WINMAR consulting services, inc.

FINAL REPORT

ASSESSMENT OF CURRENT PIPELINE FLUSHING AND DECOMMISSIONING REQUIREMENTS - RESEARCH AND FIELD TESTING

"Flushing Phase A"

RFP# CBD SOL 1435-01-99-RP-31018

March 25, 2001

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ASSESSMENT OF CURRENT PIPELINE FLUSHING AND DECOMMISSIONING REQUIREMENTS - RESEARCH AND FIELD TESTING (Flushing Phase "A")

James Wiseman

WINMAR CONSULTING SERVICES

Final Report Date: March 25, 2001

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1. Introduction

The abbreviated name for this project is "Flushing Phase A." **The purpose of this study is to assist the MMS in assessing -- and if necessary, scoping and preparing -- regulations for the flushing, handling, and possible reactivation of out-of-service pipelines.** This project focused on pipelines that have been taken out of service, but have not been flushed and filled with inhibited seawater. In keeping with this purpose, WINMAR has: reviewed current regulations for temporarily taking pipelines out-of-service lines, reviewed current practices for taking pipelines temporarily out-of-service, and reviewed practices, tools, and technologies for flushing and preserving out-of-service lines. WINMAR also assessed the effectiveness and risk/safety of the tools and practices, Finally, WINMAR performed field tests (offshore in-situ) to assess the condition of 5 out-of-service pipelines.

In a future project, already awarded to WINMAR Consulting, we will assess the condition of pipelines that have been flushed and filled with inhibited seawater. This future project is called "Flushing Phase B" to be completed in 2001-2002.

The project methodology for Flushing Phase A was carried out in a number of phases, as detailed below:

1) **Identification Phase**: The first step in this phase was a review of current regulations and practices for pipeline decommissioning and reuse -- temporary and permanent abandonments (MMS). This covered any existing regulations and/or recommended practice for out of service pipelines.

2) **Interaction Phase**: This phase was performed concurrently with Phase 1. Because Winmar has an excellent working relationship with the majority of the contractors in the Gulf of Mexico, we met with them to investigate pipeline decommissioning effectiveness, and the effects of time and the offshore environment on out-of-service pipelines. Contractors included:

- Platform and pipeline owners and operators
- Pipeline pigging and maintenance contractors
- Pipeline corrosion and corrosion inhibitor companies

3) **Assessment Phase**: **The thrust of this phase was to assess how well out-of-service pipelines fare in the marine environment - over time - for later use.** Specifically, we assessed the risks to the environment, and health and safety of operations, for the different pipeline types and varying time the lines were out of service.

To aid in the assessment, a qualitative risk analysis was used to form a reuse matrix based on a number of factor. The factors used were: pipeline product, presence of

H2S, CO2, and of course age The matrix was used to compare the pipeline samples retrieved from offshore in order to grade them in condition.

This project assumed that external corrosion protection techniques were continued during the pipeline's temporary abandonment stage. This later proved to be a good assumption as the pipeline samples recovered showed little to no external corrosion.

4) **Data Gathering Phase:** This phase entailed gathering information during pipeline decommissioning, in order to gauge the effectiveness of the regulations/guidelines which were determined during the Assessment Phase.

Because Winmar decommissions pipelines which were formerly out-of-service, we had the opportunity to actually examine the pipelines in-situ, and assess their condition. Since we know the age of the pipelines tested, and when they were taken out of service, we were able to draw MANY valuable conclusions. Data acquired consisted of:

- **Catching and sampling the fluids that were in the out-of-service pipeline.** These fluids were sampled at pre-determined intervals, and analyzed for the presence of corrosion products (in the case of fluids) and corrosive properties (in the case of gas). CO2 and H2S was tested for at this time.

- **Catching and sampling fluids during pipeline flushing.** This test was performed on the pipelines during the actual decommissioning phase. The flushwater was sampled at pre-determined intervals and analyzed for the presence of hydrocarbons, corrosion products, oxygen, and chlorides and sulfates.

5) **Recommendation/Conclusion Phase:** At this stage, Winmar has compiled and presented recommendations for regulation of out-of-service pipelines. These recommendations were discussed with MMS pipeline specialists before being summarized and finalized in the report. WINMAR also targeted and recommended specific measures that can improve the safety and effectiveness of temporary abandonment/decommissioning and/or reuse of offshore pipelines.

Definitions: In order to avoid confusion, it is important to define “Out of Service” and “Abandoned” as the terms relate to pipelines. The definitions will also be included on future regulatory updates.

Out-of-Service: A pipeline that is out-or-service is still connected either at one end or at both ends, but it is not flowing. An out-of-service pipeline may or may not be filled with inhibited seawater. The out of service period begins when the line has not been flowed for 30 consecutive days. Taking a line out of service does not require MMS approval, however notification is required.

Abandoned: An abandoned pipeline has been cut at BOTH ends. The line has either been removed, or the ends of the pipeline plugged and buried in-place. Abandoning a pipeline requires MMS approval.

2. Objectives

The objectives of this project are many-fold, but to summarize:

1) Provide data to the MMS on the condition of various types of out-of-service pipelines through research and in-field testing. This data includes the composition of any product remaining in the pipeline, the composition of seawater/inhibitor in the pipeline (if present), and the composition of seawater used to flush the pipeline.

2) Assist the MMS in determining if the Out of Service (Shut-in for less than 1 year) pipeline regulations are adequate for ensuring pipeline safety and containment. This objective must be met for the various types of pipelines – treated/untreated, gas/oil/condensate, etc.

3) Assist the MMS in determining if the “Pickled” (Shut in greater than 2 but less than 5 years, flushed and filled with inhibited seawater) pipeline regulations are adequate for ensuring pipeline safety and containment. This objective must be met for the various types of pipelines – treated/untreated, gas/oil/condensate, etc.

4) Collect information through research and field testing to determine the effectiveness of various corrosion inhibitors for the “Pickled” pipelines. Determine if the generic requirement for use of “corrosion inhibitor” is adequate, too strict, or too lenient a term.

5) Gain a general understanding of condition of pipelines on the OCS in the Gulf of Mexico through the collection of out-of-service pipeline samples.

3. Procedures

This section of the report describes the field-testing portion of the project (Phase IV). Below is the detailed procedure that was supplied to the contractor prior to any offshore work/pipeline decommissioning.

A. Offshore Procedures

General: Field trip to site will confirm location and work area available to flush pipeline. Brief Field Personnel on flushing procedure. Company procedures are to be incorporated into flush procedure. Confirm location and type of Pipeline End Flanges. Review contingency clean-up plans and fluid disposal with Field Foreman. Check flanged connection for integrity. Check for Check Valves.

1. Verify communication link is working between crews at both ends of the pipeline.
2. Verify that pipeline is LOCKED and TAGGED OUT and line has ZERO PRESSURE before removing pipeline-end flanges.
3. Check pipeline for check valves. Replace if pigs are not able to travel through valves.
4. Remove pipeline end flanges and install ANSI 600 Ball valves onto flange ends at both platforms. Close block valves.
5. Install all gauges/meters and verify both units have all openings closed and/or plugged.
6. Install fill line from pump to flushing head. This line to have an overflow by-pass to divert water overboard and a meter beyond the by-pass in order to know volume of water pumped into line. Flow direction to be controlled with block valves before meter and on overboard line.
7. Install pipe discharge line with meter from receiving end to storage/receiving tanks or to production process equipment.
8. Hook up Sampling Hose at receiving thread-o-let location.
9. Take first Gas Sample using Vacuum tube and Plastic Bag
10. Verify pipeline and discharge line at receiving end are open.
11. Check flow meter and zero.
12. Confirm Production Platform crew is ready to receive water. Open block valve Divert flow from overboard to flushing head using in-line block valves.
13. Check pressure gauges to ensure no built up in pressure is occurring at flushing site.
14. Check with receiving crew that flow has started.
15. Take second Gas Sample using Vacuum tube and Plastic Bag
16. Monitor pressure. Do not let pressure build up beyond 1000 PSI. Stop pumping if pressure starts to exceed 1440 PSI.
17. Take third Gas Sample at midpoint of Line. Take fourth sample before Flush Water arrives.

18. Once fluid returns, capture min. 2 fluid samples. One sample into Mineral Pattern Analysis Bottle and one into Oil and Grease Bottle. Take one more set of samples just before pumping ceases.
19. Label ALL sample bottles.
20. Open by-pass valve at Well Platform before shutting down pump and then closing block valve located before meter.
21. Check and bleed all pressure from fill line and pipeline. Verify zero pressure before removing any piping at either end of pipeline.
22. At Well Platform, disconnect pump and fill line. Re-confirm zero pressure and remove flushing head and block valve. Re-install blind flange initially removed from pipeline.
23. At Production Platform, remove discharge line. Re-confirm zero pressure and remove receiving hose and block valve. Re-install blind flange initially removed from pipeline.
24. Secure samples for shipment to Laboratory. Send field report copies to office.
25. De Mob equipment and personnel to shore base.

B. Pictorial Presentation

This section provides a pictorial presentation of how the offshore field testing phase was performed.

Photo #1

The flowmeter reads in hundreds of gallons pumped. It was “zeroed” and calibrated prior to commencing work.

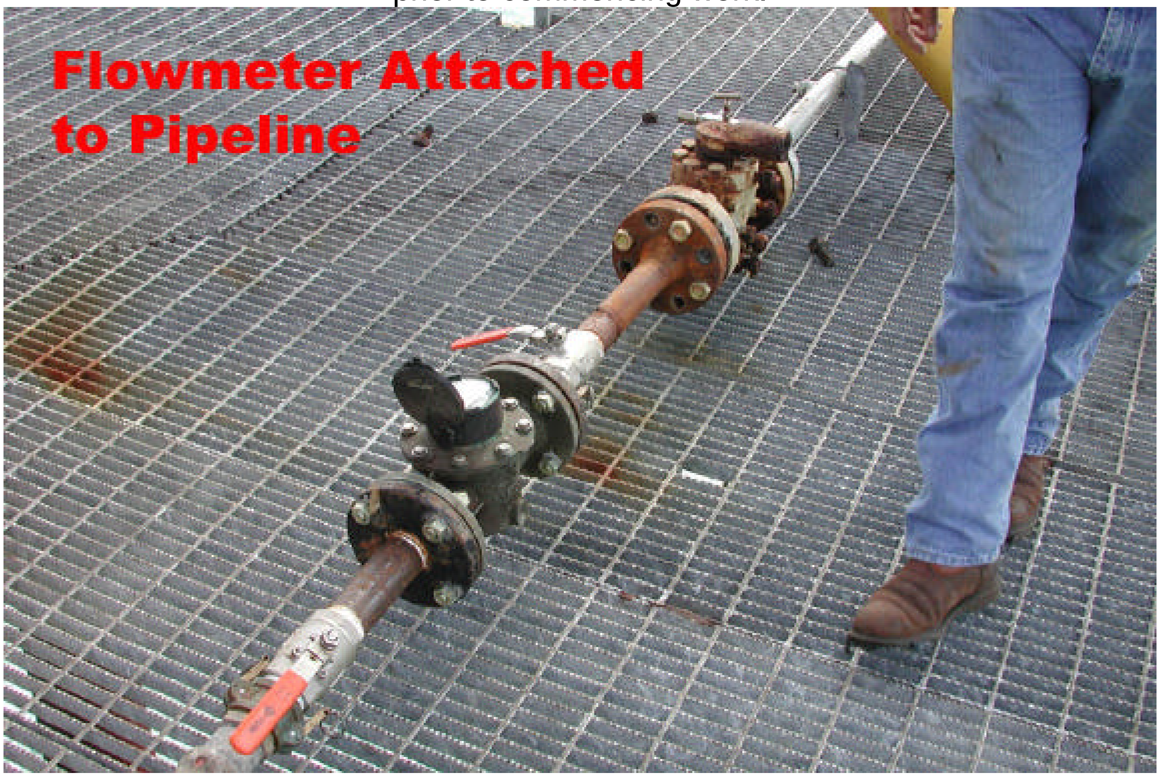


Photo #2

An assortment of flanges were kept on-hand to ensure a good fit-up to the pipeline.

Photo #3

This picture shows the workspread used, as well as one of the well protector platforms. The flushing pump is located on the jackup boat, and a hose connects the pump to the pipeline via a hose that runs across the gangway. Upon close observation, the central facility platform is visible in the background.

Photo #4

This photo shows the top-of-riser sample point at the central facility platform. This location was ideal for taking samples and was used when available. If it was impossible to hook up to the top of the riser (for example, if the riser was removed to the +10 level) then the sampling spool was used (see next photo).

Photo #5

This picture shows how gas samples were taken, to be tested for H2S. The plastic jar shown was filled with gas using the intrinsically safe pump. The length of stain tester was inserted into the plastic jar, and some gas was sucked into the length of stain test tube.

Photo #6

The sampling spool was fitted into the flushing hose – where two hoses were connected. This was done at the platform cellar deck level, between the riser and the water-receiving tank.

Photo #7

Gas Samples were taken using Tedlar bags. These sample bags are the best way to ensure that a good sample has been taken. One can be SURE that the bag is full, as opposed to a steel vacuum cylinder, where it is not obvious/foolproof.

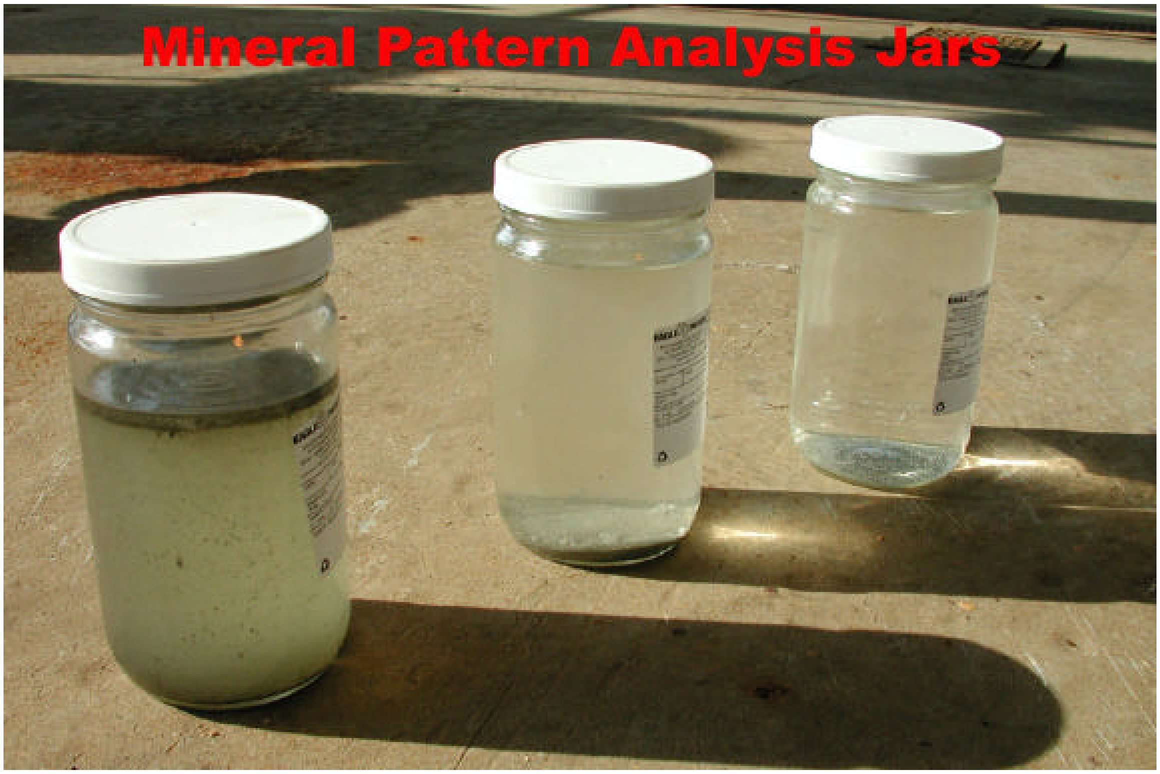


Photo #8

MPA Jars come cleaned, sealed and certified. This photo shows three samples from pipeline 2820. To take a sample, jars are simply filled, and sealed.

Photo #9

The plastic Zero Head Space jars are used for taking samples which cannot have any atmospheric air in them. Once the jars are filled with liquid, they can be purged of air and sealed. WINMAR used these jars to catch samples for oxygen and nitrogen testing.

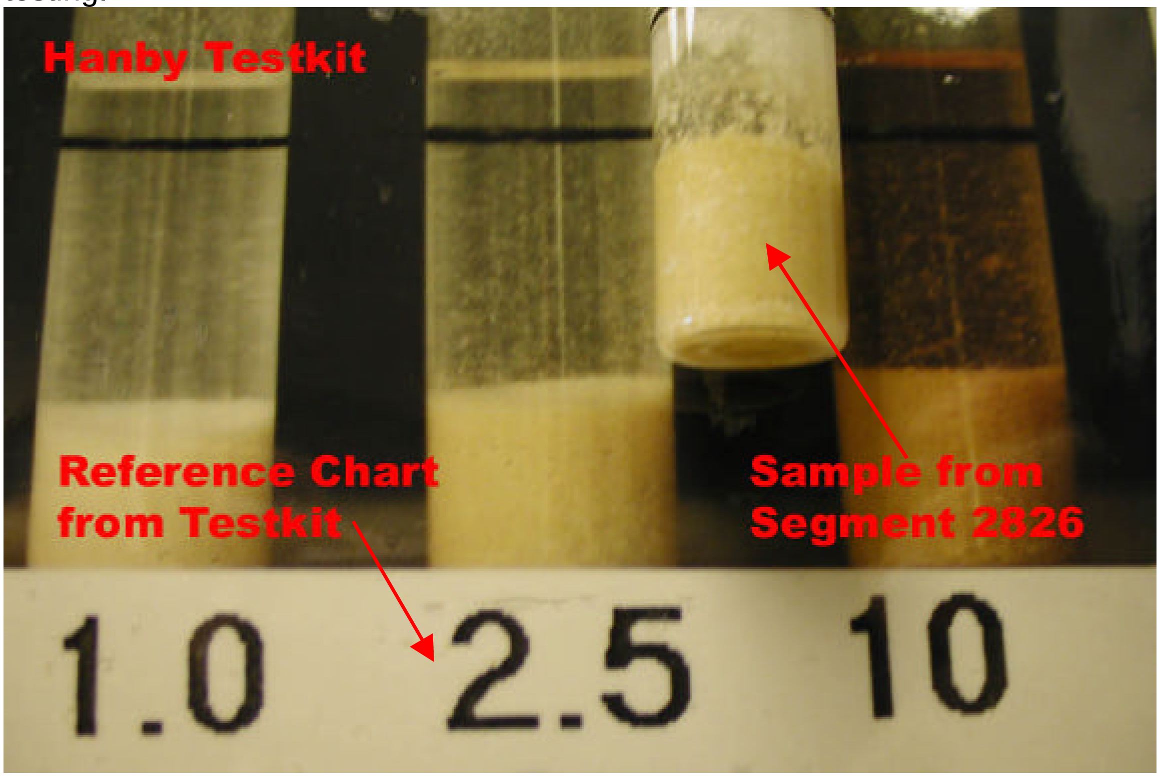


Photo #10

A Hanby Environmental Labs testkit was used as a “quick-check” in the field for the presence of oil and grease. The results from the Hanby kit were very close (to within 5 ppm) to the tests results from the lab.


Central Facility Platform Showing
Abandoned Risers
DO NOT
TIE OFF

Photo #11

4. Background and Assumptions

The following sections summarize the results for the various samples taken. The results are compiled and displayed graphically in order to help interpret and analyze the data. For each pipeline tested, the results are organized into sections. The sections are listed below, along with any assumptions made during the data interpretation:

Sample/Locations Observations

The location of the samples was derived by analyzing the amount of fluid pumped at the time the sample was taken. The flowmeter was used to obtain this volume, and the internal pipeline diameter was used to convert this volume to a distance. This process assumes that the flow in the line is uniform, and that no multi-phase flow occurs. It also assumes that the pipeline internal diameter is the same throughout the line.

Gas Composition Observations

No assumptions were made. The data is plotted exactly the same as the lab results .

Flushwater Composition Observations

No assumptions were made. The data is plotted exactly the same as the lab results.

Oil and Grease Observations

No assumptions were made for this analysis. For comparison purposes, all of the oil and grease measurements were normalized, based on volume flushed divided by total pipeline volume. These normalized results were also all plotted on the same graph, for comparison of all the different oil and grease flushing profiles.

Pipe Cutout Observations

The 5 foot pipeline sections were removed and brought to shore for examination. it is important to consider that these samples may not be representative of each pipeline as a whole.

Reference and Baseline Material

Some reference material was used in the analysis and comparison of Natural Seawater (NSW). These charts and articles are included in this section. This reference material has an excellent description of the ions and elements present in seawater, and how they react with each other and with other ions/elements.

Gaseous composition of dry air.

Constituent	Chemical symbol	Mole percent
Nitrogen	N_2	78.084
Oxygen	O_2	20.947
Argon	Ar	0.934
Carbon dioxide	CO_2	0.0350
Neon	Ne	0.001818
Helium	He	0.000524
Methane	CH_4	0.00017
Krypton	Kr	0.000114
Hydrogen	H_2	0.000053
Nitrous oxide	N_2O	0.000031
Xenon	Xe	0.0000087
Ozone*	O_3	trace to 0.0008
Carbon monoxide	CO	trace to 0.000025
Sulfur dioxide	SO_2	trace to 0.00001
Nitrogen dioxide	NO_2	trace to 0.000002
Ammonia	NH_3	trace to 0.0000003

* Low concentrations in troposphere; ozone maximum in the 30- to 40-km regime of the equatorial region.

Mackenzie, F.T. and J.A. Mackenzie (1995) **Our changing planet**. Prentice-Hall, Upper Saddle River, NJ, p 288-307.
(After Warneck, 1988; Anderson, 1989; Wayne, 1991.)

Approximately what percent of air (by volume) is made up of each of two most abundant elements?

The composition of air, by volume, is as follows:

Nitrogen	N_2	78.084
Oxygen	O_2	20.946
Argon	Ar	0.934
Neon	Ne	0.0018
*Helium	He	0.000524
Methane	CH_4	0.0002
Krypton	Kr	0.000114
*Hydrogen	H_2	0.00005
Nitrous oxide	N_2O	0.00005
Xenon	Xe	0.0000087

The two most abundant elements in the universe, marked above with asterisks, are Hydrogen (75%) and Helium (25%).

Respondents: Serge, DA

TEXT AND DIAGRAMS BY RANDY HOLMES FARLEY

Understanding Seawater

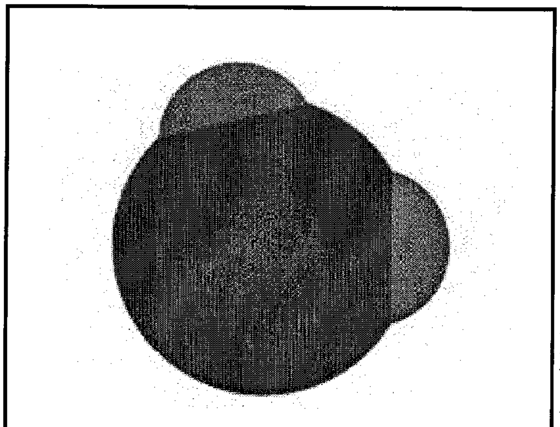
The chemistry of marine aquaria is a complex subject and one that is not easily described in a short article. Previous articles on marine chemistry in *Aquarium Frontiers* authored by Craig Bingman have dealt with selected topics of interest to marine aquarists. In particular, these articles have focused on the biochemistry taking place in aquaria. In this article I will endeavor to provide an understanding of seawater itself, rather than how the components are used by the tank inhabitants.

Do you have an opinion on the issues raised in this article? Join in the discussion by going to: Understanding Seawater.

What's In Seawater?

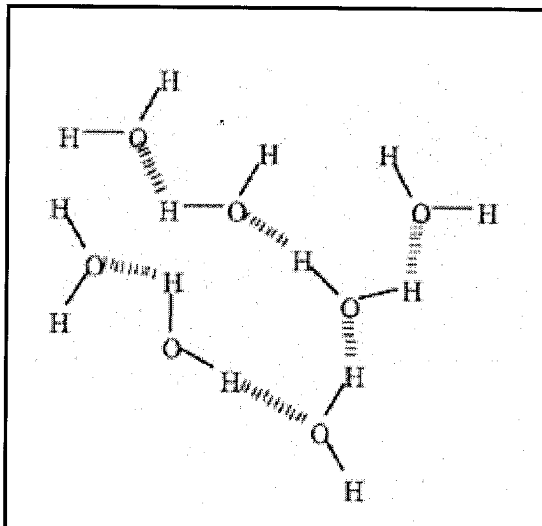
Major species

Seawater has been found to contain virtually every chemical element, although some of them are found in very small concentrations. Water is, of course, the most abundant molecule, comprising about 97 percent of seawater. Water itself is far more complicated than is generally recognized and has been an active area of chemical research for more than a hundred years.



A space filling model of a water molecule (H_2O), where the oxygen atom is shown in red and the hydrogen atoms are shown in blue.

One of the remarkable things about water is that it is liquid at room temperature. Based simply on its molecular weight, it ought to be a gas. Nitrogen (N_2) and oxygen (0_2) are much heavier than water (H_2O), and yet they are gasses and water is a liquid. Why?



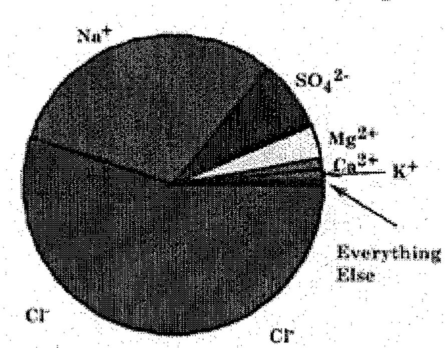
The extended hydrogen bonding network in water. Hydrogen bonds are indicated in red.

The reason involves the hydrogen bonding that takes place in water. The hydrogen atom of one molecule of water interacts strongly with the oxygen atom of a nearby water molecule. This interaction is much weaker than the bond between atoms within a single water molecule, but it is strong enough to make the water molecules "prefer" to be surrounded by each other, rather than floating around individually, as they would in a gas. Hydrogen bonding is best viewed as a fleeting interaction between water molecules that lasts only a tiny fraction of a second before breaking. Once broken, however, they quickly reform, perhaps to a different water molecule. On balance, each water molecule is bonded to one or two other water molecules almost all of the time.

Major ions

Most of the remaining constituents of seawater are inorganic ions. The major components of seawater — all ions present at greater than 1 part per million (ppm) or 1 milligram per liter (mg/L) — are shown in *Figure 1* and *Table I.* A different definition of major ions based on the numbers of ions present, rather than the weight of those ions, has a slightly different list, with lithium being added. Together, these ions account for 99.9 percent of the dissolved solutes in seawater.

Figure 1. Major ions in seawater by weight.



It is clear from *Figure 1* that seawater contains mostly table salt (sodium and chloride). In fact, sodium and chloride comprise 86 percent of the ions present in seawater, by weight.

One important point about these concentrations: they are correct for typical seawater, which contains about 35 parts of salt by weight per thousand parts of seawater (35 ppt). This seawater has a specific gravity of around 1.027, so it may be higher than is maintained in many marine aquaria. As the salinity of seawater is varied, these concentrations move up and down together. Consequently, if an aquarium contains water with a specific gravity of 1.023, the salinity is about 30 ppt and all of the concentrations in *Table I* are reduced by about 14 percent.

TABLE I
Major Species in Seawater

Species	Concentration milligrams per liter (mg/L)
Cl^- (chloride)	19,000
Na^+ (sodium)	10,500
SO_4^{2-} (sulfate)	2700
Mg^{2+} (magnesium)	1280
Ca^{2+} (calcium)	412
K^+ (potassium)	399
HCO_3^- (bicarbonate)	110
Br^- (bromide)	67
CO_3^{2-} (carbonate)	20
Sr^{2+} (strontium)	7.9
$B(OH)_3$ + $B(OH)_4^-$ (borate)	5 (as Boron)
F^- (fluoride)	1.3
Organics	1 to 2
Everything else combined (except dissolved gasses)	Less than 1

A logical question to ask is why do we not hear much discussion about chloride, sulfate or sodium levels in marine aquaria, if they are among the most abundant ions? The answer is that while they are very important, their abundance makes it difficult for them to become significantly depleted or enriched without altering the salinity. Of course, one could start out with a salt mix that did not contain the correct proportions, but assuming one starts out correctly, there isn't any normal activity in a marine aquarium that will significantly change the levels of these ions (without changing salinity).

All of these major ions are essentially unchanged in concentration at different locations in the ocean, except as salinity changes move them all up or down together. Ions that do not change concentration from place to place are referred to as "conservative type" ions, a description that also applies to some of the minor and trace elements that are discussed below.

I have. also included organics on this list, though they traditionally are not considered a major specie. As will be discussed below, organics are important in seawater, but are poorly understood.

Minor ions

There are various definitions, of which ions in seawater constitute the "minor ions." By some definitions, the list of constituents is rather long. *Table II* shows just a few of the constituents of seawater that are often labeled as minor ions. The more abundant of these are sometimes lumped with the major ions (such as lithium), while the least abundant (such as iron) are often lumped in with trace elements. Ions in this category often vary significantly with location in the ocean. That is primarily because many of them are tightly linked to biological activity. These ions can be locally depleted if biological activity is high enough. Ions that vary in this fashion are referred to as "nutrient type" ions, because they are consumed by one or more types of organism.

Trace elements

There is much discussion about trace elements in marine aquaria and for good reason. Most chemicals dissolved in seawater are classified as trace elements simply because there are so many ions and molecules present at very low concentrations. In many cases, these ions are quite variable in concentration from place to place and also as a function of depth. Anyone wishing to view extensive lists of these ions is advised to check out one of the references given at the end of this article.

Many of these trace elements are metals. While people typically view dissolved heavy metals as toxic, a great many of them are essential for organisms. Their toxicity is primarily related to their concentration: a happy medium is essential, where enough of each of these metals is present for life to exist, but not so much is present as to be toxic.

TABLE II

Some of the Minor and Trace Ions in Seawater

Species	Concentration milligrams per liter (mg/L)
Li^+ (lithium)	0.17
Rb^+ (rubidium)	0.12
$H_2PO_4^- + HPO_4^{2-} + PO_4^{3-}$ (phosphate)	0.0 to 0.3
IO_3^- (iodate)	0.03 to 0.06
I^- (iodide)	0 to 0.03
Ba^+ (barium)	0.004 to 0.02
Al^{3+} (aluminum)	0.00014 to 0.001
$Fe^{2+} + Fe^{3+}$ (iron)	0.000006 to 0.00014
Zn^{2+} (zinc)	0.000003 to 0.0006

A perfect example is copper. It is present in natural seawater at about 0.25 parts per billion (ppb), which is about a thousand times less than the toxic levels often used to kill microorganisms in the treatment of sick marine fish. It is, however, absolutely necessary for many animals to have copper available to them to survive.

Some of the most important trace elements to marine aquarists are those involved in the nitrogen cycle (ammonia/nitrite/nitrate). These are discussed in detail below.

Organics

The nature of organic molecules is certainly the most complicated aspect of seawater chemistry. Organics comprise about 2 ppm of seawater. Of this 2 ppm, the majority is in the form of dissolved organic carbon (DOC). DOC includes all fully dissolved organic compounds and any particulates that are small enough to pass through a 0.45-micron (µm) glass fiber filter. Strictly speaking then, it is not all fully dissolved. Any organic particles greater than 0.45 µm are called particulate organic carbon (POC). The POC is about a factor of 10 lower in concentration than DOC and is composed of living and dead organisms, as well as assemblies of organic molecules.

DOC is an incredibly complicated mixture of molecules that represents billions of years of biological waste products from uncounted numbers of different organisms, combined with reactions catalyzed by light, heat, inorganic catalysts (metals), biological processes, and many other factors. It includes carbohydrates (20 to 35 percent of the total), humic substances (10 to 30 percent of the total), amino acids and proteins (2 to 3 percent), hydrocarbons (less than 1 percent), carboxylic acids (1 percent) and steroids (trace).

There is also a great deal of uncharacterized organic material. In fact, the study of seawater organics is an active area of research. Additionally, the summation of all dissolved organics in the ocean is a pool of carbon larger than carbon dioxide in the atmosphere, so it cannot be ignored by those looking at the planetary carbon cycle. In addition to carbon, these organics contain significant amounts of oxygen, nitrogen, phosphorus, and sulfur.

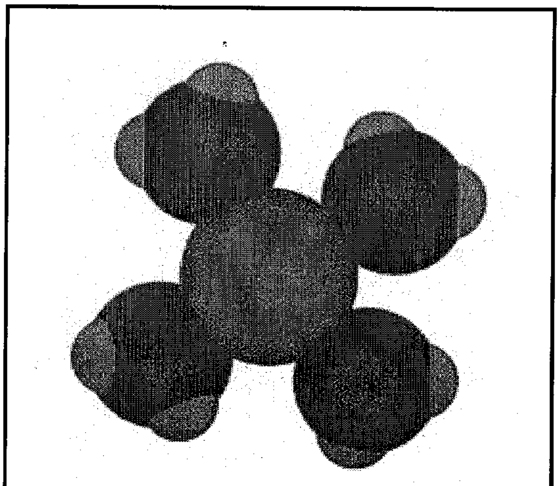
It is probably also safe to say that most, if not all, closed marine systems have higher organic levels than the ocean, although hard numbers are difficult to come by. The desire to reduce these organic levels is one of the reasons for the popularity of skimmers with marine aquaria.

What Forms Do Ions Take In Seawater?

In the previous sections I have described what ions are present in seawater, but I have not presented the forms they typically take. Contrary to popular belief, many of these ions are attached to each other in solution and do not act as completely individual species. This tendency to form ion pairs in solution is much more prevalent for some ions (e.g., Ca^{2+}, Mg^{2+}, CO_3^{2-}, F^-, OH^-) than it is for some others (e.g., Na^+, K^+, Cl^-, Br^-). In general, the tendency to form ion pairs is higher for ions with a higher net charge. In the next few sections, I will present an overview of some of these interactions and why they are important.

Simple ions

The simplest positively charged ions in solution are sodium (Na^+) and potassium (K^+). They are primarily free ions, with a shell of three to four tightly bound water molecules attached to them. This is known as the "primary hydration sphere." These water molecules are fairly tightly bound, but are rapidly exchanged with other water molecules from the bulk solution (at a rate of about a billion exchanges per second for each ion!). Beyond this first shell are another 10 to 20 water molecules that are less tightly bound, but that are still strongly influenced by the metal ion. These types of hydrating water molecules are present for all ions in solution and won't be mentioned further for each ion in turn.



Space filling model of a potassium ion (gray) surrounded by its primary hydration sphere of water molecules.

A small proportion of both sodium and potassium (about 5 percent) exists as ion pairs with sulfate, forming $NaSO_4^-$ and KSO_4^-. This type of ion pair is best viewed as a temporary association between the two ions and may only last for a very small fraction of a second before the ions move apart. Nevertheless, this type of association can have very important implications for the behavior of these ions, as will be shown below. Ions forming such pairs actually "touch" each other. That is, most or all of the hydrating water molecules that are in between them have been temporarily removed. This removal of the intervening water molecules is the primary distinction between ion pairs and ions that are simply near each other.

The simplest negatively charged ions, chloride (Cl^-) and bromide (Br^-), form few ion pairs in solution. They are primarily present in the form of hydrated free ions, with two and one tightly bound water molecules, respectively.

Carbonate

One of the more complex interactions, and one that is very important for marine reefkeepers, involves carbonate (CO_3^{2-}). Carbonate is primarily ion paired in solution, with only about 15 percent of it actually present as free CO_3^{2-} at any given point in time. This fact is very important to the maintenance of calcium and alkalinity levels in aquaria, because it is the free carbonate concentration that "wants" to precipitate with calcium as calcium carbonate ($CaCO_3$). If the free carbonate levels rise too much, the calcium levels will drop due to $CaCO_3$ precipitation.

So, what is carbonate ion paired with? Primarily magnesium, forming soluble $MgCO_3$. This is the reason why magnesium levels are so important in marine aquaria for maintenance of simultaneously high levels of alkalinity and calcium. If magnesium is too low, more carbonate will be in the free form and will "want" to precipitate as calcium carbonate.

Carbonate is also ion paired to sodium and calcium, forming soluble $NaCO_3^-$ and $CaC0_3$, respectively. The soluble calcium ion pair sounds odd, but it is essentially one individual molecule of $CaCO_3$ that is soluble in water: it is not precipitated out of the solution. The fact that carbonate is also ion paired by sodium is one of the reasons that salinity has an impact on the amount of calcium and alkalinity that can be maintained in solution: lower salinity means lower sodium, which means more free carbonate and a greater likelihood of precipitation of $CaCO_3$.

Ion pairing has another large effect on carbonate that is more subtle. In water, carbon dioxide hydrates to form H_2CO_3, which can then break up (ionize) into protons (H^+), bicarbonate (HCO_3^-) and carbonate CO_3^{2-}).

$$CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^- \rightleftharpoons 2H^+ + CO_3^{2-}$$

When CO_2 is added to water, the system will come to equilibrium with specific concentrations of each of the species shown above. By LeChatelier's principle, if one takes away something from one side of the equilibrium, the equilibrium will shift in that direction. For example, if carbonate is removed from the system, then each of the reactions shown will proceed to the right, effectively replacing some of the carbonate that was removed.

Importantly, that is exactly the effect that takes place in seawater when carbonate is "removed" by forming ion pairs. It is only the "free" concentration of these species that determines the position of the chemical equilibrium, so carbonate in the form of an ion pair does not "count," and the equilibrium shifts strongly to the right. If one then counts carbonate in all forms (free and ion paired) it is found to be far higher in seawater than in freshwater at the same pH and ion pairing is the primary reason.

The exact same effect can be seen in the solubility of $CaCO_3$.

$$CaCO_3 \rightleftharpoons Ca^{2+} + CO_3^{2-}$$

In this case, if $CaCO_3$ is added to water, it breaks apart into Ca^{2+} and CO_2^{2-}. Eventually, an equilibrium is reached where no more $CaCO_3$ will dissolve. However, if some of the carbonate is removed by ion pairing (and some of the Ca^{2+} as well), then additional $CaCO_3$ can dissolve to replace those that were "lost." This is the primary reason that $CaCO_3$ is approximately 15 times more soluble in seawater than in freshwater.

Calcium, magnesium and strontium

Calcium, magnesium and strontium are primarily present in the free form, hydrated by six to eight tightly bound water molecules. A small percentage (about 15 percent) is present as an ion pair with sulfate. Much smaller percentages are present as ion pairs with carbonate and bicarbonate. Importantly, while these complexes involve only a small percentage of the total calcium and magnesium, they involve a large portion of the total carbonate (which is possible because there is so much calcium and magnesium compared to carbonate).

Sulfate

As mentioned above, sulfate forms ionic interactions with most positively charged species in seawater. In fact, more than half of it is in the form of an ion pair, with $NaSO_4^-$ and $MgSO_4$ dominating.

Phosphate

Phosphate in marine aquaria is of tremendous importance because it is often a limiting nutrient for algae growth. In seawater, the amount of phosphate present is typically quite low (usually less than 0.1 ppm) and often varies significantly from location to location. In many marine aquaria, however, the phosphate concentration can be significantly higher (up to several ppm).

The ability to export phosphate from marine aquaria has been the topic of lengthy discussion and is the object of numerous commercial products. The nature of the inorganic phosphate present in marine aquaria, however, is certainly more complicated than traditionally credited.

Inorganic phosphate can exist in a number of forms, in a manner analogous to carbonate.

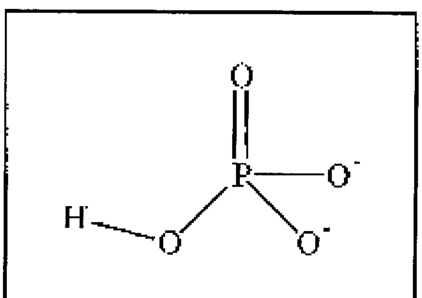
$$H_3PO_4 \rightleftharpoons H^+ + H_2PO_4^- \rightleftharpoons 2H^+ + HPO_4^{2-} \rightleftharpoons 3H^+ + PO_4^{3-}$$

Ignoring ion pairing and complex formation for the moment, phosphate is primarily found in the HPO_4^{2-} and PO_4^{3-} forms in seawater. This is quite different than in freshwater at the same pH, where the $H_2PO_4^-$ and HPO_4^{2-} forms predominate. *Table III* shows the forms of phosphate present in seawater at a pH of 8.1.

To a large extent, the high proportion of phosphate present in the PO_4^{3-} form in seawater is due to ion pairing, just as in the case of carbonate. These various phosphate species pair extensively with magnesium and calcium in seawater. PO_4^{3-} is nearly completely ion paired (96 percent), while only 44 percent of HPO_4^{2-} is paired. This is what causes the shift in the equilibrium to more of the PO_4^{3-} form in seawater compared to freshwater (just as it does for carbonate).

TABLE III
Speciation of Phosphate in Seawater

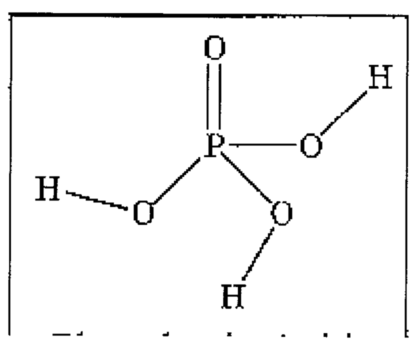
Form	**Percentage of total in seawater (at pH 8.0)**
H_3PO_4	trace
$H_2PO_4^-$	0.5 percent
HPO_4^{2-}	79.2 percent
PO_4^{3-}	20.4 percent



A Hydrogenphosphate Ion

Additionally, phosphate will interact with certain ions in a manner that is much stronger than simple ion pairs. Phosphate can, for example, complex with a number of positively charged species, including both metals (e.g., iron) and organics. These interactions further serve to reduce the concentration of free phosphate.

Phosphorus is also contained in dissolved organics. While natural seawater has more inorganic phosphate than organic forms, this may not be true in aquaria where much higher organic levels prevail.



Metals

Phosphoric Acid

The metals, in particular, are strongly ion paired in solution. Copper primarily forms soluble $CuCO_3$, iron forms soluble $Fe(OH)_3$ and silicon (not strictly a metal) forms ($Si(OH)_4$. Some of the other metals that are biologically important (e.g., zinc, molybdenum, manganese, cobalt) form a wide variety of ion pairs with different ions in solution. In some cases, the number of different species that form is extensive. *Table IV* shows the speciation of copper in seawater at a pH of 8.1.

In recent years, however, it has become more and more apparent that certain metals are largely complexed to organic materials, even in natural saltwater where the level of organics is low. In a marine aquarium, the level of organics can be higher than in the ocean, so such complexes are even more likely to form.

TABLE IV
Speciation of Copper in Seawater

Copper form	Percentage of total
$CuCO_3$	73.8
$Cu(CO_3)_2^{2-}$	14.2
$Cu(OH)^+$	4.9
Cu^{2+}	3.9
$Cu(OH)_2$	2.2
$CuSO_4$	1.0
$CuHCO_3^+$	0.1

In addition to complexation of metals to the widespread organics present in the oceans (e.g., humic acids), there is also the possibility of complexation to specific organics that were made exclusively for that purpose. For many microorganisms, metals such as iron are limiting nutrients for growth and these creatures have designed systems to bring iron to them.

Bacteria and fungi, for example, release organic compounds called siderophores into the environment. They are large organic molecules with a very high affinity for iron. The released siderophores eventually encounter an iron atom and bind very strongly to it. The organisms themselves have enzymes in their outer membranes that interact strongly with siderophores that contain iron, and transport them into the cell. Consequently, the siderophores can be viewed as collection devices for iron.

Of course, many of the siderophores released into the ocean are not quickly reabsorbed by the microorganisms and remain in solution. In a closed marine aquarium with a large population of microorganisms, one would expect that such molecules would be present in solution. Consequently, many metals in solution may be bound by such molecules.

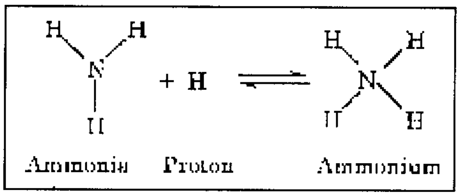
Additionally, many aquarists intentionally add complexing agents in the various supplements they add to their aquaria. These include EDTA and citrate, which are two common forms for adding iron. These will equilibrate with other metals already in the tank and the tank will then contain a variety of metals complexed to these organics.

Nitrogen compounds

The primary nitrogen compound in seawater is nitrogen gas (N_2). It is present at about 11 ppm at 25 degrees Celsius (77 degrees Fahrenheit), although its solubility is a strong function of temperature, with nearly twice as much dissolving in near freezing seawater. Nitrogen gas is present at a higher concentration than any other dissolved gas, with oxygen (0_2) at 7 ppm, argon (Ar) at 0.4 ppm and all others at sub-ppb levels (not including carbon dioxide, which is primarily ionized in seawater).

There are certain organic and inorganic forms of nitrogen at concentrations lower than nitrogen gas. The organic forms are poorly defined, but include such molecules as proteins.

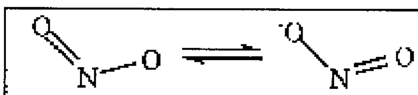
The inorganic forms are much more familiar to aquarists as components of the nitrogen cycle. The concentrations of these components in seawater are highly variable. In natural seawater, ammonia (NH_3) ranges in concentration from 0.02 to 8 ppm (as ammonia), nitrite (NO_2^-) ranges from 0.005 to 0.2 ppm (as nitrite) and nitrate (NO_3^-) ranges from 0.06 to 30 ppm (as nitrate). These values vary by location, depth and time of year. Other inorganic forms present at much lower concentration include hydroxylamine (NH_2OH), nitrous oxide (N_2O), and hyponitrite ($N_2O_2^{2-}$).



Ammonia exists in two forms in seawater. The primary form is ammonium (NH_4^+), which accounts for about 95 percent of the total in seawater at a pH of 8.1. The secondary form is free ammonia (NH_3), which accounts for the remaining 5 percent. These proportions vary strongly with pH and the free ammonia form rises as pH rises, to about 50 percent of the total at a pH of 9.5.

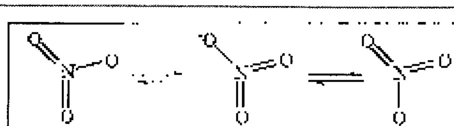
The toxicity of ammonia towards fish has been found to depend upon pH, with some researchers observing lower toxicity at lower pH. It has been suggested that this relationship between toxicity and pH is due to the proportion of ammonia in each form at a given pH. While these ideas seem to have been accepted by many in the aquarium hobby, the exact cause of this relationship is unclear and is beyond the scope of this article. This topic is discussed in more detail in *Captive Seawater Fishes* (Spotte 1992).

Nitrite and nitrate are both interesting molecules in that they exist in a number of resonance forms. If one draws a simple structure for these molecules it appears that the oxygen atoms are not all exactly the same, with one carrying a negative charge, while the others do not. Experimentally, however, this has not been found to be the case: all oxygen atoms are exactly equivalent.


Resonance Forms of Nitrite

How can this be? Resonance forms are a simple way of thinking about this, with the various forms interconverting extremely rapidly. The only thing required to convert one form to another is to move electrons around within the ion, so it can happen essentially instantly. In reality, the electrons are spread around these ions in such a way that each oxygen on average carries a partial negative charge (-¾ in the case of nitrite; -1/3 in the case of nitrate).

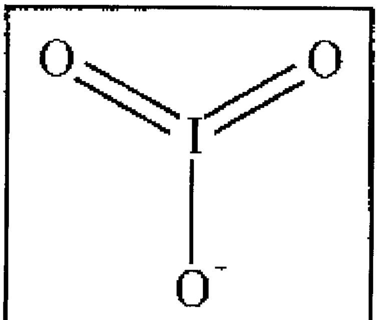
Iodine


Resonance Forms of Nitrate

Iodine seems to get an amazingly disproportionate amount of discussion with respect to marine aquaria and much of it is incorrect. The reasons for this are many, but are primarily related to its chemical and biochemical complexity. In fact, its chemical complexity is far greater than many aquarists are aware.

Iodine takes two primary forms in seawater: iodide (I^-) and iodate (IO_3^-). The often quoted value for the total concentration of iodine in seawater (0.06 ppm) is reasonably accurate, although the value varies significantly. This value, however, is a combination of both iodide and iodate. It is not correct to state that seawater contains 0.06 ppm of iodide. The value for iodide is more typically around 0.01 ppm or less, although it is sometimes as high as 0.03 ppm and sometimes as low as 0.002 ppm. The remainder is iodate.

Additionally, the interconversion between iodide and iodate in seawater is very slow. This reaction is believed to be mediated in a number of ways, including catalysis by light and microorganisms. It is probably safe to say, however, that the two are not in equilibrium in marine aquaria. One effect of this lack of equilibrium is that dosing one type does not necessarily give you any of the other type.



Iodate

It is not well known which forms are used by which organisms, so I will not comment on the necessity of maintaining specific levels of iodide or iodate. There is good evidence, however, that iodide is rapidly depleted in marine aquaria, although it is not well established where it goes. Conversion of iodide to iodate has been observed in aquaria, but this may not represent a significant sink. Iodate itself is much slower to become depleted from marine aquaria and can build up to toxic levels if it is being actively dosed.

An additional complication is that some aquarists dose a third form of iodine: I_2. Lugol's solution, for example, is a combination of iodide and iodine. When iodine (as I_2) is added to seawater, it quickly reacts to form other iodine species that probably end up as both iodide and iodate in marine tanks.

Conclusion

There are, of course, many other details of seawater chemistry that may be of interest to marine aquarists. This article is only a first pass at understanding the chemistry behind what is happening in our tanks.

For those wanting a more in depth exposure to marine chemistry, I recommend two books: *Captive Seawater Fishes. Science and Technology* by Stephen Spotte (Wiley-Interscience, New York. Pp. 942.) and *Chemical Oceanography, Second Edition* by Frank J. Millero (CRC Press, Boca Raton, FL. Pp. 469.).

The Spotte book is excellent, with sections directed specifically toward aquarium chemistry. It covers chemistry from the standpoint of aquarium keeping, rather than understanding of the natural ocean. It is also practically oriented, rather than directed toward a deep chemical understanding of phenomena.

The Millero book will only be of interest to those who are undaunted by chemical reactions and jargon. It is, however, the best marine chemistry book I have encountered. It gives a tremendous amount of detail about natural marine systems, but has no discussion about aquaria. Most of the chemical data in this paper was pulled from this book.

Previous "Biochemistry of Reef Aquariums" columns in *Aquarium Frontiers* magazine have also dealt with selected topics of interest to marine aquarists, especially the column on "Ion Pairing, Buffer Perturbation and Phosphate Export in Marine Aquariums" (Bingman, C. 1996. *Aquarium Frontiers* 3[1]:10-17).

Detailed composition of seawater

at 3.5% salinity

Element	At.weight	ppm	Element	At.weight	ppm
Hydrogen H2O	1.00797	110,000	Molybdenum Mo	0.09594	0.01
Oxygen H2O	15.9994	883,000	Ruthenium Ru	101.07	0.0000
Sodium NaCl	22.9898	10,800	Rhodium Rh	102.905	.
Chlorine NaCl	35.453	19,400	Palladium Pd	106.4	.
Magnesium Mg	24.312	1,290	Argentum (silver) Ag	107.870	0.0002
Sulfur S	32.064	904	Cadmium Cd	112.4	0.0001
Potassium K	39.102	392	Indium In	114.82	.
Calcium Ca	10.08	411	Stannum (tin) Sn	118.69	0.0008
Bromine Br	79.909	67.3	Antimony Sb	121.75	0.0003
Helium He	4.0026	0.0000072	Tellurium Te	127.6	.
Lithium Li	6.939	0.170	Iodine I	166.904	0.064
Beryllium Be	9.0133	0.0000006	Xenon Xe	131.30	0.0000
Boron B	10.811	4.450	Cesium Cs	132.905	0.0003
Carbon C	12.011	28.0	Barium Ba	137.34	0.021
Nitrogen ion	14.007	15.5	Lanthanum La	138.91	0.0000
Fluorine F	18.998	13	Cerium Ce	140.12	0.0000
Neon Ne	20.183	0.00012	Praesodymium Pr	140.907	0.0000
Aluminium Al	26.982	0.001	Neodymium Nd	144.24	0.0000
Silicon Si	28.086	2.9	Samarium Sm	150.35	0.0000
Phosphorus P	30.974	0.088	Europium Eu	151.96	0.0000
Argon Ar	39.948	0.450	Gadolinium Gd	157.25	0.0000
Scandium Sc	44.956	<0.000004	Terbium Tb	158.924	0.0000
Titanium Ti	47.90	0.001	Dysprosium Dy	162.50	0.0000
Vanadium V	50.942	0.0019	Holmium Ho	164.930	0.0000
Chromium Cr	51.996	0.0002	Erbium Er	167.26	0.0000
Manganese Mn	54.938	0.0004	Thulium Tm	168.934	0.0000
Ferrum (Iron) Fe	55.847	0.0034	Ytterbium Yb	173.04	0.0000
Cobalt Co	58.933	0.00039	Lutetium Lu	174.97	0.0000
Nickel Ni	58.71	0.0066	Hafnium Hf	178.49	<0.000
Copper Cu	63.54	0.0009	Tantalum Ta	180.948	<0.000
Zinc Zn	65.37	0.005	Tungsten W	183.85	<0.000
Gallium Ga	69.72	0.00003	Rhenium Re	186.2	0.0000
Germanium Ge	72.59	0.00006	Osmium Os	190.2	.
Arsenic As	74.922	0.0026	Iridium Ir	192.2	.
Selenium Se	78.96	0.0009	Platinum Pt	195.09	.
Krypton Kr	83.80	0.00021	Aurum (gold) Au	196.967	0.0000
Rubidium Rb	85.47	0.120	Mercury Hg	200.59	0.0001
Strontium Sr	87.62	8.1	Thallium Tl	204.37	.
Yttrium Y	88.905	0.000013	Lead Pb	207.19	0.0000
Zirconium Zr	91.22	0.000026	Bismuth Bi	208.980	0.0000
Niobium Nb	92.906	0.000015	Thorium Th	232.04	0.0000
			Uranium U	238.03	0.0033
			Plutonimu Pu	(244)	.

Note! ppm= parts per million = mg/litre = 0.001g/kg.

AQUATEXT

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Dissolved Oxygen Table (mg/l)

Temperature °C	0	5	10	Salinity 15	(ppt) 20	25	30	35
0	14.6	14.11	13.64	13.18	12.74	12.31	11.90	11.50
2	13.81	13.36	12.91	12.49	12.07	11.67	11.29	10.91
4	13.09	12.67	12.25	11.85	11.47	11.09	10.73	10.38
6	12.44	12.04	11.65	11.27	10.91	10.56	10.22	9.89
8	11.83	11.46	11.09	10.74	10.40	10.07	9.75	9.44
10	11.28	10.92	10.58	10.25	9.93	9.62	9.32	9.03
12	10.77	10.43	10.11	9.80	9.50	9.21	8.92	8.65
14	10.29	9.98	9.68	9.38	9.10	8.82	8.55	8.29
16	9.86	9.56	9.28	9.00	8.73	8.47	8.21	7.97
18	9.45	9.17	8.90	8.64	8.38	8.14	7.90	7.66
20	9.08	8.81	8.56	8.31	8.06	7.83	7.60	7.38
22	8.73	8.48	8.23	8.00	7.77	7.54	7.33	7.12
72°f 24	8.4	8.16	7.93	7.71	7.49	7.28	7.07	6.87
26	8.09	7.87	7.65	7.44	7.23	7.03	6.83	6.64
28	7.81	7.59	7.38	7.18	6.98	6.79	6.61	6.42
30	7.54	7.33	7.14	6.94	6.75	6.57	6.39	6.22

5. Results and Observations - 2820

a. Sample/Locations Observations

Gas samples were taken at the top of the riser before the blind flange was removed. Samples were taken when the odor of natural gas was present. All bolts and flange seals were intact and did not indicate any leakage. H2S length of stain samples were taken at this time as well. Sample 2820-B obtained just ahead of the flush water - had some water in it. The testing lab indicated that this water would not affect the gas samples integrity.

Water samples were taken at the same location. Water samples seemed uniform, and representative of the flush fluid stream.

A five foot (5’) sample of the pipeline was removed, which included the tubeturn to pipeline weld.

b. Gas Composition Observations

The results of the gas analysis are plotted and summarized in the results section. Atmospheric air composition is also plotted for reference purposes.

Four gas samples were taken. Two of the samples (2820-1 and 2820-A) were taken at the same time and location. Sample 1 was taken using a steel vacuum tube and Sample A was taken using a Tedlar bag. According to the lab, the Tedlar bags are the preferred sampling method, as when they are full, one can be sure they contain a sample, whereas with the tubes, there is no indication that a sample was taken. It is important to note that the composition of the two samples is different. The sample taken with the vacuum tube contains more methane and less nitrogen than the sample taken with the Tedlar bag. Sample 2820-B, which is estimated to originate 2670’ from the well protector platform is lower in methane and higher in nitrogen than the other two samples. It has almost the same amount of oxygen and nitrogen as the atmosphere. This indicates that it is probably a mixture of natural gas, and atmospheric air. This would follow from the fact that end of the pipeline was opened in order to connect the flushing pump. At that time, it would have been possible to introduce air into the line.

c. Flushwater Composition Observations

The flushwater composition for segment 2820 is plotted in the results section. Natural Seawater composition is also plotted for comparison purposes. The ions/elements plotted are: Alkalinity (CO3), Barium, Calcium, Iron, Magnesium, and Potassium.

Because of their high values (in PPM), Chlorides and Sulfates are plotted on a separate chart.

For the flushwater, the mineral pattern relative to NSW is summarized below:

Alkalinity (bicarb) – Higher
Barium – Higher/Same
Calcium – Lower/Equal (First sample much lower)
Iron – Higher
Magnesium – Lower/Equal (First sample much lower)
Potassium – Lower/Equal (First sample much lower)
Chloride – Lower
Sulfate – Lower/Higher (First sample much lower)

The first sample, containing the most hydrocarbons was MUCH lower than NSW in almost all elements/ions tested for.

The iron content is plotted as a separate graph in order to focus on these values. The first sample had a very high iron concentration of 91.3 ppm (ppm also equals milligrams/liter). This concentration is over 26,000 times greater than NSW. Observations from the field could explain this very high concentration. The sample was taken at the very front of the flushwater "slug." This slug picked up metal debris, as can be evidenced in the photographs. This debris included metal particles which were picked up from the pipe wall. The sampling procedure "dissolved" these metal particles and recorded them as a concentration value. The following two samples were lower in concentration, but still much higher than NSW values.

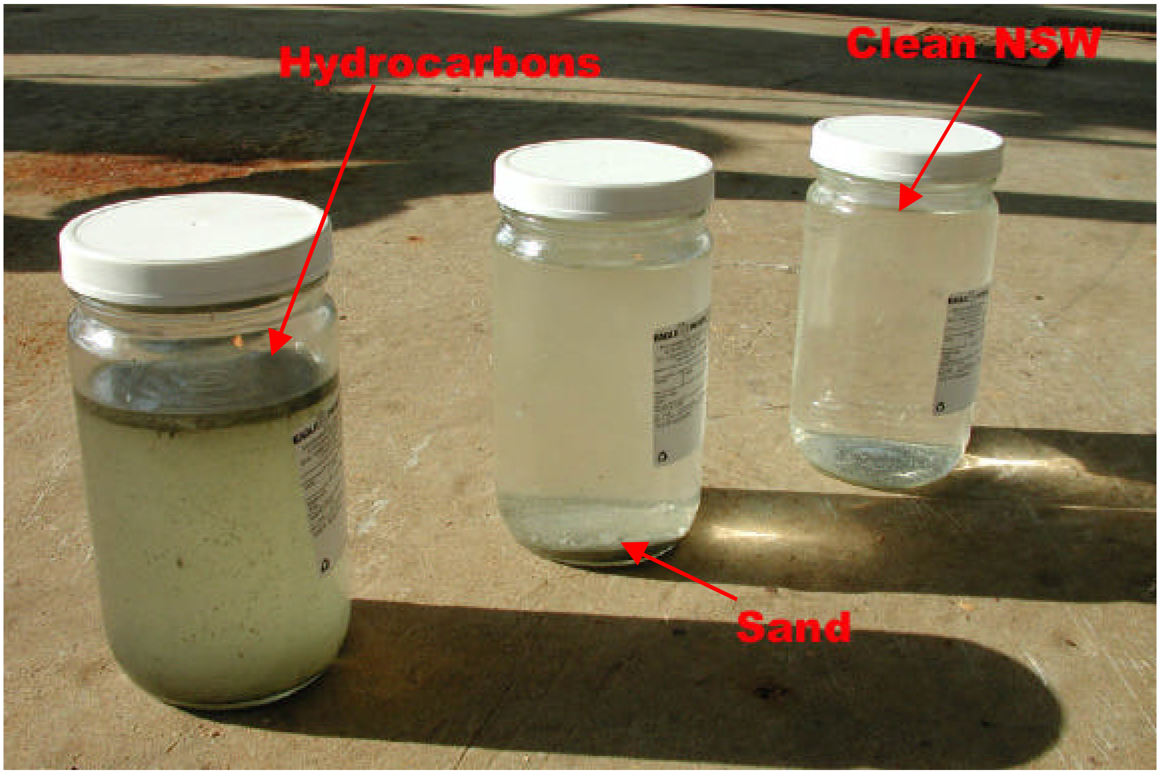


Photo #12 - Mineral Pattern Analysis Samples - 2820

The ions/elements to focus on from this analysis are those found in steel corrosion products: FeO_2, FeS. The samples showed higher than NSW concentrations of both Fe and S, indicating that corrosion has taken place, however, it is difficult to derive specific corrosion features from this data.

d. Oil and Grease Observations

Samples taken at the end of the flushing operation had no detectable oil and grease concentration. The detection limit is 2.5 PPM. The last sample was taken when approximately 1.75x the pipeline volume had been flushed. The graph shows a very rapid drop in oil and grease concentration, with the non-detectable limit appearing to be reached at 1.5x flush volume.

e. Pipe Cutout Observations

A five foot horizontal section of pipe was retrieved from near the base of the platform and includes pipe on both sides of the weld connecting the pipeline to the riser/tubeturn.

This sample showed only light surface rust and had some debris in the 5-7 o'clock position of the line, indicating that there may have been some standing fluid in the pipeline for some time. This area did not show any significant metal loss, but has a buildup or caking of silt/sand.

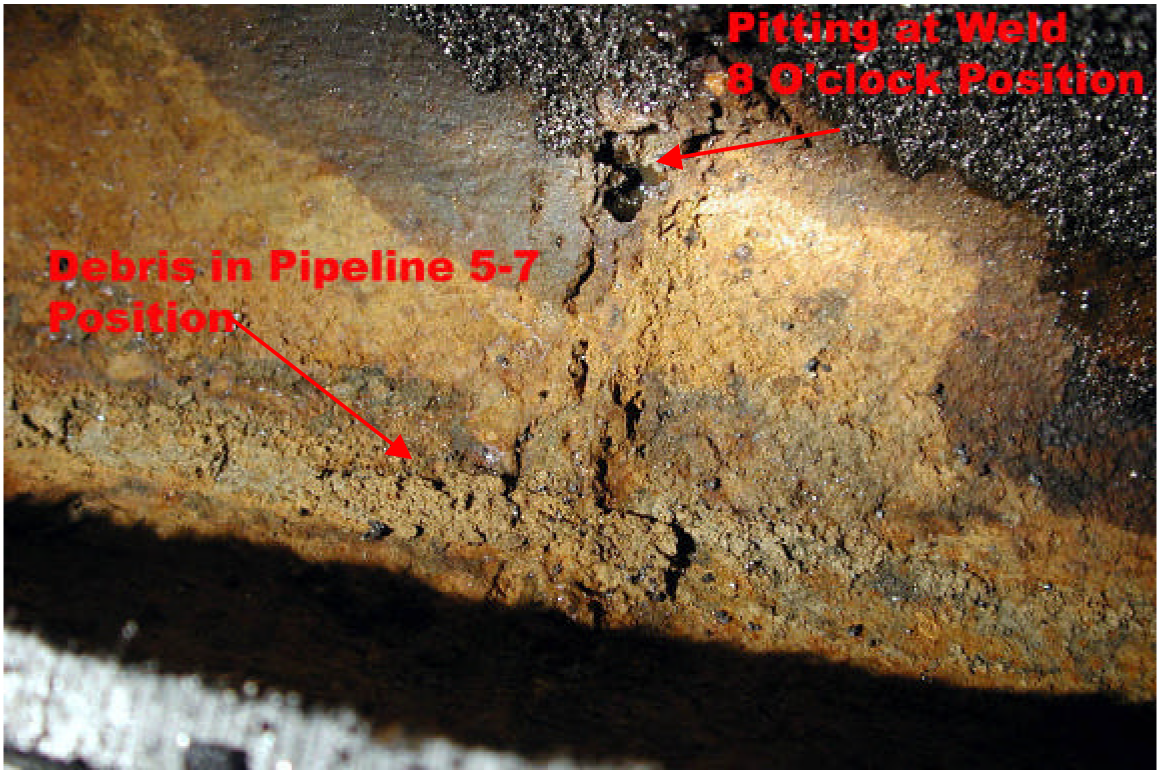
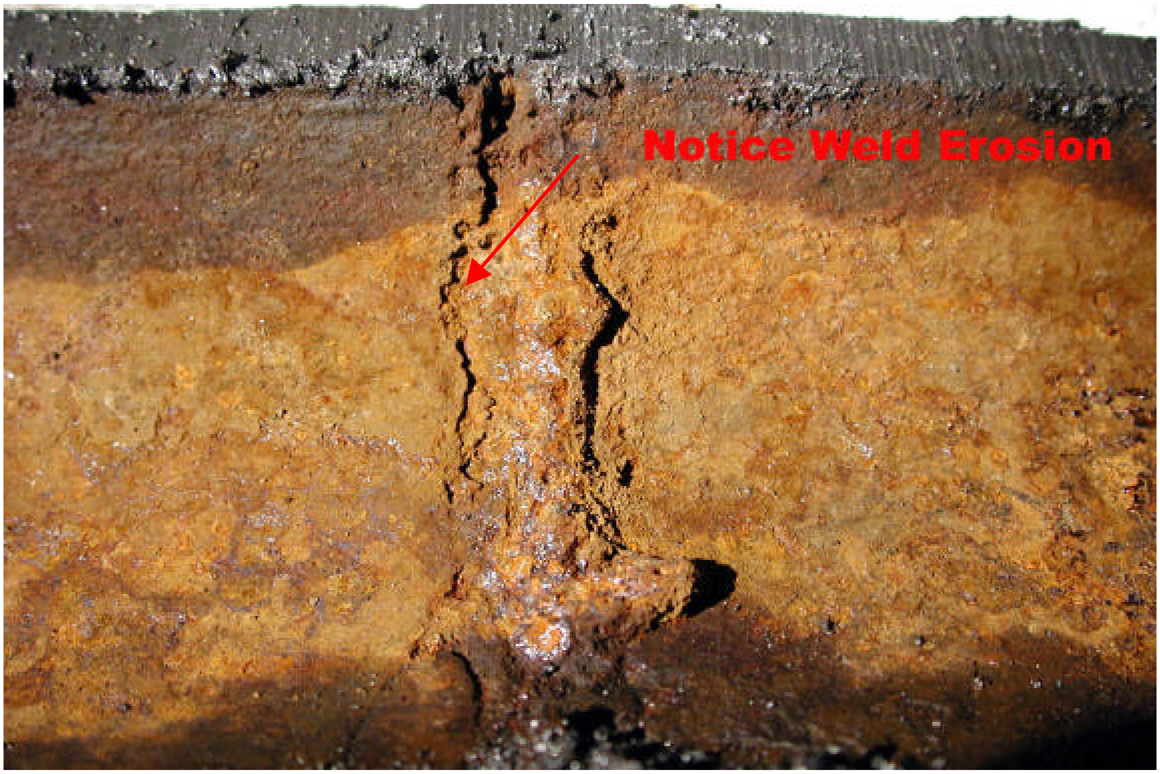


Photo #13

An important feature to note is that this sample did have a deep pit in the weld. The pit is clearly shown in the sample photos. The depth of the pit appears to be approximately 0.5*t. This defect is in the 10 o'clock position in the pipe, so it was not in the "wet" section of the pipe. Based on the shape of the defect, it appears to be a corrosion feature, and not caused by erosion (due to sand or other abrasives in the gas). This looks like an Microbial Induced Corrosion pit.



Photos #14 and #15 - Sample Photos from Line 2820

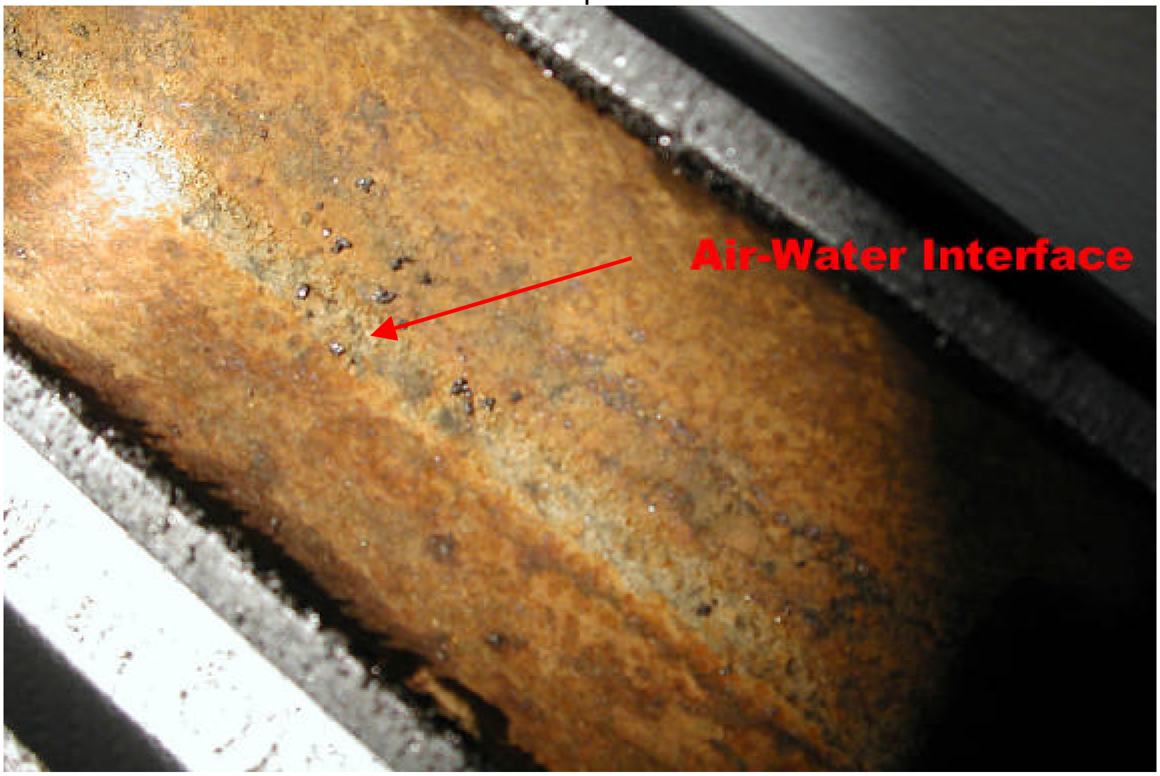


Photo #15

WINMAR consulting services, inc.

SHELL OFFSHORE INC.
HI-135-1

PLATFORM

MMS General		ODS General		MMS Location		MMS Facility	
Water	49 feet	**Function**	WP	**Lease**	741 feet	**Helideck**	Yes
Major	No	**Piles**	NA	**Complex**	10025	**Quarters**	None
Decks	1	**Slots**	3	**Longitude**	-94.119	**Generator**	No
Slots	3	**ODS ID**	738	**Latitude**	29.259	**Cranes**	NA
Wells	2	**Previous 1**	NA	**X**	3,555,877'	**Gas**	Yes
Flare	No	**Previous 2**	NA	**Y**	550,662'	**Oil**	No
Installed	01 1964	**Previous 3**	NA	**To Shore**	25 miles	**Comp**	No
Revised	12 1998	**Previous 4**	NA	**N-S feet**	S 4182'	**8 hour**	No
Removed	NA	**Notes**	NA	**E-W feet**	W 881'	**24 hour**	No

PIPELINES MMS

Segment	2820			
Origin	HI-135-1			
Terminus	HI-136-A			
O.D.	3"			
Length	1,500'			
Product	BLKG			
Status	ACT			
Installed	NA			
Abandon	NA			
Revised	Aug-94			
Operator	SHELL OFFSHORE INC.			

WELLS MMS

API Well ID	Well	Spud	Revised	Status	MD	Bot Lease	Sur Long	Sur Lat
427080004600	1	03 1964	05 1964	COM	10,777'	741	-94.119	29.259
427080004700	2	10 1964	05 1986	ST	8,678'	741	-94.112	29.260
427080004701	2	05 1986	07 1986	COM	9,450'	741	-94.115	29.260
427080004800	3	11 1964	08 1985	PA	9,663'	741	-94.104	29.265
427080004900	4	11 1964	06 1990	PA	11,483'	741	-94.116	29.269
427080005000	5	04 1965	08 1985	PA	9,006'	741	-94.089	29.262
427080006100	6	06 1965	06 1965	PA	9,085'	741	-94.089	29.271
427080007300	8	07 1967	08 1967	ST	9,452'	741	-94.103	29.260
427080007301	9	08 1967	08 1967	COM	9,020'	741	-94.106	29.260
427084023300	11	04 1986	01 1996	ST	10,824'	741	-94.075	29.262
427084023301	11	01 1996	04 1996	COM	11,033'	741	-94.075	29.262
427084023400	9	08 1986	09 1986	TA	10,230'	742	-94.132	29.259

WINMAR consulting services, inc.

PIPELINE FLUSHING AND SAMPLING RECORD

I. Pipeline Information

MMS Segment No.	2820
Date:	10/24/2000
Pipeline Origination	
Area	High Island
Block	135
Platform	#1
Lease	OCS-G-0741
Pipeline Destination	
Area	High Island
Block	136
Platform	A
Lease	OCS-G-0742
Pipeline Size (in)	3
Pipelines Length (ft)	1,500
Pipeline Volume (bbls)	13

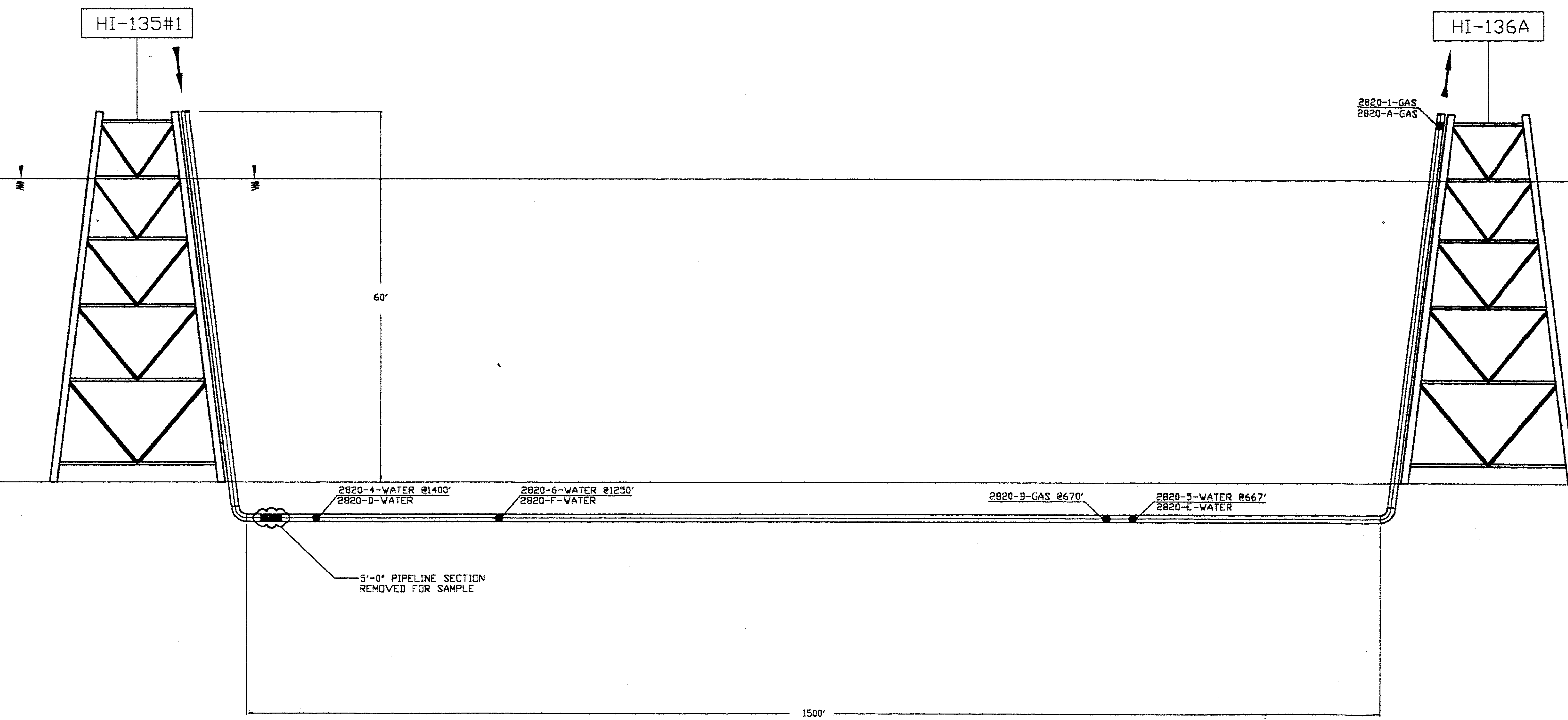
II. Flushing Information

Flushing Information	
Volume Flushed	1000g
Flow Rate (GPM)	100
Pigged Used	No
Type of Pig	No
Size of Pig	No
Clean Returns	Yes
Inhibitor	
Chemical Inhibitor Used	
Type of Chemical	
Quantity of Chemical	
Origination Riser	
Riser blind flanged w/ vent valve	Yes
Pipeline Tagged	Yes
Destination Riser	
Riser blind flanged w/ vent valve	Yes
Pipeline Tagged	Yes
Comments:	
Company Representative	
Signature	

WINMAR consulting services, inc.

III. Sampling Data - Tracking Information

Sample Location				
Platform:	HI 136A			
Pipeline Sampling Site:	Top of Riser Bleed Valve			
Flushing Start Time:	15:00			
Gas Samples	Sample ID	Sample Date	Vol. Flushed (g)	H2S (PPM)
Vacuum Tubes				
	2820-1	10/24/2000	0	0
Plastic Bags				
	2820-A	10/24/2000	0	0
	2820-B	10/24/2000	250	
Water Samples	Sample ID	Sample Date	Vol. Flushed (g)	Notes
Mineral Pattern Analysis				
	2820-4	10/24/2000	500	
	2820-5	10/24/2000	800	
	2820-6	10/24/2000	1,000	
Oil and Grease Analysis				
	2820-D	10/24/2000	500	
	2820-E	10/24/2000	800	
	2820-F	10/24/2000	1,000	
Comments:	2820-B had some water in the gas sample.			
Company Representative				
Signature				



PL SEGMENT	2820
LENGTH	1820 FT.
VOLUME FLUSHED	1000 GAL.
PL VOLUME FLG/FLG	550 GAL.

REV	DATE	DESCRIPTION	BY	APP'D
0	11/00	ISSUED	CSA	JW

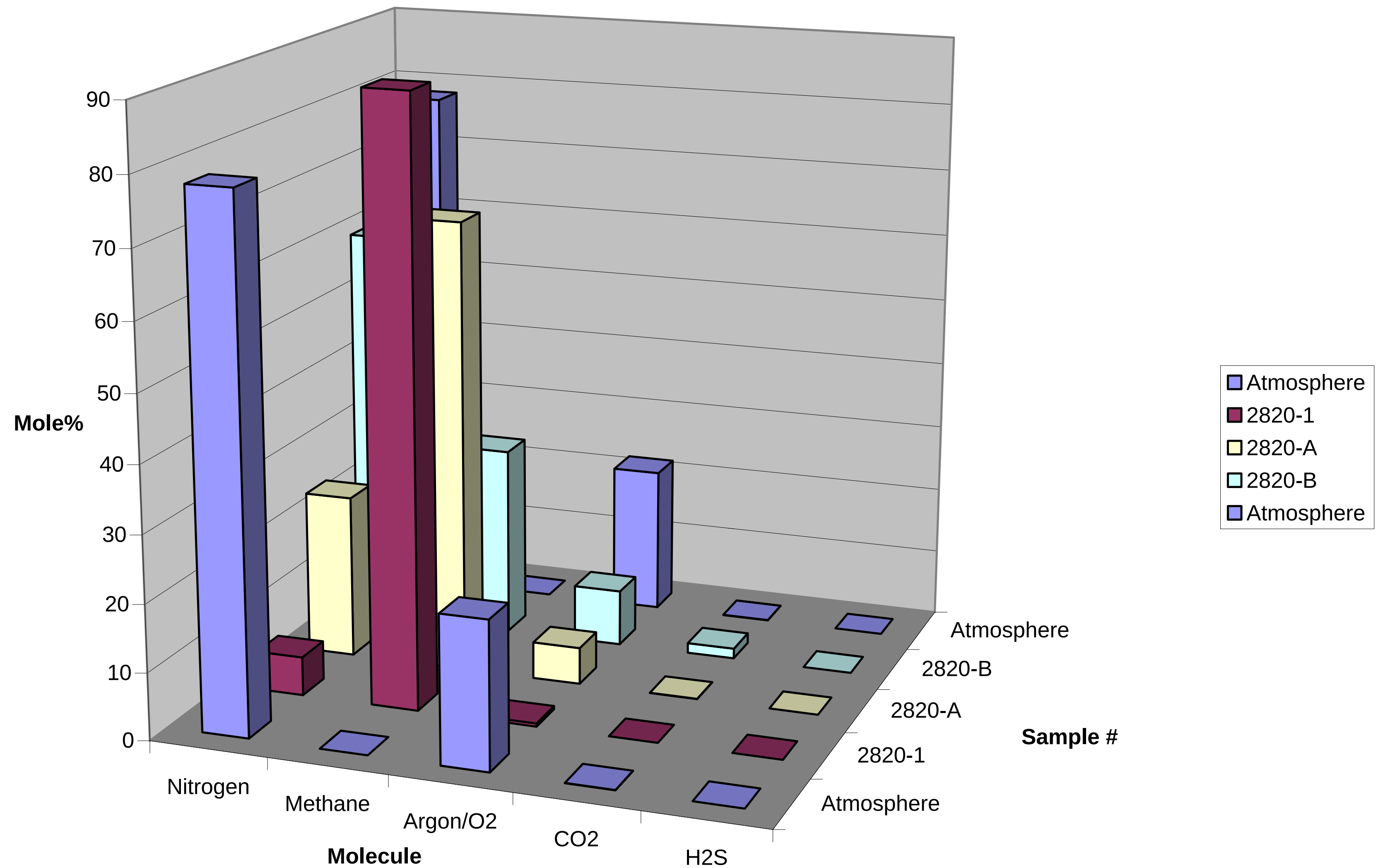
PROJECT# WM0070

PIPELINE SAMPLE LOCATIONS

HIGH ISLAND 135#1 / HIGH ISLAND 136A

	DATE	DWG. NO.	REV.
CSA	11/00	WM0070E	0

Figure 2 - Gas Composition (Major Constituents) - 2820



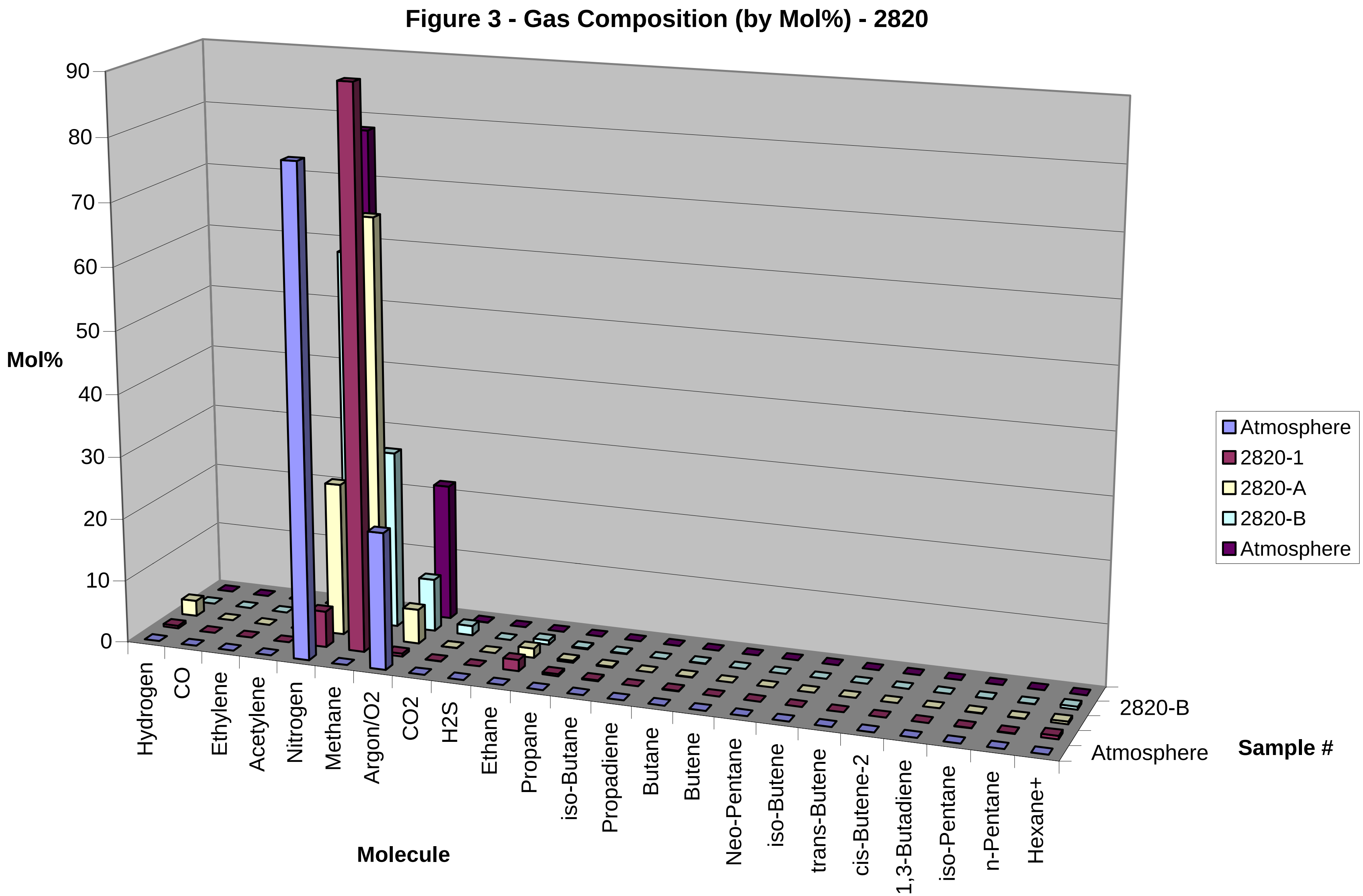


Figure 3 - Gas Composition (by Mol%) - 2820
Mol%
90
80
70
60
50
40
30
20
10
0
Hydrogen
CO
Ethylene
Acetylene
Nitrogen
Methane
Argon/O2
CO2
H2S
Ethane
Propane
iso-Butane
Propadiene
Butane
Butene
Neo-Pentane
iso-Butene
trans-Butene
cis-Butene-2
1,3-Butadiene
iso-Pentane
n-Pentane
Hexane+
Molecule
2820-B
Atmosphere
Sample #
Atmosphere
2820-1
2820-A
2820-B
Atmosphere

Figure 4 - Flushwater Composition- 2820

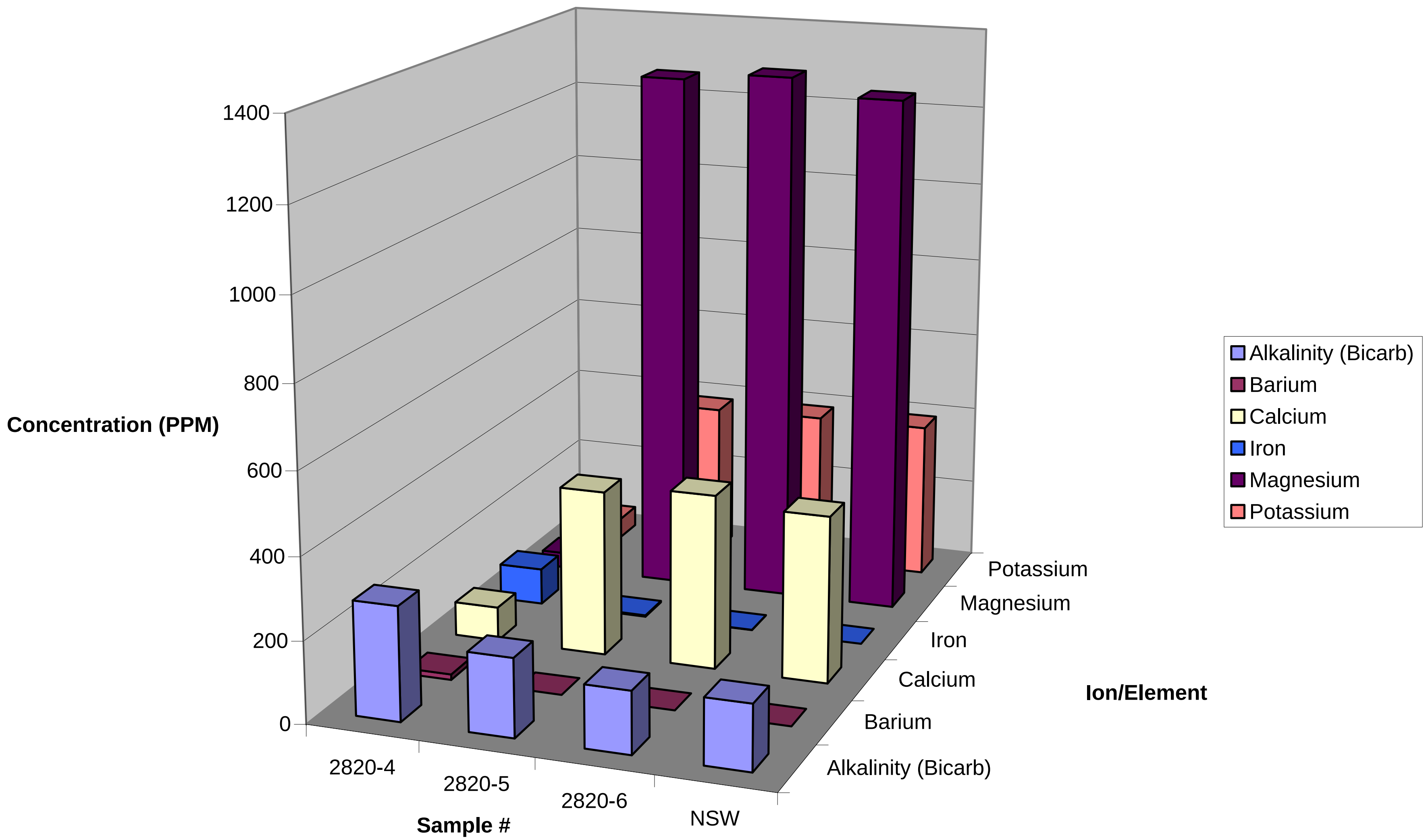


Figure 5 - Chloride and Sulfate - 2820

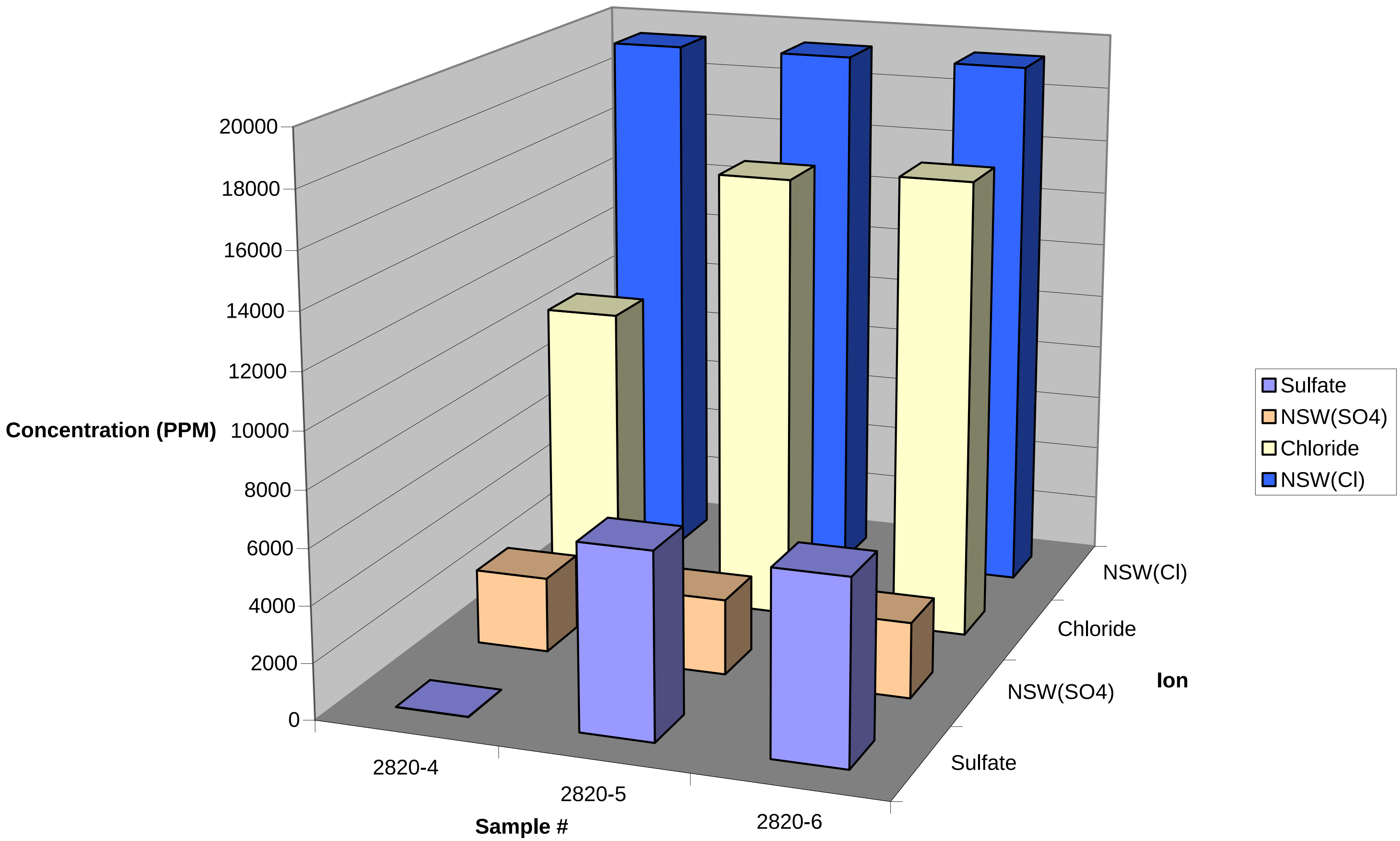
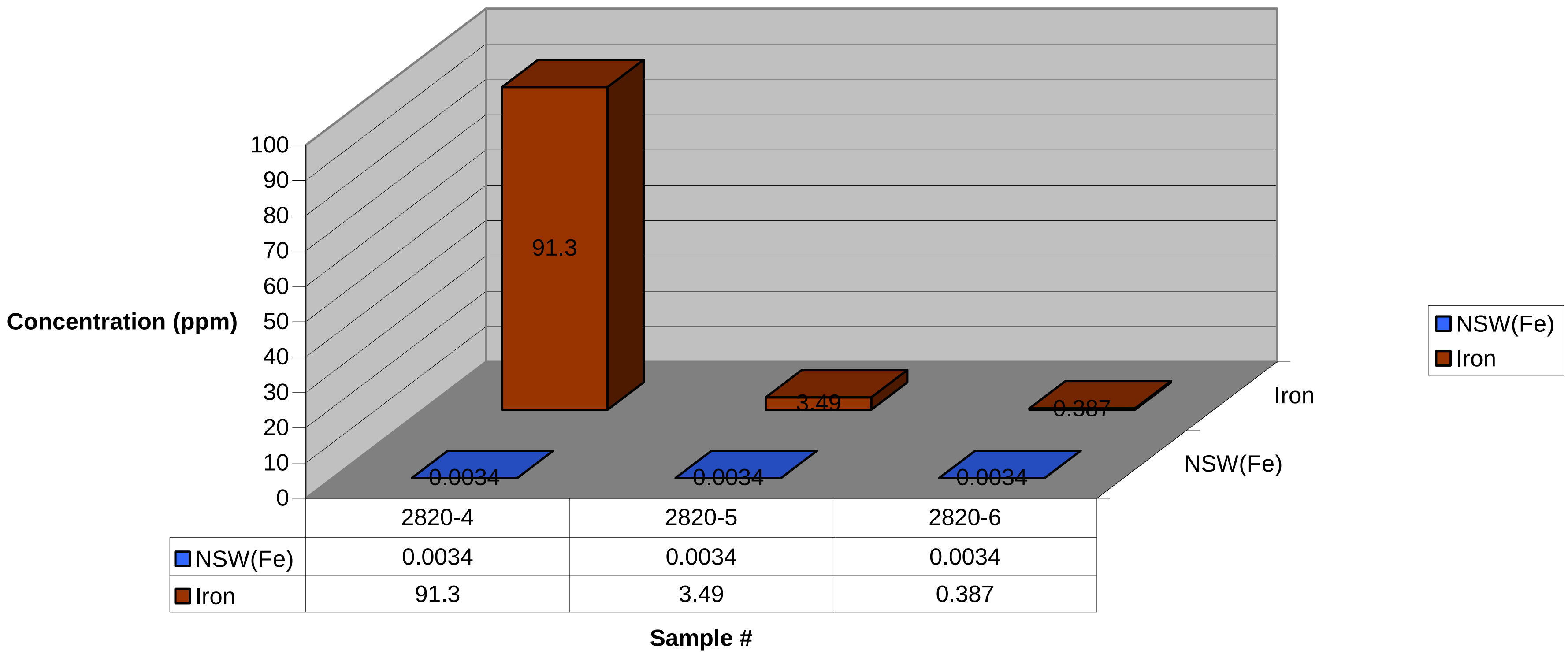


Figure 6 - Iron Concentration - 2820



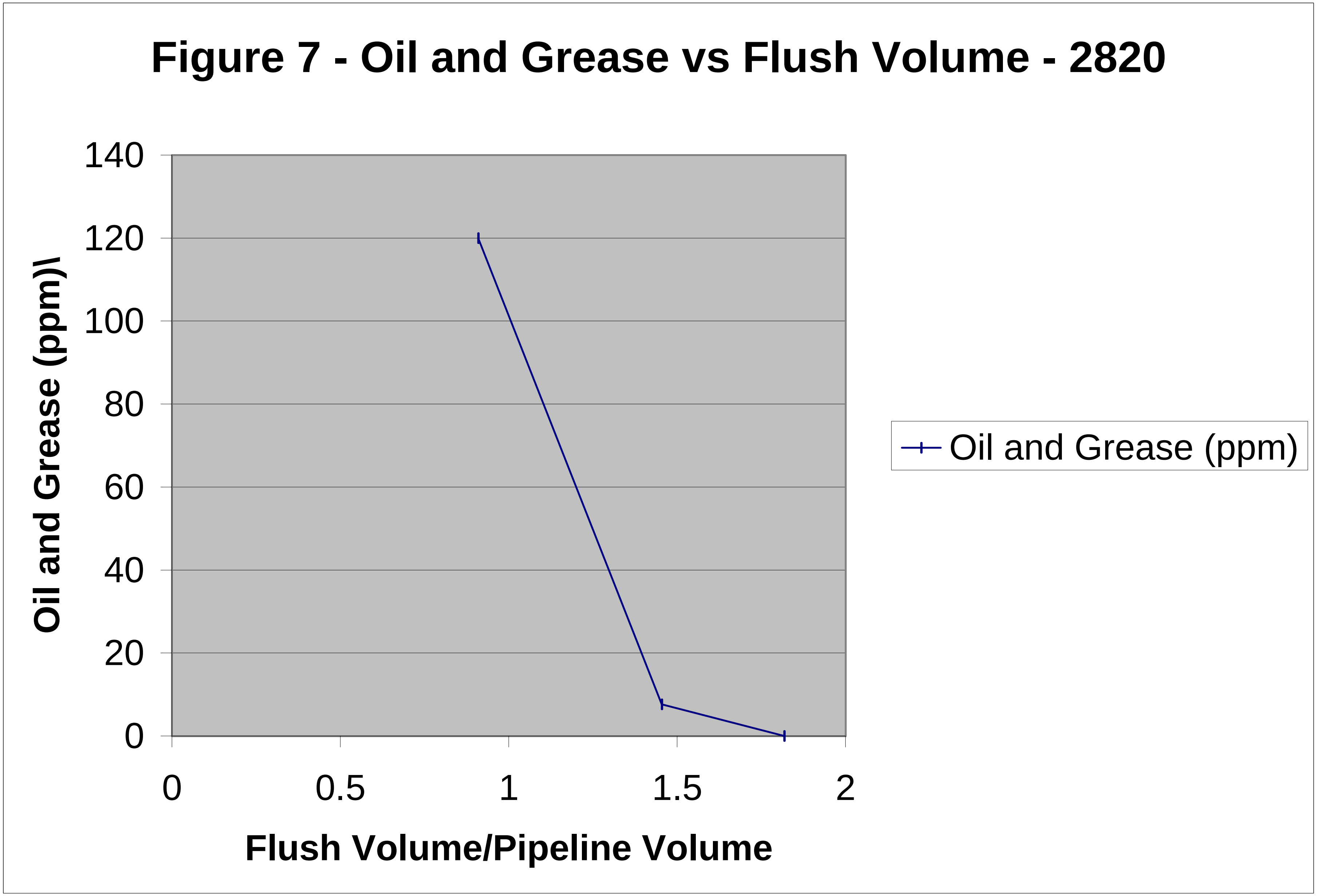


Figure 7 - Oil and Grease vs Flush Volume - 2820
Oil and Grease (ppm)\
140
120
100
80
60
40
20
0
0
0.5
1
1.5
2
Flush Volume/Pipeline Volume
Oil and Grease (ppm)

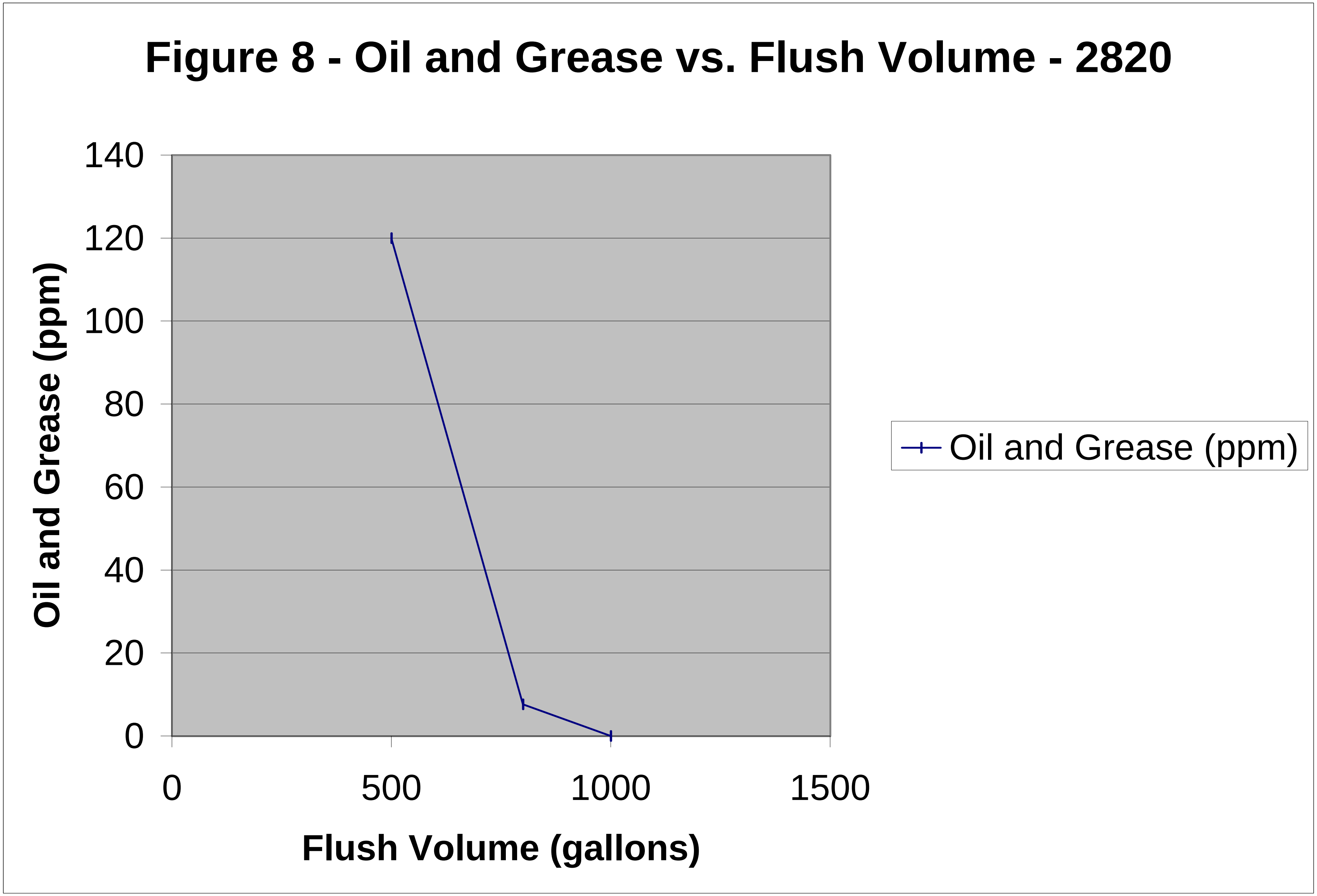


Figure 8 - Oil and Grease vs. Flush Volume - 2820
140
120
100
80
60
40
20
0
Oil and Grease (ppm)
0
500
1000
1500
Flush Volume (gallons)
Oil and Grease (ppm)

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 110003-008A

Sample ID.: 2820-1
: 10/26/00 MW0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suit 150
: Houston, Texas 77092

TCD Analysis:

COMPONENTS	SAMPLE MOL %
Hydrogen	1.445
Carbon Dioxide	0.028
Ethylene	0.000
Ethane	1.802
Acetylene	0.000
Argon/Oxygen	0.469
Nitrogen	5.783
Methane	89.273
Carbon Monoxide	0.000

UnNormalized, Mol% : 96.292

Specific Gravity : 0.6054
(Air = 1.000 @ 60F)

		Net	Gross
BTU / ft3	:	886.0 Dry	982.8 Dry
(@ 14.65 & 60F)		870.6 Wet	965.7 Wet

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Fred De Angelo

Fred C. DeAngelo

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8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 110003-008A

Sample ID.: 2820-1
: 10/26/00 MW0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suit 150
: Houston, Texas 77092

FID Analysis:

COMPONENTS	SAMPLE MOL %		
Hexanes Plus	0.530		
Methane	89.273		
Ethane/Ethylene	1.802	/	0.000
Propane	0.340		
Propylene	0.000		
iso-Butane	0.136		
Propadiene	0.000		
n-Butane	0.088		
Butene-1	0.000		
Neo-Pentane	None Detected		
iso-Butene	0.000		
trans-Butene-2	0.000		
cis-Butene-2	0.000		
1,3-Butadiene	0.000		
iso-Pentane	0.058		
n-Pentane	0.048		

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CERTIFICATE OF ANALYSIS NUMBER : 110003-008A

Sample ID.: 2820-1
: 10/26/00 MW0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suit 150
: Houston, Texas 77092

Completed Analysis:

Component	MOL %		WT%	
Hydrogen	1.445		0.166	
Carbon Dioxide	0.028		0.070	
Carbon Monoxide	0.000		0.000	
Ethylene	0.000		0.000	
Acetylene/Propylene	0.000 /	0.000	0.000 /	0.000
Argon/Oxygen	0.469		0.855	
Nitrogen	5.783		9.245	
Methane	89.273		81.681	
Ethane	1.802		3.091	
Propane	0.340		0.856	
iso-Butane	0.136		0.450	
Propadiene	0.000		0.000	
n-Butane	0.088		0.291	
Butene-1	0.000		0.000	
Neo-Pentane	0.000		0.000	
iso-Butene	0.000		0.000	
trans-Butene-2	0.000		0.000	
cis-Butene-2	0.000		0.000	
1,3-Butadiene	0.000		0.000	
iso-Pentane	0.058		0.241	
n-Pentane	0.048		0.198	
Hexane Plus	0.530		2.857	
	100.000		100.000	

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CERTIFICATE OF ANALYSIS NUMBER : 110003-001A

Sample ID.: 2820-A
: 10/26/00 WM0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suite 150
: Houston, Texas 77092

TCD Analysis:

COMPONENTS	SAMPLE MOL %
Hydrogen	0.000
Carbon Dioxide	0.039
Ethylene	0.000
Ethane	1.510
Acetylene	0.000
Argon/Oxygen	5.529
Nitrogen	24.476
Methane	67.437
Carbon Monoxide	0.000

UnNormalized, Mol% : 93.771

Specific Gravity : 0.7120
(Air = 1.000 @ 60F)

		Net	Gross
BTU / ft3	:	671.8 Dry	744.8 Dry
(@ 14.65 & 60F)		660.1 Wet	731.9 Wet

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CERTIFICATE OF ANALYSIS NUMBER : 110003-001A

Sample ID.: 2820-A
: 10/26/00 WM0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suite 150
: Houston, Texas 77092

FID Analysis:

COMPONENTS	SAMPLE MOL %	
Hexanes Plus	0.410	
Methane	67.436	
Ethane/Ethylene	1.510 /	0.000
Propane	0.300	
Propylene	0.000	
iso-Butane	0.125	
Propadiene	0.000	
n-Butane	0.079	
Butene-1	0.000	
Neo-Pentane	None Detected	
iso-Butene	0.000	
trans-Butene-2	0.000	
cis-Butene-2	0.000	
1,3-Butadiene	0.000	
iso-Pentane	0.052	
n-Pentane	0.044	

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CERTIFICATE OF ANALYSIS NUMBER : 110003-001A

Sample ID.: 2820-A
: 10/26/00 WM0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suite 150
: Houston, Texas 77092

Completed Analysis:

Component	MOL %			WT%		
Hydrogen	0.000			0.000		
Carbon Dioxide	0.039			0.083		
Carbon Monoxide	0.000			0.000		
Ethylene	0.000			0.000		
Acetylene/Propylene	0.000	/	0.000	0.000	/	0.000
Argon/Oxygen	5.529			8.577		
Nitrogen	24.476			33.260		
Methane	67.436			52.449		
Ethane	1.510			2.201		
Propane	0.300			0.642		
iso-Butane	0.125			0.351		
Propadiene	0.000			0.000		
n-Butane	0.079			0.223		
Butene-1	0.000			0.000		
Neo-Pentane	0.000			0.000		
iso-Butene	0.000			0.000		
trans-Butene-2	0.000			0.000		
cis-Butene-2	0.000			0.000		
1,3-Butadiene	0.000			0.000		
iso-Pentane	0.052			0.181		
n-Pentane	0.044			0.152		
Hexane Plus	0.410			1.881		
	100.000			100.000		

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CERTIFICATE OF ANALYSIS NUMBER : 110003-002A

Sample ID.: 2820-B
: 10/26/00 WM0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suite 150
: Houston, Texas 77092

TCD Analysis:

COMPONENTS	SAMPLE MOL %
Hydrogen	0.000
Carbon Dioxide	1.517
Ethylene	0.000
Ethane	0.694
Acetylene	0.000
Argon/Oxygen	8.403
Nitrogen	60.044
Methane	28.448
Carbon Monoxide	0.000

UnNormalized, Mol% : 88.386

Specific Gravity : 0.8848
(Air = 1.000 @ 60F)

	Net	Gross
BTU / ft3 :	303.6 Dry	336.1 Dry
(@ 14.65 & 60F)	298.3 Wet	330.2 Wet

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PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 110003-002A

Sample ID.: 2820-B
: 10/26/00 WM0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suite 150
: Houston, Texas 77092

FID Analysis:

COMPONENTS	SAMPLE MOL %		
Hexanes Plus	0.462		
Methane	28.448		
Ethane/Ethylene	0.694	/	0.000
Propane	0.172		
Propylene	0.000		
iso-Butane	0.092		
Propadiene	0.000		
n-Butane	0.068		
Butene-1	0.000		
Neo-Pentane	None Detected		
iso-Butene	0.000		
trans-Butene-2	0.000		
cis-Butene-2	0.000		
1,3-Butadiene	0.000		
iso-Pentane	0.055		
n-Pentane	0.046		

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CERTIFICATE OF ANALYSIS NUMBER : 110003-002A

Sample ID.: 2820-B
: 10/26/00 WM0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suite 150
: Houston, Texas 77092

Completed Analysis:

Component	MOL %		WT%	
Hydrogen	0.000		0.000	
Carbon Dioxide	1.517		2.605	
Carbon Monoxide	0.000		0.000	
Ethylene	0.000		0.000	
Acetylene/Propylene	0.000 /	0.000	0.000 /	0.000
Argon/Oxygen	8.403		10.488	
Nitrogen	60.044		65.646	
Methane	28.448		17.802	
Ethane	0.694		0.814	
Propane	0.172		0.296	
iso-Butane	0.092		0.209	
Propadiene	0.000		0.000	
n-Butane	0.068		0.154	
Butene-1	0.000		0.000	
Neo-Pentane	0.000		0.000	
iso-Butene	0.000		0.000	
trans-Butene-2	0.000		0.000	
cis-Butene-2	0.000		0.000	
1,3-Butadiene	0.000		0.000	
iso-Pentane	0.055		0.156	
n-Pentane	0.045		0.127	
Hexane Plus	0.462		1.705	
	100.000		100.000	

SOUTHERN PETROLEUM LABORATORIES, INC.

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8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2820-D **Collected:** **SPL Sample ID:** 00100898-06

Site: WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			**MCL**		**E413.1**	**Units: mg/L**		
Oil & Grease,Total Recoverable	120	2.0		1	E	11/06/00 9:00		461303

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
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HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2820-E | Collected: | SPL Sample ID: 00100898-07

Site: WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			MCL		E413.1	Units: mg/L		
Oil & Grease,Total Recoverable	7.6	2.0		1		11/06/00 9:00		461305

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2820-F **Collected:** **SPL Sample ID:** 00100898-08

Site: WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			**MCL**		**E413.1**	**Units: mg/L**		
Oil & Grease,Total Recoverable	ND	2.0		1		11/06/00 9:00		461306

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
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HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2820-4 **Collected:** **SPL Sample ID:** 00100896-07

Site: HI 135/136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			**MCL**	**M2320 B**		**Units: mg/L**		
Alkalinity, Bicarbonate	279	2		1		11/01/00 14:00	SN	461528
ALKALINITY, CARBONATE			**MCL**	**M2320 B**		**Units: mg/L**		
Alkalinity, Carbonate	ND	2		1		11/01/00 14:00	SN	460250
CHLORIDE, TOTAL			**MCL**	**E325.3**		**Units: mg/L**		
Chloride	10600	250		250		11/08/00 11:00	CV	468319
METALS BY METHOD 6010B, TOTAL			**MCL**	**SW6010B**		**Units: mg/L**		
Barium	13.5	0.005		1		11/10/00 22:17	E_B	471285
Calcium	84.4	0.1		1		11/10/00 22:17	E_B	471285
Iron	91.3	0.02		1		11/10/00 22:17	E_B	471285
Magnesium	38.5	1		10		11/13/00 16:22	JM	471771
Potassium	51.5	20		10		11/13/00 16:22	JM	471771

Run ID/Seq #: TJA_001110C-471285

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471771

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			**MCL**	**E150.1**		**Units: pH Units**		
pH	7.5	0.10		1		11/01/00 16:00	EC	458741
RESISTANCE @ 25 C			**MCL**	**120.1**		**Units: Mohms/cm**		
Resistance	ND	0.00100		1		11/03/00 9:15	C_V	461403
SPECIFIC GRAVITY			**MCL**	**ASTM D-1429**		**Units: Specific Gravity @**		
Specific Gravity	1.014	0		1		11/06/00 11:00	C_V	462235
SULFATE, TOTAL			**MCL**	**E375.4**		**Units: mg/L**		
Sulfate	10	1		1		11/01/00 10:00	SN	458831
TOTAL DISSOLVED SOLIDS			**MCL**	**TDS-MINERAL**		**Units: mg/L**		
Total Dissolved Solids, Calculated	17900	10		1		11/13/00 18:00	ES	471972
TOTAL SODIUM, CALCULATED			**MCL**	**TDS-MINERAL**		**Units: mg/L**		
Total Sodium, Calculated	6700	10		1		11/13/00 18:00	ES	471989
TOTAL SUSPENDED SOLIDS			**MCL**	**E160.2**		**Units: mg/L**		
Suspended Solids (Residue,Non-Filterable)	898	8		2		11/03/00 15:45	EC	462121

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2820-5 **Collected:** 10/27/00 **SPL Sample ID:** 00100896-08

Site: HI 135/136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Bicarbonate	192	2		1		11/01/00 14:00	SN	461529
ALKALINITY, CARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Carbonate	ND	2		1		11/01/00 14:00	SN	460251
CHLORIDE, TOTAL			MCL	E325.3		Units: mg/L		
Chloride	16100	250		250		11/08/00 11:00	CV	468321
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B		Units: mg/L		
Barium	0.216	0.005		1		11/10/00 22:32	E_B	471286
Calcium	409	0.1		1		11/10/00 22:32	E_B	471286
Iron	3.49	0.02		1		11/10/00 22:32	E_B	471286
Magnesium	1310	1		10		11/13/00 16:26	JM	471772
Potassium	385	20		10		11/13/00 16:26	JM	471772

Run ID/Seq #: TJA_001110C-471286

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471772

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1		Units: pH Units		
pH	7.8	0.10		1		11/01/00 16:00	EC	458742
RESISTANCE @ 25 C			MCL	120.1		Units: Mohms/cm		
Resistance	ND	0.00100		1		11/03/00 9:15	C_V	461405
SPECIFIC GRAVITY			MCL	ASTM D-1429		Units: Specific Gravity @		
Specific Gravity	1.032	0		1		11/06/00 11:00	C_V	462236
SULFATE, TOTAL			MCL	E375.4		Units: mg/L		
Sulfate	6600	1000		1000		11/01/00 10:00	SN	458833
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL		Units: mg/L		
Total Dissolved Solids, Calculated	35500	10		1		11/13/00 18:00	ES	471973
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL		Units: mg/L		
Total Sodium, Calculated	10500	10		1		11/13/00 18:00	ES	471990
TOTAL SUSPENDED SOLIDS			MCL	E160.2		Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	789	4		1		11/02/00 15:00	EC	461982

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

SPL®

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2820-6 **Collected:** 10/27/00 **SPL Sample ID:** 00100896-09

Site: HI 135/136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			**MCL**		**M2320 B**	**Units: mg/L**		
Alkalinity, Bicarbonate	152	2		1		11/01/00 14:00	SN	461531
ALKALINITY, CARBONATE			**MCL**		**M2320 B**	**Units: mg/L**		
Alkalinity, Carbonate	ND	2		1		11/01/00 14:00	SN	460253
CHLORIDE, TOTAL			**MCL**		**E325.3**	**Units: mg/L**		
Chloride	16500	250		250		11/08/00 11:00	CV	468322
METALS BY METHOD 6010B, TOTAL			**MCL**		**SW6010B**	**Units: mg/L**		
Barium	0.0693	0.005		1		11/10/00 22:36	E_B	471287
Calcium	431	0.1		1		11/10/00 22:36	E_B	471287
Iron	0.387	0.02		1		11/10/00 22:36	E_B	471287
Magnesium	1330	1		10		11/13/00 16:31	JM	471773
Potassium	390	20		10		11/13/00 16:31	JM	471773

Run ID/Seq #: TJA_001110C-471287

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471773

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			**MCL**		**E150.1**	**Units: pH Units**		
pH	8.1	0.10		1		11/01/00 16:00	EC	458744
RESISTANCE @ 25 C			**MCL**		**120.1**	**Units: Mohms/cm**		
Resistance	0.015	0.00100		1		11/03/00 9:15	C_V	461407
SPECIFIC GRAVITY			**MCL**		**ASTM D-1429**	**Units: Specific Gravity @**		
Specific Gravity	1.016	0		1		11/06/00 11:00	C_V	462237
SULFATE, TOTAL			**MCL**		**E375.4**	**Units: mg/L**		
Sulfate	6500	1000		1000		11/01/00 10:00	SN	458834
TOTAL DISSOLVED SOLIDS			**MCL**		**TDS-MINERAL**	**Units: mg/L**		
Total Dissolved Solids, Calculated	35900	10		1		11/13/00 18:00	ES	471974
TOTAL SODIUM, CALCULATED			**MCL**		**TDS-MINERAL**	**Units: mg/L**		
Total Sodium, Calculated	10600	10		1		11/13/00 18:00	ES	471991
TOTAL SUSPENDED SOLIDS			**MCL**		**E160.2**	**Units: mg/L**		
Suspended Solids (Residue,Non-Filterable)	68	4		1		11/02/00 15:00	EC	461983

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

6. Results and Observations – 2822

a. Sample Locations Observations

This pipeline was flushed and filled with seawater in October 1994. It was reflushed and abandoned in place in October 2000. Samples were taken of the entrained water that had been sitting in the pipe for 6 years, as well as the volume of flushwater that was run through the pipe. The sampling location for this pipeline was at the "sampling spoolpiece," which was connected at the platform cellar deck level.

A five foot (5') sample of the pipeline was removed, which included the tubeturn to pipeline weld.

b. Gas Composition Observations

This was a gas/condensate line, however, there were no gas samples taken, as the line was filled completely with seawater.

c. Flushwater Composition Observations

i. Mineral Pattern Analysis

Samples A-E were taken from the standing water in the pipeline, while F-H were taken from the flush water. These discreet sample types are evident in the plotted data.

For the water that stood in the pipeline for 6 years, the mineral pattern relative to NSW is summarized below:

Alkalinity (bicarb) – Lower
Barium – Equal
Calcium – Lower
Iron – Higher
Magnesium – Lower
Potassium – Similar/Equal
Chloride – Lower
Sulfate – Lower

For the flushwater, the mineral pattern relative to NSW is summarized below:

Alkalinity (bicarb) – Equal
Barium – Equal
Calcium – Equal

Iron – Higher
Magnesium – Equal
Potassium – Similar/Equal
Chloride – Lower/Equal
Sulfate – Equal

The plot of the Iron Concentration is of particular interest for this pipeline. As the standing water was pushed out of the pipeline, the sample concentrations rose sharply and linearly until all of the entrained water was pushed out. The highest value reached was 76 .1 PPM. The flushwater showed iron concentrations in the range of 0.4 - 1.29 PPM, which is much higher than natural seawater concentrations, but nothing like the levels from the entrained water. These flushwater concentrations were lower than for other pipelines, perhaps because many of the loose iron particles and all of the dissolved iron had already been pushed out of the line.

ii. Nitrogen and Oxygen Concentration

These values were tested in order to determine whether corrosion inhibitor was present in the line, and if it was, its effectiveness. In all samples, dissolved nitrogen levels were much lower than NSW. This indicated that an Amine based corrosion inhibitor was not present. It was interesting to note that nitrogen levels never reached NSW level, not even in the flushwater.

Photo #16

Dissolved oxygen levels were slightly lower than NSW in the entrained water. Interestingly, dissolved oxygen concentrations were higher than NSW levels in the flushwater. This data shows that an oxygen scavenger was not used in this pipeline when it was flushed and filled the first time.

d. Oil and Grease Observations

The first oil and grease sample was taken from the standing water in the pipeline, and the two following samples were taken from the flushwater. Of interest is the fact that oil and grease was present in the first sample at 270 PPM. These levels dropped away almost immediately during flushing, and was non-detectable by the time the pipeline was flushed 1.5 times.

e. Pipe Cutout Observations

It is clear from the photographs of sample segment 2822, that there have been significant changes to the pipe wall since it was filled with seawater. Based on the linear features of the debris in the pipe, it is evident that there was an air/water interface at some point in time after the line was filled. The pipe walls are coated with debris, the majority of which does not appear to be a corrosion product. One possibility is that seafloor mud was sucked into the pump intake and pumped into the pipe during initial flushing - a likely scenario in shallow water, with very turbid conditions. This is an important consideration for flushing and filling out-of-service pipelines. Pipelines that are required to be filled with inhibited seawater may be negatively impacted by the addition of these sediments. Better procedures may be required to ensure that sediments are not introduced during flushing and filling operations.

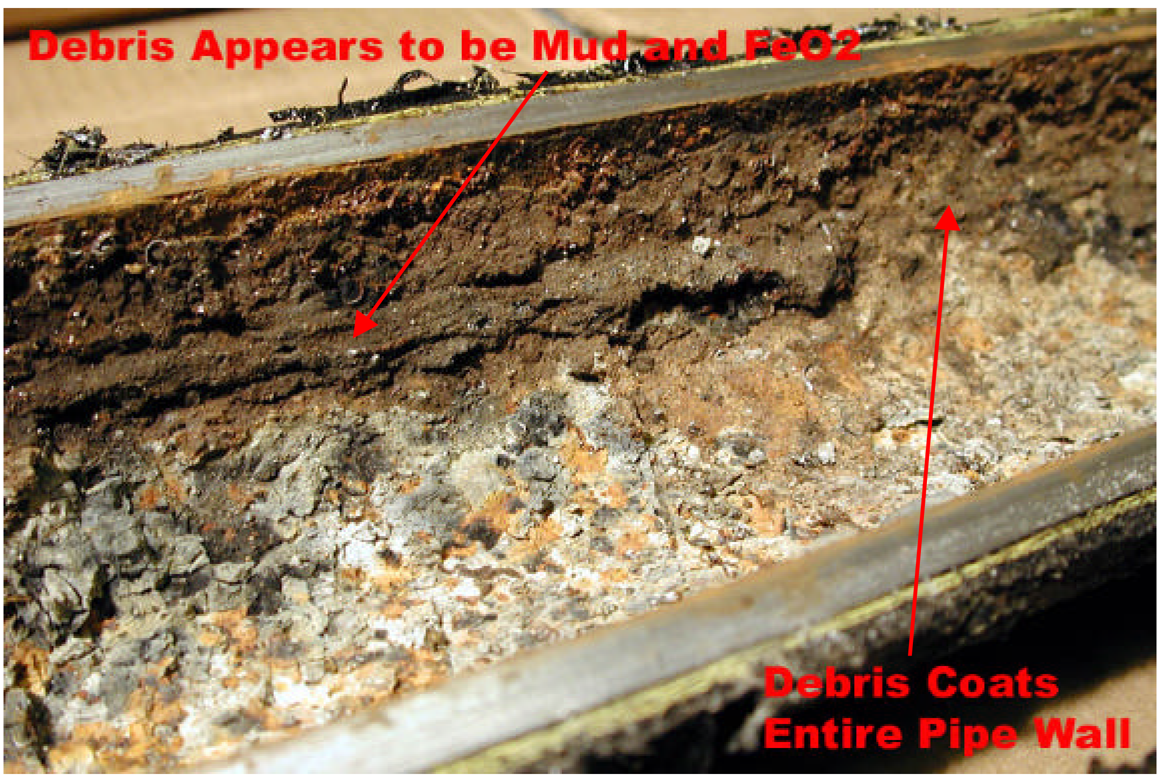


Photo #17

The line also showed significant metal loss corrosion. The weld at the tubeturn to pipeline connection also showed deep pitting corrosion.

Photos #18 and #19 - Pipeline Sample Photos - 2822

WINMAR consulting services, inc.

SHELL OFFSHORE INC.
HI-135-2

PLATFORM

MMS General		ODS General		MMS Location		MMS Facility	
Water	50 feet	**Function**	WP	**Lease**	741 feet	**Helideck**	Yes
Major	No	**Piles**	NA	**Complex**	10015	**Quarters**	None
Decks	1	**Slots**	3	**Longitude**	-94.112	**Generator**	No
Slots	3	**ODS ID**	739	**Latitude**	29.260	**Cranes**	NA
Wells	2	**Previous 1**	NA	**X**	3,558,137'	**Gas**	Yes
Flare	No	**Previous 2**	NA	**Y**	551,391'	**Oil**	Yes
Installed	01 1964	**Previous 3**	NA	**To Shore**	25 miles	**Comp**	No
Revised	05 1998	**Previous 4**	NA	**N-S feet**	S 4911'	**8 hour**	No
Removed	NA	**Notes**	NA	**E-W feet**	W 3141'	**24 hour**	No

PIPELINES MMS

Segment	2821	2822	2823	
Origin	HI-135-2	HI-135-2	HI-135-2	#N/A
Terminus	HI-136-A	HI-136-A	HI-136-A	#N/A
O.D.	3"	4"	4"	#N/A
Length	4,000'	4,000'	4,000'	#N/A
Product	BLKG	BLKG	BLKG	#N/A
Status	ACT	OUT	PABN	#N/A
Installed	NA	NA	NA	#N/A
Abandon	NA	NA	NA	#N/A
Revised	Aug-94	Oct-94	Aug-94	#N/A
Operator	SHELL OFFSHORE INC	SHELL OFFSHORE	SHELL OFFSHORE INC.	#N/A

WELLS MMS

API Well ID	Well	Spud	Revised	Status	MD	Bot Lease	Sur Long	Sur Lat
427080004600	1	03 1964	05 1964	COM	10,777'	741	-94.119	29.259
427080004700	2	10 1964	05 1986	ST	8,678'	741	-94.112	29.260
427080004701	2	05 1986	07 1986	COM	9,450'	741	-94.115	29.260
427080004800	3	11 1964	08 1985	PA	9,663'	741	-94.104	29.265
427080004900	4	11 1964	06 1990	PA	11,483'	741	-94.116	29.269
427080005000	5	04 1965	08 1985	PA	9,006'	741	-94.089	29.262
427080006100	6	06 1965	06 1965	PA	9,085'	741	-94.089	29.271
427080007300	8	07 1967	08 1967	ST	9,452'	741	-94.103	29.260
427080007301	9	08 1967	08 1967	COM	9,020'	741	-94.106	29.260
427084023300	11	04 1986	01 1996	ST	10,824'	741	-94.075	29.262
427084023301	11	01 1996	04 1996	COM	11,033'	741	-94.075	29.262
427084023400	9	08 1986	09 1986	TA	10,230'	742	-94.132	29.259

WINMAR consulting services, inc.

PIPELINE FLUSHING AND SAMPLING RECORD

I. Pipeline Information

MMS Segment No.	2822
Date:	10/27/2000
Pipeline Origination	
Area	High Island
Block	135
Platform	#2
Lease	OCS-G-0741
Pipeline Destination	
Area	High Island
Block	136
Platform	A
Lease	OCS-G-0742
Pipeline Size (in)	4
Pipelines Length (ft)	4,000
Pipeline Volume (bbls)	62

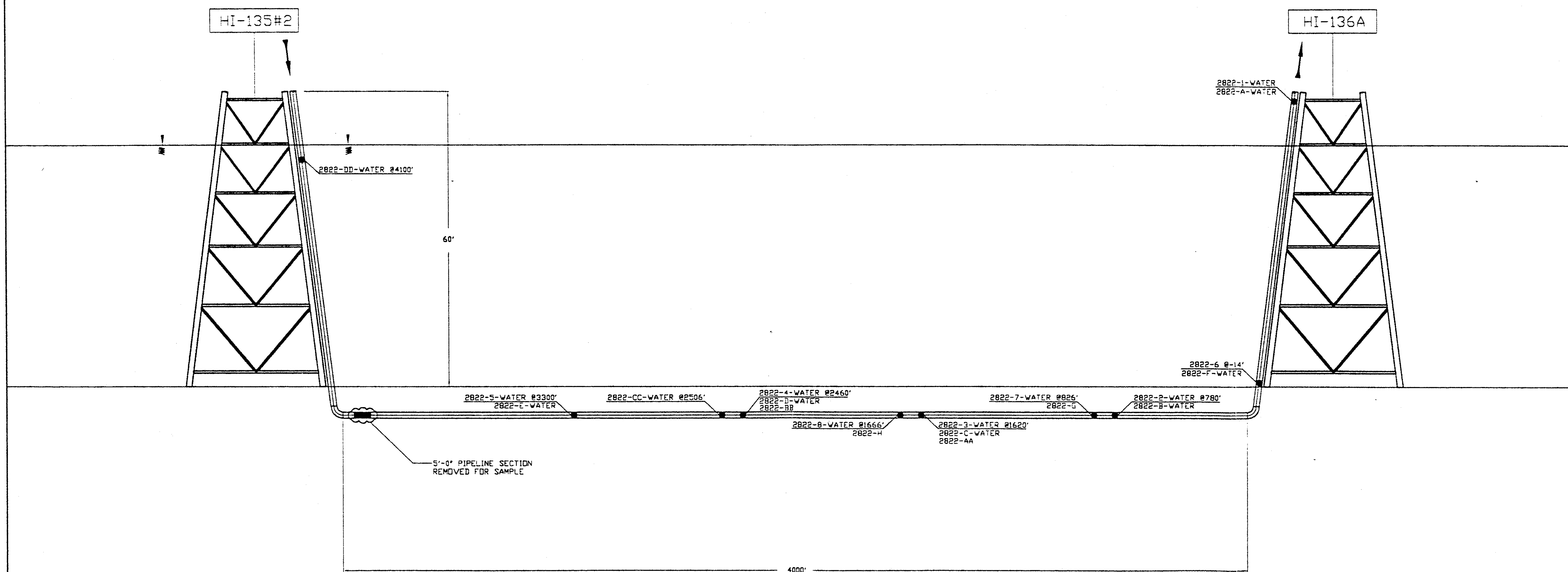
II. Flushing Information

Flushing Information	
Volume Flushed	4000g
Flow Rate (GPM)	100
Pigged Used	No
Type of Pig	No
Size of Pig	
Clean Returns	Yes
Inhibitor	
Chemical Inhibitor Used	
Type of Chemical	
Quantity of Chemical	
Origination Riser	
Riser blind flanged w/ vent valve	Yes
Pipeline Tagged	Yes
Destination Riser	
Riser blind flanged w/ vent valve	Yes
Pipeline Tagged	Yes
Comments:	
Company Representative	
Signature	

WINMAR consulting services, inc.

III. Sampling Data - Tracking Information

Sample Location				
Platform:	Hi 136A			
Pipeline Sampling Site:	Hose Connection w/ Sampling Spool			
Flushing Start Time:	13:00			
Water Samples	Sample ID	Sample Date	Vol. Flushed (g)	Notes
Plastic Bottles - Zero Head Space	2822-1	10/27/2000	0	
	2822-2	10/27/2000	500	
	2822-3	10/27/2000	1,000	
	2822-4	10/27/2000	1,500	
	2822-5	10/27/2000	200	
	2822-6	10/27/2000	2,500	
	2822-7	10/27/2000	3,000	
	2822-8	10/27/2000	3,500	
Water Samples	Sample ID	Sample Date	Vol. Flushed (g)	Notes
Mineral Pattern Analysis	2822-A	10/27/2000	0	
	2822-B	10/27/2000	500	
	2822-C	10/27/2000	1,000	
	2822-D	10/27/2000	1,500	
	2822-E	10/27/2000	2,000	
	2822-F	10/27/2000	2,500	
	2822-G	10/27/2000	3,000	
	2822-H	10/27/2000	3,500	
Oil and Grease Analysis	2822-AA	10/27/2000	1,000	
	2822-BB	10/27/2000	1,500	
	2822-CC	10/27/2000	4,000	
	2822-DD	10/27/2000	5,000	
Comments:	Pipeline at WP end had plate welded over riser top, no flange. We cold-cut, plugged, and added flange for flushing.			
Company Representative	James Wiseman			
Signature				



PL SEGMENT	2823
LENGTH	4120 FT.
VOLUME FLUSHED	4000 GAL.
PL VOLUME FLG/FLG	2472 GAL.

REV	DATE	DESCRIPTION	BY	APP'D
0	11/00	ISSUED	CSA	JW

PROJECT# WM0070

PIPELINE SAMPLE LOCATIONS

HIGH ISLAND 135#2 / HIGH ISLAND 136A

	DATE	DWG. NO.	REV.
CSA	11/00	WM0070D	0

Figure 10 - Flushwater Composition - 2822

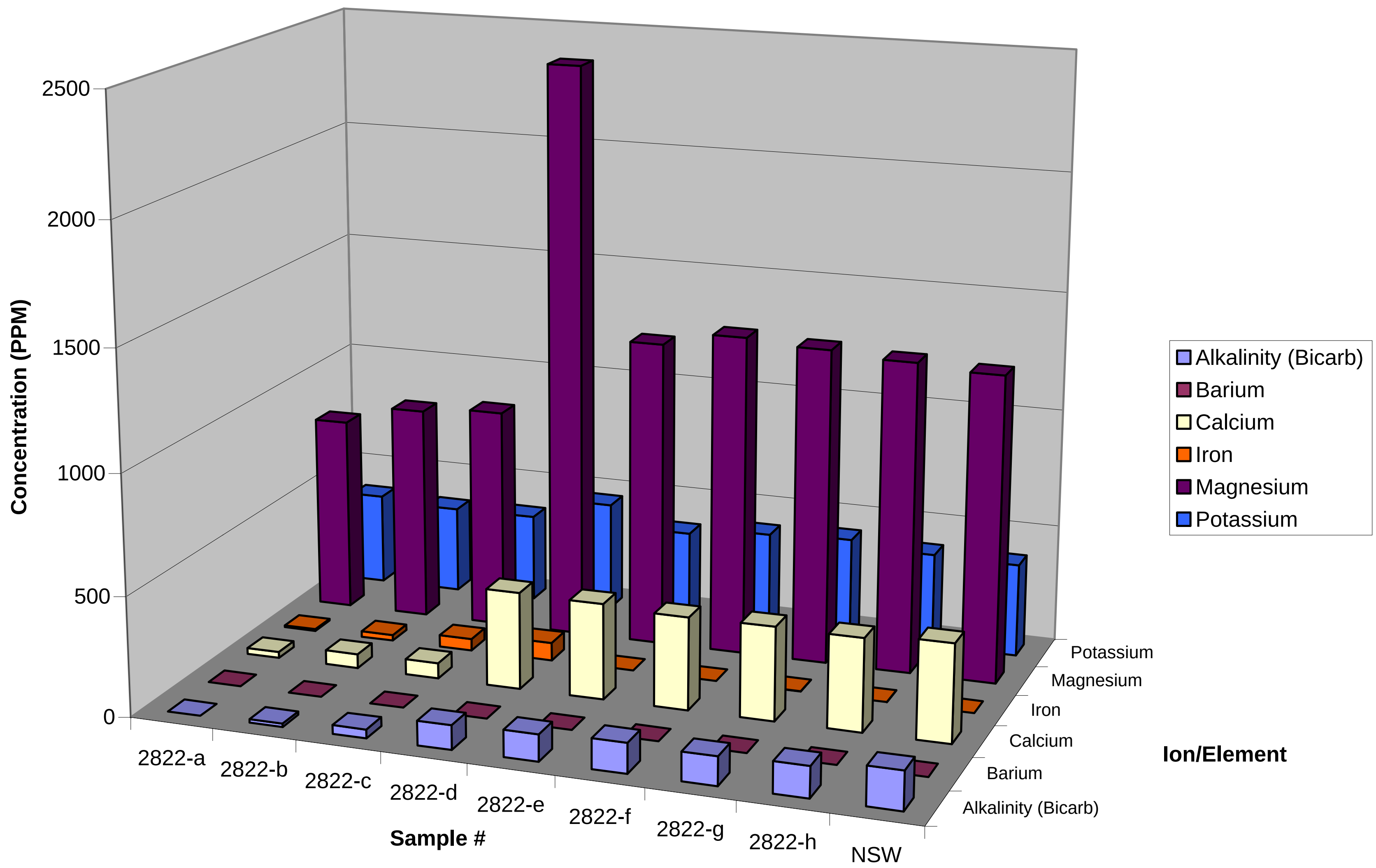


Figure 11 - Chloride and Sulfate - 2822

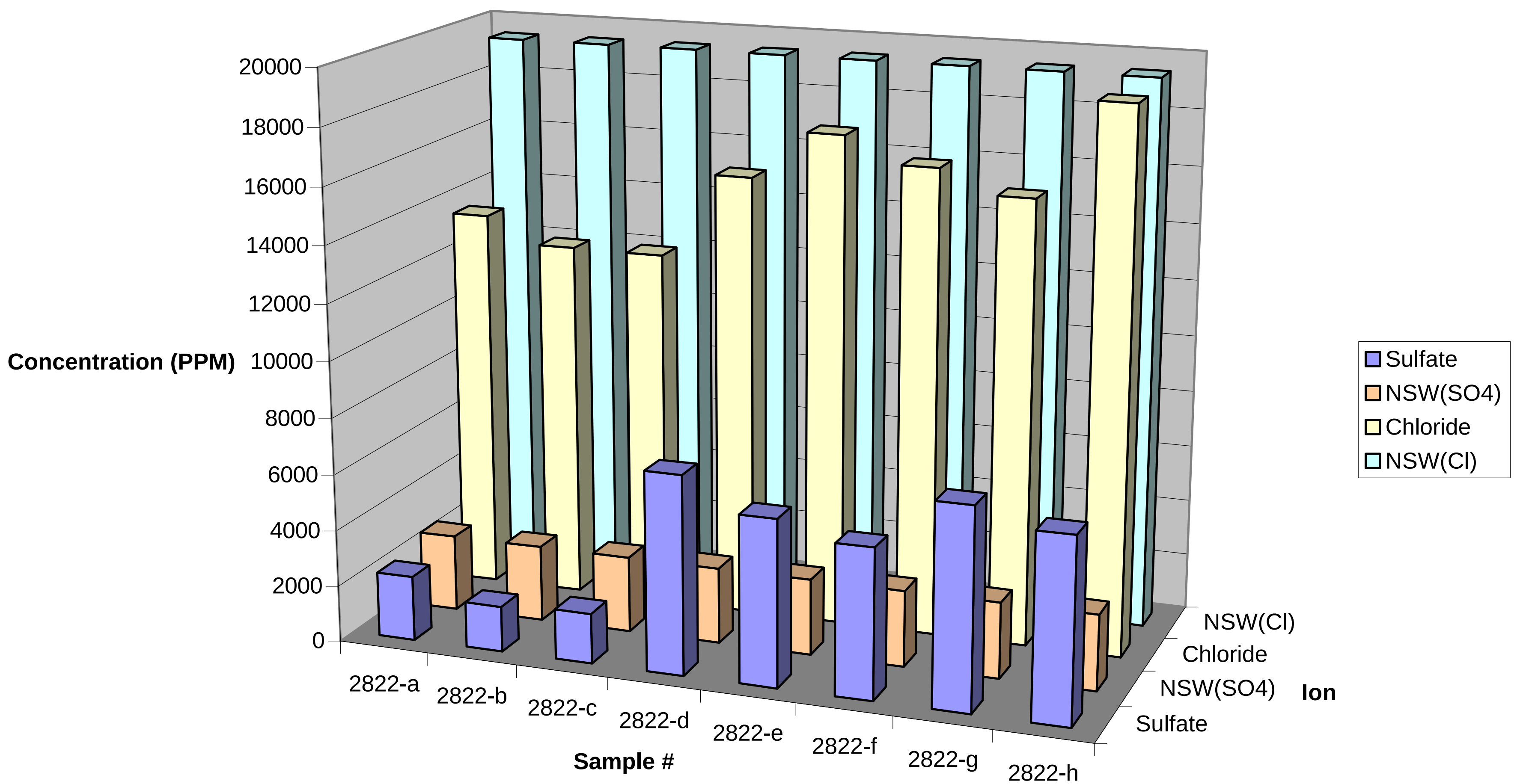
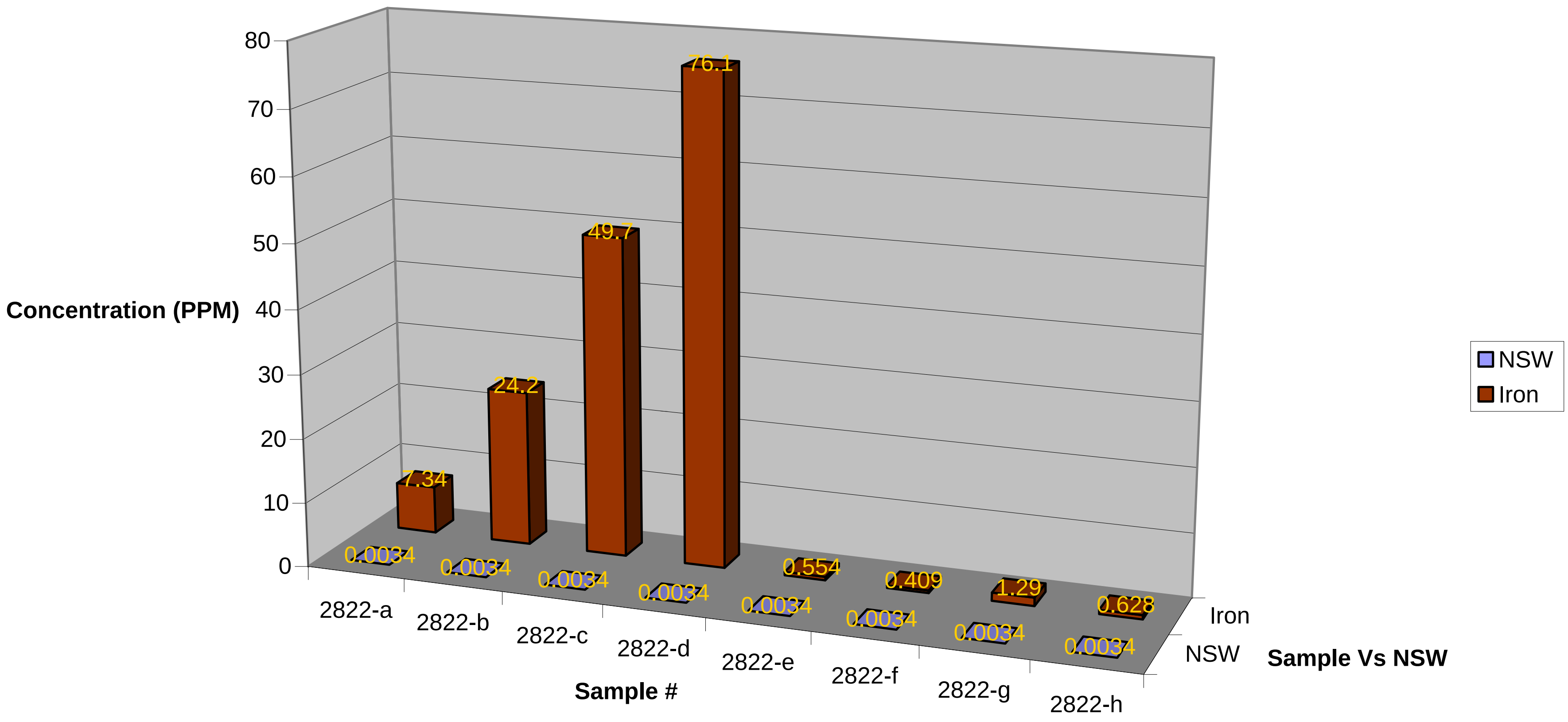


Figure 12 - Iron Concentration - 2822



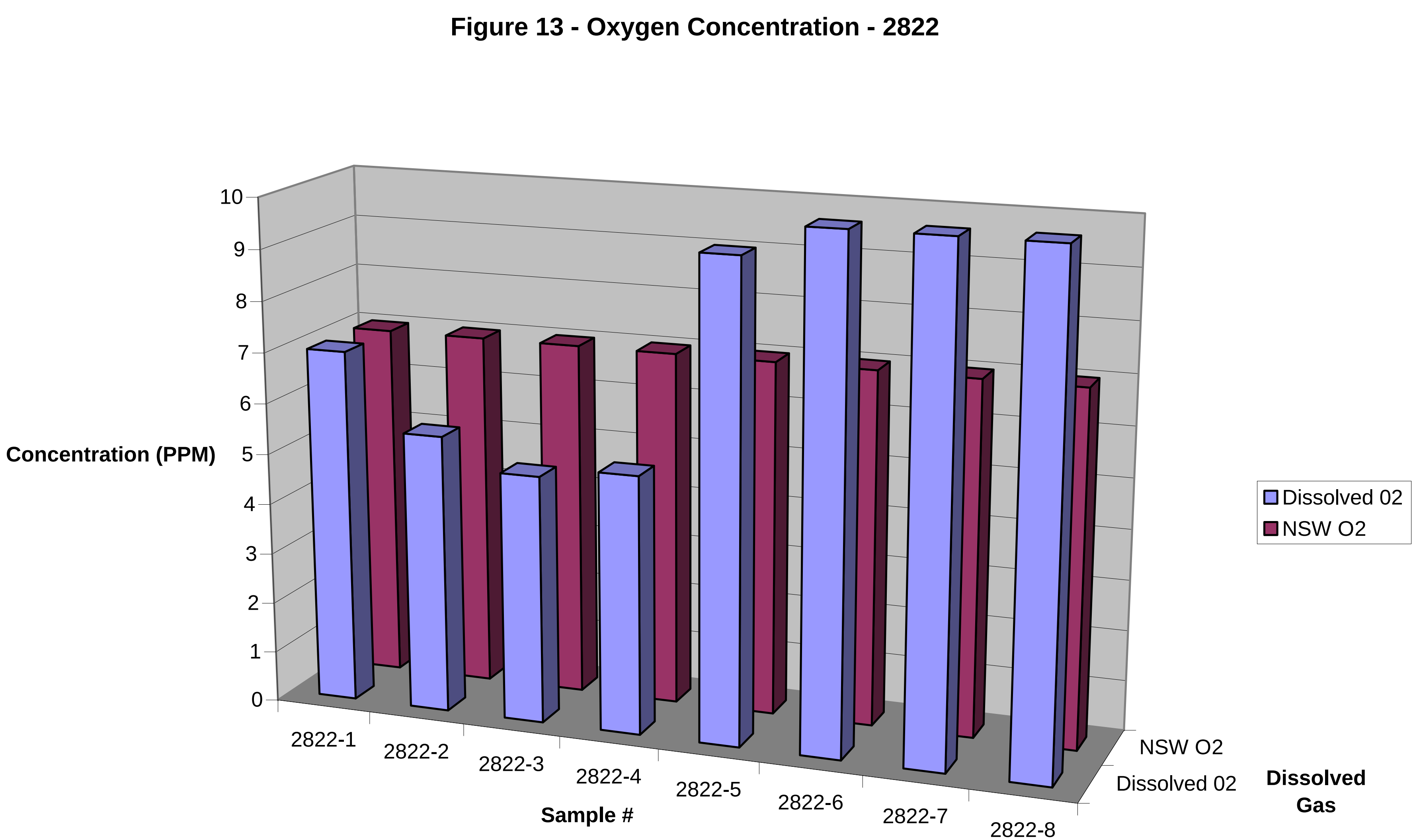
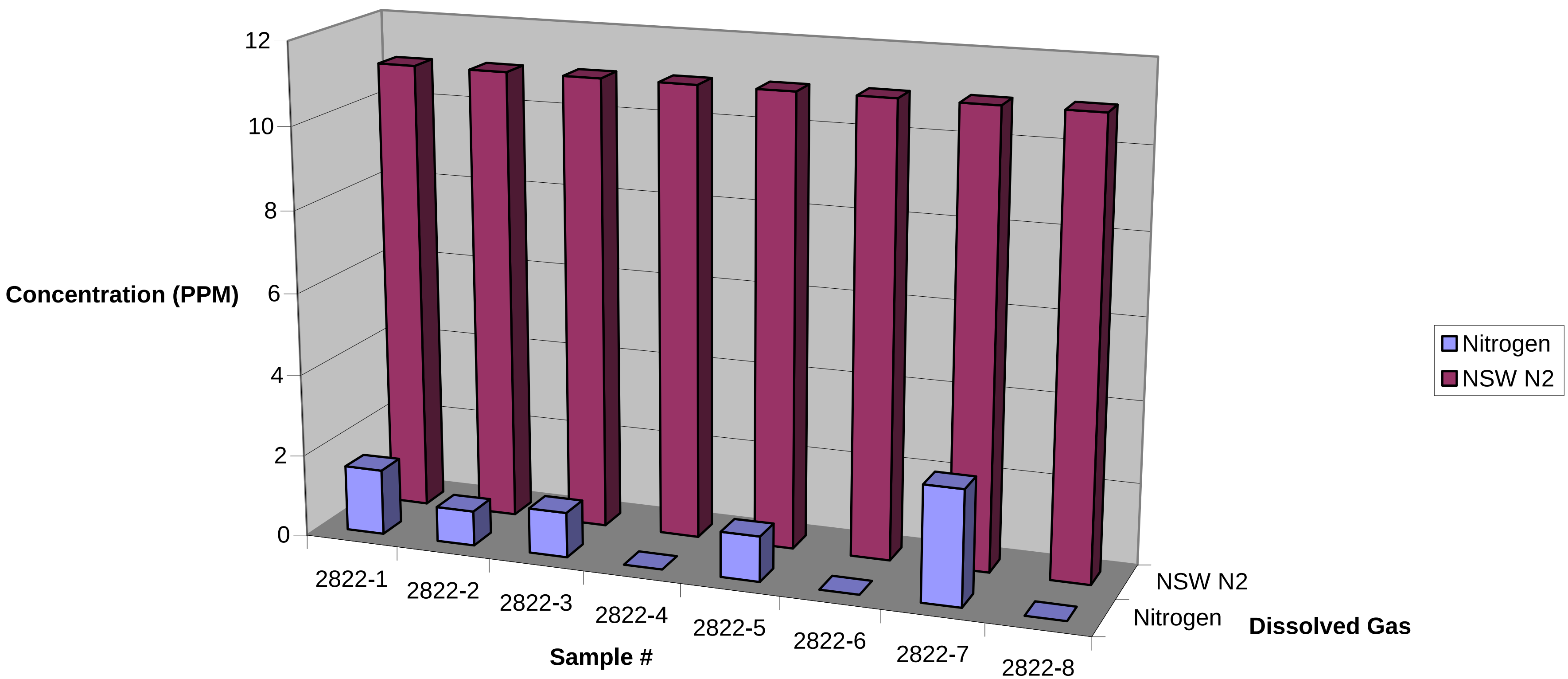


Figure 13 - Oxygen Concentration - 2822
Concentration (PPM)
10
9
8
7
6
5
4
3
2
1
0
2822-1
2822-2
2822-3
2822-4
2822-5
2822-6
2822-7
2822-8
Sample #
NSW O2
Dissolved 02
Dissolved
Gas
Dissolved 02
NSW O2

Figure 14 - Nitrogen Concentration - 2822



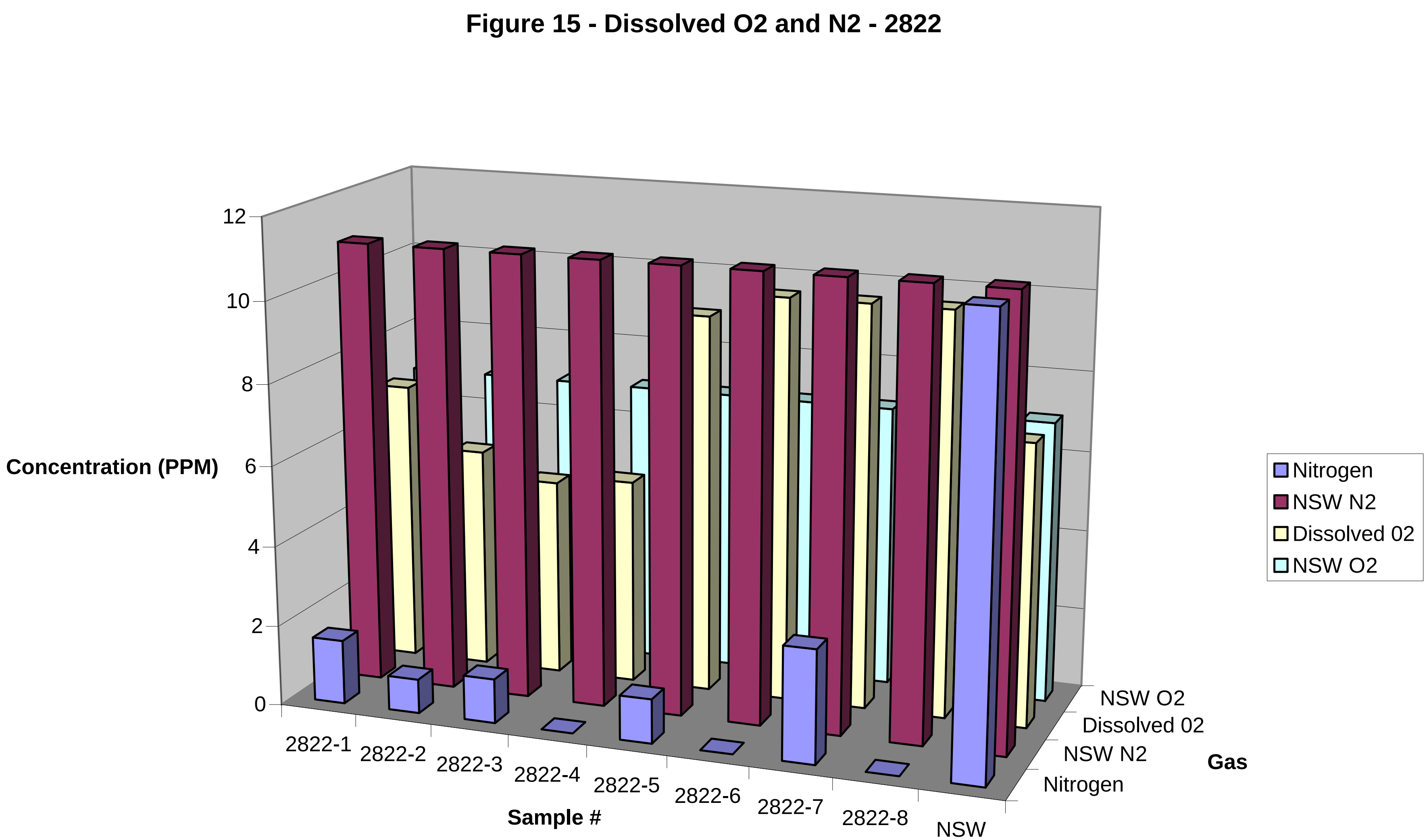


Figure 15 - Dissolved O2 and N2 - 2822
Concentration (PPM)
0
2
4
6
8
10
12
2822-1
2822-2
2822-3
2822-4
2822-5
2822-6
2822-7
2822-8
NSW
Sample #
Nitrogen
NSW N2
Dissolved 02
NSW O2
Gas
Nitrogen
NSW N2
Dissolved 02
NSW O2

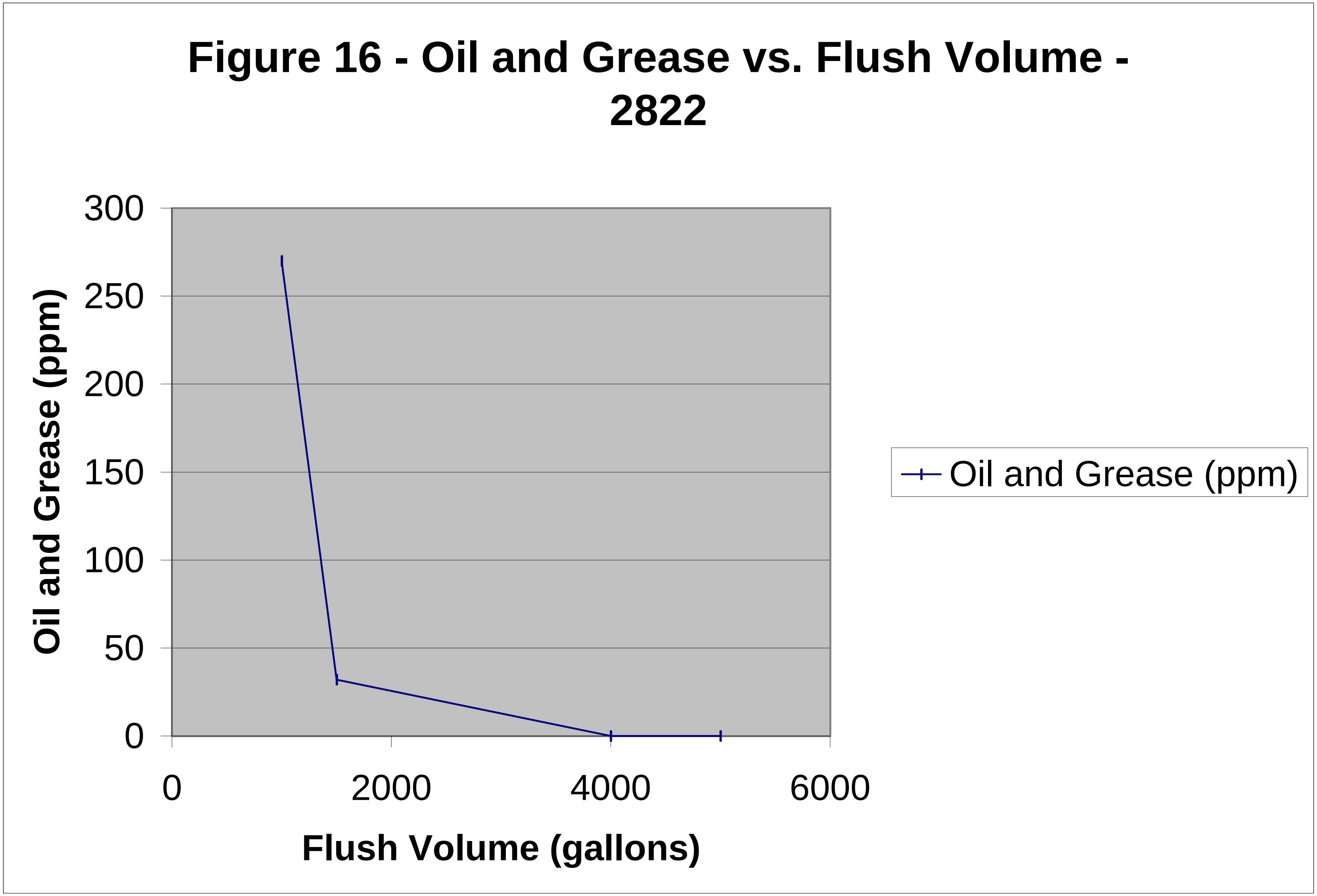


Figure 16 - Oil and Grease vs. Flush Volume - 2822
Oil and Grease (ppm)
300
250
200
150
100
50
0
0
2000
4000
6000
Flush Volume (gallons)
Oil and Grease (ppm)

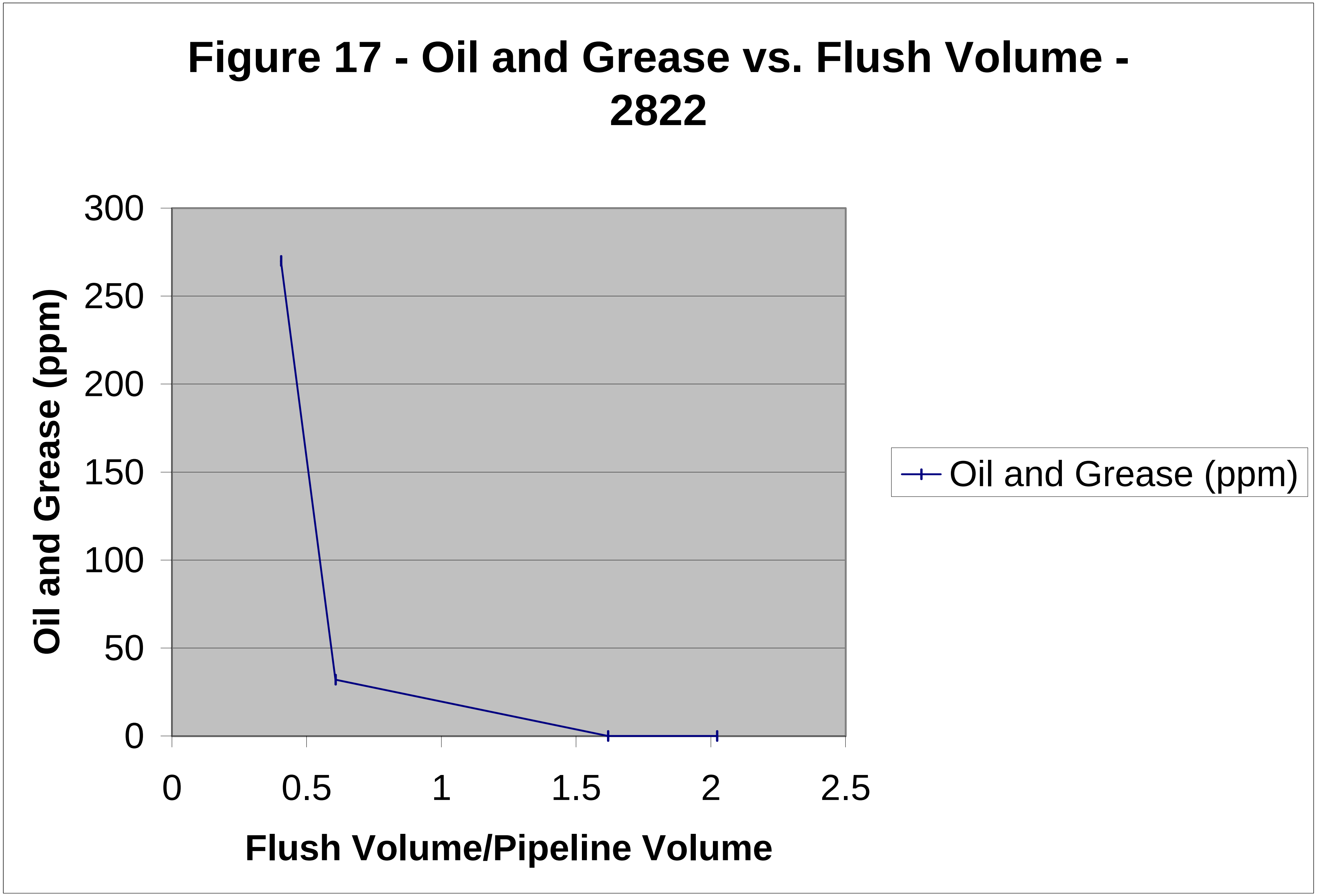


Figure 17 - Oil and Grease vs. Flush Volume - 2822
Oil and Grease (ppm)
300
250
200
150
100
50
0
0
0.5
1
1.5
2
2.5
Flush Volume/Pipeline Volume
Oil and Grease (ppm)

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
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Client Sample ID 2822-AA **Collected:** **SPL Sample ID:** 00100898-09

Site: WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			**MCL**		**E413.1**	**Units: mg/L**		
Oil & Grease,Total Recoverable	270	2.0		1	E	11/06/00 9:00		461307

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2822-BB **Collected:** **SPL Sample ID:** 00100898-10

Site: WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			**MCL**		**E413.1**	**Units: mg/L**		
Oil & Grease,Total Recoverable	32	2.0		1	E	11/06/00 9:00		461308

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2822-CC | Collected: | SPL Sample ID: 00100898-11

Site: WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			**MCL**		**E413.1**	**Units: mg/L**		
Oil & Grease,Total Recoverable	ND	2.0		1		11/06/00 9:00		461310

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2822-DD

Collected:

SPL Sample ID: 00100898-12

Site: WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			MCL		E413.1	Units: mg/L		
Oil & Grease,Total Recoverable	ND	2.0		1		11/06/00 9:00		461311

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Winmar Consulting Services

Certificate of Analysis Number:

00100895

Report To: Winmar Consulting Services
James Wiseman
5700 NW Central Drive
Suite 150
Houston
TX
77092-
ph: (713) 895-8240 fax: (713) 895-8270

Fax To: Winmar Consulting Services
James Wiseman fax : (713) 895-8270

Project Name: HI 135/136 WM0070
Site: HI 135/136 WM0070
Site Address:

PO Number: WM0070
State:
State Cert. No.:
Date Reported: 11/14/00

Client Sample ID	Lab Sample ID	Matrix	Date Collected	Date Received	COC ID	HOLD
2822-A	00100895-01	Water	10/28/00	10/30/00 12:05:00 PM		☐
2822-B	00100895-02	Water	10/28/00	10/30/00 12:05:00 PM		☐
2822-C	00100895-03	Water	10/28/00	10/30/00 12:05:00 PM		☐
2822-D	00100895-04	Water	10/28/00	10/30/00 12:05:00 PM		☐
2822-E	00100895-05	Water	10/28/00	10/30/00 12:05:00 PM		☐
2822-F	00100895-06	Water	10/28/00	10/30/00 12:05:00 PM		☐
2822-G	00100895-07	Water	10/28/00	10/30/00 12:05:00 PM		☐
-H	00100895-08	Water	10/28/00	10/30/00 12:05:00 PM		☐

Neschich,Paul
Senior Project Manager

11/20/00
Date

Joel Grice
Laboratory Director

Ted Yen
Quality Assurance Officer

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2822-A | Collected: 10/28/00 | SPL Sample ID: 00100895-01

Site: HI 135/136 WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Bicarbonate	ND	2		1		11/01/00 14:00	SN	461501
ALKALINITY, CARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Carbonate	121	2		1		11/01/00 14:00	SN	460235
CHLORIDE, TOTAL			MCL	E325.3		Units: mg/L		
Chloride	13600	500		500		11/08/00 11:00	CV	468300
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B		Units: mg/L		
Barium	0.0527	0.005		1		11/10/00 20:15	E_B	471265
Calcium	25.2	0.1		1		11/10/00 20:15	E_B	471265
Iron	7.34	0.02		1		11/10/00 20:15	E_B	471265
Magnesium	821	0.5		5		11/13/00 14:46	JM	471748
Potassium	388	2		1		11/13/00 14:41	JM	471747

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1		Units: pH Units		
pH	9.6	0.10		1		11/01/00 16:00	EC	458724
RESISTANCE @ 25 C			MCL	120.1		Units: Mohms/cm		
Resistance	ND	0.00100		1		11/03/00 9:15	C_V	461385
SPECIFIC GRAVITY			MCL	ASTM D-1429		Units: Specific Gravity @		
Specific Gravity	1.02	0		1		11/06/00 11:00	C_V	462220
SULFATE, TOTAL			MCL	E375.4		Units: mg/L		
Sulfate	2300	250		250		11/01/00 10:00	SN	458812
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL		Units: mg/L		
Total Dissolved Solids, Calculated	25600	10		1		11/13/00 18:00	ES	471958
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL		Units: mg/L		
Total Sodium, Calculated	8200	10		1		11/13/00 18:00	ES	471975
TOTAL SUSPENDED SOLIDS			MCL	E160.2		Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	117	4		1		11/02/00 15:00	EC	461968

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-B **Collected:** 10/28/00 **SPL Sample ID:** 00100895-02

Site: HI 135/136 WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Bicarbonate	14.1	2		1		11/01/00 14:00	SN	461504
ALKALINITY, CARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Carbonate	56.6	2		1		11/01/00 14:00	SN	460236
CHLORIDE, TOTAL			MCL	E325.3		Units: mg/L		
Chloride	12700	250		250		11/08/00 11:00	CV	468303
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B		Units: mg/L		
Barium	0.0703	0.005		1		11/10/00 20:20	E_B	471266
Calcium	59.3	0.1		1		11/10/00 20:20	E_B	471266
Iron	24.2	0.02		1		11/10/00 20:20	E_B	471266
Magnesium	904	0.5		5		11/13/00 14:54	JM	471750
Potassium	368	2		1		11/13/00 14:50	JM	471749

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1		Units: pH Units		
pH	9.2	0.10		1		11/01/00 16:00	EC	458726
RESISTANCE @ 25 C			MCL	120.1		Units: Mohms/cm		
Resistance	0.0052	0.00100		1		11/03/00 9:15	C_V	461387
SPECIFIC GRAVITY			MCL	ASTM D-1429		Units: Specific Gravity @		
Specific Gravity	1.02	0		1		11/06/00 11:00	C_V	462221
SULFATE, TOTAL			MCL	E375.4		Units: mg/L		
Sulfate	1620	250		250		11/01/00 10:00	SN	458815
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL		Units: mg/L		
Total Dissolved Solids, Calculated	22800	10		1		11/13/00 18:00	ES	471959
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL		Units: mg/L		
Total Sodium, Calculated	7050	10		1		11/13/00 18:00	ES	471976
TOTAL SUSPENDED SOLIDS			MCL	E160.2		Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	208	4		1		11/02/00 15:00	EC	461971

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-A **Collected:** 10/28/00 **SPL Sample ID:** 00100895-01

Site: HI 135/136 WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
TOTAL SUSPENDED SOLIDS			**MCL**		**E160.2**	**Units: mg/L**		
Suspended Solids (Residue,Non-Filterable)	117	4		1		11/02/00 15:00	EC	461968

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-B **Collected:** 10/28/00 **SPL Sample ID:** 00100895-02

Site: HI 135/136 WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
TOTAL SUSPENDED SOLIDS			**MCL**		**E160.2**	**Units: mg/L**		
Suspended Solids (Residue,Non-Filterable)	208	4		1		11/02/00 15:00	EC	461971

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

11/15/00 11:20:40 AM

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Client Sample ID 2822-C **Collected:** 10/28/00 **SPL Sample ID:** 00100895-03

Site: HI 135/136 WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	**M2320 B**		**Units: mg/L**		
Alkalinity, Bicarbonate	36.4	2		1		11/01/00 14:00	SN	461505
ALKALINITY, CARBONATE			MCL	**M2320 B**		**Units: mg/L**		
Alkalinity, Carbonate	44.4	2		1		11/01/00 14:00	SN	460237
CHLORIDE, TOTAL			MCL	**E325.3**		**Units: mg/L**		
Chloride	12700	250		250		11/08/00 11:00	CV	468304
METALS BY METHOD 6010B, TOTAL			MCL	**SW6010B**		**Units: mg/L**		
Barium	0.0457	0.005		1		11/10/00 20:34	E_B	471269
Calcium	64.9	0.1		1		11/10/00 20:34	E_B	471269
Iron	49.7	0.02		1		11/10/00 20:34	E_B	471269
Magnesium	930	0.5		5		11/13/00 15:12	JM	471755
Potassium	371	2		1		11/13/00 15:08	JM	471754

Run ID/Seq #: TJA_001110C-471269

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471754

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471755

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	**E150.1**		**Units: pH Units**		
pH	8.8	0.10		1		11/01/00 16:00	EC	458727
RESISTANCE @ 25 C			MCL	**120.1**		**Units: Mohms/cm**		
Resistance	ND	0.00100		1		11/03/00 9:15	C_V	461388
SPECIFIC GRAVITY			MCL	**ASTM D-1429**		**Units: Specific Gravity @**		
Specific Gravity	1.012	0		1		11/06/00 11:00	C_V	462222
SULFATE, TOTAL			MCL	**E375.4**		**Units: mg/L**		
Sulfate	1780	250		250		11/01/00 10:00	SN	458816
TOTAL DISSOLVED SOLIDS			MCL	**TDS-MINERAL**		**Units: mg/L**		
Total Dissolved Solids, Calculated	23000	10		1		11/13/00 18:00	ES	471960
TOTAL SODIUM, CALCULATED			MCL	**TDS-MINERAL**		**Units: mg/L**		
Total Sodium, Calculated	7040	10		1		11/13/00 18:00	ES	471977

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
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MI - Matrix Interference

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Client Sample ID 2822-C **Collected:** 10/28/00 **SPL Sample ID:** 00100895-03

Site: HI 135/136 WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
TOTAL SUSPENDED SOLIDS			**MCL**		**E160.2**	**Units: mg/L**		
Suspended Solids (Residue,Non-Filterable)	424	8		2		11/02/00 15:00	EC	461972

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-D **Collected:** 10/28/00 **SPL Sample ID:** 00100895-04

Site: HI 135/136 WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Bicarbonate	101	2		1		11/01/00 14:00	SN	461506
ALKALINITY, CARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Carbonate	20.2	2		1		11/01/00 14:00	SN	460238
CHLORIDE, TOTAL			MCL	E325.3		Units: mg/L		
Chloride	15700	250		250		11/08/00 11:00	CV	468305
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B		Units: mg/L		
Barium	0.0817	0.005		1		11/10/00 20:38	E_B	471270
Calcium	407	0.1		1		11/10/00 20:38	E_B	471270
Iron	76.1	0.02		1		11/10/00 20:38	E_B	471270
Magnesium	2420	1		10		11/13/00 15:21	JM	471757
Potassium	462	2		1		11/13/00 15:16	JM	471756

Run ID/Seq #: TJA_001110C-471270

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471756

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471757

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1		Units: pH Units		
pH	8.4	0.10		1		11/01/00 16:00	EC	458728
RESISTANCE @ 25 C			MCL	120.1		Units: Mohms/cm		
Resistance	0.0093	0.00100		1		11/03/00 9:15	C_V	461389
SPECIFIC GRAVITY			MCL	ASTM D-1429		Units: Specific Gravity @		
Specific Gravity	1.034	0		1		11/06/00 11:00	C_V	462223
SULFATE, TOTAL			MCL	E375.4		Units: mg/L		
Sulfate	7040	1000		1000		11/01/00 10:00	SN	458817
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL		Units: mg/L		
Total Dissolved Solids, Calculated	34500	10		1		11/13/00 18:00	ES	471961
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL		Units: mg/L		
Total Sodium, Calculated	8230	10		1		11/13/00 18:00	ES	471978

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-D **Collected:** 10/28/00 **SPL Sample ID:** 00100895-04

Site: HI 135/136 WM0070

Analyses/Method	Result	Rep.Limit	Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
TOTAL SUSPENDED SOLIDS		MCL		E160.2	Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	786	8	2		11/02/00 15:00	EC	461973

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-E **Collected:** 10/28/00 **SPL Sample ID:** 00100895-05

Site: HI 135/136 WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B	Units: mg/L		
Alkalinity, Bicarbonate	111	2		1	11/01/00 14:00	SN	461507
ALKALINITY, CARBONATE			MCL	M2320 B	Units: mg/L		
Alkalinity, Carbonate	20.2	2		1	11/01/00 14:00	SN	460239
CHLORIDE, TOTAL			MCL	E325.3	Units: mg/L		
Chloride	17400	250		250	11/08/00 11:00	CV	468306
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B	Units: mg/L		
Barium	0.0137	0.005		1	11/10/00 20:51	E_B	471271
Calcium	402	0.1		1	11/10/00 20:51	E_B	471271
Iron	0.554	0.02		1	11/10/00 20:51	E_B	471271
Magnesium	1290	1		10	11/13/00 15:25	JM	471758
Potassium	373	20		10	11/13/00 15:25	JM	471758

Run ID/Seq #: TJA_001110C-471271

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471758

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1	Units: pH Units		
pH	8.4	0.10		1	11/01/00 16:00	EC	458729
RESISTANCE @ 25 C			MCL	120.1	Units: Mohms/cm		
Resistance	0.0083	0.00100		1	11/03/00 9:15	C_V	461390
SPECIFIC GRAVITY			MCL	ASTM D-1429	Units: Specific Gravity @		
Specific Gravity	1.029	0		1	11/06/00 11:00	C_V	462224
SULFATE, TOTAL			MCL	E375.4	Units: mg/L		
Sulfate	5900	500		500	11/01/00 10:00	SN	458818
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL	Units: mg/L		
Total Dissolved Solids, Calculated	36500	10		1	11/13/00 18:00	ES	471962
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL	Units: mg/L		
Total Sodium, Calculated	11000	10		1	11/13/00 18:00	ES	471979
TOTAL SUSPENDED SOLIDS			MCL	E160.2	Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	37	4		1	11/02/00 15:00	EC	461974

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL

>MCL - Result Over Maximum Contamination Limit(MCL)
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MI - Matrix Interference

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Client Sample ID 2822-F **Collected:** 10/28/00 **SPL Sample ID:** 00100895-06

Site: HI 135/136 WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL		M2320 B	Units: mg/L		
Alkalinity, Bicarbonate	125	2		1		11/01/00 14:00	SN	461509
ALKALINITY, CARBONATE			MCL		M2320 B	Units: mg/L		
Alkalinity, Carbonate	4.04	2		1		11/01/00 14:00	SN	460240
CHLORIDE, TOTAL			MCL		E325.3	Units: mg/L		
Chloride	16500	250		250		11/08/00 11:00	CV	468307
METALS BY METHOD 6010B, TOTAL			MCL		SW6010B	Units: mg/L		
Barium	0.0128	0.005		1		11/10/00 19:49	E_B	471259
Calcium	388	0.1		1		11/10/00 19:49	E_B	471259
Iron	0.409	0.02		1		11/10/00 19:49	E_B	471259
Magnesium	1350	1		10		11/13/00 14:24	JM	471743
Potassium	407	20		10		11/13/00 14:24	JM	471743

Run ID/Seq #: TJA_001110C-471259

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471743

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL		E150.1	Units: pH Units		
pH	8.3	0.10		1		11/01/00 16:00	EC	458730
RESISTANCE @ 25 C			MCL		120.1	Units: Mohms/cm		
Resistance	ND	0.00100		1		11/03/00 9:15	C_V	461392
SPECIFIC GRAVITY			MCL		ASTM D-1429	Units: Specific Gravity @		
Specific Gravity	1.033	0		1		11/06/00 11:00	C_V	462225
SULFATE, TOTAL			MCL		E375.4	Units: mg/L		
Sulfate	6300	500		500		11/01/00 10:00	SN	458819
TOTAL DISSOLVED SOLIDS			MCL		TDS-MINERAL	Units: mg/L		
Total Dissolved Solids, Calculated	35100	10		1		11/13/00 18:00	ES	471963
TOTAL SODIUM, CALCULATED			MCL		TDS-MINERAL	Units: mg/L		
Total Sodium, Calculated	10500	10		1		11/13/00 18:00	ES	471980
TOTAL SUSPENDED SOLIDS			MCL		E160.2	Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	25	4		1		11/02/00 15:00	EC	461975

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-G | Collected: 10/28/00 | SPL Sample ID: 00100895-07

Site: HI 135/136 WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Bicarbonate	119	2		1		11/01/00 14:00	SN	461513
ALKALINITY, CARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Carbonate	8.08	2		1		11/01/00 14:00	SN	460241
CHLORIDE, TOTAL			MCL	E325.3		Units: mg/L		
Chloride	15700	250		250		11/08/00 11:00	CV	468308
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B		Units: mg/L		
Barium	0.0154	0.005		1		11/10/00 20:56	E_B	471272
Calcium	392	0.1		1		11/10/00 20:56	E_B	471272
Iron	1.29	0.02		1		11/10/00 20:56	E_B	471272
Magnesium	1330	1		10		11/13/00 15:29	JM	471759
Potassium	423	20		10		11/13/00 15:29	JM	471759

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1		Units: pH Units		
pH	8.4	0.10		1		11/01/00 16:00	EC	458731
RESISTANCE @ 25 C			MCL	120.1		Units: Mohms/cm		
Resistance	0.043	0.00100		1		11/03/00 9:15	C_V	461393
SPECIFIC GRAVITY			MCL	ASTM D-1429		Units: Specific Gravity @		
Specific Gravity	1.029	0		1		11/06/00 11:00	C_V	462226
SULFATE, TOTAL			MCL	E375.4		Units: mg/L		
Sulfate	7100	1000		1000		11/01/00 10:00	SN	458820
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL		Units: mg/L		
Total Dissolved Solids, Calculated	35500	10		1		11/13/00 18:00	ES	471964
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL		Units: mg/L		
Total Sodium, Calculated	10400	10		1		11/13/00 18:00	ES	471981
TOTAL SUSPENDED SOLIDS			MCL	E160.2		Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	34	4		1		11/02/00 15:00	EC	461977

Qualifiers:
ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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HOUSTON, TEXAS 77054
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Client Sample ID 2822-H | Collected: 10/28/00 | SPL Sample ID: 00100895-08

Site: HI 135/136 WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Bicarbonate	129	2		1		11/01/00 14:00	SN	461515
ALKALINITY, CARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Carbonate	8.08	2		1		11/01/00 14:00	SN	460243
CHLORIDE, TOTAL			MCL	E325.3		Units: mg/L		
Chloride	19100	250		250		11/08/00 11:00	CV	468310
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B		Units: mg/L		
Barium	0.0128	0.005		1		11/10/00 21:00	E_B	471273
Calcium	389	0.1		1		11/10/00 21:00	E_B	471273
Iron	0.628	0.02		1		11/10/00 21:00	E_B	471273
Magnesium	1310	1		10		11/13/00 15:34	JM	471760
Potassium	397	20		10		11/13/00 15:34	JM	471760

Run ID/Seq #: TJA_001110C-471273

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471760

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1		Units: pH Units		
pH	8.4	0.10		1		11/01/00 16:00	EC	458732
RESISTANCE @ 25 C			MCL	120.1		Units: Mohms/cm		
Resistance	0.02	0.00100		1		11/03/00 9:15	C_V	461395
SPECIFIC GRAVITY			MCL	ASTM D-1429		Units: Specific Gravity @		
Specific Gravity	1.025	0		1		11/06/00 11:00	C_V	462227
SULFATE, TOTAL			MCL	E375.4		Units: mg/L		
Sulfate	6500	500		500		11/01/00 10:00	SN	458822
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL		Units: mg/L		
Total Dissolved Solids, Calculated	40200	10		1		11/13/00 18:00	ES	471965
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL		Units: mg/L		
Total Sodium, Calculated	12400	10		1		11/13/00 18:00	ES	471982
TOTAL SUSPENDED SOLIDS			MCL	E160.2		Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	28	4		1		11/02/00 15:00	EC	461978

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-1 Collected: SPL Sample ID: 00100892-01

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			MCL		E360.1	Units: mg/L		
Oxygen,Dissolved	7	2		1		10/31/00 17:45	C_V	457695
NITROGEN, KJELDAHL, TOTAL			MCL		E351.3	Units: mg/L		
Nitrogen,Kjeldahl,Total	1.6	0.3		1		11/06/00 11:30	JS	465077

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-2 **Collected:** **SPL Sample ID:** 00100892-02

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			**MCL**		**E360.1**	**Units: mg/L**		
Oxygen,Dissolved	5.5	2		1		10/31/00 17:45	C_V	457698
NITROGEN, KJELDAHL, TOTAL			**MCL**		**E351.3**	**Units: mg/L**		
Nitrogen,Kjeldahl,Total	0.85	0.3		1		11/06/00 11:30	JS	465078

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-3 **Collected:** **SPL Sample ID:** 00100892-03

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			**MCL**	**E360.1**		**Units: mg/L**		
Oxygen,Dissolved	4.9	2		1		10/31/00 17:45	C_V	457700
NITROGEN, KJELDAHL, TOTAL			**MCL**	**E351.3**		**Units: mg/L**		
Nitrogen,Kjeldahl,Total	1.1	0.3		1		11/06/00 11:30	JS	465079

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-4 **Collected:** **SPL Sample ID:** 00100892-04

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			**MCL**		**E360.1**	**Units: mg/L**		
Oxygen,Dissolved	5.1	2		1		10/31/00 17:45	C_V	457701
NITROGEN, KJELDAHL, TOTAL			**MCL**		**E351.3**	**Units: mg/L**		
Nitrogen,Kjeldahl,Total	ND	0.3		1		11/06/00 11:30	JS	465080

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-5 | Collected: | SPL Sample ID: 00100892-05

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			**MCL**		**E360.1**	**Units: mg/L**		
Oxygen,Dissolved	9.4	2		1		10/31/00 17:45	C_V	457702
NITROGEN, KJELDAHL, TOTAL			**MCL**		**E351.3**	**Units: mg/L**		
Nitrogen,Kjeldahl,Total	1.1	0.3		1		11/06/00 11:30	JS	465082

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-6 **Collected:** **SPL Sample ID:** 00100892-06

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			**MCL**	**E360.1**		**Units: mg/L**		
Oxygen,Dissolved	10	2		1		10/31/00 17:45	C_V	457703
NITROGEN, KJELDAHL, TOTAL			**MCL**	**E351.3**		**Units: mg/L**		
Nitrogen,Kjeldahl,Total	ND	0.3		1		11/06/00 11:30	JS	465083

Qualifiers:
ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-7 **Collected:** **SPL Sample ID:** 00100892-07

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			**MCL**	**E360.1**		**Units: mg/L**		
Oxygen,Dissolved	10	2		1		10/31/00 17:45	C_V	457704
NITROGEN, KJELDAHL, TOTAL			**MCL**	**E351.3**		**Units: mg/L**		
Nitrogen,Kjeldahl,Total	2.8	0.3		1		11/06/00 11:30	JS	465084

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-8 **Collected:** **SPL Sample ID:** 00100892-08

Site: **HI 135/136 #WM0070**

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			**MCL**		**E360.1**	**Units: mg/L**		
Oxygen,Dissolved	10	2		1		10/31/00 17:45	C_V	457705
NITROGEN, KJELDAHL, TOTAL			**MCL**		**E351.3**	**Units: mg/L**		
Nitrogen,Kjeldahl,Total	ND	0.3		1		11/06/00 11:30	JS	465085

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Winmar Consulting Services

Certificate of Analysis Number:

00100892

Report To: Winmar Consulting Services
James Wiseman
5700 NW Central Drive
Suite 150
Houston
TX
77092-
ph: (713) 895-8240 fax: (713) 895-8270

Fax To: *Winmar Consulting Services*
James Wiseman *fax: (713) 895-8270*

Project Name: HI 135/136 #WM0070
Site: HI 135/136 #WM0070
Site Address:

PO Number:
State:
State Cert. No.:
Date Reported: 11/9/00

Client Sample ID	Lab Sample ID	Matrix	Date Collected	Date Received	COC ID	HOLD
2822-1	00100892-01	Water		10/30/00 12:04:00 PM		
2822-1	00100892-01	Water		10/30/00 12:04:00 PM	087140	
2822-2	00100892-02	Water		10/30/00 12:04:00 PM		
2822-2	00100892-02	Water		10/30/00 12:04:00 PM	087140	
2822-3	00100892-03	Water		10/30/00 12:04:00 PM		
2822-3	00100892-03	Water		10/30/00 12:04:00 PM	087140	
2822-4	00100892-04	Water		10/30/00 12:04:00 PM		
-4	00100892-04	Water		10/30/00 12:04:00 PM	087140	
822-5	00100892-05	Water		10/30/00 12:04:00 PM		
2822-5	00100892-05	Water		10/30/00 12:04:00 PM	087140	
2822-6	00100892-06	Water		10/30/00 12:04:00 PM		
2822-6	00100892-06	Water		10/30/00 12:04:00 PM	087140	
2822-7	00100892-07	Water		10/30/00 12:04:00 PM		
2822-7	00100892-07	Water		10/30/00 12:04:00 PM	087140	
2822-8	00100892-08	Water		10/30/00 12:04:00 PM		
2822-8	00100892-08	Water		10/30/00 12:04:00 PM	087140	

Neschich,Paul
Senior Project Manager

11/9/00
Date

Joel Grice
Laboratory Director

Ted Yen
Quality Assurance Officer

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2822-1 **Collected:** **SPL Sample ID:** 00100892-01

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			**MCL**		**E360.1**	**Units: mg/L**		
Oxygen,Dissolved	7	2		1		10/31/00 17:45	C_V	457695
NITROGEN, KJELDAHL, TOTAL			**MCL**		**E351.3**	**Units: mg/L**		
Nitrogen,Kjeldahl,Total	1.6	0.3		1		11/06/00 11:30	JS	466077

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-2 **Collected:** **SPL Sample ID:** 00100892-02

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			**MCL**		**E360.1**	**Units: mg/L**		
Oxygen,Dissolved	5.5	2		1		10/31/00 17:45	C_V	457698
NITROGEN, KJELDAHL, TOTAL			**MCL**		**E351.3**	**Units: mg/L**		
Nitrogen,Kjeldahl,Total	0.85	0.3		1		11/06/00 11:30	JS	465078

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL

>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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(713) 660-0901

Client Sample ID 2822-3 **Collected:** **SPL Sample ID:** 00100892-03

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			**MCL**		**E360.1**	**Units: mg/L**		
Oxygen,Dissolved	4.9	2		1		10/31/00 17:45	C_V	457700
NITROGEN, KJELDAHL, TOTAL			**MCL**		**E351.3**	**Units: mg/L**		
Nitrogen,Kjeldahl,Total	1.1	0.3		1		11/06/00 11:30	JS	465079

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-4 **Collected:** **SPL Sample ID:** 00100892-04

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			**MCL**		**E360.1**	**Units: mg/L**		
Oxygen,Dissolved	5.1	2		1		10/31/00 17:45	C_V	457701
NITROGEN, KJELDAHL, TOTAL			**MCL**		**E351.3**	**Units: mg/L**		
Nitrogen,Kjeldahl,Total	ND	0.3		1		11/06/00 11:30	JS	465080

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-5 | Collected: | SPL Sample ID: 00100892-05

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			MCL		E360.1	Units: mg/L		
Oxygen,Dissolved	9.4	2		1		10/31/00 17:45	C_V	457702
NITROGEN, KJELDAHL, TOTAL			MCL		E351.3	Units: mg/L		
Nitrogen,Kjeldahl,Total	1.1	0.3		1		11/06/00 11:30	JS	465082

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-6 | Collected: | SPL Sample ID: 00100892-06

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			MCL		E360.1	Units: mg/L		
Oxygen,Dissolved	10	2		1		10/31/00 17:45	C_V	457703
NITROGEN, KJELDAHL, TOTAL			MCL		E351.3	Units: mg/L		
Nitrogen,Kjeldahl,Total	ND	0.3		1		11/06/00 11:30	JS	465083

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-7 Collected: SPL Sample ID: 00100892-07

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			MCL		E360.1	Units: mg/L		
Oxygen,Dissolved	10	2		1		10/31/00 17:45	C_V	457704
NITROGEN, KJELDAHL, TOTAL			MCL		E351.3	Units: mg/L		
Nitrogen,Kjeldahl,Total	2.8	0.3		1		11/06/00 11:30	JS	465084

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2822-8 | Collected: | SPL Sample ID: 00100892-08

Site: HI 135/136 #WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
DISSOLVED OXYGEN			MCL		E360.1	Units: mg/L		
Oxygen,Dissolved	10	2		1		10/31/00 17:45	C_V	457705
NITROGEN, KJELDAHL, TOTAL			MCL		E351.3	Units: mg/L		
Nitrogen,Kjeldahl,Total	ND	0.3		1		11/06/00 11:30	JS	465085

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

7. Results and Observations – 2823

a. Sample Locations Observations

Time constraints interfered with this test, and only one water sample was obtained. The sample was of standing water in this pipeline segment. The pipeline was flushed and filled with seawater in 1994. The testing information is still included, as it is of some value, however it is not as complete as for the other segments tested.

A five foot (5’) sample of the pipeline was removed, which included the tubeturn to pipeline weld.

b. Gas Composition Observations

This line was completely filled with inhibited seawater, therefore no gas was present.

c. Flushwater Composition Observations

For the water that stood in the pipeline for 6 years, the mineral pattern relative to NSW is summarized below:

Alkalinity (bicarb) – Higher
Barium – Equal
Calcium – Lower
Iron – Higher
Magnesium – Lower
Potassium – Similar/Lower
Chloride – Lower
Sulfate – Higher

As with pipeline 2822, iron concentrations in 2823 were very high. This sample from the standing water yielded an iron concentration of 117 PPM, or 34,000 times NSW levels.

d. Oil and Grease Observations

Due to time constraints, no oil and grease samples were taken for this line.

e. Pipe Cutout Observations

This pipeline sample was in better condition than 2822. It showed light surface corrosion only, and no deep pitting at the weld. This sample did not have the thick coating of debris on the interior as seen in sample 2822.

Photo #20 - Sample Photo - Segment 2823

consulting services, inc.

SHELL OFFSHORE INC.
HI-135-2

PLATFORM

MMS General		ODS General		MMS Location		MMS Facility	
Water	50 feet	**Function**	WP	**Lease**	741 feet	**Helideck**	Yes
Major	No	**Piles**	NA	**Complex**	10015	**Quarters**	None
Decks	1	**Slots**	3	**Longitude**	-94.112	**Generator**	No
Slots	3	**ODS ID**	739	**Latitude**	29.260	**Cranes**	NA
Wells	2	**Previous 1**	NA	**X**	3,558,137'	**Gas**	Yes
Flare	No	**Previous 2**	NA	**Y**	551,391'	**Oil**	Yes
Installed	01 1964	**Previous 3**	NA	**To Shore**	25 miles	**Comp**	No
Revised	05 1998	**Previous 4**	NA	**N-S feet**	S 4911'	**8 hour**	No
Removed	NA	**Notes**	NA	**E-W feet**	W 3141'	**24 hour**	No

PIPELINES MMS

Segment	2821	2822	2823	
Origin	HI-135-2	HI-135-2	HI-135-2	#N/A
Terminus	HI-136-A	HI-136-A	HI-136-A	#N/A
O.D.	3"	4"	4"	#N/A
Length	4,000'	4,000'	4,000'	#N/A
Product	BLKG	BLKG	BLKG	#N/A
Status	ACT	OUT	PABN	#N/A
Installed	NA	NA	NA	#N/A
Abandon	NA	NA	NA	#N/A
Revised	Aug-94	Oct-94	Aug-94	#N/A
Operator	SHELL OFFSHORE INC	SHELL OFFSHORE	SHELL OFFSHORE INC.	#N/A

WELLS MMS

API Well ID	Well	Spud	Revised	Status	MD	Bot Lease	Sur Long	Sur Lat
427080004600	1	03 1964	05 1964	COM	10,777'	741	-94.119	29.259
427080004700	2	10 1964	05 1986	ST	8,678'	741	-94.112	29.260
427080004701	2	05 1986	07 1986	COM	9,450'	741	-94.115	29.260
427080004800	3	11 1964	08 1985	PA	9,663'	741	-94.104	29.265
427080004900	4	11 1964	06 1990	PA	11,483'	741	-94.116	29.269
427080005000	5	04 1965	08 1985	PA	9,006'	741	-94.089	29.262
427080006100	6	06 1965	06 1965	PA	9,085'	741	-94.089	29.271
427080007300	8	07 1967	08 1967	ST	9,452'	741	-94.103	29.260
427080007301	9	08 1967	08 1967	COM	9,020'	741	-94.106	29.260
427084023300	11	04 1986	01 1996	ST	10,824'	741	-94.075	29.262
427084023301	11	01 1996	04 1996	COM	11,033'	741	-94.075	29.262
427084023400	9	08 1986	09 1986	TA	10,230'	742	-94.132	29.259

PIPELINE FLUSHING AND SAMPLING RECORD

I. Pipeline Information

MMS Segment No.	2823
Date:	10/27/2000
Pipeline Origination	
Area	High Island
Block	135
Platform	#2
Lease	OCS-G-0741
Pipeline Destination	
Area	High Island
Block	136
Platform	A
Lease	OCS-G-0742
Pipeline Size (in)	4
Pipelines Length (ft)	4,000
Pipeline Volume (bbls)	62

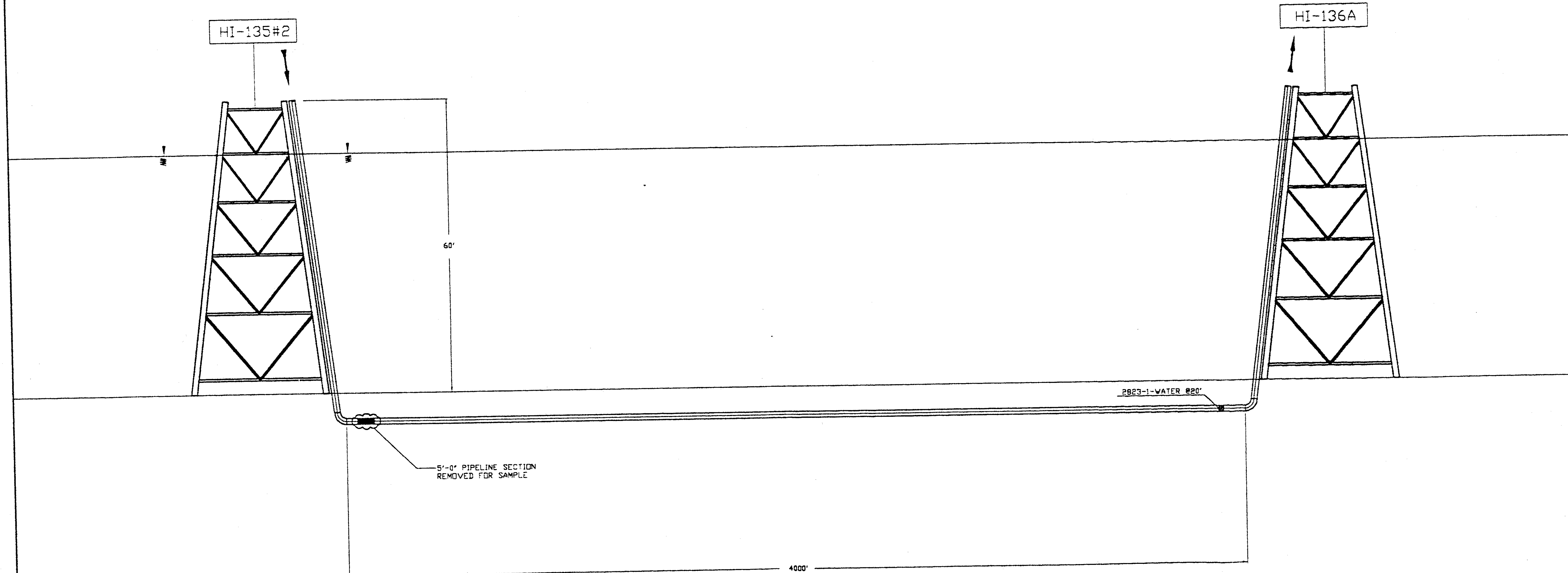
II. Flushing Information

Flushing Information	
Volume Flushed	4000g
Flow Rate (GPM)	100
Pigged Used	No
Type of Pig	No
Size of Pig	No
Clean Returns	Yes
Inhibitor	
Chemical Inhibitor Used	
Type of Chemical	
Quantity of Chemical	
Origination Riser	
Riser blind flanged w/ vent valve	Yes
Pipeline Tagged	Yes
Destination Riser	
Riser blind flanged w/ vent valve	Yes
Pipeline Tagged	Yes
Comments:	
Company Representative	
Signature	

WINMAR consulting services, inc.

III. Sampling Data - Tracking Information

Sample Location				
Platform:	HI 136A			
Pipeline Sampling Site:	End of Hose at Tank			
Flushing Start Time:	18:00			
Gas Samples	Sample ID	Sample Date	Vol. Flushed (g)	H2S (PPM)
Vacuum Tubes	N/A			
Plastic Bags	N/A			
Water Samples	Sample ID	Sample Date	Vol. Flushed (g)	Notes
Mineral Pattern Analysis				
	2823-1	10/27/2000	2,500	
Oil and Grease Analysis				
Comments:	Pipeline filled w/ seawater. Time constraints and harsh environment only permitted one sample. Pipeline spool sample taken as well.			
Company Representative				
Signature				



PL SEGMENT	2823
LENGTH	4120 FT.
VOLUME FLUSHED	4000 GAL.
PL VOLUME FLG/FLG	2472 GAL.

REV	DATE	DESCRIPTION	BY	APP'D
0	11/00	ISSUED	CSA	JW

PROJECT# WM0070

PIPELINE SAMPLE LOCATIONS

HIGH ISLAND 135#2 / HIGH ISLAND 136A

	DATE	DWG. NO.	REV.
CSA	11/00	WM0070C	0

Figure 19 - Flushwater Composition - 2823

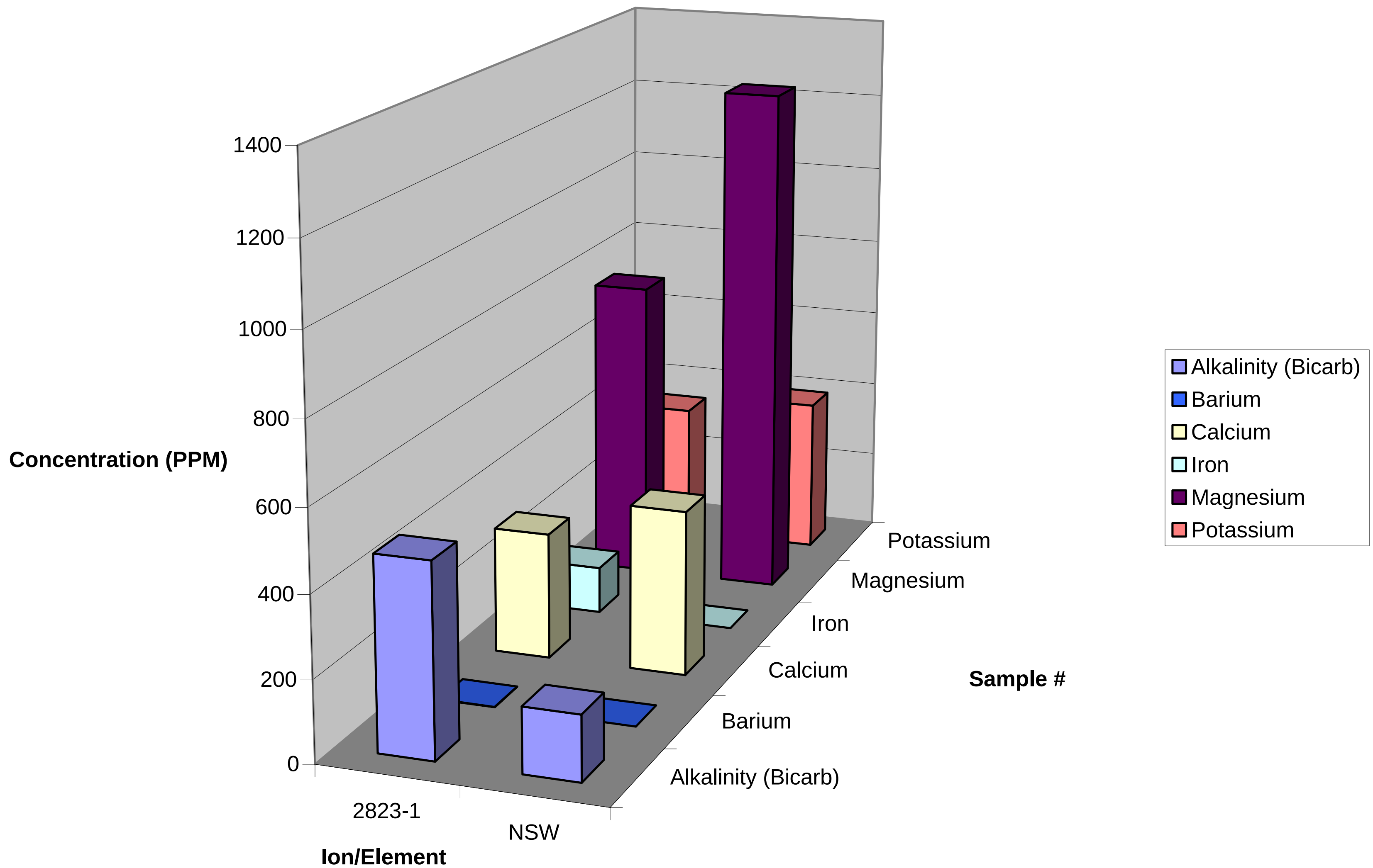
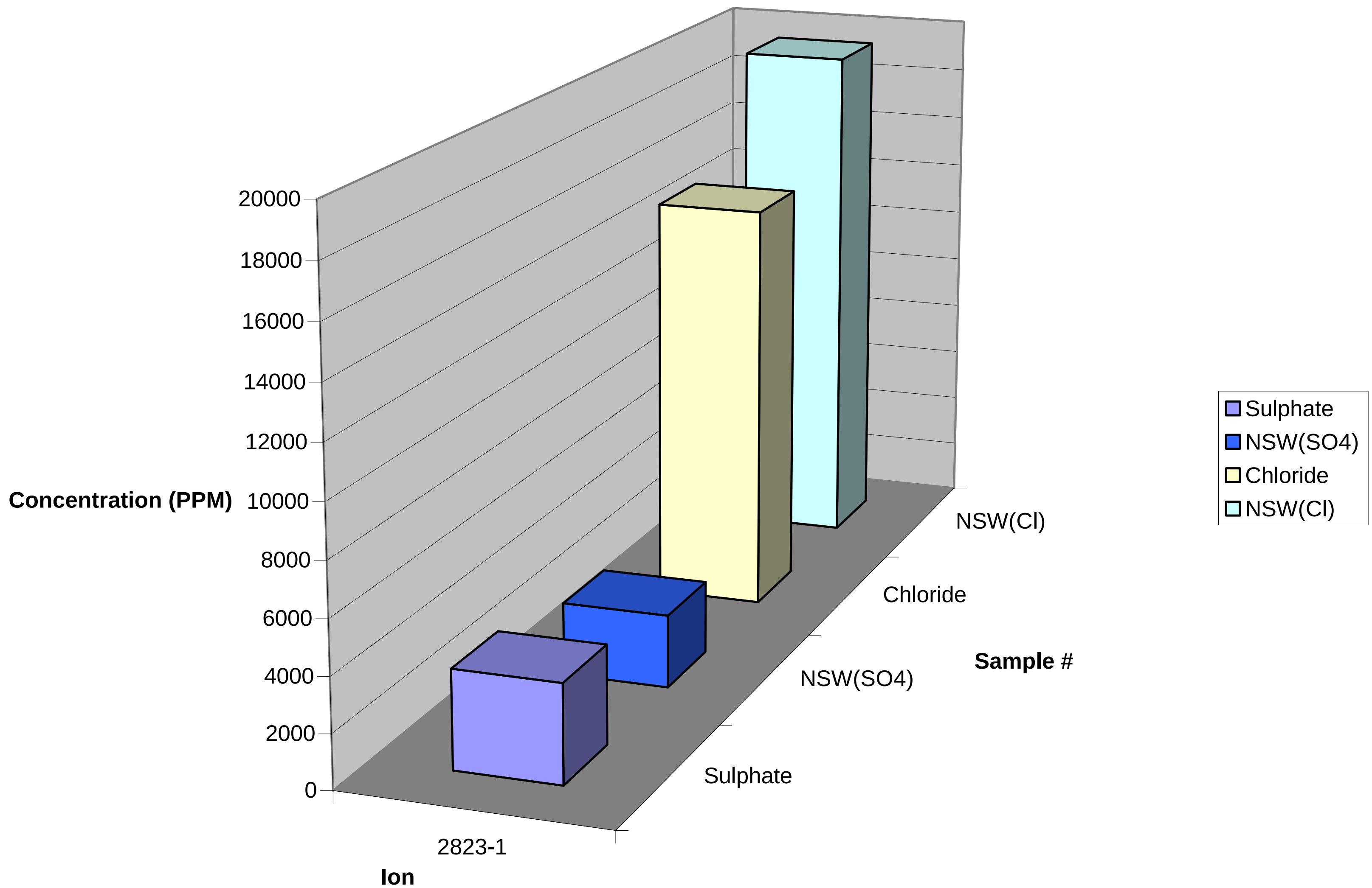


Figure 20 - Chloride and Sulphate - 2823



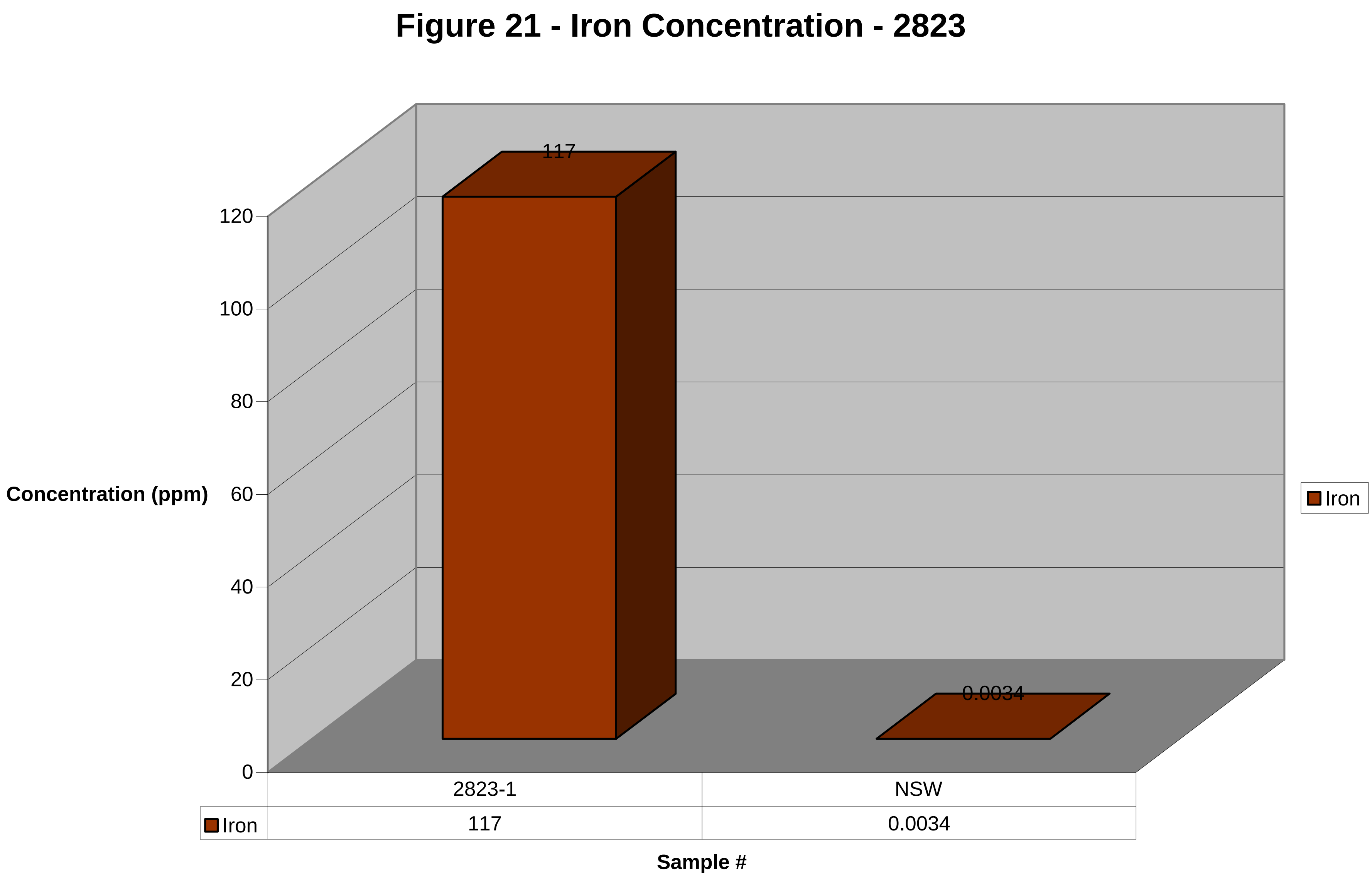


Figure 21 - Iron Concentration - 2823
Concentration (ppm)
0
20
40
60
80
100
120
117
0.0034
2823-1
NSW
Iron
117
0.0034
Sample #
Iron

SPL®

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2823-1 Collected: SPL Sample ID: 00100896-01

Site: HI 135/136

Analyses/Method	Result	Rep.Limit		Dil. Factor QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B	Units: mg/L		
Alkalinity, Bicarbonate	473	2		1	11/01/00 14:00	SN	461517
ALKALINITY, CARBONATE			MCL	M2320 B	Units: mg/L		
Alkalinity, Carbonate	295	2		1	11/01/00 14:00	SN	460244
CHLORIDE, TOTAL			MCL	E325.3	Units: mg/L		
Chloride	15300	250		250	11/08/00 11:00	CV	468311
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B	Units: mg/L		
Barium	1.14	0.005		1	11/10/00 21:04	E_B	471274
Calcium	315	0.1		1	11/10/00 21:04	E_B	471274
Iron	117	0.02		1	11/10/00 21:04	E_B	471274
Magnesium	763	0.2		2	11/13/00 15:42	JM	471762
Potassium	343	2		1	11/13/00 15:38	JM	471761

Run ID/Seq #: TJA_001110C-471274

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471761

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471762

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1	Units: pH Units		
pH	9.1	0.10		1	11/01/00 16:00	EC	458734
RESISTANCE @ 25 C			MCL	120.1	Units: Mohms/cm		
Resistance	0.0093	0.00100		1	11/03/00 9:15	C_V	461397
SPECIFIC GRAVITY			MCL	ASTM D-1429	Units: Specific Gravity @		
Specific Gravity	1.02	0		1	11/06/00 11:00	C_V	462228
SULFATE, TOTAL			MCL	E375.4	Units: mg/L		
Sulfate	3620	500		500	11/01/00 10:00	SN	458823
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL	Units: mg/L		
Total Dissolved Solids, Calculated	31200	10		1	11/13/00 18:00	ES	471966
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL	Units: mg/L		
Total Sodium, Calculated	9960	10		1	11/13/00 18:00	ES	471983

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2823-1	Collected:	SPL Sample ID: 00100896-01
	Site: HI 135/136	

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
TOTAL SUSPENDED SOLIDS			MCL		E160.2	Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	1020	8		2		11/02/00 15:00	EC	461985

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

8. Results and Observations – 2824

a. Sample/Locations Observations

Gas samples were taken at the top of the riser before the blind flange was removed. Samples were taken when the odor of natural gas was present. All bolts and flange seals were intact before testing and did not indicate any leakage. H2S length of stain tests were performed at this. This gas line was one of the longer ones tested, allowing for more samples of both gas and water.

The water samples taken at the top of riser bleed valve seemed uniform, and representative of the flush fluid stream.

A five foot (5') sample of the pipeline was removed, which included the tubeturn to pipeline weld.

b. Gas Composition Observations

The results of the gas analysis are plotted and summarized in the results section. Atmospheric air composition is also plotted for reference/comparison purposes.

The three gas samples were high in methane, and low in atmospheric components, such as nitrogen and oxygen. This indicates that the line was probably not opened in the past, and contaminated with atmospheric air. This is useful to compare to other gas lines tested, where samples were a mixture of methane and atmospheric air. This gas did not contain any H2S and negligible amounts of CO2.

c. Flushwater Composition Observations

The flushwater composition for segment 2824 is plotted in the results section. Natural Seawater composition is also plotted for comparison purposes. The ions/elements plotted are: Alkalinity (CO3), Barium, Calcium, Iron, Magnesium, and Potassium. Because of their high values (in PPM), Chlorides and Sulfates are plotted on a separate chart.

For the flushwater, the mineral pattern relative to NSW is summarized below:

Alkalinity (bicarb) – Higher for first sample, then Equal
Barium – Higher for first sample, then Equal
Calcium – Higher for first sample, then Equal
Iron – Higher
Magnesium – Lower for first sample, then Equal

Potassium – Lower for first sample, then Equal
Chloride – Higher for first sample, then Equal
Sulfate – Lower for first sample, then Equal

Again, the iron content is plotted as a separate graph in order to focus on these values. The first sample taken at the very front of the flushwater "slug" has an extremely high iron concentration of 302 ppm (ppm also equals milligrams/liter). The concentration is over 88,000 times greater than NSW. Observations from the field could explain this very high concentration. In anticipation of the incoming fluid, the sampling valve was left open so that the very first fluid out of the pipeline was taken as the first water sample. This slug picked up quite a bit of debris, and was very high in condensate, as is evidenced in the photographs. This debris included metal particles which were picked up from the pipe wall. The sampling procedure "dissolved" these metal particles and recorded them as a concentration value. The following four samples were lower in concentration, but still much higher than NSW values.

Photo #21

The ions/elements to focus on from this analysis are those found in steel corrosion products: FeO_2, FeS. The samples showed higher than NSW concentrations of iron, but Sulfate was at NSW levels.

The first sample (2824-1) is vastly different than all the other water samples taken. Concentrations of elements/ions were either much higher or much lower than NSW concentrations.

d. Oil and Grease Observations

Oil and grease was non-detectible in the final samples taken. The detection limit is 2.5 PPM. As noted above, the very first sample was high in hydrocarbons because it contained a good deal of the condensate that was present in the line. The graph shows a very rapid drop in oil and grease concentration, with the non-detectable limit appearing to be reached at 1.25x flush volume.

e. Pipe Cutout Observations

A five foot section of pipe was retrieved. This section was taken near the base of the platform, and included pipe on both sides of the riser/tubeturn weld.

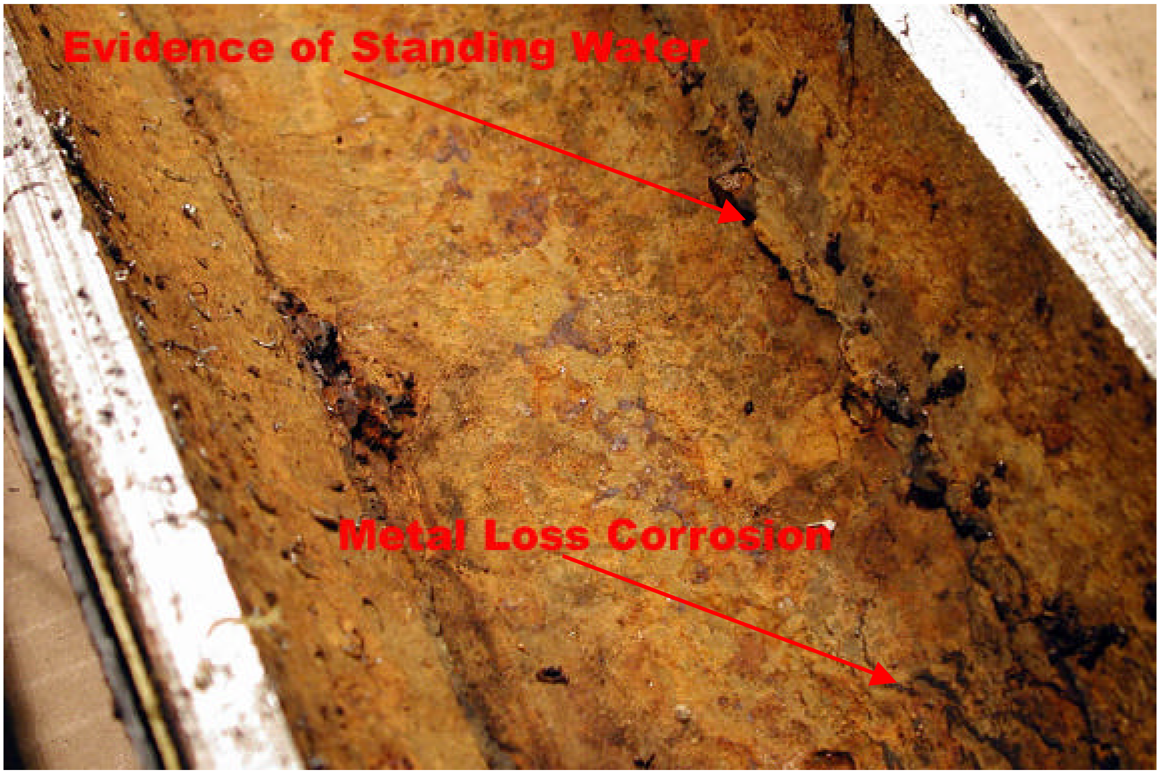
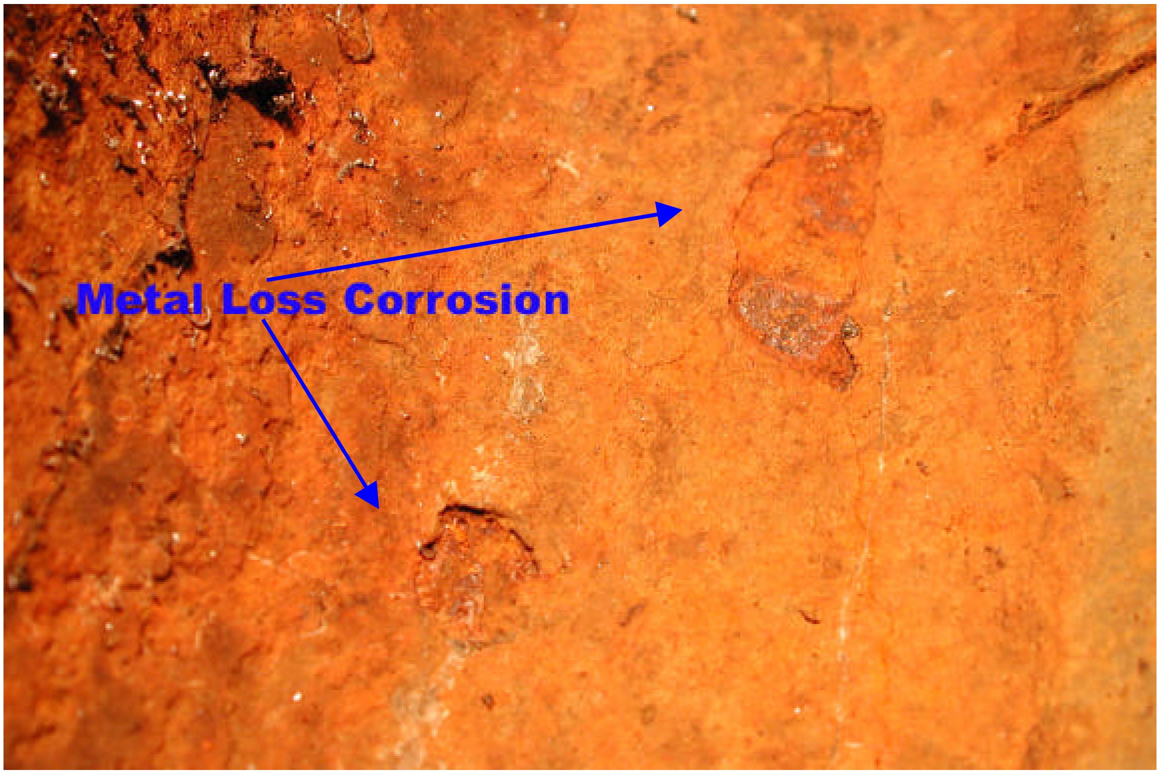


Photo #22 - Sample Photo – 2824

This pipe shows evidence of standing water/fluid present at the 5-7 o'clock position. There is some metal loss corrosion in this region, as indicated in the sample photographs. These patches were small, and no deeper than 0.1t however.



Photos #23 and #24 - Sample Photos - 2824

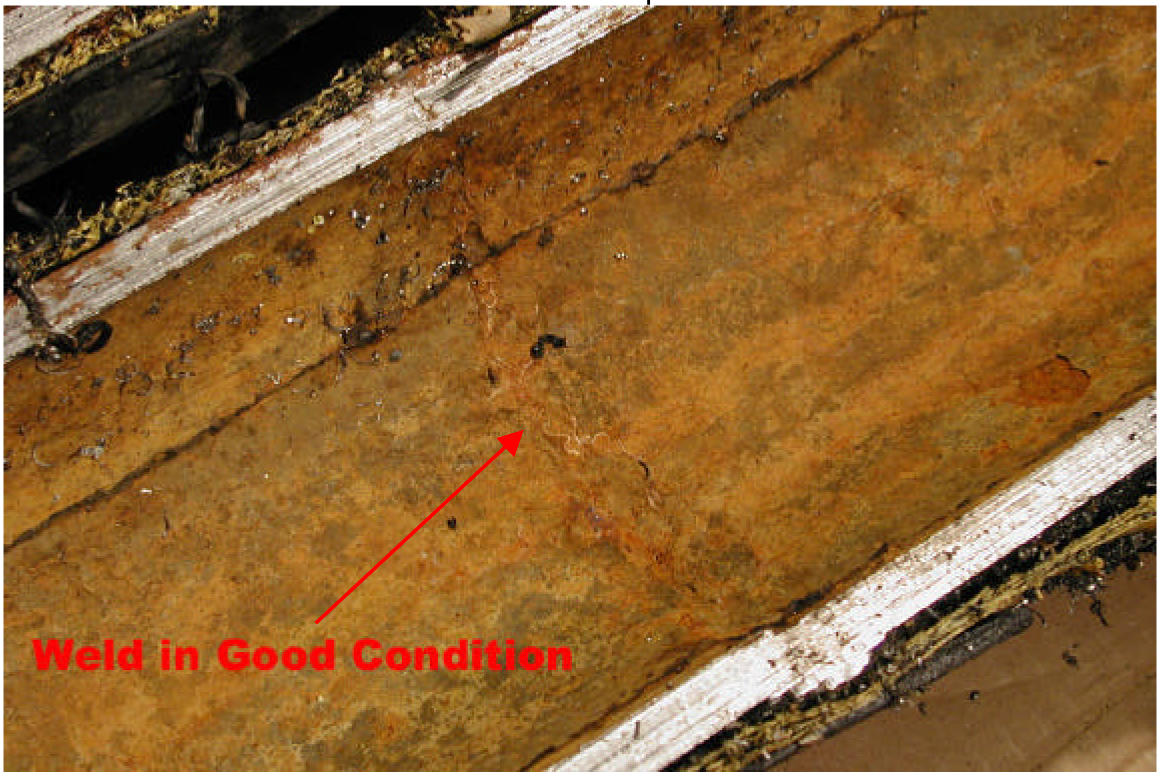


Photo #24 - The tubeturn/pipeline weld appeared to be in good condition.

WINMAR consulting services, inc.

SHELL OFFSHORE INC.
HI-135-5

PLATFORM

MMS General		ODS General		MMS Location		MMS Facility	
Water	50 feet	**Function**	WP	**Lease**	741 feet	**Helideck**	Yes
Major	No	**Piles**	NA	**Complex**	10014	**Quarters**	None
Decks	1	**Slots**	3	**Longitude**	-94.090	**Generator**	No
Slots	3	**ODS ID**	742	**Latitude**	29.262	**Cranes**	NA
Wells	2	**Previous 1**	NA	**X**	3,564,986'	**Gas**	Yes
Flare	No	**Previous 2**	NA	**Y**	552,334'	**Oil**	No
Installed	01 1965	**Previous 3**	NA	**To Shore**	25 miles	**Comp**	No
Revised	12 1998	**Previous 4**	NA	**N-S feet**	S 5854'	**8 hour**	No
Removed	NA	**Notes**	NA	**E-W feet**	E 5850'	**24 hour**	No

PIPELINES MMS

Segment	2824			
Origin	HI-135-5			
Terminus	HI-136-A			
O.D.	4"			
Length	11,500'			
Product	BLKG			
Status	ACT			
Installed	NA			
Abandon	NA			
Revised	Aug-94			
Operator	SHELL OFFSHORE INC.			

WELLS MMS

API Well ID	Well	Spud	Revised	Status	MD	Bot Lease	Sur Long	Sur Lat
427080004600	1	03 1964	05 1964	COM	10,777'	741	-94.119	29.259
427080004700	2	10 1964	05 1986	ST	8,678'	741	-94.112	29.260
427080004701	2	05 1986	07 1986	COM	9,450'	741	-94.115	29.260
427080004800	3	11 1964	08 1985	PA	9,663'	741	-94.104	29.265
427080004900	4	11 1964	06 1990	PA	11,483'	741	-94.116	29.269
427080005000	5	04 1965	08 1985	PA	9,006'	741	-94.089	29.262
427080006100	6	06 1965	06 1965	PA	9,085'	741	-94.089	29.271
427080007300	8	07 1967	08 1967	ST	9,452'	741	-94.103	29.260
427080007301	9	08 1967	08 1967	COM	9,020'	741	-94.106	29.260
427084023300	11	04 1986	01 1996	ST	10,824'	741	-94.075	29.262
427084023301	11	01 1996	04 1996	COM	11,033'	741	-94.075	29.262
427084023400	9	08 1986	09 1986	TA	10,230'	742	-94.132	29.259

WINMAR consulting services, inc.

PIPELINE FLUSHING AND SAMPLING RECORD

I. Pipeline Information

MMS Segment No.	2824
Date:	10/26/2000
Pipeline Origination	
Area	High Island
Block	135
Platform	#5
Lease	OCS-G-0742
Pipeline Destination	
Area	High Island
Block	136
Platform	A
Lease	OCS-G-0742
Pipeline Size (in)	4
Pipelines Length (ft)	11500
Pipeline Volume (bbls)	179

II. Flushing Information

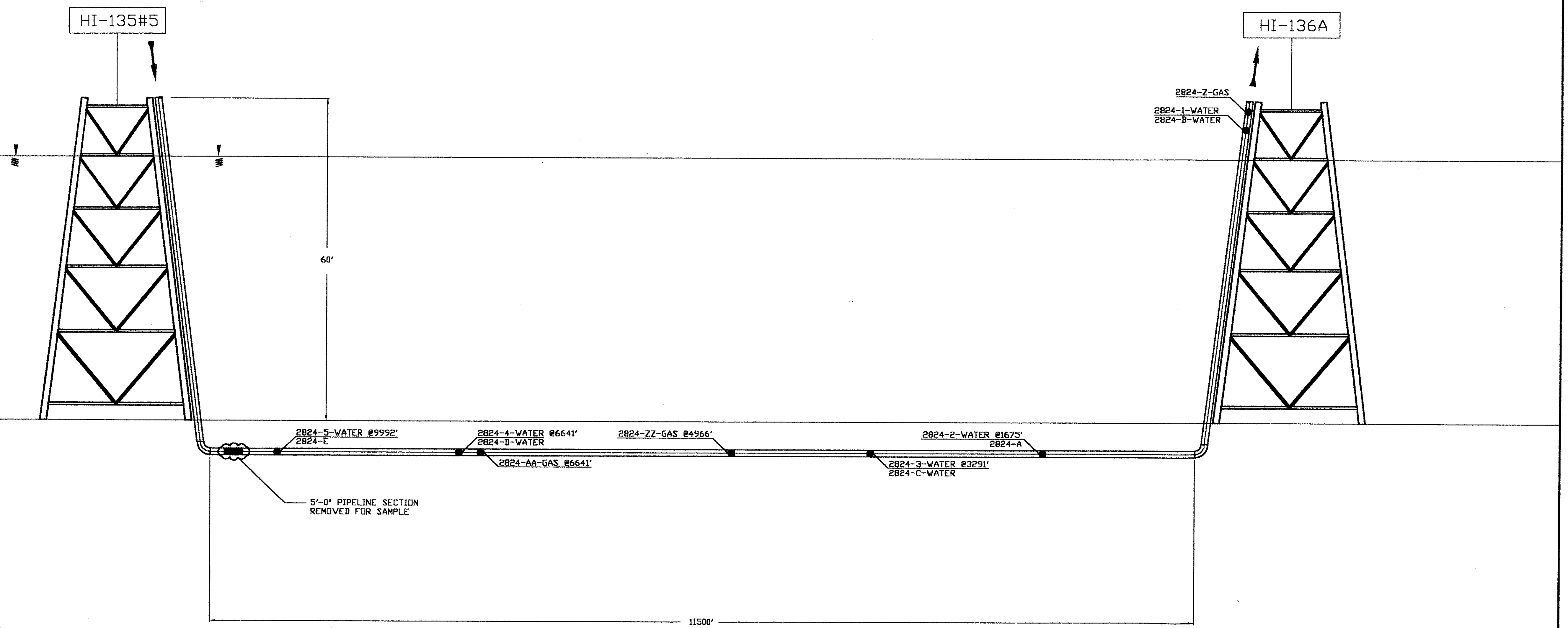
Flushing Information	
Volume Flushed	12,000g
Flow Rate (GPM)	100
Pigged Used	No
Type of Pig	No
Size of Pig	
Clean Returns	yes
Inhibitor	
Chemical Inhibitor Used	
Type of Chemical	
Quantity of Chemical	
Origination Riser	
Riser blind flanged w/ vent valve	Yes
Pipeline Tagged	Yes
Destination Riser	
Riser blind flanged w/ vent valve	Yes
Pipeline Tagged	Yes
Comments:	
Company Representative	
Signature	

WINMAR consulting services, inc.

III. Sampling Data - Tracking Information

Sample Location				
Platform:	Hi 136A			
Pipeline Sampling Site:	Hose Connection w/ Sampling Spool			
Flushing Start Time:	14:00			
Gas Samples	Sample ID	Sample Date	Vol. Flushed (g)	H2S (PPM)
Vacuum Tubes				
	None			
Plastic Bags				
	2824-Z	10/26/2000	0	0
	2824-ZZ	10/26/2000	3,000	
	2824-AA	10/26/2000	4,000	
Water Samples	Sample ID	Sample Date	Vol. Flushed (g)	Notes
Mineral Pattern Analysis				
	2824-1	10/26/2000	6,000	
	2824-2	10/26/2000	7,000	
	2824-3	10/26/2000	8,000	
	2824-4	10/26/2000	10,000	
Oil and Grease Analysis	2824-5	10/26/2000	12,000	
	2824-B	10/26/2000	6,000	
	2824-A	10/26/2000	7,000	
	2824-C	10/26/2000	8,000	
	2824-D	10/26/2000	10,000	
	2824-E	10/26/2000	12,000	
Comments:				
Company Representative	James Wiseman			
Signature				

FIGURE 22 SEGMENT 2824



PL SEGMENT	2824
LENGTH	11,620 FT.
VOLUME FLUSHED	12000 GAL.
PL VOLUME FLG/FLG	6000 GAL. (SET @ 6000 GAL.)

REV	DATE	DESCRIPTION	BY	APP'D
0	11/00	ISSUED	CSA	JW

WINMAR

PROJECT# WM0070			
PIPELINE SAMPLE LOCATIONS			
HIGH ISLAND 135 #5/ HIGH ISLAND 136A			
CSA	DATE 11/00	DWG. NO. WM0070B.DWG	REV. 0

Figure 23 - Gas Composition (Major Constituents) - 2824

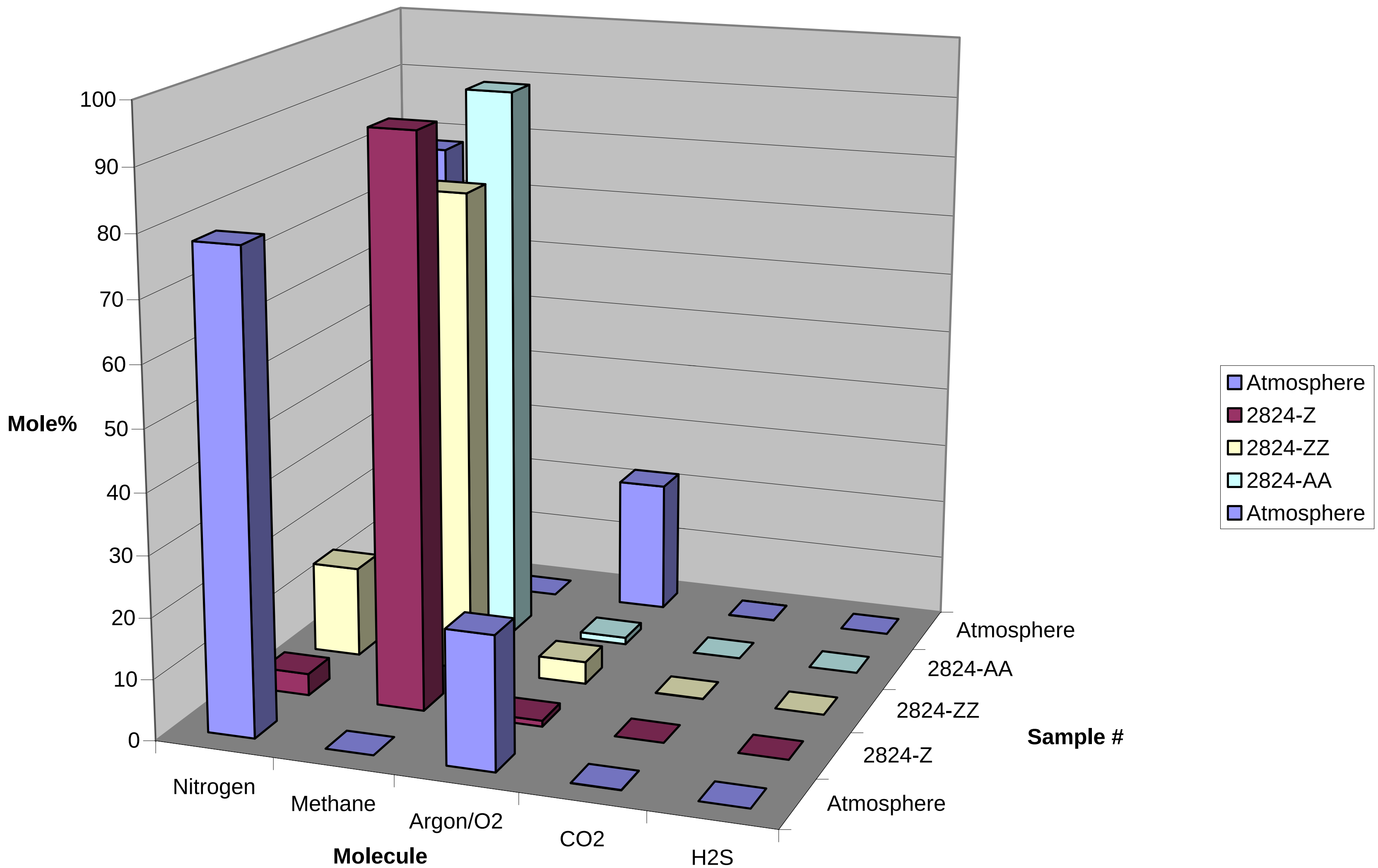


Figure 24 - Gas Composition (by Mol%) - 2824

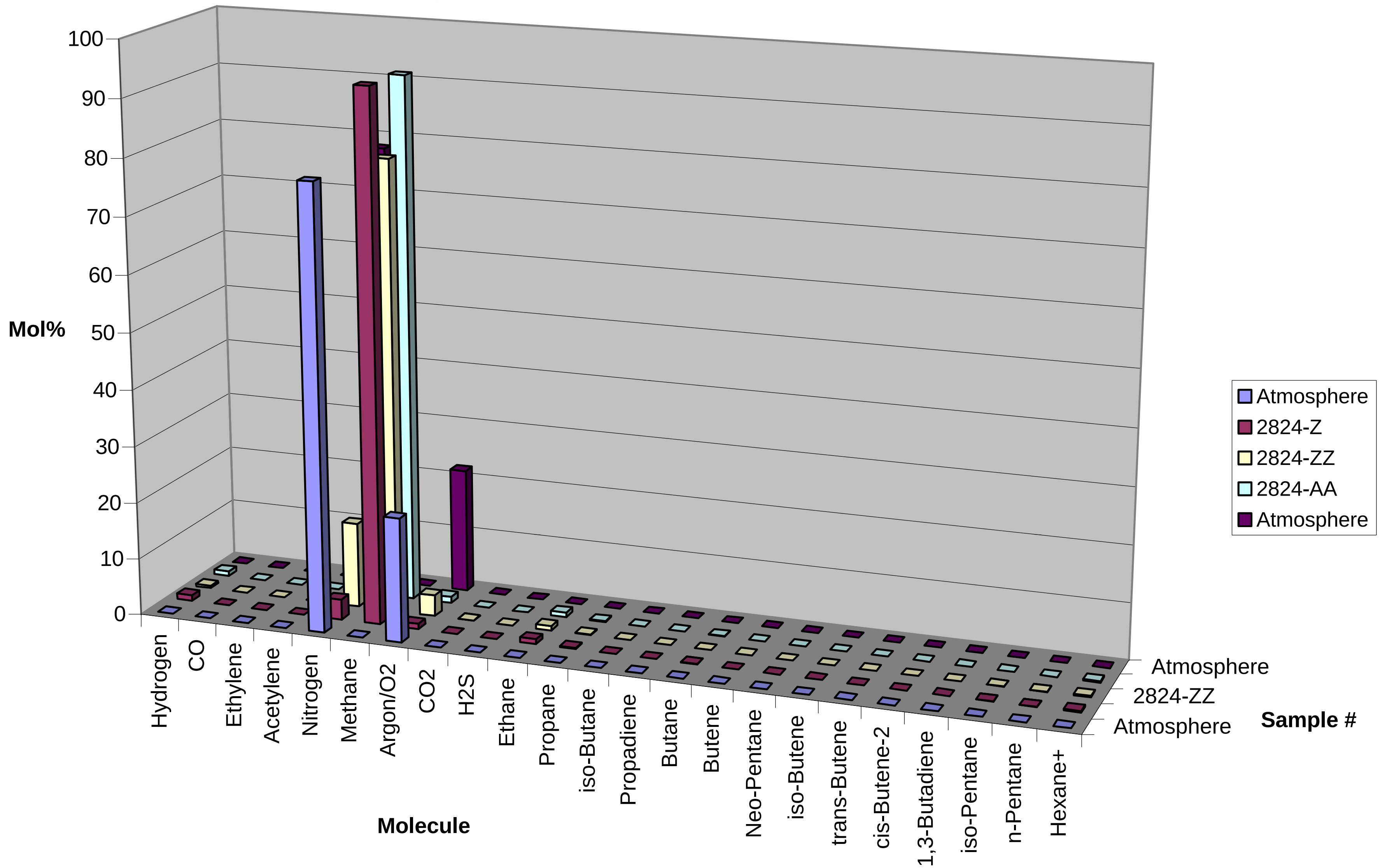


Figure 25 - Flushwater Composition - 2824

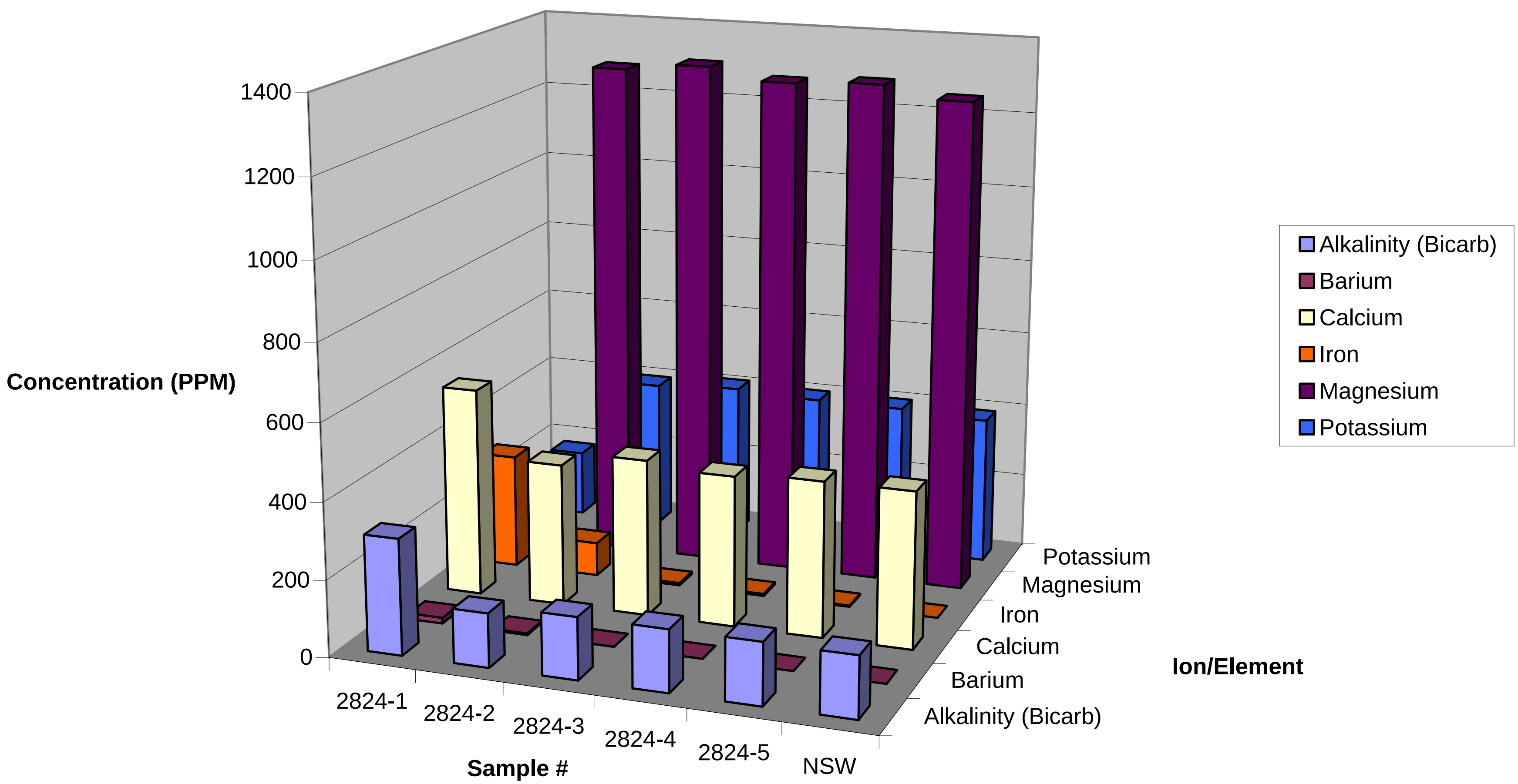


Figure 26 - Chloride and Sulfate - 2824

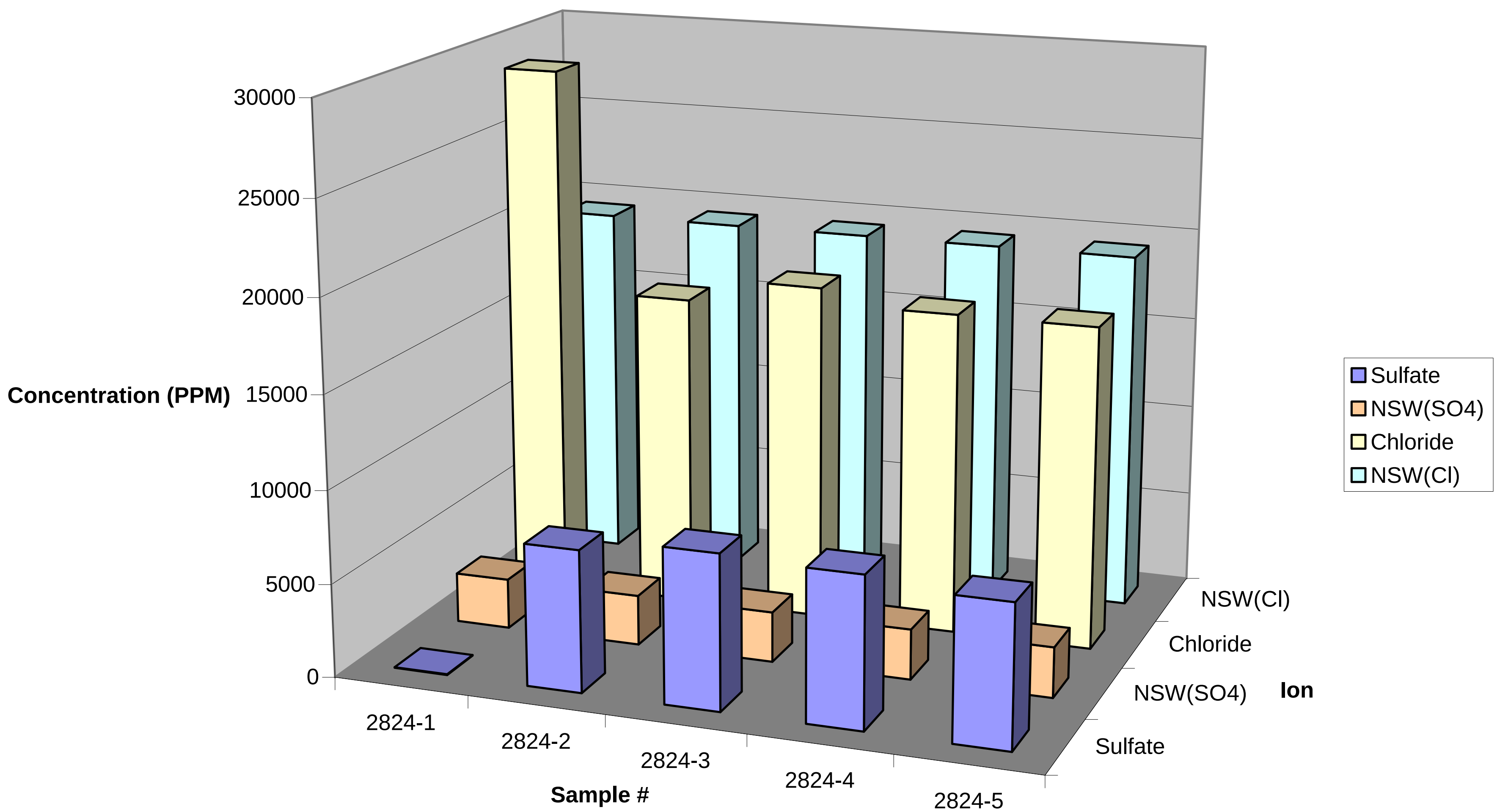
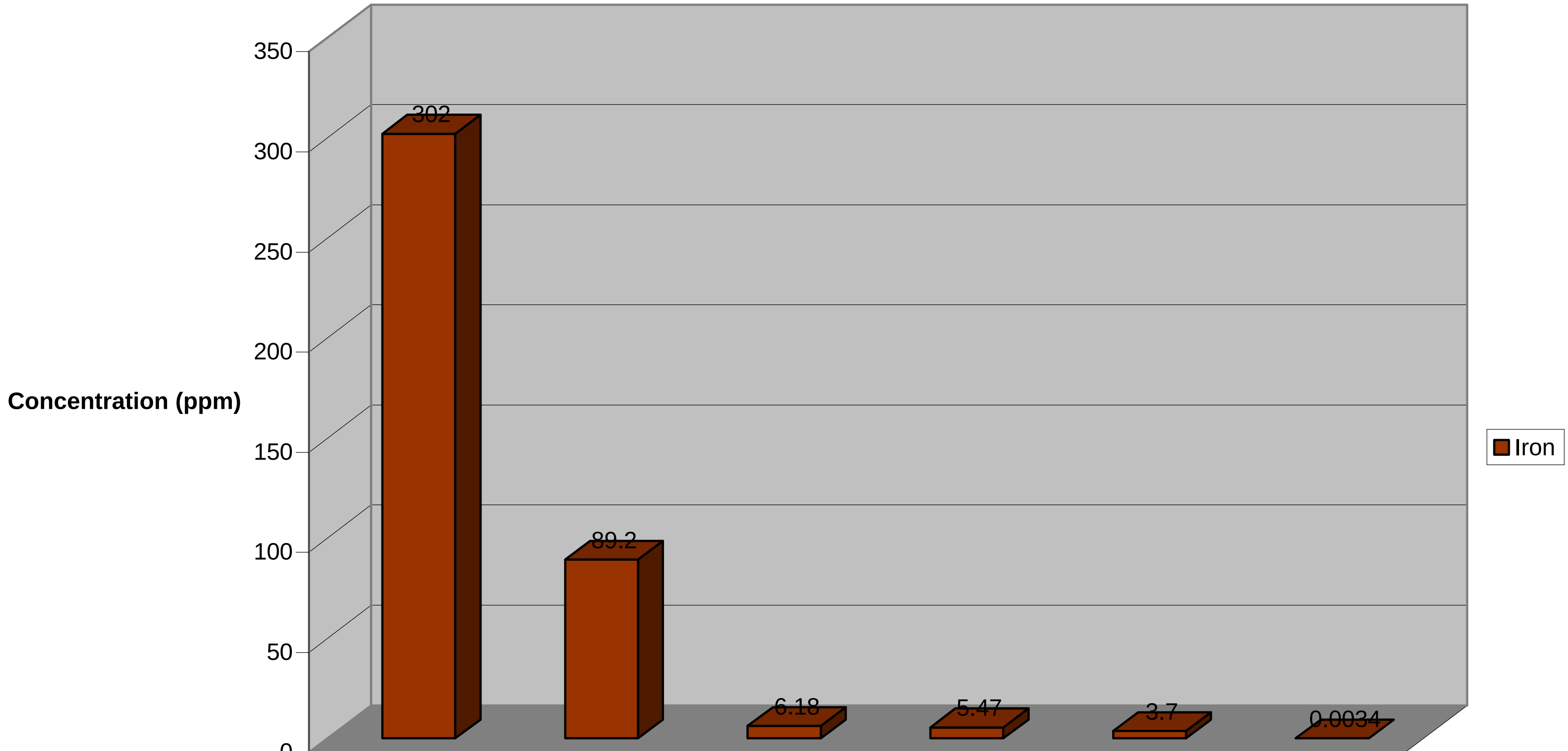


Figure 27 - Iron Concentration



	2824-1	2824-2	2824-3	2824-4	2824-5	NSW
Iron	302	89.2	6.18	5.47	3.7	0.0034

Sample #

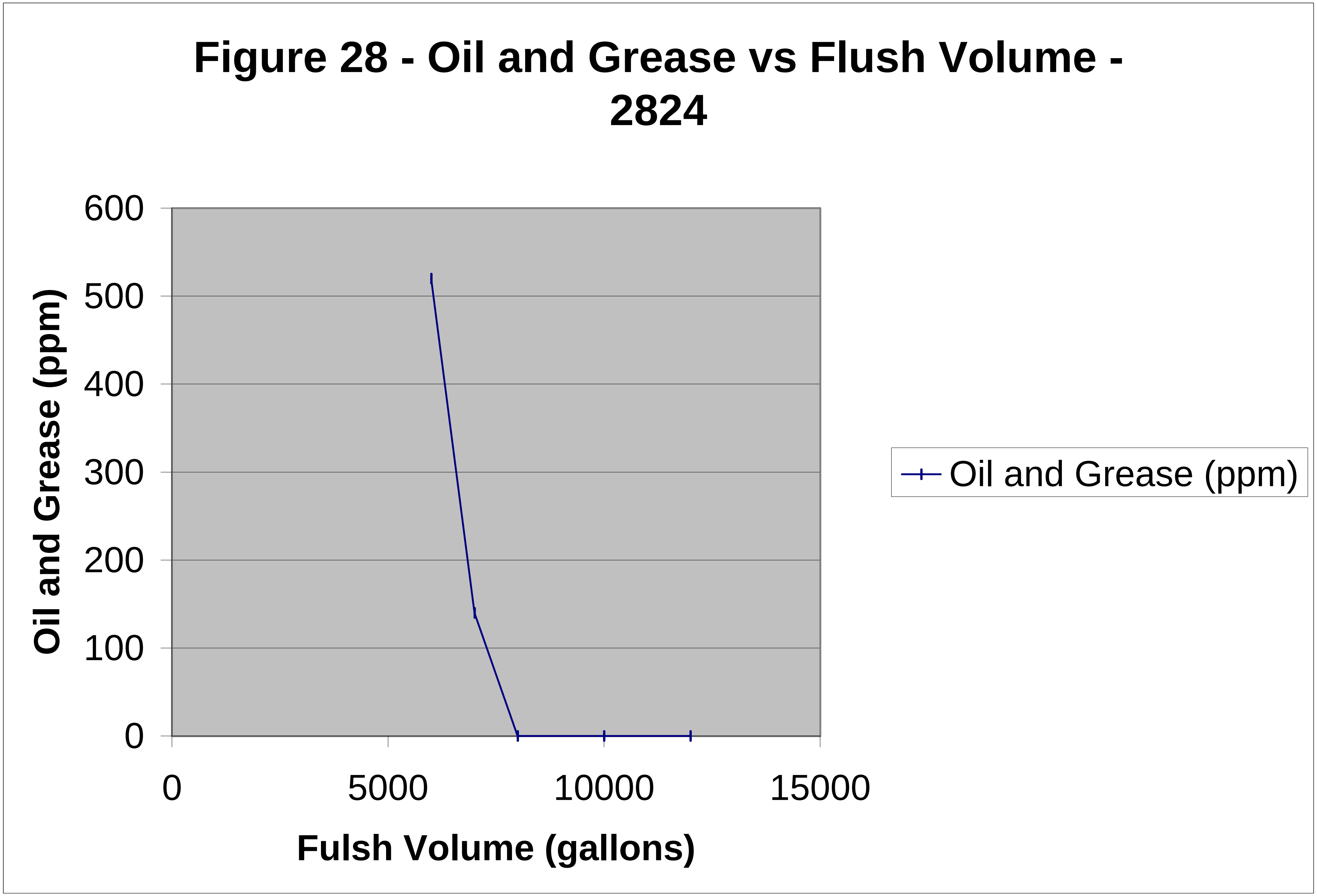


Figure 28 - Oil and Grease vs Flush Volume - 2824
Oil and Grease (ppm)
600
500
400
300
200
100
0
0
5000
10000
15000
Fulsh Volume (gallons)
Oil and Grease (ppm)

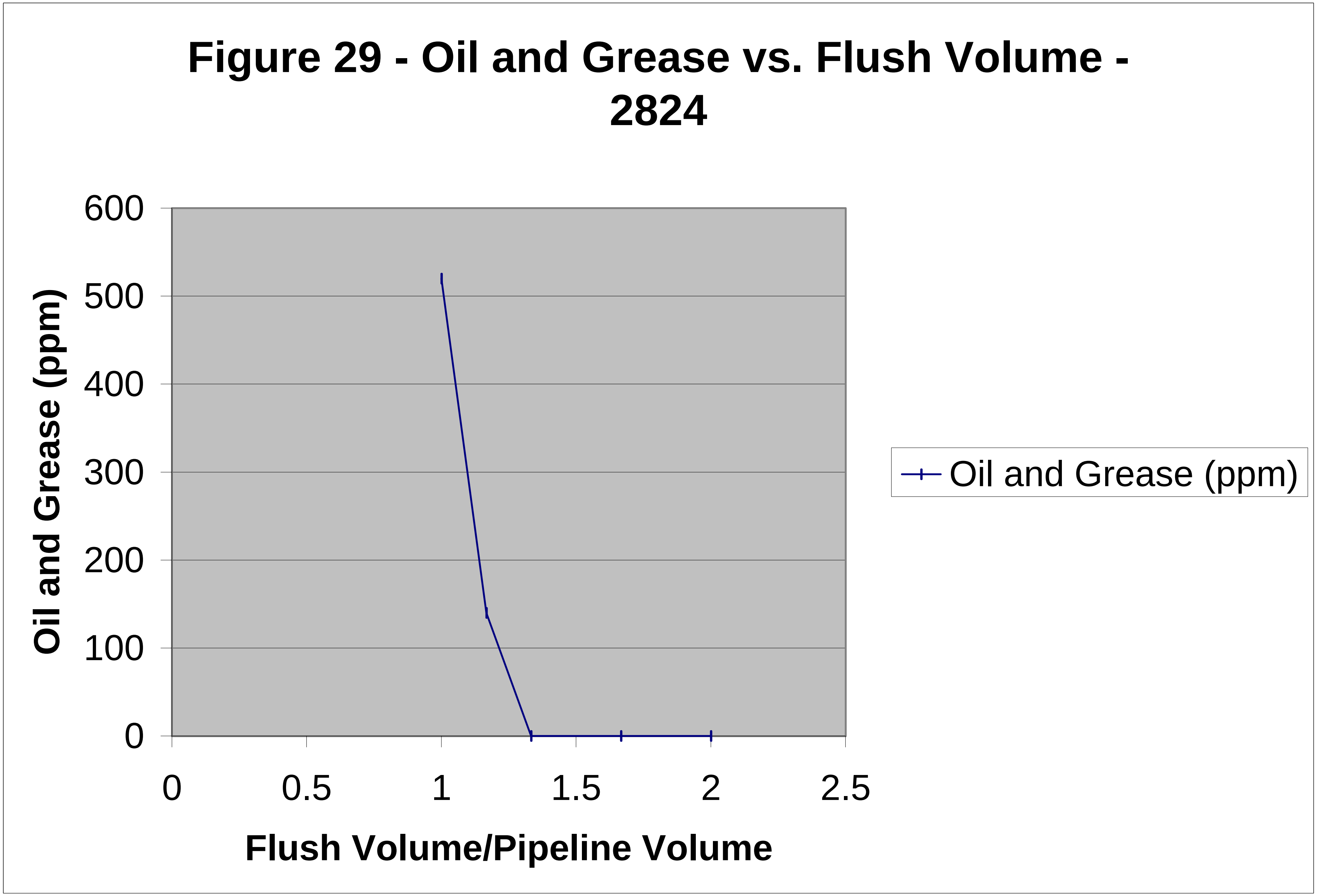


Figure 29 - Oil and Grease vs. Flush Volume - 2824
600
500
400
300
200
100
0
0
0.5
1
1.5
2
2.5
Oil and Grease (ppm)
Flush Volume/Pipeline Volume
Oil and Grease (ppm)

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 110003-003A

Sample ID.: 2824-AA
: 10/26/00 WM0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suite 150
: Houston, Texas 77092

TCD Analysis:

COMPONENTS	SAMPLE MOL %
Hydrogen	0.817
Carbon Dioxide	0.000
Ethylene	0.000
Ethane	0.824
Acetylene	0.000
Argon/Oxygen	1.108
Nitrogen	4.276
Methane	92.472
Carbon Monoxide	0.000

UnNormalized, Mol% : 96.842

Specific Gravity : 0.5879
(Air = 1.000 @ 60F)

	Net	Gross
BTU / ft3 :	872.8 Dry	969.0 Dry
(@ 14.65 & 60F)	857.6 Wet	952.2 Wet

SOUTHERN PETROLEUM LABORATORIES, INC.

Fred De Angelo

Fred C. DeAngelo

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 110003-003A

Sample ID.: 2824-AA
: 10/26/00 WM0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suite 150
: Houston, Texas 77092

FID Analysis:

COMPONENTS	SAMPLE MOL %	
Hexanes Plus	0.264	
Methane	92.472	
Ethane/Ethylene	0.824 /	0.000
Propane	0.133	
Propylene	0.000	
iso-Butane	0.031	
Propadiene	0.000	
n-Butane	0.032	
Butene-1	0.000	
Neo-Pentane	None Detected	
iso-Butene	0.000	
trans-Butene-2	0.000	
cis-Butene-2	0.000	
1,3-Butadiene	0.000	
iso-Pentane	0.022	
n-Pentane	0.023	

SOUTHERN PETROLEUM LABORATORIES, INC.

Fred De Angelo

Fred C. DeAngelo

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 110003-003A

Sample ID.: 2824-AA
: 10/26/00 WM0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suite 150
: Houston, Texas 77092

Completed Analysis:

Component	MOL %	WT%
Hydrogen	0.817	0.097
Carbon Dioxide	0.000	0.000
Carbon Monoxide	0.000	0.000
Ethylene	0.000	0.000
Acetylene/Propylene	0.000 / 0.000	0.000 / 0.000
Argon/Oxygen	1.108	2.082
Nitrogen	4.276	7.038
Methane	92.472	87.116
Ethane	0.824	1.455
Propane	0.133	0.344
iso-Butane	0.031	0.105
Propadiene	0.000	0.000
n-Butane	0.032	0.109
Butene-1	0.000	0.000
Neo-Pentane	0.000	0.000
iso-Butene	0.000	0.000
trans-Butene-2	0.000	0.000
cis-Butene-2	0.000	0.000
1,3-Butadiene	0.000	0.000
iso-Pentane	0.022	0.092
n-Pentane	0.023	0.097
Hexane Plus	0.264	1.466
	100.000	100.000

SOUTHERN PETROLEUM LABORATORIES, INC.

Fred De Angelo

Fred C. DeAngelo

SPL®

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8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 110003-004A

Sample ID.: 2824-ZZ
: 10/26/00 WM0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suite 150
: Houston, Texas 77092

TCD Analysis:

COMPONENTS	SAMPLE MOL %
Hydrogen	0.414
Carbon Dioxide	0.020
Ethylene	0.000
Ethane	0.761
Acetylene	0.000
Argon/Oxygen	3.709
Nitrogen	15.000
Methane	79.591
Carbon Monoxide	0.000

UnNormalized, Mol% : 95.310

Specific Gravity : 0.6486
(Air = 1.000 @ 60F)

	Net	Gross
BTU / ft3 :	754.2 Dry	837.2 Dry
(@ 14.65 & 60F)	741.1 Wet	822.6 Wet

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CERTIFICATE OF ANALYSIS NUMBER : 110003-004A

Sample ID.: 2824-ZZ
: 10/26/00 WM0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suite 150
: Houston, Texas 77092

FID Analysis:

COMPONENTS	SAMPLE MOL %		
Hexanes Plus	0.274		
Methane	79.591		
Ethane/Ethylene	0.761	/	0.000
Propane	0.127		
Propylene	0.000		
iso-Butane	0.029		
Propadiene	0.000		
n-Butane	0.031		
Butene-1	0.000		
Neo-Pentane	None Detected		
iso-Butene	0.000		
trans-Butene-2	0.000		
cis-Butene-2	0.000		
1,3-Butadiene	0.000		
iso-Pentane	0.021		
n-Pentane	0.023		

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CERTIFICATE OF ANALYSIS NUMBER : 110003-004A

Sample ID.: 2824-ZZ
: 10/26/00 WM0070

For : Winmar
Attn: James Wiseman
: 5700 NW Central Dr. Suite 150
: Houston, Texas 77092

Completed Analysis:

Component	MOL %			WT%		
Hydrogen	0.414			0.044		
Carbon Dioxide	0.020			0.048		
Carbon Monoxide	0.000			0.000		
Ethylene	0.000			0.000		
Acetylene/Propylene	0.000	/	0.000	0.000	/	0.000
Argon/Oxygen	3.709			6.318		
Nitrogen	15.000			22.379		
Methane	79.591			67.965		
Ethane	0.761			1.218		
Propane	0.127			0.298		
iso-Butane	0.029			0.090		
Propadiene	0.000			0.000		
n-Butane	0.031			0.095		
Butene-1	0.000			0.000		
Neo-Pentane	0.000			0.000		
iso-Butene	0.000			0.000		
trans-Butene-2	0.000			0.000		
cis-Butene-2	0.000			0.000		
1,3-Butadiene	0.000			0.000		
iso-Pentane	0.021			0.080		
n-Pentane	0.023			0.087		
Hexane Plus	0.274			1.377		
	100.000			100.000		

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HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2824-B **Collected:** **SPL Sample ID:** 00100898-02

Site: WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			**MCL**		**E413.1**	**Units: mg/L**		
Oil & Grease,Total Recoverable	520	2.0		1	E	11/06/00 9:00		461295

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

11/7/00 11:56:27 AM

HOUSTON LABORATORY
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(713) 660-0901

Client Sample ID 2824-A | Collected: | SPL Sample ID: 00100898-01

Site: WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			MCL	E413.1		Units: mg/L		
Oil & Grease,Total Recoverable	140	2.0		1	E	11/06/00 9:00		461292

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
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Client Sample ID 2824-C | Collected: | SPL Sample ID: 00100898-03

Site: WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			MCL		E413.1	Units: mg/L		
Oil & Grease,Total Recoverable	ND	2.0		1		11/06/00 9:00		461297

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

11/7/00 11:56:27 AM

HOUSTON LABORATORY
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HOUSTON, TEXAS 77054
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Client Sample ID 2824-D **Collected:** **SPL Sample ID:** 00100898-04

Site: WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			**MCL**		**E413.1**	**Units: mg/L**		
Oil & Grease,Total Recoverable	ND	2.0		1		11/06/00 9:00		461299

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

11/7/00 11:58:27 AM

HOUSTON LABORATORY
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(713) 660-0901

Client Sample ID 2824-E **Collected:** **SPL Sample ID:** 00100898-05

Site: WM0070

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			**MCL**	**E413.1**		**Units: mg/L**		
Oil & Grease,Total Recoverable	ND	2.0		1		11/06/00 9:00		461301

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2824-1 | Collected: | SPL Sample ID: 00100896-02

Site: HI 135/136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Bicarbonate	303	2		1		11/01/00 14:00	SN	461519
ALKALINITY, CARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Carbonate	ND	2		1		11/01/00 14:00	SN	460245
CHLORIDE, TOTAL			MCL	E325.3		Units: mg/L		
Chloride	28800	500		500		11/08/00 11:00	CV	468312
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B		Units: mg/L		
Barium	15.7	0.005		1		11/10/00 21:29	E_B	471277
Calcium	550	1		10		11/10/00 21:35	E_B	471278
Iron	302	0.2		10		11/10/00 21:35	E_B	471278
Magnesium	128	0.1		1		11/13/00 15:47	JM	471763
Potassium	176	2		1		11/13/00 15:47	JM	471763

Run ID/Seq #: TJA_001110C-471277

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001110C-471278

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471763

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1		Units: pH Units		
pH	5.5	0.10		1		11/01/00 16:00	EC	458736
RESISTANCE @ 25 C			MCL	120.1		Units: Mohms/cm		
Resistance	0.054	0.00100		1		11/03/00 9:15	C_V	461398
SPECIFIC GRAVITY			MCL	ASTM D-1429		Units: Specific Gravity @		
Specific Gravity	1.045	0		1		11/06/00 11:00	C_V	462230
SULFATE, TOTAL			MCL	E375.4		Units: mg/L		
Sulfate	35	5		5		11/01/00 10:00	SN	458826
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL		Units: mg/L		
Total Dissolved Solids, Calculated	47900	10		1		11/13/00 18:00	ES	471967
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL		Units: mg/L		
Total Sodium, Calculated	17600	10		1		11/13/00 18:00	ES	471984

Qualifiers:
- ND/U - Not Detected at the Reporting Limit
- B - Analyte detected in the associated Method Blank
- * - Surrogate Recovery Outside Advisable QC Limits
- J - Estimated Value between MDL and PQL
- >MCL - Result Over Maximum Contamination Limit(MCL)
- D - Surrogate Recovery Unreportable due to Dilution
- MI - Matrix Interference

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Client Sample ID 2824-1	Collected:	SPL Sample ID: 00100896-02
	Site: HI 135/136	

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
TOTAL SUSPENDED SOLIDS			MCL	E160.2		Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	9380	20		5		11/02/00 15:00	EC	461987

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2824-2 **Collected:** **SPL Sample ID:** 00100896-03

Site: HI 135/136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Bicarbonate	141	2		1		11/01/00 14:00	SN	461521
ALKALINITY, CARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Carbonate	ND	2		1		11/01/00 14:00	SN	460246
CHLORIDE, TOTAL			MCL	E325.3		Units: mg/L		
Chloride	16900	500		500		11/08/00 11:00	CV	468313
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B		Units: mg/L		
Barium	4.59	0.005		1		11/10/00 21:44	E_B	471279
Calcium	375	0.1		1		11/10/00 21:44	E_B	471279
Iron	89.2	0.02		1		11/10/00 21:44	E_B	471279
Magnesium	1320	1		10		11/13/00 16:04	JM	471767
Potassium	397	20		10		11/13/00 16:04	JM	471767

Run ID/Seq #: TJA_001110C-471279

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471767

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1		Units: pH Units		
pH	7.8	0.10		1		11/01/00 16:00	EC	458737
RESISTANCE @ 25 C			MCL	120.1		Units: Mohms/cm		
Resistance	0.0042	0.00100		1		11/03/00 9:15	C_V	461399
SPECIFIC GRAVITY			MCL	ASTM D-1429		Units: Specific Gravity @		
Specific Gravity	1.029	0		1		11/06/00 11:00	C_V	462231
SULFATE, TOTAL			MCL	E375.4		Units: mg/L		
Sulfate	7600	1000		1000		11/01/00 10:00	SN	458827
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL		Units: mg/L		
Total Dissolved Solids, Calculated	38200	10		1		11/13/00 18:00	ES	471968
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL		Units: mg/L		
Total Sodium, Calculated	11400	10		1		11/13/00 18:00	ES	471985
TOTAL SUSPENDED SOLIDS			MCL	E160.2		Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	328	16		4		11/02/00 15:00	EC	461988

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2824-3 **Collected:** **SPL Sample ID:** 00100896-04

Site: HI 135/136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			**MCL**	**M2320 B**		**Units: mg/L**		
Alkalinity, Bicarbonate	162	2		1		11/01/00 14:00	SN	461524
ALKALINITY, CARBONATE			**MCL**	**M2320 B**		**Units: mg/L**		
Alkalinity, Carbonate	ND	2		1		11/01/00 14:00	SN	460247
CHLORIDE, TOTAL			**MCL**	**E325.3**		**Units: mg/L**		
Chloride	18200	250		250		11/08/00 11:00	CV	468316
METALS BY METHOD 6010B, TOTAL			**MCL**	**SW6010B**		**Units: mg/L**		
Barium	0.487	0.005		1		11/10/00 21:53	E_B	471280
Calcium	413	0.1		1		11/10/00 21:53	E_B	471280
Iron	6.18	0.02		1		11/10/00 21:53	E_B	471280
Magnesium	1340	1		10		11/13/00 16:09	JM	471768
Potassium	410	20		10		11/13/00 16:09	JM	471768

Run ID/Seq #: TJA_001110C-471280

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471768

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			**MCL**	**E150.1**		**Units: pH Units**		
pH	8.1	0.10		1		11/01/00 16:00	EC	458738
RESISTANCE @ 25 C			**MCL**	**120.1**		**Units: Mohms/cm**		
Resistance	ND	0.00100		1		11/03/00 9:15	C_V	461400
SPECIFIC GRAVITY			**MCL**	**ASTM D-1429**		**Units: Specific Gravity @**		
Specific Gravity	1.019	0		1		11/06/00 11:00	C_V	462232
SULFATE, TOTAL			**MCL**	**E375.4**		**Units: mg/L**		
Sulfate	8300	1000		1000		11/01/00 10:00	SN	458828
TOTAL DISSOLVED SOLIDS			**MCL**	**TDS-MINERAL**		**Units: mg/L**		
Total Dissolved Solids, Calculated	41400	10		1		11/13/00 18:00	ES	471969
TOTAL SODIUM, CALCULATED			**MCL**	**TDS-MINERAL**		**Units: mg/L**		
Total Sodium, Calculated	12600	10		1		11/13/00 18:00	ES	471986
TOTAL SUSPENDED SOLIDS			**MCL**	**E160.2**		**Units: mg/L**		
Suspended Solids (Residue,Non-Filterable)	41	4		1		11/03/00 15:45	EC	462116

Qualifiers:
- ND/U - Not Detected at the Reporting Limit
- B - Analyte detected in the associated Method Blank
- * - Surrogate Recovery Outside Advisable QC Limits
- J - Estimated Value between MDL and PQL
- >MCL - Result Over Maximum Contamination Limit(MCL)
- D - Surrogate Recovery Unreportable due to Dilution
- MI - Matrix Interference

HOUSTON LABORATORY
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Client Sample ID 2824-4 **Collected:** **SPL Sample ID:** 00100896-05

Site: HI 135/136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Bicarbonate	162	2		1		11/01/00 14:00	SN	461526
ALKALINITY, CARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Carbonate	ND	2		1		11/01/00 14:00	SN	460248
CHLORIDE, TOTAL			MCL	E325.3		Units: mg/L		
Chloride	17400	250		250		11/08/00 11:00	CV	468317
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B		Units: mg/L		
Barium	0.184	0.005		1		11/10/00 21:58	E_B	471281
Calcium	397	0.1		1		11/10/00 21:58	E_B	471281
Iron	5.47	0.02		1		11/10/00 21:58	E_B	471281
Magnesium	1310	1		10		11/13/00 16:13	JM	471769
Potassium	402	20		10		11/13/00 16:13	JM	471769

Run ID/Seq #: TJA_001110C-471281

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471769

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1		Units: pH Units		
pH	8.2	0.10		1		11/01/00 16:00	EC	458739
RESISTANCE @ 25 C			MCL	120.1		Units: Mohms/cm		
Resistance	ND	0.00100		1		11/03/00 9:15	C_V	461401
SPECIFIC GRAVITY			MCL	ASTM D-1429		Units: Specific Gravity @		
Specific Gravity	1.013	0		1		11/06/00 11:00	C_V	462233
SULFATE, TOTAL			MCL	E375.4		Units: mg/L		
Sulfate	8100	1000		1000		11/01/00 10:00	SN	458829
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL		Units: mg/L		
Total Dissolved Solids, Calculated	39800	10		1		11/13/00 18:00	ES	471970
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL		Units: mg/L		
Total Sodium, Calculated	12000	10		1		11/13/00 18:00	ES	471987
TOTAL SUSPENDED SOLIDS			MCL	E160.2		Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	30	4		1		11/03/00 15:45	EC	462118

Qualifiers:
ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
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(713) 660-0901

Client Sample ID 2824-5 **Collected:** **SPL Sample ID:** 00100896-06

Site: HI 135/136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL		M2320 B	Units: mg/L		
Alkalinity, Bicarbonate	162	2		1		11/01/00 14:00	SN	461527
ALKALINITY, CARBONATE			MCL		M2320 B	Units: mg/L		
Alkalinity, Carbonate	ND	2		1		11/01/00 14:00	SN	460249
CHLORIDE, TOTAL			MCL		E325.3	Units: mg/L		
Chloride	17400	250		250		11/08/00 11:00	CV	468318
METALS BY METHOD 6010B, TOTAL			MCL		SW6010B	Units: mg/L		
Barium	0.0416	0.005		1		11/10/00 22:02	E_B	471282
Calcium	410	0.1		1		11/10/00 22:02	E_B	471282
Iron	3.7	0.02		1		11/10/00 22:02	E_B	471282
Magnesium	1320	1		10		11/13/00 16:17	JM	471770
Potassium	401	20		10		11/13/00 16:17	JM	471770

Run ID/Seq #: TJA_001110C-471282

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Run ID/Seq #: TJA_001113B-471770

Prep Method	Prep Date	Prep Initials
SW3010A	11/01/2000 8:30	MR

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL		E150.1	Units: pH Units		
pH	8.2	0.10		1		11/01/00 16:00	EC	458740
RESISTANCE @ 25 C			MCL		120.1	Units: Mohms/cm		
Resistance	ND	0.00100		1		11/03/00 9:15	C_V	461402
SPECIFIC GRAVITY			MCL		ASTM D-1429	Units: Specific Gravity @		
Specific Gravity	1.016	0		1		11/06/00 11:00	C_V	462234
SULFATE, TOTAL			MCL		E375.4	Units: mg/L		
Sulfate	7600	1000		1000		11/01/00 10:00	SN	458830
TOTAL DISSOLVED SOLIDS			MCL		TDS-MINERAL	Units: mg/L		
Total Dissolved Solids, Calculated	39100	10		1		11/13/00 18:00	ES	471971
TOTAL SODIUM, CALCULATED			MCL		TDS-MINERAL	Units: mg/L		
Total Sodium, Calculated	11800	10		1		11/13/00 18:00	ES	471988
TOTAL SUSPENDED SOLIDS			MCL		E160.2	Units: mg/L		
Suspended Solids (Residue,Non-Filterable)	51	4		1		11/03/00 15:45	EC	462119

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

9. Results and Observations – 2826

a. Sample/Locations Observations

Gas samples were taken at the top of the riser before the blind flange was removed and when the odor of natural gas was present. All bolts and flange seals were intact before testing and did not indicate any leakage. H2S length of stain tests were performed at this time. The first gas samples were taken using both vacuum tubes and Tedlar bags. The remaining samples were taken using Tedlar bags. The riser appears to have been disconnected and blind flanged at some point in the past.

The water samples taken at the top of riser bleed valve seemed uniform, and representative of the flush fluid stream.

A five foot (5') sample of the pipeline was removed, which included the tubeturn to pipeline weld.

b. Gas Composition Observations

The results of the gas analysis are plotted and summarized in the results section. Atmospheric air composition is also plotted for reference/comparison purposes.

Four gas samples were taken. Only the last sample (just before the slug of water arrived) was high in methane. The first sample was also about 30% methane. The gas samples from the center of the pipeline were mainly composed of atmospheric air. One explanation for this would be for the line to have been bled down and opened for some time-period. Since air is heavier than methane, the air would have "sunk" to the bottom of the pipeline, leaving the gas at the tops of the risers. The data confirms this, due to the fact that the sample furthest from the production platform (where the pipeline was opened) was almost completely methane.

The gas samples did not contain any H2S or CO2.

c. Flushwater Composition Observations

The flushwater composition for segment 2826 is plotted in the results section. Natural Seawater composition is also plotted for comparison purposes. The ions/elements plotted are: Alkalinity (CO3), Barium, Calcium, Iron, Magnesium, and Potassium. Because of their high values (in PPM), Chlorides and Sulfates are plotted on a separate chart.

For the flushwater, the mineral pattern relative to NSW is summarized below:

Alkalinity (bicarb) – Higher
Barium – Higher for first two samples
Calcium – Higher for first two samples
Iron – Higher
Magnesium – Lower for first two samples, then Equal
Potassium – Lower/Equal
Chloride – Higher for first two samples, then Equal
Sulfate – Lower for first two samples

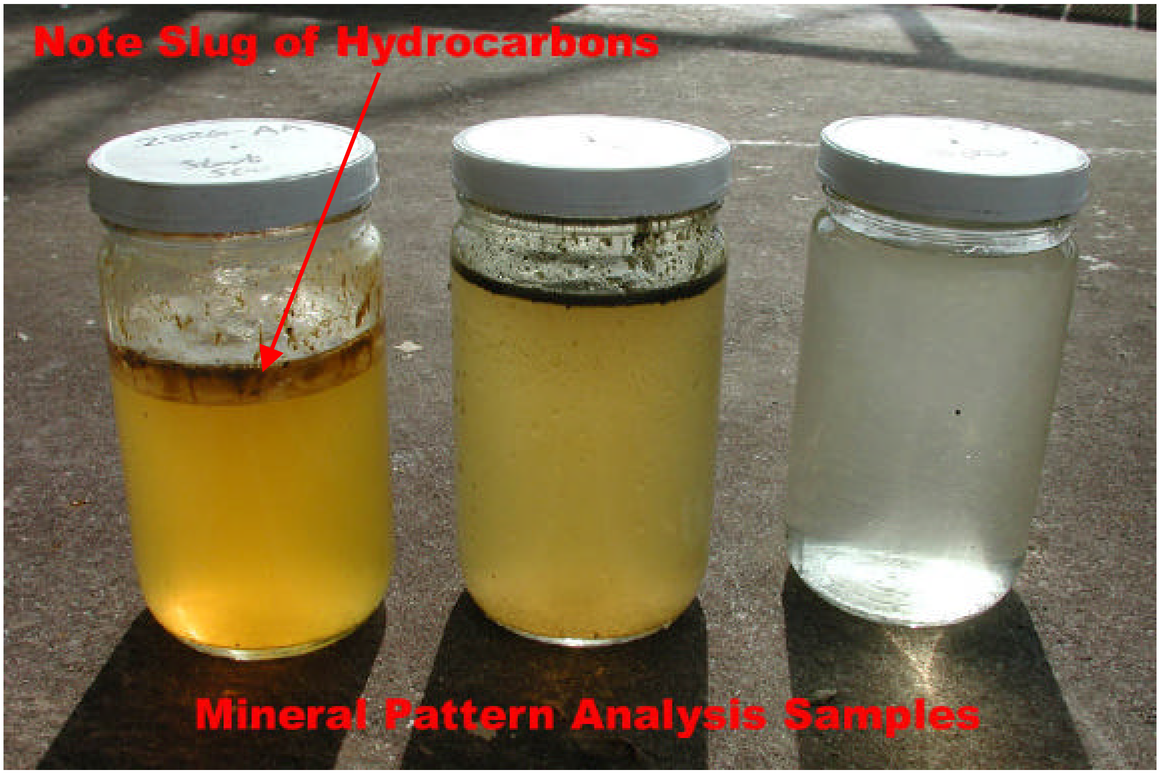


Photo #25

Again, the iron content is plotted as a separate graph in order to focus on these values. The first sample taken at the very front of the flushwater "slug" has an extremely high iron concentration of 117 ppm (ppm also equals milligrams/liter). The concentration is over 34,000 times greater than NSW. As with segment 2824, the first sample was taken right at the very front of the flushwater "slug." In fact, in anticipation of the incoming fluid, the sampling valve was left open, so that the very first fluid out of the pipeline was taken as the first water sample. The slug picked up quite a bit of debris, and was very high in condensate, as is evidenced in the photographs. This debris included metal particles which were picked up from the pipe wall. The sampling procedure "dissolved" these metal particles and recorded them as a concentration value. The following four samples were lower in concentration, but still much higher than NSW values.

The ions/elements to focus on from this analysis are those found in steel corrosion products: FeO_2, FeS. The samples showed higher than NSW concentrations of iron, but Sulfate was below NSW levels for the first two samples, and above NSW levels for the last sample.

d. Oil and Grease Observations

At completion of flushing, oil and grease was non-detectible in the samples taken. The detection limit is 2.5 PPM. As noted above, the very first sample was high in hydrocarbons because it contained a good deal of the condensate that was present in the line. The photos show this condensate as a frothy brown/orange mixture on top of the water sample. The graph shows a very rapid drop in oil and grease concentration, with the non-detectable limit appearing to be reached at 1.75x flush volume.

e. Pipe Cutout Observations

A five foot section of pipe was retrieved. This section was taken from the base of the platform, and included pipe on both sides of the weld connecting the pipeline to the riser/tubeturn. The sample included the pipe/tubeturn weld.

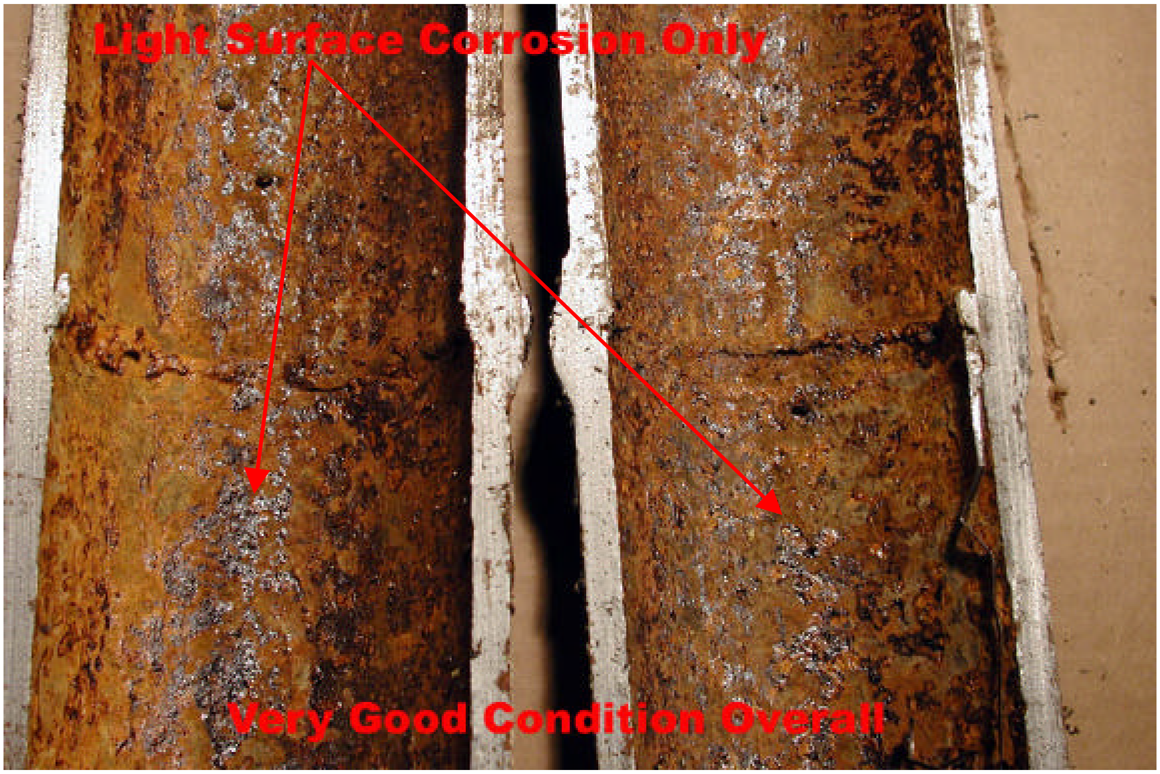


Photo #26 Sample Photo – 2826

This pipe sample appeared to be in very good condition. Light surface rust was present, but no metal loss patches were evident in the section retrieved.

The tubeturn/pipeline weld appeared to be in good condition as well.

Photo #27 - Sample Photo – 2826 Pipeline to Tubeturn Weld

WINMAR consulting services, inc.

SHELL OFFSHORE INC.
HI-136-2

PLATFORM

MMS General		ODS General		MMS Location		MMS Facility	
Water	50 feet	**Function**	WP	**Lease**	742 feet	**Helideck**	Yes
Major	No	**Piles**	NA	**Complex**	10027	**Quarters**	None
Decks	1	**Slots**	3	**Longitude**	-94.126	**Generator**	No
Slots	3	**ODS ID**	743	**Latitude**	29.261	**Cranes**	NA
Wells	2	**Previous 1**	NA	**X**	3,553,610'	**Gas**	Yes
Flare	No	**Previous 2**	NA	**Y**	551,545'	**Oil**	No
Installed	01 1965	**Previous 3**	NA	**To Shore**	25 miles	**Comp**	No
Revised	12 1998	**Previous 4**	NA	**N-S feet**	S 5065'	**8 hour**	No
Removed	NA	**Notes**	NA	**E-W feet**	E 1386'	**24 hour**	No

PIPELINES MMS

Segment	2826			
Origin	HI-136-2			
Terminus	HI-136-A			
O.D.	3"			
Length	1,500'			
Product	BLKG			
Status	ACT			
Installed	NA			
Abandon	NA			
Revised	Oct-98			
Operator	SHELL OFFSHORE INC.			

WELLS MMS

API Well ID	Well	Spud	Revised	Status	MD	Bot Lease	Sur Long	Sur Lat
427080004300	1	05 1964	06 1964	PA	12,516'	742	-94.126	29.255
427080005100	2	09 1964	10 1985	ST	9,341'	742	-94.126	29.261
427080005101	2	10 1985	12 1989	COM	9,500'	742	-94.126	29.261
427080005200	3	12 1964	11 1995	ST	10,490'	742	-94.125	29.263
427080005201	3	11 1995	02 1996	COM	9,853'	742	-94.134	29.263
427080005300	4	01 1965	05 1975	PA	10,604'	742	-94.138	29.257
427080005400	5	02 1965	02 1965	COM	9,192'	742	-94.135	29.249
427080005500	6	05 1965	06 1965	PA	9,134'	742	-94.134	29.269
427080006300	7	07 1965	08 1965	PA	9,690'	742	-94.149	29.254
427084000100	8	06 1971	11 1985	ST	9,130'	742	-94.131	29.261
427084000101	8	11 1985	01 1986	COM	11,829'	742	-94.146	29.261
427084022000	10	12 1985	12 1995	ST	10,500'	741	-94.111	29.275
427084022001	10	12 1995	12 1995	COM	10,883'	741	-94.116	29.275
427084042200	10	01 1996	02 1996	COM	10,800'	742	-94.135	29.275

WINMAR consulting services, inc.

PIPELINE FLUSHING AND SAMPLING RECORD

I. Pipeline Information

MMS Segment No.	2826
Date:	11/3/2000
Pipeline Origination	
Area	High Island
Block	136
Platform	#2
Lease	OCS-G-0742
Pipeline Destination	
Area	High Island
Block	136
Platform	A
Lease	OCS-G-0742
Pipeline Size (in)	3
Pipelines Length (ft)	1,500
Pipeline Volume (bbls)	13

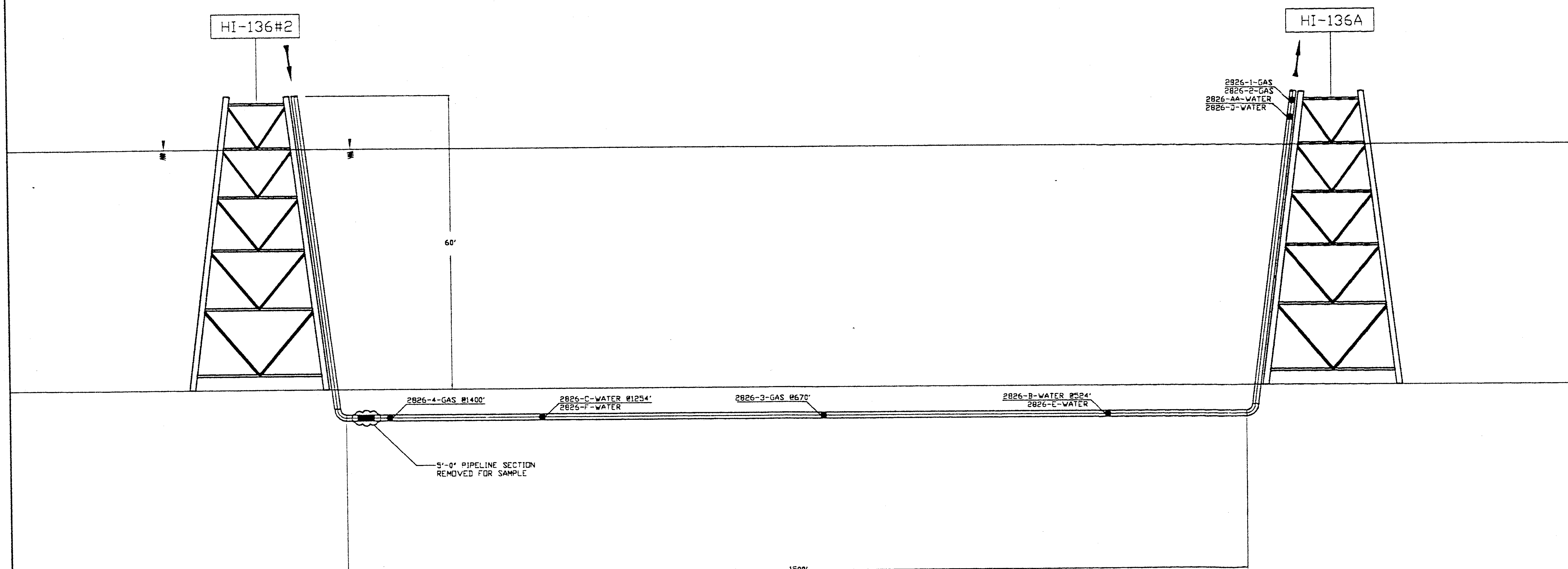
II. Flushing Information

Flushing Information	
Volume Flushed	1000 Gallons
Flow Rate (GPM)	~ 100
Pigged Used	No
Type of Pig	
Size of Pig	
Clean Returns	Yes
Inhibitor	
Chemical Inhibitor Used	
Type of Chemical	
Quantity of Chemical	
Origination Riser	
Riser blind flanged w/ vent valve	Yes
Pipeline Tagged	Yes
Destination Riser	
Riser blind flanged w/ vent valve	Yes
Pipeline Tagged	Yes
Comments:	
Company Representative	
Signature	

WINMAR consulting services, inc.

III. Sampling Data - Tracking Information

Sample Location				
Platform:	HI 136A			
Pipeline Sampling Site:	Top of Riser Bleed Valve			
Flushing Start Time:	10:00			
Gas Samples	Sample ID	Sample Date	Vol. Flushed (g)	H2S (PPM)
Vacuum Tubes	2826-1	10/23/2000	0	0
	None			
	None			
	None			
Plastic Bags	None			
	2826-2	11/3/2000	0	0
	2826-3	11/3/2000	250	
	2826-4	11/3/2000	500	
	2826-5	11/3/2000	500-600	
Water Samples	Sample ID	Sample Date	Vol. Flushed (g)	Notes
Mineral Pattern Analysis				
	2826-AA	11/3/2000	500	
	2826-B	11/3/2000	750	
	2826-C	11/3/2000	1,000	
Oil and Grease Analysis				
	2826-D	11/3/2000	500	
	2826-E	11/3/2000	750	
	2826-F	11/3/2000	1,000	
Comments:				
Company Representative	James Wiseman			
Signature				



PL SEGMENT	2826
LENGTH	1820 FT.
VOLUME FLUSHED	1000 GAL.
PL VOLUME FLG/FLG	550 GAL.

REV	DATE	DESCRIPTION	BY	APP'D
0	11/00	ISSUED	CSA	JW

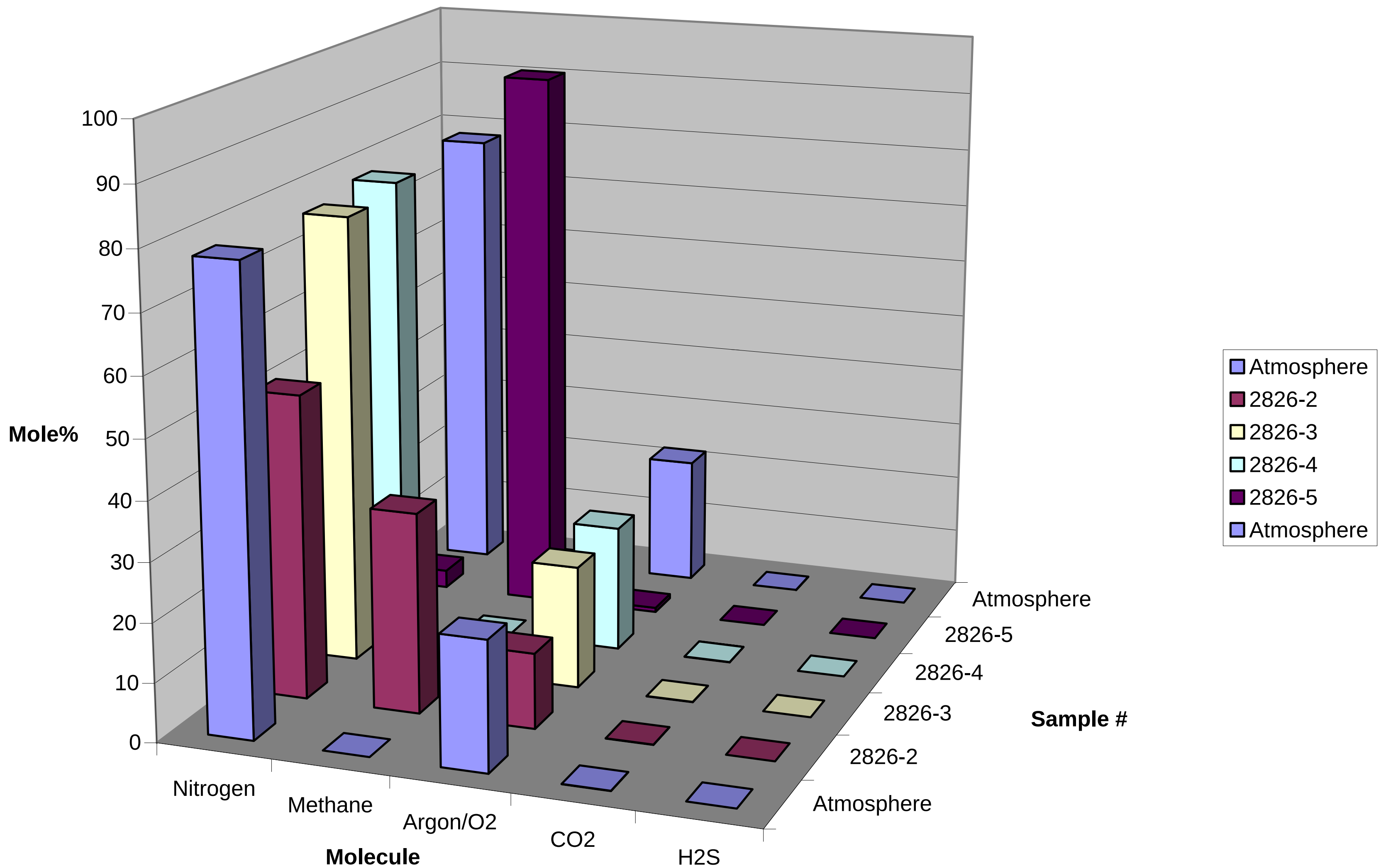
PROJECT# WM0070

PIPELINE SAMPLE LOCATIONS

HIGH ISLAND 136 #2 / HIGH ISLAND 136A

	DATE	DWG. NO.	REV.
CSA	11/00	WM0070A.DWG	0

Figure 31 - Gas Composition (Major Constituents) - 2826



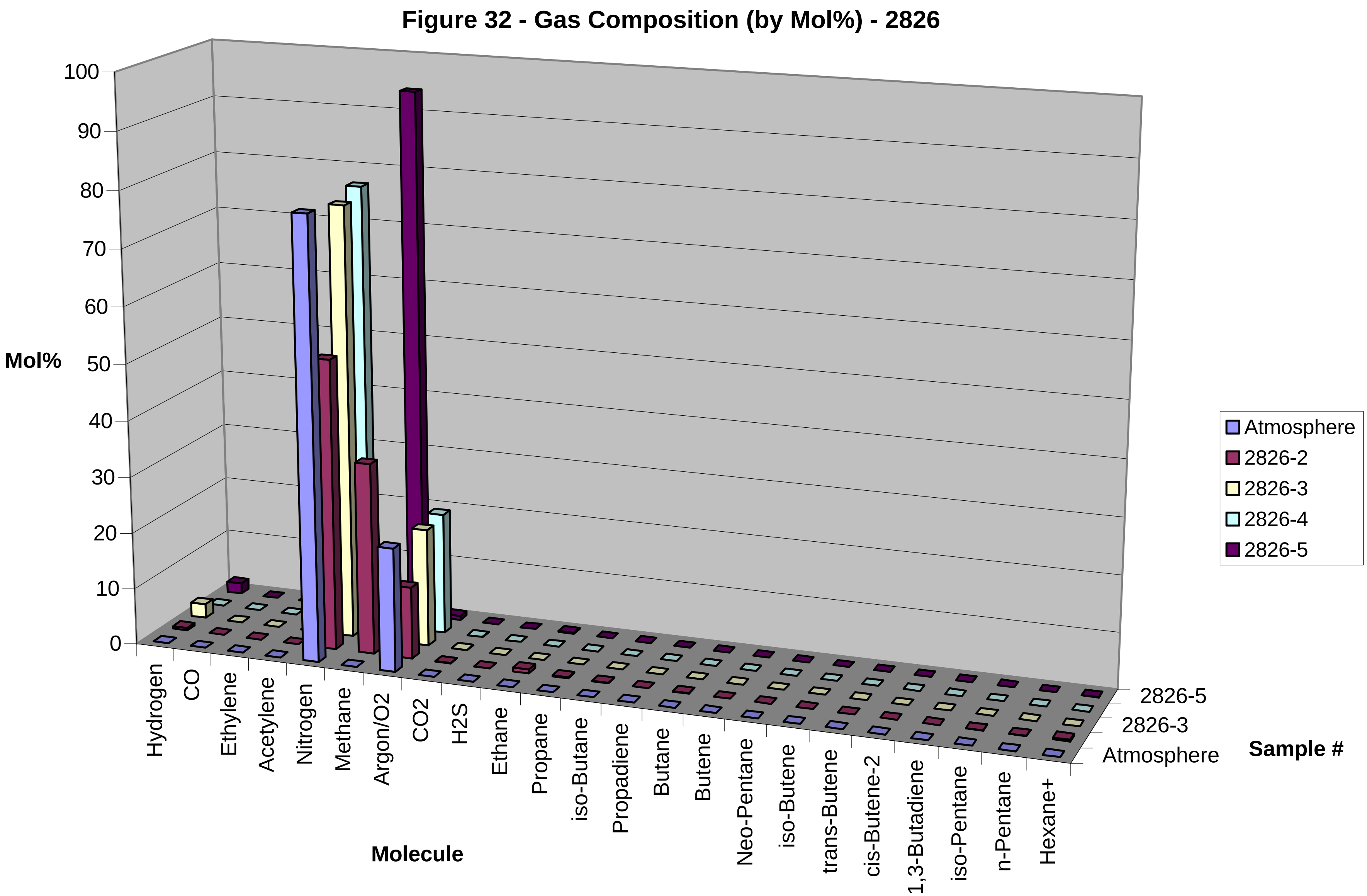


Figure 32 - Gas Composition (by Mol%) - 2826
Mol%
100
90
80
70
60
50
40
30
20
10
0
Hydrogen
CO
Ethylene
Acetylene
Nitrogen
Methane
Argon/O2
CO2
H2S
Ethane
Propane
iso-Butane
Propadiene
Butane
Butene
Neo-Pentane
iso-Butene
trans-Butene
cis-Butene-2
1,3-Butadiene
iso-Pentane
n-Pentane
Hexane+
Molecule
2826-5
2826-3
Atmosphere
Sample #
Atmosphere
2826-2
2826-3
2826-4
2826-5

Figure 33 - Flushwater Composition - 2826

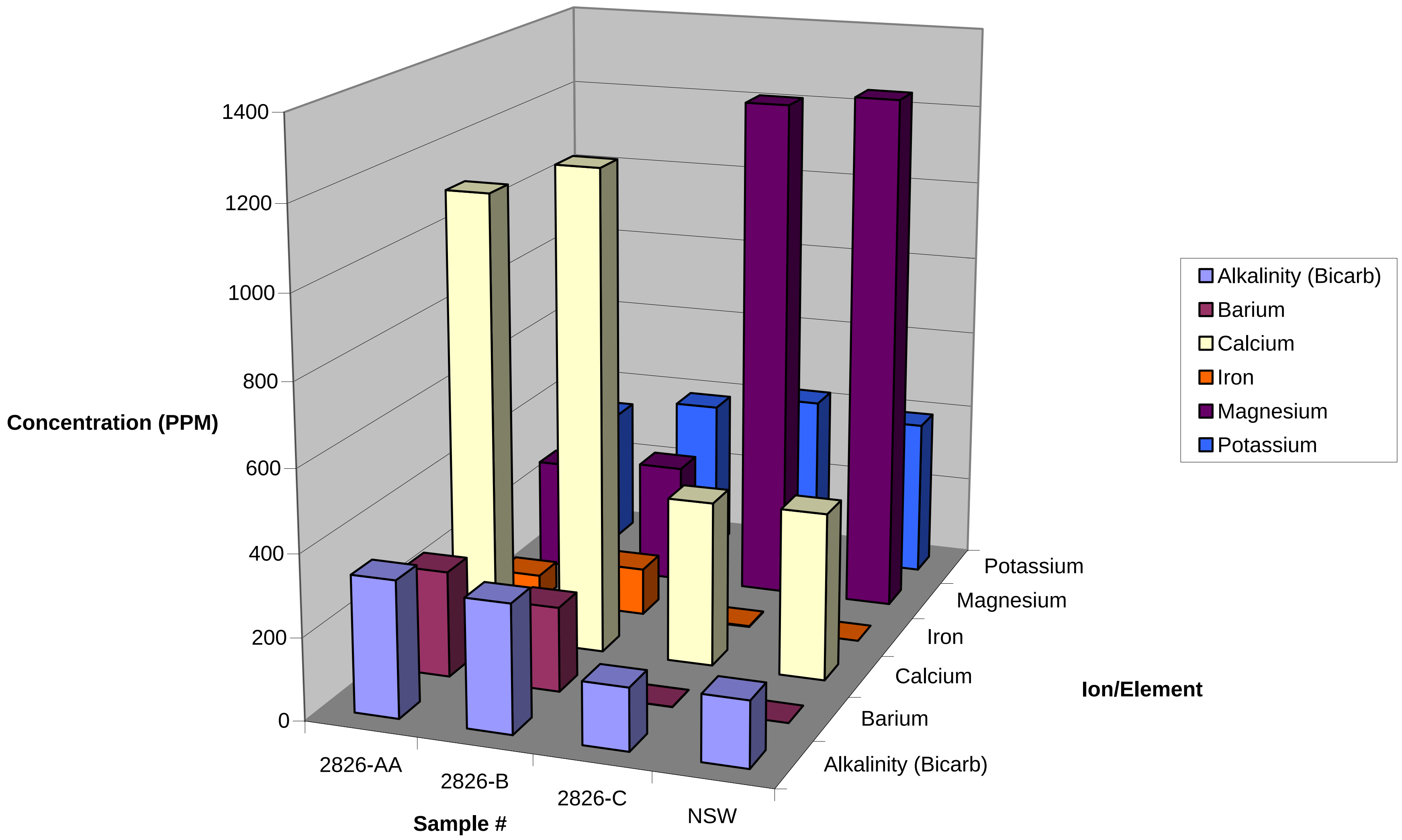


Figure 34 - Chloride and Sulfate - 2826

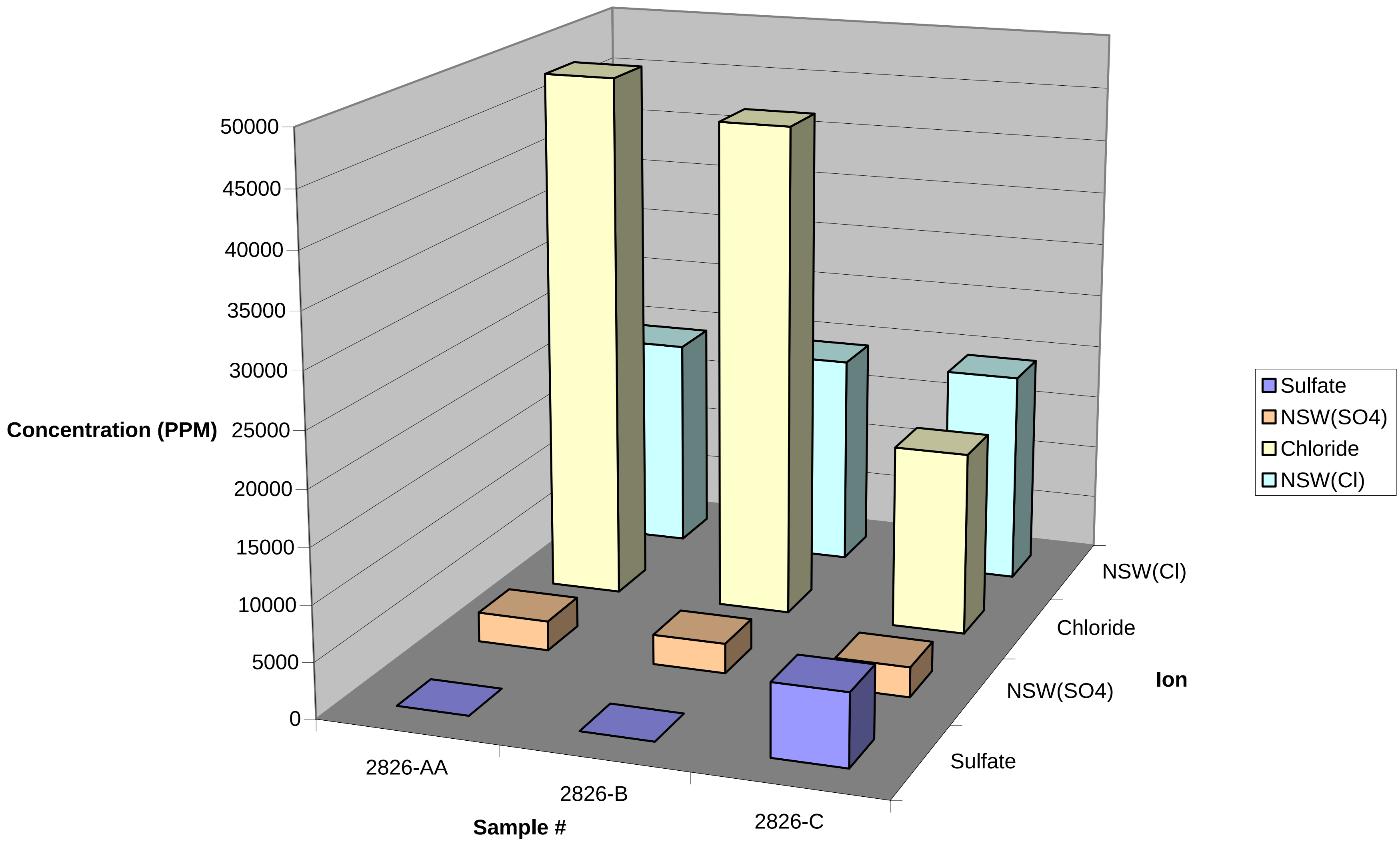
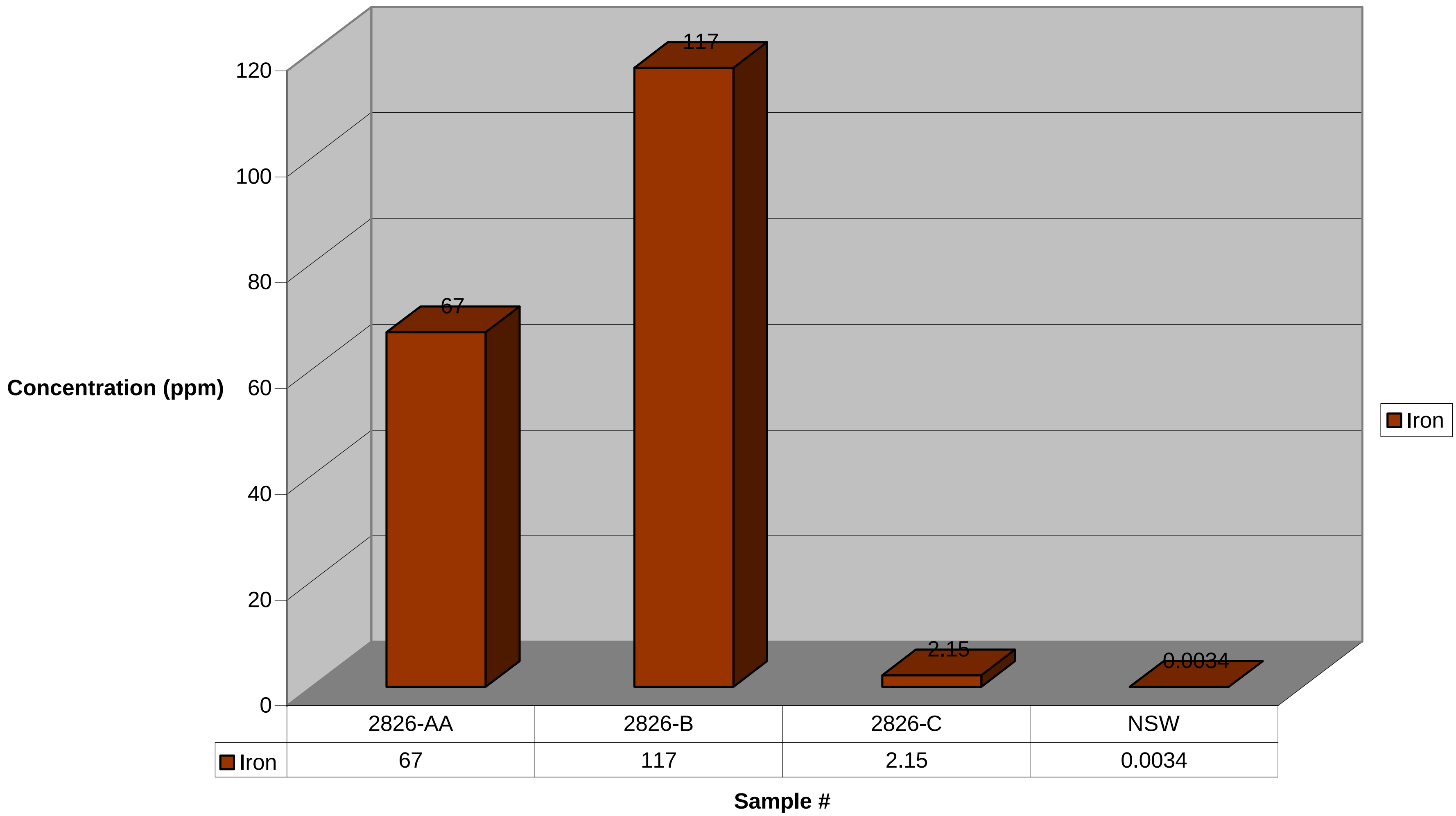


Figure 35 - Iron Concentration - 2826



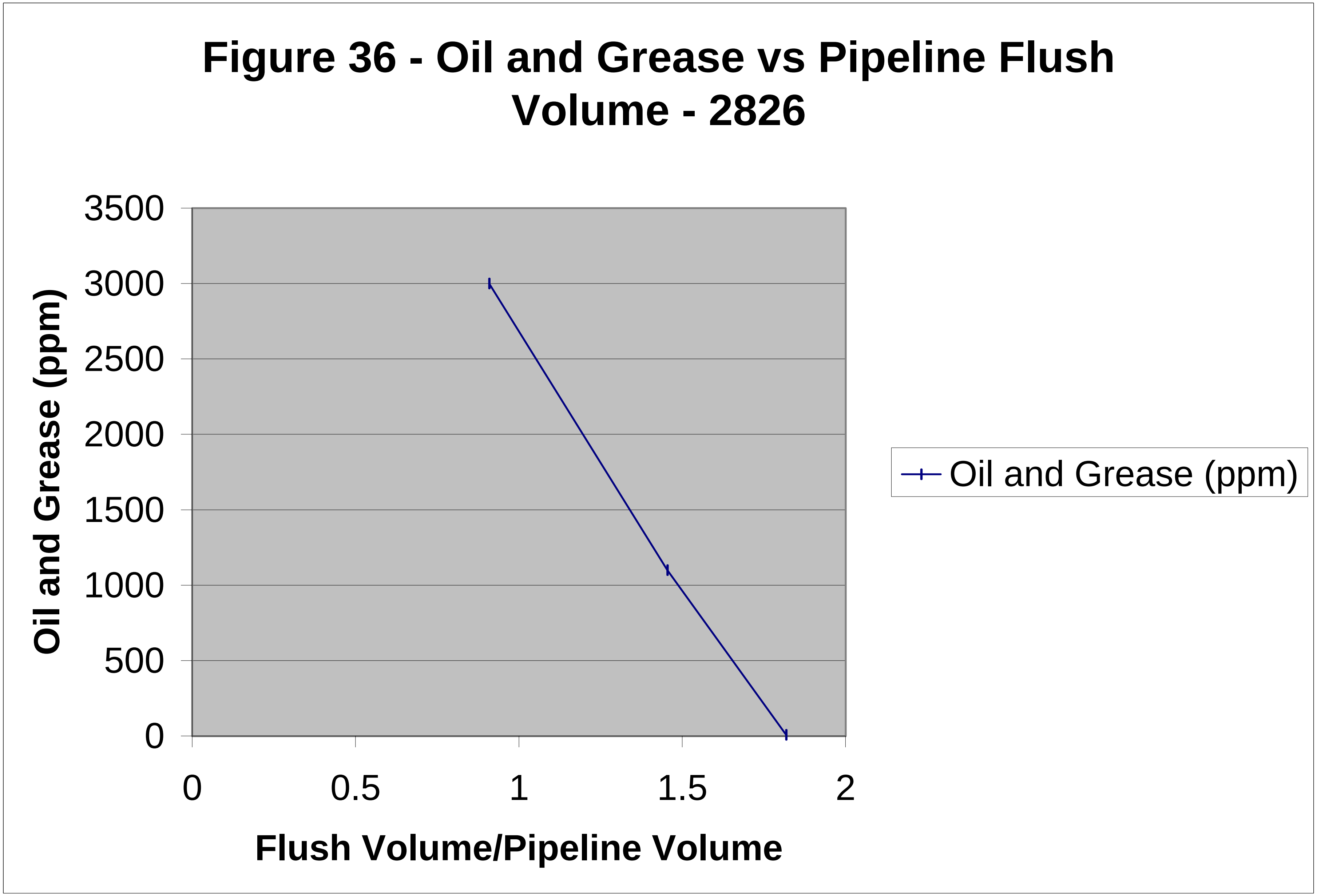


Figure 36 - Oil and Grease vs Pipeline Flush Volume - 2826
Oil and Grease (ppm)
3500
3000
2500
2000
1500
1000
500
0
0
0.5
1
1.5
2
Flush Volume/Pipeline Volume
Oil and Grease (ppm)

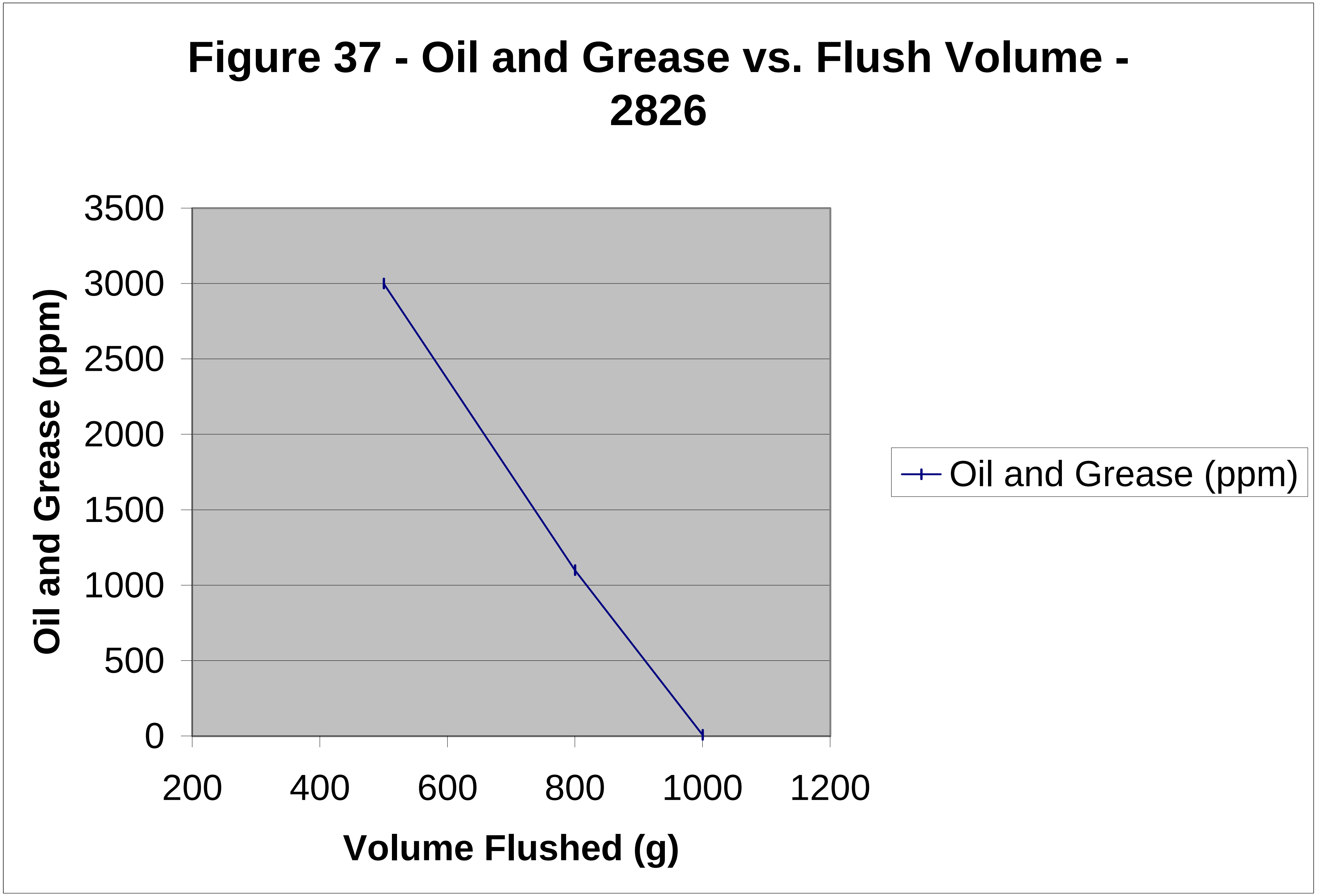


Figure 37 - Oil and Grease vs. Flush Volume - 2826
Oil and Grease (ppm)
3500
3000
2500
2000
1500
1000
500
0
200
400
600
800
1000
1200
Volume Flushed (g)
Oil and Grease (ppm)

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 2000110048-001A

Sample ID.: 2826-2
: 11/03/00
:

For : WINMAR
Attn: JAMES WISEMAN
: 5700 NW CENTRAL DRIVE
: HOUSTON TX. 77092

TCD Analysis:

COMPONENTS	SAMPLE MOL %
Hydrogen	0.409
Carbon Dioxide	0.049
Ethylene	0.000
Ethane	0.702
Acetylene	0.000
Argon/Oxygen	12.764
Nitrogen	51.534
Methane	33.872
Carbon Monoxide	0.000

UnNormalized, Mol% : 99.566

Specific Gravity : 0.8526
(Air = 1.000 @ 60F)

	Net	Gross
BTU / ft3 :	344.9 Dry	382.3 Dry
(@ 14.65 & 60 F)	338.9 Wet	375.7 Wet

SOUTHERN PETROLEUM LABORATORIES, INC.

Fred C. DeAngelo

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 2000110048-001A

Sample ID.: 2826-2
: 11/03/00

For : WINMAR
Attn: JAMES WISEMAN
: 5700 NW CENTRAL DRIVE
: HOUSTON TX. 77092

FID Analysis:

COMPONENTS	SAMPLE MOL %	
Hexanes Plus	0.324	
Methane	33.872	
Ethane/Ethylene	0.702 /	0.000
Propane	0.144	
Propylene	0.000	
iso-Butane	0.067	
Propadiene	0.000	
n-Butane	0.055	
Butene-1	0.000	
Neo-Pentane	None Detected	
iso-Butene	0.000	
trans-Butene-2	0.000	
cis-Butene-2	0.000	
1,3-Butadiene	0.000	
iso-Pentane	0.044	
n-Pentane	0.036	

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HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
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CERTIFICATE OF ANALYSIS NUMBER : 2000110048-001A

Sample ID.: 2826-2
: 11/03/00

For : WINMAR
Attn: JAMES WISEMAN
: 5700 NW CENTRAL DRIVE
: HOUSTON TX. 77092

Completed Analysis:

Component	MOL %		WT%	
Hydrogen	0.409		0.033	
Carbon Dioxide	0.049		0.088	
Carbon Monoxide	0.000		0.000	
Ethylene	0.000		0.000	
Acetylene/Propylene	0.000 /	0.000	0.000 /	0.000
Argon/Oxygen	12.764		16.534	
Nitrogen	51.534		58.474	
Methane	33.872		21.998	
Ethane	0.702		0.855	
Propane	0.144		0.258	
iso-Butane	0.067		0.158	
Propadiene	0.000		0.000	
n-Butane	0.055		0.130	
Butene-1	0.000		0.000	
Neo-Pentane	0.000		0.000	
iso-Butene	0.000		0.000	
trans-Butene-2	0.000		0.000	
cis-Butene-2	0.000		0.000	
1,3-Butadiene	0.000		0.000	
iso-Pentane	0.044		0.128	
n-Pentane	0.036		0.104	
Hexane Plus	0.324		1.241	
	100.000		100.000	

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8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 2000110048-002A

Sample ID.: 2826-3
: 11/03/00
:

For : WINMAR
Attn: JAMES WISEMAN
: 5700 NW CENTRAL DRIVE
: HOUSTON TX. 77092

TCD Analysis:

COMPONENTS	SAMPLE MOL %
Hydrogen	2.506
Carbon Dioxide	0.038
Ethylene	0.000
Ethane	0.000
Acetylene	0.000
Argon/Oxygen	20.839
Nitrogen	76.616
Methane	0.000
Carbon Monoxide	0.000

UnNormalized, Mol% : 79.960

Specific Gravity : 0.9736
(Air = 1.000 @ 60F)

		Net	Gross
BTU / ft3	:	6.8 Dry	8.1 Dry
(@ 14.65 & 60 F)		6.7 Wet	8.0 Wet

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8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 2000110048-002A

Sample ID.: 2826-3
: 11/03/00

For : WINMAR
Attn: JAMES WISEMAN
: 5700 NW CENTRAL DRIVE
: HOUSTON TX. 77092

FID Analysis:

COMPONENTS	SAMPLE MOL %	
Hexanes Plus	0.000	
Methane	0.000	
Ethane/Ethylene	0.000 /	0.000
Propane	0.000	
Propylene	0.000	
iso-Butane	0.000	
Propadiene	0.000	
n-Butane	0.000	
Butene-1	0.000	
Neo-Pentane	None Detected	
iso-Butene	0.000	
trans-Butene-2	0.000	
cis-Butene-2	0.000	
1,3-Butadiene	0.000	
iso-Pentane	0.000	
n-Pentane	0.000	

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HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 2000110048-002A

Sample ID.: 2826-3
: 11/03/00

For : WINMAR
Attn: JAMES WISEMAN
: 5700 NW CENTRAL DRIVE
: HOUSTON TX. 77092

Completed Analysis:

Component	MOL %			WT%		
Hydrogen	2.506			0.179		
Carbon Dioxide	0.038			0.059		
Carbon Monoxide	0.000			0.000		
Ethylene	0.000			0.000		
Acetylene/Propylene	0.000	/	0.000	0.000	/	0.000
Argon/Oxygen	20.839			23.637		
Nitrogen	76.616			76.124		
Methane	0.000			0.000		
Ethane	0.000			0.000		
Propane	0.000			0.000		
iso-Butane	0.000			0.000		
Propadiene	0.000			0.000		
n-Butane	0.000			0.000		
Butene-1	0.000			0.000		
Neo-Pentane	0.000			0.000		
iso-Butene	0.000			0.000		
trans-Butene-2	0.000			0.000		
cis-Butene-2	0.000			0.000		
1,3-Butadiene	0.000			0.000		
iso-Pentane	0.000			0.000		
n-Pentane	0.000			0.000		
Hexane Plus	0.000			0.000		
	100.000			100.000		

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8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 2000110048-003A

Sample ID.: 2826-4
: 11/03/00
:

For : WINMAR
Attn: JAMES WISEMAN
: 5700 NW CENTRAL DRIVE
: HOUSTON TX. 77092

TCD Analysis:

COMPONENTS	SAMPLE MOL %
Hydrogen	0.000
Carbon Dioxide	0.048
Ethylene	0.000
Ethane	0.000
Acetylene	0.000
Argon/Oxygen	21.505
Nitrogen	78.447
Methane	0.000
Carbon Monoxide	0.000

UnNormalized, Mol% : 84.391

Specific Gravity : 0.9971
(Air = 1.000 @ 60F)

	Net	Gross
BTU / ft3 :	0.0 Dry	0.0 Dry
(@ 14.65 & 60 F)	0.0 Wet	0.0 Wet

SOUTHERN PETROLEUM LABORATORIES, INC.

Fred C. DeAngelo

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 2000110048-003A

Sample ID.: 2826-4
: 11/03/00

For : WINMAR
Attn: JAMES WISEMAN
: 5700 NW CENTRAL DRIVE
: HOUSTON TX. 77092

FID Analysis:

COMPONENTS	SAMPLE MOL %	
Hexanes Plus	0.000	
Methane	0.000	
Ethane/Ethylene	0.000 /	0.000
Propane	0.000	
Propylene	0.000	
iso-Butane	0.000	
Propadiene	0.000	
n-Butane	0.000	
Butene-1	0.000	
Neo-Pentane	None Detected	
iso-Butene	0.000	
trans-Butene-2	0.000	
cis-Butene-2	0.000	
1,3-Butadiene	0.000	
iso-Pentane	0.000	
n-Pentane	0.000	

SOUTHERN PETROLEUM LABORATORIES, INC.

Fred C. DeAngelo

SPL®

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 2000110048-003A

Sample ID.: 2826-4
: 11/03/00

For : WINMAR
Attn: JAMES WISEMAN
: 5700 NW CENTRAL DRIVE
: HOUSTON TX. 77092

Completed Analysis:

Component	MOL %		WT%	
Hydrogen	0.000		0.000	
Carbon Dioxide	0.048		0.073	
Carbon Monoxide	0.000		0.000	
Ethylene	0.000		0.000	
Acetylene/Propylene	0.000 /	0.000	0.000 /	0.000
Argon/Oxygen	21.505		23.818	
Nitrogen	78.447		76.109	
Methane	0.000		0.000	
Ethane	0.000		0.000	
Propane	0.000		0.000	
iso-Butane	0.000		0.000	
Propadiene	0.000		0.000	
n-Butane	0.000		0.000	
Butene-1	0.000		0.000	
Neo-Pentane	0.000		0.000	
iso-Butene	0.000		0.000	
trans-Butene-2	0.000		0.000	
cis-Butene-2	0.000		0.000	
1,3-Butadiene	0.000		0.000	
iso-Pentane	0.000		0.000	
n-Pentane	0.000		0.000	
Hexane Plus	0.000		0.000	
	100.000		100.000	

SOUTHERN PETROLEUM LABORATORIES, INC.

Fred C. DeAngelo

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 2000110048-004A

Sample ID.: 2826-5
: 11/03/00
:

For : WINMAR
Attn: JAMES WISEMAN
: 5700 NW CENTRAL DRIVE
: HOUSTON TX. 77092

TCD Analysis:

COMPONENTS	SAMPLE MOL %
Hydrogen	1.909
Carbon Dioxide	0.000
Ethylene	0.000
Ethane	0.170
Acetylene	0.000
Argon/Oxygen	0.774
Nitrogen	3.117
Methane	93.955
Carbon Monoxide	0.000

UnNormalized, Mol% : 95.319

Specific Gravity : 0.5639
(Air = 1.000 @ 60F)

	Net	Gross
BTU / ft3 :	862.0 Dry	957.9 Dry
(@ 14.65 & 60 F)	847.0 Wet	941.2 Wet

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CERTIFICATE OF ANALYSIS NUMBER : 2000110048-004A

Sample ID.: 2826-5
: 11/03/00

For : WINMAR
Attn: JAMES WISEMAN
: 5700 NW CENTRAL DRIVE
: HOUSTON TX. 77092

FID Analysis:

COMPONENTS	SAMPLE MOL %		
Hexanes Plus	0.022		
Methane	93.955		
Ethane/Ethylene	0.170	/	0.000
Propane	0.026		
Propylene	0.000		
iso-Butane	0.010		
Propadiene	0.000		
n-Butane	0.007		
Butene-1	0.000		
Neo-Pentane	None Detected		
iso-Butene	0.000		
trans-Butene-2	0.000		
cis-Butene-2	0.000		
1,3-Butadiene	0.000		
iso-Pentane	0.005		
n-Pentane	0.005		

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PHONE (713) 660-0901

CERTIFICATE OF ANALYSIS NUMBER : 2000110048-004A

Sample ID.: 2826-5
: 11/03/00

For : WINMAR
Attn: JAMES WISEMAN
: 5700 NW CENTRAL DRIVE
: HOUSTON TX. 77092

Completed Analysis:

Component	MOL %			WT%		
Hydrogen	1.909			0.236		
Carbon Dioxide	0.000			0.000		
Carbon Monoxide	0.000			0.000		
Ethylene	0.000			0.000		
Acetylene/Propylene	0.000	/	0.000	0.000	/	0.000
Argon/Oxygen	0.774			1.517		
Nitrogen	3.117			5.349		
Methane	93.955			92.284		
Ethane	0.170			0.313		
Propane	0.026			0.071		
iso-Butane	0.010			0.035		
Propadiene	0.000			0.000		
n-Butane	0.007			0.024		
Butene-1	0.000			0.000		
Neo-Pentane	0.000			0.000		
iso-Butene	0.000			0.000		
trans-Butene-2	0.000			0.000		
cis-Butene-2	0.000			0.000		
1,3-Butadiene	0.000			0.000		
iso-Pentane	0.005			0.024		
n-Pentane	0.005			0.021		
Hexane Plus	0.022			0.126		
	100.000			100.000		

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Fred C. DeAngelo

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Winmar Consulting Services

Certificate of Analysis Number:

00110147

Report To: Winmar Consulting Services
James Wiseman
5700 NW Central Drive
Suite 150
Houston
TX
77092-
ph: (713) 895-8240 fax: (713) 895-8270

Fax To: *Winmar Consulting Services*
James Wiseman *fax: (713) 895-8270*

Project Name: WM0070
Site: HI 136
Site Address:

PO Number:
State: Texas
State Cert. No.:
Date Reported: 11/9/00

Client Sample ID	Lab Sample ID	Matrix	Date Collected	Date Received	COC ID	HOLD
2826-D	00110147-01	Water	11/3/00	11/6/00 1:15:00 PM	086580	
2826-E	00110147-02	Water	11/3/00	11/6/00 1:15:00 PM	086580	
2826-F	00110147-03	Water	11/3/00	11/6/00 1:15:00 PM	086580	

11/10/00
Date

Neschich,Paul
Senior Project Manager

Joel Grice
Laboratory Director

Ted Yen
Quality Assurance Officer

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2826-D **Collected:** 11/3/00 **SPL Sample ID:** 00110147-01

Site: HI 136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			**MCL**	**E413.1**		**Units: mg/L**		
Oil & Grease,Total Recoverable	3000	2		1		11/07/00 13:00	G_T	464849

Run ID/Seq #: EX_001107F-464849

Prep Method	Prep Date	Prep Initials
	11/07/2000 13:00	

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

11/10/00 12:45:12 PM

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HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2826-E **Collected:** 11/3/00 **SPL Sample ID:** 00110147-02

Site: HI 136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			**MCL**		**E413.1**	**Units: mg/L**		
Oil & Grease,Total Recoverable	1100	2		1		11/07/00 13:00	G_T	464850

Run ID/Seq #: EX_001107F-464850

Prep Method	Prep Date	Prep Initials
	11/07/2000 13:00	

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2826-F **Collected:** 11/3/00 **SPL Sample ID:** 00110147-03

Site: HI 136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
OIL & GREASE, TOTAL RECOVERABLE			**MCL**	**E413.1**		**Units: mg/L**		
Oil & Grease,Total Recoverable	7.8	2		1		11/07/00 13:00	G_T	464851

Run ID/Seq #: EX_001107F-464851

Prep Method	Prep Date	Prep Initials
	11/07/2000 13:00	

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

11/10/00 12:45:12 PM

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Winmar Consulting Services

Certificate of Analysis Number:

00110146

Report To: Winmar Consulting Services
James Wiseman
5700 NW Central Drive
Suite 150
Houston
TX
77092-
ph: (713) 895-8240 fax: (713) 895-8270

Fax To: *Winmar Consulting Services*
James Wiseman *fax: (713) 895-8270*

Project Name: WM0070
Site: HI 136
Site Address:

PO Number:
State: Texas
State Cert. No.:
Date Reported:

Client Sample ID	Lab Sample ID	Matrix	Date Collected	Date Received	COC ID	HOLD
2826-AA	00110146-01	Water	11/3/00	11/6/00 1:15:00 PM	086579	
2826-B	00110146-02	Water	11/3/00	11/6/00 1:15:00 PM	086579	
2826-C	00110146-03	Water	11/3/00	11/6/00 1:15:00 PM	086579	

11/20/00
Date

Neschich,Paul
Senior Project Manager

Joel Grice
Laboratory Director

Ted Yen
Quality Assurance Officer

HOUSTON LABORATORY
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HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2826-AA **Collected:** 11/3/00 **SPL Sample ID:** 00110146-01

Site: HI 136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	**M2320 B**		**Units: mg/L**		
Alkalinity, Bicarbonate	333	2		1		11/06/00 15:35	SN	465495
ALKALINITY, CARBONATE			MCL	**M2320 B**		**Units: mg/L**		
Alkalinity, Carbonate	ND	2		1		11/06/00 15:35	SN	465520
CHLORIDE, TOTAL			MCL	**E325.3**		**Units: mg/L**		
Chloride	48300	1000		1000		11/10/00 10:45	CV	469447
METALS BY METHOD 6010B, TOTAL			MCL	**SW6010B**		**Units: mg/L**		
Barium	260	0.25		50		11/16/00 19:46	E_B	476889
Calcium	1110	2		20		11/16/00 19:30	E_B	476886
Iron	67	0.02		1		11/17/00 18:06	E_B	478593
Magnesium	275	0.1		1		11/16/00 19:24	E_B	476885
Potassium	338	2		1		11/16/00 19:24	E_B	476885

Run ID/Seq #: TJA_001116D-476885

Prep Method	Prep Date	Prep Initials
SW3010A	11/07/2000 13:00	R_T

Run ID/Seq #: TJA_001116D-476886

Prep Method	Prep Date	Prep Initials
SW3010A	11/07/2000 13:00	R_T

Run ID/Seq #: TJA_001116D-476889

Prep Method	Prep Date	Prep Initials
SW3010A	11/07/2000 13:00	R_T

Run ID/Seq #: TJA_001117A-478593

Prep Method	Prep Date	Prep Initials
SW3010A	11/17/2000 12:45	R_T

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	**E150.1**		**Units: pH Units**		
pH	6.6	0.10		1		11/06/00 17:00	EC	465805
RESISTANCE @ 25 C			MCL	**120.1**		**Units: Mohms/cm**		
Resistance	6	0.00100		1		11/09/00 18:20	JS	468450
SPECIFIC GRAVITY			MCL	**ASTM D-1429**		**Units: Specific Gravity @**		
Specific Gravity	1.045	0		1		11/14/00 16:00	EC	478053
SULFATE, TOTAL			MCL	**E375.4**		**Units: mg/L**		
Sulfate	ND	1		1		11/06/00 16:00	SN	463672
TOTAL DISSOLVED SOLIDS			MCL	**TDS-MINERAL**		**Units: mg/L**		
Total Dissolved Solids, Calculated	80000	10		1		11/20/00 15:30	ES	479571

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2826-AA **Collected:** 11/3/00 **SPL Sample ID:** 00110146-01

Site: HI 136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
TOTAL SODIUM, CALCULATED			**MCL**	**TDS-MINERAL**		**Units: mg/L**		
Total Sodium, Calculated	29300	10		1		11/20/00 15:30	ES	479548
TOTAL SUSPENDED SOLIDS			**MCL**	**E160.2**		**Units: mg/L**		
Suspended Solids (Residue,Non-Filterable)	340	8		2		11/09/00 12:30	EC	468153

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

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Client Sample ID 2826-B **Collected:** 11/3/00 **SPL Sample ID:** 00110146-02

Site: HI 136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Bicarbonate	313	2		1		11/06/00 15:35	SN	465496
ALKALINITY, CARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Carbonate	ND	2		1		11/06/00 15:35	SN	465521
CHLORIDE, TOTAL			MCL	E325.3		Units: mg/L		
Chloride	45000	1000		1000		11/10/00 10:45	CV	469448
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B		Units: mg/L		
Barium	207	0.025		5		11/16/00 19:57	E_B	476891
Calcium	1190	0.5		5		11/16/00 19:57	E_B	476891
Iron	117	0.02		1		11/17/00 18:10	E_B	478594
Magnesium	298	0.1		1		11/16/00 19:50	E_B	476890
Potassium	386	2		1		11/16/00 19:50	E_B	476890

Run ID/Seq #: TJA_001116D-476890

Prep Method	Prep Date	Prep Initials
SW3010A	11/07/2000 13:00	R_T

Run ID/Seq #: TJA_001116D-476891

Prep Method	Prep Date	Prep Initials
SW3010A	11/07/2000 13:00	R_T

Run ID/Seq #: TJA_001117A-478594

Prep Method	Prep Date	Prep Initials
SW3010A	11/17/2000 12:45	R_T

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1		Units: pH Units		
pH	7.8	0.10		1		11/06/00 17:00	EC	465809
RESISTANCE @ 25 C			MCL	120.1		Units: Mohms/cm		
Resistance	6.4	0.00100		1		11/09/00 18:20	JS	468452
SPECIFIC GRAVITY			MCL	ASTM D-1429		Units: Specific Gravity @		
Specific Gravity	1.054	0		1		11/14/00 16:00	EC	478055
SULFATE, TOTAL			MCL	E375.4		Units: mg/L		
Sulfate	ND	1		1		11/06/00 16:00	SN	463673
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL		Units: mg/L		
Total Dissolved Solids, Calculated	74500	10		1		11/20/00 15:30	ES	479572
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL		Units: mg/L		
Total Sodium, Calculated	27000	10		1		11/20/00 15:30	ES	479549

Qualifiers:

ND/U - Not Detected at the Reporting Limit
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J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2826-B **Collected:** 11/3/00 **SPL Sample ID:** 00110146-02

Site: HI 136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
TOTAL SUSPENDED SOLIDS			**MCL**	**E160.2**		**Units: mg/L**		
Suspended Solids (Residue,Non-Filterable)	728	8		2		11/09/00 12:30	EC	468154

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

11/20/00 3:38:56 PM

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2826-C **Collected:** 11/3/00 **SPL Sample ID:** 00110146-03

Site: HI 136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
ALKALINITY, BICARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Bicarbonate	152	2		1		11/06/00 15:35	SN	465498
ALKALINITY, CARBONATE			MCL	M2320 B		Units: mg/L		
Alkalinity, Carbonate	ND	2		1		11/06/00 15:35	SN	465523
CHLORIDE, TOTAL			MCL	E325.3		Units: mg/L		
Chloride	16700	250		250		11/10/00 10:45	CV	469450
METALS BY METHOD 6010B, TOTAL			MCL	SW6010B		Units: mg/L		
Barium	0.181	0.005		1		11/16/00 20:19	E_B	476892
Calcium	406	0.1		1		11/16/00 20:19	E_B	476892
Iron	2.15	0.02		1		11/17/00 17:29	E_B	478586
Magnesium	1260	0.5		5		11/16/00 20:23	E_B	476893
Potassium	425	10		5		11/16/00 20:23	E_B	476893

Run ID/Seq #: TJA_001116D-476892

Prep Method	Prep Date	Prep Initials
SW3010A	11/07/2000 13:00	R_T

Run ID/Seq #: TJA_001116D-476893

Prep Method	Prep Date	Prep Initials
SW3010A	11/07/2000 13:00	R_T

Run ID/Seq #: TJA_001117A-478586

Prep Method	Prep Date	Prep Initials
SW3010A	11/17/2000 12:45	R_T

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
PH			MCL	E150.1		Units: pH Units		
pH	8.2	0.10		1		11/06/00 17:00	EC	465810
RESISTANCE @ 25 C			MCL	120.1		Units: Mohms/cm		
Resistance	18.3	0.00100		1		11/09/00 18:20	JS	468453
SPECIFIC GRAVITY			MCL	ASTM D-1429		Units: Specific Gravity @		
Specific Gravity	1.018	0		1		11/14/00 16:00	EC	478056
SULFATE, TOTAL			MCL	E375.4		Units: mg/L		
Sulfate	6500	500		500		11/06/00 16:00	SN	463674
TOTAL DISSOLVED SOLIDS			MCL	TDS-MINERAL		Units: mg/L		
Total Dissolved Solids, Calculated	36300	10		1		11/20/00 15:30	ES	479573
TOTAL SODIUM, CALCULATED			MCL	TDS-MINERAL		Units: mg/L		
Total Sodium, Calculated	10900	10		1		11/20/00 15:30	ES	479550

Qualifiers:

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J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
(713) 660-0901

Client Sample ID 2826-C **Collected:** 11/3/00 **SPL Sample ID:** 00110146-03

Site: HI 136

Analyses/Method	Result	Rep.Limit		Dil. Factor	QUAL	Date Analyzed	Analyst	Seq. #
TOTAL SUSPENDED SOLIDS			**MCL**		**E160.2**	**Units: mg/L**		
Suspended Solids (Residue Non-Filterable)	32	4		1		11/09/00 12:30	EC	468155

Qualifiers:

ND/U - Not Detected at the Reporting Limit
B - Analyte detected in the associated Method Blank
* - Surrogate Recovery Outside Advisable QC Limits
J - Estimated Value between MDL and PQL
>MCL - Result Over Maximum Contamination Limit(MCL)
D - Surrogate Recovery Unreportable due to Dilution
MI - Matrix Interference

11/20/00 3:38:58 PM

10. Results and Observations 11513

Gas and water samples were taken from this line. However, these samples were not tested because the line contained approximately 100 barrels of what appeared to be drill mud. Because it was impossible to get uncontaminated samples from throughout the line, it was decided to halt sampling and discard this data.

11. Recommendation/Conclusions

All of the pipelines tested for this project were installed in 1964. Based on the Results and Observations for the four pipeline segments where complete data was obtained - WINMAR was able to qualitatively rank the pipeline conditions. This is shown in Table 1 below. The pipelines were ranked according to the criteria listed in the table header: presence of pits, metal loss, pooled water, flushwater iron concentration, and weld erosion.

Segment	Rank	Pits Present	Metal Loss	Pooled Water	Highest Iron Concentration	Weld Erosion
2826	#1	No	No	No	117 PPM	No
2824	#2	No	Yes	Yes	302 PPM	Yes
2820	#3	Yes	No	No	70 PPM	Yes
2822	#4	Yes	Yes	Yes	76 PPM	No

Table 1 – Pipeline Ranking

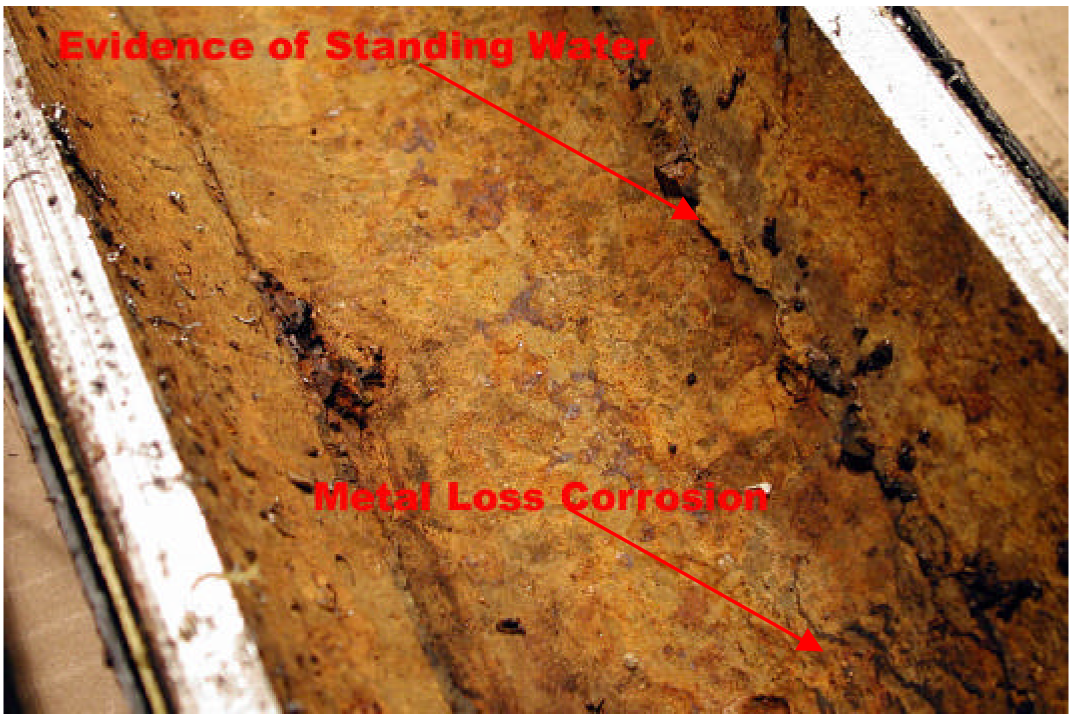
The conclusions and recommendations in this section are based on the Results and Observations from sections 6.0 through 10.0. Each conclusion will be presented, then followed by the relevant photos or results for that conclusion.

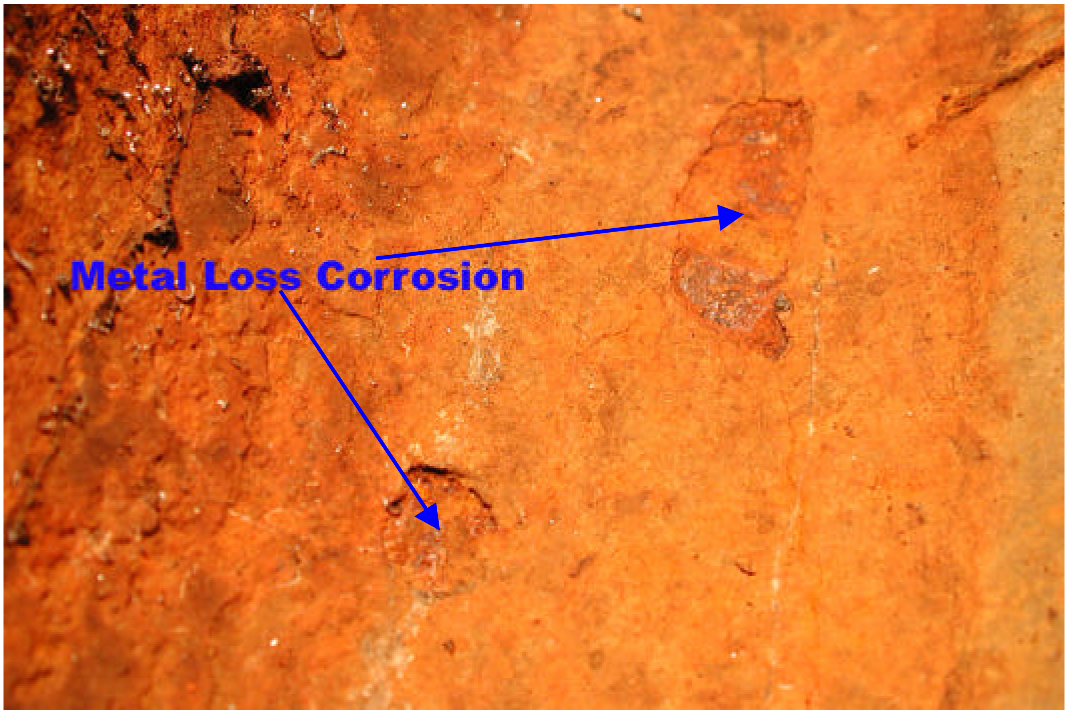
Conclusion 1) Having the unused pipeline open to air versus sealed doesn't seem to have an impact on the line condition.

This is based on analysis of segments 2824 and 2826. **Figure 23** shows that segment 2824 was sealed and remained filled predominantly with methane. **Figure 31** shows that segment 2826 was predominantly filled with atmospheric air (containing oxygen, whereas the methane filled line did not contain much oxygen). Since the air is heavier than methane, it was present in the bottom of the pipeline. These two gas pipelines were in very similar condition however, despite being filled with different fluids. Segment 2824 showed metal loss corrosion but this was in the bottom of the pipeline - which contained standing water. The "dry" portions of the lines were in very much the same condition, despite the presence of oxygen in the air-filled line.

Conclusion 2) Standing water from wellstream production pools in the pipeline and causes metal loss corrosion. The standing water also provides a medium for the growth of sulfide reducing bacteria.

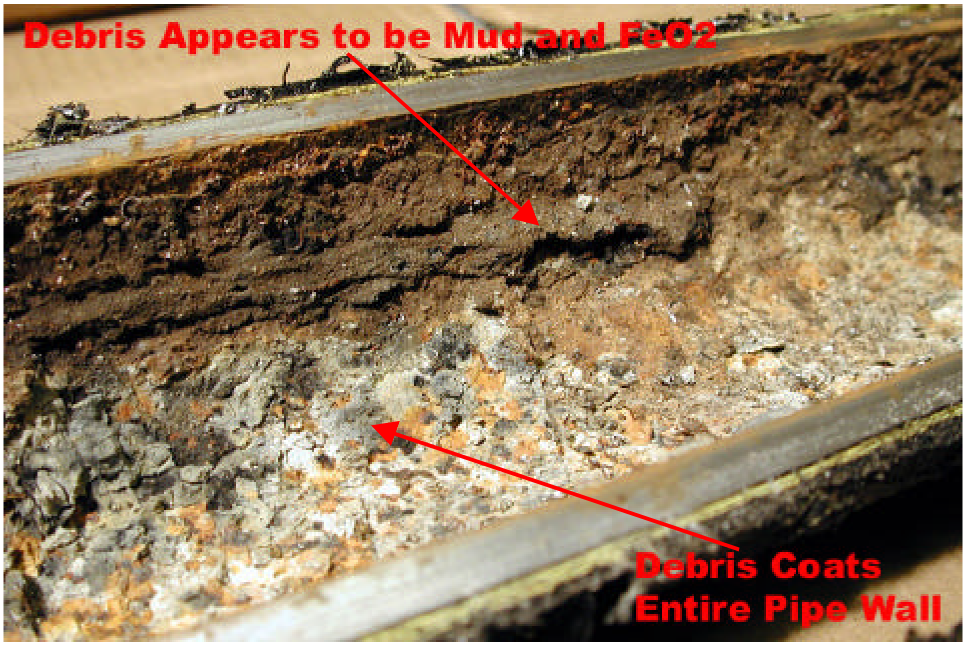
This standing water seemed to be the primary cause of loss of integrity for the pipelines tested. Segment 2824 showed evidence of standing water (as seen in the following photos). Since this line had never been pigged (non-pigabble line) the water present in the pipeline must have come from wellstream production. The sample taken near the well-protector platform showed evidence of being filled approximately 15% with water. Depending on the pipeline elevation (high and low spots) along its length, it could have contained either more, or less water. This is demonstrated in the following pictures (from segment 2824):





Conclusion 3) Composition of pipeline flush and fill water is important.

If possible, the operator should endeavor to NOT suck up any mud or particulate matter from the ocean, when filling a pipeline with seawater. This mud/sludge contains a "soup" of bacteria in much higher concentrations than found in surface seawater. These bacteria can and will contribute to Microbial Induced Corrosion (MIC). Segment 2822 shows evidence of being filled with seawater with a very high amount of suspended solids. It also shows signs of pitting corrosion at the pipeline/tubeturn weld. This is shown in the following photos from the segment 2822 pipeline sample:



Conclusion 4) Pitting corrosion is highly variable and unpredictable. Pits are present in some of the pipelines tested and not in others - despite the exact same production. Pits were present in the pipeline filled with water (2822), and also in one pipeline that was not (segment 2820). Based on this information, and this small sample size, it is necessary to conclude that we cannot correlate pitting corrosion to pipeline conditions

for these tests. It may be present to correlate the two after future flushing tests yield a larger sample size.

Recommendation) Because pooled water in out of service gas pipelines seems to be the primary factor in loss of integrity, any measure that can remove this water from the line should improve its condition. If a well or wells are “playing out” and the wells will be taken offline in the near future, WINMAR recommends that the operator examine the watercut of the gas. If the production is low volume (equaling a low fluid velocity in the pipeline) and shows a high water content, then pooled water may be present in the pipeline. One way to remove this water would be to temporarily close the well, bleed down the pipeline, disconnect the pipeline at the wellhead platform, launch/insert a “hand launch” pig, and reconnect the pipeline. The well can then be brought back online in order to run the pig, and then shut-in again when the operator wishes to temporarily abandon the well and flowline. This dewatering method would be the least expensive and most effective way to protect a non-piggable line that an operator wishes to take out of service, but not fill with inhibited seawater.

12. Appendix - Corrosion Inhibitor Information

Many different kinds of inhibitors are available, each serving its own different function. The three most common are:

- Oxygen Scavenger (Uses sulfite to bind oxygen $SO_2 \rightarrow SO_4$)
- Corrosion Inhibitor (Amine coating "seals" internal pipe wall)
- Biocide (Kills bacteria that cause corrosion (Sulfide Reducing Bacteria (SRB's))

According to the vendors and contractors polled, Oxygen scavenger is not always necessary. For closed lines, oxygen will be depleted quickly, and once it is all used, that type of corrosion ceases. Large new lines can be designed for this very small amount of corrosion.

Biocide is the most important inhibitor for out of service lines because SRB's can sit in an out of service line and cause pits. The SRB's use the sulfate in seawater as a respiration source, making sulfuric acid, which causes pitting. In an out of service line, these bacteria have a perfect environment (Moist/Wet, oxygen poor, abundant sulfate source, etc.)

Information sheets were gathered from Champion Technologies and Baker Petrolite. These are included in this Appendix as reference material.

Baker Petrolite's Oxygen Depletion graph/information differs from ours. They show oxygen depletion versus time for a pipeline that is filled with uninhibited seawater and closed. This is interesting information that will be relevant for the Flushing Phase B project.

BAKER HUGHES

Baker Petrolite

Protection of Pipelines During Hydrostatic Testing

Product Data

BAKER HUGHES

Baker Petrolite

INTRODUCTION

Before a new or rehabilitated pipeline is placed into service, it must be tested for integrity at a pressure above its designed working pressure. This is usually done with water, which may remain in the system for an extended period of time.

Water used in hydrostatic testing usually comes from one of several sources: aquifers, rivers, ponds, seas, etc. The use of water from any of these sources can cause corrosion and introduce bacteria into the pipeline. The severity of the problem is dependent upon the type and quality of water used, the length of time the water remains in the line, and the ambient temperature.

While the line is filled with water it is subjected to three types of corrosion:

1. Direct reaction of dissolved oxygen with the steel pipe to form ferric oxide/hydroxide. Pitting may be initiated. This mechanism is not generally serious because the concentration of dissolved oxygen in the water is rapidly depleted due to the reaction with the pipe wall. Our tests indicate that corrosion due to oxygen content, even with air-saturated waters, is usually minimal in a closed steel pipeline and problems rarely result from this mechanism.
2. Localized pitting and corrosion resulting from the growth of sulfate reducing bacteria (SRB) and acid producing bacteria (APB).
3. Attack by hydrogen sulfide produced as a result of SRB growth.

Mechanisms 2 and 3, which involve bacterial growth, are the most serious concerns in hydrotest waters. Sea water and high TDS brines have a greater potential for corrosion than fresh water due to their higher conductivity and sulfate levels.

Conventional wisdom has it that to protect against corrosion during hydrostatic testing, you must add three types of chemicals to the water: an oxygen scavenger, a biocide and a corrosion inhibitor. For large or long pipelines, this can be exceedingly expensive.

Baker Petrolite Corporation research data indicates that much of this expense is not necessary. In a closed system, oxygen is exhausted long before pitting due to oxygen becomes a problem. Controlling bacterial growth is generally sufficient to protect a pipeline from hydrotest damage. This can be accomplished by adding a biocide to the water prior to introducing it into the pipeline.

CHEMICAL TREATMENT RECOMMENDATIONS FOR HYDROSTATIC TEST WATERS

The following recommendations apply to both fresh water and sea water.

Biocide: X-CIDE® 102 is recommended for hydrostatic test waters. It should be used at a concentration of 250 ppm to 1000 ppm based on the total volume of water. Biocides are always recommended for hydrostatic test water unless chlorinated water (from a city water supply) is used.

Corrosion Inhibitor: If a corrosion inhibitor is desired, CRW 201 is recommended at a concentration of 100 ppm to 200 ppm based on the total volume of water.

Oxygen Scavenger: Although Baker Petrolite laboratory experiments and field experience indicate that corrosion problems due to the oxygen content of hydrostatic test waters rarely occur, an oxygen scavenger is sometimes requested as additional protection. In such a case, Baker Petrolite OSW 490C oxygen scavenger is recommended for removal of dissolved oxygen. Recommended dosage is 11 ppm OSW 490C oxygen scavenger for each ppm oxygen in the hydrotest water. Fresh water at 68 degrees F may contain up to 9 ppm dissolved oxygen.

PRODUCT APPLICATION

Before pumping the hydrostatic test water into the pipeline, a specific treatment regime should be followed to avoid interactions between products. The oxygen scavenger will deactivate the biocide, so they should not be mixed. The following is a recommended procedure for treating and mixing the water.

1. If oxygen removal is desired, measure the amount of dissolved oxygen in the water to be treated. Determine the amount of oxygen scavenger needed (11ppm OSW 490C oxygen scavenger per ppm oxygen in the water).
2. To remove oxygen, add the required amount of OSW 490C oxygen scavenger to the water tank. Mix gently; do not overmix; avoid introducing extra air into the tank. Allow approximately 15 minutes for complete scavenging. Since X-CIDE 102 biocide will interact with the oxygen scavenger, it is important to allow the recommended scavenging time to avoid biocide deactivation.
3. Add the required amount of X-CIDE 102 biocide to the tank and mix gently.
4. A corrosion inhibitor, CRW 201 can then be added to the hydrotest water if desired.

Steps 3 and 4 may be interchanged as the X-CIDE 102 biocide and CRW 201 are fully compatible.

FLUID DISPOSAL

HYDROSTATIC TEST FLUIDS CONTAINING RESIDUAL LEVELS OF BIOCIDE, AND/OR CORROSION INHIBITOR, SHOULD BE DISPOSED OF IN ACCORDANCE WITH PERTINENT STATE AND FEDERAL REGULATIONS.

The two most commonly practiced methods of disposal for hydrostatic test waters are direct discharge to receiving waters or discharge to a wastewater treatment plant. When test fluids are discharged directly to a receiving water, caution should be exercised to ensure that the level of residual biocide is below the threshold level which is capable of producing toxic effects in aquatic organisms. The hydrostatic test water can also be disposed in any salt water disposal well which is classified to handle oilfield waste.

Hydrostatic test fluids containing X-CIDE 102 biocide may be detoxified prior to their release to surface waters. Based on the residual level of biocide, a 1:1 ratio of OSW 490C oxygen scavenger should be used. An in-line mixer or surge tank should be used to promote mixing of the detoxifying agent with the hydrostatic test water. A 30-second contact time is sufficient for detoxification to take place. If the discharge from a hydrostatic test displaces a substantial percentage of the receiving water (e.g., a stream or a small bay), then the discharge should be re-aerated to avoid a fish kill due to the lack of oxygen.

Hydrostatic test fluids containing X-CIDE 102 biocide may also be discharged to a wastewater treatment plant. Aerobic bacteria are capable of utilizing X-CIDE 102 biocide as a nutrient source at concentrations of 25 ppm or less. Studies have shown that X-CIDE 102 biocide has an affinity for any type of proteinaceous material and will bind to it irreversibly. Bound X-CIDE 102 biocide is also readily biodegraded.

The results of aquatic toxicity tests carried out with X-CIDE 102 biocide and CRW 201 corrosion inhibitor are in the attached EcoTox™ reports.

Standard BOD/COD tests were performed with each product. Results of the studies indicate that both the biocide and corrosion inhibitor are readily biodegraded.

The octanol/water partition coefficient for X-CIDE 102 biocide indicates that this chemical has little propensity to bioconcentrate in the environment.

PRODUCT EVALUATION

A series of tests were conducted to (a) assess the need for chemical inhibition of hydrostatic test waters and (b) identify and evaluate the most effective program having the widest applicability.

1. Long term field evaluations were carried out in conjunction with a major oil company. These tests consisted of periodic monitoring of test cylinders made from sealed pipeline lengths. One test cylinder contained uninhibited sea water, while the sea water in the other cylinder was treated with an oxygen scavenger, a biocide, and a corrosion inhibitor. Monitoring consisted of LPR readings (instantaneous corrosion rate), soluble iron concentration measurements, and SRB enumeration (by the API RP 38 method), each taken periodically over 33 months.
2. The rate of oxygen depletion in air saturated waters was measured in test cylinders made from sealed pipeline sections of various diameters containing fresh water and sea water. In addition, the effect of the reaction of oxygen with the pipe wall was assessed over a period of time.
3. The effectiveness of selected chemicals was assessed in laboratory studies over an extended period of time in both fresh water and sea water.

The results of monitoring corrosion rate, iron concentration, and number of SRBs in the pipeline test cylinders are shown in Figures 1, 2, and 3. These outdoor tests were carried out in a temperate climate where the cylinders were subjected to ambient temperature fluctuations. Test cylinder 1 contained untreated sea water, whereas the sea water in cylinder 2 was treated with an oxygen scavenger, biocide, and corrosion inhibitor. Figure 1 shows a plot of instantaneous corrosion rate against time. The corrosion rate in cylinder 1 fluctuates widely between 8 mpy (0.2 mm/yr) and 59 mpy (1.5 mm/yr), the peaks occurring in the summer months when the ambient temperatures are the highest. The treated cylinder showed very low corrosion rates in the 0.04 to 0.08 mpy range (0.001-0.002 mm/yr). In Figure 3, the SRB levels rise to a constant 1-9 colonies/mL in the untreated fluid, whereas they remain zero in the treated cylinder. In quiescent conditions such as these, SRB colonies will attach to the pipe wall rather than float freely in the water, so low populations in the test cylinder water would be expected. A measure of bacterial activity can be gained from Figure 2 which shows a plot of soluble iron concentration in the water versus time. In the treated cylinder, the iron level remains relatively constant at 10-20 ppm; however, in the untreated cylinder, the soluble iron concentration rises initially up to 25 ppm and then falls to below 2 ppm. This is caused by the precipitation of insoluble iron sulfide, which is a result of dissolved iron reacting with hydrogen sulfide produced by SRB growth.

FIGURE 1
Corrosion Rate of Chemically Treated and Untreated Hydrostatic Test Water

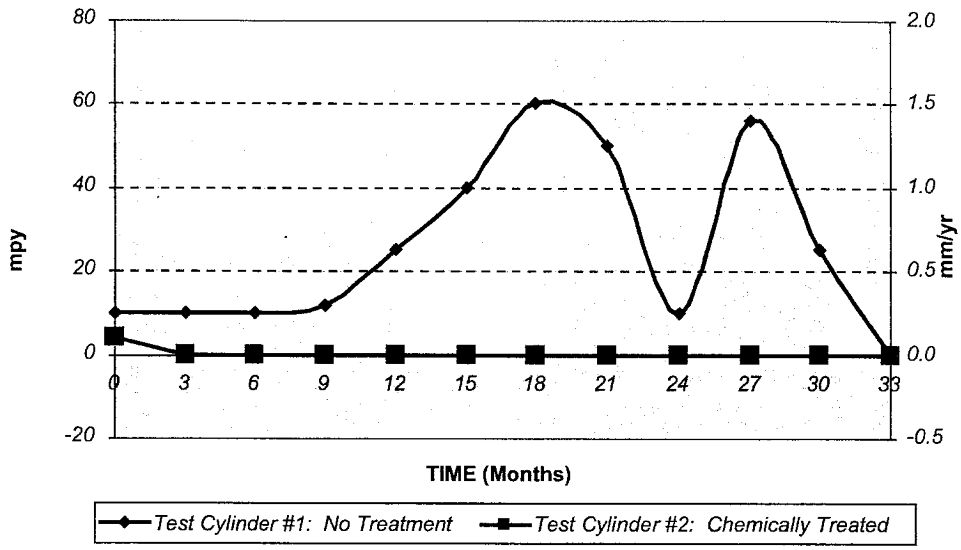


FIGURE 2
Iron Count in Chemically Treated and Untreated Hydrostatic Test Water

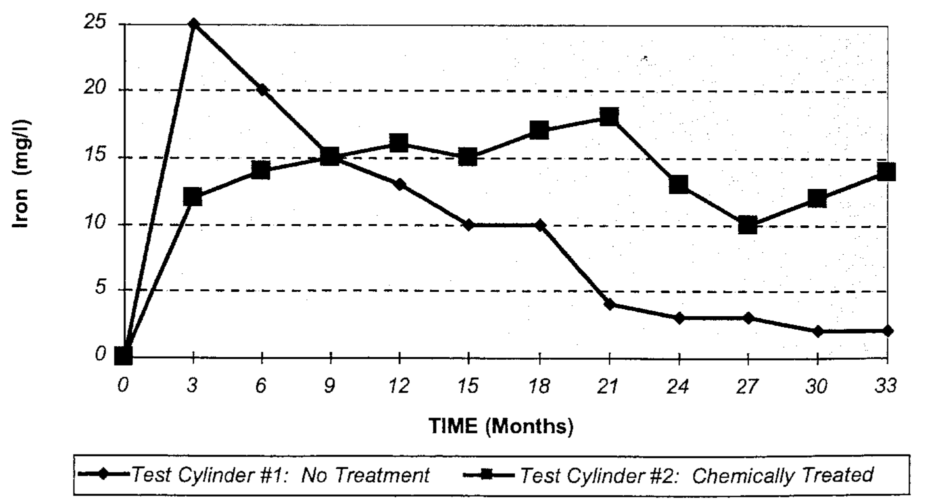
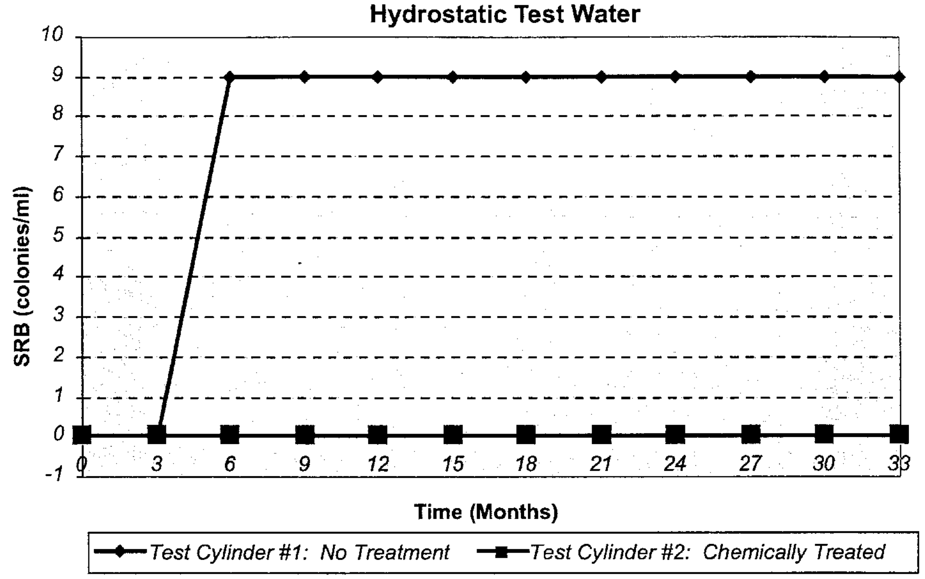


FIGURE 3
SRB Concentration of Chemically Treated and Untreated Hydrostatic Test Water



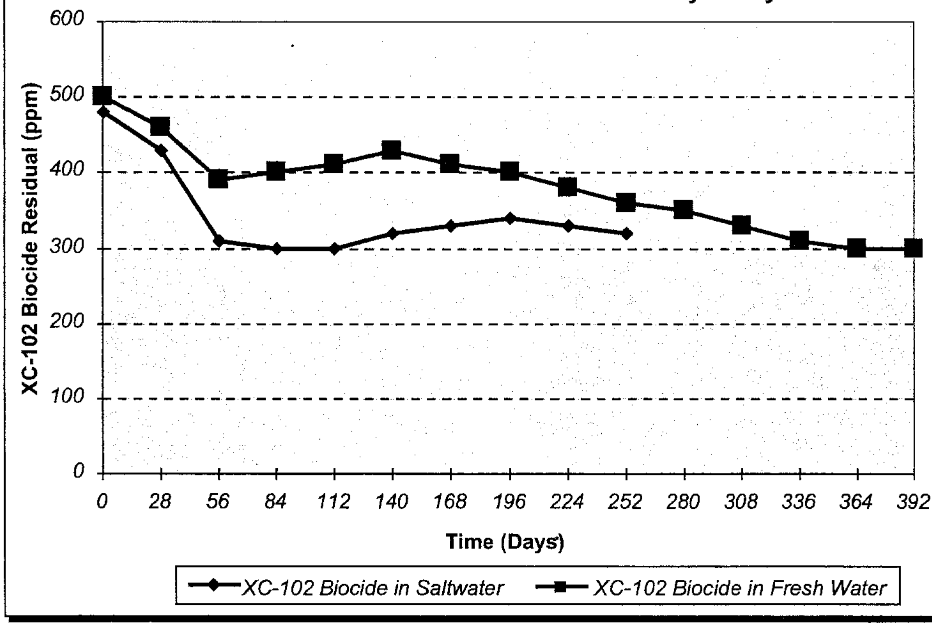
The time required for oxygen depletion to approximately 100 ppb in both fresh and sea water in a range of pipe diameters is shown in Table 1. The oxygen in the largest diameter (10" or 250 mm) cylinder was depleted in 48 hours. Metal coupons suspended in the water in the cylinders were examined after 4 months for signs of oxygen attack. No evidence of pitting was observed.

TABLE 1
Oxygen Depletion in Water-Filled Pipelines

Line Size		Water	Initial	Hours to
MM.	**Inches**	**Type**	**O_2 (ppm)**	**100 ppb**
250	10	fresh	7.2	48
100	4	fresh	6.8	26
50	2	fresh	7.0	20
250	10	sea	4.5	48
100	4	sea	4.0	30
50	2	sea	4.5	18
Temperature 20 - 22°C				

The results of biocide stability tests for X-CIDE 102 biocide are shown in Figure 4. The concentration of X-CIDE 102 biocide falls from 500 ppm and stabilizes at about 300 ppm in both fresh water and sea water.

FIGURE 4
Stability of XC-102 Biocide in Hydrostatic Test Water
Saltwater and Fresh Water Laboratory Study



Product Data

BAKER HUGHES

Baker Petrolite

CRW132
Corrosion Inhibitor

DESCRIPTION:

CRW132 is a water-soluble blend of filming amines, surfactant, and oxygen scavenger. It is an excellent packer fluid inhibitor as well as a hydrostatic test and general waterflood inhibitor.

APPLICATION:

Applications vary with specific system conditions. Contact your local Baker Petrolite products representative for advice on your system.

Your Baker Petrolite representative can evaluate your system's performance, specify the appropriate treatment and equipment, and design a comprehensive application program.

TYPICAL PROPERTIES:

Specific Gravity, 77°F(25°C)	0.97
Specific Weight, 77°F(25°C)	8.07 lbs/US gal
Flash Point, PMCC	88°F(31°C)
Pour Point	-40°F(-40°C)
Solubility (brine)	Soluble
Solubility (water)	Soluble

FEATURES AND BENEFITS:

Feature:
- Combination formula

Benefit:
- Minimizes product inventory

Feature:
- Residuals easily monitored

Benefit:
- Treatment cost minimized

Feature:
- Excellent cold weather handling properties

Benefit:
- Minimal storage and pumping requirements

MATERIAL COMPATIBILITY:

Suitable:

Metals:	admiralty brass, copper, 304 stainless steel, 316 stainless steel
Plastics:	PLEXIGLAS, HD polyethylene, HD polypropylene, PVC
Elastomers:	fiberglass, TEFLON

Not Suitable:

Metals:	aluminum, mild steel
Plastics:	
Elastomers:	Buna N (rubber), neoprene, HYPALON, VITON

SAFETY AND HANDLING:

Before handling, storage or use, see the Material Safety Data Sheet (MSDS) for details.

Baker Petrolite 24 Hour Emergency Hotline:
1-800-424-9300 (CHEMTREC) U.S.A.
1-613-996-6666 (CANUTEC) Canada
Baker Petrolite Customer Care Hotline:
1-800-872-1916 (8 a.m. to 5 p.m. CST)

Product Data

Baker Petrolite

CRW9070
Corrosion Inhibitor

DESCRIPTION:

CRW9070 corrosion inhibitor is an amine based corrosion inhibitor which can be used to treat oil wells, water injection systems and packer fluids. It is soluble in fresh water and brines up to 12.0 pounds per gallon. CRW9070 provides protection from corrosion caused by both CO_2 and H_2S.

APPLICATION:

CRW9070 corrosion inhibitor should be applied via continuous injection. A concentration of 10-50 ppm in the produced fluids is sufficient in most applications. The optimum rate needed should be based on the data obtained from the monitoring program.

For packer fluids, 0.5-2.0% should be mixed into the brine prior to injection into the annulus.

Your Baker Petrolite representative can evaluate your system's performance, specify the appropriate treatment and equipment, and design a comprehensive application program.

TYPICAL PROPERTIES:

Form	Liquid
Specific Gravity @ 72°F	0.924
Specific Weight @ 72°F	7.70 lbs/US gal
Flash Point	62°F
Pour Point	-35°F
Solubility	Water soluble
pH	9.0-12.0

FEATURES AND BENEFITS:

Feature:
- Thermally stable

Benefit:
- Effective in hot wells

Feature:
- Excellent brine solubility

Benefit:
- Mixes easily with packer fluids

Feature:
- Very water soluble

Benefit:
- Particularly effective in high fluid wells

Feature:
- Detergent properties

Benefit:
- Helps prevent under deposit corrosion

MATERIAL COMPATIBILITY:

Suitable:

Metals:	admiralty brass, aluminum, copper, mild steel, 304 stainless steel, 316 stainless steel
Plastics:	HD polyethylene
Elastomers:	TEFLON, VITON

Not Suitable:

Metals:	
Plastics:	HD polypropylene, fiberglass
Elastomers:	BUNA N (rubber), neoprene, HYPALON

SAFETY AND HANDLING:

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BPPD2022 (09/98)

Technologies

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To: SCOTIA INSTRUMENTS		**Attention: Robert MacLeod**	
Fax: 00 1 281 873 5344		**Pages: 18**	**Ref: sc327/sc**
CC:		**Fax:**	
Re: Gulf of Mexico		**Date:** August 31, 1999	

Further to our recent telephone conversation, I can now confirm the following information.

Environmental Information

Champion Technologies has reviewed the regulations for the use of chemicals in the gulf of Mexico, and can now confirm the following.

A number of U.S. operators have been previously contacted and it has been confirmed that there are no specific regulations relating to the use and discharge of chemicals in the Gulf of Mexico for 'federal' waters. A governing board or body empowered with approval and testing does not exist to directly intervene or regulate chemical use and subsequent discharge. However, there are regulation pertaining to state water (coastal waters) which are highly relevant to this project.

The Gulf of Mexico has a similar environmental position to that of the North Sea oilfield sector albeit ten years ago. It is believed that although the regulations have not been formalised, there are some general guidelines that Champion has learned about from our recent discussions with environmental regulatory bodies.

Champion Technologies has been advised to ensure that all products possess a full environmental data set relating to the Bioavailability, Bioaccumulation, Biodegradation and the toxicity information for Skeletonema, Corophium and Acartia. This is essentially a product having a full "**HOCNF Format**".

All products that have been quoted within this document have a full HOCNF Format data set.

It is known that oil soluble corrosion inhibitors are not allowed except where a corrosion inhibitor maybe be considered based on the pipeline protection period required.

The UK North Sea, Norwegian North Sea, Danish and Dutch oilfield sectors have the most sophisticated and structured environmental regulatory body in the world. Champion Technologies design, manufacture and supply in accordance with these guidelines and therefore has a full database of all the necessary environmental information for all its products. This position has ensured that Champion has the environmental technology and knowledge in order to supply to all oilfield sectors on a global basis. Champion will revert with full information as to whether the chemical speicfications detailed below will be required to be revised, once clarification is sought for chemical discharge in to federal waters.

Champion is very aware of the effect that chemicals can have on marine life and the environment as a whole. We take our responsibility as a chemical supplier very seriously and for a number of years an Environmental Policy has been an integral part of our corporate ideology.

The Blacksmith range of hydrotesting chemicals has both fully toxicity tested by the UK authorities under the Offshore Chemical Notification Scheme (OCNS). This category system reflects the toxicological properties, environmental impact and usage volume of chemicals offshore in the UK sector.

In January 1996, the new system of Harmonised Offshore Chemical Notification Format came into force. This scheme standardises the methods for testing, evaluation and approval of offshore exploration and production chemicals throughout the entire North East Atlantic Sector. This revised notification scheme supercedes the voluntary OCNS but is sufficiently similar that the old classifications will remain valid for a given period. The periods for which these will remain valid are as follows:

Category 4 : Until 1st June 1997

Category 3 : Until 1st January 1998

Category 2 : Until 1st January 1998

Category 1 : Until 1st January 1999

Category 0 : Until 1st January 2000

In addition, the revised prior notification tonnage triggers have also been amended. These are now set for the cumulative quantity of all chemicals used within each group at individual installations. This differs from the old OCNS for which the tonnage triggers were based upon the discharge of individual chemicals.

The UK Department and Trade and Industry (DTI) regulate the environmental classification of chemicals for offshore use. In doing so, each chemical is awarded a category based on it's toxicity profile. Summarised below are a selection of low toxicity packages.

Product	Application	HOCNF Category*
Champion B1150 (Bactron K-54)	Biocide	C
Champion B1710	Biocide	D
Champion OS2 (Cortron RU-206)	Oxygen Scavenger	E (OS Parcom List 'A')
Champion CP1900	Corrosion Inhibitor	B
Champion Fluorescein Dye	Leak Detection Dye	D
Champion Cleardye*	Leak Detection Dye	E

Champion Technologies

BLACKSMITH B1150

Product Data Sheet

Product Description

Blacksmith B1150 is a highly effective biocide used to control microbiological problems in both land based and offshore systems. Chemically, it comprises of a 50% solution of Glutaraldehyde.

Product Application

Blacksmith B1150 is an excellent non-selective biocide for the destruction of the major bacterial strains and is also effective against some fungi and algae.

Blacksmith B1150 is water miscible liquid which forms clear solutions in both fresh water and concentrated brines.

This product is one of the most environmentally acceptable biocides on the market.

Chemical & Physical Properties

Form:	Liquid
Colour:	Clear, colourless/light yellow
Odour:	Pungent
pH (20degC):	3-4
Boiling Water:	95degC approx.
Water Solubility:	Completely miscible
Relative Density (20degC):	1.113
Viscosity (20degC):	20mPa.s

Dosage

Blacksmith B1150 should be injected neat into the system at a dosage rate of 75-200ppm, for batch fill testing operations. Champion will be able to advise on the optimum concentration subject to systems conditions.

Environmental Information

Blacksmith B1150 is an environmentally friendly combined product and has been awarded an HOCNF Category of 1[C].

This product is also approved by the relevant authorities for use in the Danish, Dutch and Norwegian Sectors of the North Sea.

Champion Technologies
Abbotswell Road, West Tullos, Aberdeen AB12 3AD. Tel: 01224 879022 Fax: 01224 876022 Telex 73171
Registered Office: Abbotswell Road, West Tullos, Aberdeen, AB12 3AD. Registered in Scotland No. 166529

Champion Technologies

BLACKSMITH OS2

Product Data Sheet

Product Description

Blacksmith OS2 is an aqueous solution of Ammonium Bisulphite (63-65%). This product has been designed to rapidly scavenge dissolved oxygen from seawater at normal temperatures for pipeline operations and water injection systems.

This product should be injected neat into the treatment solution with the minimum exposure to air.

Product Application

Blacksmith OS2 should be injected into the treatment solution with the minimum exposure to air. For hydrotest applications it is important that Blacksmith OS2 is added to the test medium before the injection point of other hydrotesting chemicals. This product is one of the most economical methods for reducing the dissolved oxygen content to below 10ppb.

Chemical & Physical Properties

Form:	Liquid
Colour:	Clear, light yellow
Odour:	Pungent sulphurous
pH (20°C):	4.8-5.8
Boiling Point:	105°C approx.
Water Solubility:	Completely miscible
Relative Density (20°C):	1.32-1.40

Dosage

Blacksmith OS2 should be injected at 155ppm as this dosage level will ensure a rapid rate of oxygen depletion.

Environmental Information

Blacksmith OS2 is an environmentally friendly combined product and has been awarded an HOCNF Category of E (OSPARCOM List A).

Champion Technologies
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Champion Technologies

BLACKSMITH CP1900

Product Data Sheet

Product Description

Blacksmith CP1900 is a highly formulated film-forming imadazoline salt based corrosion inhibitor designed to provide corrosion protection for hydrotest operations.

This is achieved by either a continuous injection operation during pipeline flooding or as a batch treatment program, prior to pipeline start-up.

Product Application

Blacksmith CP1900 is a highly active corrosion inhibitor which effectively forms a protective barrier between the test medium and the walls of the pipeline. This product was formulated in order to have a greater environmental acceptability whilst providing enhanced corrosion protection at a low dosage level. Blacksmith CP1900 is completely miscible in fresh water and salt water mediums and is active over a wide pH range.

Chemical & Physical Properties

Form:	Liquid
Colour:	Clear amber
Flash Point:	>65°C
Relative Density (20°C):	0.996
Viscosity (25°C):	5cP.

Dosage

Blacksmith CP1900 should be inject neat into the system. if used for continuous inject at a dosage rate of 100-200ppm. Dosage levels for batch treatment programmes are subject to system conditions and therefore a Champion representative can assist with dosage recommendations.

Environmental Information

Blacksmith CP1900 has been awarded an HOCNF Category B.

Champion Technologies
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Registered Office: Abbotswell Road, West Tullos, Aberdeen, AB12 3AD. Registered in Scotland No. 166529

Champion Technologies

BLACKSMITH FLUORESCEIN DYE

Product Data Sheet

Product Description

Blacksmith Fluorescein Dye can be supplied in solid or liquid form although for hydrotesting operations the liquid form is generally favoured. Chemically, it is the sodium salt of hydroxy-o-carbonyl phenyl fluorene and has a dark orange appearance in the concentrate form.

Product Application

Blacksmith Fluorescein Dye exhibits an intense green colour upon dilution and is generally detected by UV light at 491nm making it an excellent tracer dye for use in leak detection. Blacksmith Fluorescein Dye is most commonly used for hydrotest and cementing operations. This product is generally regarded as the full strength industry standard.

Chemical & Physical Properties

Form:	Liquid
Colour:	Dark orange
Odour:	None
pH (@2% in water):	12
Relative Density (20°C):	1.0 - 1.1
Solubility:	Completely soluble in fresh and sea water.

Dosage

Blacksmith Fluorescein Dye is typically dosed in the range of 25-40ppm for hydrotest applications and 1000-4000ppm for cementing applications.

Champion Technologies

BLACKSMITH CLEAR DYE

Product Data Sheet

Product Description

Blacksmith Clear Dye is an optically sensitive tracer dye for hydrostatic testing and can be supplied in both the solid or liquid form, although for hydrotesting operations the liquid form is generally favoured. Chemically, it is an anionic fluorescent compound which offers substantial advantages over existing dye-based tracer systems.

Product Application

Blacksmith Clear Dye has been formulated to be used for hydrotest leak and pressure test operations for both fresh and saline water. This product operates as a readily traceable detector when activated by UV light although it is invisible under white light. Blacksmith Clear Dye offers advantages over more familiar leak test tracers such as Blacksmith Fluorescein Dye as the visible discharge can not be observed.

Chemical & Physical Properties

Form:	Liquid
Colour:	Yellow Solution
Odour:	None
pH:	8-9.5
Solubility (@20°C):	completely miscible

Dosage

A Champion representative can advise of the required dosage levels based on the system conditions.
Attached is the Absorption spectra for Blacksmith Clear Dye (Ref. Figure 1).

Champion Technologies
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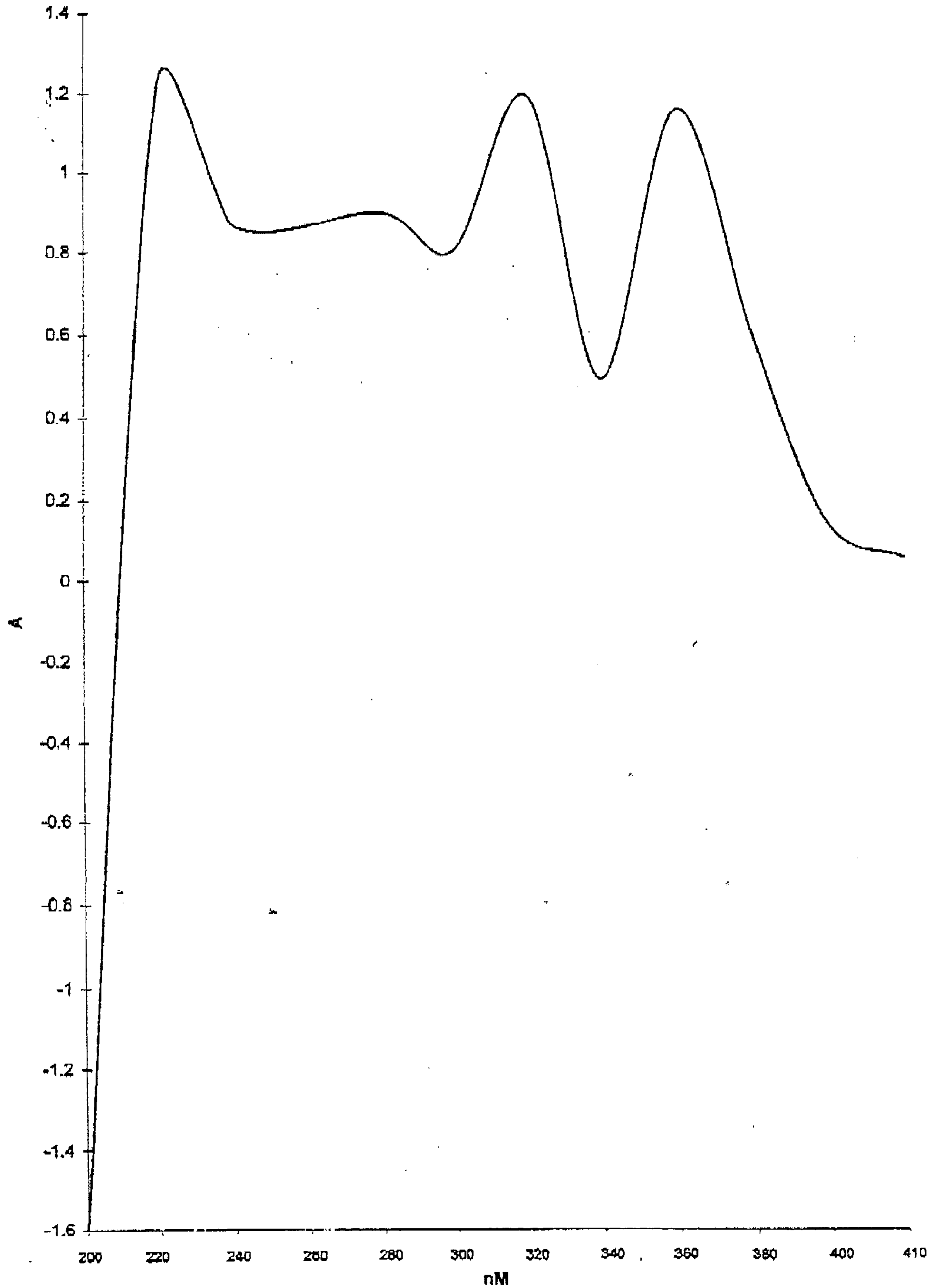


Figure 1: Absorption spectra profile for Blacksmith Clear Dye

Champion Technologies

SUBSEA

SPECIAL PRODUCTS

Innovative Chemical Solutions

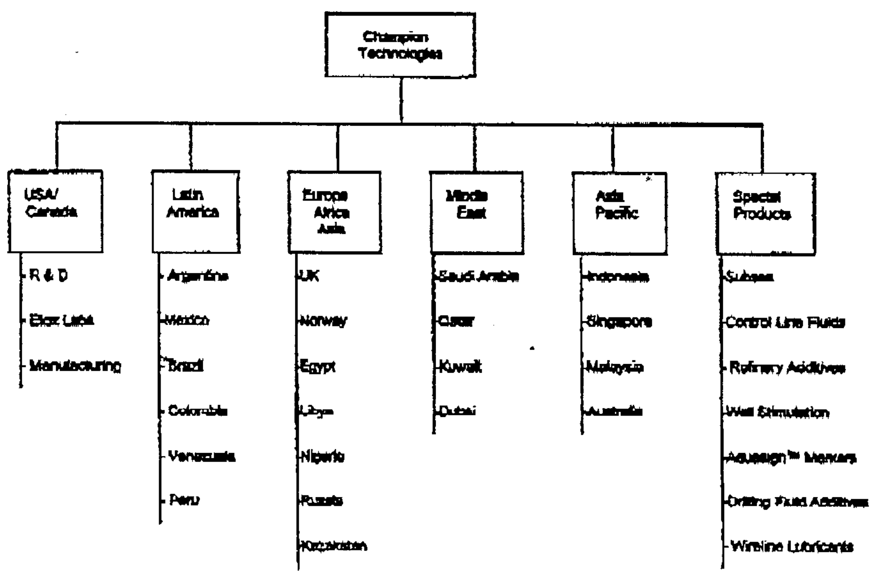
• Hydrotesting Corrosion Inhibition • Leak Detection • Wax Removal
• Solid State Chemistries • Pipeline Bundle Protection • Pipeline Swabbing
• Free-flooding Pipelay Inhibition • Hydrocarbon Decontamination
• Subsea Tie-in • ROV/Diver Intervention • Descaling

Company Overview

For over a decade Blacksmith has maintained its position as a leading North Sea oilfield chemicals service company whilst also developing a significant international portfolio through its Special Products range.

Following Blacksmith's acquisition in 1998 by Champion Technologies Inc, an International leader in speciality oilfield chemicals, Champion Technologies Special Products operates as a specialist division dealing primarily within the global service industry sector. Through Champion's established world wide infrastructure this group is able to service an increasing customer base with its Special Products and application technologies.

These Special Products are internationally recognised and respected and carry unparalleled track records. Many are industry standards and extensively used by the service industries leading contractors. Any Special Products material is available globally from any company location.



Special Products and their applications are serviced by trained and experienced individuals that work in partnership with users to modify existing or develop new chemistry deployment solutions.

Subsea Special Products

For over a decade Champion Technologies (formerly Blacksmith) has been the leader in the supply of chemical related products, services and consultancy to the North Sea Subsea and pipeline service industry.

This experience is also exported widely and in particular Champion's strategic position in the South East Asian and Latin American subsea markets is comparable to that held in the North Sea.

A range of low toxicity chemistries available for deployment in several physical forms are customised to meet specific operational conditions has secured Champion's involvement in over 100 major pipeline commissioning and decommissioning projects achieving several industry records and notable firsts. A full track record is detailed on the back page.

Blacksmith's and now Champion's unique position of dedicating an experienced project team to the subsea service industry sector allows expert technical, operational and environmental advise on the selection/application of chemicals. Cooperation with locally experienced Champion operations means a rapid high level of assistance is always available to overseas customers.

The core application of Champion's Subsea Special Products range is corrosion inhibition chemistry. Corrosion is such a vital consideration in subsea operations in that every activity where metallurgy is exposed to seawater, the potential for corrosion should be evaluated and prevented. A basic overview of the common corrosion process is enclosed within this document. In addition, throughout the past 2 years Champion has worked extensively on deepwater corrosion prevention techniques which allow chemistries to be deployed under difficult engineering and operational circumstances where the standard approaches to corrosion inhibition are not possible. However, deepwater corrosion follows a unique set of pathways, whereby an illustration of this process has been attached.

An application guide for Champion Subsea Special Products is included over. However, final selection of a Special Product and application technique usually occurs in consultation with the user and evaluates various factors, i.e. environmental, operational time and costs.

Full technical details on any application or product shall be provided on request.

Standard Seawater Corrosion Inhibition

Oxygen Scavengers	Remove dissolved oxygen from water to prevent oxygen induced corrosion. Oxygen Scavengers are designed to provide a rapid rate of oxygen depletion, i.e. at 5°C, to reduce the oxygen content by 95%, well within the first minute of injection.	Blacksmith OS2 Blacksmith OS3
Biocides	Remove bacteria from water to prevent microbiological induced corrosion. Biocides are designed to be effective on a wide range of strains, e.g. Aerobic, Anaerobic and Sulphate Reducing Bacteria. Biofilm penetration is also advantageous to eliminate biomass build up.	Blacksmith B1150 Blacksmith B1660 Blacksmith B1370 Blacksmith B1710 Blacksmith B1200
Corrosion Inhibitors	Provide tenacious film through adsorption of the inhibitor molecules onto the metal surface. The inhibitor film protects the metal from corrosion and prevents any bacterial fouling becoming directly attached to the surface.	Blacksmith CP1300/E Blacksmith CP1900 Blacksmith CP1620
Cocktail Products	Combination chemicals that contain one or more of the individual biocide, corrosion inhibitor and oxygen scavenger components.	Blacksmith O-3870R

Novel Corrosion Inhibition

Hydrotesting Sticks for free-flooding equipment or 'online' chemical insertion whilst subsea	Specific water treatment chemistries custom developed in solid form with dissolution rates designed to introduce chemistries under given operational conditions and time scales. • Inserted into various equipment (e.g. spools/bundles/risers) prior to load out. • Inserted into gaskets prior to seal plate changes/jumper installation. • ROV/diver insertion for spool pieces/flanges and during hook up operations. • Eliminates divers exposure to chemicals. • Bonded for temporary fixing to equipment by water soluble adhesives providing delayed chemical deployment.	Biocides Sticks Oxygen Scavenger Sticks Corrosion Inhibitor Sticks Cocktail Sticks Dye Sticks
Water Treatment Gels for free-flooding equipment	Specific water treatment chemistries custom developed in soluble gel form designed to introduce active 'corrosion inhibition' chemistry under operational conditions and time scales. Provides high level localised corrosion protection.	Biocides Oxygen Scavengers Corrosion Inhibitors Cocktails
Water Treatment Coatings for pipelay applications	Liquid inhibitor package designed to set with hard smooth finish. Used for 'online' seawater inhibition treatment of pipelines during free flooding operations. Contain water soluble corrosion inhibitor, biocide, oxygen scavenger and can be applied by brush/spray onto internal pipe surface prior to lay.	Biocides Oxygen Scavengers Corrosion Inhibitors Cocktails
Vapour Phase Inhibitors	Products designed to be added to the liquid test medium. On dewatering the VPI will be retained on the internal surfaces and release a corrosion inhibitor vapour which coats the metal and provides protection.	Blacksmith VPI series

Specialist Gels

Decontamination Gels	Remove hydrocarbons and retain contamination absorbed within structure of the moving gel. Decontaminates pipework to less than 40ppm oil in water post flush.	Blacksmith Musol S Gel
Swabbing Gels	Contain dehydration solvent to act hydroscopicity on the pipeline internals. Lift and retain water contamination absorbed within structure of the moving gel.	Blacksmith Methanol Solgel Blacksmith MEG Solgel
Pick Up Gels	Water or hydrocarbon based gels designed to remove pipeline debris leaving the internal surface in either a hydrophilic or hydrophobic state.	Blacksmith Aqua Solgel Blacksmith Gel Oil 10/11
Isolation Gels/Gel Pigs	Highly viscous or pre-formed water or hydrocarbon based gels used in pigging and isolation operations.	Blacksmith Solgel/Geloil Series

Leak Detection

Leak Detection Dyes	Leak detection via visual and optical fluorescence. Leak detection via optical fluorescence (chemical is colourless - no seawater colourisation). Very Low Toxicity.	Blacksmith Fluorescein LT Blacksmith Clear Dye
Leak Detection Sticks/Gels	As above in stick or gel form	As above in stick/gel

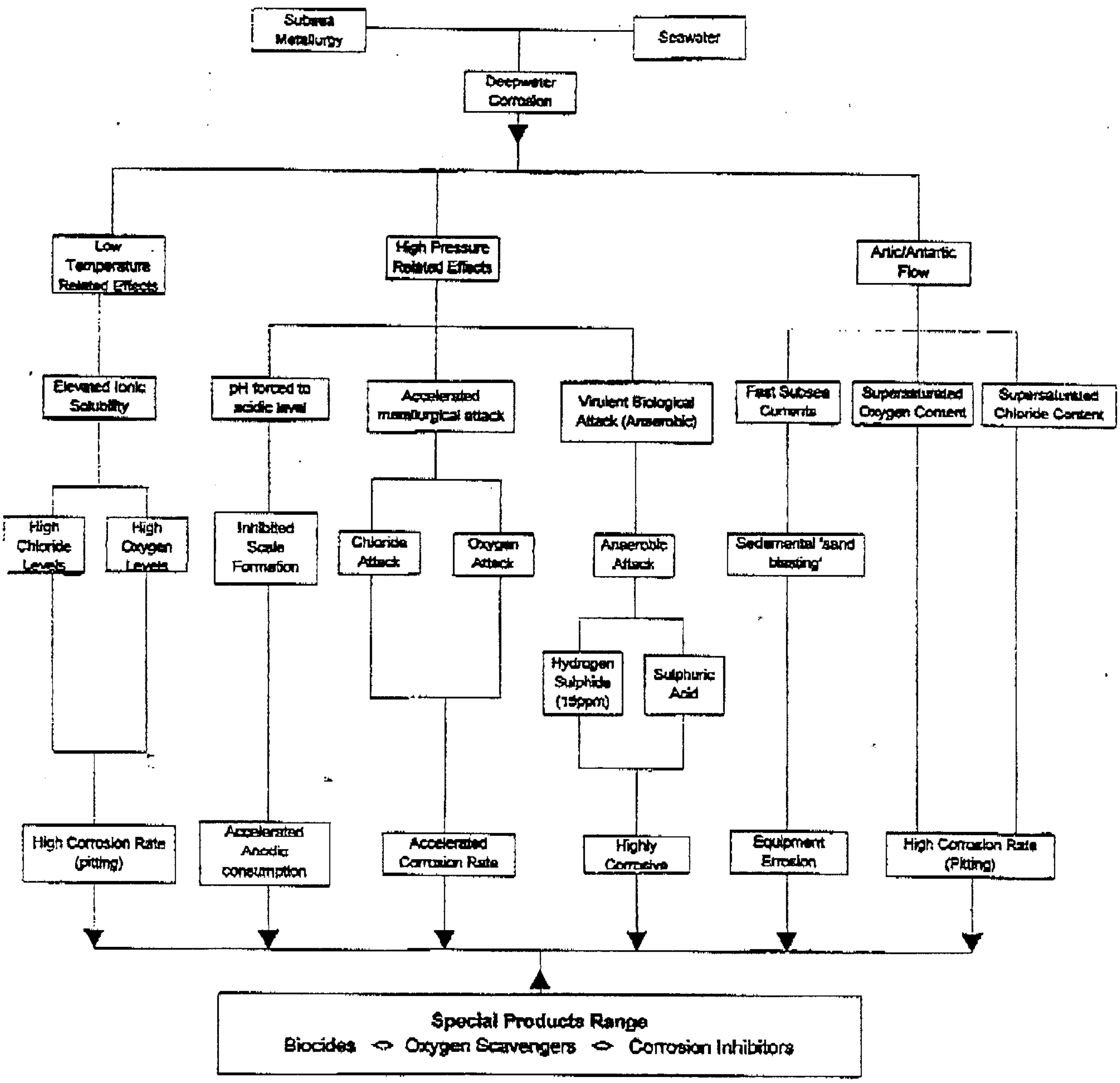
Pipeline Blockage Removal

Wax/Scale Removal	The removal of wax and scale from a pipeline can normally be satisfied by routing pigging operations under some circumstances the effectiveness of pigging can be improved with the use of chemical treatments. The exact formulation of the chemical is selected as being specific to the wax or scale.	Blacksmith Scale Dissolver range Blacksmith Wax Dissolver range

Pipeline RFO Conditioning

Swabbing Solvents	Glycols or methanol used in pipeline drying operations where advantageous over Nitrogen or vacuum.	Methanol and Glycols
Pipeline Conditioning	Post dewatering an inhibitor gel pig or slug of oil/gas phase corrosion inhibitor can be run. This conditions the pipe internal surfaces to receive fluids/gas pre protected.	Blacksmith CP1315

OVERVIEW OF DEEPWATER CORROSION PROCESS



OVERVIEW OF COMMON SUBSEA CORROSION PROCESS