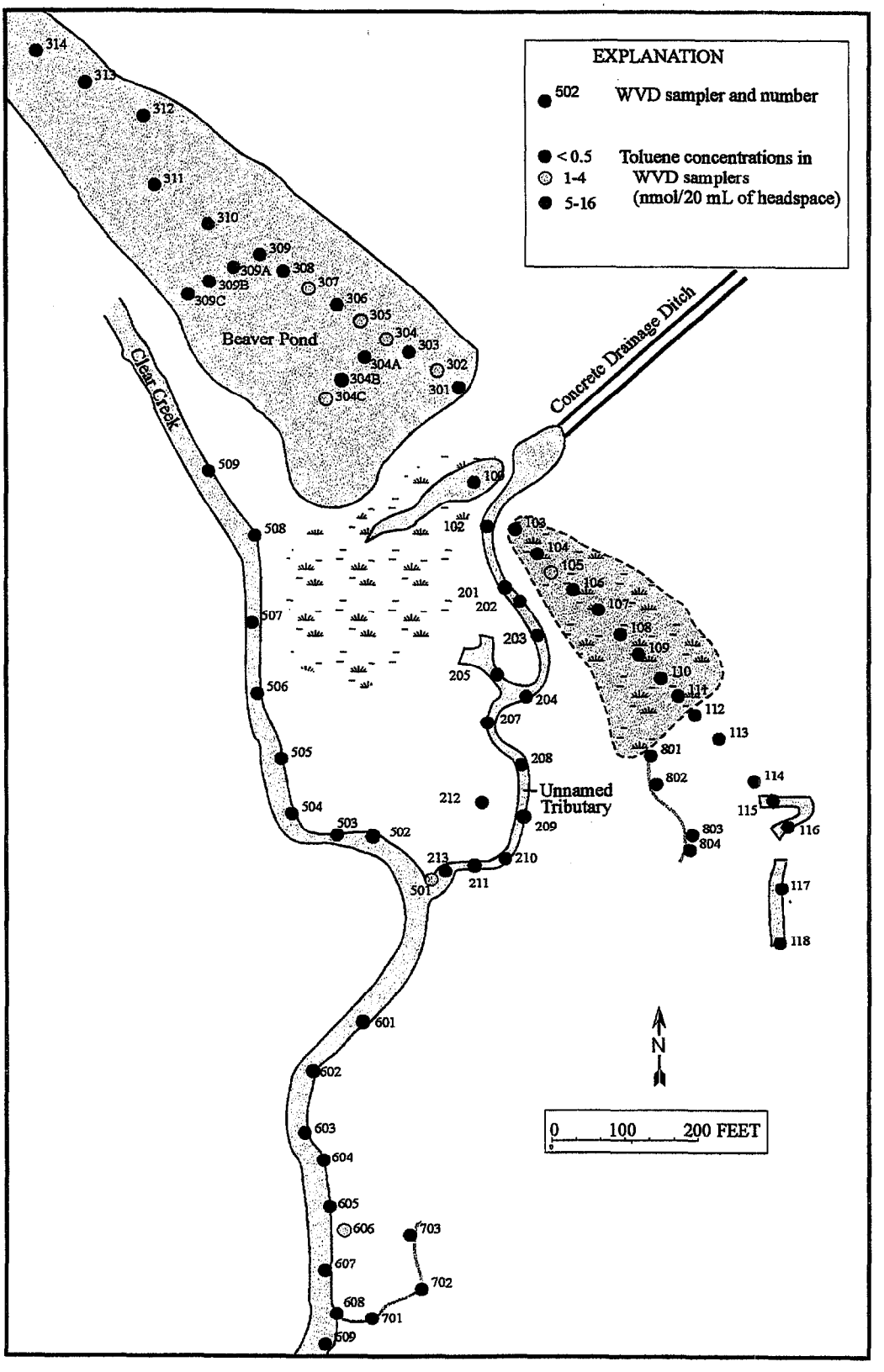


Figure 9. Toluene concentrations in water-to-vapor diffusion (WVD) samplers from Clear Creek and the eastern flood plain, NAS Whiting Field, Florida, March 1998.

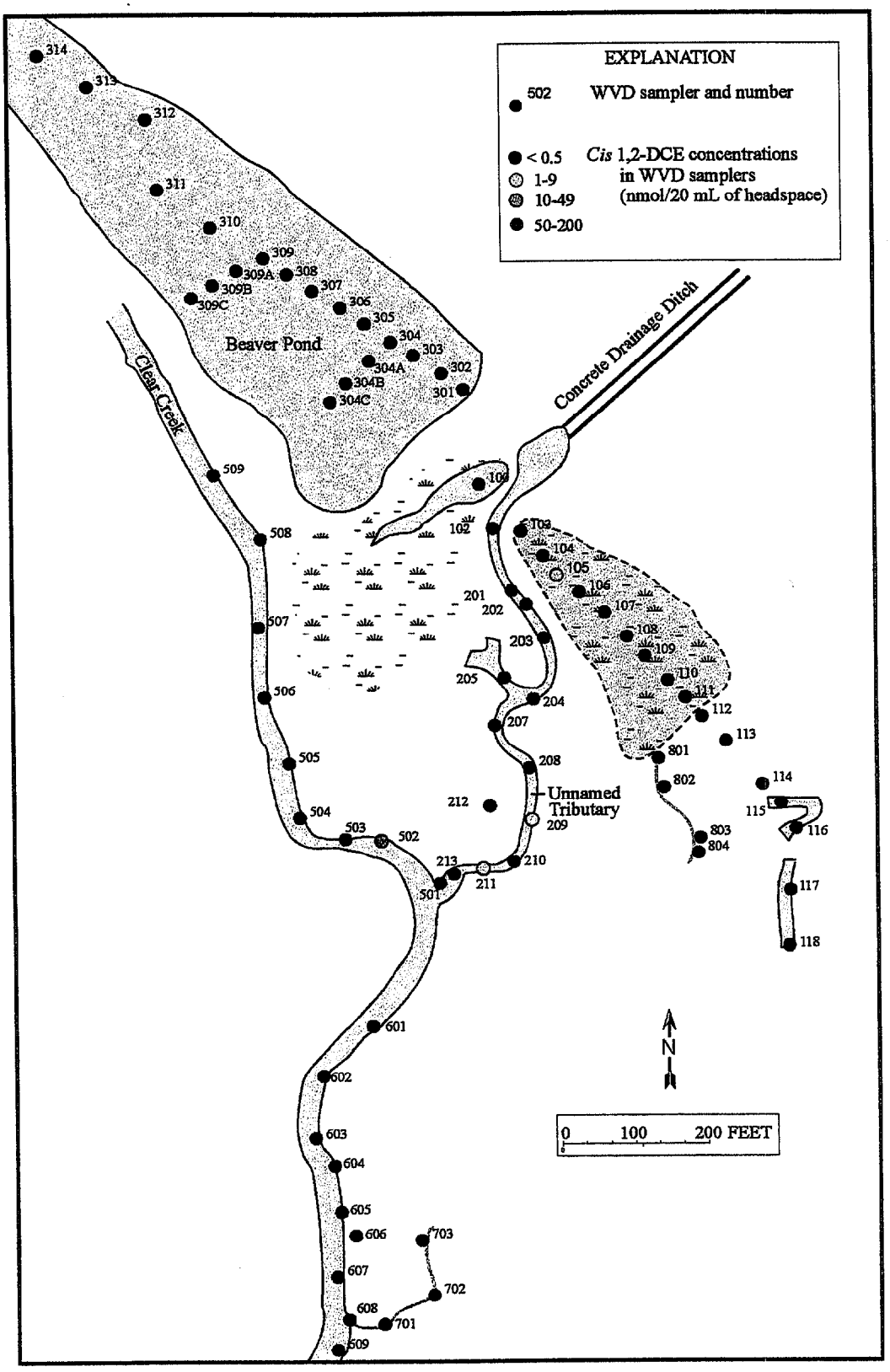


Figure 10. *Cis* 1,2-dichloroethene concentrations in water-to-vapor diffusion (WVD) samplers from Clear Creek and the eastern flood plain, NAS Whiting Field, Florida, March 1998.

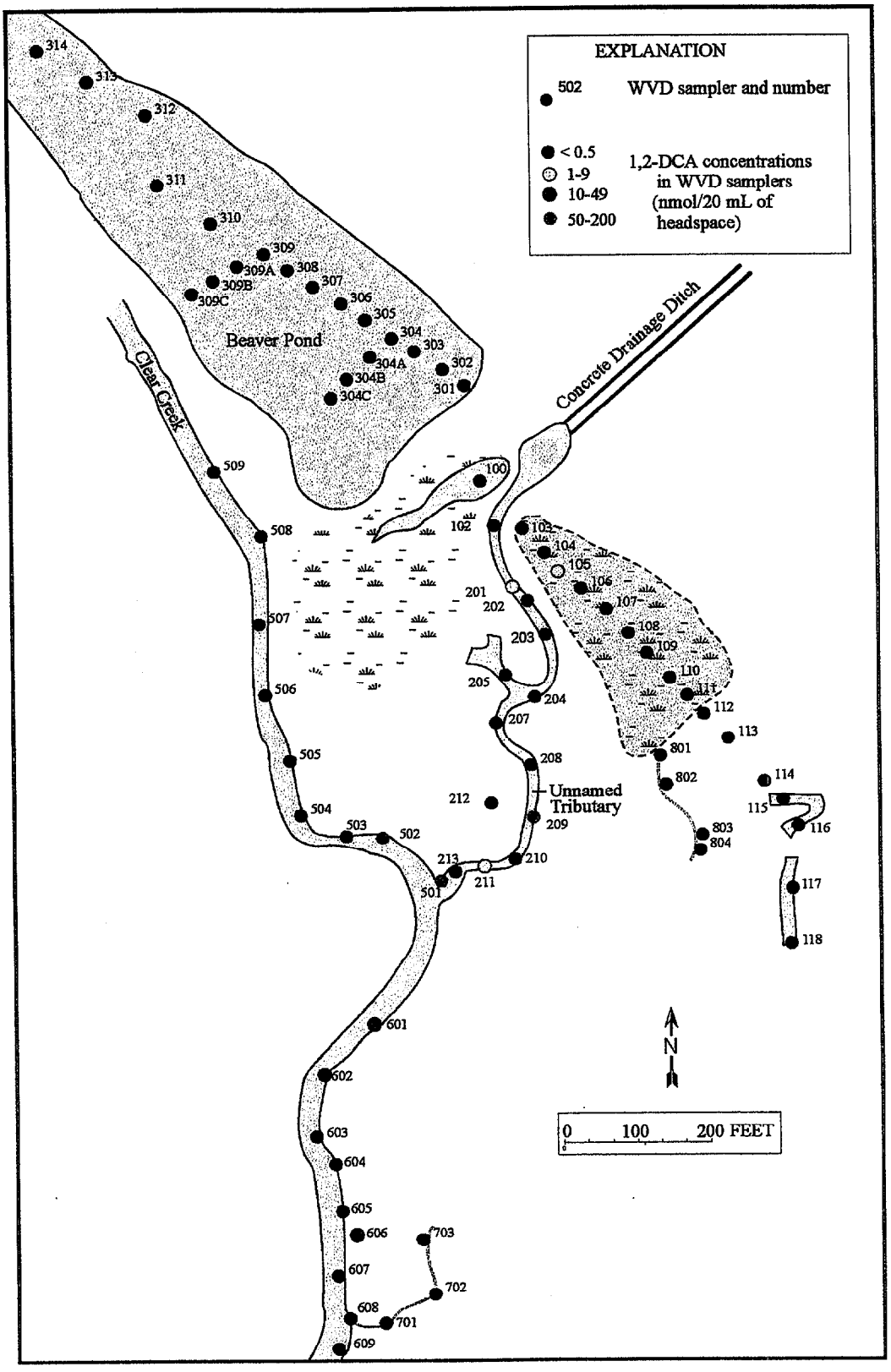


Figure 11. 1,2-Dichloroethane concentrations in water-to-vapor diffusion (WVD) samplers from Clear Creek and the eastern flood plain, NAS Whiting Field, Florida, March 1998.

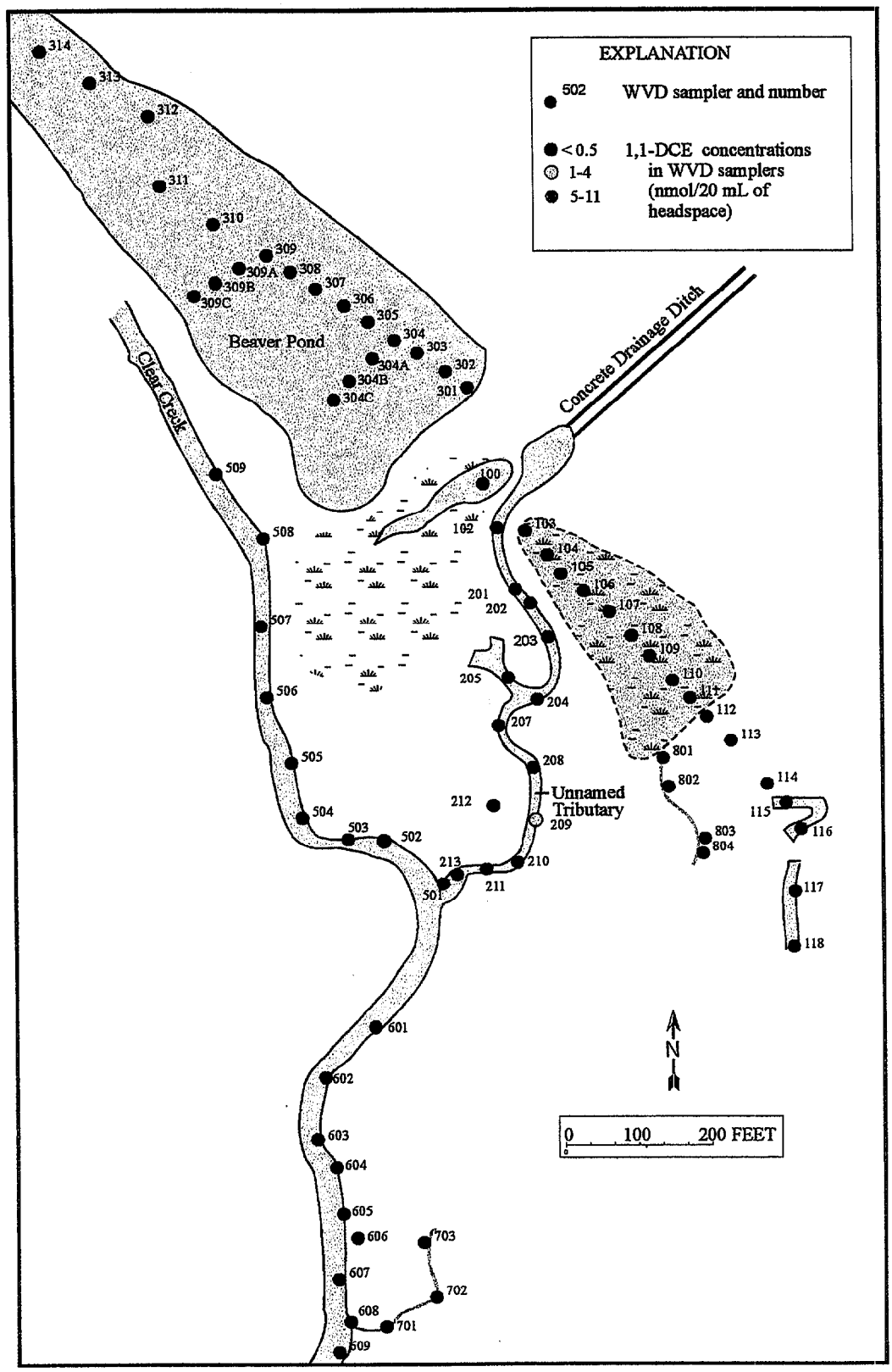


Figure 12. 1,1-Dichloroethene concentrations in water-to-vapor (WVD) diffusion samplers from Clear Creek and the eastern flood plain, NAS Whiting Field, Florida, March 1998.

Table 1. Concentrations of volatile organic compounds in the water-to-vapor diffusion samplers that contained at least one target compound at a concentration above detectable limits, Clear Creek and the adjacent flood plain, Whiting Field, Florida, March 1998.

[R, replicate sample; 1,1-DCE, 1,1-dichloroethene; c-DCE, *cis* 1,2-dichloroethene; 1,2-DCA, 1,2-dichloroethane; Benz, benzene; Tol, toluene; TCE, trichloroethene; 1,1,2-TCA, 1,1,2-trichloroethene; PCE, tetrachloroethene; nmol/20 mL, nanomoles per 20 milliliters; BDL, below detectable limits of 0.5 nmol/20 mL]

Site identification (fig. 2)	Concentrations (nmol/20 mL of head space) of target compounds in water-to-vapor diffusion samplers							
	1,1-DCE	c-DCE	1,2-DCA	Benz	Tol	TCE	1,1,2-TCA	PCE
105	BDL	1.4	2.5	BDL	BDL	BDL	BDL	BDL
111	BDL	BDL	BDL	BDL	1.3	BDL	BDL	BDL
201	BDL	BDL	7.2	5.3	BDL	BDL	BDL	BDL
203	BDL	BDL	BDL	20.2	BDL	BDL	BDL	BDL
203 R	BDL	BDL	BDL	11.7	BDL	BDL	BDL	BDL
204	BDL	BDL	BDL	9.3	BDL	BDL	BDL	BDL
205	BDL	BDL	BDL	1.4	BDL	BDL	BDL	BDL
207	BDL	BDL	BDL	2.1	BDL	BDL	BDL	BDL
209	4.5	42.6	57.7	5.4	BDL	BDL	BDL	BDL
211	BDL	4.1	5.4	4.9	BDL	BDL	BDL	BDL
302	BDL	BDL	BDL	BDL	1.7	BDL	BDL	BDL
303	BDL	BDL	BDL	6.7	BDL	BDL	BDL	BDL
304	BDL	BDL	BDL	3.9	BDL	BDL	BDL	BDL
304 C	BDL	BDL	BDL	4.5	6	BDL	BDL	BDL
305	BDL	BDL	BDL	BDL	4.5	BDL	BDL	BDL
306	BDL	BDL	BDL	5	BDL	BDL	BDL	BDL
307	BDL	BDL	BDL	BDL	2.1	BDL	BDL	BDL
308	BDL	BDL	BDL	8.1	BDL	BDL	BDL	BDL
309 A	BDL	BDL	BDL	BDL	12.1	BDL	BDL	BDL
310	BDL	BDL	BDL	10	16.4	BDL	BDL	BDL
501	10.3	119.5	187.2	13.2	1.8	BDL	BDL	BDL
502	7.3	76.9	96.9	3.5	BDL	BDL	BDL	BDL
601	BDL	BDL	7.9	6.2	BDL	BDL	BDL	BDL
602	BDL	BDL	10.8	12.2	BDL	BDL	BDL	BDL
604	BDL	BDL	BDL	5.2	BDL	BDL	BDL	BDL
605	BDL	BDL	BDL	2.7	BDL	BDL	BDL	BDL
606	BDL	BDL	20.8	16	1.4	BDL	BDL	BDL
609	BDL	BDL	BDL	4.7	BDL	BDL	BDL	BDL
802	BDL	BDL	BDL	3.3	BDL	BDL	BDL	BDL

SUMMARY

Water-to-vapor diffusion samplers were installed in stream-bed sediments and sediments from the adjacent flood-plain at Clear Creek, NAS Whiting Field, Milton, Florida, in March 1998. The samplers were recovered after 10 days. Analysis of the samplers showed the presence of benzene, toluene, 1,1-dichloroethene, *cis* 1,2-dichloroethene, and 1,2-dichloroethane beneath stream beds and flood-plain sediments. The chlorinated aliphatic compounds primarily were detected beneath Clear Creek and an unnamed tributary to Clear Creek. *Cis* 1,2-dichloroethene and 1,2-dichloroethane also were found at one site in a swamp south of the concrete drainage ditch. Benzene and toluene also were detected beneath Clear Creek and the unnamed tributary as well as at several sites in the beaver pond. An oily sheen was observed leaching from stream banks and from fine-grained sediment in the stream at sites 204, 205, and 207. Substantial flocculent was observed in surface-water bodies near sites 210 and 212.

REFERENCES

ABB Environmental Services, Inc., 1993, Clear Creek flood plain investigation report, Naval Air Station, Whiting Field, Milton, Florida: Consultant's report to Southern Division Naval Facilities Engineering Command, 21 p.

Brown and Root Environmental, 1988, Health and safety plan for RI/FS field investigation, Naval Air Station Whiting Field, Milton, Florida: Report to Southern Division Naval Facilities Engineering Command, 69 p.

Nielsen, D.M., 1991, Practical Handbook of Ground-Water Monitoring: Lewis Publishers, Chelsea, Michigan, 717 p.

Vroblesky, D.A., Lorah, M.M., and Trimble, S.P., 1991, Mapping zones of contaminated ground-water discharge using creek-bottom-sediment vapors, Aberdeen Proving Ground, Maryland: Ground Water, v. 29, no. 1, pp. 7-12.

Vroblesky, D.A., Rhodes, L.C., and Robertson, J.F., 1996, Locating VOC contamination in a fractured-rock aquifer at the ground-water/surface-water interface using passive vapor collectors: Ground Water, v. 34, no. 2, pp. 223-230.