Pseudacris regilla in the Dow's Prairie Educational Wetland: Exploring Reasons behind Pacific Chorus Frog Population Decline

Humboldt State University

Environmental Science Senior Capstone Project

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Introduction

Problem Statement

This project sought to determine if the water that fills the wetland at Dow's Prairie Educational Wetland is contaminated, and if so, if this contamination is related to the recent decrease of *Pseudacris regilla* (Pacific chorus frogs) from the site. We also attempted to determine what particular contaminants are present, as well as their source locations, so that we could recommend measures to take to help prevent future contamination from occurring.

What is Dow's Prairie Educational Wetland?

Dow's Prairie Educational Wetland (DPEW) has been a holding of the McKinleyville Land Trust (MLT) since 2008, but in the 1950's the site had supported a Christmas tree farm. Aerial photography from the 1960's, however, suggests that the wetland pond area was never under cultivation (Wiltrout et al., 2009). More recently, the parcel was privately held by the landowner who currently owns the adjacent parcel to the south, and the DPEW site went largely unmaintained for years (N. Kelley, pers. communication, 2013).

The property was acquired with the help of grants from the Simpson Timber Company (now known as the Green Diamond Resource Company), the Humboldt Area Foundation, and the Co-op Foundation (McKinleyville Land Trust, 2012). The site has since become a place to practice restoration, conservation, and education. A grant from the U.S. Fish and Wildlife Service's Schoolyard Habitat Program has been instrumental in integrating the wetland into the elementary schools curriculum. The MLT has provided guest lecturers to speak at the elementary school covering topics such as ecology, history, and art at grade appropriate levels (McKinleyville Land Trust, 2012). Youth AmeriCorps members and volunteers from the land trust and the community were able to partially restore the property by removing large amounts of invasive vegetation, allowing the wetland to be used as an outdoor classroom (Driscoll, 2011). Public access for recreation, however, is limited because the ecosystem is sensitive and one of its most delicate features, frog egg mats, must be protected from disturbances.

Site Description

Dow's Prairie Educational Wetland is a seasonal vernal pool wetland located next to Dow's Prairie Elementary School in McKinleyville, California. The pond usually fills with water during late winter and dries by late spring or early summer (Gavlas et al., 2009). The site consists of a 2.5 acre parcel that is located off of Grange Road about 100 yards west of Central Avenue (Figure 1). The property is bordered by woodlands to the south and by Dow's Prairie Elementary School to the east. To the north are Grange Road and multiple private residences. Topographic lines show that the wetland sits at the bottom of a bowl shaped basin (Figure 2). It is fed only by rainwater, a culvert on the northern side of the property, and surface water runoff from the surrounding area.

Project Summary

According to Nanette Kelley of the MLT, the *P. regilla* population at DPEW has drastically declined over the past four years. Frog egg mats were once a common sight at the wetland during the spring, and when the eggs began to hatch the elementary school would experience a "plague" of frogs on campus. Adult frogs are sometimes heard in the wooded area surrounding the wetland and during the spring there has been some evidence of *P. regilla* using the wetland as a breeding ground by the presence of dried egg mats, but the number of frogs using the wetland and laying eggs that would survive seemed noticeably low. The cause of this decline is unknown by the MLT, but speculation is that the frogs are being negatively affected by poor water quality at the site. The timing of the population decrease seemed to follow a period when a white, powdery film was visible on the surface of the water. This occurred just after a construction company that stored heavy equipment on a lot across the street from the wetland was moving to a new location. Since then, the frog population has been minimal and another population boom has not occurred.

Possible contamination sources of the water in the wetland include: contaminants brought in from a culvert that drains into the northern edge of the property, heavy metals from roadway runoff from Grange Road, pesticides, fertilizers, and other chemicals used to promote desirable plant growth, and possibly even septic contamination from nearby homes or the elementary school. There is no sewer system in the Dow's Prairie area, and all local homes and the elementary school use septic systems (McKinleyville Community Services District, pers. communication, 2013). If septic systems are not properly maintained, fecal coliform and household chemical contamination from these sources is a possibility. Additionally, several residential properties to the east and to the north of the wetland are suspected of being marijuana growing operations, known for their use of fertilizers, pesticides, and other chemicals. Runoff from chemicals such as these have been shown to have severe impacts on frog populations (Relyea and Diecks 2008). Furthermore, research has shown that heavy metal contamination is very common in soils along roadsides (Yisa, 2010). The DPEW is immediately adjacent to Grange Road, which has no curbs and drains into the wetland during rainfall events. Although there is a significant vegetation buffer between the wetland and the road, this close association leaves the habitat susceptible to heavy metal contamination.

While it is possible that water contamination is the reason for the significant reduction of *P. regilla* at DPEW, other issues may have contributed as well. We looked at past precipitation data to determine if the site has experienced drier than normal conditions during the wet season in recent years. We also attempted to determine if environmental or biological factors such as habitat disturbance or disease could have played a role in the reduction of the *P. regilla* population at DPEW since 2009.

Objectives

The objectives of this project were two-fold. The first objective was to determine what contaminants, if any, are present in Dow's Prairie Educational Wetland. The second objective was to determine what has caused the drastic decline of the *P. regilla* population from the wetland. There is a high likelihood that these two objectives are connected due to the fact that various water contaminants could negatively affect frog populations. However, other factors must be considered in regards to the cause of the frog population decline as well. Other factors that were researched included: habitat disturbance, changing weather patterns, and disease. In undertaking these two objectives we hope the ecological health of DPEW can be improved to allow for a healthy functioning ecosystem and future educational opportunities at the adjacent school.

Constraints

There were a variety of factors that presented themselves as constraints to our project, both primarily related to the time of year during which the project was being completed. Since we undertook this project during the fall semester, with studies being completed between September and October, the *P. regilla* population at the site was not present in the wetland. This is because frogs usually only use the wetland during breeding season, after which they retreat to wooded areas for the remainder of the year (Brattstrom, 1955). Breeding and egg-laying season for *P. regilla* at DPEW occurs from November to March (McKinleyville Land Trust, 2013). Not being able to do our project during this time meant that we could not determine how many frogs were using the wetland or observe *P. regilla* egg mats or tadpole metamorphosis.

Another constraint that we encountered was the inability to test water at the wetland. The wetland is seasonal and only fills during the rainy season, which in Humboldt County usually extends from late fall or early winter until the following spring (NOAA, 2013). Since our project took place in the fall, we knew it was possible that the wetland would not be wet during the duration of our project, or that it might start fill towards the final stages of it, leaving an inadequate amount of time to conduct testing. Therefore, we decided to focus on testing soils at the site for contaminants.

Background

Possible Sources of Contamination

To understand our problem we first had to understand all of the potential sources of water contamination. We identified the primary sources of water entering the wetland as direct precipitation and runoff from surrounding areas. A watershed delineation shows that the drainage area entering the wetland extends past the southern end of the elementary school into a residential area, however, we know from observing runoff characteristics during a heavy rain event in November that the extent of the watershed is much larger (Figure 3). This discrepancy between the delineated watershed and the observed watershed can likely be attributed to changes in natural runoff characteristics caused by human development, such as construction of the road, culvert, and elementary school. A culvert that drains into the northern part of the DPEW property passes under Grange Road, and the inflow end of the culvert is located in a roadside ditch along the northern side of the road (Figure 1). This means that any runoff flowing through that ditch will make its way into the wetland. This could include runoff from Grange Road or from the residential properties along the northern side of the road, including gardens and septic system leach fields. Another major source of water entering the wetland is direct runoff from Grange Road. The road has no storm drains or curbs, allowing all runoff from the southern side of the road to enter the site directly. The road has also been known to frequently flood during heavy rain events (N. Kelley, pers. communication, 2013). As the wetland sits at a lower elevation than most of the surrounding area, much of the stormwater from these floods drains directly into the wetland basin. Although a dense vegetation buffer separates the wetland from the Grange Road, road runoff may be a large factor in potential pollution. The road is not isolated and is subject to traffic every day, especially during morning drop-offs and afternoon pick-ups of children at Dow's Prairie Elementary School. In addition to runoff brought in through the culvert and from Grange Road, runoff from the elementary school and adjacent wooded areas also enters the wetland. Although the wooded areas on the south and western sides of the site are largely unmanaged, runoff from the school may be a source of contamination. The following sections describe potential pollutants at the DPEW site.

Oil & Grease

Contamination from oil and grease and their byproducts, petroleum hydrocarbons and heavy metals, is a cause of concern at DPEW because of the wetland's close proximity to Grange Road and the nature of the wetland to receive stormwater runoff. It is estimated that only 58 percent of the 150 million gallons of lubricating oil sold in California in 2004 was recycled, leaving 20 to 40 percent to be lost to combustion or leaked onto roadways (Denton, 2006). This amount of leakage, even from a numerous amount of small sources, increases the potential for harmful contaminants to enter aquatic systems and cause ecological harm.

Petroleum Hydrocarbons

Petroleum-based hydrocarbons from fuel and oil on roads are a common contaminant carried by stormwater runoff (Maltby et al., 1995). Numerous studies have found that petroleum hydrocarbons are commonly found in sediments of water bodies near roadsides and that stormwater runoff is the major source of this contamination (Matlby et al., 1995; Latimer et al., 1990; Drapper et al., 2000). The sources of these contaminants are typically from the direct application of oil to roadways through automotive leaks or from spills due to the mishandling of stored fuels. Used crankcase oil is thought to be the primary source of petroleum hydrocarbon pollution in stormwater runoff (Denton, 2006). Dow's Prairie Education Wetland is located approximately 50 feet from Grange Road and receives its stormwater drainage, especially when the road floods during heavy rain events, making it likely that this type of contaminant may be present in some quantity at the site.

Heavy Metals

Heavy metals are another common contaminant found near roadways from stormwater runoff (Yisa, 2010). Common metals found in water systems near roads are cadmium, chromium, copper, nickel, lead, and zinc (Wong et al., 2000). Sources of these metals can include anything from used oil to wear and tear of automobile brake pads and corrosion of metal items, such as auto parts. (Chicharro et al., 1998).

For the past five years the McKinleyville Community Services District (MCSD) has conducted heavy metals testing at various sites throughout McKinleyville, with some samples taken from the elementary school adjacent to the wetland site. These tests yielded positive results for lead at varied levels (MCSD, 2012). Being as the samples were collected within one hundred feet of a roadway with no drainage system, which is typical for that part of McKinleyville, it is speculated that this was a result of roadway runoff. Copper has also been positively identified at nearby roadways at levels of 1.3 mg/L, as has Aluminum at levels of 1.0 mg/L (MCSD, 2012), neither of which are considered dangerous for human consumption in water at such low levels. However, there is a possibility that metals present in the site are at high enough levels to negatively affect frog populations (Ezemonye, 2005).

Chemicals Used for Landscaping and Gardening

Organic chemicals used in landscaping and gardening, such as fertilizers, herbicides, pesticides, and fungicides may also make their way into the wetland from runoff from nearby residential gardens and Dow's Prairie Elementary School. When leached into waterways the nutrients added from these products, such as nitrogen and phosphates, can cause negative impacts to the ecosystem. Often these added nutrients will cause eutrophication by stimulating plant growth, which deprives water of oxygen, thereby killing or stressing the local biota (Wong et al., 2000). Pesticides, herbicides, and insecticides can also cause negative impacts to amphibians. Uptake of these aquatic pollutants can negatively affect the survival and development of aquatic species (Relyea and Diecks, 2008). One example of a potentially harmful chemical is glyphosate, the active ingredient in the herbicide Roundup, which is one of the most commonly used herbicides on the market. Studies have shown that glyphosate exposure can cause high rates of mortality to amphibians, and this mortality could possibly signal population declines (Relyea, 2005). In addition, pesticides can also kill non-target invertebrates in an ecosystem, thus depriving amphibians of a food source (Sánchez-Bayo, 2012).

Septic Contamination

Contamination from improperly maintained septic systems is also a possible impact at the site. Since this part of McKinleyville is not connected to the sewer system, nearby residential properties and the elementary school use septic systems and leach fields to treat their wastewater (MCSD, pers. communication, 2013). If not properly maintained, septic contamination can seep into groundwater and be carried with surface runoff during rain events, carrying fecal coliform bacteria, and virtually anything disposed of down drain pipes, including household cleaners, paint thinners, pharmaceuticals, and more. The possibility of septic contamination being present on this site is also warranted due to the findings of recent studies done in the area by Humboldt Baykeeper. A water quality monitoring program that has been collecting data in local creeks since 2005 found that up to 85% of the nearby creeks that were tested contain unusually high levels of fecal coliform, which exceeded recommended limits for fecal coliform in both drinking water and water used for recreation (Humboldt Baykeeper, 2013).

Pseudacris regilla Ecology

From the middle of winter to early spring, *Pseudacris regilla* makes their way to various bodies of water, including creeks, backyard ponds, lakes, slow moving rivers and most often wetlands. The male frogs will sit along the water bank and use their croaks in a chorus manner to attract females to mate with (Schaub and Larsen, 1978). The louder the croak the stronger the male is perceived to be. The females will lay their eggs, attaching them to various submerged aquatic plants near the shore (Digital Atlas of Idaho, 1999). The incubation period lasts from three to five weeks, and then these frogs hatch into larvae stage lasting up to five weeks (Digital Atlas of Idaho, 1999). During this period the tadpoles are equipped with a mouthpiece to scrape algae from the rocks and plants (Nafis, 200). The last few days before these larvae transition into adults they do not eat because their digestive systems are undergoing many changes, from herbivore to carnivore, when they will feast on various ants, beetles, and arthropods (Digital Atlas of Idaho, 1999). After the breeding period the frogs vacate the wetland and live amongst the trees that surround the wetland (Brattstorm, 1955).

For years, the DPEW had become a destination for a local *P. regilla* population during the spring. Based on recollected accounts of an abundance of frogs in the wetland in the past, it seems as if the waters of the wetland had been conducive to the breeding and survival of this species, offering plentiful food sources, a desirable vegetation layer, and a habitable climate.

Until 2009, *P. regilla* were so abundant at Dow's Prairie Educational Wetland that they would plague the neighboring areas. There are multiple reports of students playing with the frogs that would travel to Dow's Prairie Elementary School. There were often so many frogs that they would squeeze under the doors, invade class rooms, and even become part of the architecture as they were flattened in door jams (N. Kelley, pers. communication, 2013).

Like other amphibians, frogs are generally sensitive to water pollution. Amphibians are only present in water bodies of "good health" and for that reason are often considered an indicator species, as they will quickly show signs of decline under polluted conditions (Sheridan and Olson, 2003). In order for species of amphibians to reproduce and maintain a healthy population, the streams or wetlands must contain healthy water, food sources, and desirable habitat cover (Welsh and Oliver, 1998).

Possible Causes of Population Decline

There are several possible reasons for the decline of *P. regilla* at Dow's Prairie Educational Wetland. For one, the population may have been affected by past or ongoing water pollution. Runoff from Grange Road and the surrounding area could possibly bring contaminants such as petroleum hydrocarbons, heavy metals, fertilizers, pesticides, or even septic system related contaminants into the wetland. In addition, frogs at the site could also have been affected by other, non-pollution related factors such as disruption of habitat, disease, or natural fluctuations in weather and population dynamics.

Water Pollution

Since amphibians are typically sensitive to pollution (Welsh and Oliver, 1998), it is possible that water contamination may affect local *P. regilla* populations. Research has shown that petroleum hydrocarbon pollution in freshwater systems can negatively affect amphibian populations by lowering egg hatching success rates and negatively affecting tadpole metamorphosis (Mahaney, 1994). Additional studies have shown that survival, development, and behaviors of frogs can be negatively affected by contamination from heavy metals, fertilizers, and pesticides (Lecort et al., 1998; Relyea and Diecks, 2008). The effects of septic contamination, including fecal coliform, are greatly understudied in amphibian species, but it is also possible that high levels of this disease-causing bacterium may be negatively affecting frogs at the project site.

Habitat Disturbance and Predation

A 2010 project initiated by the McKinleyville Land Trust focused on the removal of invasive species from DPEW. According to Nanette Kelley of the MLT, a large amount of vegetation was removed from the project area immediately surrounding the wetland. The removed invasive species included invasive Himalayan blackberry and scotch broom, and these were removed using heavy machinery that was brought onto the site. While this project took place after the frog population decline occurred, it is possible that it the project disturbed the population beyond their means to recover. The reason behind this could be twofold. On one hand, the act of humans entering the habitat to remove invasive species using heavy machinery could cause a disruption. However, this is considered unlikely since the restoration work was done in the fall, prior to *P. regilla* breeding season, so any remaining members of the population would not have been in the wetland at that time. The other reason could be tied to the lack of vegetative cover around the vernal pool after invasive species removal. The invasive species likely provided the frogs with protective cover from the elements and from predators. If frogs returning to the wetland during the spring found that a lack of vegetation provided unsuitable cover, they may have left the wetland in favor of a safer habitat.

Another potential reason for the *P. regilla* population decline at DPEW could be tied to predation and habitat disturbance from a relatively new species in the wetland. Recently there have been an increased number of sightings of domestic dogs and feral cats, in the wetland (N. Kelley, pers. communication, 2013). These animals could negatively affect frog populations in the wetland in multiple ways. The first obvious reason is increased predation risk. These two animals could predate upon *P. regilla* in the wetland and cause their population to decline sharply or to migrate to a new location. The presence of these new predators in the wetland, combined with the lack of cover due to invasive plant removal could cause a decrease in the frog population. Another issue behind the presence of these animals could be tied to disturbance of the habitat as it is possible that these household and feral pets could cause a disturbance by trampling in the *P. regilla* habitat.

Disease

Amphibian chytridiomycosis is an aquatic fungal disease that attacks many amphibian species (Daszak et al., 2004). This disease causes high mortality rates among amphibian populations and is highly contagious. The disease is caused by a fungus that forms on the skin. The fungus causes an infected individuals skin to thicken, creating an inability to absorb water that eventually results in the mortality of the individual (Daszak et al., 2004). This infection has been spread worldwide and may exist in the Dow's Prairie Educational Wetland. Unfortunately, it will be difficult to determine if this is a reason behind the population decline. This is because to prove this as a source of decline would require capture *P. regilla* individuals for tissue testing.

Another pathogen that could possibly be affecting the *P. regilla* population at DPEW is the water mold, *Saprolegnia ferax*. *Saprolegnia ferax* can be found in freshwater ecosystems worldwide, where they grow on decaying plant and animal materials and have also been known to infect insects, reptiles, fish, larval amphibians, and eggs of fish and amphibians (*Saprolegnia*, 2013). Studies have suggested that *S. ferax* may be a primary cause for mass amphibian embryo mortality in the Pacific Northwest (Blaustein et al., 1994,). One study tested the effects of on *P. regilla* larvae and found that *P. regilla* larvae experienced mortality after one week of exposure to the pathogen (Romansic et al., 2008). In amphibian populations, *S. ferax* can often be identified by the presence of distinct cotton-like stands on eggs (Fernández-Benéitez et al., 2008).

Precipitation Variation

Rainfall patterns are another factor that must be considered when looking into the decline of *P. regilla* populations. This is because as a freshwater wetland that is not fed by any stream or groundwater, precipitation is a major factor for the ecosystem's health. Since the *P. regilla* population decline at DPEW occurred around 2009 (N. Kelley, pers. communication, 2013), rainfall data for that year, as well as for other recent years, was gathered. It is interesting to note that rainfall for 2008 totaled to 29.95 inches, which is a sharp decrease from the average 38.10 inches of annual precipitation usually received in the area (NOAA, 2013). In 2009, this low rainfall level was followed by another relatively dry year with a total annual precipitation amount of 28.95 inches (NOAA, 2013). Once again, this is much lower than average levels and could likely be tied to a declining frog population in the wetland. The reasoning behind this is due to the fact that frogs need water in order to survive, and lowered rainfall could negatively affect frog breeding patterns and the survival of eggs (McMenamin et al., 2008). In a study on wood frogs it was determined that higher rainfall levels were associated with higher rates of frog survival (Berven, 1990). In knowing this one can interpret that lower rainfall levels are associated with lower survival rates. Furthermore, natural variations in local weather could affect vegetation and other biota on the site, which may in turn affect *P. regilla* populations.

Overall it can be seen that a variety of factors could potentially affect the population of *P. regilla* at Dow's Prairie Educational Wetland. While water contamination is a potential factor that could cause major adverse effects to the frogs, there are a variety of other negative impacts that could be caused by both natural and anthropogenic factors. All of these factors must be considered and further researched in order to see which impact or combination of impacts has caused the disappearance of *P. regilla* in the wetland.

Methods

Investigating Possible Contaminants and their Sources

Locating the Culvert Inlet

One of our first steps in investigating possible sources of water contamination in the wetland was finding the inlet of a culvert that had been described to us by Nanette Kelley of the McKinleyville Land Trust as a source of much of the water that feeds the wetland. We first attempted to locate a GIS layer of stormwater drains and culverts in the area in order to determine the approximate location and length of the culvert. Several emails and phone calls were exchanged with the Humboldt County Planning & Building Department and the McKinleyville Community Services District in order to obtain this information. When obtaining these layers proved unsuccessful, we located the culvert on our own by going to the site and clearing a narrow path through the dense vegetation belt of *Spirea douglasii* that lies between the wetland and Grange Road, obscuring the culvert outlet.

Examining Watershed Characteristics

Another step was to delineate the DPEW watershed and observe runoff characteristics at the site, allowing us to better understand how water flowed from the surrounding area into the wetland. Watershed delineation was done using ArcMap10 GIS software and a DEM obtained from the USGS National Map. Additionally, during a heavy rain event on November 12, 2013, our team met at the site to visually observe the path of precipitation into the wetland from the surrounding landscape.

Determining the Source of the White Film on the Water in 2009

As part of our investigation into the possible sources of water contamination, we investigated sources of the "white, powdery, oily sheen" reportedly seen on the surface of the wetland in 2009 (N. Kelley, pers. communication, 2013). This was done by conducting phone interviews with local construction companies, including Hooven & Co, Inc. and Alves, Inc.

Determining what Chemicals may be Present at the Site

In determining what chemicals to test for, several steps were taken. Research of common contaminants found in stormwater runoff led us to test for heavy metals and oil and grease. In order to determine other contaminants to test for we spoke with nearby organizations as well as performed outside research on common types of fertilizers, herbicides, and pesticides used in Humboldt County. Following a request from the McKinleyville Land Trust, we contacted the McKinleyville Union School district in order to find out what fertilizers, pesticides, or other grounds keeping chemicals were used to maintain vegetation at Dow's Prairie Elementary School. In addition to this we also contacted a local hydroponics store, North Coast Horticulture, to inquire about what chemicals were commonly used among marijuana growers in the area.

Testing for Water and Soil Contamination

Heavy Metals (Soil)

Soil samples were collected from DPEW at locations A and B as shown in Figure 1. Sample A was taken just off of the southern side of Grange Road and sample B was taken from the lowest point of the wetland pond. Approximately one cup of soil was gathered at each location and then bagged and refrigerated until testing was performed. Testing for heavy metals was done through the Humboldt State University Biology Department using a soil digestion and analysis method recommended by the British of Columbia's Ministry of the Environment. The digested samples were then analyzed using a flame atomic adsorption spectroscopy machine to determine the concentration of metals present in each sample. The specific metals we analyzed for included: lead, zinc, cadmium, and chromium.

Heavy Metals (Water)

After light rain event on November 12, 2013, our group met at the wetland to collect water samples. We located areas where precipitation runoff from the elementary school and Grange Road had pooled into standing puddles, as well as an area from within the wetland pool where water had accumulated in a slight depressing in the ground (Figure 1). The samples were then stored in 100 mL plastic bottles under refrigeration until analysis was performed. Analysis was done through the Humboldt State University Biology Department. The same method was used as when testing soil samples for heavy metals, except the water sample required only microfiber paper filtration and did not need to go through a digestion process before being analyzed by flame atomic adsorption spectroscopy. The specific metals we analyzed for included: zinc, iron, cadmium, copper, and nickel.

Oil & Grease, Organophosphates, and Carbamate & Urea based Pesticides

A soil sample was collected from the DPEW at location B as shown Figure 1. Approximately nine cups of soil were collected and bagged for testing at North Coast Laboratories, a full service environmental testing laboratory located in Arcata. We requested that the soil samples be tested for oil and grease, organophosphate pesticides, and carbamate and urea based pesticides. North Coast Labs tested for oil and grease using the EPA 1664A method, organophosphate pesticides were analyzed for using the EPA 8141A method, and analysis of carbamate and urea pesticides was performed using the EPA 632 method.

Investigating Other Possible Reasons for Population Decline

Past Precipitation Trends

We researched past precipitation data to determine if drier than normal conditions could have played a role in the decline of *P. regilla* from DPEW. Rainfall data from the National Oceanic Atmospheric Administration for 1990 to 2012 was analyzed. Specific concentration was applied to analyzing cumulative precipitation levels during the *P. regilla* breeding and egg laying season from November to March since the year 2009, when the population decline at the wetland was noticed.

Results

Possible Contamination Sources

Location of the Culvert Inlet

The culvert inlet was located in a roadside ditch on the northern side of Grange Road, approximately 30 yards from where a metal gate leads into the DPEW property. The location of the culvert is shown in Figure 1.

Watershed Characteristics

A delineation of the DPEW watershed using GIS software concluded that the area draining into the wetland extended southwest across the elementary school property and into a residential area on the eastern side of Dow's Prairie Road (Figure 3). However, by observing runoff characteristics at the site during a precipitation event, and by knowing the location of the culvert inlet, we were able to conclude that the actual drainage area also includes runoff from Grange Road and the playground area at the adjacent elementary school (Figure 3).

Source of the White Film on the Water in 2009

The direct source of the white film seen on the water has not been identified. It was reported to us that Hooven & Co, Inc.'s construction company was working on a project and storing their machinery and materials on a split lot across from DPEW on the northern side of Grange Road in 2009, and that the film seemed to appear on the water shortly after they had moved their equipment out of the lot (N. Kelley, pers. communication, 2013). A phone conversation with Tim Hooven of Hooven & Co, Inc., revealed that the company had no record of storing equipment on that lot or at any other nearby lot in the Dow's Prairie area after 2005, but he recalled that Alves, Inc. may have been working in the area during that time (T. Hooven, pers. communication, 2013). This was followed by a call to Alves, Inc. to verify. An appointment for a phone interview was scheduled, but at the time of the appointment Alves declined to take our call.

Determining What Chemicals may be Present at the Site

Researching commonly available and locally used fertilizers, pesticides, and herbicides resulted in an extensive list of chemicals that could possibly be present at the site (for more information see "Recommendations for Future Study" and Appendix 3). In regards to contacting the McKinleyville Union School district about obtaining a list of chemicals used for landscaping on school property, no information was gained (McKinleyville Union School District pers. communication, 2013). Multiple in-person visits were made to the district office to gather this information. However, each visit resulted in school district personnel telling us that someone would get back to us in two to three days. Follow up phone calls returned the same result. In regards to contacting a local hydroponics stores, we were informed that possible chemicals used in the area may include fungicides such as Immunox and Eagle 20, which both contain the active ingredient myclobutanil. We were also given names of two commonly used pesticides, Floramite (active ingredient bifenazate) and Avid (active ingredient abamectin). It was also advised to us that common fertilizer elements such as potassium, nitrogen, phosphorus and sulfur could be present (Northcoast Horticulture Supply, pers. communication, 2013).

Testing for Water and Soil Contamination

Heavy Metals (Soil)

Every metal we tested for (lead, cadmium, chromium, and zinc) was identified in some quantity in each soil sample analyzed. The quantity of each metal recovered from each soil sample is summarized in Table 1.

Table 1. Concentrations of heavy metals found in soil samples taken from Dow's Prairie Educational Wetland.

	Pb	Cr	Zn	Cd
Roadside (Sample "A")	46.11 ppm	57.57 ppm	45.74 ppm	0.82 ppm
Wetland Depression (Sample "B")	95.23 ppm	51.81 ppm	36.53 ppm	0.67 ppm

Heavy Metals (Water)

Every metal we tested for (zinc, iron, cadmium, copper, and nickel) was identified in some quantity in each water sample analyzed. The quantity of each metal recovered from each water sample is summarized in Table 2.

Table 2. Concentrations of heavy metals found in water samples from Dow's Prairie Educational Wetland.

	Zn	Fe	Cd	Cu	Ni
Sample 0	0.06 ppm	0.13 ppm	0.007 ppm	0.10 ppm	0.05 ppm
Sample 1	0.02 ppm	0.42 ppm	0.000 ppm	0.03 ppm	0.01 ppm
Sample 2	0.01 ppm	0.20 ppm	0.000 ppm	0.03 ppm	0.001 ppm
Sample 3	0.003 ppm	0.01 ppm	0.001 ppm	0.04 ppm	0.03 ppm

Oil & Grease, Organophosphates, and Carbamate & Urea based Pesticides

North Coast Labs returned the soil analysis results on December 6, 2013. Oil and grease was identified in the soil sample at a concentration of 560 mg/kg. Neither organophosphates or carbamate and urea based pesticides were identified in the sample.

Other Possible Reasons for Population Decline

Past Precipitation Trends

There has been no noticeable trend of overall decreased in precipitation levels in Humboldt County during *P. regilla* breeding season since 1990, but yearly precipitation levels have varied greatly (Figure 4). Recently, after a spike in cumulative precipitation during 2006, there was a sharp reduction of precipitation during breeding season that lasted until the 2010.

Discussion

Possible Contamination Sources

Finding the inlet of the culvert that drains into DPEW was instrumental in narrowing down possible sources of water contamination. Prior to discovering that the culvert inlet is located just across from the wetland on the northern side of Grande Road, it occurred to us that stormwater discharge through the culvert may be coming from anywhere, making it difficult to make assumptions about what pollutants its runoff may be carrying. At its location on the northern side on Grange Road, the culvert accepts runoff from the road and from the residences along the road.

From inspecting the site visually and from looking at topographical maps, it was apparent that the wetland sits at the bottom of a bowl-like basin, thus receiving stormwater runoff from all directions, and maximizing the potential of contaminants to concentrate at the site. After delineating the watershed with ArcMap10 GIS, we were surprised to see that the computer delineated watershed extended southeast of the wetland, across the elementary school's lot, and onto a residential property along Dow's Prairie Road (Figure 3). Since we were able to visually observe runoff draining into the site from Grange Road and from the elementary school's playground during a heavy rain event, we know that this delineation could not represent the true size of the area draining into DPEW. By pairing our visual estimate of the watershed area with the watershed estimate generated using GIS, we were able to identify areas that we believed could be sources of possible contamination.

Despite our investigations, we were unable to identify or determine the source of the "white, oily, and powdery sheen" seen on the surface of the water in the wetland in 2009. Since it was reported to us that the film appeared on the water shortly after a construction company moved heavy equipment off of a lot they were renting on the northern side of the wetland, it remains very plausible that the film was caused by a spill of some type of chemical that was stored on the lot at that time. However, we also believe it is likely that the white film also could have been caused by a small algal bloom. Sometimes after warm or windy conditions, or for other unknown causes, algae can rise to the surface of the water and form a layer called "scum", which can turn white when it encounters sunlight (Stone and Daniels, 2006).

From our investigations into what contaminants may be present at the site, we learned that several types of contamination from several different sources may be possible. Looking within the DPEW watershed, we determined that runoff from Grange Road, Dow's Prairie Elementary School, and from the residential properties in the area could all be contributing sources of pollutants. Within these sources we identified possible contaminants as oil and grease, heavy metals, and chemicals used for landscaping and gardening, such as fertilizers, herbicides, and pesticides. We feel that landscaping chemicals used at the elementary school could be a strong contributing factor to the possible contamination of the wetland and the cause of the *P. regilla* population decline at the site. This belief is enforced by the assertion that in previous years the elementary school was forced to halt usage of one of the chemicals it used to maintain vegetation on school grounds after multiple children received chemical burns from playing in the schoolyard (N. Kelley, pers. communication, 2013). Unfortunately, we were unable to obtain further information about this chemical, or about chemicals presently used by the school, leaving us unable to further investigate this possibility. We also believe that similar types of chemicals could possibly enter the wetland from gardens of nearby residential properties, some of which are suspected of growing marijuana on site. In addition to contamination from landscaping and roadway runoff, we also acknowledge the possibility of septic contamination at the site, including the presence of fecal coliform bacteria. This belief is supported by data collected from the local area showing high levels of fecal coliform in nearby waterways, as well as the fact that wastewater in the Dow's Prairie area is maintained with septic systems. If not properly maintained, there is a possibly that material leaked from septic tanks could be present in runoff.

Testing for Water and Soil Contamination

Heavy Metals (Soils)

After testing soil samples from sampling sites near Grange Road and the wetland depression, we found that all of the results were below standards put forth by the EPA in 1993 for unsafe heavy metal levels in sludge and soil (Table 3).

Table 3. Environmental Protection Agency standards for unsafe concentrations of heavy metals in soil.

	Pb	Cr	Zn	Cd
Concentration	420 ppm	3000 ppm	7500 ppm	85 ppm

(EPA, 1993)

Although the above levels are deemed unsafe for humans there is research indicating that amphibians have a much lower tolerance for heavy metals (Ezemonye, 2005), due to how they affect amphibian mortality and hatch rates. However, most credible research pertains to the toxicity levels of heavy metals in water instead of that retained in the soils.

Heavy Metals (Water)

After testing the water samples from: the Dow's Prairie Elementary School blacktop runoff (site "0"), water flowing into the wetland area from the northeast (site "1"), an isolated puddle near the school sign to the north side of the wetland (site "2"), and a sediment rich sample collected from a depression in the wetland containing less than 20 ml of water (Site "3"), we found the levels of zinc, iron, cadmium, copper, and nickel to be under the thresholds of long-term use recreation waters put forth by the EPA in 1993 (Table 4).

Table 4. Environmental Protection Agency standards for unsafe concentrations of heavy metals in water.

	Zn	Fe	Cd	Cu	Ni
Concentration	2.0 ppm	5.0 ppm	0.01 ppm	0.2 ppm	0.2 ppm

(EPA, 1993)

Just because the water samples from DPEW and the runoff area did not contain heavy metals at concentrations exceeding these standards, does not mean that the concentrations that were present are safe for aquatic organisms or *P. regilla*. A study conducted on amphibians, *Boraras maculatus* and *Ptychadena bibroni,* in the Nigeria Niger Delta concluded that trace amounts of Pb and Cd can have detrimental effects on amphibian populations (Ezemonye, 2005). At different stages of larval development the species were introduced to Pb and Cd in levels of (0.1, 0.15, 0.2, 0.25, 0.5 ppm) at differing lengths all of which, showed differing levels of mutation and mortality increasing as the amounts of the heavy metals introduced were increased (Ezemonye, 2005). It was found that species introduced to Pb did not have a high mortality rate, while those introduced to even 0.001 ppm Cd were found to have mutations through development, while those introduced at the 0.25 ppm and higher had notable mortality rates, actual number not listed (Ezemonye, 2005). Differential acute toxicity was observed in both species at less than 0.001 of Pb and Cd (Ezemonye, 2005).

The runoff from the elementary school blacktop was 0.007 ppm and the water collected from the depression in the wetland was 0.001 ppm, both of which could have varying effects on the frog population at DPEW based on the findings of the Ezemonye study in 2005.

Lead and Cadmium have proved troublesome to at least *B. maculatus* and *P.bibroni* in the Niger Delta, however there is less supported evidence to show that other heavy metal concentrations at lower than EPA levels are also harmful to amphibian populations. However, these studies may not be conclusive due to wide variability of concentration levels at which effects to amphibians were seen.

The results concluded from the water tests can be interpreted as inconclusive, as only one repetition was taken and for this data. To be more comprehensive, multiple tests from runoff during multiple rain events would need to be taken. The results can be a good indicator of what to look for, however, especially when research has shown Cd to be devastating to amphibian populations at such low levels.

Oil & Grease, Organophosphates, and Carbamate & Urea Based Pesticides

Based on the results of soil analysis from North Coast Laboratories we can confirm that oil and grease was present in the wetland. While it is not surprising that oil and grease are washing off the road towards the wetland, as there is no curb or storm drain, we did acknowledge the possibility that the *Spirea* surrounding the wetland could have acted as a buffer. Our tests showed that oil and grease was present in the wetland soil at a level of 560 mg/kg. The ramifications of this value, however, are less clear. There is no one agreed upon threshold for oil and grease in soil, and the thresholds used by separate parties can vary wildly. The EPA does not have a numerical threshold for oil and grease in water or soil, and instead the threshold is defined as visible oil on the surface of water (Denton, 2006). Some sources say that cleanup is necessary for soils with an oil and grease content of more than 500 mg/kg (Palwak et al., 2008). Other sources say remediation is only necessary for soils with greater than 10,000 mg/kg of pure crude oil. Several American states and Canadian provinces have threshold values ranging from 1,000 mg/kg to 20,000 mg/kg (Irwin, 1997). These statistics cloud the real lesson that we learned from this test: that oil and grease is entering the wetland in a sufficient enough quantity to be present after several months of dry weather. The fact that we can find oil residue in the soil of the wetland points strongly to there being oil and grease in the water of the filled wetland during the spring. Oil and grease from automobiles has an established negative effect on amphibian communities (Mahaney, 1994), and its presence in the wetland should continue to be monitored.

Our soil samples came back from North Coast Laboratories showing no detectable levels of organophosphate or carbamate and urea based pesticides and herbicides. These results show only that these two contaminants are not currently present in the wetland soil at the level that the test was capable of detecting. The results do not mean that organophosphate or carbamate based pesticides are not in use in the area surrounding the wetland nor do they mean that these two contaminants have never contaminated the wetland. Most importantly, these results do not discount pesticide contamination as a cause for the decline of *P. regilla* at DPEW. While organophosphate and carbamate pesticides do persist in soils, there persistence is highly variable, depending on factors such as pH, temperature, and exposure to sunlight (Rajagopal, 1984; Ragnarsdottir, 2000). When we tested soils from the wetland, there had not been a major rain event for several months. It is a very real possibility that either of these pesticides could have infiltrated into the wetland, come into contact with the wildlife, and then deteriorated after the water dried. In addition, the pesticides we tested for are by no means the only pesticides that could be present in the wetland. Organohosphate and carbamate and urea based pesticides are the most common pesticides with the strongest correlation to frog declines that our budget would allow us to test for. There is no one deadly pesticide our group could have tested for. A variety of pesticides, either working alone or in conjunction with other chemicals, have been linked to amphibian declines (Davidson, 2004). Pesticide contamination in aquatic systems remains one of the biggest threats to amphibians throughout the world and pesticide testing should remain a part of any further investigation at DPEW.

Other Possible Reasons for Population Decline

A large variation in annual rainfall levels could be a potential factor in the reduction of the *P. regilla* population in the wetland, since variation in rainfall levels can cause negative impacts to amphibian populations (Kiesecker, 2001). This is because many amphibian species lay their eggs in the same time of the year, in this case from November to March. As seen in the graphs (Figure 4) there has been high variation in rainfall levels during *P. regilla* breeding seasons. This can cause issues in egg survival, especially during drier seasons (Kiesecker, 2001). Due to the heavy reliance this species has on water resources it is reasonable to assume that the variation of precipitation may have played a role in their population decline at DPEW.

While low levels of contamination were found in the wetland, the possibility of other sources of population decline still exists. These other sources include habitat disturbance, increased predation in the area, varied levels of precipitation, and amphibian diseases. The issues were identified as possible factors decreasing *P. regilla* population in the wetland. While these are all potential reasons for the decreased population, they were not tested due to a lack of time and available testing resources in the project period. All of these other sources of population decline are still likely and could be ongoing issues. Further research and testing would need to be done in order to clear these as potential reasons for population decline.

Recommendations for Future Study

Future study of the project site can be done by expanding on the work that we were unable to carry out during our project term. We recommend that future capstones groups and the McKinleyville Land Trust further investigate the possibility of water contamination and establish a program to continually monitor the frog population, their reproductive habits, and the survivorship of offspring. We believe that this work would best be done during the late winter and spring for two major reasons. The first is the timing of water in the wetland. The wetland begins to fill during the winter and by the beginning of spring the wetland is at full capacity, possibly containing new sources of contamination brought in from runoff. The second is the timing of *P. regilla's* presence in the wetland. Members of the remaining *P. regilla* population are more likely to use the wetland for breeding and egg laying during the spring. Due to the timing of our project we were unable to observe how many frogs actually use the wetland anymore, or determine if adult frogs were successful in laying eggs that were capable of metamorphosing into adults.

Analyzing Water for Contaminants

A key step that future capstone groups or the MLT could take in furthering this study would be in regards to water sampling. For studies taking place in the spring, water will likely be present in the wetland and this will allow for more effective water sampling than we were able to obtain from small runoff puddles. It is recommended that water be collected directly from the vernal pool of the wetland in order to effectively see what types of contaminants are present in areas where *P. regilla* are present. Amphibian declines have been linked to multiple stressors (Sih et al., 2004), so it is important to continue testing the site to find all the factors that may have led to the decline of *P. regilla* at DPEW. For future studies it is advised to test for additional contaminants than the ones we tested for. Due to funding constraints, we were only able to test for two pesticides in the wetland, in addition to oil and grease. We were also limited due to the fact that North Coast Laboratories is unable to test for certain chemicals, or run analysis on certain mediums. For example, many of the following chemicals required a water sample for testing and could not be completed with soil. The following is a list of chemical and contaminant tests that we considered but were unable to perform.

Glyphosate

Glyphosate is the active ingredient in Roundup, one of the most common herbicides in America (Ross & Childs, 1996). It works by disrupting the enzyme cycles of plants and is widely available for residential use as a weed killer (Franz et al., 1997). Glyphosate strongly adheres to soil particles, but research has shown that it can be very mobile in water if heavy rainfall events occur shortly after its application to the soil (Veereecken, 2005). The compound has a half-life of typically less than 25 days under laboratory conditions, but its presence in the environment is dependent on the frequency of its application (Duke et al., 1988). Though research is limited, Roundup has been shown to be lethal to amphibians, especially in their juvenile or larval stages (Relyea, 2005). North Coast Labs is able to test for Glyphosate. They require a three sample minimum and the cost of analyzing each sample is $200.

Triazine Herbicides

Triazine herbicides are a group of herbicides that include atrazine, the most commonly used herbicide in the United States (Hayes et al., 2002). Triazine based herbicides work by inhibiting photosynthesis in target plants after being absorbed through water uptake in the roots (Ross and Childs, 1996). Atrazine in particular has been the subject of considerable controversy because of its negative effect on amphibians and its persistence in the environment; it was banned in Europe and its continued approval for use by the EPA has been met with considerable backlash (Bethsass & Colangelo, 2006). Atrazine can be found in most of the water in the United States, even in precipitation and in areas where it is not being used for agriculture (Hayes et al., 2002). While atrazine does not have a long half-life, which ranges from one month to one year, its widespread use and high mobility in water are what make it such a potential threat to amphibians (Dinelli et al., 2000). Multiple studies have shown that atrazine can induce feminization in male amphibians, leading to a population that cannot breed (Renner, 2003). North Coast Labs is able to test for Triazine based herbicides.

Pyrethroids

Pyrethroids are a group of insecticides synthesized from chrysanthemums. They work as excitotoxins, over stimulating the nerves of insects, causing paralysis and death (Vijverberg and Vanden Bercken, 1990). They are extremely common pesticides for home garden use. Pyrethroids have very short half-lives in the soil, only about 12 days, and are not very mobile since they adhere strongly to soil particles (Wauchope et al., 1992). However, pyrethroids can have lethal effects on non-target species and be toxic to aquatic life (Coats et al., 1989). North Coast Labs is able to test for pyrethroids.

Abamectin

Abamectin (sometimes called avermectin) is the active ingredient in the insecticide, Avid. It is a broad-spectrum insecticide commonly used to eliminate parasites on livestock and in crops and gardens. During a visiting a local hydroponic store to inquire about common chemicals used by home gardeners in the local area, Avid was one of the common insecticides mentioned. Abamectin functions by hyperpolarizing the target pest's muscles and inducing paralysis (Edwards et al., 2001). The effects of abamectin exposure are understudied in amphibians, but studies of other aquatic organisms suggest that abamectin can be highly toxic even at low quantities (Tišler and Eržen, 2006). While the half-life of abamectin in water is only about 12 to 40 hours, its half-life in soil that can range from 14 to 217 days (Kolar and Erzin, 2006). North Coast Labs cannot test for abamectin at this time, but our inquiry led them to make a note about looking into the possibility of testing for it in the future.

Petroleum Hydrocarbons

While petroleum hydrocarbons are part of the oil and grease spectrum we tested for, oil and grease as a contaminant class also includes substances such as vegetable oil and animal fats (Martin et al., 1991). While we opted to take the broader route of testing for bulk amounts of oil and grease in the soil, petroleum hydrocarbons have their own negative effects on amphibians, such as negatively affecting tadpole growth (Mahaney, 1994).

Septic Contamination

Due to Humboldt Baykeeper's findings of elevated levels of fecal coliform in nearby streams and creeks (Humboldt Baykeeper, 2013), and because the area neighboring DPEW uses septic systems, we recommend analyzing water samples from the wetland for fecal coliform bacteria. More information on septic related contamination can be found in the "Background" section of the paper. The Humboldt State University Biology Department is able to perform this type of analysis.

Monitoring *Pseudacris regilla* in the Wetland

The second key step that future studies should take will be to monitor *P. regilla* presence in the wetland. Future capstone groups or the MLT will be able to observe *P. regilla* in the wetland from late winter to spring from the tadpole phase to the adult phases of their lifecycle, as well as conduct egg-mat surveys, monitor for signs of disease, and possibly even collect live specimens for observation or tissue testing. In order to collect live specimens, the collector must apply for a Scientific Collecting Permit from the California Department of Fish and Game. The SCP process formalizes, "what, how many, when, and where" you may take animals, in addition to other reporting and notification requirements ("While in the Field", 2013). Once the samples have been collected, the collector would have to send the specimens to a private lab for analysis. North Coast Labs in Arcata does provide animal tissue analysis for agrochemicals, but it would be prudent to explore other labs as well.

In addition to monitoring the presence and biological health of *P. regilla* in the wetland, conducting a study on current ambient noise levels in the area may lead to findings of possible reasons for frog population declines, as frogs rely on their vocal calls for mating (Paris, 2005). Sources of increased ambient noise levels in the area include overhead plane traffic from the airport, surrounding vehicular traffic, and general noise from the elementary school and surrounding area. This will greatly expand upon the work that we have already done in the wetland and allow for a more in-depth analysis of why the *P. regilla* population at DPEW is declining.

Conclusion

During the course of this project we have considered and researched several possibilities for the decline of *Pseudacris regilla* from Dow's Prairie Educational Wetland. After examining several possible sources of contamination in the watershed and performing testing for certain contaminants, as well as considering other factors such a habitat disturbance, disease, and variations in precipitation levels, we were unable pinpoint a discrete cause of the population decline. We do believe that any of these factors, or a combination of multiple factors, could still be valid causes, and we encourage other groups to continue studying *P. regilla* in the wetland using our research as a base. Additional testing for contamination and the establishment of a program to monitor the *P. regilla* population at Dow's Prairie Educational Wetland are the focus of our recommendations. We hope these recommendations will assist other groups, such as future capstone students or the McKinleyville Land Trust, to better determine the cause of *P. regilla* decline from the site so they can take measures to help protect this species and the overall health of the Dow's Prairie Educational Wetland ecosystem.

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Appendix A –Figures

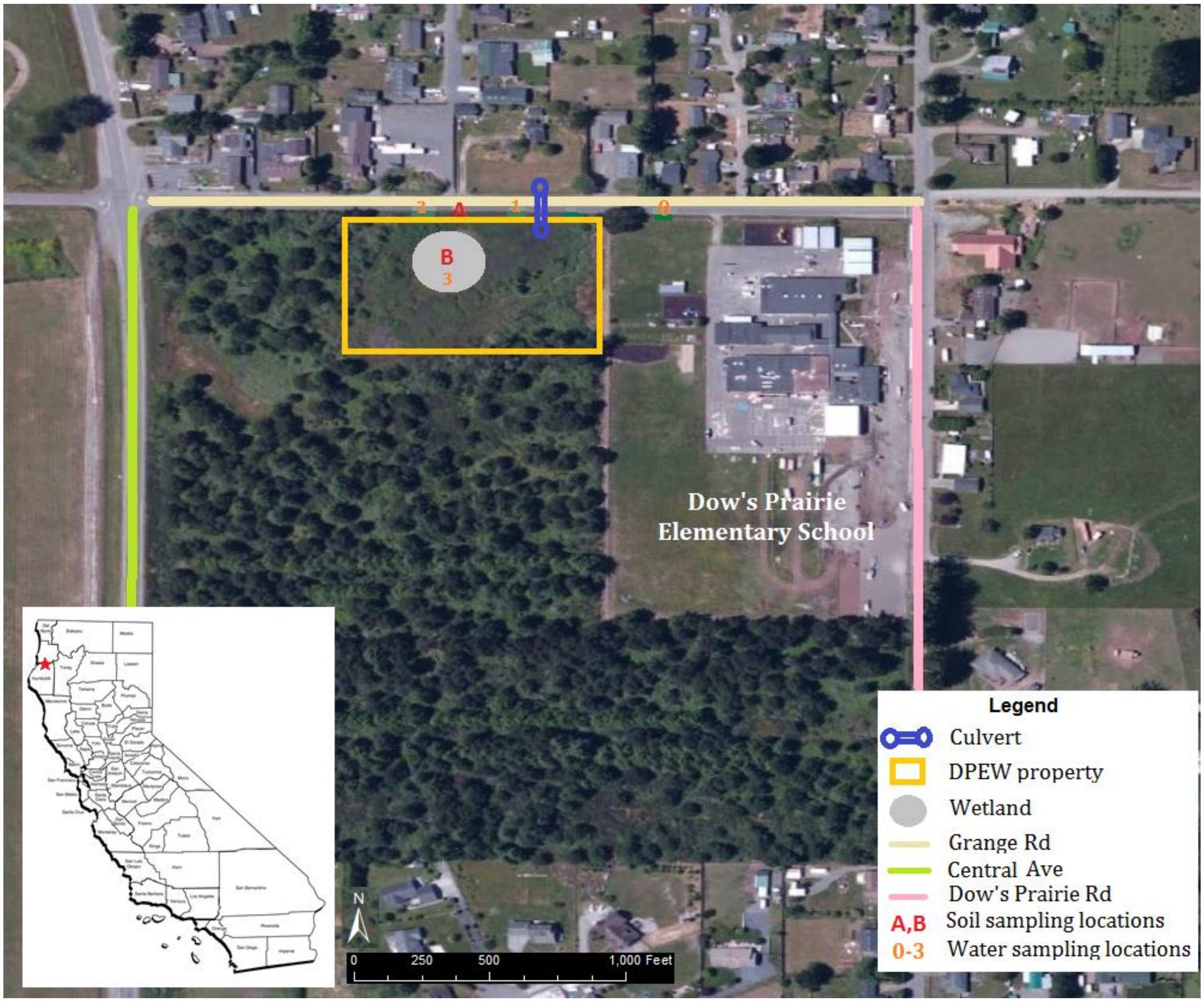

Figure 1. Site map showing the Dow's Prairie Educational Wetland site, surrounding location, and other notable features.

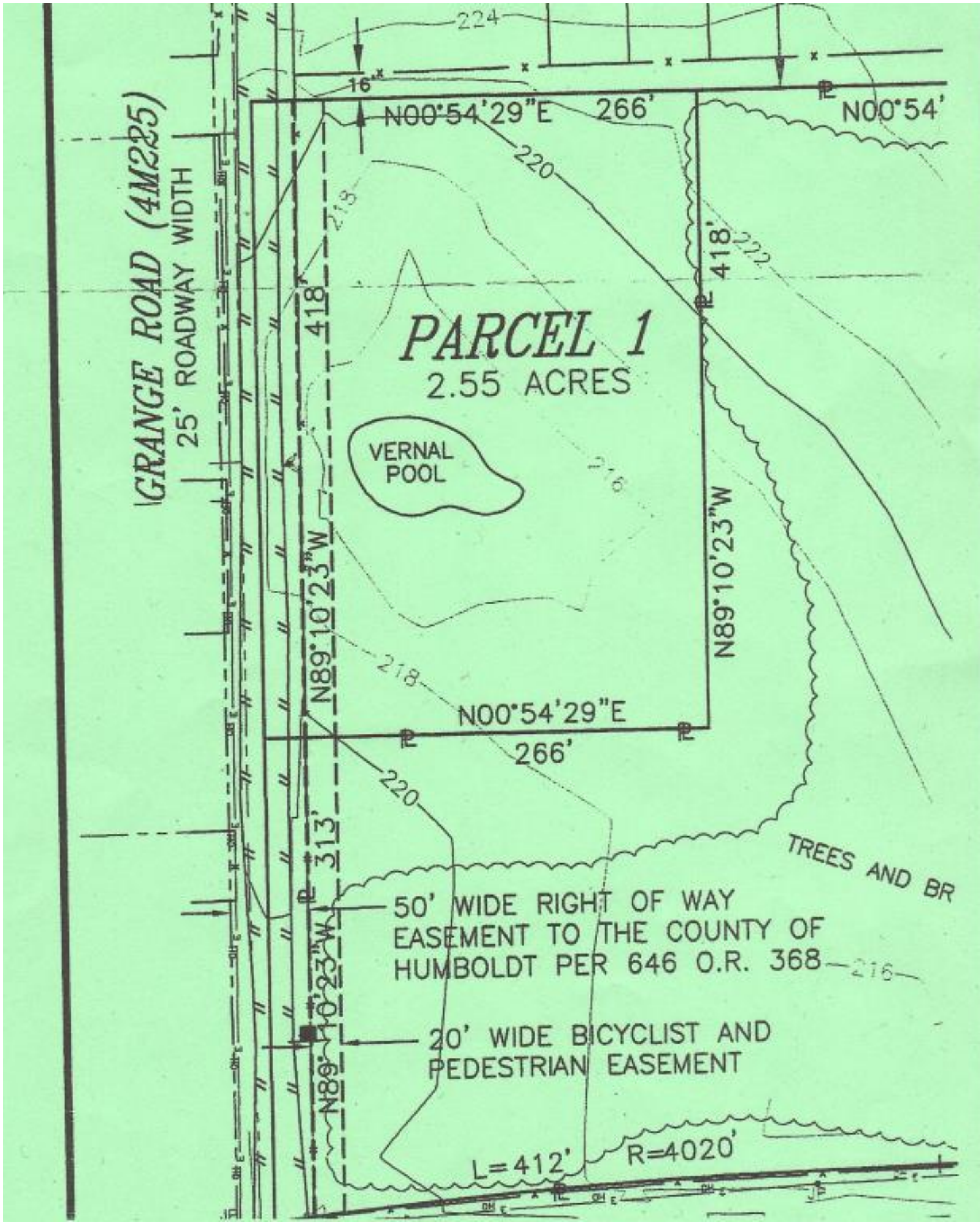

Figure 2. Topographic map of the Dow's Prairie Educational Wetland site (Image source: McKinleyville Land Trust).

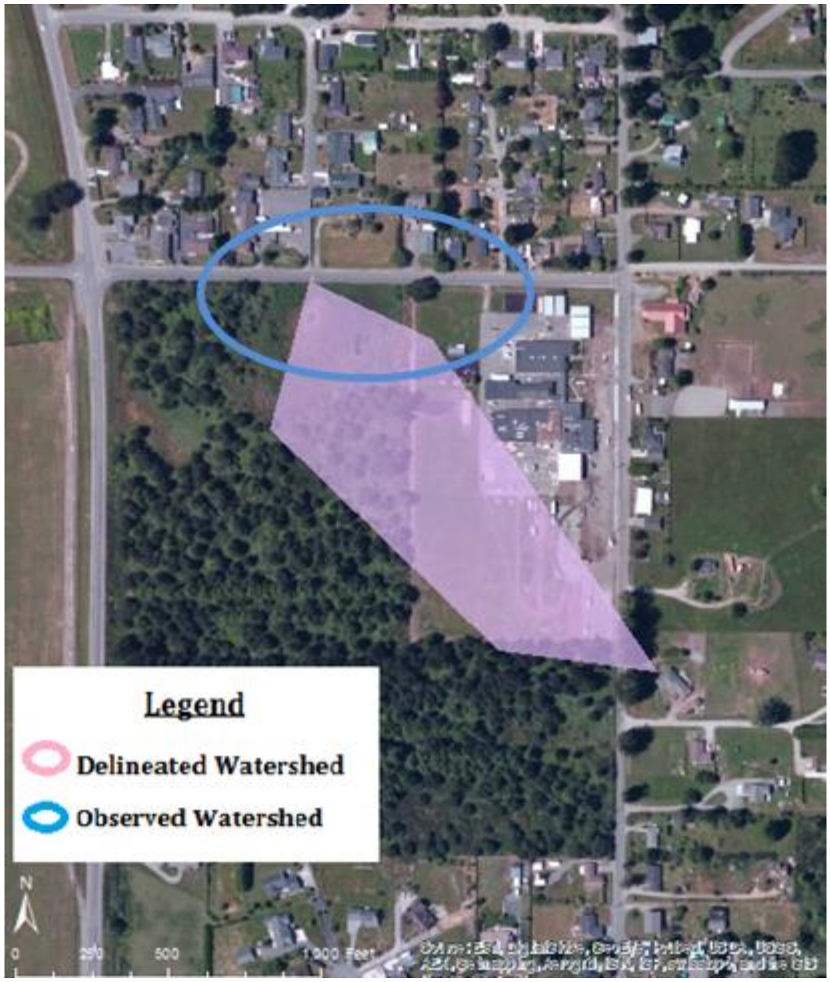

Figure 3. Map showing a GIS delineated watershed and an observed watershed area for Dow's Prairie Educational Wetland.

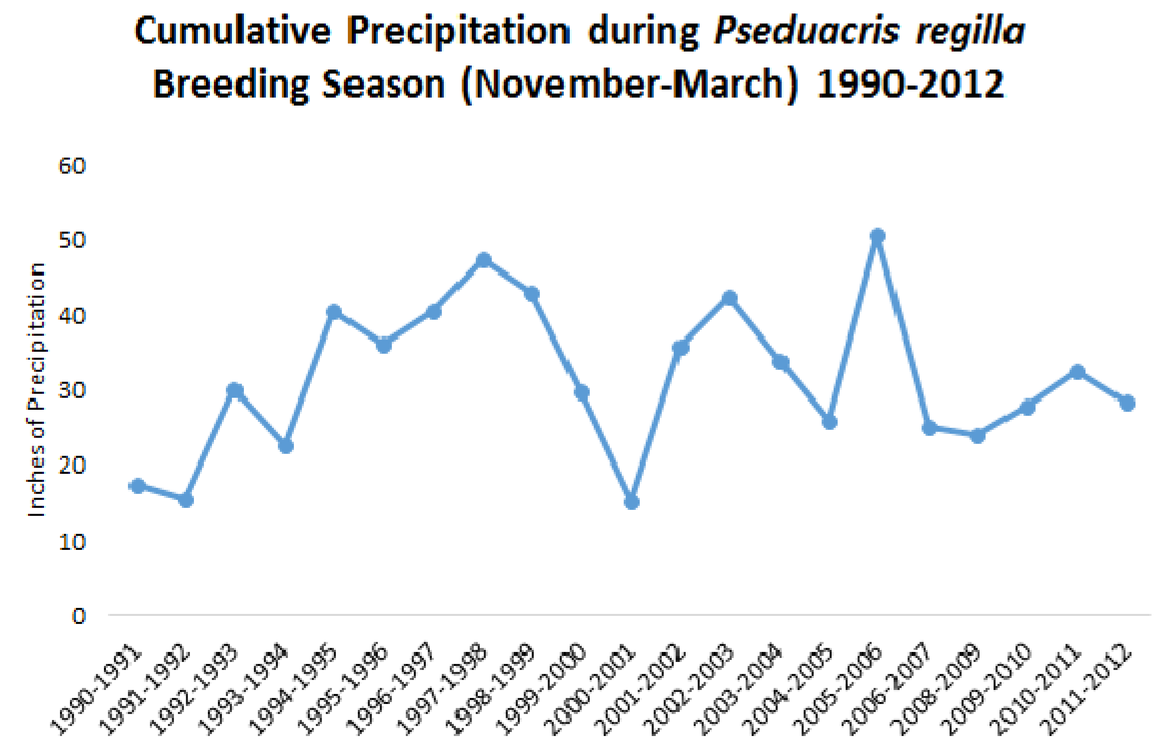

Figure 4. Cumulative precipitation levels in Humboldt County during *Pseudacris regilla* breeding season from 1990 to 2012 (NOAA, 2013).

Appendix B –Implementation Plan

Understanding the problem

Our group met with Nanette Kelley of the McKinleyville Land Trust (MLT) on September 17, 2013 to get an overview of the site and the concerns that MLT has about possible water contamination and the apparent decrease in a Pacific chorus frog (*Pseudacris regilla*) population. That same weekend, we met Nanette at Dow's Prairie Educational Wetland to get a sense of the site and its surroundings.

Research

Research has been an ongoing and extensive part of nearly every step of this project. Each of us has done research on what contaminants could be entering the wetland and what effect they may have had on the *P. regilla* population that was formerly abundant at the site. We researched *P. regilla* ecology to get a better understanding of the species' habitat requirements, lifecycle, breeding behaviors, and their tolerance to certain environmental pollutants. We also researched other factors that could have contributed to the *P. regilla* decline, including disease, natural fluctuations, and habitat disturbance.

Collecting samples

After our first site visit with Nanette on September 17, 2013, our group took soil samples from three locations at the project site to test for chemical contaminants once we further researched which contaminants were most likely to be present at the site.

Finding the culvert

On September 17, 2013 and October 1, 2013 our group unsuccessfully attempted to locate the culvert that feeds into the wetland by looking through a dense thicket of vegetation in the area that we were told the culvert outlet was in. Joe then exchanged communication with the McKinleyville Community Services District and the Humboldt County Planning Department for approximately three weeks to try to get a GIS layer showing locations of culverts in the Dow's Prairie area, which ultimately proved to be a dead end. On October 12, 2013, Cooper met with a MLT board member at the site to clear some of the *Spirea* from where the culvert was believed to be, and locating both ends of the culvert was finally successful. Finding the culvert was necessary to get a better visual of the point of entry for the water and to determine the source of the water entering it.

Finding the source of unusual film on the water in the wetland

When interviewing Nanette Kelley on September 17, 2013 we were informed that there was a white film over the wetland in 2009 that was seen by multiple members of the MLT. Preceding this white film there was a construction company adjacent to the Dow's Prairie Educational Wetland.

Joe Ostini contacted Tim Hooven, from Hooven Construction, discovering that they were not renting a lot in the Dow's Prairie area any time after 2005. Tim Hooven had record of Alves construction being in that area, after confirming this with Nanette Kelley, Joe Ostini called Alves Construction on November 7, 2013, finding that they were renting the lot adjacent to the wetland. We are currently waiting for an official phone interview to determine if Alves Construction could be the cause of the white film.

Researching past precipitation data

In order to determine if it was possible that *P. regilla* populations had been negatively affected by drier than usual precipitation in recent years, we looked at past precipitation data. On November 6, 2013, Corinne researched local past weather data, finding data from NOAA of monthly and annual precipitation totals and the variation between observed and normal levels dating from 1990 to 2012. On November 7, 2013, John worked to compile the data into a graphic that would easily show trends over time.

Drafting a proposal for soil testing

On November 7, 2013 our group was informed that the MLT Board of Directors would be meeting to make a decision on whether or not to grant us funding to order soil testing to be done through North Coast Laboratories to test for contaminants that may be entering the site. On November 10, 2013 Cooper and Corinne met to complete an informal proposal that was distributed among board members to help them with their decision.

Collecting water samples

Corinne and Joe went to the site on November 12, 2013 to collect water samples during a precipitation event. Three water samples were collected, one from road runoff at the school sign, another from runoff coming from the school near the gate to the wetland, and the last from a depression in the wetland on the north side. These samples will be used to test pH and ionic conductivity, and may potentially be used to test for oil and grease through North Coast Laboratories.

Inquiries at McKinleyville Union School District and a local hydroponics store

Based on recommendations relayed to us by the MLT Board of Directors on November 12, 2013, inquiries will be made in order to further research possible pesticide and fertilizer contamination in the wetland. Two sources will be explored on November 14, 2013. We will inquire with the McKinleyville Union School District in regards to what pesticides they have used in the past to treat vegetation at the school. This is important to research as our group was told that a pesticide formerly used by the district had caused chemical burns to students in the past (N. Kelley, pers. communication, 2013). The second set of inquires will be made with local hydroponics stores. To further understand what fertilizers may be contaminating the wetland we will speak to local hydroponic supply stores in regards to what fertilizers are commonly used by marijuana grow operations. In doing this we will have a better understanding of what to look for in our tests.

Testing at North Coast Laboratories

Testing for fertilizers, pesticides, and oil and grease will be done with North Coast Labs. Samples will be dropped off by a group member on November 18, 2013. When will sample results be available?

Delineating the watershed

On November 19, 2013, our group will delineate the drainage area entering the wetland using topographical maps and GIS software. This will give us a better understanding of the amount of water that enters the wetland and allow us to better identify possible sources of contamination.

Results and Conclusions

After our group gets our soil sample results back from North Coast Laboratories on December 6, 2013, we will begin to discuss our findings and formulate conclusions based on research and background data.

Appendix C –Soil Testing Proposal to the McKinleyville Land Trust

November 11, 2013

Dow's Prairie Educational Wetland
Humboldt State University
Environmental Science Senior Capstone Project

Dear McKinleyville Land Trust Board of Directors,

We have been working this semester to determine if the water entering the Dow's Prairie Educational Wetland is contaminated and if that contamination is related to the drastic reduction of Pacific chorus frogs (*Pseudacris regilla)* from the site in recent years. Since the seasonality of the wetlands inundation does not coincide with our project term, we seek to analyze a soil sample taken from the lowest point of the wetland depression in order to investigate the possible presence of the following contaminants.

Possible sources of contaminants include runoff from Grange Road and from the culvert which brings stormwater into the wetland from the northern side of the road. Along with contaminants such as oil and grease, which are commonly found in roadway runoff, several residential properties across the road from the wetland have gardens and a few are suspected of being marijuana grow houses, introducing the possibility of organic contamination from pesticides and fertilizers.

If approved, all testing would be conducted through North Coast Laboratories in Arcata and the results will be incorporated into our final report which will be provided to you in December 2013.

- Oil & Grease ($95)

Runoff from Grange Road readily enters the wetland due to the close proximity of the road and the basin-like topography of the wetland. Oil and grease can negatively affect amphibians by blocking gills and altering respiration. Additionally, research has also shown that petroleum based oil contamination in freshwater ecosystems can affect tadpole growth and metamorphosis (Mahaney, 1994).

- Organophosphorus pesticides ($150)

Organophosphorus pesticides are cholinesterase inhibiting pesticides that are commonly used for both residential and commercial purposes by inhibiting nervous system functioning of the targeted pests (Davidson, 2004). While having a generally low persistence in the environment, organophosphorus pesticides can bioaccumulate significantly in tadpoles (Hall and Kolbe, 1980) and in soils for years after application (Ragnarsdottir, 2000). Cholinesterase inhibiting pesticides have been shown to have a strong negative effect on amphibian populations in freshwater ecosystems near areas of known use (Sparling et al. 2001).

- Carbamates & urea based pesticides & herbicides ($150)

Carbamates are another cholinesterase inhibiting pesticide with uses and functions very similarly to organophosphate pesticides. They also have been shown to have a strong effect on amphibian populations, very similar to those listed for organophosphorus pesticides above.

We would like to thank you for taking the time to consider our request for funding to complete this testing, and for providing us with the opportunity to work on this project this semester. We hope that our findings will help contribute to promoting the health and overall well-being of this fascinating ecosystem.

Sincerely,
Corinne Kennah, Cooper Rodgers, John Looney, and Joseph Ostini

Appendix D –Laboratory Analysis Result Sheets

Heavy Metals (soil)

See pages 40-46.

Heavy Metals (water)

See pages 47-56.

Oil & Grease, Organophosphates and Carbamate & Urea based Pesticides (soil)

See pages 57-80.

Heavy Metals Laboratory Analysis Results (Soil)

Method: ENVS410Cd Page 1 Date: 11/14/2013 3:40:05 PM

===

Analysis Begun

Logged In Analyst: dwb2 Technique: AA Flame
Spectrometer: AAnalyst 400, S/N 201S11111401 Autosampler:

Sample Information File:
Batch ID:
Results Data Set: Dows Prairie Results
Results Library: C:\Users\Public\PerkinElmer\AA\Data\Results\Results.mdb

===

Method Loaded
Method Name: ENVS410Lead Method Last Saved: 11/14/2013 3:09:03 PM
Method Description: ENVS410Lead

===

Sequence No.: 1 Autosampler Location:
Sample ID: blank Date Collected: 11/14/2013 3:12:11 PM
Analyst: Data Type: Original

Replicate Data: blank Analyte: Pb 283.31

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[0.00]	0.038	3:12:12 PM	Yes
2		[0.00]	0.038	3:12:17 PM	Yes
3		[0.00]	0.038	3:12:21 PM	Yes
Mean:		[0.00]	0.038		
SD:		0.0000	0.0000		
%RSD:		0.00%	0.05		

Auto-zero performed.

===

Sequence No.: 2 Autosampler Location:
Sample ID: .5 Date Collected: 11/14/2013 3:12:48 PM
Analyst: Data Type: Original

Replicate Data: .5 Analyte: Pb 283.31

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[0.5]	0.009	3:12:50 PM	Yes
2		[0.5]	0.009	3:12:54 PM	Yes
3		[0.5]	0.009	3:12:58 PM	Yes
Mean:		[0.5]	0.009		
SD:		0.000	0.0003		
%RSD:		0.00%	2.86		

Standard number 1 applied. [0.5]
Correlation Coef.: 1.000000 Slope: 0.01830 Intercept: 0.00000

===

Sequence No.: 3 Autosampler Location:
Sample ID: 5 Date Collected: 11/14/2013 3:13:41 PM
Analyst: Data Type: Original

Replicate Data: 5 Analyte: Pb 283.31

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[5]	0.089	3:13:42 PM	Yes
2		[5]	0.089	3:13:46 PM	Yes
3		[5]	0.089	3:13:51 PM	Yes
Mean:		[5]	0.089		
SD:		0.00	0.0002		
%RSD:		0.00%	0.23		

Standard number 2 applied. [5]
Correlation Coef.: 0.999993 Slope: 0.01787 Intercept: 0.00000

Calibration data for Pb 283.31 **Equation: Linear Through Zero**

ID	Mean Signal (Abs)	Entered Conc. mg/L	Calculated Conc. mg/L	Standard Deviation	%RSD
blank	0.000	0	0.000	0.00	0.05
.5	0.009	0.5	0.512	0.00	2.86
5	0.089	5.0	4.999	0.00	0.23

Correlation Coef.: 0.999993 Slope: 0.01787 Intercept: 0.00000

Sequence No.: 4 **Autosampler Location:**
Sample ID: SampleA **Date Collected: 11/14/2013 3:17:51 PM**
Analyst: **Data Type: Original**

Replicate Data: SampleA **Analyte: Pb 283.31**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	10.79	10.79	0.193	3:17:52 PM	Yes
Sample concentration is greater than that of the highest standard.					
2	10.80	10.80	0.193	3:17:56 PM	Yes
Sample concentration is greater than that of the highest standard.					
3	10.70	10.70	0.191	3:18:01 PM	Yes
Sample concentration is greater than that of the highest standard.					
Mean:	10.76	10.76	0.192		
SD:	0.058	0.058	0.0010		
%RSD:	0.54%	0.54%	0.54		

Sample concentration is greater than that of the highest standard.

Sequence No.: 5 **Autosampler Location:**
Sample ID: SampleB **Date Collected: 11/14/2013 3:18:52 PM**
Analyst: **Data Type: Original**

Replicate Data: SampleB **Analyte: Pb 283.31**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	4.729	4.729	0.085	3:18:54 PM	Yes
2	4.661	4.661	0.083	3:18:58 PM	Yes
3	4.669	4.669	0.083	3:19:03 PM	Yes
Mean:	4.686	4.686	0.084		
SD:	0.0370	0.0370	0.0007		
%RSD:	0.79%	0.79%	0.79		

Method Loaded
Method Name: ENVS410Cr **Method Last Saved: 11/14/2013 3:22:02 PM**
Method Description: ENVS410Cr

Sequence No.: 6 **Autosampler Location:**
Sample ID: blank **Date Collected: 11/14/2013 3:22:47 PM**
Analyst: **Data Type: Original**

Replicate Data: blank **Analyte: Cr 357.87**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[0.00]	0.043	3:22:49 PM	Yes
2		[0.00]	0.044	3:22:53 PM	Yes
3		[0.00]	0.044	3:22:58 PM	Yes
Mean:		[0.00]	0.044		

```
SD:                 0.0000    0.0005
%RSD:               0.00%     1.24
Auto-zero performed.

==========================================================================================
Sequence No.: 7                                  Autosampler Location:
Sample ID: 1 standard                            Date Collected: 11/14/2013 3:23:47 PM
Analyst:                                         Data Type: Original

------------------------------------------------------------------------------------------
Replicate Data: 1 standard                       Analyte: Cr 357.87
Repl   SampleConc  StndConc  BlnkCorr   Time        Signal
 #     mg/L        mg/L      Signal                 Stored
 1                 [1]       0.014      3:23:48 PM   Yes
 2                 [1]       0.014      3:23:53 PM   Yes
 3                 [1]       0.015      3:23:57 PM   Yes
Mean:              [1]       0.014
SD:                0.00      0.0006
%RSD:              0.00%     4.00
Standard number 1 applied. [1]
Correlation Coef.: 1.000000   Slope: 0.01413    Intercept: 0.00000

==========================================================================================
Sequence No.: 8                                  Autosampler Location:
Sample ID: 5 standard                            Date Collected: 11/14/2013 3:24:38 PM
Analyst:                                         Data Type: Original

------------------------------------------------------------------------------------------
Replicate Data: 5 standard                       Analyte: Cr 357.87
Repl   SampleConc  StndConc  BlnkCorr   Time        Signal
 #     mg/L        mg/L      Signal                 Stored
 1                 [5]       0.062      3:24:39 PM   Yes
 2                 [5]       0.062      3:24:43 PM   Yes
 3                 [5]       0.062      3:24:48 PM   Yes
Mean:              [5]       0.062
SD:                0.00      0.0001
%RSD:              0.00%     0.18
Standard number 2 applied. [5]
Correlation Coef.: 0.998881   Slope: 0.01250    Intercept: 0.00000
   The calibration curve may not be linear.

------------------------------------------------------------------------------------------
Calibration data for Cr 357.87                      Equation: Linear Through Zero
```

ID	Mean Signal (Abs)	Entered Conc. mg/L	Calculated Conc. mg/L	Standard Deviation	%RSD
blank	0.000	0	0.000	0.00	1.24
1 standard	0.014	1.0	1.130	0.00	4.00
5 standard	0.062	5.0	4.970	0.00	0.18

```
Correlation Coef.: 0.998881   Slope: 0.01250    Intercept: 0.00000

==========================================================================================
Sequence No.: 9                                  Autosampler Location:
Sample ID: SampleA                               Date Collected: 11/14/2013 3:25:22 PM
Analyst:                                         Data Type: Original

------------------------------------------------------------------------------------------
Replicate Data: SampleA                          Analyte: Cr 357.87
Repl   SampleConc  StndConc  BlnkCorr   Time        Signal
 #     mg/L        mg/L      Signal                 Stored
 1     5.816       5.816     0.073      3:25:24 PM   Yes
   Sample concentration is greater than that of the highest standard.
 2     5.855       5.855     0.073      3:25:28 PM   Yes
   Sample concentration is greater than that of the highest standard.
 3     5.890       5.890     0.074      3:25:32 PM   Yes
   Sample concentration is greater than that of the highest standard.
Mean:  5.854       5.854     0.073
```

```
SD:    0.0366      0.0366    0.0005
%RSD:  0.63%       0.63%     0.63
   Sample concentration is greater than that of the highest standard.

=================================================================================================
Sequence No.: 10                                       Autosampler Location:
Sample ID: SampleB                                     Date Collected: 11/14/2013 3:26:16 PM
Analyst:                                               Data Type: Original

-------------------------------------------------------------------------------------------------
Replicate Data: SampleB                                Analyte: Cr 357.87
Repl   SampleConc  StndConc  BlnkCorr   Time          Signal
 #     mg/L        mg/L      Signal                   Stored
 1     5.881       5.881     0.074      3:26:18 PM     Yes
   Sample concentration is greater than that of the highest standard.
 2     5.837       5.837     0.073      3:26:22 PM     Yes
   Sample concentration is greater than that of the highest standard.
 3     5.835       5.835     0.073      3:26:27 PM     Yes
   Sample concentration is greater than that of the highest standard.
Mean:  5.851       5.851     0.073
SD:    0.0262      0.0262    0.0003
%RSD:  0.45%       0.45%     0.45
   Sample concentration is greater than that of the highest standard.

=================================================================================================
Method Loaded
Method Name: ENVS410ZN                                 Method Last Saved: 11/14/2013 3:29:44 PM
Method Description: ENVS410 Zn

=================================================================================================
Sequence No.: 11                                       Autosampler Location:
Sample ID: Blank                                       Date Collected: 11/14/2013 3:30:04 PM
Analyst:                                               Data Type: Original

-------------------------------------------------------------------------------------------------
Replicate Data: Blank                                  Analyte: Zn 213.86
Repl   SampleConc  StndConc  BlnkCorr   Time          Signal
 #     mg/L        mg/L      Signal                   Stored
 1                 [0.00]    0.196      3:30:05 PM     Yes
 2                 [0.00]    0.192      3:30:10 PM     Yes
 3                 [0.00]    0.196      3:30:14 PM     Yes
Mean:              [0.00]    0.194
SD:                0.0000    0.0020
%RSD:              0.00%     1.01
Auto-zero performed.

=================================================================================================
Sequence No.: 12                                       Autosampler Location:
Sample ID: .1 Standard                                 Date Collected: 11/14/2013 3:30:42 PM
Analyst:                                               Data Type: Original

-------------------------------------------------------------------------------------------------
Replicate Data: .1 Standard                            Analyte: Zn 213.86
Repl   SampleConc  StndConc  BlnkCorr   Time          Signal
 #     mg/L        mg/L      Signal                   Stored
 1                 [0.1]     0.041      3:30:43 PM     Yes
 2                 [0.1]     0.041      3:30:48 PM     Yes
 3                 [0.1]     0.058      3:30:52 PM     Yes
Mean:              [0.1]     0.047
SD:                0.000     0.0099
%RSD:              0.00%     20.95
Standard number 1 applied. [0.1]
Correlation Coef.: 1.000000   Slope: 0.47050    Intercept: 0.00000

=================================================================================================
Sequence No.: 13                                       Autosampler Location:
Sample ID: 1 Standard                                  Date Collected: 11/14/2013 3:31:16 PM
```

Analyst: Data Type: Original

Replicate Data: 1 Standard **Analyte: Zn 213.86**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[1]	0.365	3:31:18 PM	Yes
2		[1]	0.337	3:31:22 PM	Yes
3		[1]	0.336	3:31:26 PM	Yes
Mean:		[1]	0.346		
SD:		0.00	0.0165		
%RSD:		0.00%	4.77		

Standard number 2 applied. [1]
Correlation Coef.: 0.998426 Slope: 0.34758 Intercept: 0.00000
The calibration curve may not be linear.

Calibration data for Zn 213.86 **Equation: Linear Through Zero**

ID	Mean Signal (Abs)	Entered Conc. mg/L	Calculated Conc. mg/L	Standard Deviation	%RSD
Blank	0.000	0	0.000	0.00	1.01
.1 Standard	0.047	0.1	0.135	0.01	20.95
1 Standard	0.346	1.0	0.995	0.02	4.77

Correlation Coef.: 0.998426 Slope: 0.34758 Intercept: 0.00000

===

Sequence No.: 14 **Autosampler Location:**
Sample ID: SampleA **Date Collected: 11/14/2013 3:31:53 PM**
Analyst: **Data Type: Original**

Replicate Data: SampleA **Analyte: Zn 213.86**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	4.118	4.118	1.431	3:31:56 PM	Yes
Sample concentration is greater than that of the highest standard.					
2	4.131	4.131	1.436	3:32:01 PM	Yes
Sample concentration is greater than that of the highest standard.					
3	4.135	4.135	1.437	3:32:05 PM	Yes
Sample concentration is greater than that of the highest standard.					
Mean:	4.128	4.128	1.435		
SD:	0.0093	0.0093	0.0032		
%RSD:	0.23%	0.23%	0.23		

Sample concentration is greater than that of the highest standard.

===

Sequence No.: 15 **Autosampler Location:**
Sample ID: SampleB **Date Collected: 11/14/2013 3:32:28 PM**
Analyst: **Data Type: Original**

Replicate Data: SampleB **Analyte: Zn 213.86**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	4.650	4.650	1.616	3:32:30 PM	Yes
Sample concentration is greater than that of the highest standard.					
2	4.636	4.636	1.611	3:32:34 PM	Yes
Sample concentration is greater than that of the highest standard.					
3	4.661	4.661	1.620	3:32:39 PM	Yes
Sample concentration is greater than that of the highest standard.					
Mean:	4.649	4.649	1.616		
SD:	0.0128	0.0128	0.0044		
%RSD:	0.27%	0.27%	0.27		

Sample concentration is greater than that of the highest standard.

===

Method Loaded
Method Name: ENVS410Cd **Method Last Saved: 11/14/2013 3:34:46 PM**
Method Description: ENVS410Cd

==

Sequence No.: 16 **Autosampler Location:**
Sample ID: Blank **Date Collected: 11/14/2013 3:35:22 PM**
Analyst: **Data Type: Original**

Replicate Data: Blank **Analyte: Cd 228.80**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[0.00]	0.156	3:35:22 PM	Yes
2		[0.00]	0.157	3:35:26 PM	Yes
3		[0.00]	0.156	3:35:30 PM	Yes
Mean:		[0.00]	0.156		
SD:		0.0000	0.0002		
%RSD:		0.00%	0.11		

Auto-zero performed.

==

Sequence No.: 17 **Autosampler Location:**
Sample ID: .1 standard **Date Collected: 11/14/2013 3:36:20 PM**
Analyst: **Data Type: Original**

Replicate Data: .1 standard **Analyte: Cd 228.80**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[0.1]	0.038	3:36:24 PM	Yes
2		[0.1]	0.038	3:36:28 PM	Yes
3		[0.1]	0.038	3:36:33 PM	Yes
Mean:		[0.1]	0.038		
SD:		0.000	0.0002		
%RSD:		0.00%	0.57		

Standard number 1 applied. [0.1]
Correlation Coef.: 1.000000 Slope: 0.37879 Intercept: 0.00000

==

Sequence No.: 18 **Autosampler Location:**
Sample ID: 1 standard **Date Collected: 11/14/2013 3:37:07 PM**
Analyst: **Data Type: Original**

Replicate Data: 1 standard **Analyte: Cd 228.80**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[1]	0.296	3:37:08 PM	Yes
2		[1]	0.297	3:37:12 PM	Yes
3		[1]	0.301	3:37:17 PM	Yes
Mean:		[1]	0.298		
SD:		0.00	0.0023		
%RSD:		0.00%	0.79		

Standard number 2 applied. [1]
Correlation Coef.: 0.999110 Slope: 0.29912 Intercept: 0.00000
The calibration curve may not be linear.

Calibration data for Cd 228.80 **Equation: Linear Through Zero**

ID	Mean Signal (Abs)	Entered Conc. mg/L	Calculated Conc. mg/L	Standard Deviation	%RSD
Blank	0.000	0	0.000	0.00	0.11
.1 standard	0.038	0.1	0.127	0.00	0.57
1 standard	0.298	1.0	0.997	0.00	0.79

Correlation Coef.: 0.999110 Slope: 0.29912 Intercept: 0.00000

===

Sequence No.: 19
Sample ID: SampleA
Analyst:

Autosampler Location:
Date Collected: 11/14/2013 3:38:09 PM
Data Type: Original

Replicate Data: SampleA

Analyte: Cd 228.80

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.076	0.076	0.023	3:38:13 PM	Yes
2	0.075	0.075	0.023	3:38:17 PM	Yes
3	0.076	0.076	0.023	3:38:21 PM	Yes
Mean:	0.076	0.076	0.023		
SD:	0.0004	0.0004	0.0001		
%RSD:	0.55%	0.55%	0.55		

===

Sequence No.: 20
Sample ID: SampleB
Analyst:

Autosampler Location:
Date Collected: 11/14/2013 3:39:00 PM
Data Type: Original

Replicate Data: SampleB

Analyte: Cd 228.80

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.080	0.080	0.024	3:39:02 PM	Yes
2	0.082	0.082	0.025	3:39:06 PM	Yes
3	0.085	0.085	0.026	3:39:10 PM	Yes
Mean:	0.083	0.083	0.025		
SD:	0.0025	0.0025	0.0007		
%RSD:	3.03%	3.03%	3.03		

Heavy Metals Laboratory Analysis Results (Water)

```
Method: 111513 Ni wp                              Page  14                  Date: 11/19/2013 3:10:40 PM
 1                  [0.00]    0.182     2:04:22 PM    Yes
 2                  [0.00]    0.181     2:04:27 PM    Yes
 3                  [0.00]    0.182     2:04:31 PM    Yes
Mean:               [0.00]    0.182
SD:                 0.0000    0.0002
%RSD:               0.00%     0.10
Auto-zero performed.

==================================================================================================
Sequence No.: 2                                  Autosampler Location:
Sample ID: 0.1ppm Std                            Date Collected: 11/19/2013 2:04:51 PM
Analyst:                                         Data Type: Original

--------------------------------------------------------------------------------------------------
Replicate Data: 0.1ppm Std                       Analyte: Zn 213.86
Repl    SampleConc  StndConc  BlnkCorr   Time        Signal
 #      mg/L        mg/L      Signal                 Stored
 1                  [0.1]     0.039     2:04:51 PM    Yes
 2                  [0.1]     0.039     2:04:55 PM    Yes
 3                  [0.1]     0.038     2:05:00 PM    Yes
Mean:               [0.1]     0.039
SD:                 0.000     0.0002
%RSD:               0.00%     0.53
Standard number 1 applied. [0.1]
Correlation Coef.: 1.000000   Slope: 0.38585    Intercept: 0.00000

==================================================================================================
Sequence No.: 3                                  Autosampler Location:
Sample ID: 1ppm Std                              Date Collected: 11/19/2013 2:05:19 PM
Analyst:                                         Data Type: Original

--------------------------------------------------------------------------------------------------
Replicate Data: 1ppm Std                         Analyte: Zn 213.86
Repl    SampleConc  StndConc  BlnkCorr   Time        Signal
 #      mg/L        mg/L      Signal                 Stored
 1                  [1]       0.293     2:05:20 PM    Yes
 2                  [1]       0.296     2:05:25 PM    Yes
 3                  [1]       0.302     2:05:29 PM    Yes
Mean:               [1]       0.297
SD:                 0.00      0.0043
%RSD:               0.00%     1.45
Standard number 2 applied. [1]
Correlation Coef.: 0.998908   Slope: 0.29798    Intercept: 0.00000
   The calibration curve may not be linear.

--------------------------------------------------------------------------------------------------
Calibration data for Zn 213.86                     Equation: Linear Through Zero
                                     Entered  Calculated
                      Mean Signal    Conc.     Conc.      Standard
        ID              (Abs)        mg/L      mg/L       Deviation      %RSD
      2% HCl            0.000         0        0.000        0.00         0.10
    0.1ppm Std          0.039        0.1       0.129        0.00         0.53
     1ppm Std           0.297        1.0       0.996        0.00         1.45
Correlation Coef.: 0.998908   Slope: 0.29798    Intercept: 0.00000

==================================================================================================
Sequence No.: 4                                  Autosampler Location:
Sample ID: sample 0                              Date Collected: 11/19/2013 2:07:38 PM
Analyst:                                         Data Type: Original

--------------------------------------------------------------------------------------------------
Replicate Data: sample 0                         Analyte: Zn 213.86
Repl    SampleConc  StndConc  BlnkCorr   Time        Signal
 #      mg/L        mg/L      Signal                 Stored
 1      0.074       0.074     0.022     2:07:39 PM    Yes
 2      0.060       0.060     0.018     2:07:44 PM    Yes
 3      0.053       0.053     0.016     2:07:48 PM    Yes
```

Mean:	0.062	0.062	0.019
SD:	0.0108	0.0108	0.0032
%RSD:	17.25%	17.25%	17.25

==========

Sequence No.: 5 — Autosampler Location:
Sample ID: sample 1 — Date Collected: 11/19/2013 2:08:28 PM
Analyst: — Data Type: Original

Replicate Data: sample 1 — Analyte: Zn 213.86

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.017	0.017	0.005	2:08:29 PM	Yes
2	0.013	0.013	0.004	2:08:33 PM	Yes
3	0.014	0.014	0.004	2:08:38 PM	Yes
Mean:	0.015	0.015	0.004		
SD:	0.0019	0.0019	0.0006		
%RSD:	13.24%	13.24%	13.24		

==========

Sequence No.: 6 — Autosampler Location:
Sample ID: sample 2 — Date Collected: 11/19/2013 2:09:18 PM
Analyst: — Data Type: Original

Replicate Data: sample 2 — Analyte: Zn 213.86

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.013	0.013	0.004	2:09:19 PM	Yes
2	0.006	0.006	0.002	2:09:23 PM	Yes
3	0.003	0.003	0.001	2:09:28 PM	Yes
Mean:	0.007	0.007	0.002		
SD:	0.0052	0.0052	0.0015		
%RSD:	72.71%	72.71%	72.71		

==========

Sequence No.: 7 — Autosampler Location:
Sample ID: sample 3 — Date Collected: 11/19/2013 2:10:48 PM
Analyst: — Data Type: Original

Replicate Data: sample 3 — Analyte: Zn 213.86

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	-0.014	-0.014	-0.004	2:10:50 PM	Yes
2	-0.018	-0.018	-0.005	2:10:54 PM	Yes
3	-0.020	-0.020	-0.006	2:10:59 PM	Yes
Mean:	-0.017	-0.017	-0.005		
SD:	0.0031	0.0031	0.0009		
%RSD:	17.70%	17.70%	17.70		

==========

Method Loaded
Method Name: Fe water test — Method Last Saved: 11/19/2013 2:16:52 PM
Method Description: Iron water test
User canceled analysis.

==========

Sequence No.: 9 — Autosampler Location:
Sample ID: blank — Date Collected: 11/19/2013 2:19:32 PM
Analyst: — Data Type: Original

Replicate Data: blank — Analyte: Fe 248.33

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored

1	[0.00]	0.040	2:19:32 PM	Yes
2	[0.00]	0.040	2:19:37 PM	Yes
3	[0.00]	0.040	2:19:41 PM	Yes
Mean:	[0.00]	0.040		
SD:	0.0000	0.0003		
%RSD:	0.00%	0.78		

Auto-zero performed.

==

Sequence No.: 10 **Autosampler Location:**
Sample ID: 5ppmFe **Date Collected: 11/19/2013 2:20:05 PM**
Analyst: **Data Type: Original**

Replicate Data: 5ppmFe **Analyte: Fe 248.33**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[5]	0.288	2:20:07 PM	Yes
2		[5]	0.289	2:20:11 PM	Yes
3		[5]	0.289	2:20:15 PM	Yes
Mean:		[5]	0.289		
SD:		0.00	0.0005		
%RSD:		0.00%	0.19		

Standard number 1 applied. [5]
Correlation Coef.: 1.000000 Slope: 0.05779 Intercept: 0.00000

Calibration data for Fe 248.33 **Equation: Linear Through Zero**

ID	Mean Signal (Abs)	Entered Conc. mg/L	Calculated Conc. mg/L	Standard Deviation	%RSD
blank	0.000	0	0.000	0.00	0.78
5ppmFe	0.289	5.0	5.000	0.00	0.19

Correlation Coef.: 1.000000 Slope: 0.05779 Intercept: 0.00000

==

Sequence No.: 11 **Autosampler Location:**
Sample ID: sample 0 **Date Collected: 11/19/2013 2:20:47 PM**
Analyst: **Data Type: Original**

Replicate Data: sample 0 **Analyte: Fe 248.33**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	1.823	1.823	0.105	2:20:48 PM	Yes
2	2.068	2.068	0.120	2:20:52 PM	Yes
3	2.029	2.029	0.117	2:20:57 PM	Yes
Mean:	1.973	1.973	0.114		
SD:	0.1316	0.1316	0.0076		
%RSD:	6.67%	6.67%	6.67		

==

Sequence No.: 12 **Autosampler Location:**
Sample ID: sample 1 **Date Collected: 11/19/2013 2:21:23 PM**
Analyst: **Data Type: Original**

Replicate Data: sample 1 **Analyte: Fe 248.33**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.407	0.407	0.024	2:21:24 PM	Yes
2	0.445	0.445	0.026	2:21:29 PM	Yes
3	0.414	0.414	0.024	2:21:33 PM	Yes
Mean:	0.422	0.422	0.024		
SD:	0.0203	0.0203	0.0012		
%RSD:	4.80%	4.80%	4.80		

Sequence No.: 13
Sample ID: sample 2
Analyst:
Autosampler Location:
Date Collected: 11/19/2013 2:33:42 PM
Data Type: Original

Replicate Data: sample 2 Analyte: Fe 248.33

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.203	0.203	0.012	2:33:43 PM	Yes
2	0.206	0.206	0.012	2:33:48 PM	Yes
3	0.196	0.196	0.011	2:33:52 PM	Yes
Mean:	0.202	0.202	0.012		
SD:	0.0053	0.0053	0.0003		
%RSD:	2.65%	2.65%	2.65		

Sequence No.: 14
Sample ID: sample 3
Analyst:
Autosampler Location:
Date Collected: 11/19/2013 2:38:29 PM
Data Type: Original

Replicate Data: sample 3 Analyte: Fe 248.33

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	1.954	1.954	0.113	2:38:30 PM	Yes
2	1.863	1.863	0.108	2:38:35 PM	Yes
3	1.777	1.777	0.103	2:38:39 PM	Yes
Mean:	1.864	1.864	0.108		
SD:	0.0886	0.0886	0.0051		
%RSD:	4.75%	4.75%	4.75		

Method Loaded
Method Name: ENVS410Cd Method Last Saved: 11/14/2013 3:34:46 PM
Method Description: ENVS410Cd

Sequence No.: 15
Sample ID: Blank
Analyst:
Autosampler Location:
Date Collected: 11/19/2013 2:41:15 PM
Data Type: Original

Replicate Data: Blank Analyte: Cd 228.80

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[0.00]	0.127	2:41:15 PM	Yes
2		[0.00]	0.127	2:41:19 PM	Yes
3		[0.00]	0.127	2:41:24 PM	Yes
Mean:		[0.00]	0.127		
SD:		0.0000	0.0001		
%RSD:		0.00%	0.08		

Auto-zero performed.

Sequence No.: 16
Sample ID: .1 standard
Analyst:
Autosampler Location:
Date Collected: 11/19/2013 2:41:50 PM
Data Type: Original

Replicate Data: .1 standard Analyte: Cd 228.80

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[0.1]	0.029	2:41:52 PM	Yes
2		[0.1]	0.030	2:41:56 PM	Yes
3		[0.1]	0.030	2:42:01 PM	Yes
Mean:		[0.1]	0.030		

SD: 0.000 0.0001
%RSD: 0.00% 0.46
Standard number 1 applied. [0.1]
Correlation Coef.: 1.000000 Slope: 0.29569 Intercept: 0.00000

==========

Sequence No.: 17 **Autosampler Location:**
Sample ID: 1 standard **Date Collected: 11/19/2013 2:42:24 PM**
Analyst: **Data Type: Original**

Replicate Data: 1 standard **Analyte: Cd 228.80**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[1]	0.247	2:42:28 PM	Yes
2		[1]	0.246	2:42:33 PM	Yes
3		[1]	0.246	2:42:37 PM	Yes
Mean:		[1]	0.246		
SD:		0.00	0.0009		
%RSD:		0.00%	0.35		

Standard number 2 applied. [1]
Correlation Coef.: 0.999510 Slope: 0.24686 Intercept: 0.00000
The calibration curve may not be linear.

Calibration data for Cd 228.80 **Equation: Linear Through Zero**

ID	Mean Signal (Abs)	Entered Conc. mg/L	Calculated Conc. mg/L	Standard Deviation	%RSD
Blank	0.000	0	0.000	0.00	0.08
.1 standard	0.030	0.1	0.120	0.00	0.46
1 standard	0.246	1.0	0.998	0.00	0.35

Correlation Coef.: 0.999510 Slope: 0.24686 Intercept: 0.00000

==========

Sequence No.: 18 **Autosampler Location:**
Sample ID: sample 0 **Date Collected: 11/19/2013 2:43:16 PM**
Analyst: **Data Type: Original**

Replicate Data: sample 0 **Analyte: Cd 228.80**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.017	0.017	0.004	2:43:17 PM	Yes
2	0.008	0.008	0.002	2:43:22 PM	Yes
3	0.002	0.002	0.000	2:43:26 PM	Yes
Mean:	0.009	0.009	0.002		
SD:	0.0073	0.0073	0.0018		
%RSD:	82.26%	82.26%	82.26		

==========

Sequence No.: 19 **Autosampler Location:**
Sample ID: sample 1 **Date Collected: 11/19/2013 2:43:52 PM**
Analyst: **Data Type: Original**

Replicate Data: sample 1 **Analyte: Cd 228.80**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	-0.003	-0.003	-0.001	2:43:54 PM	Yes
2	-0.003	-0.003	-0.001	2:43:58 PM	Yes
3	-0.001	-0.001	-0.000	2:44:02 PM	Yes
Mean:	-0.002	-0.002	-0.001		
SD:	0.0010	0.0010	0.0003		
%RSD:	42.51%	42.51%	42.51		

==========

Sequence No.: 20
Sample ID: sample 2
Analyst:

Autosampler Location:
Date Collected: 11/19/2013 2:44:26 PM
Data Type: Original

Replicate Data: sample 2
Analyte: Cd 228.80

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	-0.002	-0.002	-0.001	2:44:28 PM	Yes
2	-0.001	-0.001	-0.000	2:44:32 PM	Yes
3	-0.001	-0.001	-0.000	2:44:37 PM	Yes
Mean:	-0.002	-0.002	-0.000		
SD:	0.0007	0.0007	0.0002		
%RSD:	44.63%	44.63%	44.63		

Sequence No.: 21
Sample ID: sample 3
Analyst:

Autosampler Location:
Date Collected: 11/19/2013 2:45:01 PM
Data Type: Original

Replicate Data: sample 3
Analyte: Cd 228.80

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.001	0.001	0.000	2:45:02 PM	Yes
2	-0.000	-0.000	-0.000	2:45:06 PM	Yes
3	0.002	0.002	0.000	2:45:11 PM	Yes
Mean:	0.001	0.001	0.000		
SD:	0.0009	0.0009	0.0002		
%RSD:	126.62%	126.62%	126.62		

Method Loaded
Method Name: Cu envs410 water
Method Description: copper water test
Method Last Saved: 11/19/2013 2:51:37 PM

Sequence No.: 22
Sample ID: blank
Analyst:

Autosampler Location:
Date Collected: 11/19/2013 2:51:47 PM
Data Type: Original

Replicate Data: blank
Analyte: Cu 324.75

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[0.00]	0.023	2:51:51 PM	Yes
2		[0.00]	0.023	2:51:55 PM	Yes
3		[0.00]	0.023	2:51:59 PM	Yes
Mean:		[0.00]	0.023		
SD:		0.0000	0.0001		
%RSD:		0.00%	0.50		

Auto-zero performed.

Sequence No.: 23
Sample ID: blank
Analyst:

Autosampler Location:
Date Collected: 11/19/2013 2:53:06 PM
Data Type: Original

Replicate Data: blank
Analyte: Cu 324.75

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[0.00]	0.002	2:53:07 PM	Yes
2		[0.00]	0.002	2:53:12 PM	Yes
3		[0.00]	0.002	2:53:16 PM	Yes
Mean:		[0.00]	0.002		
SD:		0.0000	0.0001		

%RSD: 0.00% 4.44
Auto-zero performed.

==========

Sequence No.: 24
Sample ID: 1ppm
Analyst:

Autosampler Location:
Date Collected: 11/19/2013 2:53:34 PM
Data Type: Original

Replicate Data: 1ppm **Analyte: Cu 324.75**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[1]	0.143	2:53:34 PM	Yes
2		[1]	0.146	2:53:38 PM	Yes
3		[1]	0.147	2:53:43 PM	Yes
Mean:		[1]	0.145		
SD:		0.00	0.0018		
%RSD:		0.00%	1.21		

Standard number 1 applied. [1]
Correlation Coef.: 1.000000 Slope: 0.14530 Intercept: 0.00000

==========

Sequence No.: 25
Sample ID: 5ppm
Analyst:

Autosampler Location:
Date Collected: 11/19/2013 2:54:05 PM
Data Type: Original

Replicate Data: 5ppm **Analyte: Cu 324.75**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[5]	0.581	2:54:09 PM	Yes
2		[5]	0.583	2:54:13 PM	Yes
3		[5]	0.585	2:54:18 PM	Yes
Mean:		[5]	0.583		
SD:		0.00	0.0021		
%RSD:		0.00%	0.37		

Standard number 2 applied. [5]
Correlation Coef.: 0.996425 Slope: 0.11795 Intercept: 0.00000
The calibration curve may not be linear.

Calibration data for Cu 324.75 **Equation: Linear Through Zero**

ID	Mean Signal (Abs)	Entered Conc. mg/L	Calculated Conc. mg/L	Standard Deviation	%RSD
blank	0.000	0	0.000	0.00	4.44
1ppm	0.145	1.0	1.232	0.00	1.21
5ppm	0.583	5.0	4.942	0.00	0.37

Correlation Coef.: 0.996425 Slope: 0.11795 Intercept: 0.00000

==========

Sequence No.: 26
Sample ID: sample 0
Analyst:

Autosampler Location:
Date Collected: 11/19/2013 2:54:43 PM
Data Type: Original

Replicate Data: sample 0 **Analyte: Cu 324.75**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.122	0.122	0.014	2:54:44 PM	Yes
2	0.088	0.088	0.010	2:54:49 PM	Yes
3	0.075	0.075	0.009	2:54:53 PM	Yes
Mean:	0.095	0.095	0.011		
SD:	0.0245	0.0245	0.0029		
%RSD:	25.81%	25.81%	25.81		

==========

Sequence No.: 27   Autosampler Location:
Sample ID: sample 1   Date Collected: 11/19/2013 2:55:19 PM
Analyst: Data Type: Original

Replicate Data: sample 1   Analyte: Cu 324.75

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.030	0.030	0.004	2:55:23 PM	Yes
2	0.030	0.030	0.004	2:55:27 PM	Yes
3	0.027	0.027	0.003	2:55:31 PM	Yes
Mean:	0.029	0.029	0.003		
SD:	0.0016	0.0016	0.0002		
%RSD:	5.50%	5.50%	5.50		

Sequence No.: 28   Autosampler Location:
Sample ID: sample 2   Date Collected: 11/19/2013 2:55:51 PM
Analyst: Data Type: Original

Replicate Data: sample 2   Analyte: Cu 324.75

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.024	0.024	0.003	2:55:52 PM	Yes
2	0.024	0.024	0.003	2:55:56 PM	Yes
3	0.027	0.027	0.003	2:56:00 PM	Yes
Mean:	0.025	0.025	0.003		
SD:	0.0019	0.0019	0.0002		
%RSD:	7.57%	7.57%	7.57		

Sequence No.: 29   Autosampler Location:
Sample ID: sample 3   Date Collected: 11/19/2013 2:56:23 PM
Analyst: Data Type: Original

Replicate Data: sample 3   Analyte: Cu 324.75

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.043	0.043	0.005	2:56:25 PM	Yes
2	0.041	0.041	0.005	2:56:29 PM	Yes
3	0.042	0.042	0.005	2:56:33 PM	Yes
Mean:	0.042	0.042	0.005		
SD:	0.0007	0.0007	0.0001		
%RSD:	1.66%	1.66%	1.66		

Method Loaded
Method Name: 111513_Ni_wp   Method Last Saved: 11/15/2013 3:45:53 PM
Method Description: 111513_Ni_wp

Sequence No.: 30   Autosampler Location:
Sample ID: Blank   Date Collected: 11/19/2013 3:03:09 PM
Analyst: Data Type: Original

Replicate Data: Blank   Analyte: Ni 232.00

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[0.00]	0.052	3:03:11 PM	Yes
2		[0.00]	0.052	3:03:15 PM	Yes
3		[0.00]	0.052	3:03:19 PM	Yes
Mean:		[0.00]	0.052		
SD:		0.0000	0.0003		
%RSD:		0.00%	0.48		

Auto-zero performed.

==========

Sequence No.: 31 | **Autosampler Location:**
Sample ID: 1ppm standard | **Date Collected: 11/19/2013 3:03:36 PM**
Analyst: | **Data Type: Original**

Replicate Data: 1ppm standard   **Analyte: Ni 232.00**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[1]	0.066	3:03:36 PM	Yes
2		[1]	0.065	3:03:40 PM	Yes
3		[1]	0.065	3:03:45 PM	Yes
Mean:		[1]	0.065		
SD:		0.00	0.0003		
%RSD:		0.00%	0.53		

Standard number 1 applied. [1]
Correlation Coef.: 1.000000   Slope: 0.06538   Intercept: 0.00000

==========

Sequence No.: 32 | **Autosampler Location:**
Sample ID: 2ppm standard | **Date Collected: 11/19/2013 3:04:03 PM**
Analyst: | **Data Type: Original**

Replicate Data: 2ppm standard   **Analyte: Ni 232.00**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1		[2]	0.122	3:04:04 PM	Yes
2		[2]	0.122	3:04:09 PM	Yes
3		[2]	0.122	3:04:13 PM	Yes
Mean:		[2]	0.122		
SD:		0.00	0.0002		
%RSD:		0.00%	0.17		

Standard number 2 applied. [2]
Correlation Coef.: 0.996176   Slope: 0.06200   Intercept: 0.00000

Calibration data for Ni 232.00   **Equation: Linear Through Zero**

ID	Mean Signal (Abs)	Entered Conc. mg/L	Calculated Conc. mg/L	Standard Deviation	%RSD
Blank	0.000	0	0.000	0.00	0.48
1ppm standard	0.065	1.0	1.054	0.00	0.53
2ppm standard	0.122	2.0	1.971	0.00	0.17

Correlation Coef.: 0.996176   Slope: 0.06200   Intercept: 0.00000

==========

Sequence No.: 33 | **Autosampler Location:**
Sample ID: sample 0 | **Date Collected: 11/19/2013 3:04:41 PM**
Analyst: | **Data Type: Original**

Replicate Data: sample 0   **Analyte: Ni 232.00**

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.074	0.074	0.005	3:04:43 PM	Yes
2	0.041	0.041	0.003	3:04:47 PM	Yes
3	0.034	0.034	0.002	3:04:51 PM	Yes
Mean:	0.050	0.050	0.003		
SD:	0.0213	0.0213	0.0013		
%RSD:	42.66%	42.66%	42.66		

==========

Sequence No.: 34 | **Autosampler Location:**
Sample ID: sample 1 | **Date Collected: 11/19/2013 3:05:40 PM**

Analyst: Data Type: Original

Replicate Data: sample 1 Analyte: Ni 232.00

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.011	0.011	0.001	3:05:42 PM	Yes
2	0.008	0.008	0.000	3:05:46 PM	Yes
3	0.010	0.010	0.001	3:05:51 PM	Yes
Mean:	0.010	0.010	0.001		
SD:	0.0017	0.0017	0.0001		
%RSD:	17.06%	17.06%	17.06		

===

Sequence No.: 35 Autosampler Location:
Sample ID: sample 2 Date Collected: 11/19/2013 3:06:11 PM
Analyst: Data Type: Original

Replicate Data: sample 2 Analyte: Ni 232.00

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.010	0.010	0.001	3:06:11 PM	Yes
2	0.012	0.012	0.001	3:06:16 PM	Yes
3	0.015	0.015	0.001	3:06:20 PM	Yes
Mean:	0.013	0.013	0.001		
SD:	0.0027	0.0027	0.0002		
%RSD:	21.27%	21.27%	21.27		

===

Sequence No.: 36 Autosampler Location:
Sample ID: sample 3 Date Collected: 11/19/2013 3:06:42 PM
Analyst: Data Type: Original

Replicate Data: sample 3 Analyte: Ni 232.00

Repl #	SampleConc mg/L	StndConc mg/L	BlnkCorr Signal	Time	Signal Stored
1	0.026	0.026	0.002	3:06:43 PM	Yes
2	0.026	0.026	0.002	3:06:48 PM	Yes
3	0.027	0.027	0.002	3:06:52 PM	Yes
Mean:	0.026	0.026	0.002		
SD:	0.0010	0.0010	0.0001		
%RSD:	3.60%	3.60%	3.60		

NORTH COAST LABORATORIES LTD.

December 03, 2013

Cash Customer
All charges have been paid
Release report to client
,
Attn: Cooper Rodgers

RE: Dows Prairie Wetland

Order No.: 1311283
Invoice No.: 112694
PO No.:
ELAP No.1247-Expires July 2014

SAMPLE IDENTIFICATION

Fraction	Client Sample Description
01B	Wetland Site 1

ND = Not Detected at the Reporting Limit

Limit = Reporting Limit

Flag = Explanation in Case Narrative

All solid results are expressed on a wet-weight basis unless otherwise noted.

REPORT CERTIFIED BY

Laboratory Supervisor(s)

QA Unit

Jesse G. Chaney, Jr.
Laboratory Director

5680 West End Road • Arcata, California 95521-9202 • 707-822-4649 • FAX 707-822-6831

North Coast Laboratories, Ltd. **Date:** 03-Dec-2013

CLIENT:	Cash Customer
Project:	Dows Prairie Wetland
Lab Order:	1311283

CASE NARRATIVE

The sample was received outside the EPA recommended temperature of less than or equal to 6° C.

EPA 8141:
Due to the breakdown of a non-target analyte in the analytical system, the recovery of dichlorvos was above the upper acceptance limit in the laboratory control sample, laboratory control sample duplicate, and matrix spike. There were no detectable levels of the analyte in the sample; therefore, the data were accepted.

The surrogate recovery was below the lower acceptance limit in sample "Wetland Site 1." The data were approved based on the response of a standard analyzed at or below the method reporting limit that demonstrated sufficient instrument sensitivity to detect the target analytes if they were present in the sample.

The recoveries of most analytes and the surrogate were below the lower acceptance limits in the matrix spike sample. The data were approved based on the response of a standard analyzed at or below the method reporting limit that demonstrated sufficient instrument sensitivity to detect the target analytes if they were present in the sample.

The relative percent difference (RPD) between the laboratory control samples was above the acceptance limit for parathion. This indicates that the sample results could be variable. Since there were no detectable levels of analyte in the sample, the data were accepted.

NORTH COAST LABORATORIES
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Date: 03-Dec-2013
WorkOrder: 1311283

ANALYTICAL REPORT

Client Sample ID: Wetland Site 1
Lab ID: 1311283-01B

Received: 11/19/2013
Collected: 11/18/2013 16:00

Test Name: Carbamate and Urea Pesticides **Reference:** EPA 632 Modified

Parameter	Result	Flag	Limit	Units	DF	Extracted	Analyzed
Oxamyl	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Methomyl	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Fenuron	ND		0.20	mg/kg	1.0	11/26/2013	11/28/2013
Monuron	ND		0.20	mg/kg	1.0	11/26/2013	11/28/2013
Propoxur	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Carbofuran	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Carbaryl	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Fluometuron	ND		0.20	mg/kg	1.0	11/26/2013	11/28/2013
Diuron	ND		0.20	mg/kg	1.0	11/26/2013	11/28/2013
Propham	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Siduron	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Methiocarb	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Linuron	ND		0.20	mg/kg	1.0	11/26/2013	11/28/2013
Swep	ND		0.20	mg/kg	1.0	11/26/2013	11/28/2013
Chlorpropham	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Barban	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Neburon	ND		0.20	mg/kg	1.0	11/26/2013	11/28/2013
Surrogate: 3,4-Dinitrotoluene	71.8		65-113	% Rec	1.0	11/26/2013	11/28/2013

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ANALYTICAL REPORT

Client Sample ID: Wetland Site 1

Lab ID: 1311283-01B

Received: 11/19/2013

Collected: 11/18/2013 16:00

Test Name: Organophosphorous Pesticides **Reference:** EPA 8141A

Parameter	Result	Flag	Limit	Units	DF	Extracted	Analyzed
Dichlorvos	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Mevinphos	ND		1.0	mg/kg	1.0	11/26/2013	11/28/2013
Ethoprophos	ND		1.0	mg/kg	1.0	11/26/2013	11/28/2013
Phorate	ND		1.0	mg/kg	1.0	11/26/2013	11/28/2013
Demeton-S	ND		2.0	mg/kg	1.0	11/26/2013	11/28/2013
Diazinon	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Disulfoton	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Dimethoate	ND		2.0	mg/kg	1.0	11/26/2013	11/28/2013
Ronnel	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Methyl Parathion	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Chlorpyrifos	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Malathion	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Parathion	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Fenthion	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Tetrachlorvinphos	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Ethion	ND		0.50	mg/kg	1.0	11/26/2013	11/28/2013
Fensulfothion	ND		1.0	mg/kg	1.0	11/26/2013	11/28/2013
Azinphos	ND		2.5	mg/kg	1.0	11/26/2013	11/28/2013
Coumaphos	ND		2.5	mg/kg	1.0	11/26/2013	11/28/2013
Surrogate: Triphenylphosphate	26.1		29.9-137	% Rec	1.0	11/26/2013	11/28/2013

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CLIENT: Cash Customer
Work Order: 1311283
Project: Dows Prairie Wetland

QC SUMMARY REPORT

Method Blank

Sample ID: **MB-29889** Batch ID: **29889** Test Code: **632S** Units: **mg/kg** Analysis Date **11/28/2013 5:24:01 AM** Prep Date: **11/26/2013**

Client ID: Run ID: **ORLC5_131127A** SeqNo: **1111115**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Oxamyl	ND	0.50									
Methomyl	ND	0.50									
Fenuron	ND	0.20									
Monuron	ND	0.20									
Propoxur	ND	0.50									
Carbofuran	ND	0.50									
Carbaryl	ND	0.50									
Fluometuron	ND	0.20									
Diuron	ND	0.20									
Propham	ND	0.50									
Siduron	ND	0.50									
Methiocarb	ND	0.50									
Linuron	ND	0.20									
Swep	ND	0.20									
Chlorpropham	ND	0.50									
Barban	ND	0.50									
Neburon	ND	0.20									
Surrogate: 3,4-Dinitrotoluene	0.880	0.10	1.00	0	88.0%	65	113	0			

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: Cash Customer
Work Order: 1311283
Project: Dows Prairie Wetland

QC SUMMARY REPORT
Method Blank

Sample ID: **MB-29891** Batch ID: **29891** Test Code: **8140S** Units: **mg/kg** Analysis Date **11/28/2013 2:27:03 AM** Prep Date: **11/26/2013**
Client ID: Run ID: **ORGC13_131127A** SeqNo: **1111283**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Dichlorvos	ND	0.50									
Mevinphos	ND	1.0									
Ethoprophos	ND	1.0									
Phorate	ND	1.0									
Demeton-S	ND	2.0									
Diazinon	ND	0.50									
Disulfoton	ND	0.50									
Dimethoate	ND	2.0									
Ronnel	ND	0.50									
Methyl Parathion	ND	0.50									
Chlorpyrifos	ND	0.50									
Malathion	ND	0.50									
Parathion	ND	0.50									
Fenthion	ND	0.50									
Tetrachlorvinphos	ND	0.50									
Ethion	ND	0.50									
Fensulfothion	ND	1.0									
Azinphos	ND	2.5									
Coumaphos	ND	2.5									
Surrogate: Triphenylphosphate	4.75	0.10	5.00	0	95.0%	30	137	0			

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: Cash Customer
Work Order: 1311283
Project: Dows Prairie Wetland

QC SUMMARY REPORT

Sample Matrix Spike

Sample ID: **1311283-01BMS** Batch ID: **29889** Test Code: **632S** Units: **mg/kg** Analysis Date **11/28/2013 9:19:41 AM** Prep Date: **11/26/2013**

Client ID: **Wetland Site 1** Run ID: **ORLC5_131127A** SeqNo: **1111118**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Oxamyl	0.4894	0.50	1.00	0	48.9%	54	119	0			JS
Methomyl	0.6510	0.50	1.00	0	65.1%	57	123	0			
Fenuron	0.5581	0.20	1.00	0	55.8%	71	111	0			S
Monuron	0.5688	0.20	1.00	0	56.9%	76	107	0			S
Propoxur	0.4933	0.50	1.00	0	49.3%	59	127	0			JS
Carbofuran	0.4942	0.50	1.00	0	49.4%	62	121	0			JS
Carbaryl	0.5992	0.50	1.00	0	59.9%	69	115	0			S
Fluometuron	0.5589	0.20	1.00	0	55.9%	74	111	0			S
Diuron	0.5572	0.20	1.00	0	55.7%	64	114	0			S
Propham	0.6543	0.50	1.00	0	65.4%	51	126	0			
Siduron	0.5401	0.50	1.00	0	54.0%	75	117	0			S
Methiocarb	0.5123	0.50	1.00	0	51.2%	72	124	0			S
Linuron	0.5838	0.20	1.00	0	58.4%	74	114	0			S
Swep	0.5474	0.20	1.00	0	54.7%	75	117	0			S
Chlorpropham	0.8775	0.50	1.00	0.247	63.0%	70	114	0			S
Barban	0.6430	0.50	1.00	0	64.3%	67	115	0			S
Neburon	0.4657	0.20	1.00	0	46.6%	69	110	0			S
Surrogate: 3,4-Dinitrotoluene	0.559	0.10	1.00	0	55.9%	65	113	0			S

Qualifiers:
ND - Not Detected at the Reporting Limit
S - Spike Recovery outside accepted recovery limits
B - Analyte detected in the associated Method Blank
J - Analyte detected below quantitation limits
R - RPD outside accepted recovery limits

CLIENT: Cash Customer
Work Order: 1311283
Project: Dows Prairie Wetland

QC SUMMARY REPORT

Sample Matrix Spike

Sample ID: **1311283-01BMS** Batch ID: **29891** Test Code: **8140S** Units: **mg/kg** Analysis Date **11/28/2013 4:39:55 AM** Prep Date: **11/26/2013**

Client ID: **Wetland Site 1** Run ID: **ORGC13_131127A** SeqNo: **1111286**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Dichlorvos	4.245	0.50	2.50	0	170%	46	145	0			S
Mevinphos	2.584	1.0	2.50	0	103%	32	131	0			
Ethoprophos	2.039	1.0	2.50	0	81.5%	38	135	0			
Phorate	1.683	1.0	2.50	0	67.3%	39	146	0			
Demeton-S	ND	2.0	2.50	0	63.4%	30	137	0			
Diazinon	1.983	0.50	2.50	0	79.3%	42	132	0			
Disulfoton	1.534	0.50	2.50	0	61.4%	37	139	0			
Dimethoate	2.148	2.0	2.50	0	85.9%	17	134	0			
Ronnel	1.925	0.50	2.50	0	77.0%	32	172	0			
Methyl Parathion	1.858	0.50	2.50	0	74.3%	27	141	0			
Chlorpyrifos	1.967	0.50	2.50	0	78.7%	37	150	0			
Malathion	1.884	0.50	2.50	0	75.4%	48	139	0			
Parathion	1.804	0.50	2.50	0	72.2%	28	152	0			
Fenthion	1.978	0.50	2.50	0	79.1%	37	137	0			
Tetrachlorvinphos	1.829	0.50	2.50	0	73.1%	44	135	0			
Ethion	3.921	0.50	5.00	0	78.4%	51	128	0			
Fensulfothion	2.279	1.0	2.50	0	91.2%	20	138	0			
Azinphos	2.642	2.5	2.50	0	106%	38	146	0			
Coumaphos	ND	2.5	2.50	0	89.3%	39	143	0			
Surrogate: Triphenylphosphate	3.61	0.10	5.00	0	72.2%	30	137	0			

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

North Coast Laboratories, Ltd.

Date: 12/3/2013

CLIENT: Cash Customer
Work Order: 1311283
Project: Dows Prairie Wetland

QC SUMMARY REPORT

Laboratory Control Spike

Sample ID: **LCS-29889** Batch ID: **29889** Test Code: **632S** Units: **mg/kg** Analysis Date **11/28/2013 6:42:38 AM** Prep Date: **11/26/2013**

Client ID: Run ID: **ORLC5_131127A** SeqNo: **1111116**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Oxamyl	0.8240	0.50	1.00	0	82.4%	54	119	0			
Methomyl	0.8131	0.50	1.00	0	81.3%	57	123	0			
Fenuron	0.7935	0.20	1.00	0	79.3%	71	111	0			
Monuron	0.8036	0.20	1.00	0	80.4%	76	107	0			
Propoxur	0.8264	0.50	1.00	0	82.6%	59	127	0			
Carbofuran	0.8189	0.50	1.00	0	81.9%	62	121	0			
Carbaryl	0.8104	0.50	1.00	0	81.0%	69	115	0			
Fluometuron	0.8122	0.20	1.00	0	81.2%	74	111	0			
Diuron	0.8509	0.20	1.00	0	85.1%	64	114	0			
Propham	0.8798	0.50	1.00	0	88.0%	51	126	0			
Siduron	0.8674	0.50	1.00	0	86.7%	75	117	0			
Methiocarb	0.8669	0.50	1.00	0	86.7%	72	124	0			
Linuron	0.8886	0.20	1.00	0	88.9%	74	114	0			
Swep	0.8652	0.20	1.00	0	86.5%	75	117	0			
Chlorpropham	0.8112	0.50	1.00	0	81.1%	70	114	0			
Barban	0.9669	0.50	1.00	0	96.7%	67	115	0			
Neburon	0.7164	0.20	1.00	0	71.6%	69	110	0			
Surrogate: 3,4-Dinitrotoluene	0.816	0.10	1.00	0	81.6%	65	113	0			

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: Cash Customer
Work Order: 1311283
Project: Dows Prairie Wetland

QC SUMMARY REPORT

Laboratory Control Spike Duplicate

Sample ID: **LCSD-29889** Batch ID: **29889** Test Code: **632S** Units: **mg/kg** Analysis Date **11/28/2013 8:01:09 AM** Prep Date: **11/26/2013**

Client ID: Run ID: **ORLC5_131127A** SeqNo: **1111117**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Oxamyl	0.8446	0.50	1.00	0	84.5%	54	119	0.824	2.46%	30	
Methomyl	0.8155	0.50	1.00	0	81.5%	57	123	0.813	0.291%	30	
Fenuron	0.8096	0.20	1.00	0	81.0%	71	111	0.794	2.01%	30	
Monuron	0.8279	0.20	1.00	0	82.8%	76	107	0.804	2.99%	30	
Propoxur	0.9308	0.50	1.00	0	93.1%	59	127	0.826	11.9%	30	
Carbofuran	0.7528	0.50	1.00	0	75.3%	62	121	0.819	8.42%	30	
Carbaryl	0.8251	0.50	1.00	0	82.5%	69	115	0.810	1.80%	30	
Fluometuron	0.8246	0.20	1.00	0	82.5%	74	111	0.812	1.52%	30	
Diuron	0.8671	0.20	1.00	0	86.7%	64	114	0.851	1.89%	30	
Propham	0.9162	0.50	1.00	0	91.6%	51	126	0.880	4.06%	30	
Siduron	0.8898	0.50	1.00	0	89.0%	75	117	0.867	2.54%	30	
Methiocarb	0.8382	0.50	1.00	0	83.8%	72	124	0.867	3.36%	30	
Linuron	0.8789	0.20	1.00	0	87.9%	74	114	0.889	1.10%	30	
Swep	0.8361	0.20	1.00	0	83.6%	75	117	0.865	3.42%	30	
Chlorpropham	0.8043	0.50	1.00	0	80.4%	70	114	0.811	0.856%	30	
Barban	0.9125	0.50	1.00	0	91.3%	67	115	0.967	5.79%	30	
Neburon	0.8132	0.20	1.00	0	81.3%	69	110	0.716	12.7%	30	
Surrogate: 3,4-Dinitrotoluene	0.809	0.10	1.00	0	80.9%	65	113	0.816	0.877%	0	

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: Cash Customer
Work Order: 1311283
Project: Dows Prairie Wetland

QC SUMMARY REPORT

Laboratory Control Spike

Sample ID: **LCS-29891** Batch ID: **29891** Test Code: **8140S** Units: **mg/kg** Analysis Date **11/28/2013 3:11:27 AM** Prep Date: **11/26/2013**

Client ID: Run ID: **ORGC13_131127A** SeqNo: **1111284**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Dichlorvos	7.396	0.50	2.50	0	296%	46	145	0			S
Mevinphos	3.216	1.0	2.50	0	129%	32	131	0			
Ethoprophos	2.556	1.0	2.50	0	102%	38	135	0			
Phorate	2.298	1.0	2.50	0	91.9%	39	146	0			
Demeton-S	2.488	2.0	2.50	0	99.5%	30	137	0			
Diazinon	2.630	0.50	2.50	0	105%	42	132	0			
Disulfoton	2.462	0.50	2.50	0	98.5%	37	139	0			
Dimethoate	2.606	2.0	2.50	0	104%	17	134	0			
Ronnel	2.540	0.50	2.50	0	102%	32	172	0			
Methyl Parathion	1.860	0.50	2.50	0	74.4%	27	141	0			
Chlorpyrifos	2.567	0.50	2.50	0	103%	37	150	0			
Malathion	2.566	0.50	2.50	0	103%	48	139	0			
Parathion	2.054	0.50	2.50	0	82.1%	28	152	0			
Fenthion	2.615	0.50	2.50	0	105%	37	137	0			
Tetrachlorvinphos	2.215	0.50	2.50	0	88.6%	44	135	0			
Ethion	5.095	0.50	5.00	0	102%	51	128	0			
Fensulfothion	2.699	1.0	2.50	0	108%	20	138	0			
Azinphos	2.958	2.5	2.50	0	118%	38	146	0			
Coumaphos	2.690	2.5	2.50	0	108%	39	143	0			
Surrogate: Triphenylphosphate	4.91	0.10	5.00	0	98.1%	30	137	0			

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: Cash Customer
Work Order: 1311283
Project: Dows Prairie Wetland

QC SUMMARY REPORT

Laboratory Control Spike Duplicate

Sample ID: **LCSD-29891** Batch ID: **29891** Test Code: **8140S** Units: **mg/kg** Analysis Date **11/28/2013 3:55:51 AM** Prep Date: **11/26/2013**

Client ID: Run ID: **ORGC13_131127A** SeqNo: **1111285**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Dichlorvos	6.988	0.50	2.50	0	280%	46	145	7.40	5.67%	30	S
Mevinphos	3.058	1.0	2.50	0	122%	32	131	3.22	5.03%	30	
Ethoprophos	2.535	1.0	2.50	0	101%	38	135	2.56	0.843%	30	
Phorate	2.173	1.0	2.50	0	86.9%	39	146	2.30	5.59%	30	
Demeton-S	2.376	2.0	2.50	0	95.0%	30	137	2.49	4.59%	30	
Diazinon	2.485	0.50	2.50	0	99.4%	42	132	2.63	5.67%	30	
Disulfoton	2.284	0.50	2.50	0	91.3%	37	139	2.46	7.51%	30	
Dimethoate	2.290	2.0	2.50	0	91.6%	17	134	2.61	12.9%	30	
Ronnel	2.396	0.50	2.50	0	95.8%	32	172	2.54	5.84%	30	
Methyl Parathion	1.671	0.50	2.50	0	66.8%	27	141	1.86	10.7%	30	
Chlorpyrifos	2.306	0.50	2.50	0	92.2%	37	150	2.57	10.7%	30	
Malathion	2.162	0.50	2.50	0	86.5%	48	139	2.57	17.1%	30	
Parathion	1.459	0.50	2.50	0	58.4%	28	152	2.05	33.8%	30	R
Fenthion	2.440	0.50	2.50	0	97.6%	37	137	2.62	6.93%	30	
Tetrachlorvinphos	2.158	0.50	2.50	0	86.3%	44	135	2.22	2.62%	30	
Ethion	4.947	0.50	5.00	0	98.9%	51	128	5.10	2.96%	30	
Fensulfothion	2.738	1.0	2.50	0	110%	20	138	2.70	1.44%	30	
Azinphos	2.886	2.5	2.50	0	115%	38	146	2.96	2.47%	30	
Coumaphos	2.598	2.5	2.50	0	104%	39	143	2.69	3.48%	30	
Surrogate: Triphenylphosphate	4.61	0.10	5.00	0	92.3%	30	137	4.91	6.15%	30	

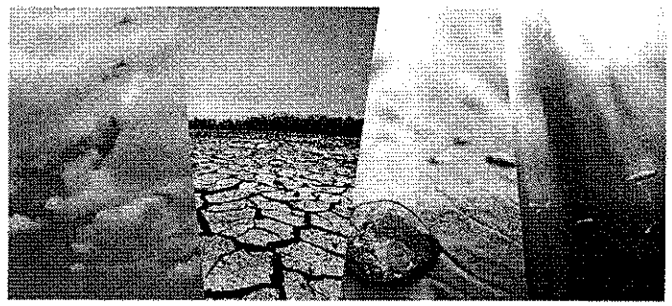
Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits

Calscience Environmental Laboratories, Inc.

CALSCIENCE

WORK ORDER NUMBER: 13-11-1660

The difference is service



AIR | SOIL | WATER | MARINE CHEMISTRY

Analytical Report For

Client: North Coast Laboratories, Ltd.

Client Project Name: 1311283

Attention: Trudie Blasi
5680 West End Road
Arcata, CA 95521-9202

Approved for release on 12/02/2013 by:
Don Burley
Project Manager

ResultLink ▸

Email your PM ▸

Calscience Environmental Laboratories, Inc.

Contents

Client Project Name: 1311283
Work Order Number: 13-11-1660

Calscience Environmental Laboratories, Inc.

Work Order Narrative

Condition Upon Receipt:

Samples were received under Chain of Custody (COC) on 11/21/13. They were assigned to Work Order 13-11-1660.

Unless otherwise noted on the Sample Receiving forms all samples were received in good condition and within the recommended EPA temperature criteria for the methods noted on the COC. The COC and Sample Receiving Documents are integral elements of the analytical report and are presented at the back of the report.

Holding Times:

All samples were analyzed within prescribed holding times (HT) and/or in accordance with the Calscience Sample Acceptance Policy unless otherwise noted in the analytical report and/or comprehensive case narrative, if required.

Any parameter identified in 40CFR Part 136.3 Table II that is designated as "analyze immediately" with a holding time of <= 15 minutes (40CFR-136.3 Table II, footnote 4), is considered a "field" test and the reported results will be qualified as being received outside of the stated holding time unless received at the laboratory within 15 minutes of the collection time.

Quality Control:

All quality control parameters (QC) were within established control limits except where noted in the QC summary forms or described further within this report.

Additional Comments:

Air - Sorbent-extracted air methods (EPA TO-4A, EPA TO-10, EPA TO-13A, EPA TO-17): Analytical results are converted from mass/sample basis to mass/volume basis using client-supplied air volumes.

New York NELAP air certification does not certify for all reported methods and analytes, reference the accredited items here: http://www.calscience.com/PDF/New_York.pdf

Solid - Unless otherwise indicated, solid sample data is reported on a wet weight basis, not corrected for % moisture. All QC results are always reported on a wet weight basis.

Subcontractor Information:

Unless otherwise noted below (or on the subcontract form), no samples were subcontracted.

7440 Lincoln Way, Garden Grove, CA 92841-1427 • TEL: (714) 895-5494 • FAX: (714) 894-7501

Calscience Environmental Laboratories, Inc.

Sample Summary

Client:	North Coast Laboratories, Ltd.	Work Order:	13-11-1660
	5680 West End Road	Project Name:	1311283
	Arcata, CA 95521-9202	PO Number:	
		Date/Time Received:	11/21/13 09:15
		Number of Containers:	1
Attn:	Trudie Blasi		

Sample Identification	Lab Number	Collection Date and Time	Number of Containers	Matrix
1311283-01A / Wetland Site 1	13-11-1660-1	11/18/13 16:00	1	Solid

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Calscience Environmental Laboratories, Inc.

Analytical Report

North Coast Laboratories, Ltd.		Date Received:	11/21/13
5680 West End Road		Work Order:	13-11-1660
Arcata, CA 95521-9202		Preparation:	N/A
		Method:	EPA 1664A (M)
		Units:	mg/kg
Project: 1311283			Page 1 of 1

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
1311283-01A / Wetland Site 1	**13-11-1660-1-A**	**11/18/13 16:00**	**Solid**	**N/A**	**12/02/13**	**12/02/13 13:30**	**D1202HEML1**

Parameter	Result	RL	DF	Qualifiers
HEM: Oil and Grease	560	10	1	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-12-040-431**	**N/A**	**Solid**	**N/A**	**12/02/13**	**12/02/13 13:30**	**D1202HEML1**

Parameter	Result	RL	DF	Qualifiers
HEM: Oil and Grease	ND	10	1	

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RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCSD

North Coast Laboratories, Ltd.
5680 West End Road
Arcata, CA 95521-9202

Date Received: 11/21/13
Work Order: 13-11-1660
Preparation: N/A
Method: EPA 1664A (M)

Project: 1311283

Page 1 of 1

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-12-040-431	Solid	N/A	12/02/13	12/02/13 13:30	D1202HEML1

Parameter	Spike Added	LCS Conc.	LCS %Rec.	LCSD Conc.	LCSD %Rec.	%Rec. CL	RPD	RPD CL	Qualifiers
HEM: Oil and Grease	40.00	43.30	108	40.00	100	64-132	8	0-34	

RPD: Relative Percent Difference. CL: Control Limits

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Calscience Environmental Laboratories, Inc.

Sample Analysis Summary Report

Work Order: 13-11-1660

Method	Extraction	Chemist ID	Instrument	Analytical Location
EPA 1664A (M)	N/A	691	N/A	1

Location 1: 7440 Lincoln Way, Garden Grove, CA 92841

Calscience Environmental Laboratories, Inc.

Glossary of Terms and Qualifiers

Work Order: 13-11-1660 Page 1 of 1

Qualifiers	Definition
*	See applicable analysis comment.
<	Less than the indicated value.
>	Greater than the indicated value.
1	Surrogate compound recovery was out of control due to a required sample dilution. Therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike (MS) or Matrix Spike Duplicate (MSD) compound was out of control due to suspected matrix interference. The associated LCS recovery was in control.
4	The MS/MSD RPD was out of control due to suspected matrix interference.
5	The PDS/PDSD or PES/PESD associated with this batch of samples was out of control due to suspected matrix interference.
6	Surrogate recovery below the acceptance limit.
7	Surrogate recovery above the acceptance limit.
B	Analyte was present in the associated method blank.
BU	Sample analyzed after holding time expired.
BV	Sample received after holding time expired.
E	Concentration exceeds the calibration range.
ET	Sample was extracted past end of recommended max. holding time.
HD	The chromatographic pattern was inconsistent with the profile of the reference fuel standard.
HDH	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but heavier hydrocarbons were also present (or detected).
HDL	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but lighter hydrocarbons were also present (or detected).
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
JA	Analyte positively identified but quantitation is an estimate.
ME	LCS Recovery Percentage is within Marginal Exceedance (ME) Control Limit range (+/- 4 SD from the mean).
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
SG	The sample extract was subjected to Silica Gel treatment prior to analysis.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.

Solid - Unless otherwise indicated, solid sample data is reported on a wet weight basis, not corrected for % moisture. All QC results are reported on a wet weight basis.

Any parameter identified in 40CFR Part 136.3 Table II that is designated as "analyze immediately" with a holding time of <= 15 minutes (40CFR-136.3 Table II, footnote 4), is considered a "field" test and the reported results will be qualified as being received outside of the stated holding time unless received at the laboratory within 15 minutes of the collection time.

A calculated total result (Example: Total Pesticides) is the summation of each component concentration and/or, if "J" flags are reported, estimated concentration. Component concentrations showing not detected (ND) are summed into the calculated total result as zero concentrations.

NORTH COAST LABORATORIES LTD.

Sub-Contract Chain of Custody Record

Date Shipped: 11/19/2013
PO #: 1311283

13-11-1660

Subcontractor: Calscience Enironmental Labs
7440 Lincoln Way
Garden Grove, CA 92841

Attn: SAMPLE RECEIVING 714 895-5494

Send Results to: North Coast Labs
5680 West End Road
Arcata, CA 95521
(707) 822-4649

Attn: Trudie Biasi, tblasi@northcoastlabs.com

NCL Sample # / Sample ID	Collection Date / Bottle	Matrix	State Form System / Source	Sampler / Employer	Analysis / Remarks
1 **1311283-01A** Wetland Site 1	11/18/2013 04:00 pm 8-oz soil jar	Soil			Subcontracted Analysis GREASE and OIL

		Date/Time			Date/Time
Relinquished by:	[signature]	11/19/13 1100	**Received by:**		
Relinquished by:			**Received by:** (GSO)	[signature]	11/21/13 0915

Special Instructions: Please include NCL Sample #, Sample ID, and QC data on all analytical work; include PO # on invoice.

Return to Contents

GSO GOLDEN STATE OVERNIGHT

< WebShip > > > > >

800-322-5555 www.gso.com

(1660)

Ship From:
SAMPLE CONTROL
NORTH COAST LABORATORIES
5680 WEST END RD
ARCATA, CA 95521

Ship To:
SAMPLE RECEIVING
CALSCIENCE ENVIRONMENTAL LABS
7440 LINCOLN WAY
GARDEN GROVE, CA 92841

COD:
$0.00

Reference:

Delivery Instructions:

Signature Type:
SIGNATURE REQUIRED

Tracking #: 523257145

PDS

ORC A

GARDEN GROVE

D92841A

18315250

Print Date : 11/19/13 09:54 AM

1 of 1

Send Label To Printer | Print All | Edit Shipment | Finish

LABEL INSTRUCTIONS:

Do not copy or reprint this label for additional shipments - each package must have a unique barcode.

STEP 1 - Use the "Send Label to Printer" button on this page to print the shipping label on a laser or inkjet printer.

STEP 2 - Fold this page in half.

STEP 3 - Securely attach this label to your package, do not cover the barcode.

STEP 4 - Request an on-call pickup for your package, if you do not have scheduled daily pickup service or Drop-off your package at the nearest GSO drop box. Locate nearest GSO dropbox locations using this link.

ADDITIONAL OPTIONS:

Send Label Via Email | Create Return Label

TERMS AND CONDITIONS:

By giving us your shipment to deliver, you agree to all the service terms and conditions described in this section. Our liability for loss or damage to any package is limited to your actual damages or $100 whichever is less, unless you pay for and declare a higher authorized value. If you declare a higher value and pay the additional charge, our liability will be the lesser of your declared value or the actual value of your loss or damage. In any event, we will not be liable for any damage, whether direct, incidental, special or consequential, in excess of the declared value of a shipment whether or not we had knowledge that such damage might be incurred including but not limited to loss of income or profit. We will not be liable for your acts or omissions, including but not limited to improper or insufficient packaging, securing, marking or addressing. Also, we will not be liable if you or the recipient violates any of the terms of our agreement. We will not be liable for loss, damage or delay caused by events we cannot control, including but not limited to acts of God, perils of the air, weather conditions, act of public enemies, war, strikes, or civil commotion. The highest declared value for our GSO Priority Letter or GSO Priority Package is $500. For other shipments the highest declared value is $10,000 unless your package contains items of "extraordinary value", in which case the highest declared value we allow is $500. Items of "extraordinary value" include, but or not limited to, artwork, jewelry, furs, precious metals, tickets, negotiable instruments and other items with intrinsic value.

Calscience Environmental Laboratories, Inc.

WORK ORDER #: 13-11-1660

SAMPLE RECEIPT FORM

Cooler 1 of 1

CLIENT: NCL

DATE: 11/21/13

TEMPERATURE: Thermometer ID: SC2 (Criteria: 0.0 °C – 6.0 °C, not frozen except sediment/tissue)

Temperature 2.9 °C - 0.2 °C (CF) = 2.7 °C ☐ Blank ☑ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by: ________).

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling.

☐ **Received at ambient temperature, placed on ice for transport by Courier.**

Ambient Temperature: ☐ Air ☐ Filter

Checked by: 836

CUSTODY SEALS INTACT:

☐ Cooler	☐ ________	☐ No (Not Intact)	☑ Not Present	☐ N/A	Checked by: 836
☐ Sample	☐ ________	☐ No (Not Intact)	☑ Not Present		Checked by: 836

SAMPLE CONDITION:	Yes	No	N/A
Chain-Of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☐	☐
☐ Collection date/time, matrix, and/or # of containers logged in based on sample labels.			
☐ No analysis requested. ☐ Not relinquished. ☐ No date/time relinquished.			
Sampler's name indicated on COC	☐	☑	☐
Sample container label(s) consistent with COC	☑	☐	☐
Sample container(s) intact and good condition	☑	☐	☐
Proper containers and sufficient volume for analyses requested	☑	☐	☐
Analyses received within holding time	☑	☐	☐
Aqueous samples received within 15-minute holding time			
☐ pH ☐ Residual Chlorine ☐ Dissolved Sulfides ☐ Dissolved Oxygen	☐	☐	☑
Proper preservation noted on COC or sample container	☐	☐	☑
☐ Unpreserved vials received for Volatiles analysis			
Volatile analysis container(s) free of headspace	☐	☐	☑
Tedlar bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE:

Solid: ☐4ozCGJ ☑8ozCGJ ☐16ozCGJ ☐Sleeve (_____) ☐EnCores® ☐TerraCores® ☐________

Aqueous: ☐VOA ☐VOAh ☐VOAna₂ ☐125AGB ☐125AGBh ☐125AGBp ☐1AGB ☐1AGBna₂ ☐1AGBs ☐500AGB ☐500AGJ ☐500AGJs ☐250AGB ☐250CGB ☐250CGBs ☐1PB ☐1PBna ☐500PB ☐250PB ☐250PBn ☐125PB ☐125PBznna ☐100PJ ☐100PJna₂ ☐________ ☐________ ☐________

Air: ☐Tedlar® ☐Canister **Other:** ☐________ **Trip Blank Lot#:**__________ Labeled/Checked by: 836

Container: C: Clear A: Amber P: Plastic G: Glass J: Jar B: Bottle Z: Ziploc/Resealable Bag E: Envelope — Reviewed by: 774

Preservative: h: HCL n: HNO_3 na₂: $Na_2S_2O_3$ na: NaOH p: H_3PO_4 s: H_2SO_4 u: Ultra-pure znna: $ZnAc_2$+NaOH f: Filtered — Scanned by: 836

NORTH COAST LABORATORIES LTD.
5680 West End Road • Arcata • CA 95521-9202
707-822-4649 Fax 707-822-6831

Chain of Custody

P. ______ of ______

LABORATORY NUMBER: 1311283

Attention: Cooper Rodgers
Results & Invoice to: Cooper Rodgers
Address: 1060 K St.

Phone: 818-667-6657
Copies of Report to: Cbr33@humboldt.Edu
JI044@humboldt.edu
Sampler (Sign & Print): Cooper Rodgers C Rodgers

PROJECT INFORMATION

Project Number:
Project Name: Dows Prairie Wetland
Purchase Order Number:

LAB ID	SAMPLE ID	DATE	TIME	MATRIX*
	Wetland Site 1	11/18/13	4:00	Soil

ANALYSIS	CONTAINER	PRESERVATIVE
Oil and grease	Ziplock	
Organophosphate	Ziplock	
Carbamate + Urea	Ziplock	

TAT: ☐ STD (2-3 Wk) ☐ Other:
PRIOR AUTHORIZATION IS REQUIRED FOR RUSH SAMPLES.

REPORTING REQUIREMENTS:
☐ State Forms
☐ Geotracker ☐ SWAMP ☐ Other EDD:
☐ Final Report PDF ☐ FAX By:

CONTAINER CODES: 1—½ gal. pl; 2—250 ml pl; 3—500 ml pl; 4—1 L Nalgene; 5—250 ml BG; 6—500 ml BG; 7—1 L BG; 8—40 ml VOA; 9—60 ml VOA; 10—125 ml VOA; 11—4 oz glass jar; 12—8 oz glass jar; 13—brass tube; 14—other
PRESERVATIVE CODES: a—HNO_3; b—HCl; c—H_2SO_4; d—$Na_2S_2O_3$; e—NaOH; f—$C_2H_3O_2Cl$; g—other

SPECIAL INSTRUCTIONS	SAMPLE CONDITION
Paid w/check 1137 $398.00	Temperature 16.6 C
	Received On Ice? Y / (N)
	Samples Intact? (Y) / N
	Preserved? Y / (N)
	Preserved @ NCL? Y / N / (NA)

RELINQUISHED BY (Sign & Print)	DATE/TIME	RECEIVED BY (Sign)	DATE/TIME
C Rodgers	11/19/13	[signature]	11/19/13 1036

SAMPLE DISPOSAL
☐ NCL Disposal of Non-Contaminated
☐ Return ☐ Pickup

CHAIN OF CUSTODY SEALS Y/N/NA
SHIPPED VIA: UPS Fed-Ex (Hand)

***MATRIX:** DW=Drinking Water; Eff=Effluent; Inf=Influent; SW=Surface Water; GW=Ground Water; WW=Waste Water; S=Soil; O=Other.

ALL CONTAMINATED NON-AQUEOUS SAMPLES WILL BE RETURNED TO CLIENT