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NATIONAL INSURANCE RISK PROFILE FEASIBILITY STUDY AND REMEDIAL DESIGN
TASK 2 SUPPLEMENTAL SITE CHARACTERIZATION REPORT NSWC INDIAN HEAD MD
12/1/1987
E C JORDAN

**NIRP FEASIBILITY STUDY
AND
REMEDIAL DESIGN**

**TASK 2 - SUPPLEMENTAL SITE
CHARACTERIZATION REPORT**

**NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND**

DECEMBER 1987

E.C. JORDAN CO.

ENGINEERS &
SCIENTISTS

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5245-01

January 4, 1988

Ms. Paula Pritz
Martin Marietta Energy Systems, Inc.
Oak Ridge National Laboratories
104 Union Valley Road, P.O. Box M
Oak Ridge, Tennessee 37831

Dear Paula:

**RE: Submittal of the NIRP Feasibility Study and Remedial Design
Task 2 - Supplemental Site Characterization Report
Naval Ordnance Station, Indian Head, Maryland**

E.C. Jordan is pleased to submit five (5) copies of the Task 2 Report for your review and comments. As stated in the Task 1 Work Plan, comments will be incorporated into the Feasibility Study Report.

We appreciate your patience while awaiting this report and apologize for its delayed submittal. Please call me or David Crane with any questions or concerns regarding this report or any aspects of the NOS project. We look forward to hearing from you.

Very truly yours,

E.C. JORDAN



for Tony Allen
Project Manager

TA/fgb

Enclosure

cc: Thomas Woo, NOS Indian Head w/5 enclosures
Lydia Chaing, CHESDIV w/5 enclosures

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EXECUTIVE SUMMARY

The Confirmation Study conducted at the Naval Ordnance Station in Indian Head, Maryland, in 1985 indicated mercury contamination of sediments in the stream and tidal pond as well as elevated levels of total mercury in surface water samples collected from the stream. According to the Confirmation Study, an estimated 200 to 500 pounds of mercury is contained in the stream and pond sediments. Based on the potential threat to human health and the environment, the Navy is addressing the mercury contamination problem by performing a Feasibility Study and Remedial Design to implement remedial action at the site.

Jordan was authorized by the U.S. Department of the Navy through its contractor, Martin Marietta Energy Systems, Inc., to conduct a Feasibility Study/Remedial Design at NOS. Jordan was given notice to proceed on September 25, 1987 and began conducting Task 2 - Supplemental Site Characterization. The purpose of the Supplemental Site Characterization Study (Task 2) of the project is to complete the understanding of the physical environment and assess the distribution, migration and fate of mercury in sediment and surface water for use in conducting a feasibility study. The Task 2 - Supplemental Site Characterization Report was prepared to present and evaluate data collected during the E.C. Jordan (Jordan) field effort.

Mercury is used at NOS as a catalyst to perform a purity analysis of nitroglycerin. This analysis was performed in a laboratory in the nitroglycerin plant office (Building 766). For over twenty years prior to 1981, droplets of mercury were accidentally disposed of down the sink and floor drains in the laboratory. The drains discharge to a storm drainage manhole and then into a stream. The stream flows into a tidal pond which discharges via a seven foot diameter culvert into Mattawoman Creek. The manhole, stream and tidal pond comprise Site 8.

Geology beneath NOS consists of approximately 600 feet of clay. Information reviewed on the installation of water supply wells and pump test data suggest that no significant aquifers exist beneath NOS due to low production capability of the clays. A ground penetrating radar survey and sediment corings of the upper few feet confirmed that Site 8 is underlain by clay.

The Supplemental Site Characterization conducted at NOS consisted of a review of existing data, elevation and distance survey, 8 surface water samples and hydrology measurements, 79 sediment samples, ground penetrating radar survey, 12 surface soil samples, laboratory analytical program, and computer

modeling to estimate sediment volume. The field portion of the investigation was conducted between October 19 and 28, 1987.

The results of the investigation indicated the following:

- o The pond has a basal flow of approximately 23 gallons per minute, and increases to approximately 117 gallons per minute subsequent to industrial process water discharges into the Atkins Road tributary.
- o The beaver dam at the Noble Road culvert, by increasing the water depth in the tidal pond, enhances the tendency of particles to remain in the pond.
- o Mercury migration appears to be related to sediment transport rather than migration in solution in surface water.
- o The total volume of sediments in the stream and tidal pond is approximately 23,042 cubic yards. The depth ranges from 2 to 7 feet.
- o The volume of sediments containing more than the indicated concentrations of mercury is estimated as follows:

Mercury Concentration <u>(mg/Kg)</u>	Volume <u>(cu. yd.)</u>
0.1	12,313
1	7,555
5	2,276

1.0 INTRODUCTION

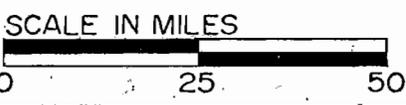
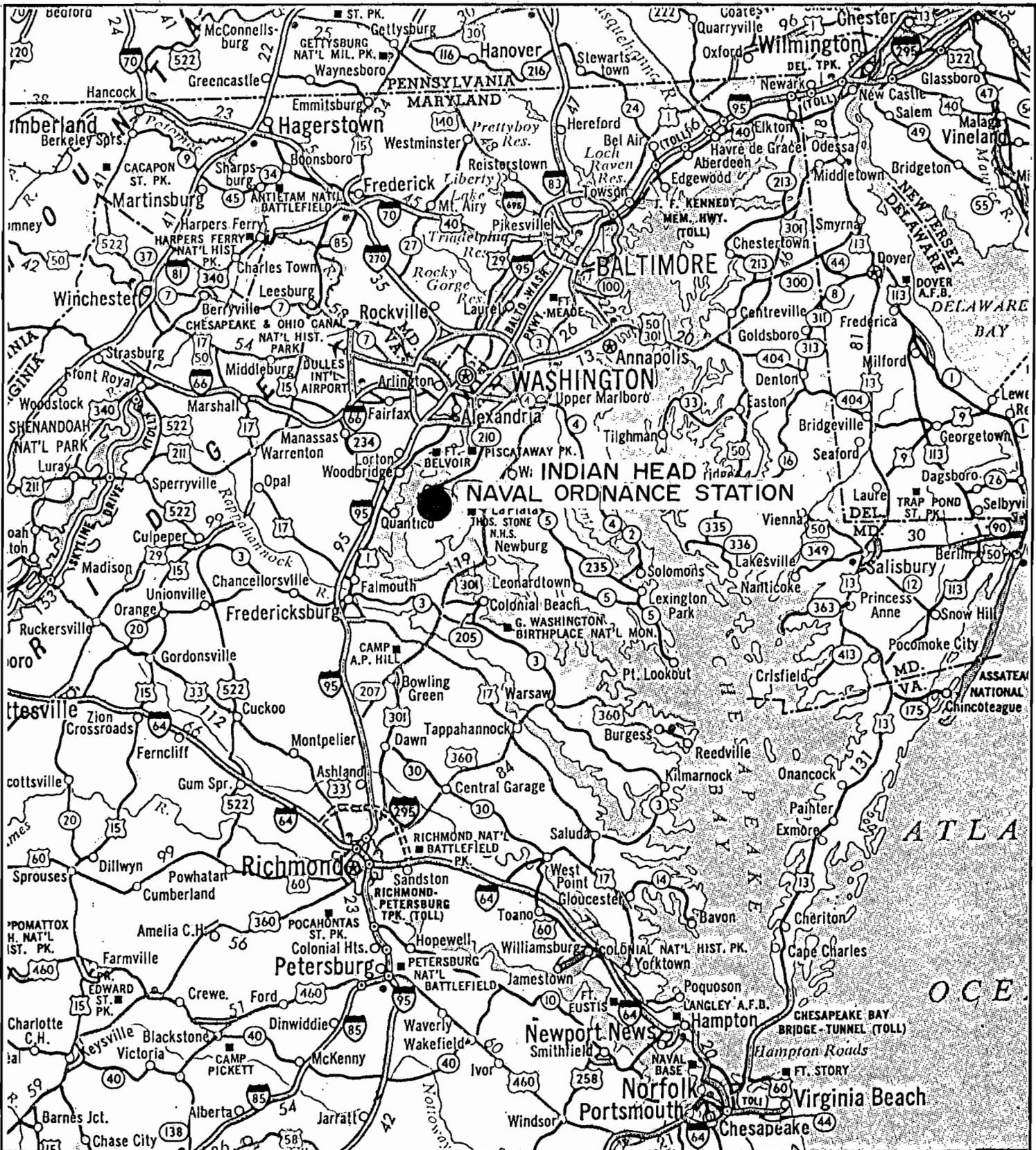
On February 23, 1987, E.C. Jordan Co. (Jordan) was authorized by Martin Marietta Energy Systems Inc. to conduct a feasibility study/remedial design for the Department of the Navy at the Naval Ordnance Station (NOS) located in Indian Head, Maryland (Figure 1-1). In June 1987, Jordan completed Task 1 of the project by submitting an approved Final Work Plan for the Feasibility Study and Remedial Design to the Navy and Martin Marietta Energy Systems Inc. The Work Plan describes the scope of work and methodology which were employed by Jordan to conduct Task 2 - Supplemental Site Characterization.

On September 25, 1987, Jordan was given notice to proceed by Martin Marietta Energy Systems, Inc. and began conducting Task 2 - Supplemental Site Characterization at NOS. This Supplemental Site Characterization Report describes the scope of the work conducted during the field investigation, and presents and evaluates the physical engineering data and laboratory chemical results. These results are used to provide conclusions which will further focus the remedial alternatives included in the Feasibility Study.

1.1 Background

Existing evidence suggests that mercury contamination from the Nitroglycerin Plant Office Laboratory (Bldg. 766), may be migrating in the surface water and sediment of a small stream that flows into a tidal pond downgradient of the laboratory. This pond discharges to Mattawoman Creek and the Potomac River. The release of mercury poses a potential threat to human health and the environment.

Mercury is used as a catalyst at NOS to perform a purity analysis of nitroglycerin. The nitrate-ester analysis is conducted at a laboratory in the Nitroglycerin (NG) Plant Laboratory Office. For over 20 years prior to 1981 small amounts of mercury used in laboratory tests in Building 766 were inadvertently disposed of down the sink and floor drains which discharged into a storm drainage manhole outside the building and then into the small stream. Since 1981, the floor drain has been sealed and these practices have been discontinued. The stream flows across 0.25 miles of Navy property into a tidal pond and then into Mattawoman Creek. The drainage has a total relief of 36 feet.



**LOCATION OF NOS
INDIAN HEAD**

E.C. JORDAN CO.
ENGINEERS & SCIENTISTS

TASK 2 SUPPLEMENTAL
SITE CHARACTERIZATION

U.S. DEPT. OF NAVY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

FIGURE 1-1

The Verification and Characterization phase of the Confirmation Study were conducted by CH₂M Hill in 1985. This stream and tidal pond comprise Site 8 in this report. Sediment samples collected from the stream just below the manhole during this study contained mercury concentrations as high as 1,100 mg/kg. Lower concentrations were found in sediments as far as 2,500 feet downgradient from the NG Plant Laboratory Office. Concentrations in sediments at the outfall into Mattawoman Creek (3.5 mg/kg) were still above the background levels suggested in the Confirmation Study (0.45-1.5 mg/kg). Seven unfiltered water samples from within the creek also revealed elevated total mercury concentrations, up to 0.17 mg/l. Of the seven water samples collected in January 1984 the three from the stream exceeded the USEPA National Interim Primary drinking water standard of 2.0 ug/l. The remaining four samples collected from tidal pond were below the drinking water criteria. These water samples were all collected during cold water conditions (January 1984).

Estimates from the Confirmation Study suggest that 200 to 500 pounds of mercury may reside in the soils along the drainage area and in sediments of the stream and pond. The study also suggested that the pond probably traps much of the sediment from the drainage and that more than 95 percent of the mercury at Site 8 is located in the pond.

To characterize the geology beneath NOS, Jordan personnel reviewed existing soil boring and well installation logs available at NOS. These records indicate that the geology beneath NOS consists of approximately 600 feet of clay. Additionally, information reviewed on the installation of water supply wells and pump test data at NOS suggest that significant aquifers do not exist at reasonable depths beneath NOS, due to the low production capability of the clays present. This geologic interpretation was confirmed during the ground penetrating radar survey and the sediment coring program conducted during the field investigation of this Supplemental Site Characterization Study. The results from these investigations support that Site 8 is underlain by clay.

1.2 Purpose

The purpose of the Supplemental Site Characterization Study (Task 2) of the project is to complete the understanding of the physical environment and assess the distribution, migration and fate of mercury in sediment and surface water for use in conducting a feasibility study. Based on the results of these additional investigations and the previous data, an environmental evaluation of alternatives will be conducted and a Feasibility Study Report (FSR) and Remedial Design prepared.

1.3 Scope

The scope of this field investigation was to provide information to perform a Feasibility Study of remedial alternatives for Site 8. The Task 2 Supplemental Site Characterization Study was conducted October 19-28, 1987. The field work included survey of the stream area, surface water hydrology measurements, ground penetrating radar survey (GPR) to determine the depth and volume of sediment present in the stream and pond; and surface water, sediment, and surface soil sampling to assess the extent and migration of mercury contamination. Surface water samples were analyzed for total mercury, dissolved mercury, and total suspended solids. Surface soil and sediment samples were analyzed for total mercury. Ten percent of the soil and sediment samples were analyzed for EPTOX and Toxicity Characteristics Leaching Procedure (TCLP) metals. This report is to summarize the data collected for the Feasibility Study during Jordan's field effort.

2.0 FIELD INVESTIGATION

The field investigation at NOS consisted of the following activities which were conducted by Jordan at NOS in accordance with the NACIP Feasibility Study and Remedial Design Final Work Plan dated June 1987.

- o Elevation and distance survey;
- o Surface water hydrology measurements;
- o Surface water sampling;
- o Sediment sampling;
- o Ground penetrating radar survey; and
- o Surface soil sampling.

The methods of investigation and sampling, physical and chemical results and an evaluation of those results are presented in the following sections.

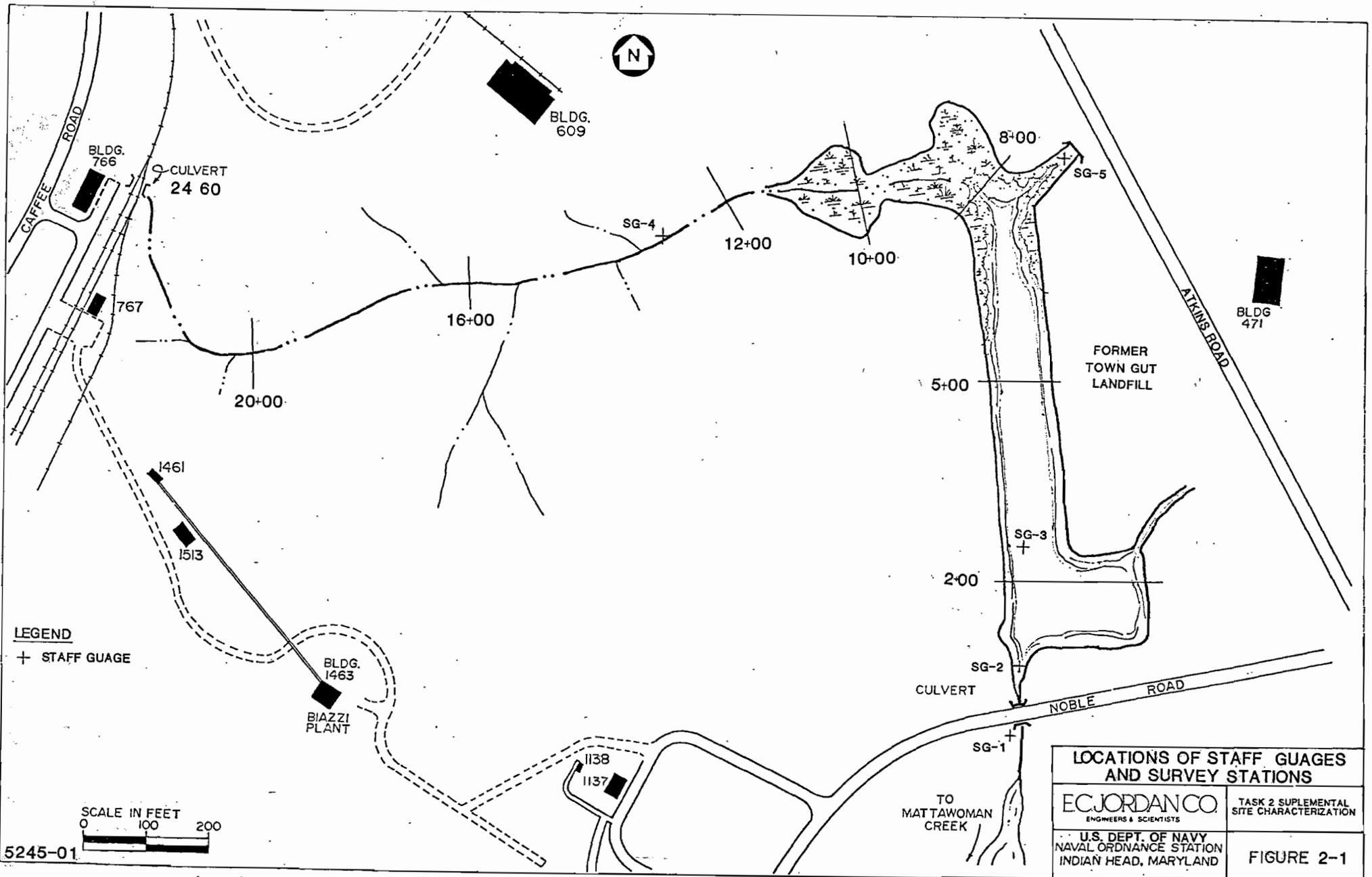
2.1 Elevation Survey

An elevation survey was conducted to determine staff gauge elevations, elevations of surface soil sample locations, and elevations of several points in the stream between Building 766 and the pond. Locations of survey stations and staff gauges is presented in Figure 2-1. Data collected during the survey is presented in Appendix C. This information was used in the surface water hydrology study and analysis of surface soil sample results and will be used in subsequent stages of the project.

The survey was conducted beginning on October 19 with the location of permanent benchmarks and measurement of stations from Noble Road to Building 766. Elevations of staff gauges were obtained on October 20; elevations of surface soil sampling locations and selected points in the stream were measured October 24 and 25.

2.2 Surface Water Hydrology

The surface water hydrology study was conducted to characterize flow from the pond into Mattawoman Creek as well as to gather data on the tributaries into the pond. The purpose of collecting this data was to facilitate the evaluation and design of remedial control measures involving water treatment.



LEGEND

+ STAFF GAUGE



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LOCATIONS OF STAFF GAUGES AND SURVEY STATIONS	
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<small>U.S. DEPT. OF NAVY NAVAL ORDNANCE STATION INDIAN HEAD, MARYLAND</small>	
FIGURE 2-1	

The hydrology study began on October 20 with the installation of staff gauges and the removal of a beaver dam from the inlet to the Noble Road culvert. The dam was in place when Jordan personnel arrived at NOS and was removed to facilitate the collection of flow data from the culvert. On October 22, Jordan personnel installed a V-notch weir in the culvert. The beaver was not removed and consequently damaged the V-notch weir and attempted to rebuild the dam at the culvert inlet each night during Jordan's field effort. As a result of this activity, the water level in the pond fluctuated approximately two feet and gathering accurate data from the V-notch weir was not feasible. Because of this difficulty, direct volume measurements of the pond were taken as a precaution. During the evaluation process, this data was determined to be the most indicative of actual flow conditions out of the pond.

The area currently referred to as the tidal pond was at one time in an inland extension of Mattawoman Creek. The construction of Noble Road restricted flow between the tidal pond and Mattawoman Creek. Discharge is now confined to flow through the seven foot diameter Noble Road culvert. In addition to interfering with data collection efforts in the culvert, the beaver activity affects tidal influence on the pond. The upstream dam raised the water level of the pond to an elevation well above the observed tidal cycles. This results in little potential for tidal flushing of the tidal pond. On only one occasion did (October 21, 1987) Jordan personnel observe tidal flow from Mattawoman Creek into the pond. This occurred after the beaver dam had been removed on the previous day.

2.2.1 Methods of Measurement

Data were collected from the staff gauges, the V-notch weir, and by direct measurement. Due to the circumstances described previously, Jordan personnel determined the direct measurement data to be the most accurate. This data will therefore be used in the evaluation of outflow from the tidal pond.

Direct measurements were obtained from the weir by filling a four gallon container with water flowing from the notch and measuring the time required to fill this volume. Each measurement was triplicated to determine the average time to fill the container. From these measurements the discharge from the pond to Mattawoman Creek was calculated in gallons per minute (gpm). Discharge measurements were collected on October 22 and 23. The October 22 measurement was taken approximately five hours after the installation of the weir. By that time the water level had stabilized following removal of the beaver dam and this measurement is believed to be indicative of base flow. The subsequent increase in discharge on October 23, 1987 is believed to be related to an upstream discharge of process water into the tributary which flows under Atkins Road.

2.2.2 Results - Surface Water Hydrology

Several direct measurements of discharge were obtained. The results presented in the following table are based on triplicate measurements to determine an average time:

<u>Date/Time of Test</u>	<u>Average Time (secs)</u>	<u>Volume (gals)</u>	<u>Discharge (gpm)</u>
October 22 (15:44)	10.31	4	23
October 23 (9:30)	2.17	4	110
October 23 (12:45)	2.06	4	117
October 23 (16:20)	3.35	4	72

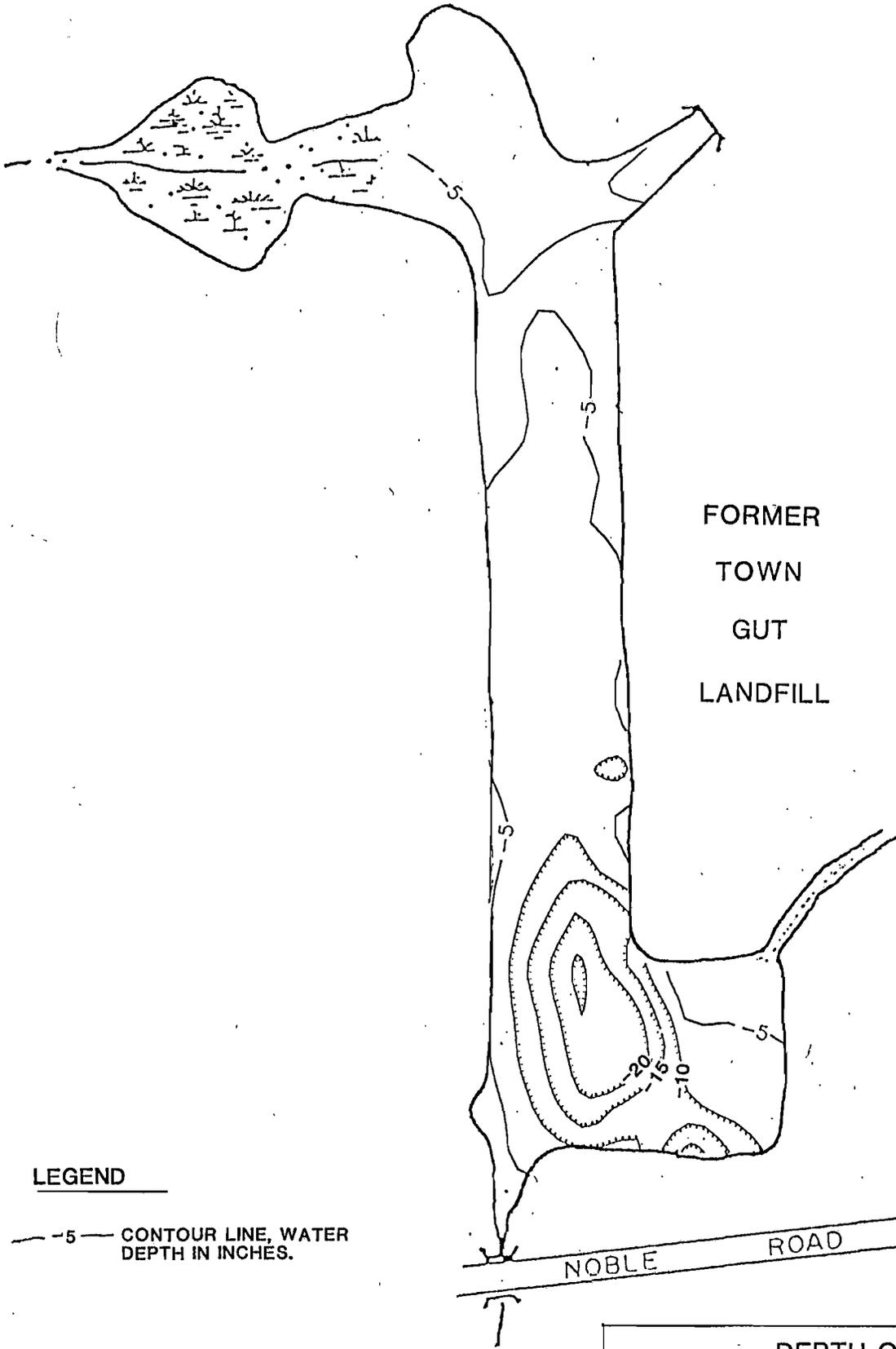
Figure 2-2 presents water depths in the tidal pond which were measured during the ground penetrating radar (GPR) survey. Pond depths ranged from 5-25 inches and averaged approximately 8 inches.

2.2.3 Evaluation

Due to the continual disruptive nocturnal activity of the beaver living in the tidal pond, measurements of tidal flow into the pond were not possible and weir calculation (Kulin and Compton) were not reliable. Although direct measurements of discharge into Mattawoman Creek are sparse, some general observations are relevant to this study. Firstly, the beaver dam at the culvert reduces the amount of sediments discharged into Mattawoman Creek. Not only does this dam provide a natural sedimentation basin, it also eliminates tidal flushing of the tidal pond. Secondly, discharge flow from the tidal pond at the time of this study under static flow conditions was approximately 23 gallons per minute. Following a process water discharge from the Atkins Road tributary pond discharge flow increased to approximately 117 gallons per minute. Therefore, anthropogenic discharges into the tributaries upstream of the tidal pond will increase the discharge flow and possibly sediment transport into Mattawoman Creek.

2.3 Surface Water Sampling Program

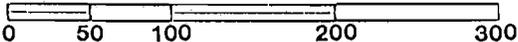
Two rounds of surface water samples, one representing relatively low flow and one representing relatively high flow conditions were collected at three locations around the pond (See Figure 2-3). The first round was collected on October 21; the second round was collected on October 26.



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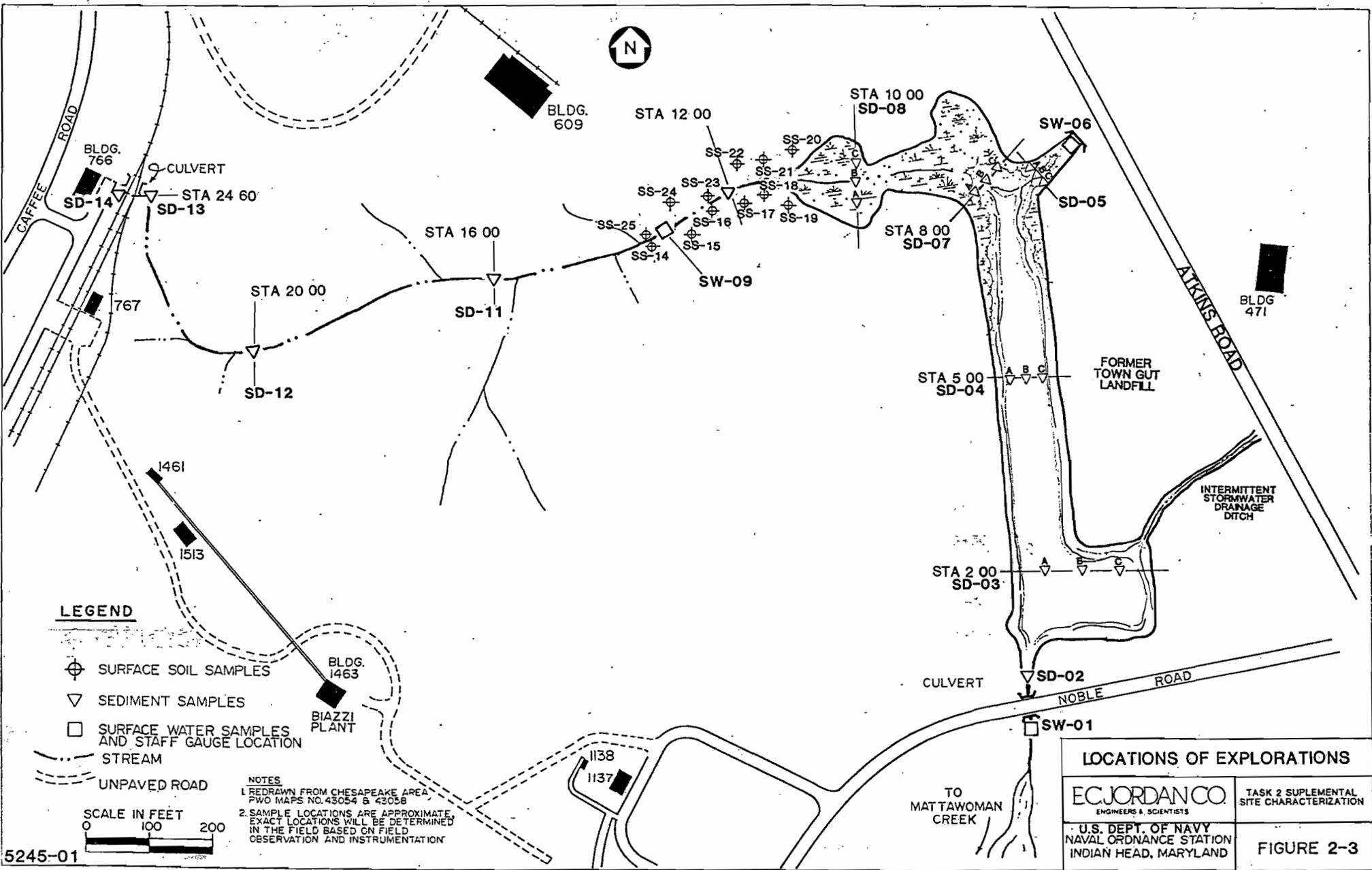
-5- CONTOUR LINE, WATER DEPTH IN INCHES.

SCALE IN FEET



5245-01

DEPTH OF WATER IN TIDAL POND	
EG. JORDAN CO. ENGINEERS & SCIENTISTS	TASK 2 SUPPLEMENTAL SITE CHARACTERIZATION
U.S. DEPT. OF NAVY NAVAL ORDNANCE STATION INDIAN HEAD, MARYLAND	FIGURE 2-2



LOCATIONS OF EXPLORATIONS	
ECJORDAN CO. <small>ENGINEERS & SCIENTISTS</small>	<small>TASK 2 SUPPLEMENTAL SITE CHARACTERIZATION</small>
<small>U.S. DEPT. OF NAVY NAVAL ORDNANCE STATION INDIAN HEAD, MARYLAND</small>	
FIGURE 2-3	

2.3.1 Methods of Investigation

Surface water samples were collected to determine the portion of dissolved mercury and the portion present in suspended sediments. This information was collected to assist in the selection and design of remedial measures, as mercury present in suspended sediments would require different control measures than mercury dissolved in the water.

The locations of the surface water samples were chosen to detect differences in concentrations at each tributary and whether mercury is being transported from the pond into Mattawoman Creek either in suspended sediments or dissolved in the water. Samples were collected at the following locations:

<u>Sample Number</u>	<u>Sample Location</u>
SW-01 A, B, C	Southern end of the Noble Road Culvert
SW-06 A, B	Southern end of Atkins Road Culvert
SW-09 A, B	Stream from Building 766 at entrance to the tidal pond.
SW-26 A	Tap water collected from Building 765

Samples designated with an "A" (e.g. SW-01-A) were collected during the low flow conditions during the first round of surface water sampling. Samples designated with a "B" (e.g. SW-01-B) were collected during higher flow conditions, following a period of light rain and on the outgoing tide. The sample designated with a "C" (SW-01-C) was a quality control duplicate of SW-01-A. SW-26-A was a sample of tap water used in field decontamination of sampling equipment.

Surface water samples to be analyzed for total mercury and total suspended solids (TSS) were collected directly into 250 ml plastic sample containers. Samples to be analyzed for dissolved mercury were collected in a clean 500 ml glass jar, vacuum filtered through 0.45 um filters, and placed into 250 ml plastic containers. Samples collected for both total and dissolved mercury were preserved with 5 ml of nitric acid to pH less than 2. A Field Data and Quality Assurance Report was completed for each sample collected. Copies of these reports are presented in Appendix B. All water samples were cooled to 4°C and shipped via Federal Express to CompuChem Laboratories for chemical analysis. Surface water samples were analyzed for dissolved and total mercury and total suspended solids. A list of the analytical method for each of the parameters and the related detection limit is presented in Appendix A.

2.3.2 Results - Surface Water Sampling

Surface water sampling results are presented in Table 2-1. Dissolved mercury was not present above laboratory detection limits of 0.20 ug/l in any of the surface water samples collected. Levels of total mercury were found above detection limits in samples SW-09-A (1.45 ug/l) and SW-09-B (0.22 ug/l). TSS levels were 34 mg/l and below the detection limit of 4 mg/l in SW-09-A and B, respectively. No measurable levels of total mercury were detected in any of the remaining surface water samples.

2.3.3 Evaluation of Surface Water Results

Based on the analytical results presented in Table 2-1 it is apparent that the small amount of migration that was occurring during the time that surface water sample collection was associated with suspended sediments. Surface water samples SW-09-A and SW-09-B contained total mercury (unfiltered sample), however, the same samples did not contain dissolved mercury (filtered sample) above the detection limit.

As indicated by the sample locations, the analytical results demonstrate that low levels of adsorbed mercury on sediments are being transported from the stream to the tidal pond. However, mercury is not coming into the pond from other tributaries and that detectable levels of mercury in either dissolved or total form was not leaving the tidal pond.

Total mercury concentrations found in samples SW-09-A (1.45 ug/l) and SW-09-B (0.22 ug/l) do not exceed the Maximum Contamination Level (MCL) of 2.0 ug/l for mercury in drinking water. It should be noted, however, that a major rainfall event did not occur during Jordan's field effort, so the possibility exists of higher total mercury concentrations during high flow periods. The total mercury concentrations in samples SW-01-A and B were below detection limits. This indicates that mercury-containing sediments are settling out in the pond. This settling is partially aided by the beaver dam, which increases the depth of this basin.

2.4 Sediment Sampling Program

To evaluate the sediments within the study area, the site was divided into two sections: (1) The upper stream from STA 24+60 down to the upper section of the tidal pond to STA 8+00 (see Figure 2-1); and (2) the tidal pond from STA 8+00 down to the culvert at Noble Road.

Sediment sampling in the stream was conducted on October 25, 1987. A total of 90 sediment samples were collected during the Task 2 field effort. Cores to depths of three feet were collected in the stream and at the north end of the Noble Road

TABLE 2-1
SUMMARY OF ANALYTICAL RESULTS
SURFACE WATER SAMPLES
TASK 2 - SUPPLEMENTAL SITE CHARACTERIZATION
NOS INDIAN HEAD

SAMPLE	TOTAL MERCURY (ug/L)	DISSOLVED MERCURY (ug/L)	TOTAL SUSPENDED SOLIDS (mg/L)
SW-01-A	BDL	BDL	16
SW-01-C (1)	BDL	BDL	15
SW-01-B	BDL	BDL	BDL
SW-06-A	BDL	BDL	14
SW-06-B	BDL	BDL	13
SW-09-A	1.45	BDL	34
SW-09-B	0.22	BDL	BDL
SW-26-A	BDL	BDL	10

NOTES:

(1) SW-01-C is a QA duplicate of SW-01-A.

BDL - Below laboratory detection limit of 0.2 ug/L for mercury;
4.0 mg/L for total suspended solids.

culvert. Cores to five feet were collected in the pond on October 22, 26, and 27. All core samples were analyzed for total mercury and ten percent were analyzed for EP Toxicity and TCLP metals.

2.4.1 Methods of Investigation

Figure 2-2 shows the locations of the sediment samples collected during the investigation. The purpose of collecting these sediment samples was to determine mercury concentrations at the specified depths in the sediments and to calculate the volume of sediments for evaluation of remedial technologies.

Sediment samples were collected using five to ten foot length of 1.25 inch polyvinyl chloride (PVC) pipe. The length of sampling pipe depended upon the water depth at each sampling location. The end of the pipe was sharpened to allow the pipe to cut through the sediments. Each piece of pipe was decontaminated according to procedures as specified in the approved Quality Assurance Project Plan (QAPP).

A total of ten stations were sampled for sediment analysis. Samples were collected in the stream at six stations (Noble Road, 10+00, 12+00, 16+00, 20+00, and 24+60). These cores were collected by driving the PVC pipe using a lead filled plastic mallet to a predetermined depth, or until the pipe met with refusal due to the underlying clay. The core pipe was then removed from the sediments and returned to the staging area for core extraction.

For samples collected in the pond at stations 8+00, 5+00, 2+00, and at the SD-05 transect (Figure 2-3), the cores were collected with the use of a vibrating corer. A tee fitting was placed on top of the PVC core pipe, and the vibrating head of a concrete vibrator was inserted through the tee fitting. The vibrations of the vibrating head are transferred to the PVC core pipe. The oscillation of the core pipe loosens the surrounding material allowing the core pipe to easily penetrate the sediments. The tee fitting was removed, after the core pipe was advanced to the desired depth, and the top of the core pipe capped and sealed with electrical tape. The core pipe was then pulled out of the sediments, taped closed on the bottom end, and returned to shore for core extraction.

Sample length was then measured to determine the amount of sediment within the core pipe. From observations during core collection, it appeared that the sediments became compacted as the core pipe was driven. Therefore, if the core was collected from 0 to 5 feet and contained only 3 feet of material, Jordan personnel assumed that compaction had occurred and cut the 3 feet of material into 5 separate but equal sections. The cored sediments were then extruded from each section, composited, and

placed into properly labeled sample jars. The samples were iced and shipped via Federal Express to CompuChem for laboratory chemical analysis.

Droplets of elemental mercury were found in stream sediments near Building 766 during supplemental site characterization sampling in October 1987. In November 1987, NOS personnel discovered and removed 10-15 grams of elemental mercury from the manhole near Building 766. NOS personnel decided to pour a new concrete base into the manhole to contain any remaining contamination and to aid in future cleaning of the manhole. The drain pipe from Building 766 was removed during renovations in late 1987. No other source of mercury contamination is known to be present.

2.4.2 Results - Sediment Sampling

The results of chemical analyses for the sediment samples are presented in Table 2-2. Ten percent of the samples were analyzed for EPTOX and TCLP metals. The results of these analyses are presented in Table 2-3. Droplets of free mercury were observed in sample SD-13 (from 0 to 1 foot deep) collected near the culvert by Building 766 (this sample was not analyzed by the laboratory). Total mercury concentrations in samples analyzed ranged from a high of 21 mg/kg (SD-08-C1), at station 10+00, to below the quantifiable detection limit of 0.10 mg/kg. The criteria for EPTOX are presented in Appendix D.

2.4.3 Evaluation of Sediment Sample Results

Mercury was detected above the detection limit (0.10 mg/kg) in 37 of the 77 sediment samples analyzed from the stream and tidal pond. Mercury was consistently detected in the top one foot of sediment in both the stream and tidal pond. Only two of the 20 locations sampled did not contain mercury in the top one foot of sediment. Sediments analyzed from the stream consistently contained detectable mercury to a depth of two feet where that depth of sediment existed. In stream sediment collected from depths of 2 to 3 feet, levels of mercury ranged from below detection limits (SD-10) to 1.1 mg/kg (SD-12). In the tidal pond, however, mercury distribution in sediments was generally limited to the top foot of sediments near the edges and top 2 feet in the center. Mercury concentrations in stream and tidal pond sediments decreased with vertical depth.

Due to the fact that no regulatory criteria exist for mercury in sediments both EPTOX and TCLP analyses were performed on percent of the samples to ascertain whether the sediments should be classified as a hazardous material. The results of these analyses do not exceed the EPTOX or TCLP criteria for any of the eight priority pollutant metals including mercury (See Appendix D).

TABLE 2-2
TOTAL MERCURY ANALYTICAL RESULTS
SEDIMENT SAMPLES
TASK 2 - SUPPLEMENTAL SITE CHARACTERIZATION
NOS INDIAN HEAD

STATION NUMBER	SAMPLE NUMBER	MERCURY CONCENTRATION (MG/KG) VS. SAMPLE DEPTH				
		0-1 FT	1-2 FT	2-3 FT	3-4 FT	4-5 FT
NOBLE RD.	SD-02	BDL (1)	BDL	BDL	--	--
2+00	SD-03-B (2)	1.1	3.3	BDL	BDL	BDL
	SD-03-C	0.2	BDL	BDL	--	--
5+00	SD-04-A	1.2	BDL	BDL	BDL	BDL
	SD-04-B	1.2	BDL	--	BDL	0.36
	SD-04-C	1.5	0.85	BDL	BDL	BDL
NE STREAM	SD-05-A	0.42	BDL	BDL	BDL	BDL
	SD-05-B	BDL	BDL	--	--	--
	SD-05-C	1.25	BDL	BDL	BDL	0.1
8+00	SD-07-A	10	0.1	2.2	BDL	0.13
	SD-07-B	0.34	BDL	BDL	BDL	BDL
	SD-07-C	1	BDL	BDL	BDL	BDL
10+00	SD-08-A	2.2	0.14	BDL	BDL	0.1
	SD-08-B	1	0.3	BDL	BDL	BDL
	SD-08-C	21	0.35	0.15	0.1	BDL
12+00	SD-10	0.44	3.9	BDL	--	--
16+00	SD-11	9.6	1.6	0.98	--	--
20+00	SD-12	4.1	2.7	1.1	--	--
24+60	SD-13	SEE NOTE (3)	0.22	--	--	--
MANHOLE	SD-14	3.4	--	--	--	--

NOTES:

- (1) BDL - BELOW LABORATORY DETECTION LIMIT OF 0.1 MG/KG.
- (2) "A", "B", AND "C" REFER TO LOCATIONS SHOWN ON FIGURE 2-3.
- (3) FREE MERCURY WAS VISIBLE IN SAMPLE SD-13-A; SAMPLE WAS NOT ANALYZED.
- INDICATES SAMPLE NOT TAKEN.

TABLE 2-3
 EP TOXICITY AND TCLP ANALYTICAL RESULTS
 SEDIMENT SAMPLES
 TASK 2 - SUPPLEMENTAL SITE CHARACTERIZATION
 NOS INDIAN HEAD

SAMPLE NO.	SD-02-A2		SD-04-A2		SD-04-B1		SD-07-B2	
	EPTOX	TCLP	EPTOX	TCLP	EPTOX	TCLP	EPTOX	TCLP
ANALYTE:	(ug/L)							
ARSENIC	6.8 []	5 []	7 []	15	209	197	18	11
CADMIUM	BDL	BDL	BDL	BDL	BDL	5.4	BDL	BDL
CHROMIUM	25	BDL	31	5.8 []	19	17	95	BDL
MERCURY	0.29	0.22	BDL	BDL	BDL	BDL	1.5	BDL
SELENIUM	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
SILVER	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BARIUM	198	264	304	382	424	429	745	227
LEAD	11	4 []	25	5.3	150	157	42.6	4.9 []

SAMPLE NO.	SD-08-C5		SD-10-A2		SD-12-A2		SD-13-A2	
	EPTOX	TCLP	EPTOX	TCLP	EPTOX	TCLP	EPTOX	TCLP
ANALYTE:	(ug/L)							
ARSENIC	BDL	4.6 []	11 N	7.8 []	9.7 []	4.9 []	BDL	BDL
CADMIUM	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CHROMIUM	227	BDL	20	21	7.3 []	11	257	BDL
MERCURY	0.51 *	BDL	84 N	127 N	26 N	115 N	0.74 N	2.3 N
SELENIUM	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
SILVER	BDL	BDL	35	30	BDL	BDL	BDL	BDL
BARIUM	804	210	178 []	179 []	180 []	81 []	631	171 []
LEAD	274	NA	670	575	21 *	42 *	290	15

NOTES:

N - Indicates spike sample recovery is not within control limits.

[] - Indicates concentration above instrument detection limits, but below contract required detection limit (CRDL).

BDL - Below detection limit. Detection limits in ug/l: As - 10; Cd - 5;

Cr-10; Hg - 0.2; Se - 5; Ag - 10; Ba - 200; and Pb - 5

* - Indicates duplicate analysis is not within control limits.

2.5. Sediment Volume

The sediment volume investigation involved a combination of hand-core sampling, vibrating core sampling, and a GPR survey. The core samples were taken in conjunction with the sediment sampling. Sediment cores in the stream were collected on October 25; pond sediments were collected on October 22, 26 and 27. The GPR survey was conducted on October 23.

2.5.1 Methods of Investigation

The sediment volume investigation in the stream (from STA 24+60 down to STA 8+00) was conducted in conjunction with the sediment sampling described in Section 2.3.2. As the core pipe was being driven into the stream bed, the depth was noted at which the penetration rate showed. This depth was observed to be the depth of the sediments at the station. Additionally, as the core sample was extracted, the thickness of the sediments and the clay were measured.

To determine the depth of sediments in the pond a ground penetrating radar (GPR) survey was conducted. The GPR operates as an echo-ranging system, in which the transmitter emits a short radar impulse and the receiver picks up the return echoes. Depths are determined by the time difference taken for the signal to be transmitted and received by the GPR instrumentation. The GPR instrumentation was mounted in a fiberglass canoe, which was paddled across the pond on the surveyed transect lines.

Transect lines from east to west were established at 50 foot intervals across the pond. The sediment cores collected at stations 2+00, 5+00, and 8+00, were to be used as a ground truthing method.

2.5.2 Results - Sediment Volume Investigation

The volume of sediments between STA 24+60 and STA 8+00 (see Figure 2-1) was calculated in segments, from station to station, and is presented in Table 2-4. The length measured is the actual stream distance, in feet, as measured from station to station. The average width was calculated from the width of the stream at both stations, except for the segment between STA 10+00 and STA 8+00 where the width is irregular. At these stations the width was averaged from four measurements between these stations. The average sediment depth was calculated using the measured sediment thickness at each of the two stations.

TABLE 2-4
 ESTIMATION OF SEDIMENT VOLUME IN THE STREAM (STA 24+60 TO STA 8+00)
 TASK 2 - SUPPLEMENTAL SITE CHARACTERIZATION
 NOS INDIAN HEAD

SEGMENT LOCATION (1)	STREAM LENGTH	AVERAGE WIDTH (2)	AVERAGE DEPTH	CU. FT.	CU. YDS.	CU. YDS./1 FT. DEP
FROM STA. 24+60 TO STA.20+00	460 FT	4 FT	2 FT	3,680	136	68
FROM STA. 20+00 TO STA. 16+00	400 FT	10 FT	3 FT	12,000	444	148
FROM STA. 16+00 TO STA. 12+00	400 FT	20 FT	3 FT	24,000	889	296
FROM STA. 12+00 TO STA. 10+00	200 FT	80 FT	4.5 FT	72,000	2,667	593
FROM STA. 10+00 TO STA.8+00	200 FT	138 FT	5 FT	138,000	5,111	1,022
TOTAL					9,247	2,127

NOTES:

- (1) STATION LOCATIONS PRESENTED ON FIGURE 2-1.
- (2) AVERAGE CALCULATED FROM MEASUREMENTS AT BOTH END POINTS.

Figure 2-4 depicts an isopach map showing the thickness of the sediments, with the pond, from STA 8+00 down to Noble Road. This figure was computer generated by the interpolation of over 250 data points, showing sediment thickness, collected during the GPR survey. The map is divided into the following sections:

- o STA 1+00 to STA 2+00;
- o STA 2+00 to STA 5+00; and
- o STA 5+00 to STA 8+00.

The area (in square feet) for each section, within the contour lines and between the station numbers, was calculated using a dot grid. Each of these areas were assigned a letter (from A to Z) and are shown on Figure 2-4 and presented in Table 2-5. The average thickness of the sediments (Table 2-5), within a contour area, was obtained by averaging the values found (by GPR) along a transect line and within the contour area.

2.5.3 Evaluation of Sediment Volume Investigations

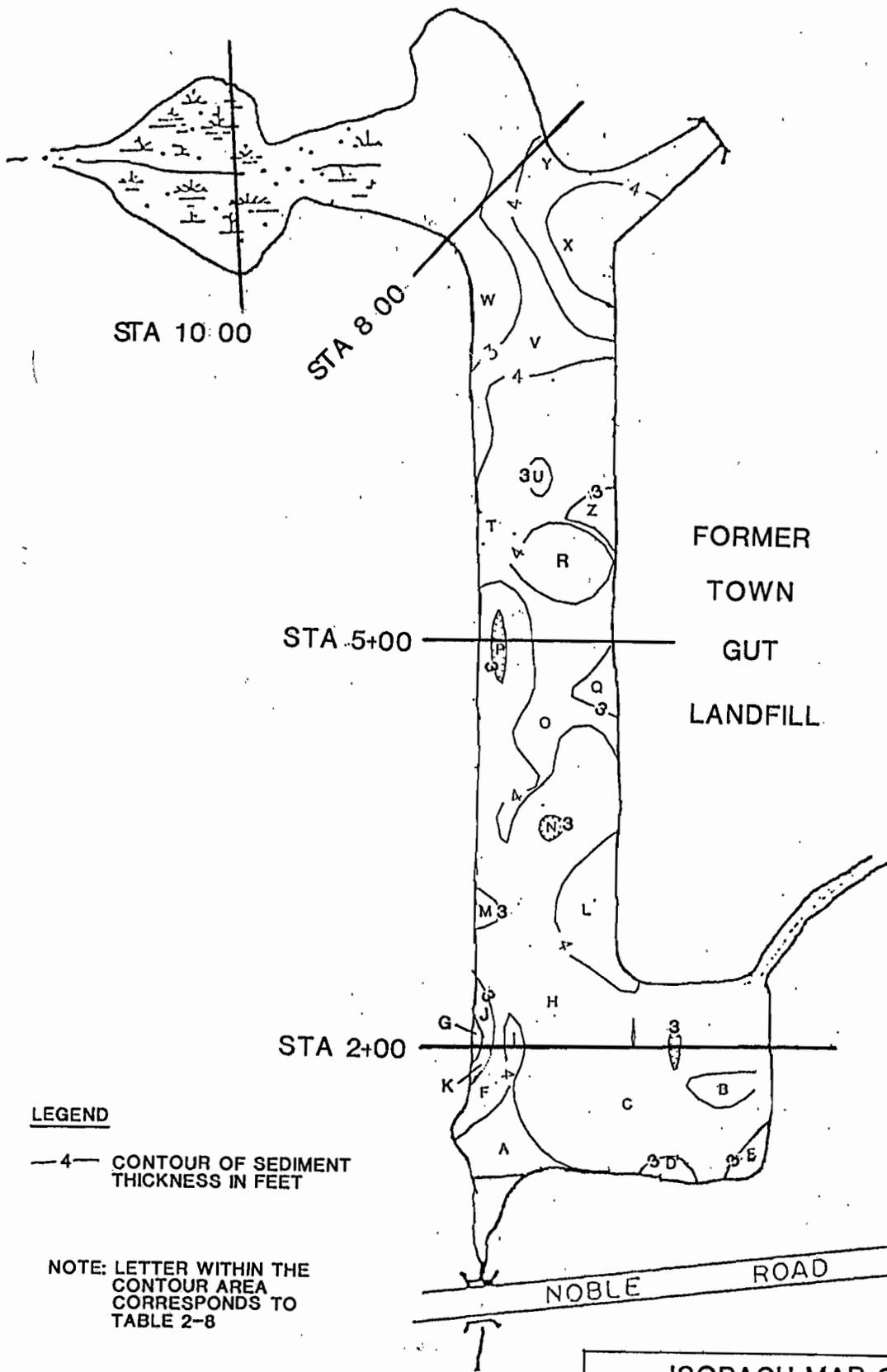
Based on the GPR survey results and the results of the sediment coring the total volume of sediment contained in the stream and tidal pond (STA 24+60 to the Noble Road culvert) is approximately 23,042 cubic yards. The stream sediments (STA 24+60 to the STA 8+00) comprise 9,247 cubic yards and the tidal pond sediments (STA 8+00 to Noble Road culvert) consist of approximately 13,795 cubic yards.

Based on the sediment volume information and the sediment quality data, volumes of sediment contaminated to varying degrees have been estimated. These estimates are shown in Table 2-6.

The tidal pond, from the culvert at Noble Road to STA 12+00 comprises approximately 148,600 square feet. Each foot of sediment, throughout the pond, which contained mercury above some target concentration would contain an approximate volume of 3,890 cubic yards of sediment. Figure 2-5 presents the estimated depth of sediments in the tidal pond which contains mercury above 0.10 mg/kg. As the Task 3 Feasibility Study progresses, similar figures can be generated for other mercury levels.

2.6. Surface Soil Sampling

Surface soil samples were collected from the floodplain area adjacent to the stream immediately upgradient of the pond. This area has flooded in the past when beavers dammed up the

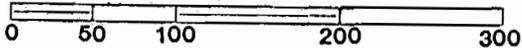


LEGEND

— 4 — CONTOUR OF SEDIMENT THICKNESS IN FEET

NOTE: LETTER WITHIN THE CONTOUR AREA CORRESPONDS TO TABLE 2-8

SCALE IN FEET



ISOPACH MAP OF SEDIMENTS IN TIDAL POND

E.C. JORDAN CO.
ENGINEERS & SCIENTISTS

TASK 2 SUPPLEMENTAL SITE CHARACTERIZATION

U.S. DEPT. OF NAVY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

FIGURE 2-4

TABLE 2-5
VOLUME OF SEDIMENTS IN TIDAL POND
TASK 2 - SUPPLEMENTAL SITE CHARACTERIZATION
NOS INDIAN HEAD

STA 1+00 TO STA 2+00

SECTION(1)	SQUARE FEET	AVERAGE THICKNESS IN FEET	CUBIC FEET	CUBIC YARDS
A	2656.2	4	10625	393.5
B	1250	2.7	3375	125
C	15625	3.5	54687.5	2025.5
D	156	3.7	156	21.4
E	312.5	3.1	968.7	35.9
F	1093.7	3.0	3281	121.5
G	312.5	2.0	625	23.1
			TOTAL	2745.9

STA 2+00 TO STA 5+00

H	24375	3.3	80437.5	2979.2
I	156	4.0	624	23.1
J	625	2.0	1250	46.3
K	312.5	1.7	531.2	19.7
L	3906	4.2	16405	607.6
M	625	3.5	2187.5	81
N	312.5	4.3	1343.8	49.8
O	5156	4.0	20624	763.9
P	468	2.5	1170	43.3
Q	625	4.7	2937.5	108.8
			TOTAL	4722.7

STA 5+00 TO STA 8+00

R	3281	4.8	15748.8	583.3
S	1562	3.3	5154.6	190.9
T	12812	4.1	52529.2	1945.5
U	625	3.9	2437	90.3
V	8125	3.5	28437	1053.2
W	6406	2.5	16015	593.1
X	3437	4.5	15466	572.8
Y	8437	3.8	32060	1187.4
Z	781	3.8	2968	109.9
			TOTAL	6326.4

TOTAL SEDIMENTS IN POND 13,795

(1) SECTION REFERS TO THE LETTER WITHIN THE CONTOURS LINES SHOWN IN FIGURE 2-4

TABLE 2-6
 ESTIMATED SEDIMENT VOLUMES FOR SELECTED MERCURY CONCENTRATIONS
 TASK 2 - SUPPLEMENTAL SITE CHARACTERIZATION
 NOS INDIAN HEAD

CUBIC YARDS CONTAINING:

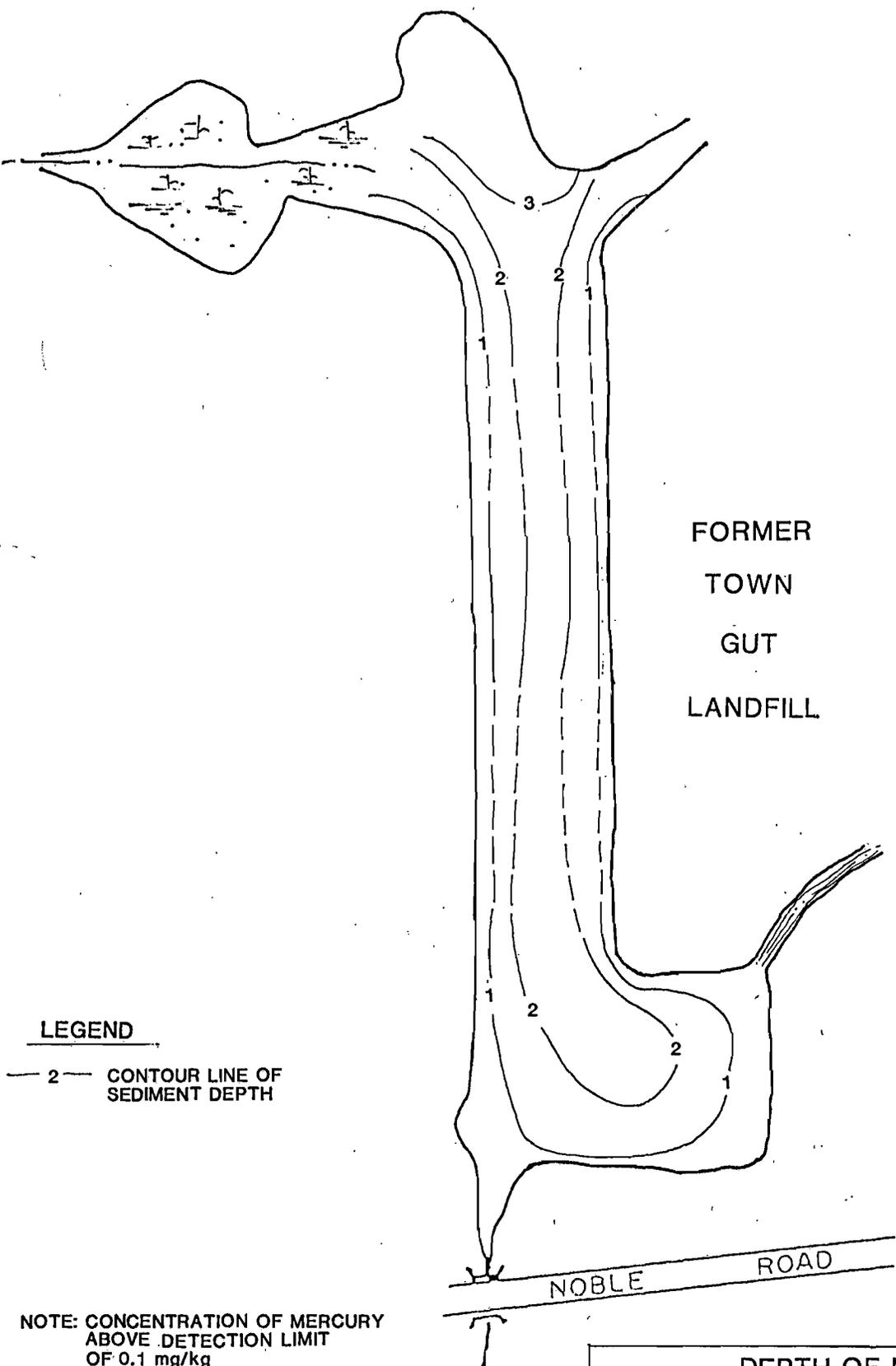
SEGMENT LOCATION (1)	>= 0.1 mg/Kg	>= 1 mg/Kg	>=5 mg/Kg
FROM STA. 24+60 TO STA. 12+00	1,469	1,254	661
FROM STA. 12+00 TO NOBLE RD. CULVERT	10,844	6,301	1,615
TOTAL	12,313	7,555	2,276

NOTES:

(1) STATION LOCATIONS PRESENTED ON FIGURE 2-1.



FORMER
TOWN
GUT
LANDFILL

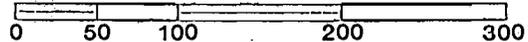


LEGEND

— 2 — CONTOUR LINE OF
SEDIMENT DEPTH

NOTE: CONCENTRATION OF MERCURY
ABOVE DETECTION LIMIT
OF 0.1 mg/kg

SCALE IN FEET



**DEPTH OF MERCURY
CONTAMINATION IN SEDIMENTS**

E.C. JORDAN CO.
ENGINEERS & SCIENTISTS

TASK 2 SUPPLEMENTAL
SITE CHARACTERIZATION

U.S. DEPT. OF NAVY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

FIGURE 2-5

Noble Road culvert, causing the water level in the pond to rise several feet. In an effort to characterize the extent of contamination caused by deposition of mercury containing sediments, twelve samples were collected at varying elevations and distances relative to the stream.

2.6.1 Methods of Investigations

Figure 2-3 shows the locations of the surface soil samples. All samples were analyzed for total mercury concentration. Additionally, EPTOX and TCLP analyses were performed on samples SS-14 and SS-23. Surface soil samples were collected on October 23, 1987. Surface soil samples were chosen and marked with wooden stakes prior to collection. Soil samples were collected from depths of 0-3 inches at each location using a clean stainless steel spoon. Each sample was composited prior to placing it into a 4-ounce glass sample container. Samples were cooled to 4°C and shipped via Federal Express to CompuChem.

2.6.2 Results - Surface Soil Sampling

Surface soil analytical results are presented in Table 2-7. Concentrations of mercury detected ranged from 0.12 mg/kg in sample SS-14 to 25 mg/kg in sample SS-15. EPTOX and TCLP results are presented in Table 2-8.

2.6.3 Evaluation of Surface Soil Results

Background levels presented by the Conner and Shacklette (1975) for the soils in the eastern U.S. range from 0.019 - 3.4 mg/kg. Results from SS-15 (25 mg/kg) and SS-24 (4.2 mg/kg) exceeded upper level of this range. It was anticipated that the higher levels of mercury in surface soils would occur at points of low elevation near the stream. Surveyed elevations of soil sampling locations (see Appendix A) did not confirm these expectations as no correlation was apparent between higher elevations and lower mercury levels.

Extracts of surface soil samples SS-14, SS-19 and SS-23, analyzed for EP Toxicity did not exceed standards for any of the elements analyzed. Maximum allowable levels for determining EP Toxicity are presented in Appendix D.

TABLE 2-7
 TOTAL MERCURY ANALYTICAL RESULTS
 SURFACE SOIL SAMPLES
 TASK 2 - SUPPLEMENTAL SITE CHARACTERIZATION
 NOS INDIAN HEAD

SAMPLE NUMBER	TOTAL MERCURY (MG/KG)
SS-14	0.12
SS-15	25
SS-16	0.39
SS-17	4
SS-18	0.14
SS-19	1.5
SS-20	0.36
SS-21	0.16
SS-22	1.7
SS-23	0.28
SS-24	4.2
SS-25	0.6

TABLE 2-8
 EP TOXICITY AND TCLP ANALYTICAL RESULTS
 SURFACE SOIL SAMPLES
 TASK 2 - SUPPLEMENTAL SITE CHARACTERIZATION
 NOS INDIAN HEAD

SAMPLE NO.	SS-14		SS-19		SS-23	
	EPTOX	TCLP	EPTOX	TCLP	EPTOX	TCLP
ANALYTE: (ug/L)						
Arsenic	12 N	11 N	2 [] N	BDL N	7.5 []	10 [] N
Cadmium	BDL	BDL	BDL	BDL	5.8	BDL
Chromium	155	15	BDL	5 []	13	12
Mercury	2.5 N	BDL	BDL *	0.53 *	6.2 N	1.4 N
Selenium	BDL	BDL	BDL	BDL N	BDL	BDL
Silver	BDL	BDL	BDL	BDL	BDL	BDL
Barium	1120	461	115 []	94 []	236	240
Lead	1170 N	86 N	80	BDL	384 N	260 N

NOTES:

- N - Indicates spike sample recovery is not within control limits.
- * - Indicates duplicate analysis is not within control limits.
- [] - Indicates concentration above instrument detection limits, but less than contract rethe contract required detection limit (CRDL).
- BDL - Below detection limit. Detection limits in ug/l: As - 10; Cd - 5; Cr-10; Hg - 0.2; Se - 5; Ag - 10; Ba - 200; and Pb - 5

3.0 CONCLUSIONS

The following conclusions are based upon field observations, review of the analytical data, file information and previous studies conducted at Indian Head:

1. The stream and tidal ponds are underlain by approximately 600 feet of clay which apparently does not contain significant water supply aquifers.
2. The surface water in the tidal pond ranges from 5 to 25 inches and averages 8 inches in depth.
3. Basal flow discharge from the tidal pond during the field investigation was approximately 23 gallons per minute.
4. Tidal pond discharge can increase to approximately 117 gallons per minute subsequent to an upstream release of industrial process water from the Atkins Road tributary.
5. The beaver dam at the Noble Road culvert enhances the tendency of particles to remain in the pond by increasing water depth.
6. Mercury migration appears to be related to sediment transport rather than migration in solution in surface water.
7. The stream and tidal pond contain a total of 23,042 cubic yards of sediment which ranges from 2 to 7 feet in thickness and is underlain by clay.
8. The volume of sediments containing more than these concentrations of mercury is estimated as follows:

<u>Mercury Concentration</u> <u>mg/kg</u>	<u>Volume</u> <u>(cu. yd.)</u>
0.1	12,313
1	7,555
5	2,276

4.0 REFERENCES

Conner, J.J. and H.T. Shacklette, 1975. **Background Geochemistry of Some Rocks, Soils, Plants and Vegetables in the Conterminous United States.** U.S. Geological Survey Professional Paper 574 F.

Kulin, Gershon, and Phillip R. Compton, 1975. **A Guide to Methods and Standards for the Measurement of Water Flow,** National Technical Information Service, Springfield, VA.

CH₂M Hill, 1985. **NACIP Confirmation Study, Naval Ordnance Station, Indian Head, Maryland.** September 1985.

APPENDIX A

Methods and Detection Limits

5245IH04.TXT
DOC F00

Change in Inorganic Analytical Policies

CompuChem® Laboratories, Inc., is a member of EPA's Inorganic Contract Laboratory Program (CLP), which includes the assessment of twenty-three (23) metals in aqueous and non-aqueous (soil/sediment) matrices. The methodologies employed in the program are considered to be the State-of-the-Art and are subject to modifications as improvements are implemented.

Associated with the Inorganics CLP are certain Quality Control (QC) requirements which provide for the generation of analytical data of known, high quality. In an effort to be able to pass along the benefits of our involvement in the program, CompuChem® has made the decision to adopt the methodologies and reporting conventions utilized by the EPA in the CLP. Included in the policies being adopted for all metals analyses are the following:

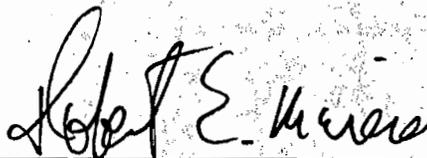
- 1) On a quarterly basis, instrumental detection limits are experimentally determined for each Inductively Coupled Plasma (ICP) and Atomic Absorption Spectrophotometer (AAS) system in the laboratory.
- 2) For ICP systems, on a quarterly basis, interelement and background correction factors are determined using an Interference Check Standard. Another quarterly requirement for ICP analysis is a linear range verification determination for each element analyzed.
- 3) On a daily basis, and for each AAS or ICP system used, an instrument calibration is performed. For AAS calibration, a blank and at least three calibration standards are employed and for ICP calibration, a mid-concentration standard is analyzed. After this preliminary calibration, the calibration is verified for accuracy by the analysis of an Initial Calibration Verification Standard. To assure calibration accuracy during the course of analysis, a Calibration Verification Standard is analyzed at a frequency of 10% or every two hours, whichever is more frequent. Acceptance and rerun criteria, established by EPA in the CLP, for the Initial and Continuing Calibration Verification Standards will be used for all analyses.
- 4) An ICP Interference Check Standard is analyzed at a minimum of twice per shift to verify interelement and background correction factors. Acceptance and rerun criteria established by EPA in the CLP will be used for all analyses.
- 5) Other QC measures being employed for all analyses include an ICP serial dilution analysis for each group of samples analyzed and duplicate injections for each furnace AAS element, per sample. Duplicate injections must agree within 20% or the sample is rerun once.

In adopting the EPA-CLP methodologies and reporting conventions, the following points should be realized since differences in the presentation of the data will be apparent:

- 1) If the analytical result is a value equal to or greater than the instrument detection limit, but less than EPA's Contract Required Detection Limit (CRDL), the value will be reported in brackets (i.e., [8.7]).
- 2) If an element was analyzed for and not detected, the instrument detection limit value is reported with a "U" (i.e., 10U).
- 3) Results for the analysis of water samples will be reported in units of ug/L and for solid samples, the units will be mg/kg.
- 4) The instrument detection limits (reported with a "U" if the element is not detected) necessarily will be required to be determined on a per sample basis for solid matrices, since they are dependent on the sample size taken. In the CLP, a 1.0 to 1.5g. sample is taken for each of two digestion procedures; one for digestion and subsequent analysis by ICP and another for a different digestion and subsequent analysis by AAS. If mercury is required, a third, separate portion of the sample is taken. Our policy will continue to be to report results based on the as-received sample although our clients have the option to have results reported on a dry weight basis.

For informational purposes, attached is a table presenting EPA's CRDL and CompuChem's 4th Quarter, 1987, experimentally determined instrument detection limits for both ICP and AAS instrumentation.

If clarification or any additional information is required concerning this new policy, please feel free to contact your Customer Service Representative.



Robert E. Meierer,
Director of Quality Assurance

10/20/87

Element	Water CRDL (ug/L)	Solid(1) CRDL (mg/kg)	Instrument Detection Limit (ug/L)		
			Jarrell Ash 1100 ICP	Video 22 AAS	Video 12 AAS
Aluminum	200	20	20		
Antimony	60	6	26		
Arsenic (2)	10	1	45	1.4 F	
Barium	200	20	1		
Beryllium	5	0.5	1		
Cadmium	5	0.5	5		
Calcium	5000	500	17		
Chromium	10	1	4		
Cobalt	50	5	2		
Copper	25	2.5	7		
Iron	100	10	3		
Lead (2)	5	0.5	29	2.0 F	
Magnesium	5000	500	84		
Manganese	15	1.5	2		
Mercury	0.2	0.1			0.13 (C.V.)
Nickel	40	4	23		
Potassium	5000	500	1600		
Selenium (2)	5	0.5	53	2.7 F	
Silver	10	1	6		
Sodium	5000	500	1000		
Thallium (2)	10	1	96	0.8 F	
Vanadium	50	5	1		
Zinc	20	2	1		

Notes: (1) based on a nominal size of 1.0 g of solid sample, in a final volume of 100 ml (after digestion).

(2) These elements typically are determined by Furnace (F) AAS

C.V. = Cold Vapor

APPENDIX B

Surface Water Quality Assurance and Data Reports

5245IH04.TXT
DOC F00

SW 01 A+C

WATER QUALITY MONITORING
FIELD DATA AND QUALITY ASSURANCE REPORT

PROJECT NOS INDIAN HEAD JOB NO 5245-01

STATION NO SW-01A, C (DUP) DATE 10-2-87

DESCRIPTION/LOCATION DOWNSTREAM END OF NOBLE ROAD CULVERT

FIELD DATA

TIME 01410 AIR TEMP 65 WEATHER CLEAR, BREEZY

WELL SW WATER DEPTH 1.5 SAMPLE DEPTH 0.5 SAMPLE METHOD GRAB

VOL. NA SAMPLE TEMP 17.2 °C IN SITU IN BOTTLE SP. COND. 1000 IN SITU @ 25° C IN BOTTLE

pH 7.28 IN SITU IN BOTTLE Eh 7.46 IN SITU IN BOTTLE DISSOLVED O₂ _____ ppm IN SITU IN BOTTLE

SAMPLE APPEARANCE Clear / lt yellow

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
SW-01A, @		250	plastic	No	4° / 250	TSS
SW-01A, @		↓	↓	No	HNO ₃ / 250	Total Hg
SW-01A, @		↓	↓	Yes	HNO ₃ / 250	Diss Hg
SW-01 C				No	4°	TSS
SW-01 C				No	HNO ₃	Total Hg
SW-01 C		↓	↓	Yes	HNO ₃	Diss Hg

REMARKS/OBSERVATIONS Low Flow

FIELD EQUIPMENT QUALITY ASSURANCE CHECKLIST

pH METER BUFFER CHECK pH 4 4.01 pH 7 7.02 pH 10 _____

SP. COND. METER STANDARDS CHECK 1680 Eh PROBE _____

PUMP TUBING RINSED NA CHANGED NA SAMPLER BLANK _____

FILTRATION BLANK WITH PRES: _____ FILTERS ACID WASHED _____

SAMPLER Clark

WATER QUALITY MONITORING FIELD DATA AND QUALITY ASSURANCE REPORT

PROJECT NOS INDIAN HEAD JOB NO 5245-01

STATION NO SW-06 A DATE 10-21-87

DESCRIPTION/LOCATION ATKINS RD CULVERT

FIELD DATA

TIME 1520 AIR TEMP 65°F WEATHER Clear, Breezy

WELL DEPTH NA WATER DEPTH 1.5 ft SAMPLE DEPTH 0.5 ft SAMPLE METHOD Grab

VOL. SAMPLE IN SITU SP. IN SITU
PURGED NA TEMP. 16.9 °C IN BOTTLE COND. 1600 @ 25° C IN BOTTLE

pH 7.17 IN SITU IN BOTTLE Eh 6.26 IN SITU IN BOTTLE DISSOLVED O₂ _____ ppm IN BOTTLE

SAMPLE APPEARANCE clear, yellow, fibrous sediment (SS)

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
SW-06A		250	plastic	Yes	HNO ₃ 250	Diss Hg
SW-06A		↓	↓	No	HNO ₃ 30	Total Hg
SW-06A		↓	↓	No	4% 250	TSS

REMARKS/OBSERVATIONS Low Flow

FIELD EQUIPMENT QUALITY ASSURANCE CHECKLIST

pH METER BUFFER CHECK pH 4 4.01 pH 7 7.00 pH 10 _____

SP. COND. METER STANDARDS CHECK 1680 Eh PROBE

PUMP TUBING RINSED CHANGED SAMPLER BLANK

FILTRATION BLANK WITH PRES: _____ FILTERS ACID WASHED _____

SAMPLER Clark

WATER QUALITY MONITORING FIELD DATA AND QUALITY ASSURANCE REPORT

PROJECT NOS Indian Head JOB NO 5245.01

STATION NO SW-09A DATE 10-21-87

DESCRIPTION/LOCATION midstream at STA 12+00

FIELD DATA

TIME 1320 AIR TEMP 65 WEATHER Clear, breezy

WELL DEPTH NA WATER DEPTH NA SAMPLE DEPTH NA SAMPLE METHOD grab

VOL. PURGED NA SAMPLE TEMP. 17.2 °C IN SITU IN BOTTLE SP. COND. 1000.1 @ 25° C IN SITU IN BOTTLE

pH 7.28 IN BOTTLE Eh 7.46 IN BOTTLE DISSOLVED O₂ _____ ppm IN SITU IN BOTTLE

SAMPLE APPEARANCE _____

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
SW-09A		250ml	plastic	No	HNO ₃ 1ml	Total Hg
SW-09A		250ml	plastic	Yes	HNO ₃ 1ml	Dissolved Hg
SW-09A		250ml	plastic	No		Total Suspended Solids

REMARKS/OBSERVATIONS Low Flow

FIELD EQUIPMENT QUALITY ASSURANCE CHECKLIST

pH METER BUFFER CHECK pH 4 4.01 pH 7 7.00 pH 10 _____

SP. COND. METER STANDARDS CHECK _____ Eh PROBE _____

PUMP TUBING RINSED _____ CHANGED _____ SAMPLER BLANK _____

FILTRATION BLANK WITH PRES. _____ FILTERS ACID WASHED _____

SAMPLER Clark

WATER QUALITY MONITORING FIELD DATA AND QUALITY ASSURANCE REPORT

PROJECT NOS INDIAN HEAD JOB NO 5245-01

STATION NO SW 01 B DATE 10-26-87

DESCRIPTION/LOCATION BELOW NOBLE RD CULVERT

FIELD DATA

TIME 1025 AIR TEMP 55° WEATHER clear

WELL DEPTH NA WATER DEPTH NA 1.5' SAMPLE DEPTH 0.5' SAMPLE METHOD grab

VOL: SAMPLE IN SITU SP. IN SITU
PURGED NA TEMP. 10.7 °C IN BOTTLE COND. 925 @ 25° C IN BOTTLE

pH 8.74 IN SITU IN BOTTLE Eh 5.91 IN BOTTLE DISSOLVED O₂ ppm IN BOTTLE

SAMPLE APPEARANCE clear, light yellow

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
SW-01-B		250ml	plastic	no	$\frac{V_{DO_2}}{1ml}$	Total Hg
SW-01-B		↓	plastic	yes	$\frac{V_{DO_2}}{1ml}$	Dissolved Ig
SW-01-B		↓	plastic	no		Total Susp Solids

REMARKS/OBSERVATIONS Higher Flow - tide going out

FIELD EQUIPMENT QUALITY ASSURANCE CHECKLIST

pH METER BUFFER CHECK pH 4 4.399 pH 7 7 pH 10 10.05

SP. COND. METER STANDARDS CHECK 11.80 Eh PROBE

PUMP TUBING RINSED CHANGED SAMPLER BLANK

FILTRATION BLANK WITH PRES: FILTERS ACID WASHED

SAMPLER Clark

WATER QUALITY MONITORING FIELD DATA AND QUALITY ASSURANCE REPORT

PROJECT NOS Indian Head JOB NO 5245.01

STATION NO SW-06 B DATE 10-26-87

DESCRIPTION/LOCATION below culvert @ Atkins Road

FIELD DATA

TIME 1053 AIR TEMP 55° WEATHER Clear

WELL DEPTH NA WATER DEPTH 1.5 SAMPLE DEPTH 0.5 SAMPLE METHOD grab

VOL. PURGED NA SAMPLE TEMP. 12.8 °C IN BOTTLE COND. 850 / IN SITU @ 25° C IN BOTTLE

pH 8.05 IN SITU IN BOTTLE Eh 6.75 IN SITU IN BOTTLE DISSOLVED O₂ _____ ppm IN BOTTLE

SAMPLE APPEARANCE _____

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
SW-06B		250ml	plastic	NO	HNO ₃ 1ml	Total Hg
SW-06B		250ml	plastic	yes	HNO ₃ 1ml	Dissolved Hg
SW-06B		250ml	plastic	NO		Total Suspended Solids

REMARKS/OBSERVATIONS _____

FIELD EQUIPMENT QUALITY ASSURANCE CHECKLIST

pH METER BUFFER CHECK pH 4 3.99 pH 7 7.00 pH 10 10.05

SP. COND. METER STANDARDS CHECK _____ Eh PROBE _____

PUMP TUBING RINSED _____ CHANGED _____ SAMPLER BLANK _____

FILTRATION BLANK WITH PRES. _____ FILTERS ACID WASHED _____

SAMPLER M. R. Clark

WATER QUALITY MONITORING FIELD DATA AND QUALITY ASSURANCE REPORT

PROJECT NOS Indian Head JOB NO 5245.01

STATION NO SW-09B DATE 10-26-87

DESCRIPTION/LOCATION at midstream at STA 12+00

FIELD DATA

TIME 1119 AIR TEMP 55° WEATHER clear

WELL DEPTH N/A WATER DEPTH 0.51 SAMPLE DEPTH 0.25' SAMPLE METHOD grab

VOL. PURGED NA SAMPLE TEMP. 13.4 °C IN SITU IN BOTTLE SP. COND. 490 1 IN SITU IN BOTTLE @ 25° C

pH 8.29 IN SITU IN BOTTLE Eh 6.61 IN SITU IN BOTTLE DISSOLVED O₂ _____ ppm IN SITU IN BOTTLE

SAMPLE APPEARANCE clear light, yellow

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
SW-09B		250ml	plastic	NO	HNO ₃ 1ml	Total Hg
SW-09B		250ml	plastic	yes	HNO ₃ 1ml	Dissolved Hg
SW-09B		250ml	plastic	NO		Total Suspended Solids

REMARKS/OBSERVATIONS _____

FIELD EQUIPMENT QUALITY ASSURANCE CHECKLIST

pH METER BUFFER CHECK pH 4 3.99 pH 7 7.00 pH 10 10.05

SP. COND. METER STANDARDS CHECK _____ Eh PROBE _____

PUMP TUBING RINSED _____ CHANGED _____ SAMPLER BLANK _____

FILTRATION BLANK WITH PRES. _____ FILTERS ACID WASHED _____

SAMPLER CLARK

APPENDIX C
Survey Data

5245IH04.TXT
DOC F00

ELEVATIONS OF TIDAL POND AREA
NOS INDIAN HEAD
IN FEET ABOVE MEAN SEA LEVEL

LOCATION	ELEVATION POINT *	ELEVATION
SG-1	TOS	3.09
SG-2	TOS	4.00
SG-3	TOS	4.28
SG-4	TOS	8.24
SG-5	TOS	3.98
SS-14	LS	8.37
SS-15	LS	7.28
SS-16	LS	7.33
SS-17	LS	5.53
SS-18	LS	5.52
SS-19	LS	4.53
SS-20	LS	5.41
SS-21	LS	7.37
SS-22	LS	5.58
SS-23	LS	6.67
SS-24	LS	7.50
SS-25	LS	8.92
STA-16+00	LS	10.03
STA-20+00	LS	15.17

* TOS - TOP OF STAKE ; LS - LAND SURFACE

**TABLE C-2
STAFF GAUGE ELEVATIONS**

	October 20, 1987	October 24, 1987
SG#1	3.09	3.09
SG#2	4.15	4.00
SG#3	4.28	4.28
SG#4	8.24	8.24
SG#5	3.98	3.98

5245IH04.TXT
DOC F00

APPENDIX D
EPTOX Criteria

5245IH04.TXT
DOC F00

Constituent	Concentration mg/l.
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0
Endrin	0.02
Lindane	0.4
Methoxychlor	10.0
Toxaphene	0.5
2,4 - D	10.0
2,4,5 - TP	1.0