Data Report:

Characterization of Bryan Mound Crude Oil for the National Oil and Hazardous Substances Pollution Contingency Plan Product Schedule (NCPPS)

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SUBMITTED TO:

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Office of Land and Emergency Management
Office of Emergency Management
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BRIEF

This data report summarizes the physical-chemical properties, aquatic toxicity, and dispersant effectiveness of Bryan Mound Crude (BMC) oil. BMC has been selected as a new reference oil for the National Oil and Hazardous Substances Pollution Contingency Plan Product Schedule (NCPPS). Analyses were conducted at the US Environmental Protection Agency (US EPA) Office of Research and Development (ORD) AWBERC Facility in Cincinnati, OH, and two contracted labs, Core Laboratories Saybolt in Deer Park, TX and Hydrosphere Research in Alachua, FL. ORD coordinated with the Office of Land and Emergency Management (OLEM) Office of Emergency Management (OEM) throughout the duration of this effort.

EPA/600/X-23/356

RELEVANCE

Under section 311 of the Clean Water Act (CWA), as amended by section 4201 of the Oil Pollution Action of 1990 (OPA), the President is directed to prepare and publish the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) for removal of oil and hazardous substances. Section 311(d)(2)(G) directs the President to include a Schedule identifying dispersants, other chemicals, and other spill mitigating devices and substances, if any, that may be used in carrying out the NCP. The authority of the President to implement this portion of the CWA is currently delegated to the U.S. Environmental Protection Agency (EPA) (56 FR 54757, 1991). Subpart J of the NCP governs the use of chemical or biological agents to respond to oil discharges.

The predecessor of the NCP was first published in 1970 (35 FR 8508) and contained Annex X - Schedule of Dispersants and other Chemicals to Treat Oil Spills. EPA became responsible for Annex X in 1973 (38 FR 21243). In 1994, EPA revised the NCP in response to the passage of the OPA (59 FR 47384) to its current regulatory requirements with respect to the authorization of use, data requirements for listing, and effectiveness and toxicity testing protocols for products on the Schedule. The current NCPPS Technical Notebook is maintained by EPA and contains a compilation of manufacturer product bulletins provided on safety, storage, application methods, toxicity and effectiveness data, and physical properties.

Oil spill remediation countermeasure products must be evaluated and approved before they may be used to remove or control discharges. Products listed in the NCP Product Schedule can be found at *https://www.epa.gov/emergency-response/alphabetical-list-ncp-product-schedule-products-available-use-during-oil-spill*. EPA requires that product manufacturers submit toxicity data for all products listed on the NCPPS. Dispersants and bioremediation agents must also undergo effectiveness testing using reference oils in accordance with the published testing protocols developed by the EPA (Venosa, 2002; Haines et al., 2003; Sorial et al., 2004 a and b).

NCPPS reference oils are maintained by the EPA. Bryan Mound Crude (BMC) oil was selected as a new reference oil for dispersant effectiveness testing (88 FR 38333, effective December 11, 2023) to replace dwindling supplies of existing oil. To be listed on the NCPPS, the dispersant must demonstrate for each temperature a dispersant effectiveness at the 95% lower confidence level (LCL_{95}) greater than or equal to 75% at 25°C and 70% at 5°C. Reported here are the results of BMC testing for chemical and physical characterization, dispersant effectiveness using select NCPPS dispersant products, and acute toxicity of BMC to two standard test species: an estuarine crustacean (mysid; *Americamysis bahia*) and an estuarine fish (inland silverside; *Menidia berylina*). Results will be submitted to OLEM in support of the NCPPS and decision-making by On-Scene Coordinators (OSCs) regarding products for use during emergency response operations.

METHODOLOGY

Quality Assurance Project Plans

L14866-QP-1-7 Category A

G-LRPCD-0021545-QP-1-1 Category B

Oil and Dispersants

Bryan Mound Crude (BMC) is a light, sweet crude oil, obtained from the Department of Energy Strategic Petroleum Reserve in 2021. Eight chemical dispersant products currently listed on the NCPPS were used to treat the oil and evaluate the dispersant effectiveness. Chemical dispersant products used were (in alphabetical order) Accell® Clean DWD, Corexit® EC9500A, Dispersit SPC 1000™, Finasol® OSR 52, JD-2000 ™, Nokomis 3-AA, Saf-Ron Gold, and ZI-400. Products were chosen based on availability at the time of testing. Results are reported 'masked' to avoid bias.

Dispersant Effectiveness Baffle Flask Test

The EPA Baffle Flask Test (BFT) procedure was used for determining Dispersant Effectiveness (DE) for a specific oil-dispersant-temperature combination in six 150 mL baffled trypsinizing flasks (Venosa et al., 2002). Tests were conducted in controlled temperature rooms at 5 and 25 °C. Artificial seawater (120-mL of 31‰ adapted from Spotte et al., 1984) and 100 µL crude oil were added to the flask followed by 4 µL of a dispersant pipetted directly onto the oil slick to yield a Dispersant to Oil Ratio (DOR) of 1:25. The flasks received turbulent mixing at 250 rpm on an orbital shaker table. Following the mixing, the contents were allowed to settle for 10 ± 0.25 minutes to allow undispersed oil to reform a slick on the seawater surface before draining 30-mL through a stopcock at the base of the flask. The dispersed oil sample underwent liquid-liquid extraction using dichloromethane and analyzed with a UV-vis spectrophotometer between wavelengths of 340 – 400nm. The DE value, which is the lower 95% confidence limit of the six independent replicates (DE LCL_{95}) was reported for each treatment.

Physico-Chemical Characterization of Source Oil

BMC oil was shipped to Deer Park, TX for characterization by a certified laboratory. A chemical assay for the oil was generated using standard methods and provided to the EPA. Assay methods and results can be found in the attachment within the Appendix. BMC oil was analyzed for monoaromatic hydrocarbons (i.e., benzene, toluene, ethylbenzene and xylenes; BTEX), polycyclic aromatic hydrocarbons (PAHs), and alkanes in the EPA laboratory in Cincinnati, OH. Analysis for BTEX was performed by adding oil-soaked absorbent pads to a vial and spiking with a deuterated BTEX mix, surrogate mix and internal standards. The samples were then quantified using an Agilent 7890A Gas Chromatograph (GC) with a 5975C mass selective detector (MSD) with Triple Axis Detector and CombiPal autosampler (CTC Analytics) following EPA Method 524.3 modified to perform head space analysis instead of purge and trap (US EPA, 2009). The concentrations of the target compounds were corrected based on the recoveries of the deuterated compounds and reported in nanograms. The mass of oil (in mg) attached to the absorbent pads was evaluated by

extracting with DCM and measuring on a Shimadzu UV 1800 spectrophotometer. Final results are reported as ng BTEX per mg crude oil.

For analysis of PAHs and alkanes, oil samples were diluted in DCM and quantified using an Agilent 7890A GC with an Agilent 7000 GC/MS (GC/Mass Spectrometry) Triple Quad and a CombiPal autosampler (CTC Analytics), equipped with a DB-5 capillary column by J&W Scientific (30 m, 0.25 mm I.D., and 0.25 mm film thickness) and a pulsed splitless injection port (US EPA, 2018). Alkanes analyzed included C10-C35 normal aliphatics and branched alkanes (pristine and phytane). PAHs analyzed included 2-4 ring compounds and their alkylated homologs (i.e., C0-C4 naphthalenes, C0-C4 phenanthrenes, C0-C3 fluorenes, C0-C4 dibenzothiophenes, C0-C4 napthobenzothiophenes, C0-C4 pyrenes and C0-C4 chrysenes). Concentrations of the detected alkanes and PAHs were summed to compute total alkane and PAH concentrations, respectively (µg analyte/mg crude oil).

Toxicity

Toxicity testing was conducted at Hydrosphere Research, Inc. in Alachua, FL. Water Accommodated Fractions (WAFs) were prepared with oil loadings of 25 g oil per liter of water, under slow-stir conditions maintaining a 20% vortex for 18 h and settling for 6 h before sampling the aqueous exposure test solutions via slow siphon. Stock solutions were then serially diluted and used in toxicity tests (Barron and Kawaihae, 2003). Fresh source oils, stock solutions and exposure media were extracted and analyzed for alkanes, BTEX, aromatics and Total Petroleum Hydrocarbons (TPH) at the EPA laboratory in Cincinnati, OH. Samples were analyzed for C9-C32 TPH by gas chromatography-flame ionization detection (GC-FID) following EPA SW-846, Method 8015B-DRO. Reported concentration of stock solutions in milligrams TPH/L was used to calculate exposure concentrations for all toxicity tests.

Acute toxicity experiments were conducted using two standard test species, estuarine crustacean (mysid; *Americamysis bahia*) and an estuarine fish (inland silverside; *Menidia berylina*) at Hydrosphere Research, Inc. in Alachua, FL. Toxicity data were generated from tests with five concentrations and one control for each oil and test species. Standard toxicity test protocols and exposure conditions followed those summarized in Barron et al. (2018). The acute toxicity of oil was estimated using test-specific dose response data. These were generated from the average response across replicates as percent WAF and hydrocarbon metric (BTEX, TPH, alkanes, PAH) measured in each WAF. Effect concentrations for each metric of hydrocarbon exposure were based on concentrations in the stock WAF solution (initial measured), or on the geometric mean of the concentration in the stock WAF solution and exposure media at the end of the test period (day 2 or 4 of test). All statistical analyses were performed using the R statistical platform (v. 3.3.3) and associated packages (R Development Core Team, 2018; Ritz et al., 2015). Acute endpoints included the 20th and median lethal concentrations (LC20 and LC50, respectively).

RESULTS

Physico-Chemical Characterization

A chemical assay for the oil was generated using standard methods and provided to the EPA. Assay data results can be found in the attachment within the Appendix. For additional chemical information, Department of Energy also maintains assay lists for all Strategic Petroleum Reserve oils (https://www.spr.doe.gov/reports/Crude_Oil_Assays.html). BMC oil is considered a light crude oil based on the density (0.8320 mg/ml at 15°C), API gravity (38.6 at 15°C) and viscosity (4.721 cSt at 25°C) values. BMC is considered a sweet crude due to low sulfur content of 0.377 % by mass. Hydrocarbon analyses showed total alkane concentration of 90.4 µg/mg and total PAH concentration of 15.70 µg/mg, on par with other light sweet crude oils.

Dispersant Effectiveness

BFT average effectiveness and DE_{LCL95} values for BMC oil tested with masked chemical dispersants (DOR 1:25) are presented in Table 1. Histograms of these data are presented in Figure 1. Oil without dispersant (control) exhibited the lowest BFT DE LCL_{95} with values of 11.47% and 6.78 % at 25 and 5°C, respectively. Treatments with chemical dispersant exhibited higher DE values compared to the control. DE LCL_{95} values for oil treated with dispersants ranged between 51.46 - 96.10 % at 25°C and 50.52 - 91.80 % at 5°C. At 25 °C, Products B and C exhibited higher DE compared to products D, E, and G. Temperature did not appear to substantially impact DE in Products A, F and H.

Table 1. *Dispersant Effectiveness of BMC oil treated with chemical dispersants (masked letters A-H) and untreated control at DOR 1:25. DE average and LCL95 % values are provided. Treatments were conducted at 25 and 5oC.*

	25°C					5°C				
Dispersant *Masked ID*	Average (%)	Stdev (σ)	Variance (σ^2)	Coef. of Variation (RSD)	LCL_{95} (%)	Average (%)	Stdev (σ)	Variance (σ^2)	Coef. of Variation (RSD)	LCL_{95} (%)
A	98.44	5.92	35.10	6.02	93.57	95.13	3.49	12.18	3.67	91.80
B	98.46	2.87	8.21	2.91	96.10	93.01	6.14	37.74	6.61	87.96
C	96.98	1.51	2.27	1.55	95.54	89.16	6.28	39.49	7.05	83.99
D	89.48	5.13	26.32	5.73	85.26	90.59	1.67	2.79	1.84	89.00
E	87.74	2.68	7.20	3.06	85.18	91.56	2.52	6.34	2.75	89.16
F	58.78	8.89	79.02	15.12	51.46	55.93	6.57	43.14	11.74	50.52
G	64.03	10.22	104.49	15.96	55.62	74.86	9.10	82.88	12.16	67.37
H	76.03	6.34	40.22	8.34	70.82	78.46	11.07	122.55	14.11	69.36
Control	15.88	5.36	28.76	33.77	11.47	7.89	1.34	1.80	17.02	6.78

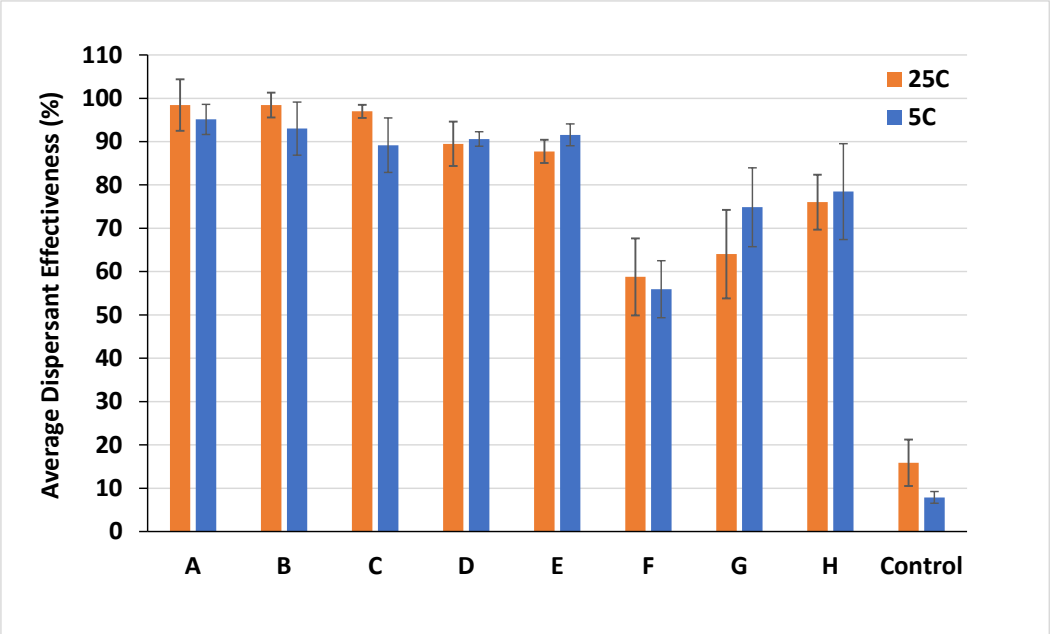

Figure 1. *Dispersant Effectiveness of BMC oil treated with chemical dispersants (masked letters A-H) and untreated control at DOR 1:25. DE average and LCL_{95} % values are provided. Treatments were conducted at 25 and 5°C. The error bars represent one standard deviation from the mean.*

Toxicity

Toxicity results and monitoring of test conditions at Hydrosphere Research, Inc. laboratories can be found in the attachment within the Appendix. Acute toxicity for BMC oil without dispersant (oil-only) was compared using standard WAF mixing procedures. Acute definitive bioassay tests were conducted using two standard test species: mysid shrimp (*Americamysis bahia;* 48-hour) *and* inland silverside minnow (*Menidia beryllina;* 96-hour). Percent mean survival is provided in Table 2 where the 100 % WAF resulted in a mean survival of 60 % for (*A. bahia*) and 67% for (*M. beryllina*).

Table 2. *Percent mean survival for acute toxicity testing of Bryan Mound Crude oil using standard species Americamysis bahia (48-hour) and Menidia beryllina (96-hour).*

BMC %WAF	**48-hour *A. bahia* Survival**			**96-hour *M. beryllina* Survival**				
	0 hr	24 hr	48 hr	0 hr	24 hr	48 hr	72 hr	96 hr
Control	100	100	100	100	100	100	100	100
6.25	100	100	100	100	100	100	100	100
12.5	100	100	100	100	100	100	100	100
25	100	100	100	100	100	97	97	97
50	100	100	100	100	100	100	100	100
100	100	60	60	100	70	67	67	67
LC_{50} (%)	-	-	>100%	-	-	-	-	>100%

Total petroleum hydrocarbons (TPH) concentrations in the fractional and 100% WAFs ranged between 0.55 – 8.74 mg/L (Table 3). No reportable median lethal concentration (LC50) could be calculated based on survival and mean concentrations, however extrapolated values (LC50*) were calculated as 9.18 and 9.4 mg/L for *A. bahia* and *M. beryllina*, respectively. The 20th percentile lethal concentrations (LC20) were calculated as 7.1 mg/L for *A. bahia* and 8.1 mg/L for *M. beryllina*. Figure 2 shows the percent survival as a function of TPH for both species. EPA's new decision-rule (88 FR 38333) does not require manufacturers to provide oil-only test results. Thus, median LC20 and LC50 values for the BMC oil without dispersant reported here will provide a comparative value for the EPA.

Table 3. *Total Petroleum Hydrocarbon concentration within fractional WAF treatments and the median and 20th percentile lethal concentration for acute toxicity testing of Bryan Mound Crude oil using standard species Americamysis bahia (48-hour) and Menidia beryllina (96-hour).*

Species	**48-hour *A. bahia***	**96-hour *M. beryllina***
Oil	BMC	BMC
Oil dosing	25g/L	25g/L
100% WAF conc at time 0hr (mg TPH/L)	8.74	8.74
Control	*0.00*	*0.00*
Treatment 1 – 6.25 % WAF	*0.55*	*0.55*
Treatment 2 – 12.5 % WAF	*1.09*	*1.09*
Treatment 3 – 25 % WAF	*2.19*	*2.19*
Treatment 4 – 50 % WAF	*4.37*	*4.37*
Treatment 5 – 100 % WAF	*8.74*	*8.74*
LC_{50} (%)	>100%	>100%
($CI_{95\%}$)	--	--
LC_{50} (mg/L)	>8.74	>8.74
($CI_{95\%}$)	--	--
LC_{50} (%) *	105	108
($CI_{95\%}$)	83 - 127	73 - 143
LC_{50} (mg/L) *	9.18	9.4
($CI_{95\%}$)	7.3 - 11.1	6.4 - 12.5
LC_{20} (%)	88.8	92.9
($CI_{95\%}$)	43 - 133	64.6 - 121.3
LC_{20} (mg/L)	7.7	8.1
($CI_{95\%}$)	3.8 - 11.7	5.6 - 10.6
Observed mortality at endpoint in 100% WAF	40% mortality	33.33% mortality
* *extrapolated value*		

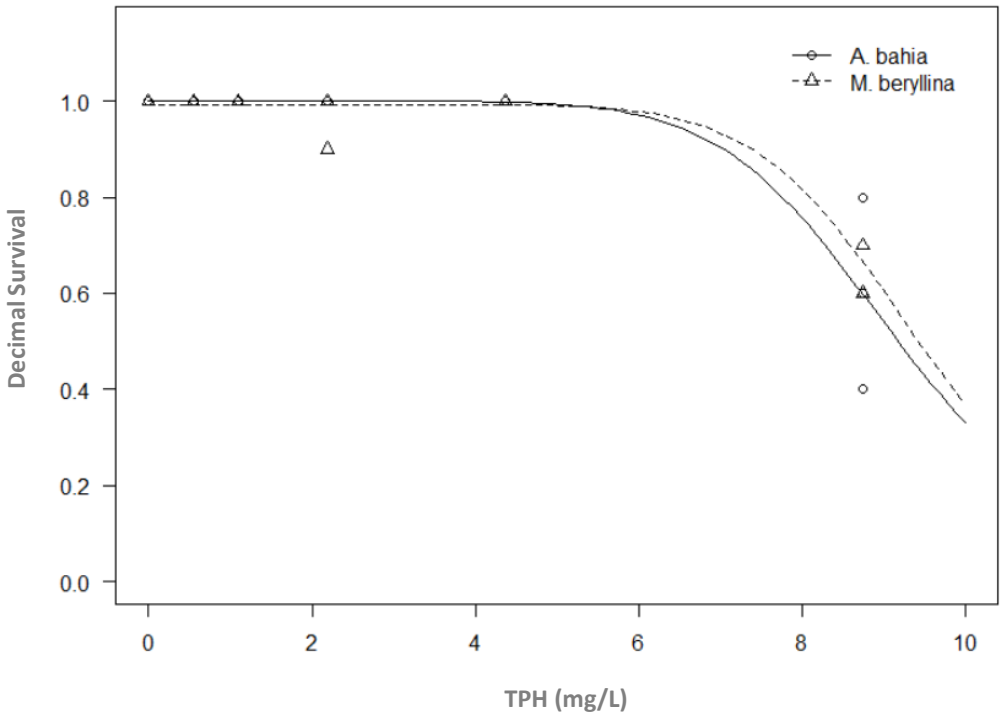

Figure 2. *Percent survival as a function of Total Petroleum Hydrocarbons (TPH) for A. bahia and M. beryllina test species.*

SUMMARY

Reported here are the data results of the physical-chemical properties, aquatic toxicity, and dispersant effectiveness of Bryan Mound Crude (BMC) oil. BMC has been selected as a new reference oil for the National Oil and Hazardous Substances Pollution Contingency Plan Product Schedule (NCPPS; 88 FR 38333) for the EPA Office of Land and Emergency Management (OLEM) Office of Emergency Management (OEM).

APPENDIX

Appendix 1. Report of Toxicity Tests Bryan Mound Oil Water Accommodating Fraction

Appendix 2. Brian Mound September 2022 Crude Assay Report

REFERENCES

35 FR 8508 (1970) The Council on Environmental Quality (CEQ) published in the Federal Register a National Oil and Hazardous Materials Pollution Contingency Plan, June 2, 1970.

38 FR 21243 (1973) Assignment of functions under section 311 of the Federal Water Pollution Control Act, as Amended, Executive Order 11735, August 3, 1973.

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Venosa, A.D., D.W. King, G.A. Sorial (2002) The baffled flask test for dispersant effectiveness: a round robin evaluation of reproducibility and repeatability. Spill Sci. Technol. Bull. 7:299-308.

APPENDIX 1

Hydrosphere research

Providing Environmental and Product Toxicity Testing Since 1986

Prepared for:

Pegasus Technical Services
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Cincinnati, OH 45268

PEGASUS TECHNICAL SERVICES, INC.
Combining Management and Technical Consulting Services

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Prepared by:
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Test Location:
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Contact Information:
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Test Number:
PEG-01 22218

Tests Conducted:
48-Hour Acute Definitive Bioassay Studies with the mysid shrimp (*Americamysis bahia*)

96-Hour Acute Definitive Bioassay Studies with the inland silverside minnow (*Menidia beryllina*)

Samples Tested:
Bryan Mound Oil WAF

Report of Toxicity Tests Performed for Pegasus Technical Services
Bryan Mound Oil WAF

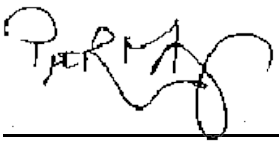
Abstract

At the request of Pegasus Technical Services, Hydrosphere conducted a series of bioassay tests to determine the potential aquatic acute toxicity effects of the Bryan Mound Oil Water Accommodating Fraction. Acute studies were conducted using the mysid shrimp (*Americamysis bahia*) and the inland silverside minnow (*Menidia beryllina*).

These tests were conducted in a manner consistent with EPA methods. Hydrosphere Research believes the results are true and accurate.

Revision 1

A data entry error was discovered after the original report was issued. A note has been added to the data sheet in appendix C, titled "Acute Saltwater Method (EPA-821-R-02-012, Method 2007.0)". The note corrects the data entry for the 100%, C replicate at 24 hours. The original value was recorded as "6^{4}" and should have been 8. This changed the 24-hour percent survival from 53% to 60%. The error does not change the report 48-hour LC_{50}. By extension, Table 4 was also corrected in this revision.



11/02/2023

Peter R. Meyer, Laboratory Director Date

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Introduction

The Bryan Mound oil was shipped from Pegasus Technical Services to Hydrosphere Research. Hydrosphere Research received the sample in good condition.

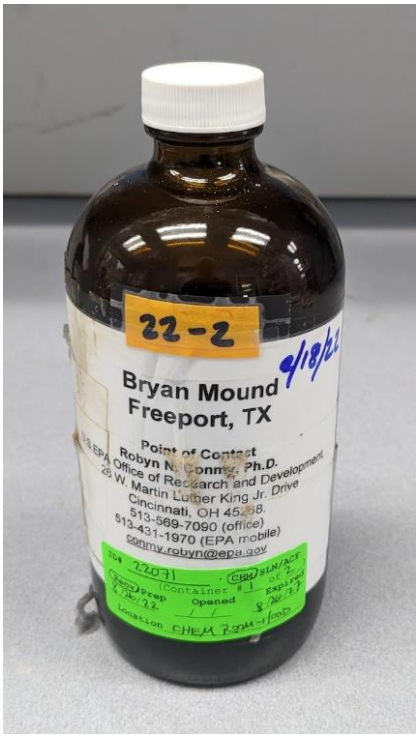
Using the Bryan Mound oil, Hydrosphere Research prepared Water Accommodating Fractions (WAF) in synthetic seawater. The WAF solutions were used to conduct acute effect concentration studies using the mysid shrimp (*Americamysis bahia*) and the inland silverside minnow (*Menidia beryllina*).

The laboratory bench sheets for the WAF range finding studies are included in Appendix A. The laboratory bench sheets for the WAF solutions effect concentration determination studies are in Appendix B. The Standard Reference Toxicity Tests are in Appendix C.

Materials and Methods

WAF Preparation

Figure 1. Bryan Mound Oil



The WAF materials were prepared from control water and the Bryan Mound oil. The control water was synthetic seawater (SSW). Control water and a magnetic PTFE stir bar were added to a glass cylinder and the cylinder was placed on a stir plate. The cylinder was covered with a glass plate with a silicone gasket to seal the contents of the cylinder. The cover had two access holes fitted with a glass tub in one and a silicone stopper in the other. The glass tube allowed access to the WAF sample below the oil line. Bryan Mound oil was slowly added to the cylinder at the designated concentration of 25 gm/L. Stirring was initiated to energize the system. The goal was to achieve a shallow vortex of oil into the aqueous layer without having the oil break apart into globules. The goal was to have a vortex that was 20% of the aqueous layer's height. The system was carefully watched to ensure that the vortex did not break apart. The vortex was reduced to approximately 15%. Figure 2 below illustrates the setup. The cylinder and cover were wrapped with aluminum foil to keep the system dark. One section was left loose to allow observations.

Stirring continued for 18 hours at room temperature. The system was checked periodically to ensure the vortex was stable. The stir plate was turned off after 18 hours and checked for any evidence that oil globules had broken off from the vortex during stirring. The system was then allowed to settle for 6 hours. At the end of the settling period, the WAF was collected by siphoning it with silicone tubing through the access tube in the glass plate cover into an aluminum foil wrapped glass jar. The jar was covered with a foil lined lid to prevent loss of volatile chemicals.

The collected WAF sample preparation was recorded in the lab's "Chemical & Solutions Logbook" and assigned the number 23138·SLN. Other sample preparation notes were recorded on a "Laboratory Notes" bench sheet located in appendix B. These samples constitute the 100% WAF samples recorded on the test bench sheets. For the exposure test solutions, dilutions of the 100% WAF sample were prepared with the appropriate control waters.

Figure 2. WAF systems prior to covering for light blockage.

WAF Sampling

WAF stock solutions and test solutions were subsampled and shipped to Pegasus Technical Solutions, Inc. All samples were preserved with HCl. Below is a table which summarizes the WAF stock solutions and test solutions.

Table 1. WAF Stock Solutions and Test Solutions Sub-Sampling

Hydrosphere Solution ID	Hydrosphere Solution Description	Date Solution Prepared	Date Sampled	Date Shipped to Pegasus
SSW·5982	BryanMoundOil·WAF/230510/Salt/AcuteEC,Control,@0hr/SS&MS	5/10/23	5/10/23	5/15/23
23139·SLN	BryanMoundOil·WAF/230510/Salt/AcuteEC,6.25%,@0hr/SS&MS	5/10/23	5/10/23	5/15/23
23138·SLN	BryanMoundOil·WAF/230510/Salt/AcuteEC,100%,@0hr/SS&MS	5/10/23	5/10/23	5/15/23
23143·SLN	BryanMoundOil·WAF/230512/Salt/AcuteEC,Control,@48hr/MS	5/12/23	5/12/23	5/15/23
23144·SLN	BryanMoundOil·WAF/230512/Salt/AcuteEC,6.25%,@48hr/MS	5/12/23	5/12/23	5/15/23
23145·SLN	BryanMoundOil·WAF/230512/Salt/AcuteEC,100%,@48hr/MS	5/12/23	5/12/23	5/15/23
23146·SLN	BryanMoundOil·WAF/230514/Salt/AcuteEC,Control,@96hr/SS	5/14/23	5/14/23	5/15/23
23147·SLN	BryanMoundOil·WAF/230514/Salt/AcuteEC,6.25%,@96hr/SS	5/14/23	5/14/23	5/15/23
23148·SLN	BryanMoundOil·WAF/230514/Salt/AcuteEC,100%,@96hr/SS	5/14/23	5/14/23	5/15/23
UPW(0.055µS)	Field Reagent Blank (FRB)	5/10/23	5/10/23	5/15/23

Test Organisms

The test organisms used in this study were the mysid shrimp (*A. bahia*) and the inland silverside minnow (*M. beryllina*). The mysid shrimp (*A. bahia*) test organisms were cultured in-house. The inland silverside (*M. beryllina*) test organisms were commercially obtained (Aquatic Indicators, St. Augustine, FL).

The test organism information is described in Table 2. Test Organism Information.

Table 2. Test Organism Information

Test Organism	Source	Organism Age
A. bahia	In-house Cultures	3 days
M. beryllina	Commercially Obtained	12 days

Test Methods

The summary of the test methods used are described in the following table:

Table 3. Summary of Test Methods

	Acute *A. bahia*	Acute *M. beryllina*
Test method	EPA-821-R-02-012, Method 2007.0	EPA-821-R-02-012, Method 2006.0
Test type	Static non-renewal	Static non-renewal
Test duration	48 hours	96 hours
Salinity	20 ± 2‰	20 ± 2‰
Renewal	NA	NA
Temperature	25 ± 1 °C. Test temperatures must not deviate (maximum minus minimum temperature) by more than 3 °C during the test.	
Light quality	Ambient laboratory illumination	
Light intensity	10–20 (E/m2/s)	
Photoperiod	16 h light, 8 h darkness, with phase in/out period recommended	
Test chamber size	500 mL	1 L
Test solution volume.	200 mL	200 mL
Age of test organism	1–5 days	9–14 days
No. organisms per test chamber	10	10
No. of replicate chambers per concentration	3	3
Feeding regime	Refer to specific feeding procedures provided in each test method	
Aeration	None, unless DO falls below 4.0 mg/L, then aerate all chambers. Rate: <100 bubbles/minute	
Physical / Chemical Measurements	Daily temperatures were measured in one replicate for each test concentration. Exposure test solutions were analyzed daily for pH, dissolved oxygen, and either conductivity or salinity.	
Test concentrations	5 exposure concentrations and a control	
Test acceptability chambers per concentration	≥90% survival in controls	

All statistical calculations were made using CETIS® (Tidepool Scientific Software, McKinleyville, CA). The sample statistical results are in Appendices A and B.

The bioassay tests were performed at Hydrosphere Research, 11842 Research Circle, Alachua, FL 32615; telephone number (386) 462-7889. The laboratory is NELAC/P certified by the State of Florida Department of Health and Rehabilitation Services (E82295).

Results

Bryan Mound Oil WAF Test Results

The results of the acute definitive tests are summarized in the tables and figures below. The raw data and bench sheets are included in Appendix B.

Table 4. 48-hour Acute *A. bahia* Survival

48-hour *M. bahia* % Mean Survival				
Bryan Mound Oil WAF	% WAF	0 Hours	24 Hours	48 Hours
	Control	100	100	100
	6.25	100	100	100
	12.5	100	100	100
	25	100	100	100
	50	100	100	100
	100	100	60	60
	LC50	-	-	**>100%**

Figure 3. 48-hour Acute *A. bahia* Survival

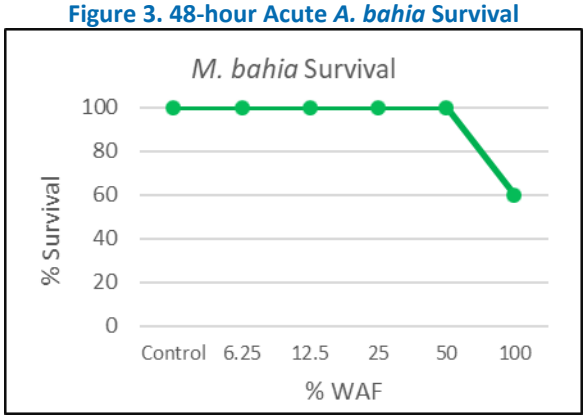
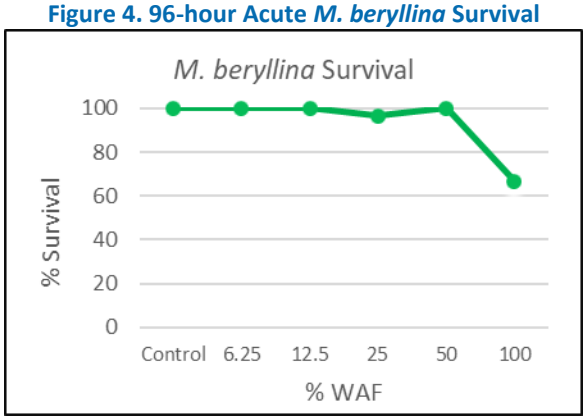


Table 5. 96-hour Acute *M. beryllina* Survival

96-hour *M. beryllina* % Mean Survival						
Bryan Mound Oil WAF	% WAF	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours
	Control	100	100	100	100	100
	6.25	100	100	100	100	100
	12.5	100	100	100	100	100
	25	100	100	97	97	97
	50	100	100	100	100	100
	100	100	70	67	67	67
	LC50	-	-	-	-	**>100%**

Figure 4. 96-hour Acute *M. beryllina* Survival



Quality Assurance

All phases of the study including, but not limited to, sample handling and storage, glassware preparation, test organism culturing/acquisition and acclimation, test organism handling during test, and maintaining appropriate test conditions were conducted per the applicable method. No known deviations were noted during the study.

All chemicals were certified products used before expiration dates (where applicable). All identification, service, and calibration information pertaining to laboratory instruments is recorded in calibration and maintenance logbooks. The bioassay tests were acceptable tests based on control performance and test conditions.

Standard Reference Toxicant Test Results

The results for the standard reference toxicant tests are in Appendix C which includes the control charts, statistics, and raw data.

Summary and Conclusions

The Bryan Mound Oil Water Accommodating Fraction produced a 48-hour LC_{50} of >100% for the mysid shrimp (*Americamysis bahia*) and a 96-hour LC_{50} of >100% for the inland silverside minnow (*Menidia beryllina*).

Dissolved oxygen, temperature, and pH remained within the limits established in the test methods. The Acute and Chronic Standard Reference Toxicant tests demonstrated that the test organisms used in this study were of acceptable health and sensitivity.

No unusual observations or deviations from standard test protocol were noted. No unusual qualitative test organism behaviors were observed in the test exposures. These test results only relate to the samples described in this report and meet all requirements of NELAC.

References

U.S. Environmental Protection Agency. *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*. Fifth Edition. EPA-821-R-02-012. October 2002.

Method Guidance and Recommendations for Whole Effluent Toxicity (WET) Testing (40 CFR Part 136). EPA 821-B-00-004. July 2000.

Handbook of Analytical Quality Control in Water and Wastewater Laboratories. EPA-600/4-79-019. March 1979.

Chemical and physical parameters reported herein were determined by methods described in *Methods for Chemical Analysis of Water and Waste*. EPA 600/4-79-020. March 1983.

Comprehensive Environmental Toxicity Information System (CETIS®), Version 1.9.7.9, Tidepool Scientific Software, McKinleyville, CA.

Appendix A.

Sample Shipping Labels


RETURN USEPA – OARM
23/Aug/2022 22:00 4626
JENNIFER TANT
(513) 569-7185
US EPA
26 W. MARTIN LUTHER KING DRIVE
CINCINNATI OH 45268-0001
5 LBS
1 OF 1
DWT: 8,8,10
SHIP TO:
PETER MEYER
(386) 462-7889
HYDROSPHERE RESEARCH ENV SERVICES
11842 RESEARCH CIRCLE
ALACHUA FL 32615-6817
received 8.26.22 @ ~10:00 pm
CHEM lock 22071 CHM
FL 326 0-02
UPS GROUND
TRACKING #: 1Z A43 F24 03 5056 0256
BILLING: 3RD PARTY
HAZARDOUS MATERIALS - GROUND ONLY
HAZ#: UN1267
Reference Name: Robyn Conmy
Dept: CESER/HSMMD
For Air Services Only
Passenger Aircraft
Cargo Aircraft Only
Emergency Contact Number
770-853-8707
ER Registrant
Jennifer Tant
Account Number
X43F24
Return Number
1ZA43F2403505602560256
Hazardous Materials Description and Quantity
UN1267, Petroleum crude oil, 3, I, 1 Fiberboard Box x 0.9 L
Carrier Use Only
Trailer
SLIC
Date
I hereby declare that the contents of this consignment are fully and accurately described above by the proper Shipping name and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.
If this shipment contains radioactive material acceptable for passenger aircraft, such material is intended for use in, incidental to, research, medical diagnosis or treatment.
Signature
Date
8/24/22
1Z A43 F24 03 5056 0256
HIPO – 1636
P: BLUE S: IN I: 628
HYDROSPHERE RESEARCH ENV SERVIC
11842 RESEARCH CIR
ALACHUA FL 32618

Appendix B.

48 & 96-hour Acute Raw Data Sheets & Statistical Results for the Range Finder Studies

Hydrosphere research

Acute Saltwater Method (EPA-821-R-02-012, Method 2007.0)

Survival

Client:	Pegasus Technical Services, Inc.	**Control Water:**	SSW
Code:	PEG-01 **Job:** 22218	**Diluent:**	SSW
Species:	*Mysidopsis bahia* **Code:** MS	**Test Vessel:**	500-mL Glass Jar
ID #:	2072 **Age:** 5d ☑ Lab, ☐ Com①	**Test Volume:**	200-mLs per replicate

Initiaton Date: 3/8/23 **Termination Date:** 3/10/23

Sample Description:

Product: ~~Fuel oil WRD~~ WAF (25 gm/L)
Test : **Range-finder (RF)**

Sample Description	% WAF	REP	Live Counts W 0h	Live Counts R 24h	Live Counts F 48h	pH 0h new	pH 24h old solution	pH 48h old solution	Dissolved Oxygen (mg/L) 0h new	Dissolved Oxygen (mg/L) 24h old solution	Dissolved Oxygen (mg/L) 48h old new	Salinity (‰) 0h new	Salinity (‰) 24h old solution	Salinity (‰) 48h old new
Control	0	A	10	10	10	7.9	7.7	8.0	7.3	7.5	7.4	20.8	20.5	21.3
		B	10	10	10									
		C	10	10	10									
WAF	0.01	A	10	10	10	8.0	8.0	7.9 8.1 RG 3110	7.3	7.4	7.4	20.8	20.6	21.6
		B	10	10	10									
		C	10	10	10									
	0.1	A	10	10	10	8.1	8.0	8.0	7.4	7.4	7.4	20.8	20.3	21.2
		B	10	10	10									
		C	10	10	10									
	1	A	10	10	10	8.1	8.0	8.1	7.4	7.4	7.3	20.8	20.6	21.8
		B	10	10	10									
		C	10	10	10									
	10	A	10	10	10	8.1	8.0	8.1	7.4	7.4	7.3	20.8	20.5	21.4
		B	10	10	10									
		C	10	10	10									
	100	A	10	10	10	8.1	8.0	8.1	7.4	7.3	7.3	20.8	20.4	21.4
		B	10	10	10									
		C	10	10	10									
Meter ID #:			420	421	428	428	421	428	428	421	428	428	421	428
Initials:			BB	DM	RG	MC	DM	RG	MC	DM	RG	MC	DM	RG
Time:			1600	1415	1535									

Control ID:	5917	Terminate Test ±30-min of initiation time.
Dilution ID:	5917	
Working Stock ID:	23048 · SLN	
Oil ID ID:	22071 · CHM	

Random-ization Template #	Feeding Type:	Artemia (concentrated slurry)		
2		2-drops (0.1-mL) 2-times, daily		
	Amount:	n/a	930	930
	Time:	1530	1600	—

Notes & Comments

① BRYAN MOUND OIL - JP 3/31

Photoperiod is 16L:8D, Illuminiation is ambient (50 to 100 ftcd)

① Check Box: **Lab** = In-House Reared, **Com** = Commercially obtained

Sample Description	% WAF	Temperature (°C) (acceptable range for a valid test is 25±1°C) 0	24	48
Control	0	25.0	25.4	25.7
WAF	0.01	25.0	25.2	25.7
	0.1	25.0	25.2	25.7
	1	25.0	25.1	25.7
	10	25.0	25.0	25.7
	100	25.0	24.7	25.6
Meter ID # :		421	426	425

CETIS Analytical Report

Test Code/ID: PEG-01 22218MSA / 16-4365-1580

Reference Toxicant 96-h Acute Survival Test — Hydrosphere Research

Analysis ID:	11-3875-8435	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	14 Mar-23 12:11	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Edit Date:	14 Mar-23 12:10	**MD5 Hash:**	92B8802B84E90A6B6D096CCFFF74D484	**Editor ID:**	003-737-857-6
Batch ID:	18-0705-0917	**Test Type:**	Survival (48h)	**Analyst:**	Lab Tech
Start Date:	08 Mar-23 16:00	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	~~Mod Hard Synthetic~~ Water
Ending Date:	10 Mar-23 15:35	**Species:**	Mysidopsis bahia	**Brine:**	SSW 5ppt
Test Length:	48h	**Taxon:**	Malacostraca	**Source:**	In-House Culture **Age:** 5d
Sample ID:	18-0787-2617	**Code:**	6BC1F269	**Project:**	Product Toxicity Test
Sample Date:	08 Mar-23	**Material:**	Product	**Source:**	Pegasus Technical Services
Receipt Date:	08 Mar-23	**CAS (PC):**		**Station:**	~~Fuel Oil WRD~~ WAF
Sample Age:	16h	**Client:**	Pegasus		Bryan Hound 01 3/31

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1528842	200	Yes	Two-Point Interpolation

Point Estimates

Level	mg/L	95% LCL	95% UCL
LC50	>100	---	---

48h Survival Rate Summary

			Calculated Variate(A/B)							Isotonic Variate	
Conc-mg/L	**Code**	**Count**	**Mean**	**Median**	**Min**	**Max**	**CV%**	**%Effect**	**A/B**	**Mean**	**%Effect**
0	D	3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
0.01		3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
0.1		3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
1		3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
10		3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
100		3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%

48h Survival Rate Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
0.01		1.0000	1.0000	1.0000
0.1		1.0000	1.0000	1.0000
1		1.0000	1.0000	1.0000
10		1.0000	1.0000	1.0000
100		1.0000	1.0000	1.0000

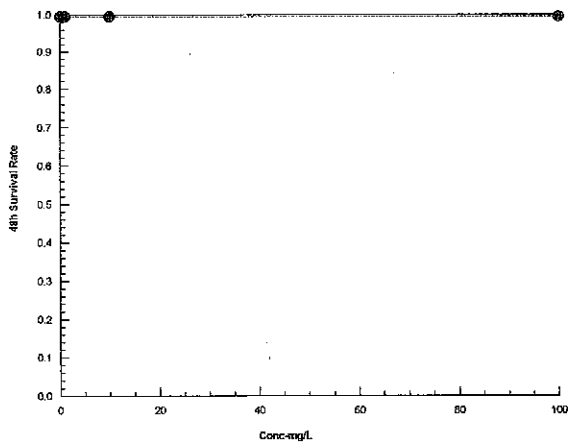
48h Survival Rate Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
0.01		10/10	10/10	10/10
0.1		10/10	10/10	10/10
1		10/10	10/10	10/10
10		10/10	10/10	10/10
100		10/10	10/10	10/10

Reference Toxicant 96-h Acute Survival Test **Hydrosphere Research**

Analysis ID:	11-3875-8435	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	14 Mar-23 12:11	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Edit Date:	14 Mar-23 12:10	**MD5 Hash:**	92B8802B84E90A6B6D096CCFFF74D484	**Editor ID:**	003-737-857-6

Graphics



Hydrosphere research

Acute Saltwater Method (EPA-821-R-02-012, Method 2006.0)

Survival

Client:	Pegasus Technical Services, Inc.	**Control Water:**	SSW
Code:	PEG-01 **Job:** 22218	**Diluent:**	SSW
Species:	*Menidia beryllina* **Code:** SS	**Test Vessel:**	1-L Glass Jar
ID #:	2065 **Age:** 12d ☐ Lab, ☑ Com①	**Test Volume:**	200-mLs per replicate

Initiaton Date: 3/8/23 **Termination Date:** 3/12/23

Sample Description:

Product: ~~Fuel oil WRD~~ WAF (**25 gm/L**) ②

Test : **Range-finder (RF)**

Sample Description	% WAF	REP	Live Counts W 0	R 24	F 48	S_d 72	S_v 96	pH (acceptable range for a valid test is 6 to 9) 0 new	24 old solution	48 old solution	72 old solution	96 old	Dissolved Oxygen (mg/L) (acceptable minimum for a valid test is 4.0-mg/L) 0 new	24 old solution	48 old solution	72 old solution	96 old	Salinity (‰) (20±2‰; FedReg / Vol80, No14 / Jan2015) 0 new	24 old solution	48 old solution	72 old solution	96 old
Control	0	A	10	10	10	10	10	7.9	7.8	7.8	7.9	7.9	7.3	7.3	7.4	7.5	7.4	20.8	20.5	20.4	20.7	20.6
		B	10	10	10	10	9'															
		C	10	10	9'	9	9															
WAF	0.01	A	10	10	10	10	10	8.0	8.0	7.9	8.1	8.0	7.3	7.3	7.4	7.4	7.3	20.8	20.5	20.8	21.0	21.1
		B	10	10	10	10	10															
		C	10	9°	9	9	8'															
	0.1	A	10	10	10	10	10	8.1	8.0	8.0	8.1	8.1	7.4	7.3	7.4	7.4	7.3	20.8	20.5	20.9	21.4	21.5
		B	10	10	10	10	10															
		C	10	10	10	9'	9															
	1	A	10	10	9	9	9	8.1	8.0	8.0	8.1	8.0	7.4	7.3	7.4	7.4	7.3	20.8	20.3	20.5	20.8	20.8
		B	10	10	10	10	10															
		C	10	10	10	10	10															
	10	A	10	10	10	10	10	8.1	8.0	8.0	8.1	8.1	7.4	7.3	7.3	7.4	7.2	20.8	20.4	20.6	20.9	20.9
		B	10	10	10	10	10															
		C	10	10	10	8'	8															
	100	A	10	9'	9	9	9	8.1	8.0	8.0	8.1	8.1	7.4	7.3	7.3	7.3	7.2	20.8	20.4	20.6	20.8	20.8
		B	10	8[2]	8	8	8															
		C	10	10	9'	9	9															
Meter ID #:			✓	421	421	411	421	428	421	421	411	421	428	421	421	411	421	428	421	421	411	421
Initials:			MC	DM	DM	RK	DM	MC	DM	DM	RK	DM	MC	DM	DM	RK	DM	MC	DM	DM	RK	DM
Time:			1545	1439	1449	1637	1525															

Control ID:	5917
Diluent ID:	5917
Working Stock ID:	23048 · SLN
Oil ID ID:	22071 · CHM

Terminate Test ±30-min of initiation time.

Random-ization Template #	Feeding Type:	Artemia (concentrated slurry)
2	**Amount:**	none ☒
	Time:	

Notes & Comments

① 9° DM 3/9/23

② BRYAN MOUND OIL, JR 3/3'

Photoperiod is 16L:8D, Illuminiation is ambient (50 to 100 ftcd)

① Check Box: **Lab** = In-House Reared, **Com** = Commercially obtained

Sample Description	% WAF	Temperature (°C) (acceptable range for a valid test is 25±1°C) 0	24	48	72	96
Control	0	25.1	25.3	25.6	25.0	25.6
WAF	0.01	25.1	25.4	25.5	25.1	25.5
	0.1	25.0	25.5	25.6	25.1	25.6
	1	25.0	25.4	25.5	25.2	25.5
	10	25.0	25.5	25.4	25.2	25.4
	100	25.1	25.5	25.3	25.3	25.5
Meter ID # :		426	426	426	425	426

CETIS Analytical Report

Test Code/ID: PEG-01 22218 / 10-1101-7421

Reference Toxicant 96-h Acute Survival Test — Hydrosphere Research

Analysis ID:	15-2719-7493	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	14 Mar-23 12:12	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Edit Date:	14 Mar-23 12:05	**MD5 Hash:**	6A22360F0EE35D2B537C2F23E926E9CB	**Editor ID:**	003-737-857-6

Batch ID:	12-1014-8483	**Test Type:**	Survival (96h)	**Analyst:**	Lab Tech
Start Date:	08 Mar-23 15:45	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	~~Mod-Hard Synthetic~~ Water
Ending Date:	12 Mar-23 15:25	**Species:**	Menidia beryllina	**Brine:**	SSW- 5917
Test Length:	96h	**Taxon:**	Actinopterygii	**Source:**	In-House Culture **Age:** 12 d

Sample ID:	05-9696-9274	**Code:**	2395073A	**Project:**	Product Toxicity Test
Sample Date:	08 Mar-23	**Material:**	Product	**Source:**	~~Pegasus Technical Services~~
Receipt Date:	08 Mar-23	**CAS (PC):**		**Station:**	~~Fuel Oil WRD~~ WAF Bryer Mound Oil JRm 3/30
Sample Age:	16h	**Client:**	Pegasus		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	434087	200	Yes	Two-Point Interpolation

Test Acceptability Criteria

Attribute	Test Stat	TAC Limits Lower	Upper	Overlap	Decision
Control Resp	0.9333	0.9	>>	Yes	Passes Criteria

Point Estimates

Level	mg/L	95% LCL	95% UCL
LC50	>100	---	---

96h Survival Rate Summary

			Calculated Variate(A/B)							Isotonic Variate	
Conc-mg/L	Code	Count	Mean	Median	Min	Max	CV%	%Effect	A/B	Mean	%Effect
0	D	3	0.9333	0.9000	0.9000	1.0000	6.19%	0.00%	28/30	0.9500	0.00%
0.01		3	0.9333	1.0000	0.8000	1.0000	12.37%	0.00%	28/30	0.9500	0.00%
0.1		3	0.9667	1.0000	0.9000	1.0000	5.97%	-3.57%	29/30	0.9500	0.00%
1		3	0.9667	1.0000	0.9000	1.0000	5.97%	-3.57%	29/30	0.9500	0.00%
10		3	0.9333	1.0000	0.8000	1.0000	12.37%	0.00%	28/30	0.9333	1.75%
100		3	0.8667	0.9000	0.8000	0.9000	6.66%	7.14%	26/30	0.8667	8.77%

96h Survival Rate Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	0.9000	0.9000
0.01		1.0000	1.0000	0.8000
0.1		1.0000	1.0000	0.9000
1		0.9000	1.0000	1.0000
10		1.0000	1.0000	0.8000
100		0.9000	0.8000	0.9000

96h Survival Rate Binomials

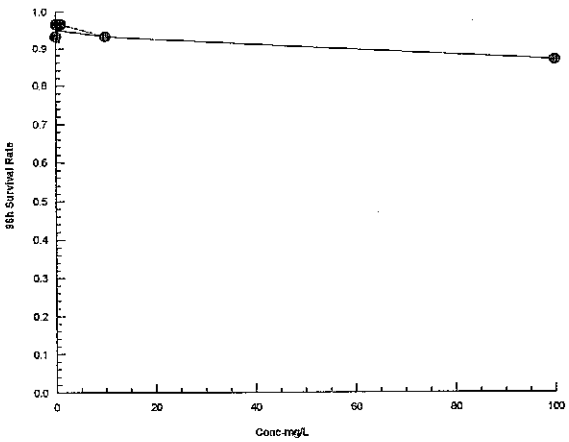
Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	9/10	9/10
0.01		10/10	10/10	8/10
0.1		10/10	10/10	9/10
1		9/10	10/10	10/10
10		10/10	10/10	8/10
100		9/10	8/10	9/10

Reference Toxicant 96-h Acute Survival Test

Hydrosphere Research

Analysis ID:	15-2719-7493	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	14 Mar-23 12:12	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Edit Date:	14 Mar-23 12:05	**MD5 Hash:**	6A22360F0EE35D2B537C2F23E926E9CB	**Editor ID:**	003-737-857-6

Graphics



Hydrosphere research

Laboratory Notes

Client: Pegasus Technical Services | **Code:** PEG-01 | **Job:** 22218

Task Title: 25 gm/L WAF prep | **Task Page 1 of 2**

1) Product Name: Bryan Mound Oil | Tech Initials: PRM

2) Lab ID: 22071 · CHM | Date: 3/7/2023

OIL ~ WAF Preparation (Range-finding Test)

oil mass for WAF: **25** g/L

	Saltwater Tests		
	SS	MS	Both
%	**600**	**600**	**1200**
0.01	0.06	0.06	0.12
0.1	0.6	0.6	1.2
1	6	6	12
10	60	60	120
100	600	600	1200
Bioassay WAF (mLs)	666.66	666.66	**1333.32**

Number of renewals	**1**	
WAF for renewals (mL)	**1333.32**	
Oil chem for WAF	**1000**	
BTEX for WAF	**80**	
Total WAF (mL)	2413	2613
Rounded	**2700**	
Mass of Oil (gm)	**67.5**	

Glass Cylinder

Inside dimensions (measured, not calc!)

6	diameter (in)	14.3	cm (width)	Item 1
8	height (in)	18.7	cm (height)	Item 2
20.32	height (cm)	**3.0**	L (volume)	Item 3

OIL~WAF

OIL ~ WAF Preparation (Range-finding Test)

Saltwater SS & MS

Item 4	**WAF needed**	**2700**	mLs
Item 5	**Cylinder**	3003.3	mLs
Item 6	**WAF height**	**16.81**	cm (from inside bottom, up)
Item 7	height+20%	20.17	cm (from inside bottom, up)
Item 8	cover ht of	18.7	cm (from inside bottom, up)
Item 9	is what %?	**11.2**	**% (shoot for 20%!)**
Item 10	20% vortex	**13.45**	cm (from inside bottom, up)

OIL

from "Mass of Oil (gms)"

Item 11	**Oil needed**	**67.5**	~ mLs
Item 12	**Diameter**	14.30	cm
Item 13	**Oil thickness**	0.42	cm

Labor Hours to perform tasks on this page: NA

Hydrosphere research

Laboratory Notes

Client:	Pegasus Technical Services	Code:	PEG-01	Job:	22218

Task Title	25 gm/L WAF prep	Task Page 2 of 2

1) Product Name:	Bryan Mound Oil	Tech Initials:	PRM
2) Lab ID:	22071 · CHM	Date:	3/7/2023

WAF Mixture

Oil Mass:	**25**	gms/L	
Oil ID:	22071	· CHM	
Water Volume:	**2.70**	L	
Water ID:	5917	SSW	
Product (unit/L):	**NA**	units: gm	
Product ID:	**NA**	· CHM	

1) Initiation 18-hours of Mixing on Stir Plate (Target is to achieve a 20% vortox)

Date :	3/7/2023		
Time:	14:10	Init	PRM
Product Target:	#VALUE!	units	gm
Product added :		units	gm
Time:	NA	Init	NA
Vortex Height:	14		%

	Event	Mass (gms)	Action
A	Oil Needed	**67.5**	Tare Cup
B	Add Oil to Cup ①	68.01	weigh
C	Left in Cup	2.09	weigh
D	Total Oil in Jar	65.92	B-C
E	Oil needed	1.58	A-D
F	Target for Cup	3.67	C+E
G	Oil added to Cup	3.68	weigh
H	Left in Cup	1.82	weigh
I	**Oil added to Jar**	1.86	G-H
J	Total Oil in Jar	67.78	D+I
K	Oil needed	-0.28	A-(D+H)
L	Target for Cup	1.54	H+K
M	Oil added to Cup		weigh
N	Left in Cup		weigh
O	**Oil added to Jar**	0.00	M-N
P	Total Oil in Jar	67.78	J+O
Q	**Percent of Total**	100.41%	((D+(+O)/A)*100

2) Terminate Mixing (at 18-hours)

Date :	3/8/2023		
Time:	8:05	Init	LH
System Stable?:	yes		

3) Collection of WAF (after 6-hours settling)

Time:	14:15	Init	PRM
Solution ID:	23048	· SLN	

Notes & Comments

① Cup is an aluminum foil (acetone rinsed) lined 5.5 oz Solo Cup or DM16 cup

Appendix C.

48 & 96-hour Acute Raw Data Sheets & Statistical Results for the Definitive Studies

Hydrosphere research

Acute Saltwater Method (EPA-821-R-02-012, Method 2007.0)

Survival

Client:	Pegasus Technical Services, Inc.	**Control Water:**	SSW
Code:	PEG-01 **Job:** 22218	**Diluent:**	SSW
Species:	*Mysidopsis bahia* **Code:** MS	**Test Vessel:**	500-mL Glass Jar
ID #:	2145 **Age:** 3d ☑ Lab, ☐ Com①	**Test Volume:**	200-mLs per replicate

Initiaton Date: 5/10/23 **Termination Date:** 5/12/23

Sample Description:

Product: Bryan Mound Oil WAF (**25 gm/L**)
Test : **Effect Concentration (EC)**

Sample Description	% WAF	REP	Live Counts W 0h	R 24h	F 48h	pH (acceptable range for a valid test is 6 to 9) 0h new	24h old solution	48h old solution	Dissolved Oxygen (mg/L) (acceptable minimum for a valid test is 4.0-mg/L) 0h new	24h old solution	48h old new	Salinity (‰) (20±2‰; FedReg / Vol80, No14 / Jan2015) 0h new	24h old solution	48h old new
Control	0	A	10	10	10	8.2	7.8	7.9	7.4	7.6	7.4	20.7	21.0	20.6
		B	10	10	10									
		C	10	10	10									
WAF	6.25	A	10	10	10	8.2	7.9	7.9	7.4	7.5	7.2	20.7	20.9	20.8
		B	10	10	10									
		C	10	10	10									
	12.5	A	10	10	10	8.2	8.0	8.0	7.3	7.5	7.3	20.7	20.9	20.8
		B	10	10	10									
		C	10	10	10									
	25	A	10	10	10	8.2	8.0	8.0	7.3	7.4	7.4	20.6	20.8	20.7
		B	10	10	10									
		C	10	10	10									
	50	A	10	10	10	8.2	8.0	7.9	7.3	7.4	7.3	20.6	20.7	20.6
		B	10	10	10									
		C	10	10	10									
	100	A	10	6	6	8.2	8.0	8.0	7.2	7.4	7.2	20.5	20.7	20.7
		B	10	4	4									
		C	10	~~6~~ 3	8									
Meter ID #:			X	X	X	436	436	436	436	436	436	436	436	436
Initials:			MC	MC	DM		MC	DM		MC	DM		MC	DM
Time:			1600	1510	1536									

Sample Description	% WAF	Temperature (°C) (acceptable range for a valid test is 25±1°C) 0	24	48
Control	0	25.6	25.5	25.5
WAF	6.25	25.6	25.5	25.4
	12.5	25.6	25.6	25.6
	25	25.5	25.6	25.4
	50	25.6	25.6	25.4
	100	25.6	25.5	25.4
Meter ID # :		426	425	426

Control ID:	5982
Diluent ID:	5982
Working Stock ID:	23138 · SLN
Oil ID ID:	22071 · CHM

Terminate Test ±30-min of initiation time.

Notes & Comments

① 25.6 - MC 5/10

② data entry error. the count at 24 hours for replicate "C" should be 8. DM 11/1/23

Random-ization Template #	Feeding Type:	Artemia (concentrated slurry)		
2	Amount:	2-drops (0.1-mL) 2-times, daily		
	Time:	X	1015	1015
		1600	1515	X

Photoperiod is 16L:8D, Illuminiation is ambient (50 to 100 ftcd)

① Check Box: **Lab** = In-House Reared, **Com** = Commercially obtained

CETIS Analytical Report

Reference Toxicant 96-h Acute Survival Test — **Hydrosphere Research**

Analysis ID:	00-6458-4846	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	10 Jul-23 14:11	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Edit Date:	10 Jul-23 14:10	**MD5 Hash:**	DB26147371EC252DF1653D082A0ADFF1	**Editor ID:**	003-737-857-6
Batch ID:	20-5567-3677	**Test Type:**	Survival (48h)	**Analyst:**	Lab Tech
Start Date:	10 May-23 16:00	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	12 May-23 15:36	**Species:**	Mysidopsis bahia	**Brine:**	
Test Length:	48h	**Taxon:**	Malacostraca	**Source:**	In-House Culture **Age:**
Sample ID:	19-9553-9355	**Code:**	76F1839B	**Project:**	Product Toxicity Test
Sample Date:	08 Mar-23	**Material:**	Product	**Source:**	Pegasus Technical Services
Receipt Date:	08 Mar-23	**CAS (PC):**		**Station:**	~~Fuel Oil WRD WAF~~ Drp-Mond
Sample Age:	63d 16h	**Client:**	Pegasus		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1761206	200	Yes	Two-Point Interpolation

Point Estimates

Level	mg/L	95% LCL	95% UCL
LC50	>100	---	---

48h Survival Rate Summary

			Calculated Variate(A/B)							Isotonic Variate	
Conc-mg/L	Code	Count	Mean	Median	Min	Max	CV%	%Effect	A/B	Mean	%Effect
0	D	3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
6.25		3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
12.5		3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
25		3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
50		3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
100		3	0.6000	0.6000	0.4000	0.8000	33.33%	40.00%	18/30	0.6000	40.00%

48h Survival Rate Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
6.25		1.0000	1.0000	1.0000
12.5		1.0000	1.0000	1.0000
25		1.0000	1.0000	1.0000
50		1.0000	1.0000	1.0000
100		0.6000	0.4000	0.8000

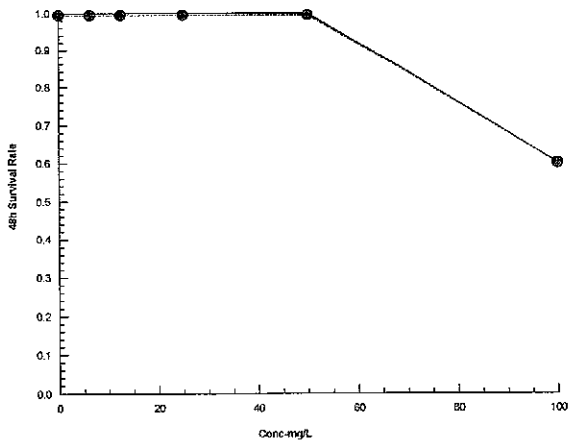
48h Survival Rate Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
6.25		10/10	10/10	10/10
12.5		10/10	10/10	10/10
25		10/10	10/10	10/10
50		10/10	10/10	10/10
100		6/10	4/10	8/10

Reference Toxicant 96-h Acute Survival Test **Hydrosphere Research**

Analysis ID:	00-6458-4846	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	10 Jul-23 14:11	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Edit Date:	10 Jul-23 14:10	**MD5 Hash:**	DB26147371EC252DF1653D082A0ADFF1	**Editor ID:**	003-737-857-6

Graphics



Hydrosphere research

Acute Saltwater Method (EPA-821-R-02-012, Method 2006.0)

Survival

Client:	Pegasus Technical Services, Inc.	**Control Water:**	SSW
Code:	PEG-01 **Job:** 22218	**Diluent:**	SSW
Species:	*Menidia beryllina* **Code:** SS	**Test Vessel:**	1-L Glass Jar
ID #:	2138 **Age:** 12d ☐ Lab, ☒ Com①	**Test Volume:**	200-mLs per replicate

Initiaton Date: 5·10·23 **Termination Date:** 5·14·23

Sample Description:

Product: Bryan Mound Oil WAF (**25 gm/L**)
Test : **Effect Concentration (EC)**

Sample Description	% WAF	REP	Live Counts W 0	Rv 24	F 48	S 72	S 96	pH (acceptable range for a valid test is 6 to 9) 0 new	24 old solution	48 old solution	72 old solution	96 old	Dissolved Oxygen (mg/L) (acceptable minimum for a valid test is 4.0-mg/L) 0 new	24 old solution	48 old solution	72 old solution	96 old	Salinity (‰) (20±2‰; FedReg / Vol80, No14 / Jan2015) 0 new	24 old solution	48 old solution	72 old solution	96 old
Control	0	A	10	10	10	10	10	8.2	8.0	8.0	8.1	8.1	7.4	7.5	7.5	7.3	7.6	20.7	21.0	20.7	20.8	20.7
		B	10	10	10	10	10															
		C	10	10	10	10	10															
WAF	6.25	A	10	10	10	10	10	8.2	8.0	DM 7.5 ①	8.2	8.1	7.4	7.5	7.4	7.3	7.6	20.7	20.9	20.9	20.8	21.0
		B	10	10	10	10	10															
		C	10	10	10	10	10															
	12.5	A	10	10	10	10	10	8.2	8.0	7.9	8.2	8.1	7.3	7.5	7.3	7.2	7.5	20.7	20.8	20.8	21.1	20.8
		B	10	10	10	10	10															
		C	10	10	10	10	10															
	25	A	10	10	10	10	10	8.2	7.9	7.9	8.2	8.0	7.3	7.5	7.1	7.3	7.5	20.6	20.8	20.7	20.9	20.9
		B	10	10	10	10	10															
		C	10	10	9	9	9															
	50	A	10	10	10	10	10	8.2	8.0	8.1	8.2	8.0	7.3	7.4	7.2	7.3	7.4	20.6	20.8	20.9	20.7	20.9
		B	10	10	10	10	10															
		C	10	10	10	10	10															
	100	A	10	7	6	6	6	8.2	8.0	8.0	8.2	8.0	7.2	7.4	7.2	7.2	7.4	20.5	20.7	20.7	21.0	21.2
		B	10	7	7	7	7															
		C	10	7	7	7	7															
Meter ID #:			X	X	436	X	X	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436
Initials:			PRm	MC	DM	DM	PRm	PRm	MC	DM	DM	PRm	PRm	MC	DM	DM	PRm	PRm	MC	DM	DM	PRm
Time:			1600	1500	1510	1145	1550															

Control ID:	5982
Diluent ID:	5982
Working Stock ID:	23138 · SLN
Oil ID ID:	22071 · CHM

Terminate Test ±30-min of initiation time.

Notes & Comments

① 8.0 DM 5/12/23

Randomization Template #	Feeding Type:	Artemia (concentrated slurry)
2	Amount:	none ☒
	Time:	

Photoperiod is 16L:8D, Illumination is ambient (50 to 100 ftcd)

① Check Box: **Lab** = In-House Reared, **Com** = Commercially obtained

Sample Description	% WAF	Temperature (°C) (acceptable range for a valid test is 25±1°C) 0	24	48	72	96
Control	0	25.6	25.5	25.5	25.3	25.7
WAF	6.25	25.6	25.6	25.4	25.3	25.8
	12.5	25.5	25.6	25.4	25.3	25.7
	25	25.6	25.5	25.4	25.3	25.7
	50	25.6	25.6	25.4	25.3	25.7
	100	25.5	25.6	25.4	25.3	25.7
Meter ID # :		426	425	426	425	425

Reference Toxicant 96-h Acute Survival Test — **Hydrosphere Research**

Analysis ID:	11-2930-8763	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	10 Jul-23 13:39	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Edit Date:	10 Jul-23 13:38	**MD5 Hash:**	E37159E96EC4282E5B6BD6931244B90C	**Editor ID:**	003-737-857-6
Batch ID:	09-2954-8760	**Test Type:**	Survival (96h)	**Analyst:**	Lab Tech
Start Date:	10 May-23 16:00	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Synthetic Saltwater
Ending Date:	14 May-23 15:50	**Species:**	Menidia beryllina	**Brine:**	
Test Length:	96h	**Taxon:**	Actinopterygii	**Source:**	In-House Culture **Age:**
Sample ID:	01-7230-7040	**Code:**	A453260	**Project:**	Product Toxicity Test
Sample Date:	08 Mar-23	**Material:**	Product	**Source:**	Pegasus Technical Services
Receipt Date:	08 Mar-23	**CAS (PC):**		**Station:**	Bryan Mound Oil WAF (25gm/L)
Sample Age:	63d 16h	**Client:**	Pegasus		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1733420	200	Yes	Two-Point Interpolation

Test Acceptability Criteria

		TAC Limits			
Attribute	**Test Stat**	**Lower**	**Upper**	**Overlap**	**Decision**
Control Resp	1	0.9	>>	Yes	Passes Criteria

Point Estimates

Level	mg/L	95% LCL	95% UCL
LC50	>100	---	---

96h Survival Rate Summary

			Calculated Variate(A/B)							Isotonic Variate	
Conc-mg/L	**Code**	**Count**	**Mean**	**Median**	**Min**	**Max**	**CV%**	**%Effect**	**A/B**	**Mean**	**%Effect**
0	D	3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
6.25		3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
12.5		3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	1.0000	0.00%
25		3	0.9667	1.0000	0.9000	1.0000	5.97%	3.33%	29/30	0.9833	1.67%
50		3	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	30/30	0.9833	1.67%
100		3	0.6667	0.7000	0.6000	0.7000	8.66%	33.33%	20/30	0.6667	33.33%

96h Survival Rate Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
6.25		1.0000	1.0000	1.0000
12.5		1.0000	1.0000	1.0000
25		1.0000	1.0000	0.9000
50		1.0000	1.0000	1.0000
100		0.6000	0.7000	0.7000

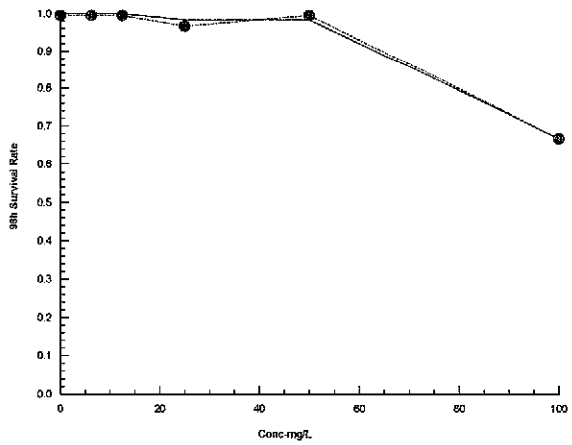
96h Survival Rate Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
6.25		10/10	10/10	10/10
12.5		10/10	10/10	10/10
25		10/10	10/10	9/10
50		10/10	10/10	10/10
100		6/10	7/10	7/10

Reference Toxicant 96-h Acute Survival Test **Hydrosphere Research**

Analysis ID:	11-2930-8763	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	10 Jul-23 13:39	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Edit Date:	10 Jul-23 13:38	**MD5 Hash:**	E37159E96EC4282E5B6BD6931244B90C	**Editor ID:**	003-737-857-6

Graphics



Hydrosphere research

Laboratory Notes

Client:	Pegasus Technical Services	Code:	PEG-01	Job:	22218
Task Title:	25 gm/L WAF prep			**Task Page 1 of 2**	
1) Product Name:	Bryan Mound Oil			Tech Initials:	PRM
2) Lab ID:	22071 · CHM			Date:	5/9/2023

OIL ~ WAF Preparation (Effective Concentration Test)

oil mass for WAF: **25** g/L

	Saltwater Tests		
	SS	MS	Both
%	600	600	1200
6.25	37.5	37.5	75
12.5	75	75	150
25	150	150	300
50	300	1800	600
100	600	300	1200
Bioassay WAF (mLs)	1162.5	2362.5	2325

Number of renewals	1	
WAF for renewals (mL)	2325	
Oil chem for WAF	1000	
BTEX for WAF	80	
Total WAF (mL)	3405	3605
Rounded	3500	
Mass of Oil (gm)	87.5	

Glass Cylinder (OD) — Inside dimensions (measured, not calc!)

7	diameter (in)	17.2	cm (width)	Item 1
7	height (in)	17.3	cm (height)	Item 2
17.78	height (cm)	4.0	L (volume)	Item 3

OIL~WAF

OIL ~ WAF Preparation (Effective Concentration Test)

Saltwater SS & MS

Item 4	**WAF needed**	3500	mLs
Item 5	**Cylinder**	4019.7	mLs
Item 6	**WAF height**	15.06	cm (from inside bottom, up)
Item 7	height+20%	18.08	cm (from inside bottom, up)
Item 8	cover ht of	17.3	cm (from inside bottom, up)
Item 9	is what %?	14.8	**% (shoot for 20%!)**
Item 10	20% vortex	12.05	cm (from inside bottom, up)

OIL

from "Mass of Oil (gms)"

Item 11	**Oil needed**	87.5	~ mLs
Item 12	**Diameter**	17.20	cm
Item 13	**Oil thickness**	0.38	cm

Labor Hours to perform tasks on this page: NA

Hydrosphere research

Laboratory Notes

Client:	Pegasus Technical Services	Code:	PEG-01	Job:	22218
Task Title	25 gm/L WAF prep			Task Page 2 of 2	
1) Product Name:	Bryan Mound Oil			Tech Initials:	PRM
2) Lab ID:	22071 · CHM			Date:	5/9/2023

WAF Mixture

Oil Mass:	**25**	gms/L	
Oil ID:	22071	· CHM	
Water Volume:	**3.50**	L	
Water ID:	5976	SSW	
Product (unit/L):	**NA**	units: gm	
Product ID:	**NA**	· CHM	

	Event	Mass (gms)	Action
A	Oil Needed	**87.5**	Tare Cup
B	Add Oil to Cup ①	90.20	weigh
C	Left in Cup	2.50	weigh
D	Total Oil in Jar	87.70	B-C
E	Oil needed	-0.20	A-D
F	Target for Cup	2.30	C+E
G	Oil added to Cup		weigh
H	Left in Cup		weigh
I	**Oil added to Jar**	0.00	G-H
J	Total Oil in Jar	87.70	D+I
K	Oil needed	-0.20	A-(D+H)
L	Target for Cup	-0.20	H+K
M	Oil added to Cup		weigh
N	Left in Cup		weigh
O	**Oil added to Jar**	0.00	M-N
P	Total Oil in Jar	87.70	J+O
Q	**Percent of Total**	100.23%	((D+I+O)/A)*100

1) Initiation 18-hours of Mixing on Stir Plate (Target is to achieve a 20% vortox)

Date :	5/9/2023		
Time:	14:26	Init	PRM
Product Target:	#VALUE!	units	gm
Product added :		units	gm
Time:	NA	Init	NA
Vortex Height:	15		%

2) Terminate Mixing (at 18-hours)

Date :	5/10/2023		
Time:	8:25	Init	PRM
System Stable?:	yes		

3) Collection of WAF (after 6-hours settling)

Time:	14:30	Init	PRM
Solution ID:	23138	· SLN	

Notes & Comments

① Cup is an aluminum foil (acetone rinsed) lined 5.5 oz Solo Cup or DM16 cup

Hydrosphere research

Hydrosphere Research
11842 Research Circle, Alachua FL 32615
(386) 462-7889

PAGE 1 of 1

Project Name:	WAF Bioassays for Pegasus Technical Services
Project Manager:	Peter R. Meyer
Company:	Hydrosphere Research
Phone:	386-462-7889
Address:	11842 Research Circle, Alachua FL 32615
Sampler's Signature:	PRM

Sample I.D. (Type / PrepDate / WaterType / TestType / SpeciesTested)	Date	Time	LAB ID	Matrix	Number of Containers	Analysis Requested: Oil Chemistries: TPH & PAH	Analysis Requested: BTEX	Analysis Requested	Analysis Requested	Analysis Requested	REMARKS
Field Reagent Blank (FRB)	5/10/2023	15:00	UPW(0.055µS)	Grab	3	1	1				
BryanMoundOil·WAF/230510/Salt/AcuteEC,Control,@0hr/SS&MS	5/10/2023	15:00	SSW·5982	Grab	4	2	2				
BryanMoundOil·WAF/230510/Salt/AcuteEC,6.25%,@0hr/SS&MS	5/11/2023	15:00	23139·SLN	Grab	4	2	2				
BryanMoundOil·WAF/230510/Salt/AcuteEC,100%,@0hr/SS&MS	5/10/2023	15:15	23138·SLN	Grab	4	2	2				
BryanMoundOil·WAF/230512/Salt/AcuteEC,Control,@48hr/MS	5/12/2023	15:45	23143·SLN	Grab	3	1	2				
BryanMoundOil·WAF/230512/Salt/AcuteEC,6.25%,@48hr/MS	5/12/2023	15:45	23144·SLN	Grab	3	1	2				
BryanMoundOil·WAF/230512/Salt/AcuteEC,100%,@48hr/MS	5/12/2023	15:45	23145·SLN	Grab	3	1	2				
BryanMoundOil·WAF/230514/Salt/AcuteEC,Control,@96hr/SS	5/14/2023	16:00	23146·SLN	Grab	3	1	2				
BryanMoundOil·WAF/230514/Salt/AcuteEC,6.25%,@96hr/SS	5/14/2023	16:00	23147·SLN	Grab	3	1	2				
BryanMoundOil·WAF/230514/Salt/AcuteEC,100%,@96hr/SS	5/14/2023	16:00	23148·SLN	Grab	3	1	2				

Correction: date is 5/10/2023, not 5/11/2023. PRM-230710

TURNAROUND REQUIREMENTS
____ 24 hr ____ 48 hr ____ 5 day
____ Standard (21 days)
____ Provide FAX Preliminary Results
Requested Report Date:_____

Invoice Information
P.O. # _____
Bill to: _____

REPORT REQUIREMENTS
____ I. Routine Report: Results, Method Blank, Surrogate, as required
____ II. Report Dup., MS, MSD as required
____ III. Data Validation Report (includes raw data)
____ IV. CLP Deliverable Report
____ V. EDD

Comments/Special Instructions:
SS = *M. beryllina*, MS = *Mysidopsis bahia*

RELINQUISHED BY:
Signature: PRM
Printed Name: Peter R. Meyer
Firm: Hydrosphere Research
Date/Time: 5.15.23 16:00

RECEIVED BY:
Signature: _____
Printed Name: _____
Firm: _____
Date/Time: _____

RELINQUISHED BY:
Signature: _____
Printed Name: _____
Firm: _____
Date/Time: _____

RECEIVED BY:
Signature: _____
Printed Name: _____
Firm: _____
Date/Time: _____

Appendix D.

Reference Toxicant Data for All Test Species

Control Chart - I

Control Limits for Standard Reference Toxicant Tests

ACUTE ··· *Mysidopsis bahia* (cultured at Hydrosphere Research)

LC_{50} = 494 µg/L

The LC50 is within the control limits.

QA Signature: _____ Date: 06/02/2023

Note: Dates with no corresponding LC50 data point, if present on chart, indicates an invalid test.
Note: If the control limit(s) for two or more consecutive tests are exceeded then the results must be explained here and the test must be repeated immediately. (EPA-821-R-02-012, Sections 4.15.3 &4.15.4, page 18). Also, Section 4.15.2 of the same Method states that "...reference toxicant results should not be used as a de facto criterion for rejection of individual effluent or receiving water tests."

LC50
AVG
Upper Control Limit
Lower Control Limit

LC50 (µg/L Cu^{2+} ion)

1000
900
800
700
600
500
400
300
200
100
0

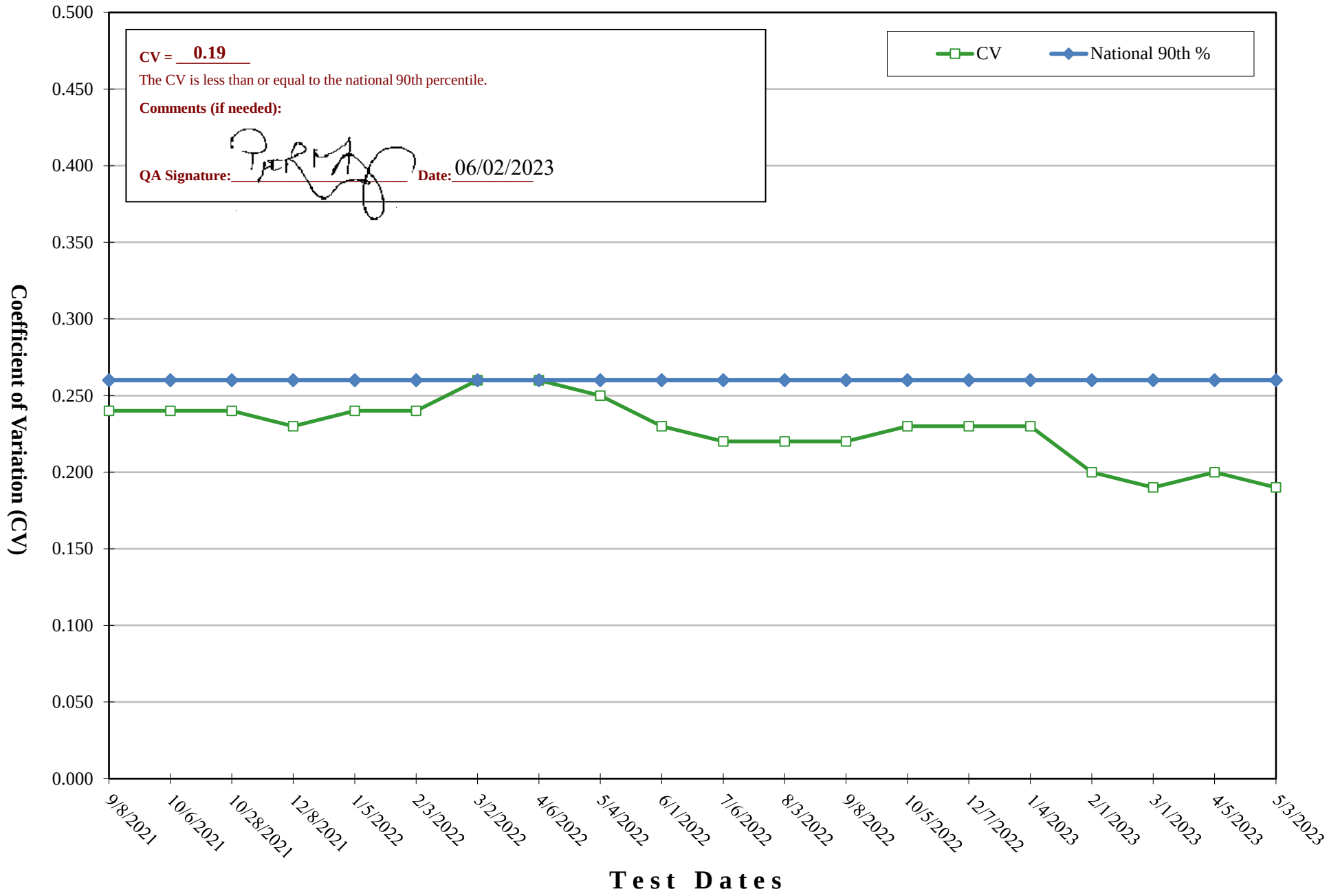
9/8/2021
10/6/2021
10/28/2021
12/8/2021
1/5/2022
2/3/2022
3/2/2022
4/6/2022
5/4/2022
6/1/2022
7/6/2022
8/3/2022
9/8/2022
10/5/2022
12/7/2022
1/4/2023
2/1/2023
3/1/2023
4/5/2023
5/3/2023

Test Dates

Control Chart - II

Coefficient of Variation for Standard Reference Toxicant Tests

ACUTE ··· *Mysidopsis bahia* (cultured at Hydrosphere Research)



REFERENCE TOXICANT LOG · Last 20

Test: **48-hour Acute**

Species: *Mysidopsis bahia*

Vendor: **Hydrosphere Research**

Toxicant: Copper Sulfate (**µg** Cu / L)

N	DATE	LC50	AVG	S.D.	2 SD	+ 2 SD.	- 2 SD	CV	National 75th %	National 90th %	Lower Control Limit	Upper Control Limit
437	9/8/2021	379	345.69	81.66	163.32	509.01	182.37	0.24	0.26	0.26	182.37	509.01
438	10/6/2021	402	346.03	81.89	163.78	509.81	182.25	0.24	0.26	0.26	182.25	509.81
439	10/28/2021	385	348.61	82.29	164.57	513.18	184.03	0.24	0.26	0.26	184.03	513.18
440	12/8/2021	462	358.63	83.33	166.66	525.28	191.97	0.23	0.26	0.26	191.97	525.28
441	1/5/2022	446	363.45	85.56	171.12	534.57	192.33	0.24	0.26	0.26	192.33	534.57
442	2/3/2022	472	364.17	86.44	172.88	537.05	191.28	0.24	0.26	0.26	191.28	537.05
443	3/2/2022	601	379.22	99.85	199.69	578.91	179.52	0.26	0.26	0.26	179.52	578.91
444	4/6/2022	472	388.70	99.13	198.26	586.95	190.44	0.26	0.26	0.26	190.44	586.95
445	5/4/2022	472	396.73	99.01	198.02	594.74	198.71	0.25	0.26	0.26	198.71	594.74
446	6/1/2022	398	403.09	94.48	188.96	592.05	214.12	0.23	0.26	0.26	214.12	592.05
447	7/6/2022	428	410.58	89.90	179.79	590.37	230.79	0.22	0.26	0.26	230.79	590.37
448	8/3/2022	290	410.61	89.86	179.72	590.33	230.88	0.22	0.26	0.26	230.88	590.33
449	9/8/2022	357	408.65	90.61	181.21	589.86	227.43	0.22	0.26	0.26	227.43	589.86
450	10/5/2022	322	404.18	92.64	185.28	589.46	218.89	0.23	0.26	0.26	218.89	589.46
451	12/7/2022	554	416.87	95.05	190.10	606.97	226.77	0.23	0.26	0.26	226.77	606.97
452	1/4/2023	513	423.17	97.14	194.28	617.45	228.89	0.23	0.26	0.26	228.89	617.45
453	2/1/2023	440	432.54	88.48	176.97	609.50	255.57	0.20	0.26	0.26	255.57	609.50
454	3/1/2023	323	436.51	81.05	162.10	598.60	274.41	0.19	0.26	0.26	274.41	598.60
455	4/5/2023	321	428.56	84.28	168.57	597.13	259.99	0.20	0.26	0.26	259.99	597.13
456	5/3/2023	494	426.61	82.16	164.32	590.93	262.28	0.19	0.26	0.26	262.28	590.93

Bioassay

Hydrosphere research

SRT	Standard Reference Toxicant Test	**Job #**	May 2023
Toxicant	Copper; Cu^{2+}, desiccated	**Benchsheet Set # for this Job** (Unique combination of Sample + Method)	1
Stock Solution	100 mg/L	**Test Concentration**	µg/L
		Set page 1 **of** 1	

Document	Acute Saltwater Method (EPA-821-R-02-012)						
Species	*Mysidopsis bahia*	Code	MS	Method #	2007.0	SOP #	TST-003
Feeding	*Artemia* Nauplii; Concentrate	Rate Fed	2-drops (0.1-mL) 2-times, daily				
Control Water	SSW	Synthetic Seawater	Exposure Volume	200 mLs	Test Vessel Type	Plastic Cup; DM16	

Day 0 ~ Start Date: 5/3/23 W day — Note: Test Salinity is **20‰ !!!**

mLs of **Copper** ↑ 400mLs w/ SSW	NA	0.22	0.44	0.88	1.76	3.52	Note: **CASCADE** is 7.04mLs ↑ 800mLs !!
Dilution #	1	2	3	4	5	6	Control / Diluent ID: 5976
Toxicant (µg/L)	**Control**	**55**	**110**	**220**	**440**	**880**	Toxicant ID: 23089 SLN
NEW Solutions: pH (S.I.)	7.9	8.0	8.0	8.0	8.0	8.0	pH Meter ID: 421
NEW Solutions: Dissolved Oxygen (mg/L)	8.6	8.7	8.6	8.7	8.7	8.7	D.O. Meter ID: ↓
NEW Solutions: Salinity (‰)	20.5	20.6	20.5	20.5	20.5	20.4	Cond. Meter ID: ↓
Live Counts; Replicate A	10	10	10	10	10	10	WQ Inititals: DM
Live Counts; Replicate B	10	10	10	10	10	10	WQ Time: 12:27

Stocking Initials: DM Time: 16:15 Age: ~~2d~~ 5d ID#: 2137 Randomization #: 1

Feedings (Time): DM 5/3 ① ~~16:15~~ Evening 2-drops (0.1-mL) 2-times, daily

Day 1 (24 hours) ~ Date: 5/4/23 R day

Dilution #	1	2	3	4	5	6	Control / Diluent ID: NA
% Sample	**Control**	**55**	**110**	**220**	**440**	**880**	Effluent ID: NA
OLD Solutions: Temperature (°C)	25.1	25.1	25.0	25.0	24.9	24.9	Thermometer ID: 426
OLD Solutions: pH (S.I.)	7.6	7.8	7.8	7.9	7.9	7.9	pH Meter ID: 421
OLD Solutions: Dissolved Oxygen (mg/L)	8.5	8.5	8.4	8.4	8.4	8.4	D.O. Meter ID: ↓
OLD Solutions: Salinity (‰)	21.6	21.6	21.8	21.8	21.8	21.7	Cond. Meter ID: ↓
Live Counts; Replicate A	10	10	10	10	10	9'	Count &WQ Inititals: DM
Live Counts; Replicate B	10	10	10	10	10	10	Count &WQ Time: 11:28

Feedings (Time): 09:45 Morning — 16:45 Evening 2-drops (0.1-mL) 2-times, daily

Day 2 (48 hours) ~ End Date: 5/5/23 F day — Note: terminate test ±30 minutes of time initiated !!!

Dilution #	1	2	3	4	5	6	Control / Diluent ID: NA
% Sample	**Control**	**55**	**110**	**220**	**440**	**880**	Effluent ID: NA
OLD Solutions: Temperature (°C) ③	~~25.3~~	~~25.2~~	24.7	24.7	24.7		② Thermometer ID: 426
OLD Solutions: pH (S.I.)	7.7	7.9	7.9	7.9	7.9		pH Meter ID: 421
OLD Solutions: Dissolved Oxygen (mg/L)	8.4	8.0	8.0	8.0	8.0		D.O. Meter ID: ↓
OLD Solutions: Salinity (‰)	23.0	22.9	23.5	23.5	23.4		Cond. Meter ID: ↓
Live Counts; Replicate A	10	10	10	10	6'	0	Count &WQ Inititals: DM
Live Counts; Replicate B	10	10	~~9~~ 10	9'	6'	0	Count &WQ Time: 15:45

Feedings (Time): 09:50 Morning 2-drops (0.1-mL) 2-times, daily (DM 5/5)

Notes & Comments

① 18:00 DM 5/4/23 ③ 24.7, 24.7 DM 5/5/23

② 24.7, 7.9, 7.9, 23.1, 2', 4'

CETIS Analytical Report

Mysidopsis 96-h Acute Survival Test — **Hydrosphere Research**

Analysis ID:	18-5334-1020	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	11 May-23 10:37	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Edit Date:	11 May-23 10:37	**MD5 Hash:**	9B2A474FF6E2D34D2D5E846A9C7135DE	**Editor ID:**	003-737-857-6
Batch ID:	03-2515-4518	**Test Type:**	Survival (48h)	**Analyst:**	Lab Tech
Start Date:	03 May-23 16:15	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Synthetic Saltwater
Ending Date:	05 May-23 15:45	**Species:**	Mysidopsis bahia	**Brine:**	Tropic Marin
Test Length:	47h	**Taxon:**	Malacostraca	**Source:**	In-House Culture **Age:**
Sample ID:	02-8866-8015	**Code:**	1134B96F	**Project:**	Standard Reference Toxicant Test
Sample Date:	03 May-23 16:15	**Material:**	Copper sulfate	**Source:**	Reference Toxicant
Receipt Date:	03 May-23 16:15	**CAS (PC):**		**Station:**	Aquatic Indicators
Sample Age:	---	**Client:**	Internal Lab		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	61400	200	Yes	Two-Point Interpolation

Point Estimates

Level	µg/L	95% LCL	95% UCL
LC50	493.9	493.9	493.9

48h Survival Rate Summary

			Calculated Variate(A/B)							Isotonic Variate	
Conc-µg/L	Code	Count	Mean	Median	Min	Max	CV%	%Effect	A/B	Mean	%Effect
0	D	2	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	20/20	1.0000	0.00%
55		2	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	20/20	1.0000	0.00%
110		2	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	20/20	1.0000	0.00%
220		2	0.9500	0.9500	0.9000	1.0000	7.44%	5.00%	19/20	0.9500	5.00%
440		2	0.6000	0.6000	0.6000	0.6000	0.00%	40.00%	12/20	0.6000	40.00%
880		2	0.0000	0.0000	0.0000	0.0000	---	100.00%	0/20	0.0000	100.00%

48h Survival Rate Detail

Conc-µg/L	Code	Rep 1	Rep 2
0	D	1.0000	1.0000
55		1.0000	1.0000
110		1.0000	1.0000
220		1.0000	0.9000
440		0.6000	0.6000
880		0.0000	0.0000

48h Survival Rate Binomials

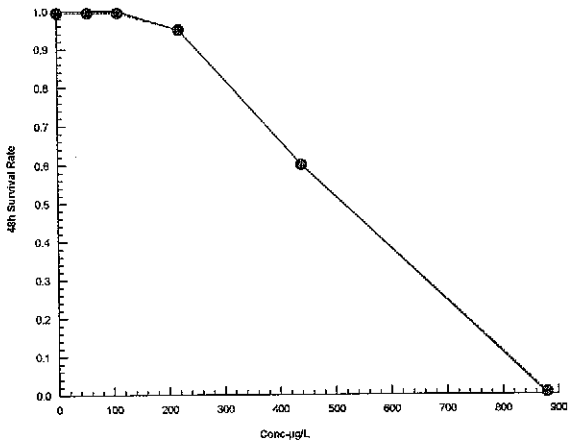
Conc-µg/L	Code	Rep 1	Rep 2
0	D	10/10	10/10
55		10/10	10/10
110		10/10	10/10
220		10/10	9/10
440		6/10	6/10
880		0/10	0/10

Mysidopsis 96-h Acute Survival Test

Hydrosphere Research

Analysis ID:	18-5334-1020	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	11 May-23 10:37	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Edit Date:	11 May-23 10:37	**MD5 Hash:**	9B2A474FF6E2D34D2D5E846A9C7135DE	**Editor ID:**	003-737-857-6

Graphics

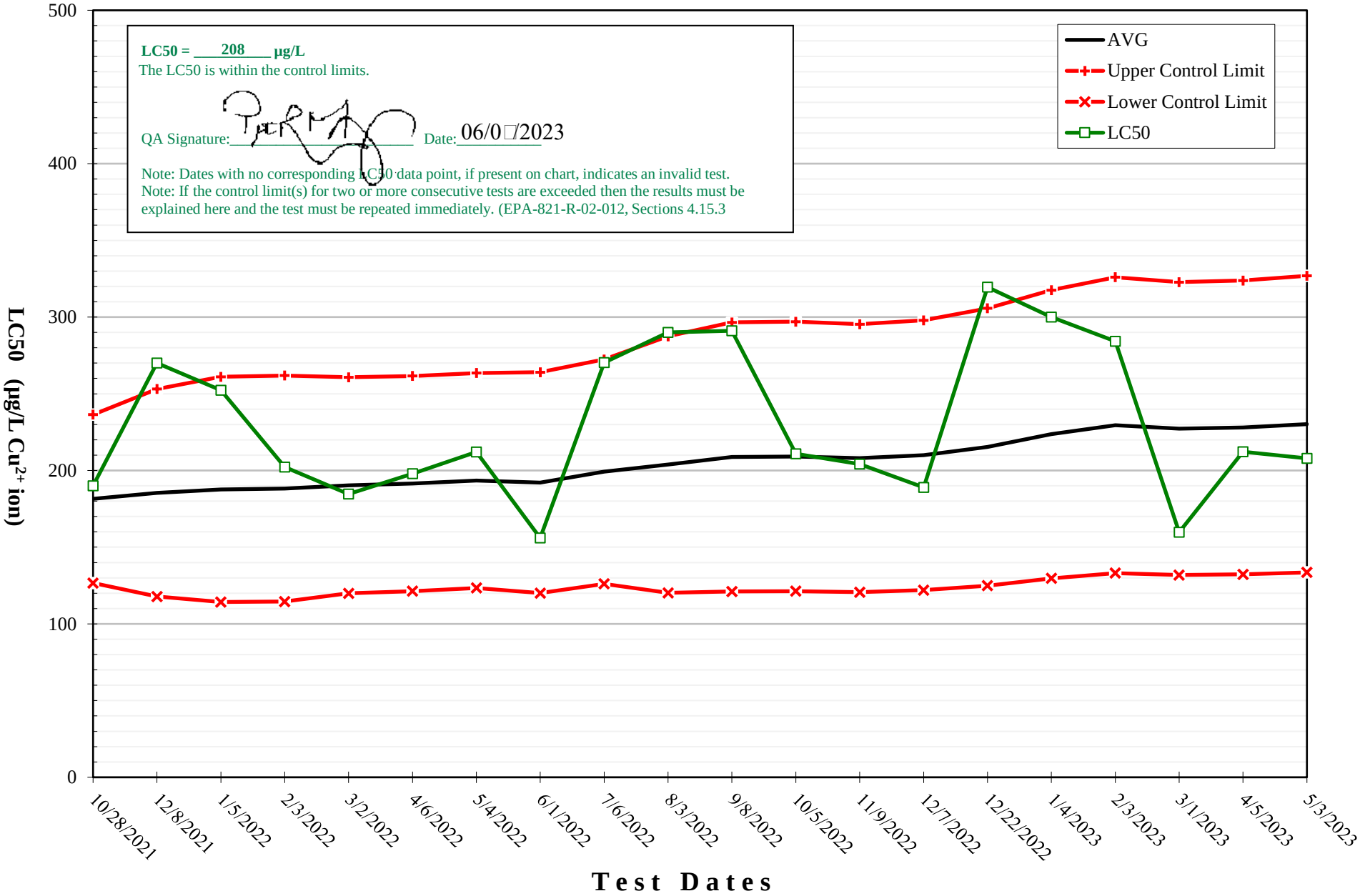


AQUATIC INDICATORS

Control Chart - I

Control Limits for Standard Reference Toxicant Tests

ACUTE ··· *Menidia beryllina* (conducted by Hydrosphere Research)



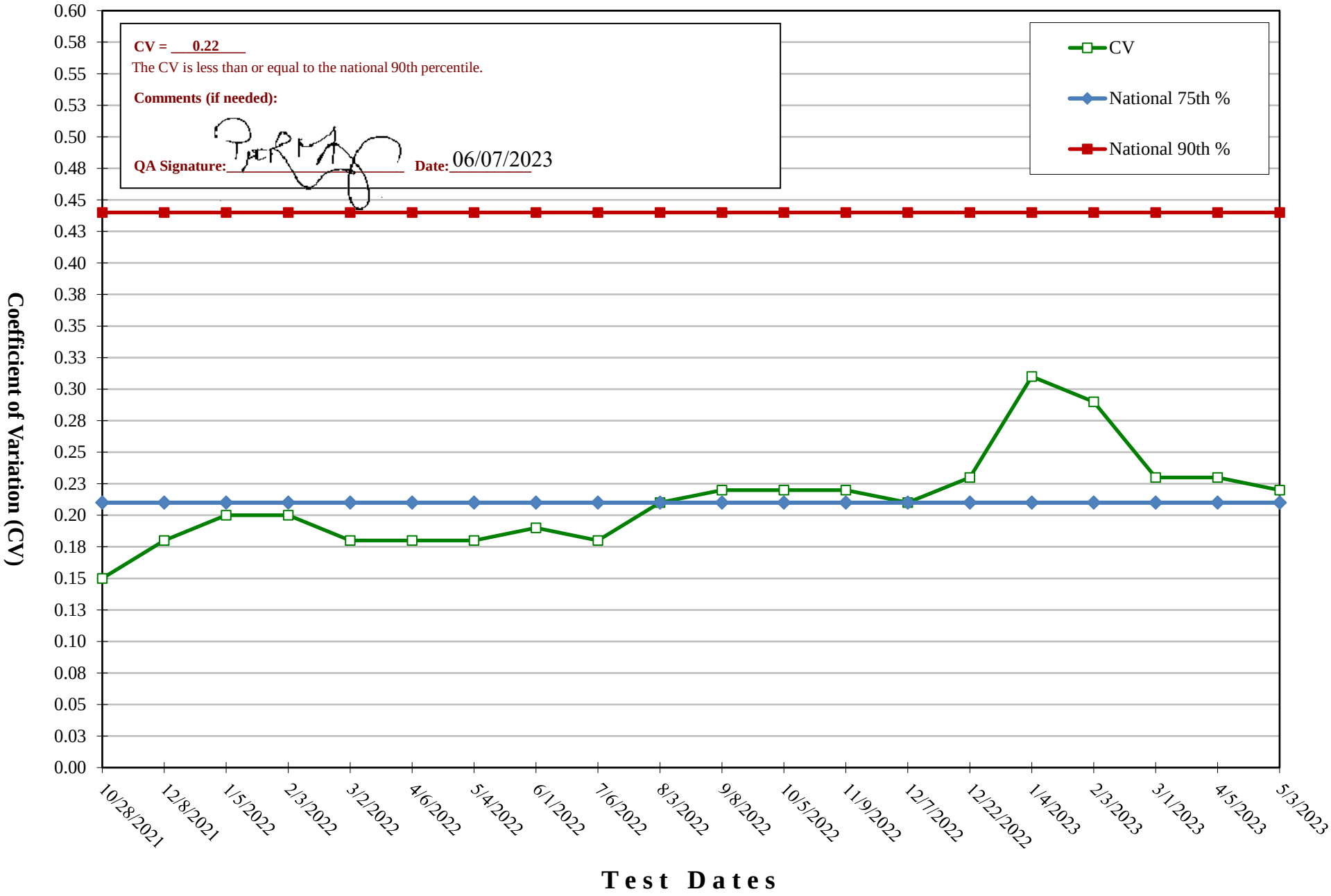
Version 1 (12031·DCF, effective 7/31/12)

AQUATIC INDICATORS

Control Chart - II

Coefficient of Variation for Standard Reference Toxicant Tests

ACUTE ··· *Menidia beryllina* (conducted by Hydrosphere Research)



Version 1 (12031·DCF)

REFERENCE TOXICANT LOG · Last 20

Test: 48-hour Acute

Species: *Menidia beryllina*

Vendor: Aquatic Indicators

Toxicant: Copper Sulfate (µg Cu / liter)

Aquatic Indicators, Inc.

N	DATE	LC50	AVG	S.D.	2S.D.	+2S.D.	- 2 SD	CV	National 75th %	National 90th %	Lower Control Limit	Upper Control Limit
458	10/28/2021	190	182	27.44	54.89	236.41	126.63	0.15	0.21	0.44	126.63	236.41
459	12/8/2021	270	185	33.82	67.64	253.10	117.82	0.18	0.21	0.44	117.82	253.10
460	1/5/2022	252	188	36.69	73.38	261.04	114.27	0.20	0.21	0.44	114.27	261.04
461	2/3/2022	202	188	36.83	73.66	261.87	114.55	0.20	0.21	0.44	114.55	261.87
462	3/2/2022	185	190	35.21	70.43	260.77	119.92	0.18	0.21	0.44	119.92	260.77
463	4/6/2022	198	191	35.06	70.12	261.61	121.37	0.18	0.21	0.44	121.37	261.61
464	5/4/2022	212	193	35.03	70.06	263.55	123.43	0.18	0.21	0.44	123.43	263.55
465	6/1/2022	156	192	35.98	71.97	264.02	120.09	0.19	0.21	0.44	120.09	264.02
466	7/6/2022	270	199	36.57	73.14	272.38	126.11	0.18	0.21	0.44	126.11	272.38
467	8/3/2022	290	204	41.81	83.62	287.48	120.23	0.21	0.21	0.44	120.23	287.48
468	9/8/2022	291	209	45.97	91.94	300.79	116.90	0.22	0.21	0.44	121.13	296.56
469	10/5/2022	211	209	45.96	91.93	301.07	117.22	0.22	0.21	0.44	121.30	296.98
470	11/9/2022	204	208	45.77	91.54	299.53	116.44	0.22	0.21	0.44	120.63	295.34
471	12/7/2022	189	210	43.97	87.93	297.87	122.00	0.21	0.21	0.44	122.00	297.87
472	12/22/2022	320	215	50.34	100.68	315.99	114.62	0.23	0.21	0.44	124.88	305.73
473	1/4/2023	300	224	69.52	139.04	362.69	84.62	0.31	0.21	0.44	129.72	317.59
474	2/3/2023	284	230	67.65	135.31	364.87	94.25	0.29	0.21	0.44	133.15	325.98
475	3/1/2023	160	227	51.79	103.58	330.88	123.72	0.23	0.21	0.44	131.84	322.77
476	4/5/2023	212	228	51.43	102.86	330.93	125.20	0.23	0.21	0.44	132.28	323.85
478	5/3/2023	208	230	49.52	99.04	329.25	131.16	0.22	0.21	0.44	133.52	326.90

Bioassay

Hydrosphere research

SRT	Standard Reference Toxicant Test	**Job #**	May 2023
Toxicant	Copper; Cu^{2+}, desiccated	**Benchsheet Set # for this Job** (Unique combination of Sample + Method)	1
Stock Solution	100 mg/L	**Test Concentration**	µg/L
		Set page	1 of 1

Document	Acute Saltwater Method (EPA-821-R-02-012)						
Species	*Menidia beryllina*	Code	SS	Method #	2006.0	SOP #	TST-004
Feeding	*Artemia* Nauplii; Concentrate	Rate Fed	0.2 mLs; 2-hours prior to test solution renewal				
Control Water	SSW	Synthetic Seawater	Exposure Volume	200 mLs	Test Vessel Type	Plastic Cup; DM32	

Day 0 ~ Start Date: 5/31/23 W day — Note: Test Salinity is **20‰ !!!**

mLs of **Copper** ↑ 400mLs w/ SSW	NA	0.3	0.6	1.2	2.4	4.8	Note: **CASCADE** is 9.6mLs ↑ 800mLs !!!

	Dilution #	1	2	3	4	5	6	Control / Diluent ID: 59 70
	Toxicant (µg/L)	**Control**	**75**	**150**	**300**	**600**	**1,200**	Toxicant ID: 23089 SLN
NEW Solutions	pH (S.I.)	7.9	8.0	8.0	8.0	8.0	8.0	pH Meter ID: 421
	Dissolved Oxygen (mg/L)	8.6	8.7	8.7	8.6	8.6	8.7	D.O. Meter ID:
	Salinity (‰)	20.5	20.5	20.5	20.5	20.4	20.3	Cond. Meter ID: ↓
	Live Counts; Replicate A	10	10	10	10	10	10	WQ Initials: DM
	Live Counts; Replicate B	10	10	10	10	10	10	WQ Time: 12:33
	Stocking Initials: LH	Time: 15:50	Age: 12d0h	ID#: 2130				Randomization #: 1

Day 1 (24 hours) ~ Date: 5/4/23 R day

	Dilution #	1	2	3	4	5	6	Control / Diluent ID: NA
	% Sample	**Control**	**75**	**150**	**300**	**600**	**1200**	Effluent ID: NA
OLD Solutions	Temperature (°C)	25.3	25.3	25.3	25.3	25.3	25.1	Thermometer ID: 426
	pH (S.I.)	7.6	7.8	7.9	7.9	7.9	7.9	pH Meter ID: 421
	Dissolved Oxygen (mg/L)	7.8	7.6	7.7	7.6	7.7	7.8	D.O. Meter ID:
	Salinity (‰)	21.4	21.5	21.6	21.6	21.5	21.4	Cond. Meter ID: ↓
	Live Counts; Replicate A	10	10	10	37	19	0[10]	Count &WQ Initials: DM
	Live Counts; Replicate B	10	10	10	46	37	0[10]	Count &WQ Time: 11:32

Day 2 (48 hours) ~ End Date: 5/5/23 F day — Note: terminate test ±30 minutes of time initiated !!!

	Dilution #	1	2	3	4	5	6	Control / Diluent ID: NA
	% Sample	**Control**	**75**	**150**	**300**	**600**	**1200**	Effluent ID: NA
OLD Solutions	Temperature (°C)	25.3	25.3	25.2	25.0	25.1		Thermometer ID: 426
	pH (S.I.)	7.6	7.8	7.8	7.9	7.9		pH Meter ID: 421
	Dissolved Oxygen (mg/L)	7.8	7.6	7.5	7.5	7.6		D.O. Meter ID: ↓
	Salinity (‰)	22.4	22.4	22.7	22.9	22.8		Cond. Meter ID:
	Live Counts; Replicate A	10	10	10	12	01		Count &WQ Initials: DM
	Live Counts; Replicate B	10	10	82	04	03		Count &WQ Time: 15:30

Notes & Comments

011days LH 5:15

CETIS Analytical Report

Inland Silverside 96-h Acute Survival Test

Hydrosphere Research

Analysis ID:	10-4185-1005	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	11 May-23 10:28	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Edit Date:	11 May-23 10:28	**MD5 Hash:**	965379A7651F65E1373BE05603FB5078	**Editor ID:**	003-737-857-6
Batch ID:	15-8077-9378	**Test Type:**	Survival (48h)	**Analyst:**	Lab Tech
Start Date:	03 May-23 15:50	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Synthetic Saltwater
Ending Date:	05 May-23 15:30	**Species:**	Menidia beryllina	**Brine:**	Tropic Marin
Test Length:	48h	**Taxon:**	Actinopterygii	**Source:**	Aquatic Indicators, FL **Age:**
Sample ID:	02-3335-8766	**Code:**	DE8C5AE	**Project:**	Standard Reference Toxicant Test
Sample Date:	03 May-23 15:50	**Material:**	Copper sulfate	**Source:**	Reference Toxicant
Receipt Date:	03 May-23 15:50	**CAS (PC):**		**Station:**	Aquatic Indicators
Sample Age:	---	**Client:**	Aquatic Indicators		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	819946	200	Yes	Two-Point Interpolation

Point Estimates

Level	µg/L	95% LCL	95% UCL
LC50	207.9	154.6	258.4

48h Survival Rate Summary

			Calculated Variate(A/B)							Isotonic Variate	
Conc-µg/L	Code	Count	Mean	Median	Min	Max	CV%	%Effect	A/B	Mean	%Effect
0	D	2	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	20/20	1.0000	0.00%
75		2	1.0000	1.0000	1.0000	1.0000	0.00%	0.00%	20/20	1.0000	0.00%
150		2	0.9000	0.9000	0.8000	1.0000	15.71%	10.00%	18/20	0.9000	10.00%
300		2	0.0500	0.0500	0.0000	0.1000	141.42%	95.00%	1/20	0.0500	95.00%
600		2	0.0000	0.0000	0.0000	0.0000	---	100.00%	0/20	0.0000	100.00%
1200		2	0.0000	0.0000	0.0000	0.0000	---	100.00%	0/20	0.0000	100.00%

48h Survival Rate Detail

Conc-µg/L	Code	Rep 1	Rep 2
0	D	1.0000	1.0000
75		1.0000	1.0000
150		1.0000	0.8000
300		0.1000	0.0000
600		0.0000	0.0000
1200		0.0000	0.0000

48h Survival Rate Binomials

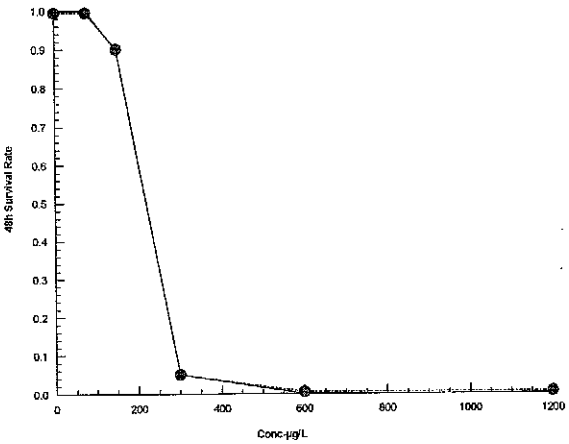
Conc-µg/L	Code	Rep 1	Rep 2
0	D	10/10	10/10
75		10/10	10/10
150		10/10	8/10
300		1/10	0/10
600		0/10	0/10
1200		0/10	0/10

Inland Silverside 96-h Acute Survival Test

Hydrosphere Research

Analysis ID:	10-4185-1005	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.9.7
Analyzed:	11 May-23 10:28	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Edit Date:	11 May-23 10:28	**MD5 Hash:**	965379A7651F65E1373BE05603FB5078	**Editor ID:**	003-737-857-6

Graphics



APPENDIX 2

Pegasus Technical Services, Inc.

Bryan Mound Crude Oil

September 2022

Job: 15911

Core Lab
RESERVOIR OPTIMIZATION

Digitally Generated by: Saybolt LP
Reason: Laboratory data
Location: Deer Park - Laboratory
Date: 2023.05.31 20:46:57 -06:00

PEGASUS TECHNICAL SERVICES, INC.
26 WEST MARTIN LUTHER KING DRIVE
45268, Cincinnati
United States

Saybolt
A CORE LABORATORIES COMPANY

Attention of : Ms. D. Sundaravadivelu

Analysis Report

Report number	: **13072/00015911.1/L/23**	Submitted date	: 03-24-2023
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 03-24-2023
Date of issue	: 05-31-2023	Date completed	: 05-31-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14490450
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (Whole Oil)		

NAME	METHOD	UNIT	RESULT
Gravity API at 60 °F	ASTM D 5002	°API	38.6
Relative Density at 60/60 °F	ASTM D 5002	-	0.8320
Asphaltenes	ASTM D 6560	mass %	0.48
Micro Carbon Residue	ASTM D 4530	mass %	2.11
UOP K factor	UOP 375	-	12.1
Organic chloride	ASTM D 4929		
Organic chloride in Naphtha fraction proc. B		µg/g	<1
Organic chloride in original sample		µg/g	<1
Hydrogen Sulfide and Mercaptan Sulphur	UOP 163		
Hydrogen Sulfide, as S		mg/kg	<1
Mercaptan, as S		mg/kg	14.5
Hydrogen Sulfide	ASTM D 5705	ppm	<1
Kinematic Viscosity at 77 °F	ASTM D 445	mm^2/s	4.721
Kinematic Viscosity at 100 °F	ASTM D 445	mm^2/s	3.547
Metals by ICP	ASTM D 5708		
Copper (Cu) Method B		mg/kg	< 0.1
Iron (Fe) - Method B		mg/kg	1.1
Nickel (Ni) - Method B		mg/kg	4.3
Vanadium (V) - Method B		mg/kg	8.7
Nitrogen	ASTM D 5762	WT%	0.0832
Pour Point	ASTM D 97	°C	-48
Salt Content	ASTM D 3230	WT%	0.00038
Sediment By Extraction	ASTM D 473	mass %	0.03
Sulphur (S)	ASTM D 4294	mass %	0.377
VPCR4 at 100 °F	ASTM D 6377	psi	6.54
Water Karl Fischer	ASTM D 4928	mass %	0.02
Wax content	UOP 46 obs.	mass %	3.6
Acid Number	ASTM D 664		
Acid number		mg KOH/g	0.23
Sample Size		g	6.69

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Sample object	: Pegasus Tech Svc	Sample number	: 14490450
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (Whole Oil)		

NAME	METHOD	UNIT	RESULT
Inflection or buffer endpoint		-	Inflection
Light Hydrocarbons in Crude Oil, Extended	ASTM D 7900 mod.		
Benzene		LV %	0.27
Toluene		LV %	0.60
Ethyl Benzene		LV %	0.14
M-Xylene		LV %	0.39
p-Xylene		LV %	0.12
o-Xylene		LV %	0.20
Simulated Distillation	ASTM D 7169		
IBP (0.5%)		°F	21
5% recovered		°F	138
10% recovered		°F	193
15% recovered		°F	236
20% recovered		°F	278
25% recovered		°F	327
30% recovered		°F	377
35% recovered		°F	428
40% recovered		°F	475
45% recovered		°F	520
50% recovered		°F	568
55% recovered		°F	614
60% recovered		°F	666
65% recovered		°F	720
70% recovered		°F	777
75% recovered		°F	830
80% recovered		°F	897
85% recovered		°F	978
90% recovered		°F	1085
95% recovered		°F	1242
FBP (99.5%)		°F	>1328
Boiling Range Residue		mass %	3.5

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Sample object	: Pegasus Tech Svc	Sample number	: 14490450
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (Whole Oil)		

NAME	METHOD	UNIT	RESULT
Recovery		mass %	96.5

Signed by: Dan Carlson - Chemist III
Issued by: Saybolt LP
Place and date of issue: Deer Park - 05-31-2023

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Report Date	: 05-31-2023	Date received	: 05-14-2023
Date of issue	: 05-31-2023	Date completed	: 05-14-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586585
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (IBP-75°F)		

NAME	METHOD	UNIT	RESULT
Yield, LV%	ASTM D 2892	LV %	3.16
Yield, LV%	ASTM D 2892	LV %	2.23
Gravity API at 60 °F	ASTM D 4052	°API	111.7
Relative Density at 60/60 °F	ASTM D 4052	-	0.5818
DHA Analysis	DHA		Attached

Signed by: Dan Carlson - Chemist III
Issued by: Saybolt LP
Place and date of issue: Deer Park - 05-31-2023

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Analysis Report

Report number	: **13072/00015911.1/L/23**	Submitted date	: 04-16-2023
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 05-05-2023
Date of issue	: 05-31-2023	Date completed	: 05-25-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586586
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (75-175°F)		

NAME	METHOD	UNIT	RESULT
Yield, LV%	ASTM D 2892	LV %	8.32
Yield on crude	ASTM D 2892	vol %	6.76
Gravity API at 60 °F	ASTM D 4052	°API	79.6
Relative Density at 60/60 °F	ASTM D 4052	-	0.6702
DHA Analysis	DHA		Attached
Sulphur (S)	ASTM D 5453	Wt%	0.0013
Organic chloride	ASTM D 4929	ppm	<1
Hydrogen Sulfide and Mercaptan Sulphur	UOP 163		
Hydrogen Sulfide, as S		mg/kg	<1
Mercaptan, as S		mg/kg	11
Hydrogen Sulfide	ASTM D 5705	ppm	<1
Research Octane Number (RON)	ASTM D 2699	-	67
Motor Octane Number (MON)	ASTM D 2700	-	65
Simulated Distillation	ASTM D 2887		
IBP (0.5%)		°F	28
5% recovered		°F	70
10% recovered		°F	74
15% recovered		°F	90
20% recovered		°F	92
25% recovered		°F	94
30% recovered		°F	96
35% recovered		°F	98
40% recovered		°F	113
45% recovered		°F	132
50% recovered		°F	135
55% recovered		°F	140
60% recovered		°F	148
65% recovered		°F	157
70% recovered		°F	158
75% recovered		°F	159

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Date of issue	: 05-31-2023	Date completed	: 05-25-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586586
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (75-175°F)		

NAME	METHOD	UNIT	RESULT
80% recovered		°F	166
85% recovered		°F	169
90% recovered		°F	180
95% recovered		°F	187
FBP (99.5%)		°F	209
Boiling Range Residue		mass %	--

Signed by: Dan Carlson - Chemist III
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Date of issue	: 05-31-2023	Date completed	: 05-25-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586587
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (175-250°F)		

NAME	METHOD	UNIT	RESULT
Yield on crude	ASTM D 2892	vol %	10.22
Yield on crude	ASTM D 2892	mass %	9.14
API Gravity & Relative Density	ASTM D 4052		
API Gravity		-	60.5
Relative Density at 60/60°F		-	0.7371
PIANO	ASTM D 6733		
See Attached			See Attached
Sulphur (S)	ASTM D 5453	mg/kg	0.0018
Organic chloride	ASTM D 4929		
Organic chloride in original sample		µg/g	<1
Hydrogen Sulfide and Mercaptan Sulphur	UOP 163		
Hydrogen Sulfide, as S		mg/kg	<1
Mercaptan, as S		mg/kg	10
Hydrogen Sulfide	ASTM D 5705	ppm v/v	8
Research Octane Number (RON)	ASTM D 2699	-	55
Motor Octane Number (MON)	ASTM D 2700	-	56
Simulated Distillation	ASTM D 2887		
IBP (0.5%)		°F	132
5% recovered		°F	167
10% recovered		°F	185
15% recovered		°F	191
20% recovered		°F	196
25% recovered		°F	201
30% recovered		°F	205
35% recovered		°F	211
40% recovered		°F	213
45% recovered		°F	215
50% recovered		°F	221
55% recovered		°F	223
60% recovered		°F	224

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Date of issue	: 05-31-2023	Date completed	: 05-25-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586587
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (175-250°F)		

NAME	METHOD	UNIT	RESULT
65% recovered		°F	229
70% recovered		°F	237
75% recovered		°F	241
80% recovered		°F	247
85% recovered		°F	251
90% recovered		°F	260
95% recovered		°F	264
FBP (99.5%)		°F	286

Signed by: Dan Carlson - Chemist III
Issued by: Saybolt LP
Place and date of issue: Deer Park - 05-31-2023

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		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 05-05-2023
Date of issue	: 05-31-2023	Date completed	: 05-25-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586588
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (250-375°F)		

NAME	METHOD	UNIT	RESULT
Yield on crude	ASTM D 2892	vol %	13.87
Yield on crude	ASTM D 2892	mass %	13.05
API Gravity & Relative Density	ASTM D 4052		
API Gravity		-	51.0
Relative Density at 60/60°F		-	0.7755
PIANO	ASTM D 6733		
See Attached			See Attached
Organic chloride	ASTM D 4929		
Organic chloride in original sample		µg/g	<1
Hydrogen Sulfide and Mercaptan Sulphur	UOP 163		
Hydrogen Sulfide, as S		mg/kg	<1
Mercaptan, as S		mg/kg	26.4
Hydrogen Sulfide	ASTM D 5705	ppm v/v	60
Research Octane Number (RON)	ASTM D 2699	-	30
Motor Octane Number (MON)	ASTM D 2700	-	27
Aniline Point	ASTM D 611	°C	53.90
Elemental analysis	ASTM D 5291		
Carbon		mass %	85.89
Hydrogen		mass %	14.09
Naphthalenes	ASTM D 1840		
Naphthalenes procedure B		vol %	0.28
Smoke Point	ASTM D 1322	mm	23
Sulphur (S)	ASTM D 4294	mass %	0.0117
Simulated Distillation	ASTM D 2887		
IBP (0.5%)		°F	210
5% recovered		°F	247
10% recovered		°F	261
15% recovered		°F	273
20% recovered		°F	278
25% recovered		°F	286

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Date of issue	: 05-31-2023	Date completed	: 05-25-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586588
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (250-375°F)		

NAME	METHOD	UNIT	RESULT
30% recovered		°F	290
35% recovered		°F	296
40% recovered		°F	305
45% recovered		°F	309
50% recovered		°F	314
55% recovered		°F	322
60% recovered		°F	328
65% recovered		°F	334
70% recovered		°F	340
75% recovered		°F	348
80% recovered		°F	351
85% recovered		°F	360
90% recovered		°F	370
95% recovered		°F	385
FBP (99.5%)		°F	406

Signed by: Dan Carlson - Chemist III
Issued by: Saybolt LP
Place and date of issue: Deer Park - 05-31-2023

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Date of issue	: 05-31-2023	Date completed	: 05-31-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586589
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (375-530°F)		

NAME	METHOD	UNIT	RESULT
Yield on crude	ASTM D 2892	vol %	15.96
Yield on crude	ASTM D 2892	mass %	15.77
API Gravity & Relative Density	ASTM D 4052		
API Gravity		-	40.6
Relative Density at 60/60°F		-	0.8221
Organic chloride	ASTM D 4929		
Organic chloride in original sample		µg/g	<1
Hydrogen Sulfide and Mercaptan Sulphur	UOP 163		
Hydrogen Sulfide, as S		mg/kg	<1
Mercaptan, as S		mg/kg	23
Hydrogen Sulfide	ASTM D 5705	ppm v/v	90
Aniline Point	ASTM D 611	°C	64.55
Elemental analysis	ASTM D 5291		
Carbon		mass %	85.87
Hydrogen		mass %	14.06
Naphthalenes	ASTM D 1840		
Naphthalenes procedure B		vol %	3.44
Smoke Point	ASTM D 1322	mm	17
Sulphur (S)	ASTM D 4294	mass %	0.0646
Acid Number	ASTM D 664		
Acid number		mg KOH/g	0.1
Sample Size			20.0155
Inflection or buffer endppoint		-	Inf
Cloud Point	ASTM D 2500	°C	-39
Freezing Point	ASTM D 2386	°C	-35.0
FIA (hydrocarbon types)	ASTM D 1319		
Saturates		vol %	81.9
Olefins		vol %	1.0
Aromatics		vol %	17.1
Kinematic Viscosity at 77 °F	ASTM D 445	mm^2/s	2.361

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Date of issue	: 05-31-2023	Date completed	: 05-31-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586589
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (375-530°F)		

NAME	METHOD	UNIT	RESULT
Kinematic Viscosity at 100 °F	ASTM D 445	mm^2/s	1.885
Total Nitrogen	ASTM D 4629	mg/kg	1.6
Pour Point [1]	ASTM D 97	°C	-41
UOP K factor	UOP 375	-	11.8
Cetane Index	ASTM D 976	-	47.8
Simulated Distillation	ASTM D 2887		

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Sample object	: Pegasus Tech Svc	Sample number	: 14586589
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (375-530°F)		

NAME	METHOD	UNIT	RESULT
IBP (0.5%)		°F	333
5% recovered		°F	377
10% recovered		°F	389
15% recovered		°F	402
20% recovered		°F	413
25% recovered		°F	423
30% recovered		°F	428
35% recovered		°F	438
40% recovered		°F	448
45% recovered		°F	455
50% recovered		°F	461
55% recovered		°F	469
60% recovered		°F	479
65% recovered		°F	487
70% recovered		°F	493
75% recovered		°F	499
80% recovered		°F	509
85% recovered		°F	516
90% recovered		°F	524
95% recovered		°F	536
FBP (99.5%)		°F	571

Remarks:

1 Derived from Spiral

Signed by: Dan Carlson - Chemist III
Issued by: Saybolt LP
Place and date of issue: Deer Park - 05-31-2023

PEGASUS TECHNICAL SERVICES, INC.
26 WEST MARTIN LUTHER KING DRIVE
45268, Cincinnati
United States

Saybolt
A CORE LABORATORIES COMPANY

Attention of : Ms. D. Sundaravadivelu

Analysis Report

Report number	: **13072/00015911.1/L/23**	Submitted date	: 03-24-2023
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 05-05-2023
Date of issue	: 05-31-2023	Date completed	: 05-25-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586590
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (530-650°F)		

NAME	METHOD	UNIT	RESULT
Yield on crude	ASTM D 2892	vol %	12.16
Yield on crude	ASTM D 2892	mass %	12.50
API Gravity & Relative Density	ASTM D 4052		
API Gravity		-	34.0
Relative Density at 60/60°F		-	0.8549
Aniline Point	ASTM D 611	°C	76.70
Elemental analysis	ASTM D 5291		
Carbon		mass %	86.53
Hydrogen		mass %	13.22
Naphthalenes	ASTM D 1840		
Naphthalenes procedure B		vol %	7.83
Smoke Point	ASTM D 1322	mm	15
Sulphur (S)	ASTM D 4294	mass %	0.241
Acid Number	ASTM D 664		
Acid number		mg KOH/g	0.2
Sample Size			20.0080
Inflection or buffer endpoint		-	Inf
Cloud Point	ASTM D 2500	°C	14
Kinematic Viscosity at 130 °F	ASTM D 445	mm^2/s	3.498
Kinematic Viscosity at 100 °F	ASTM D 445	mm^2/s	5.188
Nitrogen	ASTM D 5762	WT%	0.0163
Pour Point	ASTM D 97	°C	-6
UOP K factor	UOP 375	-	11.8
Cetane Index	ASTM D 976	-	52.0
Simulated Distillation	ASTM D 2887		
IBP (0.5%)		°F	495
5% recovered		°F	532
10% recovered		°F	545
15% recovered		°F	553
20% recovered		°F	560

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Analysis Report

Report number	: **13072/00015911.1/L/23**	Submitted date	: 03-24-2023
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 05-05-2023
Date of issue	: 05-31-2023	Date completed	: 05-25-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586590
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (530-650°F)		

NAME	METHOD	UNIT	RESULT
25% recovered		°F	568
30% recovered		°F	574
35% recovered		°F	581
40% recovered		°F	584
45% recovered		°F	590
50% recovered		°F	597
55% recovered		°F	605
60% recovered		°F	609
65% recovered		°F	615
70% recovered		°F	623
75% recovered		°F	630
80% recovered		°F	635
85% recovered		°F	644
90% recovered		°F	652
95% recovered		°F	660
FBP (99.5%)		°F	695

Signed by: Dan Carlson - Chemist III
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Place and date of issue: Deer Park - 05-31-2023

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United States

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A CORE LABORATORIES COMPANY

Attention of : Ms. D. Sundaravadivelu

Analysis Report

Report number	: **13072/00015911.1/L/23**	Submitted date	: 04-16-2023
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 05-07-2023
Date of issue	: 05-31-2023	Date completed	: 05-31-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586591
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (650°F plus)		

NAME	METHOD	UNIT	RESULT
Yield on crude	ASTM D 2892	vol %	36.31
Yield on crude	ASTM D 2892	mass %	40.55
API Gravity & Relative Density	ASTM D 4052		
API Gravity [1]		-	20.8
Relative Density at 60/60°F [1]		-	0.9291
Acid Number	ASTM D 664		
Acid number		mg KOH/g	0.58
Sample Size		g	1.3233
Inflection or buffer Endpoint		-	Inf
Asphaltenes	ASTM D 6560	mass %	1.2
Micro Carbon Residue	ASTM D 4530	mass %	4.96
Kinematic Viscosity at 130 °F	ASTM D 445	mm^2/s	102.4
Kinematic Viscosity at 180 °F	ASTM D 445	mm^2/s	31.66
Metals by ICP	ASTM D 5708		
Iron (Fe) - Method B		mg/kg	0.4
Nickel (Ni) - Method B		mg/kg	10.2
Vanadium (V) - Method B		mg/kg	19.2
Metals by ICP	ASTM D 5708		
Copper (Cu) - Method B		mg/kg	< 0.1
Nitrogen	ASTM D 5762	WT %	0.2076
Pour Point	ASTM D 97	°C	24
Sulphur (S)	ASTM D 4294	mass %	0.824
Elemental analysis	ASTM D 5291		
Carbon		mass %	86.72
Hydrogen		mass %	12.26
Simulated Distillation	ASTM D 7169		
IBP (0.5%)		°F	639
5% recovered		°F	675
10% recovered		°F	699
15% recovered		°F	723

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Analysis Report

Report number	: **13072/00015911.1/L/23**	Submitted date	: 04-16-2023
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 05-07-2023
Date of issue	: 05-31-2023	Date completed	: 05-31-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586591
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (650°F plus)		

NAME	METHOD	UNIT	RESULT
20% recovered		°F	748
25% recovered		°F	772
30% recovered		°F	794
35% recovered		°F	818
40% recovered		°F	843
45% recovered		°F	871
50% recovered		°F	900
55% recovered		°F	932
60% recovered		°F	966
65% recovered		°F	1005
70% recovered		°F	1048
75% recovered		°F	1096
80% recovered		°F	1152
85% recovered		°F	1216
90% recovered		°F	1298
95% recovered		°F	--
FBP (99.5%)		°F	>1328
Boiling Range Residue		mass %	8.1
Recovery		mass %	91.9

Remarks:

1 by Calc.

Signed by: Dan Carlson - Chemist III
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Analysis Report

Report number	: **13072/00015911.1/L/23**	Submitted date	: 03-24-2023
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 05-07-2023
Date of issue	: 05-31-2023	Date completed	: 05-31-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586592
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (650-850°F)		

NAME	METHOD	UNIT	RESULT
Yield on crude	ASTM D 5236	vol %	15.60
Yield on crude	ASTM D 5236	mass %	16.77
API Gravity & Relative Density	ASTM D 4052		
API Gravity		-	26.7
Relative Density at 60/60°F		-	0.8947
Aniline Point	ASTM D 611	°C	87.65
Elemental analysis	ASTM D 5291		
Carbon		mass %	86.53
Hydrogen		mass %	12.94
Sulphur (S)	ASTM D 4294	mass %	0.464
Acid Number	ASTM D 664		
Acid number		mg KOH/g	0.38
Sample Size		g	4.0534
inflection or buffer endpoint		-	Inf
Cloud Point [1]	ASTM D 2500	°C	28.6
Kinematic Viscosity at 130 °F	ASTM D 445	mm^2/s	14.72
Kinematic Viscosity at 180 °F	ASTM D 445	mm^2/s	6.736
Nitrogen	ASTM D 5762	WT%	0.0684
Pour Point	ASTM D 97	°C	24
Micro Carbon Residue	ASTM D 4530	mass %	<0.01
Refractive index at 60 °C	ASTM D 1747	-	1.4795
Cetane Index [1]	ASTM D 976	-	61.4
Wax content	UOP 46 obs.	mass %	13.1
UOP K factor	UOP 375	-	11.9
Simulated Distillation	ASTM D 2887		
IBP (0.5%)		°F	639
5% recovered		°F	672
10% recovered		°F	684
15% recovered		°F	695
20% recovered		°F	705

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Analysis Report

Report number	: **13072/00015911.1/L/23**	Submitted date	: 03-24-2023
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 05-07-2023
Date of issue	: 05-31-2023	Date completed	: 05-31-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586592
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (650-850°F)		

NAME	METHOD	UNIT	RESULT
25% recovered		°F	715
30% recovered		°F	724
35% recovered		°F	735
40% recovered		°F	745
45% recovered		°F	756
50% recovered		°F	766
55% recovered		°F	777
60% recovered		°F	788
65% recovered		°F	799
70% recovered		°F	811
75% recovered		°F	824
80% recovered		°F	837
85% recovered		°F	852
90% recovered		°F	872
95% recovered		°F	902
FBP (99.5%)		°F	970

Remarks:

1 Derived from Spiral

Signed by: Dan Carlson - Chemist III
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Place and date of issue: Deer Park - 05-31-2023

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Report number	: **13072/00015911.1/L/23**	Submitted date	: 03-24-2023
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 05-07-2023
Date of issue	: 05-31-2023	Date completed	: 05-31-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586593
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (850-1050°F)		

NAME	METHOD	UNIT	RESULT
Yield on crude	ASTM D 5236	vol %	11.52
Yield on crude	ASTM D 5236	mass %	12.76
API Gravity & Relative Density	ASTM D 4052		
API Gravity		-	22.0
Relative Density at 60/60°F		-	0.9216
Aniline Point	ASTM D 611	°C	100.40
Elemental analysis	ASTM D 5291		
Carbon		mass %	86.63
Hydrogen		mass %	12.55
Sulphur (S)	ASTM D 4294	mass %	0.668
Acid Number	ASTM D 664		
Acid number		mg KOH/g	0.59
Sample Size		g	2.0362
Inflection or buffer endpoint		-	Inf
Cloud Point [1]	ASTM D 2500	°C	46.6
Kinematic Viscosity at 130 °F	ASTM D 445	mm^2/s	87.68
Kinematic Viscosity at 180 °F	ASTM D 445	mm^2/s	26.90
Nitrogen	ASTM D 5762	WT%	0.1522
Pour Point	ASTM D 97	°C	45
Micro Carbon Residue	ASTM D 4530	mass %	0.90
Refractive index at 60 °C	ASTM D 1747	-	1.4955
Wax content	UOP 46 obs.	mass %	14.9
Metals by ICP	ASTM D 5708		
Iron (Fe) - Method B		mg/kg	< 0.1
Nickel (Ni) - Method B		mg/kg	0.1
Vanadium (V) - Method B		mg/kg	0.1
Metals by ICP	ASTM D 5708		
Copper (Cu) - Method B		mg/kg	< 0.1
UOP K factor	UOP 375	-	12.1
Simulated Distillation	ASTM D 7169		

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Analysis Report

Report number	: **13072/00015911.1/L/23**	Submitted date	: 03-24-2023
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 05-07-2023
Date of issue	: 05-31-2023	Date completed	: 05-31-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586593
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (850-1050°F)		

NAME	METHOD	UNIT	RESULT
IBP (0.5%)		°F	692
5% recovered		°F	780
10% recovered		°F	813
15% recovered		°F	836
20% recovered		°F	854
25% recovered		°F	869
30% recovered		°F	883
35% recovered		°F	896
40% recovered		°F	908
45% recovered		°F	919
50% recovered		°F	930
55% recovered		°F	940
60% recovered		°F	951
65% recovered		°F	963
70% recovered		°F	975
75% recovered		°F	987
80% recovered		°F	1000
85% recovered		°F	1014
90% recovered		°F	1032
95% recovered		°F	1054
FBP (99.5%)		°F	1122
Boiling Range Residue		mass %	0.5
Recovery		mass %	99.5

Remarks:

1 Deerived from Spiral

Signed by: Dan Carlson - Chemist III
Issued by: Saybolt LP
Place and date of issue: Deer Park - 05-31-2023

PEGASUS TECHNICAL SERVICES, INC.
26 WEST MARTIN LUTHER KING DRIVE
45268, Cincinnati
United States

Saybolt
A CORE LABORATORIES COMPANY

Attention of : Ms. D. Sundaravadivelu

Analysis Report

Report number	: **13072/00015911.1/L/23**	Submitted date	: 03-24-2023
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 05-07-2023
Date of issue	: 05-31-2023	Date completed	: 05-31-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586594
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (1050°F plus)		

NAME	METHOD	UNIT	RESULT
Yield on crude	ASTM D 5236	vol %	9.19
Yield on crude	ASTM D 5236	mass %	11.02
API Gravity & Relative Density	ASTM D 4052		
API Gravity [1]		-	10.5
Relative Density at 60/60°F [1]		-	0.9968
Acid Number	ASTM D 664		
Acid number		mg KOH/g	1.1
Sample Size		g	0.6891
Inflection or buffer endpoint		-	Inf
Asphaltenes	ASTM D 6560	mass %	3.8
Micro Carbon Residue	ASTM D 4530	mass %	19.0
UOP K factor	UOP 375	-	12.0
Kinematic Viscosity at 210 °F	ASTM D 445	mm^2/s	1294
Kinematic Viscosity at 180 °F	ASTM D 445	mm^2/s	3423
Metals by ICP	ASTM D 5708		
Iron (Fe) - Method B		mg/kg	3.5
Nickel (Ni) - Method B		mg/kg	38.0
Vanadium (V) - Method B		mg/kg	73.4
Metals by ICP	ASTM D 5708		
Copper (Cu) - Method B		mg/kg	< 0.1
Nitrogen	ASTM D 5762	WT%	0.5137
Sulphur (S)	ASTM D 4294	mass %	1.45
Elemental analysis	ASTM D 5291		
Carbon		mass %	87.13
Hydrogen		mass %	11.03
Simulated Distillation	ASTM D 7169		
IBP (0.5%)		°F	976
5% recovered		°F	1038
10% recovered		°F	1062
15% recovered		°F	1079

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Analysis Report

Report number	: **13072/00015911.1/L/23**	Submitted date	: 03-24-2023
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 05-31-2023	Date received	: 05-07-2023
Date of issue	: 05-31-2023	Date completed	: 05-31-2023
Sample object	: Pegasus Tech Svc	Sample number	: 14586594
Sample type	: Submitted		
Sample submitted as	: Petroleum Crude Oil		
Marked	: Bryan Mound Crude Sep 2022 (1050°F plus)		

NAME	METHOD	UNIT	RESULT
20% recovered		°F	1095
25% recovered		°F	1111
30% recovered		°F	1126
35% recovered		°F	1141
40% recovered		°F	1157
45% recovered		°F	1173
50% recovered		°F	1190
55% recovered		°F	1207
60% recovered		°F	1226
65% recovered		°F	1247
70% recovered		°F	1269
75% recovered		°F	1294
80% recovered		°F	1317
85% recovered		°F	--
90% recovered		°F	--
95% recovered		°F	--
FBP (99.5%)		°F	>1328
Boiling Range Residue		mass %	17.8
Recovery		mass %	82.2

Remarks:

1 By D-70

Signed by: Dan Carlson - Chemist III
Issued by: Saybolt LP
Place and date of issue: Deer Park - 05-31-2023

Pegasus Technical Services, Inc.
Bryan Mound Crude Sept. 2022
15911

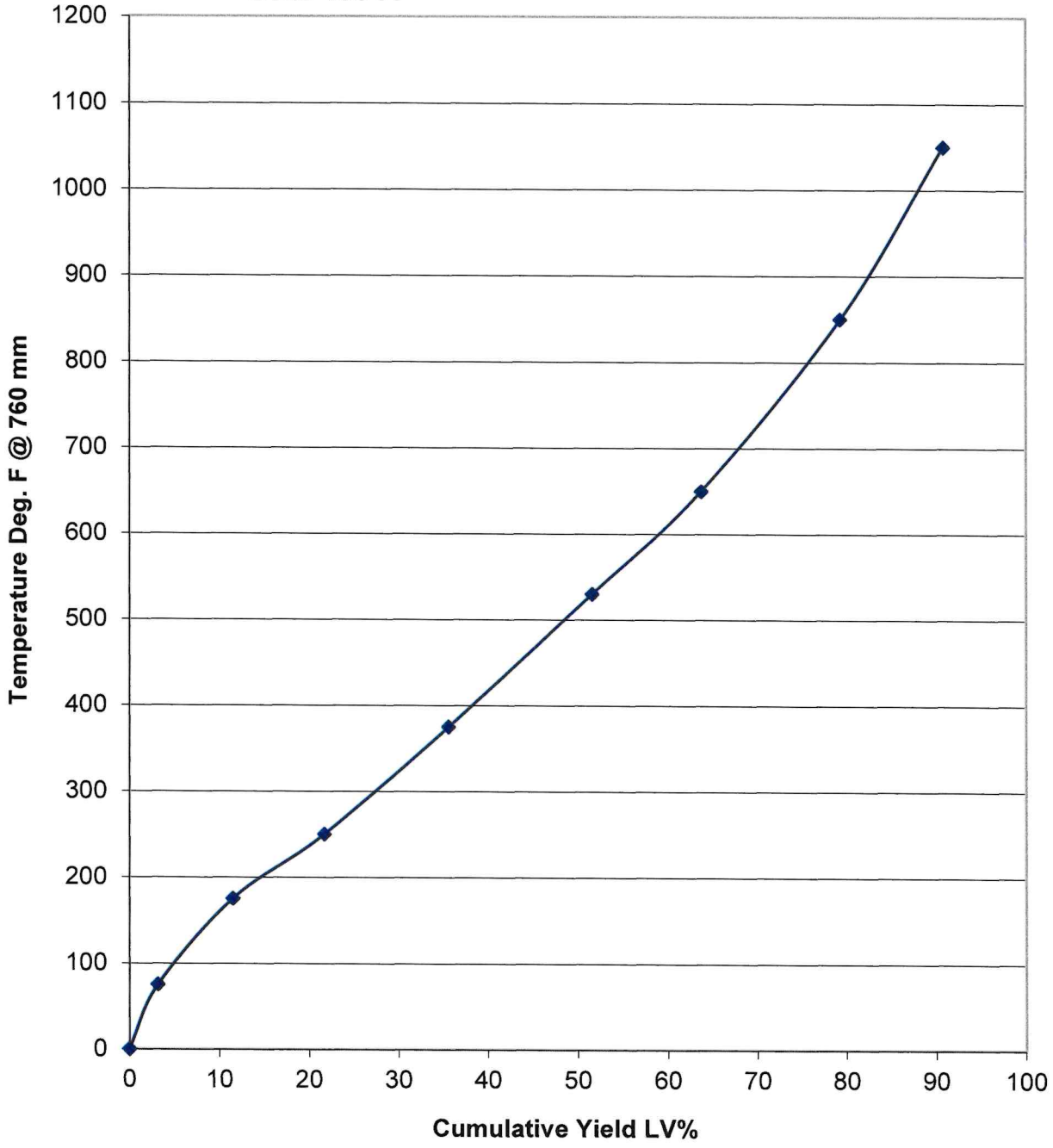
FRACTIONAL DISTILLATION SUMMARY

LV %	LV%	Cum.LV%	WT%	Cum WT%	API Gravity	SPG @ 60 F
Original					38.6	0.8320
IBP-75	3.16	3.16	2.23	2.23	111.7	0.5818*
75-175	8.32	11.48	6.76	8.99	79.6	0.6702*
175-250	10.22	21.70	9.14	18.13	60.5	0.7371
250-375	13.87	35.57	13.05	31.18	51.0	0.7755
375-530	15.96	51.53	15.77	46.95	40.6	0.8221
530-650	12.16	63.69	12.50	59.45	34.0	0.8549
650+	36.31	100.00	40.55	100.00	20.8	0.9291
650-850	15.60	79.29	16.77	76.22	26.7	0.8947
850-1050	11.52	90.81	12.76	88.98	22.0	0.9216
1050+	9.19	100.00	11.02	100.00	10.5	0.9968
Total	100.00		100.00			

* By GC

Core Lab
RESERVOIR OPTIMIZATION

Pegasus Technical Services
Bryan Mound Sept. 2022
Job: 15911



Saybolt LP
A Core Laboratories Company
201 Deerwood Glen Dr
Deer Park, TX 77536
281-478-1300

Pegasus 5/31/2023

Sample Number **15911-14586585** ASTM D2163

Sample ID **Bryan Mound Crude Sept 2022**

IBP-75F

	WT %	LV %	MOL %
Ethane	0.21	0.34	0.41
Propane	12.89	14.79	17.25
Isobutane	11.39	11.77	11.57
N-Butane	46.25	46.06	46.97
2,2-Dimethylpropane	0.25	0.24	0.20
1-Butyne	0.01	0.01	0.01
3-Methyl-1-butene	0.03	0.03	0.03
Isopentane	20.53	19.11	16.80
1-Pentene	0.02	0.02	0.02
N-Pentane	7.49	6.91	6.13
2,2-Dimethylbutane	0.01	0.01	0.01
Cyclopentane	0.05	0.04	0.04
2,3-Dimethylbutane	0.02	0.02	0.01
2-Methylpentane	0.11	0.10	0.08
3-Methylpentane	0.06	0.05	0.04
N-Hexane	0.19	0.17	0.13
Methylcyclopentane	0.05	0.04	0.04
Benzene	0.01	0.01	0.01
Cyclohexane	0.03	0.02	0.02
2-Methylhexane	0.02	0.02	0.01
3-Methylhexane	0.01	0.01	0.01
N-Heptane	0.02	0.02	0.01
Methylcyclohexane	0.02	0.02	0.01
Toluene	0.32	0.21	0.20
Total	100.00	100.02	100.01
Hexanes	0.44	0.39	0.31
Heptanes	0.14	0.12	0.10
Octanes Plus	0.34	0.23	0.21

Pressure Base, psia	14.696
Sample Specific Gravity	0.5818
Sample Molecular Weight	59
Sample Density, Lbs/Gallon in Air	4.8446
Sample Density, Lbs/Gallon in Vacuum	4.8506
Sample Gross Heating Value, BTU/Lb	21098
Sample Vapor Equivalent, cu.ft./gal	31.2
C5 Plus Specific Gravity	0.7443

Saybolt LP
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201 Deerwood Glen Dr
Deer Park, TX 77536
281-478-1300

Pegasus 5/31/2023
Sample Number **15911-14586585** ASTM D2163
Sample ID **Bryan Mound Crude Sept 2022**
IBP-75F

		WT %	LV %	MOL %
C5 Plus Molecular Weight	87.7			
C5 Plus Density, Lbs/Gallon in Air	6.1978			
C5 Plus Density, Lbs/Gallon in Vacuum	6.2054			
C5 Plus Gross Heating Value BTU/Lb	19751			
C5 Plus Vapor Equivalent, cu.ft./gal	26.85			
C6 Plus Specific Gravity	0.8258			
C6 Plus Molecular Weight	91.4			
C6 Plus Density, Lbs/Gallon in Air	6.8764			
C6 Plus Density, Lbs/Gallon in Vacuum	6.8849			
C6 Plus Gross Heating Value BTU/Lb	18878			
C6 Plus Vapor Equivalent, cu.ft./gal	28.59			
C7 Plus Specific Gravity	0.8659			
C7 Plus Molecular Weight	92.5			
C7 Plus Density, Lbs/Gallon in Air	7.2103			
C7 Plus Density, Lbs/Gallon in Vacuum	7.2192			
C7 Plus Gross Heating Value BTU/Lb	18354			
C7 Plus Vapor Equivalent, cu.ft./gal	29.62			

Saybolt LP
A Core Laboratories Company
201 Deerwood Glen Dr
Deer Park, TX 77536
281-478-1300

Pegasus Tech Svc 4/18/2023
Sample Number **15911-14586586** ASTM D-6733
Sample ID **Bryan Mound Crude Sept 2022**
75-175F

	WT %	LV %	MOL %
Propane	0.05	0.07	0.09
Isobutane	0.27	0.32	0.37
N-Butane	2.19	2.51	3.00
2,2-Dimethylpropane	0.02	0.02	0.02
1,4-Pentadiene	0.01	0.01	0.01
Isopentane	10.63	11.38	11.75
N-Pentane	22.67	24.06	25.05
2-methyl-1,3-butadiene	0.01	0.01	0.01
3,3-Dimethyl-1-butene	0.01	0.01	0.01
cis-2-Pentene	0.01	0.01	0.01
2,2-Dimethylbutane	0.47	0.48	0.43
Cyclopentane	2.74	2.44	3.11
2,3-Dimethylbutane	1.30	1.31	1.20
2-Methylpentane	11.67	11.87	10.80
3-Methylpentane	6.98	6.98	6.46
N-Hexane	19.13	19.29	17.70
trans-3-Hexene	0.01	0.01	0.01
2,2-Dimethylpentane	0.23	0.23	0.18
Methylcyclopentane	8.24	7.32	7.81
2,4-Dimethylpentane	0.53	0.52	0.42
2,2,3-Trimethylbutane	0.04	0.04	0.03
Benzene	2.42	1.83	2.47
3,3-Dimethylpentane	0.07	0.07	0.06
Cyclohexane	5.08	4.34	4.81
2-Methylhexane	1.16	1.14	0.92
2,3-Dimethylpentane	0.41	0.39	0.33
1,1-Dimethylcyclopentane	0.34	0.30	0.28
3-Methylhexane	0.99	0.96	0.79
cis-1,3-Dimethylcyclopentane	0.43	0.38	0.35
trans-1,3-Dimethylcyclopentane	0.33	0.29	0.27
3-Ethylpentane	0.05	0.05	0.04
trans-1,2-Dimethylcyclopentane	0.58	0.51	0.47
N-Heptane	0.55	0.54	0.44
Methylcyclohexane	0.28	0.24	0.23
2,2-Dimethylhexane	0.01	0.01	0.01
Ethylcyclopentane	0.01	0.01	0.01

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Pegasus Tech Svc 4/18/2023
Sample Number 15911-14586586 ASTM D-6733
Sample ID Bryan Mound Crude Sept 2022
75-175F

		WT %	LV %	MOL %
Toluene		0.06	0.05	0.05
Unidentified		0.02	0.00	0.00
Total		100.00	100.00	100.00
Total Paraffins		44.54	46.40	46.19
Total Isoparaffins		34.83	35.77	33.81
Total Olefins		0.05	0.05	0.05
Total Naphthenes		18.03	15.83	17.34
Total Aromatics		2.48	1.88	2.52
Unclassified		0.07	0.07	0.09
Total C4		2.46	2.83	3.37
Total C5		36.10	37.94	39.97
Total C6		55.30	53.43	51.69
Total C7		6.06	5.72	4.87
Total C8		0.01	0.01	0.01
C4 Paraffin		2.19	2.51	3.00
C5 Paraffin		22.67	24.06	25.05
C6 Paraffin		19.13	19.29	17.70
C7 Paraffin		0.55	0.54	0.44
C4 Isoparaffin		0.27	0.32	0.37
C5 Isoparaffin		10.65	11.40	11.77
C6 Isoparaffin		20.42	20.64	18.89
C7 Isoparaffin		3.48	3.40	2.77
C8 Isoparaffin		0.01	0.01	0.01
C5 Olefin		0.04	0.04	0.04
C6 Olefin		0.01	0.01	0.01
C5 Naphthene		2.74	2.44	3.11
C6 Naphthene		13.32	11.66	12.62
C7 Naphthene		1.97	1.73	1.61
C6 Aromatic		2.42	1.83	2.47
C7 Aromatic		0.06	0.05	0.05
Mol WT of Sample, gm/mol	79.72			
Density of Sample, gm/cc	0.6695			

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Pegasus Tech Svc 5/8/2023
Sample Number **15911-14586587** ASTM D-6733
Sample ID **Bryan Mound Crude Sept 2022**
175-250F

	WT %	LV %	MOL %
N-Butane	0.02	0.03	0.03
Isopentane	0.03	0.04	0.04
N-Pentane	0.12	0.14	0.17
2,2-Dimethylbutane	0.01	0.01	0.01
Cyclopentane	0.11	0.11	0.16
2,3-Dimethylbutane	0.08	0.09	0.09
2-Methylpentane	0.73	0.82	0.85
3-Methylpentane	0.64	0.71	0.75
N-Hexane	2.86	3.18	3.34
2,2-Dimethylpentane	0.13	0.14	0.13
Methylcyclopentane	2.36	2.31	2.82
2,4-Dimethylpentane	0.34	0.37	0.34
2,2,3-Trimethylbutane	0.03	0.03	0.03
Benzene	0.75	0.63	0.97
3,3-Dimethylpentane	0.13	0.14	0.13
Cyclohexane	4.43	4.17	5.29
2-Methylhexane	4.05	4.37	4.07
2,3-Dimethylpentane	1.37	1.44	1.38
1,1-Dimethylcyclopentane	0.91	0.88	0.93
3-Methylhexane	5.04	5.37	5.06
cis-1,3-Dimethylcyclopentane	2.01	1.98	2.06
trans-1,3-Dimethylcyclopentane	1.91	1.87	1.96
3-Ethylpentane	0.38	0.40	0.38
trans-1,2-Dimethylcyclopentane	3.50	3.41	3.59
2,2,4-Trimethylpentane	0.03	0.03	0.03
N-Heptane	13.80	14.80	13.85
Methylcyclohexane	15.01	14.30	15.38
2,2-Dimethylhexane	1.30	1.37	1.14
Ethylcyclopentane	1.12	1.07	1.15
2,5-Dimethylhexane	0.61	0.64	0.54
2,4-Dimethylhexane	0.80	0.84	0.70
trans,cis-1,2,4-Trimethylcyclopentane	1.26	1.24	1.13
3,3-Dimethylhexane	0.18	0.19	0.16
trans,cis-1,2,3-Trimethylcyclopentane	1.35	1.31	1.21
C8 Olefin	0.39	0.40	0.35
2,3,4-Trimethylpentane	0.15	0.15	0.13

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Pegasus Tech Svc 5/8/2023

Sample Number **15911-14586587** ASTM D-6733

Sample ID **Bryan Mound Crude Sept 2022**

175-250F

	WT %	LV %	MOL %
Toluene	6.32	5.35	6.90
2,3-Dimethylhexane	0.57	0.59	0.50
2-Methyl-3-ethylpentane	0.22	0.22	0.19
2-Ethyl-1-hexene	4.20	4.13	3.76
4-Methylheptane	1.39	1.45	1.22
3,4-Dimethylhexane	0.15	0.15	0.13
cis,trans-1,2,4-Trimethylcyclopentane	0.15	0.14	0.13
3-Methylheptane	3.31	3.44	2.91
cis-1,3-Dimethylcyclohexane	1.90	1.82	1.70
3-Ethylhexane	0.51	0.52	0.45
trans-1,4-Dimethylcyclohexane	0.95	0.91	0.85
1,1-Dimethylcyclohexane	0.38	0.36	0.34
trans-1-Ethyl-3-methylcyclopentane	0.34	0.33	0.30
cis-1-Ethyl-3-methylcyclopentane	0.35	0.33	0.31
trans-1-Ethyl-2-methylcyclopentane	0.66	0.63	0.59
1-Ethyl-1-methylcyclopentane	0.09	0.08	0.08
trans-1,2-Dimethylcyclohexane	1.04	0.98	0.93
cis,cis-1,2,3-Trimethylcyclopentane	0.02	0.02	0.02
trans-3-Octene	0.60	0.61	0.54
cis-1,4-Dimethylcyclohexane	0.05	0.04	0.04
N-Octane	5.47	5.71	4.81
2,2,4-Trimethylhexane	0.04	0.04	0.03
Isopropylcyclopentane	0.04	0.04	0.04
2,3,5-Trimethylhexane	0.03	0.03	0.02
2,2-Dimethylheptane	0.04	0.04	0.03
cis-1,2-Dimethylcyclohexane	0.10	0.09	0.09
2,4-Dimethylheptane	0.14	0.14	0.11
4,4-Dimethylheptane	0.01	0.01	0.01
Ethylcyclohexane	0.85	0.79	0.76
2-Methyl-4-ethylhexane	0.01	0.01	0.01
2,6-Dimethylheptane	0.25	0.26	0.20
1,1,3-Trimethylcyclohexane	0.18	0.17	0.14
C9 Naphthene	0.05	0.05	0.04
2,5-Dimethylheptane	0.11	0.11	0.09
3,5-Dimethylheptane	0.04	0.04	0.03
2-Methyl-3-ethylhexane	0.01	0.01	0.01

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Pegasus Tech Svc 5/8/2023
Sample Number **15911-14586587** ASTM D-6733
Sample ID **Bryan Mound Crude Sept 2022**
175-250F

	WT %	LV %	MOL %
2,3,3,Trimethylhexane	0.36	0.37	0.28
Ethylbenzene	0.03	0.03	0.03
2,3,4-Trimethylhexane	0.04	0.04	0.03
trans,trans-1,2,4-Trimethylcyclohexane	0.01	0.01	0.01
Meta-Xylene	0.51	0.43	0.48
Para-Xylene	0.17	0.14	0.16
2,3-Dimethylheptane	0.06	0.06	0.05
3,4-Dimethylheptane D/L	0.04	0.04	0.03
4-Ethylheptane	0.01	0.01	0.01
4-Methyloctane	0.03	0.03	0.02
2-Methyloctane	0.04	0.04	0.03
3-Methyloctane	0.01	0.01	0.01
Styrene	0.03	0.03	0.03
Ortho-Xylene	0.10	0.08	0.09
cis-1-Ethyl-3-methylcyclohexane	0.01	0.01	0.01
N-Nonane	0.02	0.02	0.02
Unidentified	0.03	0.03	0.05
Total	100.00	100.00	100.00
Total Paraffins	22.29	23.88	22.22
Total Isoparaffins	23.45	24.81	22.36
Total Olefins	5.22	5.17	4.68
Total Naphthenes	41.14	39.45	42.06
Total Aromatics	7.88	6.66	8.63
Unclassified	0.03	0.03	0.05
Total C4	0.02	0.03	0.03
Total C5	0.26	0.29	0.37
Total C6	11.86	11.92	14.12
Total C7	56.05	55.92	57.34
Total C8	30.28	30.30	26.90
Total C9	1.50	1.51	1.19
C4 Paraffin	0.02	0.03	0.03
C5 Paraffin	0.12	0.14	0.17
C6 Paraffin	2.86	3.18	3.34
C7 Paraffin	13.80	14.80	13.85
C8 Paraffin	5.47	5.71	4.81
C9 Paraffin	0.02	0.02	0.02

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Pegasus Tech Svc 5/8/2023

Sample Number **15911-14586587** ASTM D-6733

Sample ID **Bryan Mound Crude Sept 2022**

175-250F

		WT %	LV %	MOL %
C5 Isoparaffin		0.03	0.04	0.04
C6 Isoparaffin		1.46	1.63	1.70
C7 Isoparaffin		11.47	12.26	11.52
C8 Isoparaffin		9.26	9.63	8.13
C9 Isoparaffin		1.23	1.25	0.97
C8 Olefin		5.22	5.17	4.68
C5 Naphthene		0.11	0.11	0.16
C6 Naphthene		6.79	6.48	8.11
C7 Naphthene		24.46	23.51	25.07
C8 Naphthene		9.53	9.11	8.52
C9 Naphthene		0.25	0.24	0.20
C6 Aromatic		0.75	0.63	0.97
C7 Aromatic		6.32	5.35	6.90
C8 Aromatic		0.81	0.68	0.76
Mol WT of Sample, gm/mol	100.59			
Density of Sample, gm/cc	0.7379			

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Pegasus Tech Svc 5/8/2023

Sample Number **15911-14586588** ASTM D-6733

Sample ID **Bryan Mound Crude Sept 2022**

250-375F

	WT %	LV %	MOL %
N-Hexane	0.01	0.01	0.01
Methylcyclopentane	0.01	0.01	0.02
5-Methyl-1-hexene	0.04	0.04	0.05
2-Methylhexane	0.03	0.03	0.04
2,3-Dimethylpentane	0.01	0.01	0.01
1,1-Dimethylcyclopentane	0.01	0.01	0.01
3-Methylhexane	0.05	0.06	0.06
5-Methyl-cis-2-hexene	0.03	0.03	0.04
trans-1,3-Dimethylcyclopentane	0.03	0.03	0.04
trans-1,2-Dimethylcyclopentane	0.05	0.05	0.07
N-Heptane	0.25	0.28	0.32
2,3-Dimethyl-2-pentene	0.80	0.82	1.04
2,2-Dimethylhexane	0.08	0.09	0.09
Ethylcyclopentane	0.07	0.07	0.09
2,5-Dimethylhexane	0.04	0.04	0.04
2,4-Dimethylhexane	0.06	0.07	0.07
trans,cis-1,2,4-Trimethylcyclopentane	0.14	0.14	0.16
3,3-Dimethylhexane	0.02	0.02	0.02
trans,cis-1,2,3-Trimethylcyclopentane	0.17	0.17	0.19
3-Methyl-1-heptene	0.02	0.02	0.02
C8 Olefin	0.21	0.22	0.24
Toluene	0.56	0.50	0.78
2,3-Dimethylhexane	0.10	0.11	0.11
2-Methyl-3-ethylpentane	0.04	0.04	0.04
2-Methylheptane	0.97	1.07	1.09
4-Methylheptane	0.34	0.37	0.38
3,4-Dimethylhexane	0.04	0.04	0.04
cis,trans-1,2,4-Trimethylcyclopentane	0.04	0.04	0.05
3-Methylheptane	0.99	1.08	1.11
cis-1,3-Dimethylcyclohexane	0.92	0.92	1.05
3-Ethylhexane	0.17	0.18	0.19
trans-1,4-Dimethylcyclohexane	0.46	0.46	0.52
1,1-Dimethylcyclohexane	0.18	0.18	0.21
trans-1-Ethyl-3-methylcyclopentane	0.16	0.16	0.18
cis-1-Ethyl-3-methylcyclopentane	0.17	0.17	0.19
trans-1-Ethyl-2-methylcyclopentane	0.33	0.33	0.38

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Pegasus Tech Svc 5/8/2023
Sample Number **15911-14586588** ASTM D-6733
Sample ID **Bryan Mound Crude Sept 2022**

250-375F	**WT %**	**LV %**	**MOL %**
1-Ethyl-1-methylcyclopentane	0.05	0.05	0.06
trans-1,2-Dimethylcyclohexane	0.85	0.84	0.97
cis,cis-1,2,3-Trimethylcyclopentane	0.01	0.01	0.01
trans-3-Octene	0.54	0.58	0.62
cis-1,4-Dimethylcyclohexane	0.03	0.02	0.03
N-Octane	4.45	4.86	4.98
2,2,4-Trimethylhexane	0.08	0.09	0.08
2,3,5-Trimethylhexane	0.07	0.07	0.07
cis-1-Ethyl-2-methylcyclopentane	0.07	0.07	0.08
2,2-Dimethylheptane	0.11	0.12	0.11
cis-1,2-Dimethylcyclohexane	0.23	0.22	0.26
2,4-Dimethylheptane	0.49	0.53	0.49
4,4-Dimethylheptane	0.06	0.06	0.06
Nonenes	1.48	1.59	1.69
Ethylcyclohexane	2.62	2.55	2.99
2-Methyl-4-ethylhexane	0.04	0.04	0.04
1,1,4-Trimethylcyclohexane	1.20	1.18	1.22
1,1,3-Trimethylcyclohexane	1.47	1.45	1.49
C9 Naphthene	0.87	0.86	0.88
2,5-Dimethylheptane	0.67	0.72	0.67
3,5-Dimethylheptane	0.30	0.32	0.30
2-Methyl-3-ethylhexane	0.13	0.14	0.13
2,3,3,Trimethylhexane	1.07	1.15	1.07
Ethylbenzene	0.35	0.31	0.42
2,3,4-Trimethylhexane	0.88	0.91	0.88
trans,trans-1,2,4-Trimethylcyclohexane	0.07	0.07	0.07
Meta-Xylene	3.02	2.68	3.64
Para-Xylene	0.84	0.75	1.01
2,3-Dimethylheptane	1.09	1.15	1.09
3,4-Dimethylheptane D/L	0.41	0.43	0.41
3,4-Dimethylheptane L/D	0.11	0.12	0.11
4-Ethylheptane	0.06	0.06	0.06
4-Methyloctane	1.15	1.22	1.15
2-Methyloctane	1.47	1.58	1.47
cis,cis-1,2,3-Trimethylcyclohexane	0.11	0.11	0.11
3-Ethylheptane	0.31	0.33	0.31

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Pegasus Tech Svc 5/8/2023
Sample Number **15911-14586588** ASTM D-6733
Sample ID **Bryan Mound Crude Sept 2022**
250-375F

	WT %	LV %	MOL %
3-Methyloctane	0.34	0.36	0.34
trans,cis-1,2,4-Trimethylcyclohexane	1.74	1.71	1.76
Ortho-Xylene	1.82	1.59	2.19
cis,trans-1,2,4-Trimethylcyclohexane	0.10	0.10	0.10
2,4,6-Trimethylheptane	0.04	0.04	0.04
trans-1-Methyl-2-propylcyclopentane	0.02	0.02	0.02
2,2,6-Trimethylheptane	0.98	0.98	0.88
cis-1-Ethyl-3-methylcyclohexane	0.93	0.89	0.94
trans-1-Ethyl-4-methylcyclohexane	0.73	0.70	0.74
1-Nonene	0.04	0.04	0.04
Isobutylcyclopentane	0.09	0.09	0.09
trans,trans-1,2,3-Trimethylcyclohexane	0.16	0.15	0.16
N-Nonane	8.17	8.73	8.15
1-Ethyl-1-methylcyclohexane	0.16	0.16	0.16
trans-1-Ethyl-3-methylcyclohexane	0.12	0.12	0.12
Isopropylbenzene	0.35	0.31	0.37
Bicyclononane	0.84	0.83	0.85
Isopropylcyclohexane	0.49	0.47	0.50
2,4-Dimethyloctane	0.23	0.25	0.21
2,5-Dimethyloctane	0.21	0.22	0.19
cis-1-Ethyl-4-methylcyclohexane	0.41	0.40	0.42
Sec-butylcyclopentane	0.07	0.07	0.07
tert-Butylcyclopentane	0.18	0.17	0.18
3,5-Dimethyloctane	1.62	1.70	1.46
N-propylcyclohexane	0.39	0.38	0.40
2,7-Dimethyloctane	0.42	0.45	0.38
2,6-Dimethyloctane	1.64	1.73	1.47
3,3-Dimethyloctane	0.24	0.25	0.22
n-Propylbenzene	0.91	0.81	0.97
3,6-Dimethyloctane	0.36	0.38	0.32
4,5-Dimethyloctane	0.95	0.99	0.85
3-methyl-5-ethylheptane	0.24	0.25	0.22
1-Methyl-3-ethylbenzene	1.20	1.06	1.28
1-Methyl-4-ethylbenzene	0.57	0.51	0.61
1,3,5-Trimethylbenzene	0.86	0.76	0.92
4-Ethyloctane	0.39	0.41	0.35

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Pegasus Tech Svc 5/8/2023
Sample Number 15911-14586588 ASTM D-6733
Sample ID Bryan Mound Crude Sept 2022

250-375F	WT %	LV %	MOL %
2,3-Dimethyloctane	0.19	0.20	0.17
5-Methylnonane	0.08	0.08	0.07
4-Methylnonane	0.37	0.39	0.33
1-Methyl-2-ethylbenzene	1.65	1.44	1.76
2-Methylnonane	1.18	1.25	1.06
3-Ethyloctane	0.26	0.27	0.23
1,2,3,5-Tetramethylcyclohexane	0.32	0.31	0.29
3-Methylnonane	1.14	1.19	1.02
1,4 Dimethyl-2-ethylcyclohexane	2.18	2.13	1.99
trans-1-Ethyl-2-methylcyclohexane	0.60	0.59	0.61
cis-1-Methyl-3-propylcyclohexane	0.89	0.87	0.81
cis-1,3-Diethylcyclohexane	0.16	0.16	0.15
trans-1,4-Diethylcyclohexane	0.17	0.17	0.16
trans-1-Methyl-3-propylcyclohexane	0.16	0.16	0.15
1-Ethyl-2,3-dimethylcyclohexane	0.20	0.20	0.18
Decenes	1.66	1.60	1.51
Isobutylbenzene	0.37	0.33	0.35
sec-Butylbenzene	0.44	0.39	0.42
C10 Naphthenes	0.72	0.70	0.66
C10 Paraffins	0.45	0.46	0.37
N-Decane	5.90	6.20	5.30
trans-1,3-Diethylcyclohexane	0.07	0.07	0.06
1,2,3-Trimethylbenzene	0.87	0.75	0.93
1-Methyl-3-isopropylbenzene	0.40	0.36	0.38
1-Methyl-4-isopropylbenzene	0.28	0.25	0.27
cis-1,4-Diethylcyclohexane	0.16	0.16	0.15
Indan (2,3-Dihydroindene)	0.19	0.15	0.21
Sec-butylcyclohexane	0.21	0.21	0.19
1-Methyl-2-isopropylbenzene	0.56	0.49	0.53
2,6-Dimethylnonane	1.50	1.65	1.23
Butylcyclohexane	1.04	1.00	0.95
1-Methyl-3-n-propylbenzene	0.55	0.49	0.52
1-Methyl-4-n-propylbenzene	0.41	0.37	0.39
1,4-Diethylbenzene	0.36	0.32	0.34
N-Butylbenzene	0.32	0.29	0.30
1,3-Dimethyl-5-ethylbenzene	0.18	0.16	0.17

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Pegasus Tech Svc 5/8/2023
Sample Number 15911-14586588 ASTM D-6733
Sample ID Bryan Mound Crude Sept 2022

250-375F	WT %	LV %	MOL %
1,2-Diethylbenzene	0.08	0.07	0.08
trans-Decalin	0.41	0.35	0.38
1-Methyl-2-n-propylbenzene	0.56	0.49	0.53
5-Methyldecane	0.44	0.45	0.36
4-Methyldecane	0.48	0.49	0.39
1,4-Dimethyl-2-ethylbenzene	0.25	0.22	0.24
2-Methyldecane	0.84	0.86	0.69
3-Methyldecane	0.15	0.15	0.12
1,2-Dimethyl-4-ethylbenzene	0.76	0.67	0.72
1,3-Dimethyl-2-ethylbenzene	0.06	0.05	0.06
1,2-Dimethyl-3-Ethylbenzene	0.32	0.28	0.30
C11 Aromatics	0.49	0.43	0.42
C11 Naphthenes	1.22	1.18	0.93
C11 Paraffins	0.30	0.31	0.23
C11 Olefins	0.84	0.75	0.81
N-Undecane	2.60	2.70	2.13
1,2,4,5-Tetramethylbenzene	0.18	0.16	0.17
1,2,3,5-Tetramethylbenzene	0.18	0.16	0.17
C12 Unidentified	0.02	0.02	0.02
5-Methylindan	0.06	0.05	0.06
4-Methylindan	0.13	0.11	0.13
1,2,3,4-Tetramethylbenzene	0.18	0.15	0.17
Pentylbenzene	0.10	0.09	0.09
5-Methylundecane	0.09	0.09	0.07
4-Methylundecane	0.05	0.05	0.04
2-Methylundecane	0.05	0.05	0.04
3-Methylundecane	0.02	0.02	0.02
Tetralin	0.09	0.07	0.09
Naphthalene	0.02	0.02	0.02
1,2-Dimethylindan	0.01	0.01	0.01
2-Ethylindan	0.02	0.02	0.02
1,3,5-Triethylbenzene	0.01	0.01	0.01
N-Dodecane	0.08	0.08	0.06
1,3-Dimethylindan	0.01	0.01	0.01
Unidentified	0.35	0.38	0.25
Total	100.00	100.00	100.00

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250-375F

	WT %	LV %	MOL %
Total Paraffins	21.46	22.86	20.95
Total Isoparaffins	27.05	28.58	25.49
Total Olefins	5.66	5.69	6.06
Total Naphthenes	24.90	24.33	25.17
Total Aromatics	20.76	18.29	22.27
Unclassified	0.18	0.25	0.06
Total C6	0.02	0.02	0.03
Total C7	1.93	1.93	2.55
Total C8	20.60	20.54	23.71
Total C9	35.20	35.39	35.97
Total C10	32.77	32.47	30.00
Total C11	9.00	9.10	7.44
Total C12	0.30	0.30	0.24
C6 Paraffin	0.01	0.01	0.01
C7 Paraffin	0.25	0.28	0.32
C8 Paraffin	4.45	4.86	4.98
C9 Paraffin	8.17	8.73	8.15
C10 Paraffin	5.90	6.20	5.30
C11 Paraffin	2.60	2.70	2.13
C12 Paraffin	0.08	0.08	0.06
C7 Isoparaffin	0.09	0.10	0.11
C8 Isoparaffin	2.93	3.20	3.26
C9 Isoparaffin	8.76	9.31	8.76
C10 Isoparaffin	11.35	11.85	10.17
C11 Isoparaffin	3.71	3.91	3.02
C12 Isoparaffin	0.21	0.21	0.17
C7 Olefin	0.87	0.89	1.13
C8 Olefin	0.77	0.82	0.88
C9 Olefin	1.52	1.63	1.73
C10 Olefin	1.66	1.60	1.51
C11 Olefin	0.84	0.75	0.81
C6 Naphthene	0.01	0.01	0.02
C7 Naphthene	0.16	0.16	0.21
C8 Naphthene	6.43	6.33	7.33
C9 Naphthene	10.15	9.93	10.28
C10 Naphthene	6.93	6.72	6.40

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250-375F

		WT %	LV %	MOL %
C11 Naphthene		1.22	1.18	0.93
C7 Aromatic		0.56	0.50	0.78
C8 Aromatic		6.03	5.33	7.26
C9 Aromatic		6.60	5.79	7.05
C10 Aromatic		6.93	6.10	6.62
C11 Aromatic		0.63	0.56	0.55
C12 Aromatic		0.01	0.01	0.01
Mol WT of Sample, gm/mol	127.89			
Density of Sample, gm/cc	0.7721			