



FILE: 1611-3.1

DEPARTMENT OF THE NAVY

ENGINEERING FIELD ACTIVITY, NORTHEAST
NAVAL FACILITIES ENGINEERING COMMAND
10 INDUSTRIAL HIGHWAY
MAIL STOP, #82
LESTER, PA 19113-2090

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WILMINGTON, MA 01897-1000
IN REPLY REFER TO

5090
Code EV23/CF

AUG 23 2004

0349

Ms. Kymberlee Keckler, Remedial Project Manager
Federal Facilities Superfund Section
USEPA Region 1
1 Congress Street, Suite 1100
Boston MA, 02114-2023

27292

Mr. Paul Kulpa, Project Manager
Office of Waste Management
Rhode Island Department Of Environmental Management
235 Promenade St.
Providence Rhode Island, 02908-5767

SUBJECT: RESPONSE TO COMMENTS, DRAFT WORK PLAN FOR SEDIMENT
EVALUATION, FORMER ROBERT E. DERECKTOR SHIPYARD, NAVAL STATION
NEWPORT, NEWPORT, RHODE ISLAND

Dear Ms. Keckler/ Mr. Kulpa:

Enclosed please find responses to comments for the subject
work plan. The field work will take place at the site during the
period from August 23-30, 2004.

Please note that the work plan was submitted to you on July
27, 2004 not for review and comment, but for information. We
discussed the issue of regulatory review at our RPM meeting of
April 8, 2004, held at Naval Station Newport, and we believe
consensus was reached that regulatory review was unnecessary.

Although we take notice of RIDEMs' concerns expressed in
their comments, we also note that this work was discussed at the
April 8, 2004 RPM meeting. During that meeting, we believe
consensus was reached on the scope of the sediment sampling
effort.

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If you have any questions, please do not hesitate to contact me at (610) 595-0567 x142.

Sincerely,



CURTIS A. FRYE, P.E.
Remedial Project Manager
By Direction of the
Commanding Officer

Encl:

- (1) Responses to NOAA Comments, Draft Work Plan, Marine Sediment Sampling, Former Derecktor Shipyard, Naval Station Newport, Newport, RI, July 2004 (Comments dated August 4, 2004)
- (2) Responses to USEPA Comments, Draft Work Plan, Marine Sediment Sampling, Former Derecktor Shipyard, Naval Station Newport, Newport, RI, July 2004 (Comments dated August 4, 2004)
- (3) Responses to RIDEM Comments, Draft Work Plan, Marine Sediment Sampling, Former Derecktor Shipyard, Naval Station Newport, Newport, RI, July 2004 (Comments dated August 10, 2004)
- (4) Quality Assurance Project Plan, Sediment Forensic Investigation, Former Robert E. Derecktor Shipyard

c: K. Finkelstein, NOAA
C. Mueller, NSN
J. Stump, Gannett Fleming
S. Parker, TtNUS

ENCLOSURE (1)
Responses to NOAA Comments
Draft Work Plan, Marine Sediment Sampling
Former Derecktor Shipyard,
Naval Station Newport
Comments Dated August 4, 2004

Comment:

Thank you for the CD outlining the plan for sediment collection. The number of samples are appropriate. I do not have any negative comments concerning the plan except for the obvious question of why it has taken so long to get this project moving again. Rather than spending time and money on a new round of sampling to determine extent and nature of contamination, this sampling should have been completed long ago as an RD/RA assignment.

Response:

Comment is noted. The Navy is striving to finalize the FS and reach consensus with the PRGs and scope of the remedial actions that are appropriate for the site. It is likely that additional testing will be required in remedial design or remedial action (RD/RA) phases based on the remedies that are proposed and accepted by the regulatory parties and the public.

ENCLOSURE (2)
Responses to USEPA Comments
Draft Work Plan, Marine Sediment Sampling
Former Derecktor Shipyard,
Naval Station Newport
Comments Dated August 4, 2004

EPA (reviewed) the Work Plan- Marine Sediment Sampling for Former Derecktor Shipyard Naval Station Newport, Rhode Island dated July 2004. The focus of the review was to determine the adequacy of proposed sampling locations and chemical analysis. This review was a quick turn around review due to the Navy desire to implement the plan and perform sampling two weeks after EPA received the Work Plan.

The sample locations proposed in the plan are adequate for purposes of collecting current sediment chemistry data from a subset of previously sampled locations. The proposed sediment sample locations include those locations that previously exceeded PRGs.

The proposed chemical analysis are adequate. However, the merit of collecting TPH data is questionable.

Response:

The Navy concurs that the TPH data is of little value pertaining to ecological risk. However, TPH is a state regulated contaminant group and therefore needs to be considered, as long as it is appropriately qualified with the forensic information that is proposed.

ENCLOSURE (3)
Responses to RIDEM Comments
Draft Work Plan, Marine Sediment Sampling
Former Derecktor Shipyard,
Naval Station Newport
Comments Dated August 10, 2004

1. Section 1.0, Introduction, Page 1-3.

"Analysis of Sediments samples using forensic techniques (TPH fingerprinting and extended PAH analysis) to identify probable hydrocarbon contaminant sources."

The Office of Waste Management questions the need to perform a forensic study at the site. A Remedial Investigation, Ecological Risk Assessment, Human Health Risk Assessment and Feasibility Study have already been performed at the site. These studies delineated the areas of contamination, determined the source of contamination, assessed the risk associated with the contamination and proposed remedial alternatives to address the contamination. At this stage in the process the Navy wants to go back to the first step in the remedial investigation phase and ascertain the source of the contamination. These issues have already been addressed and consensus has been reached. The Work Plan has not provided any information supporting a position that the original studies were in error. Therefore, unless the Navy can produce this information, the Office of Waste Management does not approve of the proposed forensic study.

Response:

At the RPMs meeting April 8, 2003, the Navy stated their intention to conduct additional sediment sampling at Coddington Cove to update our information on the condition of the sediments there. The EPA indicated that a full work plan review cycle by the regulatory parties was not necessary, as long as the same analysis was conducted on the new samples as was done in the past. The Navy agreed that the work plan would be submitted in for everyone's information. Our recollection was that RIDEM was silent on the subject of the work plan review, and the minutes of the meeting indicate that RIDEM did suggest sampling nearer to the piers, indicating concurrence with the effort.

Conducting the forensic effort and sampling the reference stations will help us better understand the PAHs in the sediment in Coddington Cove and throughout Narragansett Bay. It is our intention to conduct this study as planned in order to use up to date information for the update of the FS report.

2. Section 1.0, Introduction, Page 1-3.

"Analysis of sediments samples using forensic techniques (TPH fingerprinting and extended PAH analysis) to identify probable hydrocarbon contaminant sources."

The Work Plan proposes conducting a forensic analysis for TPH and PAHs. The work plan has not included a section describing how this forensic study will be performed, the standards to be used in the study, the nature of the analysis being performed, the limitations of the study, etc. Obviously, as the needed information was not provided it is not possible to either review or approve the forensic study. Therefore please include a section that provides the necessary details concerning the forensic study.

Be advised that the Office of Waste Management has raised a number of questions concerning the validity of previous forensic studies performed by the Navy. The studies were found to be inadequate and the information generated by the studies could not be used for making decision at the site. Therefore, if the proposed study is of a similar design to the previously rejected studies,

the Office of Waste Management will not approve any report based upon these studies or use the information generated from these studies to support decisions for the site.

Response:

The Navy has undertaken a forensic study at the OFFTA site, which is presumably the study noted in the comment above. The Navy believes that this study was very useful in helping to understand the hydrocarbons in the sediment at that site. This is the type of work that is planned for Coddington Cove described in the subject work plan. The Navy intends to conduct this study as we hope it will provide information on hydrocarbon sources.

Provided as enclosure (4) to this response summary is the Quality Assurance Project Plan provided by the analytical laboratory conducting the forensic analysis. Additional detail will be provided in the analytical reports.

3. Section 3.2 Sediment Sample Collection, Page 3-2.

The Work Plan proposes collecting sediment samples from the 0-6 inch interval. As justification for this interval the report should include a table depicting the depths and observed concentration of contaminants observed in the previous studies. This information is needed to ascertain whether the proposed samples will be collected at the correct depth.

Response:

The former sample results were evaluated and it was noted that high concentrations of PAHs were found in the "S" interval, which were taken from 0-6 inches in depth (DSY-27 and 29). The highest concentrations of PCBs were also found at this interval (DSY-27). The Ecological Risk Assessment Report (final, May 1997), states that sedimentation rates are approximately 0.5 cm (0.2 inches) per year. Presuming minimal artificial disturbances of the sediments, samples collected in 1996 from the 0-6 inch interval would now be 1.6 inches to 7.6 inches below sediment surface.

Additionally, the 0-6 inch interval is viewed as the likely zone of bioturbation by marine organisms, and therefore the likely zone of exposure. Using this information, the 0-6 inch interval is adequate for the purposes of this sampling effort.

4. Section 3.2 Sediment Sample Collection, Page 3-2.

The Work Plan proposes collecting sediment samples from the 0-6 inch interval. Certain areas may have been deepened or built up as a result of the docking and long term mooring of the aircraft carriers. Therefore, the work plan should specify that samples in the vicinity of the ships will be collected from the 0-6 and 6-12 inch interval.

Response:

The Navy concurs with this possibility, and therefore samples in the vicinity of the Carriers at Pier 1 will be collected from both intervals as suggested above.

5. Table 3-1, Marine Sediment Sample Locations and Selection Rationale, Page 3-3.

This section of the document calls for the collection of six background samples. The function of the additional sampling effort at Derecktor Shipyard is to ascertain whether the docking of the two aircraft carriers and one battleship, as well as the current use of Pier # 2 has resulted in a redistribution of contamination at the site. The background sample locations were not affected by contamination from Derecktor Shipyard nor were they subject to the berthing of the aforementioned ships. As such, there is no justification for the collection of additional samples at

the background station. Therefore, the proposed sampling effort in these areas must be deleted from the report.

Response:

The Navy concurs that the ship movement would have no bearing on the reference stations. The purpose of the sample collection effort is to update the site database with current conditions of the distribution of the contaminants in the sediment. This includes not only what is present at the site, but also what would normally be present at the site had there never been any activity or releases from that site.

Specifically, sampling the reference stations will provide a better understanding of the PAH concentrations that are present in the bay. It is understood that the marine sediments are somewhat dynamic not only at the site but all over the bay, it is necessary to have a comprehensive understanding of the condition of the sediments in these unaffected areas. A larger number of reference stations will provide more data and therefore more comprehensive understanding of the background condition. Therefore these reference stations will be sampled.

6. Table 3-1, Marine Sediment Sample Locations and Selection Rationale, Page 3-3.

The function of the proposed sampling effort is to determine whether activities at the site have resulted in a redistribution of contaminants. In order to address this concern the following sampling stations must be added to the plan:

Collection of four samples on the north side and four samples on the south side of Pier # 2 (Pier used by Coast Guard). Sampling stations should be equally spaced along the length of the pier.

Collection of four samples on the north side and four samples on the south side of Pier # 1 (Inactive ship pier). Sampling stations should be equally spaced along the length of the pier.

Collection of four sample samples along a centerline in between piers 1 and 2.

Response:

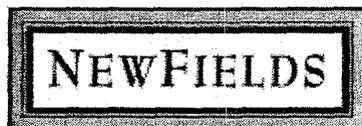
In order to compare sample results to previous analyses, sample stations previously sampled will be visited. The area to the North and South of Piers 1 and 2 are covered by the selected stations, and those added based on comments provided by RIDEM at the meeting 4/8/04.

ENCLOSURE (4)

Quality Assurance Project Plan

Sediment Forensic Investigation

Former Robert E. Derecktor Shipyard



DRAFT

**WORK/QUALITY ASSURANCE PROJECT PLAN
HYDROCARBON CHARACTERIZATION
NAVAL STATION NEWPORT, RHODE ISLAND
FORMER ROBERT E. DEREKTOR SHIPYARD
SITE 19
NEW ENGLAND EDUCATION AND TRAINING CENTER (NETC)**

August 2004

prepared for

Tetra Tech NUS, Inc.
55 Jonspin Road
Wilmington, MA 01887

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TABLE OF CONTENTS

1. General Information.....	3
2. Technical Approach.....	4
3. Sample Collection and Laboratory Subcontractor	5
4. Sample Preparation.....	6
5. Sample Analysis	10
6. Hydrocarbon Interpretation and Reporting.....	17
7. References	18

1. GENERAL INFORMATION

Project Name: Navy Derecktor Shipyard

Project Number: NF 0005-034-850

Client: Tetra Tech NUS, Inc.
55 Jonspin Road
Engineering Field Activity Northeast
Wilmington, MA 01887

QAPP Effective Date: August 24, 2004

Version Number: 1.0

Project Manager: Stephen Emsbo-Mattingly

Prepared by: Stephen Emsbo-Mattingly Date: 08/20/2004

Reviewed by: Elizabeth Porta Date: 08/24/2004

Laboratory Due Date: Net 30 days from sample receipt

Final Report: Net 30 days from receipt of the final laboratory deliverable

2. TECHNICAL APPROACH

Pursuant to the Tetra Tech Statement of Work (SOW), NewFields will characterize the hydrocarbon chemistry in approximately 30 samples from the shoreline of Coddington Cove, selected hot spots and reference stations.

It is our understanding that Tetra Tech will arrange for the collection of the forensic samples. Based on the SOW, we understand that approximately 30 samples be collected as follows:

- Narragansett Reference Stations (6 sediments)
- Coddington Cove shoreline and piers (up to 22 sediments)
- Blind Duplicates (3 sediments)

Based on recent forensic investigations at Navy shipyard sites, we recommend that approximately 6 additional samples be considered for this study. These samples include:

- Historical Fueling Source Area (2 soil or 1 NAPL)
- Pavement Core (2 asphalt samples from each of 2 cores)

The field samples will be analyzed by specialized forensic analytical methods that have been used successfully in the past to determine the origins of PAHs in sediments (Emsbo-Mattingly et al., 2002; Stout et al., 2002; Stout et al., 2003; Stout et al., 2004). These methods include:

- High Resolution Hydrocarbon Fingerprints
- Alkylated PAHs
- Biomarkers
- Total Organic Carbon (TOC)

Based on the available chemistry and historical data, NewFields will determine the likely origin(s) of PAHs in these samples. Historical activities around the site indicated that the most likely origins of PAHs could include former ship fueling operations and urban runoff. Consequently, the sampling program will emphasize these PAH sources. The conclusion of this investigation will be used to evaluate remedial actions for the site.

3. SAMPLE COLLECTION AND LABORATORY SUBCONTRACTOR

Soil and sediment samples should be collected in hydrocarbon free 8 oz clear wide mouth jars – 4 oz jars are also acceptable. Non-aqueous phase liquid (NAPL) samples will be collected in 2 x 40 mL VOC vials. Waters should be collected in 2 x 1 L amber round bottles. Tetra Tech will provide the required sampling containers, coolers, and chain of custody records.

The samples shall be chilled immediately after collection. The samples will be wrapped in a sufficient quantity of bubble wrap to prevent sample container breakage. The shipping cooler should be packed with ice that is double-bagged in zip-lock freezer bags for next day shipment.

The sample delivery address is:

Stephen Emsbo-Mattingly
c/o Liz Porta
Woods Hole Group Analytical Laboratory
375 Paramount Drive, Suite 2
Raynham, MA 02767
Tel: 508-822-9300
Fax: 508-822-3288
Email: eporta@whgrp.com

The field team shall fax copies of the COCs to Liz Porta within 24 hours of sample release to the courier. Saturday delivery is subject to availability by the laboratory and must be confirmed at least 48 hours prior to shipment.

4. SAMPLE PREPARATION

The analytical laboratory will handle each sample according to the provisions in Table 1. The soil and sediment samples will be serially extracted using a shaker table as per NOAA methods for the Status and Trends program (Peven and Uhler, 1993; WHG SOP OP-013). The nominal sample size will be 30 g wet weight. Excess water will be removed by centrifuge and decanting until the each sample is greater than 50% solid. Thereafter, a 10 g aliquot will be dried to determine the percent solid content.

After the percent solid content is determined, approximately 0.5 g of the dried sample will be ground, acidified with hydrochloric acid (HCl), re-dried, and analyzed for total organic content (TOC). This procedure will be repeated a second time in order to generate replicate independent burns for each sample. The average of the two replicate samples will be the TOC concentration for the forensic interpretation.

Table 1. Summary of Analytical Parameters.

Approximate #/ Matrix	Parameter/ Reference Method	Laboratory SOP	Container/Storage	Holding Time
30 Sediment	High Resolution Hydrocarbon Fingerprint (EPA 8015)	TPH-8100 Rev 1.1 07/15/1999	4oz/8oz Wide Mouth Glass Store Below 6°C	Extraction: 14 d from collection Analysis: 40 d from preparation
30 Sediment	Alkylated PAHs (EPA 8270)	O-008 Rev 2.0 07/25/2002	4oz/8oz Wide Mouth Glass Store Below 6°C	Extraction: 14 d from collection Analysis: 40 d from preparation
30 Sediment	Biomarkers (EPA 8270)	O-008 Rev 2.0 07/25/2002	4oz/8oz Wide Mouth Glass Store Below 6°C	Extraction: 14 d from collection Analysis: 40 d from preparation
30 Sediment	Total Organic Carbon (TOC) (EPA 9060)	W-028	4oz/8oz Wide Mouth Glass Store Below 6°C	Analysis: 28 d from collection

After physically separating the free water from the sample, the remaining moisture will be removed by mixing with sodium sulfate until the sample flows like sand. The resulting sample will be spiked with surrogate (Table 2) and serially extracted three times (6 hrs for 1st extraction, 2 hrs for 2nd extraction and 30 minutes for 3rd) with 100 mL dichloromethane (DCM). Three extracts will be combined into an Erlenmeyer flask after filtering through a powder funnel containing glass wool plug and sodium sulfate. The sample extract will be concentrated to 1 mL using Kuderna Danish apparatus and nitrogen blow down. The sample extract will be treated with activated copper to remove sulfur. The extract will then be quantitatively transferred a 4 mL vial with a Teflon lined septa. During this process, the final volume will be adjusted to 1.8 mL with DCM.

The concentrated extract will be split into two portions with the following volumes: 0.9 mL for analysis by GC/FID plus PAHs and 0.9 mL for fractionation. Section 5 details the analytical procedure for the GC/FID and PAH methods. The remaining 0.9 mL sample extract shall be solvent exchanged to hexane and fractionated on a 5 g silica gel column. The aliphatic fraction will be concentrated to 0.9 mL and transferred to the GC/MS laboratory for biomarker analysis.

Table 2. Quality Control Spiking Schedule for Extracted Samples

Mixture	Applicability	Content in DCM Solvent	Spike Volume
FID Surrogate	All Field and QC Samples	o-Terphenyl 500 ng/ μ L Tetracosane-d50 500 ng/ μ L	100 μ L
PAH Surrogate	All Field and QC Samples	2-Methylnaphthylene-d10 10 ng/ μ L Pyrene-d10 10 ng/ μ L Benzo(b)fluoranthene-d12 10 ng/ μ L	100 μ L
Biomarker Surrogate	All Field and QC Samples	5(β)H-Cholane 10 ng/ μ L	100 μ L
FID Analyte Spike	LCS and MS Samples	Selected n-C ₉ to n-C ₃₆ Normal Alkanes 500 ng/ μ L	100 μ L
PAH Analyte Spike	LCS and MS Samples	Priority Pollutant PAH 10 ng/ μ L	100 μ L

Each sample batch will have several QC parameters with which to assess data quality. An analytical batch is defined as 20 or fewer samples prepared or analyzed per day. The associated QC parameters are described in Table 3 for extracted samples and Table 4 for TOC samples. All of the batch QC samples will be analyzed by all methods regardless of the applicable performance criteria. Corrective actions are listed in the approximate order of execution. The NewFields Project Manager can adjust the corrective actions based on the needs of the interpretation.

Field samples shall be stored for 6 months after the laboratory report is delivered to NewFields. Analyzed samples and extracts can be discarded after the holding time. Laboratory records shall be archived for a minimum of 5 years.

Table 3. Sample Preparation QC Parameters for Extracted Samples

QC Parameter/Purpose	Data Quality Objective (DQO)	Corrective Action
Surrogate Recovery/ Accuracy measured as the sample specific extraction efficiency	50% - 130% Recovery	Review Integration Evaluate Coelution Potential Review with Project Manager Re-Extract and Analyze to Demonstrate Matrix Effect
Procedural Blank/ Accuracy relative to bias from background conditions in the lab	Less than sample equivalent of low calibration standard Less than 5x detected analyte concentration in field samples	Review Integration Evaluate Ret Time Shift Review with Project Manager Re-Extract and Analyze Batch if within calibration range and 5x sample concentration Flag sample hits within 5x the blank concentration
Laboratory Control Sample/ Accuracy for Target Analytes	50% - 130% Recovery For FID and PAH Analytes	Review Integration Evaluate Ret Time Shift Review with Project Manager Re-Extract and Analyze Batch
Duplicate/ Precision for target analytes	Less than 30% RPD	Review Integration Evaluate Coelution Potential Review with Project Manager Flag duplicate outliers within the calibration range
Matrix Spike/ Accuracy for target analytes in native sample matrix	50% - 150% recovery for 90% of the analytes spiked >5 times native sample	Review Integration Evaluate Coelution Potential Review with Project Manager Flag duplicate outliers within the calibration range

Table 4. QC Parameters for TOC Samples

QC Parameter/Purpose	Data Quality Objective (DQO)	Corrective Action
Procedural Blank/ Accuracy relative to bias from background conditions in the lab	Less than sample equivalent of low calibration standard Less than 5x detected analyte concentration in field samples	Review Integration Evaluate Ret Time Shift Review with Project Manager Re-Extract and Analyze Batch if within calibration range and 5x sample concentration Flag sample hits within 5x the blank concentration
Duplicate/ Precision for target analytes	Less than 30% RPD	Review Instrument Data Review with Project Manager Flag duplicate outlier within the calibration range
Standard Reference Material/ Accuracy for target analyte	50% - 130% Recovery	Review Instrument Data Review with Project Manager Re-Extract and Analyze Batch

5. SAMPLE ANALYSIS

The concentrated sample extracts will be spiked with internal standard at a rate of 100 μL of internal standard mix for every 900 μL of sample extract (Table 5). Whenever possible, the internal standard should be added to the extract in the sample preparation laboratory immediately after concentration. The resulting mixture yields a 1.0 mL working extract volume for the respective analytical laboratories with a 1:2 split of the final extract volume; i.e., a 2.0 mL final extract volume with a 1.0 mL split for FID/PAH and a 1.0 mL split for biomarkers. The analyst shall remove 150 μL of working extract for each analysis using a 250 μL gas tight syringe and transfer to a low volume insert equipped with an aluminum crimp cap. The remaining extract shall be stored in a 2 mL screw cap vial with a Teflon® liner.

High resolution hydrocarbon fingerprints will be generated from a concentrated sample extract using a gas chromatograph equipped with a flame ionization detector (GC/FID, EPA Method 8015B modified). The resulting chromatogram will focus on the hydrocarbon elution range from nonane (n-C9) to hexatriacontane (n-C36). This range includes many possible hydrocarbon source materials (i.e., #2, #4, and #6 fuels, coal tars, asphalt residues, and others). The concentration of total extractable hydrocarbons (TEH) will be calculated for each sample. The target analytes for the GC/FID method are presented in Table 6.

Table 5. Internal Standard Spiking Schedule.

Mixture	Applicability	Content in DCM Solvent	Spike Volume
FID Internal Standard	All Field and QC Samples	5 α -Androstane 500 ng/ μL	100 μL
PAH Internal Standard	All Field and QC Samples	Acenaphthene-d10 5 ng/ μL Chrysene-d12 5 ng/ μL	100 μL
Biomarker Internal Standard	All Field and QC Samples	Acenaphthene-d10 5 ng/ μL Chrysene-d12 5 ng/ μL	100 μL

A second aliquot of the concentrated extract will be analyzed for selected PAH isomers and alkylated groups (Table 7) on a gas chromatograph equipped with a mass spectrometer operated in selected ion monitoring mode (GC/MS/SIM, EPA Method 8270B modified). This method replaces the SPCC, CCC, and retention time check criteria with pattern recognition techniques and independent reference sample evaluation criteria. These data will help differentiate petroleum and combustion derived PAH sources.

The fractionated extract will be analyzed for selected biomarkers (Table 8) and associated biomarker fingerprints on a gas chromatograph equipped with a mass spectrometer operated in selected ion monitoring mode (GC/MS/SIM, EPA Method 8270B modified). These biomarker patterns help identify and match petroleum based on the petroleum formation from which the materials ultimately originated.

Finally, total organic carbon (TOC) will be measured using EPA Method 9060. This method will help identify the presence of large molecular weight organics that do not chromatograph well (e.g., asphaltines).

Analytical quality control (QC) parameters will be associated with every analytical instrument sequence (Table 9). Corrective actions are listed in the approximate order of execution. The NewFields Project Manager can adjust the corrective actions based on the needs of the interpretation.

The laboratory data will include hardcopy and electronic data deliverables (EDD). The hardcopy will include the sample preparation and analytical records. The scale of the high resolution hydrocarbon fingerprints (GC/FID) should start immediately after the solvent peak and extend to the end of the run with the vertical axis scaled to the tallest non-QC peak. The scale of the biomarker fingerprints will vary based on the retention times of reference peaks from the crude oil reference sample. The biomarker fingerprints should include triterpanes stacked on top of steranes, normal alkanes stacked on top of alkylcyclohexanes, and sesquiterpanes without association. The ECC will be required for all quantitative results. These data should be formatted for Excel with samples in columns and analytes in rows.

Target analyte qualifiers shall be applied to concentrations with associated QC outliers. The qualifiers must be defined in the hardcopy and electronic data deliverables. Some suggested qualifiers are presented in Table 10.

Table 6. General Hydrocarbon Target Analytes.

Abbrev	Analytes
C9	n-Nonane (C9)
C10	n-Decane (C10)
C11	n-Undecane (C11)
C12	n-Dodecane (C12)
C13	n-Tridecane (C13)
C14	n-Tetradecane (C14)
C15	n-Pentadecane (C15)
C16	n-Hexadecane (C16)
C17	n-Heptadecane (C17)
Pr	Pristane
C18	n-Octadecane (C18)
Ph	Phytane
C19	n-Nonadecane (C19)
C20	n-Eicosane (C20)
C21	n-Heneicosane (C21)
C22	n-Docosane (C22)
C23	n-Tricosane (C23)
C24	n-Tetracosane (C24)
C25	n-Pentacosane (C25)
C26	n-Hexacosane (C26)
C27	n-Heptacosane (C27)
C28	n-Octacosane (C28)
C29	n-Nonacosane (C29)
C30	n-Triacontane (C30)
C31	n-Hentriacontane (C31)
C32	n-Dotriacontane (C32)
C33	n-Tritriacontane (C33)
C34	n-Tetratriacontane (C34)
C35	n-Pentatriacontane (C35)
C36	n-Hexatriacontane (C36)
C37	n-Heptatriacontane (C37)
C38	n-Octatriacontane (C38)
C40	n-Tetracontane (C40)
TSH	Total Saturated Hydrocarbons
TEM	Total Extractable Material

TSH Sum of target normal alkanes and isoprenoid hydrocarbons

TEM Sum of all material eluting between n-C₉ and n-C₄₀

Table 7. Primary PAH Analytes.

PAH Analyte	Abbreviation	Ring Number
Naphthalene	NO	2
C1-Naphthalenes	N1	2
C2-Naphthalenes	N2	2
C3-Naphthalenes	N3	2
C4-Naphthalenes	N4	2
Biphenyl	B	2
Acenaphthylene	AY	3
Acenaphthene	AE	3
Dibenzofuran	DF	3
Fluorene	FO	3
C1-Fluorenes	F1	3
C2-Fluorenes	F2	3
C3-Fluorenes	F3	3
Dibenzothiophene	DBT0	3
C1-Dibenzothiophenes	DBT1	3
C2-Dibenzothiophenes	DBT2	3
C3-Dibenzothiophenes	DBT3	3
C4-Dibenzothiophenes	DBT4	3
Anthracene	A0	3
Phenanthrene	P0	3
C1-Phenanthrenes/Anthracenes	PA1	3
C2-Phenanthrenes/Anthracenes	PA2	3
C3-Phenanthrenes/Anthracenes	PA3	3
C4-Phenanthrenes/Anthracenes	PA4	3
Fluoranthene	FL0	4
Pyrene	PY0	4
C1-Fluoranthenes/Pyrenes	FP1	4
C2-Fluoranthenes/Pyrenes	FP2	4
C3-Fluoranthenes/Pyrenes	FP3	4
C0-Benzo(b)naphthothiophene	BNT0	4
C1-Benzo(b)naphthothiophene	BNT1	4
C2-Benzo(b)naphthothiophene	BNT2	4
C3-Benzo(b)naphthothiophene	BNT3	4
C4-Benzo(b)naphthothiophene	BNT4	4
Benzo(a)anthracene	BA0	4
Chrysene	C0	4
C1-Chrysenes	BC1	4
C2-Chrysenes	BC2	4
C3-Chrysenes	BC3	4
C4-Chrysenes	BC4	4
Benzo(b)fluoranthene	BB	5
Benzo(k)fluoranthene	BJK	5
Benzo(e)pyrene	BEP	5
Benzo(a)pyrene	BAP	5
Perylene	PER	5
Indeno(1,2,3-c,d)pyrene	IND	6
Dibenz(a,h)anthracene	DA	5
Benzo(g,h,i)perylene	GHI	6

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Table 8. Primary Biomarker Analytes.

Abbrev	Terpanes
T4	C23 Tricyclic Terpene
T5	C24 Tricyclic Terpene
T6	C25 Tricyclic Terpene
T6a	C24 Tetracyclic Terpene
T6b	C26 Tricyclic Terpene-22S
T6c	C26 Tricyclic Terpene-22R
T7	C28 Tricyclic Terpene-22S
T8	C28 Tricyclic Terpene-22R
T9	C29 Tricyclic Terpene-22S
T10	C29 Tricyclic Terpene-22R
T11	18a-22,29,30-Trisnorhopane-TS
T12	17a(H)-22,29,30-Trisnorhopane-TM
T14a	17a/b,21b/a 28,30-Bisnorhopane
T14b	17a(H),21b(H)-25-Norhopane
T15	30-Norhopane
T16	18a(H)-30-Norneohopane-C29Ts
X	17a(H)-Diahopane
T17	30-Normoretane
T18	18a(H)&18b(H)-Oleananes
T19	Hopane
T20	Moretane
T21	30-Homohopane-22S
T22	30-Homohopane-22R
T26	30,31-Bishomohopane-22S
T27	30,31-Bishomohopane-22R
T30	30,31-Trishomohopane-22S
T31	30,31-Trishomohopane-22R
T32	Tetrakishomohopane-22S
T33	Tetrakishomohopane-22R
T34	Pentakishomohopane-22S
T35	Pentakishomohopane-22R

Abbrev	Steranes
S4	13b(H),17a(H)-20S-Diacholestane
S5	13b(H),17a(H)-20R-Diacholestane
S8	13b,17a-20S-Methyladiacholestane
S12	14a(H),17a(H)-20S-Cholestane
S17	14a(H),17a(H)-20R-Cholestane
S18	13b,17a-20R-Ethyladiacholestane
S19	13a,17b-20S-Ethyladiacholestane
S20	14a,17a-20S-Methylcholestane
S24	14a,17a-20R-Methylcholestane
S25	14a(H),17a(H)-20S-Ethylcholestane
S28	14a(H),17a(H)-20R-Ethylcholestane
S14	14b(H),17b(H)-20R-Cholestane
S15	14b(H),17b(H)-20S-Cholestane
S22	14b,17b-20R-Methylcholestane
S23	14b,17b-20S-Methylcholestane
S26	14b(H),17b(H)-20R-Ethylcholestane
S27	14b(H),17b(H)-20S-Ethylcholestane

Table 9. Analytical QC Parameters for GC Methods

QC Parameter/Frequency/Purpose	Data Quality Objective (DQO)	Corrective Action
Tune for GC/MS/ Run before every ICal/ Instrumental reproducibility relative to established performance standard	m/z 69: Base peak > 100,000 counts m/z 219: 30% - 60% base peak counts m/z 502: 2% - 8% base peak counts	Re-Run Tune Clean Source Review with Project Manager
Initial Calibration (ICal)/ Run after major maintenance/ Precision for target analytes over calibration range	%RSD < 25% for 90% of analytes %RSD < 35% for all analytes	Review Integrations Re-Tune and Re-Run ICal Instrument Maintenance Clean Source Review with Project Manager
Continuing Calibration (CCal)/ Run every 10 samples/ Precision of target analytes throughout the analytical sequence	%D < 25% for 90% of analytes %D < 35% for all analytes	Review Integrations Re-Run CCal Instrument Maintenance Clean Source Review with Project Manager
Crude Oil Reference Sample (RS)/ Run after ICal/ Accuracy for target analytes	± 35% Difference for analytes with reference values within the calibration range	Review Integrations Re-Analyze RS Review with Project Manager Re-Extract and Analyze Batch
Internal Standard/ Evaluate in every field and QC sample/ Accuracy of analytical procedure for each sample	50% to 200% of area counts From the middle ICal standard	Review Integrations Re-Analyze Review with Project Manager

Table 10. Suggested Data Qualifiers.

Qualifier	Use
U	Analyte not detected, sample specific MDL will be reported
B	Analyte detected in sample < 5X detected in the blank
J	Analyte detected between RL and ND (< 3X S/N)
E	Estimated concentration
NA	Not Applicable
D	Secondary dilution performed
D1	Tertiary dilution performed
^a	Value outside of QC Limits
§	Surrogate value outside of acceptable range

6. HYDROCARBON INTERPRETATION AND REPORTING

NewFields will analyze the data to determine chemical “fingerprints” of the potential source samples collected from “hot spots” and reference stations match the shoreline samples from Coddington Cove. As necessary, this analysis will draw upon reference materials analyzed as part of past forensic investigations for the Navy. This comparison may also include multivariate analysis of the PAH data (e.g., principal component analysis).

The data interpretation will require the receipt of several documents from Tetra Tech. These will include past environmental reports from the site, a detailed site history, regional land use history (emphasis on Sanborn and aerial photography), and electronic map with sampling locations and property boundaries.

At the conclusion of the study NewFields will provide a draft written report summarizing the data and the forensic interpretation. This report will include descriptions of the samples, the tabulated data, and the chromatographic fingerprints.

NewFields will deliver the forensic interpretation report approximately 30 days after it receives the laboratory data. NewFields will store the supporting data for two years after the submission of the final deliverable for the project.

7. REFERENCES

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