Laboratory Studies on Trophic Effects and Fish Health

May, 1996

Prepared for:

Suncor Inc.

952-2307

This report is one of a series of reports prepared for Suncor Inc. Oil Sands Group for the Environmental Impact Assessment for the development and operation of the Steepbank Mine, north of Fort McMurray, Alberta. These reports provided information and analysis in support of Suncor's application to the Alberta Energy Utilities Board and Alberta Environmental Protection to develop and operate the Steepbank Mine, and associated reclamation of the current mine (Lease 86/17) with Consolidated Tailings technology.

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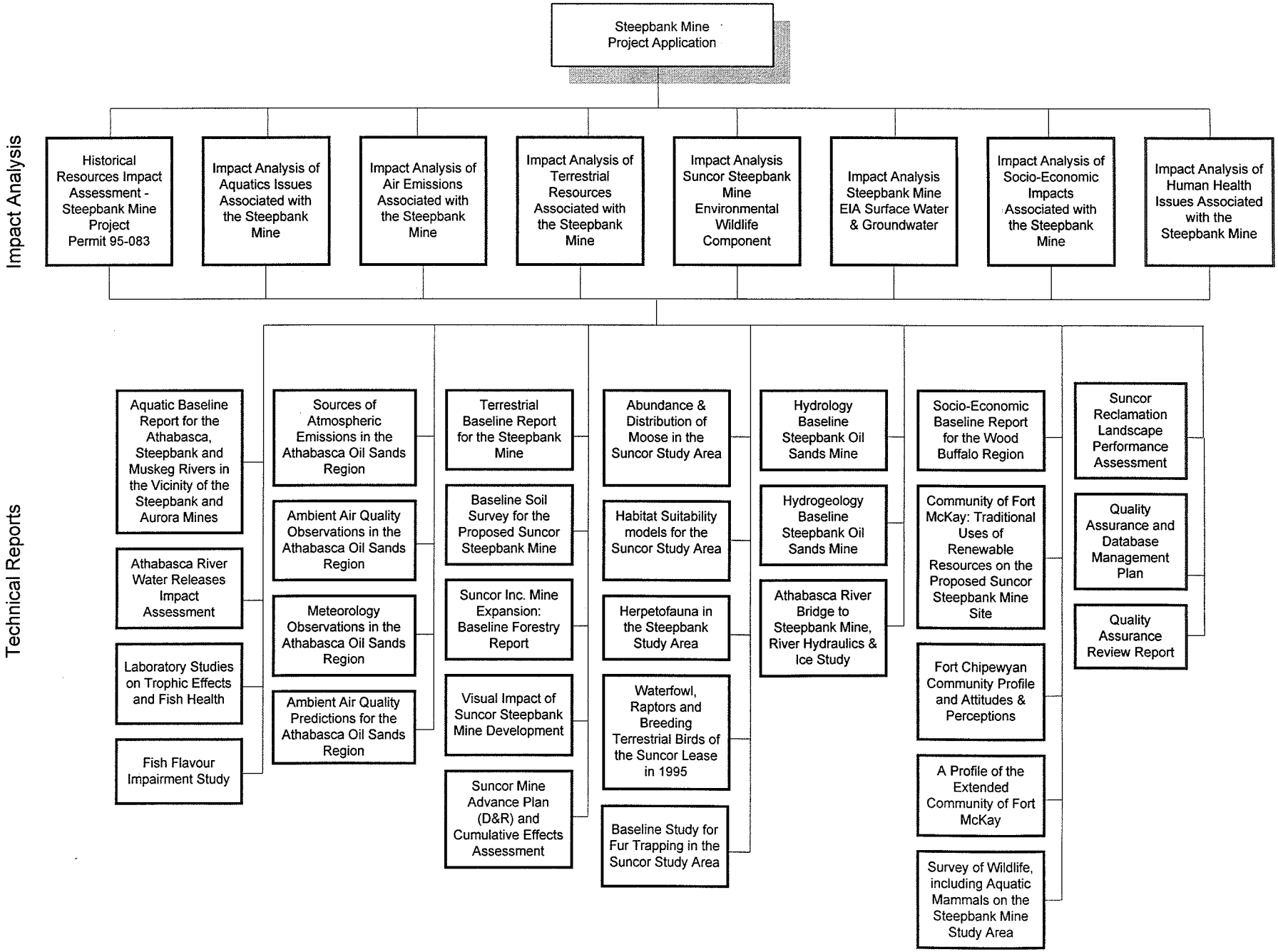

Reports Prepared for the Steepbank Mine Environmental Assessment

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LABORATORY STUDIES ON TROPHIC LEVEL EFFECTS AND FISH HEALTH EFFECTS OF SUNCOR TAR ISLAND DYKE WASTEWATER

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LABORATORY INVESTIGATIONS ON SUNCOR TAR ISLAND DYKE WASTEWATERS

EXECUTIVE SUMMARY

Laboratory studies were conducted on Suncor Tar Island Dyke wastewater and Athabasca River water to:

- assess effects on major trophic components of aquatic ecosystems,
- assess effects on the general condition and health of fish, and
- relate chemical characteristics to measured responses.

Trophic level effects were assessed with a battery of acute and chronic Environment Canada Test Methods with species representative of major trophic levels in aquatic systems. The test battery included a microbe, plant, invertebrates and fish. Three samples of Tar Island Dyke water and Athabasca River water were tested over a three month period. The samples were not toxic to algae and *Daphnia*. Tar Island Dyke water was moderately lethal to fish, inhibited bacterial luminescence and affected reproduction in *Ceriodaphnia*. Athabasca River water was marginally toxic to fish and inhibited reproduction in *Ceriodaphnia*. The toxicity measured in the trophic level effects tests was considered moderate, as opposed to extreme, and with dilution Tar Island Dyke water will have little or no impact on major trophic components of aquatic ecosystems.

Fish condition and health are recognized indicators of ecosystem conditions and overall health. Fish health effects were assessed by exposing fish to a range of Tar Island Dyke concentrations and Athabasca River water under controlled laboratory conditions for periods of 7 and 28 days (two tests). Positive and negative controls were included in the experimental design. Fish health effects were assessed based on a number of observations and biomarkers including a thorough internal and external examination, measurment of selected blood parameters (lactate, hemoglobin, glucose, protein, hematocrit), histopathological assessment of selected tissues and organs, and analysis of liver mixed function oxidase activity.

Challenge tests were conducted on fry reared in each treatment for 28 days and included disease resistance, swimming stamina, and growth. No growth effects were noted although the fish in Athabasca River water were larger overall (grew better). However, the fish and fry exposed to β-naphthoflavone were less able to resist the pathogen, *Vibrio anguillarum* and had less overall swimming endurance.

Short and long term exposures to Tar Island Dyke water and Athabasca River water had little to no effect on all external and internal morphological and anatomical characteristics assessed. There were some slight changes in blood and plasma constituents associated with the conditions that were visibly stressful to the fish (10% Tar Island Dyke and naphthenic acids in the 28 day test, and 50% Tar Island Dyke water in the 7 day test). However, these differences and observations of fish condition did not indicate a potential for longer term, chronic impairment of fish health.

Mixed function oxidase activity in fish livers were measured by Dr. J. Parrott of the National Water Research Institute and EnviroTest Laboratories (split samples from the 28 day test). Semipermeable membrane devices (SPMD) were deployed in each tank (7 and 28 day tests). Extracts were tested with hepatic cell cultures for MFO induction by Dr. J. Parrott.

Levels of mixed function oxidase activity were induced in livers from fish exposed to β-naphthoflavone and 10% Tar Island Dyke, relative to the Athabasca River (28 day test). Very little induction was noted after the 7 day exposure. (results for fish livers from the 28 day test and the SPMD extracts were not available at the time of writing).

A histopathological assessment of the fish from the 28 day test exposed to Athabasca River, 10% Tar Island Dyke and naphthenic acids was done by Dr. C. Rousseaux and Dr. R. Muller. The pathology observed in the 10% Tar Island Dyke and naphthenic acids was consistent with but not diagnostic of toxicity. No conclusions were made on the condition of fish exposed to Athabasca River water.

These findings support the conclusion that with moderate dilution, Tar Island Dyke water will have little to no sublethal, chronic effects on fish health and condition.

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1.0 INTRODUCTION

A detailed understanding of the effects of release and discharge waters on major trophic levels in aquatic systems (i.e. algae, zooplankton and fish) is essential in gaining regulatory approval for the expansion of Suncor's Oil Sands Operation in Northern Alberta. The best method for assessing potential impacts is through a combination of field, laboratory and applied modeling studies. A major emphasis is placed on fish because of their position at the top of the food chain in aquatic systems. As such, they are generally considered excellent indicators of ecosystem health.

Biotic and abiotic factors can, indirectly and directly, individually and collectively be stressful to fish. Physiological stress diverts energy from other critical functions and can have a longer term effect on the general health and condition of the individual and in turn populations. No single parameter can be used to assess the general health and condition of fish. However, morphological and anatomical observations and measurements are extremely useful for derivation of health condition indices. Changes in these characteristics are often a result of longer term changes in biochemical and physiological processes.

Very few studies have unequivocally linked an environmental stressor on a molecular basis to longer term, higher level changes in morphological and anatomical characteristics, organism survival, population and ecosystem effects. This is a result of the complexity, interconnectiveness, and redundancy of biochemical and physiological process, in living organisms, and how these processes respond to changing environmental conditions (ecosystem structure and function).

The objective of the field study was to measure and document existing conditions around Suncor's operation with emphasis being placed on fish populations. The laboratory studies focused on 1) quantifying potential ecosystem effects through a battery of acute and chronic tests with species representative of major trophic levels in aquatic systems, and 2) assessment of fish health effects. The later was done by exposing fish to Suncor wastewater under controlled laboratory conditions. Information

from the laboratory exposures on potential stressors affecting fish health may also be used to verify field observations.

Results from both the field and laboratory studies were integrated through fate and effects simulation models.

The field and modeling studies will be reported elsewhere. This document covers laboratory investigations conducted on Suncor, Tar Island Dyke water and Athabasca River water. The objectives of the laboratory study reported were to:

- assess acute and chronic effects on species representative of major trophic levels in freshwater systems,
- assess sublethal effects on fish health and monitor selective biochemical and physiological responses, and
- provide a chemical characterization of the wastewater.

Trophic level effects were assessed using a test battery consisting of a microbe, plant, invertebrate, and fish. All major trophic levels were represented with the test battery. Plants convert chemical energy and light into biomass and they serve as a major food source for invertebrates and some fish. The invertebrates convert plant matter and detritus into biomass and they are a major food source for fish. Effects detected at each level could indicate potential impacts on receiving water ecosystem structure and function. However, the results must be interpreted in the context of site specific conditions.

The test battery applied to the Suncor wastewaters incorporated standard test methods developed by Environment Canada for assessment of acute or chronic toxicity in freshwater. The acute tests included:

- bacterial luminescence (*Vibrio fischeri*)
- survival of the crustacean, *Daphnia magna*
- survival of rainbow trout, *Oncorhynchus mykiss*

The chronic tests were:

- algal growth inhibition with *Selenastrum capricornutum*
- survival and reproduction in the crustacean, *Ceriodaphnia dubia*
- survival and growth of larval fathead minnows, *Pimephales promelas*

Acute effects are measured over relatively short time periods compared to the life span of the test organism (usually a time period less than 10% of the life span). Lethality is often measured as an endpoint in acute tests. Sublethal, chronic effects are manifested over longer exposure periods and can include developmental effects, growth and reproduction along with various other biochemical, physiological, behavioral, and genetic endpoints. The test battery was applied to each wastewater collected for the 7 and 28 day tests, along with all batches of Athabasca River water.

The sublethal, chronic effects on fish were assessed based on physiological, biochemical and health related indices. Short term biochemical and physiological responses can lead to longer term changes in anatomical and morphological characteristics. Health effect indicators incorporated in the study design included both short term responses and longer term effects on the organism. The short term response indicators were changes in liver mixed function oxidase activity, and levels of plasma glucose, protein and lactic acid. Longer term effects were assessed through and internal and external examination of exposed fish, changes in organ characteristics, tissue moisture contents, hematocrit and hemoglobin levels, differential cell counts and challenge test with larval fry (growth, disease resistance, and swimming stamina).

Analysis of MFO induction in the trout and walleye, and with extracts of the SPMD's (see below) were done by Dr. J. Parrott of the National Water Research Institute (NWRI), Burlington. Liver samples for MFO analysis were also sent to EnviroTest Laboratories for quality assurance purposes. Tissue samples of juvenile walleye and trout from the 28 day test were sent to Dr. C. Rousseaux for histopathological

assessment. Although these reports and data are included here, it is beyond the scope of this study to interpret third party results.

The final component of the study was a chemical characterization of the wastewaters. Samples were submitted to EnviroTest Laboratories Ltd. and Chemex Laboratories Ltd. for analysis of Oil Sands related target compounds. These data were required for interpretation of the biological response data.

An additional component of the characterization was the inclusion of semipermeable membrane devices in the experimental design (SPMD; Environmental Sampling Technologies, St. Joseph, MI). The device is a semipermeable membrane similar to dialysis tubing, roughly 25 mm wide and one meter long containing one gram of purified lipid material. The lipid material passively accumulates fat soluble substances; the final concentration or partitioning is determined by the solubility of the material. In a flow through test, accumulation of material is limited by the capacity of the lipid since the test solutions are continuously renewed. The SPMD provides an indication of potential bioaccumulable materials. Uptake is the first step in response initiation and a comparison of the type and amounts of materials accumulated in the SPMDs with tissue residues will help in assessment of measured short and long term health effects.

The overall study design included both short and long term exposures. The short term exposure was done over a 7 day period. The full battery of acute and chronic trophic level tests were conducted on the samples. Fish health effects were done on three sizes of trout, (5 to 10 g and 50 to 100g) juvenile trout, and larval sac fry and walleye (5 to 10 g) exposed to a broad range of wastewater concentrations (0.1%, 1%, 10%, and 50%), Athabasca River water, laboratory dilution water (negative control) and two positive controls (naphthenic acids and β-naphthoflavone or BNF). Semipermeable membrane devices were also included in the study design. The complete suite of fish health condition factors were examined at the end of the 7 day exposure. Challenge tests on the larval trout were, however, not done because the period of exposure was too short to obtain meaningful results (growth, swimming stamina and disease resistance).

The long term test (28 days) involved the same basic design. However, the number of walleye per treatment was increased from 3 to 10 and smaller juvenile trout (5 - 10 g) were omitted. The trophic effects tests and all components of the fish health effects were included in the 28 day study. Further, the 50% Tar Island Dyke treatment was replaced with a 0.01% treatment because 50% was acutely lethal to fish and the emphasis of the study was on sublethal, chronic effects.

The report is divided into four major sections dealing with Quality Assurance, Methods, Results and Discussion, and Conclusions and Recommendations. Each section is then divided into, trophic level testing, fish health effects and chemical analyses. Work completed by other agencies and individuals was incorporated into the appropriate sections and or appended.

2.0 QUALITY ASSURANCE

A Quality Assurance Plan was developed for the laboratory investigations and covered all aspects of every test from collection and receipt of sample to analyses of test data. The objective of the Plan was to ensure that test data met predefined performance standards. This was accomplished through a continuous review and update of methods, practices and policies. Control practices measure performance and allow independent assessment of quality assurance.

Components of the QAP developed for the laboratory investigations were:

- detailed methods document
- chain of custody forms
- in-life audits
- independent review and verification of data

The method document contains Standard Operating Procedures (SOP) for conducting each element of the laboratory investigation. This can include formal HydroQual SOP's

for routine tests and procedures, copies of standard test methods, generic methods, references and notes. It was a working document, subject to continual review and revision depending on study needs. There were also specific Quality Assurance practices built into each method (summarized in Table 1).

A complete paper trail was kept on all samples and biological materials. This covered the initial collection, holding and final disposal of water and test organisms. In some cases, tissues were forwarded to third parties for analysis and inspection. Chain of custody and shipping documents covering all movements were logged and archived.

In-life audits were conducted during both the short and long term tests. These were designed to insure that data collection procedures were being followed and that data quality objectives were being met. Data reviews were also conducted after test termination and all data was independently checked and verified.

3.0 TEST METHODS

Two tests were done on Tar Island Dyke and Athabasca River water. The short term, 7 day test was initiated on 95/08/30 and terminated on 95/09/07. All assessments of fish health and related parameters except differential blood cell counts and the challenge tests were completed on the exposed fish. Two sizes of juvenile trout (5- 10 g and 50 - 100 g), larval trout, and juvenile walleye (5-10 g) were used . Walleye were included in the test design because they were identified as an important native species in the Athabasca River.

The main objective of the 7 day test was to define optimal exposure conditions for the 28 day test. The range of test treatments extended from acute lethality to a level believed below the concentration that would have any measurable effect on aquatic life (NOEC). Positive and negative controls were also included in the study design. The positive controls were β-naphthoflavone (BNF) and naphthenic acids (1 mg/L). The β-naphthoflavone was injected into the peritoneal cavity at the commencement of the test

at an approximate dose of 10 μg/g fish. The naphthenic acids were administered in solution through a peristaltic pump (constant flow).

The conditions and procedures in the 28 day test were the same as the 7 day test with the following exceptions:

- differential blood cell counts were made on blood from the large trout
- challenge tests were conducted on the exposed larval fry
- 10 g trout were not included
- the 50% Tar Island Dyke treatment was replaced with 0.01%

The methods section is divided into four parts dealing with each major study component and includes sample collection, trophic effects testing, fish health effects assessment, and chemical characterization.

3.1 Sample Collection, Storage, and Disposal

Sample collection dates and trophic test summaries are presented in Table 2. Tar Island Dyke water was the Suncor wastewater selected for the initial testing. This is water that seeps through the sand dyke holding tailings from the mining operation. It is collected in two physically separate areas and required compositing of the sample for testing.

The quality of the Tar Island Dyke wastewater can vary over time and it was important to obtain a representative sample. For this reason, smaller samples were tested before collection of the larger volume for the flow through test. This was to help establish upper treatment levels, confirm toxicity, and to determine volume requirements. Less volume would be required for more toxic samples and the emphasis was on sublethal rather than acute effects.

One trip was made to collect the large sample of Tar Island Dyke and Athabasca River water for the 7 day test; two trips were required for the 28 day test. The samples were

collected in 2 or 5 m^3 polyethylene tanks. The tanks were shipped on a flatbed trailer by Bear Trucking Ltd. and the samples were received at HydroQual Laboratories Ltd. within 12 hours of collection. The samples were pumped immediately into polyethylene holding tanks located in the facility and stored under ambient conditions until used (Figure 1).

The tanks were precleaned before collection of the samples with Sparkleen followed by numerous rinses with laboratory dilution water. The tanks were not rinsed with an organic solvent. Each tank was labeled and specifically used for only one type of sample. The pumps and hose were thoroughly rinsed after each set of samples. The Athabasca River water was downloaded first, followed by the Tar Island Dyke sample. The pump and hose were completely drained after pumping the river water to minimize carryover.

During the test and at test termination all sample was discharged to sewer with dilution in compliance with the City of Calgary By-laws.

3.2 Trophic Level Testing

A battery of acute and chronic tests were run on each sample of Tar Island Dyke and Athabasca River water. The test organisms were species representative of major trophic levels in aquatic systems and included microbes, plants, invertebrates, and vertebrates. Two levels of testing were done; screening and definitive. Screening tests were done on the undiluted sample and they provided some indication as to whether the sample was toxic or not. The definitive tests included five or more treatment levels plus a control. These tests provide a measure of the intensity or potency of sample toxicity.

All trophic level tests were done according to established Environment Canada Test Methods all validity criteria were met (summarized in Table 3). Test validity criteria are performance standards for the acceptance of test data and results (Quality Control

program). Reference toxicants tests were run with each test monthly or more frequently (Table 4).

All endpoints were determined using computer programs and standard methods recommended by Environment Canada. The test concentration causing a 25 and 50% change in the response variable were calculated with the method appropriate to the data (Probit, binomial, Bootstrap, Logit, interpolation, etc.). The dose or response variables included lethality (LCx), inhibition (ICx), and effective concentrations (ECx).

The no observed and lowest observed effect concentrations (NOEC and LOEC) were also determined for all tests except bacterial luminescence. The NOEC and LOEC were obtained with the computer program TOXSTAT (Ver 3.4; West Inc. and Gulley, 1994). The statistical method was selected based on the distribution and variance of the data.

The test data, quality assurance information, endpoints and all statistical procedures were documented in the test reports.

3.3 Fish Health Effects

Fish health effects were assessed based on a number of biochemical and physiological measurements, and internal and external observations on selected features and characteristics, and challenge tests, along with survival and behavioral observations. All effects have a molecular basis which is manifested into biochemical, physiological and organismic level responses. Measurements at different levels provide greater insight into the chemical or physical nature of the stress. No single parameter can provide comprehensive information on the general health and condition of an organism exposed to environmental stress. Hence, a number of parameters (biomarkers) must be interpreted collectively.

Large trout were incorporated into the 7 day and 28 day tests to permit sampling and analyses of blood. These fish and the smaller juvenile walleye were measured and

weighed, examined externally and internally (necropsy), their livers were removed and the tissue preserved for histopathological assessment (28 day test only). Muscle samples were also taken for residue analysis and dry weights.

Sac-fry exposed and grown to swim up in each treatment were used to assess growth, disease resistance and swimming stamina in a series of challenge tests. These are more generic measurements of fish condition that are largely affected by many biochemical and physiological processes.

The following test conditions were assessed:

- Laboratory control
- Athabasca River water (undiluted)
- Tar Island Dyke water (0.01%, 0.1%, 1.0%, 10%, and 50%)
- mg/L naphthenic acids
- β-naphthoflavone (10 μg/L)

The 50% Tar Island Dyke in laboratory dilution water was only included in the 7 day test because it was found acutely toxic and the focus of the study was on sublethal effects. This treatment was replaced with a 0.01% Tar Island Dyke treatment in the 28 day exposure.

β-naphthoflavone and naphthenic acids were incorporated into the study design as positive controls. β-naphthoflavone was injected into the peritoneal cavities of larger, juvenile trout in the 7 day test, at a dose rate of 10 μg per gram of fish. The β-naphthoflavone was solubilized and injected in a corn oil solution (controls were injected with corn oil alone). β-naphthoflavone was obtained from Aldrich Chemical Company Inc. (Lot No. 093103X). In the 28 day test, a solution of β-naphthoflavone in methanol was added daily to the tank to obtain a final nominal exposure concentration of 10 μg/L. This was the same procedure used by Dr. J. Parrott for induction of liver MFO in small trout.

The treatment level for naphthenic acids was set at 1 mg/L. In the short term exposure, a solution of naphthenic acids in tap water was metered into the treatment tank with dilution to obtain the final desired test concentration. Solutions had to be prepared fresh every one to two days. This method was changed in the 28 day exposure. A volume of a concentrated solution of naphthenic acids was added daily to achieve a 1 mg/L dose rate. The naphthenic acids salt was obtained from Syncrude Canada Ltd. and manufactured by Eastman Kodak Company (Lot No.B142134).

The fish exposure unit (FEU) is described first followed by details on each component of the fish health assessment.

3.3.1 Fish Exposure Unit (FEU)

The fish exposure unit consists of eight 200 L and eight 400 L glass aquaria fitted with standpipes to regulate water levels. A 20 L square acrylic container with a perforated bottom was held in place, half submerged on one side of the large tanks, to hold the fry (termed fry vessel).

The dilution water was dechlorinated City of Calgary water (chemical profile Table 5). Major physical and chemical parameters were similar to those for Athabasca River water.

A dilution water line was run from a 400 L header tank down along each set of eight test tanks and back to the header tank. A submersible pump connected to one end of the line was used to maintain a constant flow and back pressure. Above each tank, there was a line off the main dilution water loop fitted with an adjustable valve. Flow was directed into the fry vessel and then out through the side-wall mounted stand pipe. The stand pipes were connected with a flexible hose to a common drain.

The samples of Tar Island Dyke and Athabasca River water were delivered in a similar manner with submersible pumps connected to lines running around the treatment

tanks. Lines off the loop were fitted with adjustable valves for flow control. The sample and dilution water lines were connected in such a way as to facilitate complete mixing (dilution) of the influent streams before entering the tank.

Flows were measured with a calibrated flow meter and confirmed gravimetrically and volumetrically. Flow checks and adjustments were also done twice daily initially and then less frequently as required. Day to day variations in flow rates did not exceed 5%. Flow rates were adjusted to give two tank volume exchanges per day. Volume through puts were also confirmed from daily measurements of the amount of sample volume used (measured off of storage tanks).

All tanks were aerated at rates not exceeding 7.5 mL/min per liter of solution using oil free, compressed air. Two diaphragm pumps were dedicated to the FEU tanks (one pump for each set of eight tanks).

Dilution water temperature was regulated with a chiller unit on the header tank. The sample holding tanks were not fitted with chillers. Ambient conditions were close to the desired test temperature (15 ± 2^0C).

Overhead lighting was provided with cool-white fluorescent tubes with a sixteen hour light and eight hour dark photoperiod. Light intensity at the water surface was less than 400 lux. The entire FEU was in a specially constructed, elevated and insulated enclosure. Access was restricted and all attempts were made to minimize disruption throughout the tests. All activity was confined to one to two hours every morning and one hour in the late afternoon.

The basic layout of the FEU is illustrated in Figure 2. Photographs of the system and the fry vessel are shown in Figure 3.

3.3.2 Exposure and Monitoring

The walleye were obtained from the Fisheries Branch of Saskatchewan Environmental Resource Management with the assistance of R. J. Sanden. The fish were picked up from the Edenwold Walleye Rearing Ponds on July 20, 1995 and transported back to HydroQual Laboratories Ltd. on the same day. They were initially held in a small swimming pool equipped with an external filter. Salt was added to a final concentration of 0.2% as precaution against disease. Mortality dropped to <1% after 2 weeks holding time. The fish were fed daily a diet of fresh snapper or cod purchased from a local supermarket. The fillets were cut into small pieces for feeding (roughly 5 to 10% body weight per day). The water in the holding pool was changed weekly.

Juvenile trout (5 to 10 g and 50 to 100 g) were obtained from Bob Allen's Trout Farm, Calgary, located 15 km from the test facility. The fish were collected and transported by HydroQual staff. Fertilized eggs were obtained from Spring Valley Trout Farm in Langley, BC. The eggs were shipped by air to Calgary and maintained at 15^{0}C until needed. Both operations were certified as disease free.

The tests were initiated when the sac fry were about 7 - 14 days from swim up. The objective was to maximize exposure of the fish to the test samples over the non-feeding to swim up stages. Feeding at swim up is a critical stage of trout development.

In the short term test (7 day), the small juvenile trout and walleye (5 to 10 g) were separately confined in nets suspended in the surface layer of the larger tanks. Large trout were also placed into the tanks and the larval fry were confined to the fry vessels. Three fish of each species (juvenile trout and walleye) were placed in the nets, ten large trout were put into the tank proper and 300 larval fry were placed in the fry vessels. Water quality conditions were monitored daily to ensure that flow rates were sufficient to prevent fouling from food and waste.

For the long term exposure (28 day), the walleye were kept in the smaller tanks (200 L) and only larger trout were exposed in the 400 L tanks along with the larval fry.

The fish were placed into the system approximately one week before test initiation. Laboratory dilution water was passed through each tank and sample lines were closed off. Moribund fish or fish showing signs of stress from handling were removed. After one week, the tests were initiated with the addition of sample to achieve the desired test concentrations. A volume equal to the volume added was initially removed to maintain a constant tank volume. Hence, the desired test concentration was obtained within a matter of minutes. The flow rate was then adjusted to give the final desired treatment levels.

Semipermeable membrane devices (SPMD) were deployed in each tank. Only a few SPMD's were used in the short term exposure and these were placed on the tank bottom. In the 28 day test, the SPMD's were suspended in the center of the tank which made it easier to clean the tanks and observe the fish. The SPMD's were contained in double layered, black fiberglass screen tubes to reduce exposure to light and prevent consumption by the test fish.

Conductance, pH, dissolved oxygen, temperature, ammonia, and flows were measured daily in the morning. Flow checks and adjustments were also made in the late afternoon (early evening). All activity was confined to this time to minimize disturbance of the fish during the test. The fish were also fed and the tanks cleaned once daily. The trout were fed a ration of trout chow (pellets or starter chow for the fry) and the walleye were given fresh snapper or cod equal to roughly 5% of their body weight per day. Signs of stress or abnormal behavior were recorded. Survival was also scored and dead fish removed from the tanks. Dead fish were examined, measured and weighed, and then frozen (archived).

At test termination, the fish were processed following the procedure outlined in Figure 4. The large fish were bled, then euthanized with a sharp blow to the head, measured, weighed, examined, and tissues removed. The smaller trout and walleye were euthanized, measured, weighed, examined and tissues removed for analysis. The small fry were transferred to tanks with laboratory dilution water for later disease resistance, and stamina tests, and assessment of growth (challenge tests).

Details on assessment procedures, test and analytical methods, are given in the following sections.

3.3.3 Effects Assessment in Juvenile Trout and Walleye

Walleye and trout roughly 5 to 10 g were used in the 7 day test; however only the small walleye were included in the 28 day exposure. Large, juvenile trout (50 - 100 g) were used in both tests.

3.3.3.1 Necropsy

The health and condition of each exposed juvenile fish were assessed following the standardized autopsy procedure of Goede (1993). This is a systematic procedure for obtaining quantitative morphological data and information on the external and internal condition of the fish (parameters summarized in Table 6). Many of the morphological and anatomical characteristics assessed provided little relevant information due to the fish being hatchery reared and hence in good condition. Further, changes in some features required exposures longer than 28 days or more severe conditions. However, the full autopsy procedure was followed to obtain data comparable to that collected on field populations to permit resolution of potential subtle effects caused by exposure conditions.

3.3.3.2. Hematology

Blood samples were removed from the caudal veins of the larger trout before euthanizing the fish. The syringe (3 mL with 22 1/2 gauge needle) was heparinized immediately before use with a freshly prepared heparin solution (50,000 IU/mL; the syringe was filled and emptied to coat the inner barrel). The whole blood was processed as follows:

- one drop placed on each of three slides for blood smears and manual counts of white and red blood cells
- mL removed for hemoglobin analysis
- of the volume (≈1 mL) was placed into a microfuge tube for separation and analyses of plasma constituents
- two hematocrit tubes were filled and plugged with putty

The hematocrit tubes were spun at full speed for five minutes. The hematocrit (%) was read directly on the rotor. The buffy zone volume was also noted and recorded (<1%, 1% or >1%).

The microfuge tube with 1 mL of whole blood was centrifuged at high speed in a bench top centrifuge for 5 minutes. The plasma was then removed and placed into a second microfuge tube.

Protein, lactate and glucose levels were measured in the plasma and total hemoglobin in the whole blood. All results were expressed in mass units per 100 mL volume (blood or plasma). The analyses were done in 16 x 100 mm glass tubes which were read directly in a Milton Roy Spectronic Model 21 spectrophotometer. Ten to twenty percent of the samples tested were duplicates and a blank and standard were analyzed for every 10 to 15 samples. The reagents and standards were freshly prepared on the day required. All attempts were made to complete the analyses on the day of sample collection. The whole blood and plasma were then frozen (-20^{0}C) and archived.

Total hemoglobin was measured colormeterically at 540 nm following addition of Drabkin's solution (2.5 mL to 10μL of sample; Sigma Diagnostics, Procedure No. 525). The reagent quantitatively converts total hemoglobin to cyanmethemoglobin which absorbs at 540 nm. Sample values were obtained against a cyanmethomoglobin standard curve (Sigma Catalogue No. 525-18).

Total plasma protein was measured with the dye, brilliant blue G on an aliquot diluted 100 times with deionized water (Coomassie blue; Sigma Diagnostic Procedure No.

610). The reagent was added to 10 μL of the diluted plasma and the absorbence was read at 595 nm (10 μL of sample plus 2.5 mL of reagent). The protein standard was prepared fresh on the day of analysis and discarded after use (Sigma Catalogue No. 610-30).

Total lactate was determined on 10 μL of plasma with a quantitative, enzymatic assay (Sigma Diagnostic Procedure No. 735). Lactic acid was converted by lactic oxidase to pyruvate and hydrogen peroxide. The hydrogen peroxide catalyzed the oxidative condensation of chromogen precursors to produce a colored dye with an absorbence maximum at 540 nm. The lactate reagent was added to 10 μL of plasma (2.5 mL of reagent diluted 2.5 x with deionized water). The reaction was allowed to proceed for one hour at room temperature. The absorbence was then measured at 540 nm and lactate levels calculated from a standard curve for lactate (Sigma Catalogue No. 735-11).

Plasma glucose levels were also determined enzymatically with the Trinder reagent (Sigma Diagnostic Procedure No. 315). Glucose was oxidized to gluconic acid and hydrogen peroxide by glucose oxidase. The hydrogen peroxide formed reacts in the presence of peroxidase with 4-aminoantipyrine and p-hydroxybenzene sulfonate to form quinoneimine dye with an absorbence maximum at 505 nm. The reagent (2.5 mL) was added to 10 μL of plasma, the tubes were incubated at ambient temperature for one hour and the absorbence read at 505 nm. Glucose levels were obtained from a glucose standard curve prepared the same way (Sigma Catalogue No. 16-300).

The blood smears were air dried and then fixed with immersion in methanol for five minutes. The slides were stained for one minute with Wright-Griemsa after rehydration in deionized water for two minutes. Excess stain was removed with three to four rinses for one to two minutes each in deionized water. Three slides were prepared for each fish. The slides were examined at a magnification of 1,000 (oil immersion). The lymphocytes or white blood cells and erythrocytes (red blood cells) were counted in three fields containing from 50 to 100 cells. Slides for fish from two treatments were counted by two different technicians. The counts were done by technicians who had

no knowledge of the identity of the slides to assess consistency in scoring and data reliability.

3.3.3.3 Tissue Residue Analysis and Dry Weights

Tissue residue and dry weight data were not done on fish from the 7 day test. Tissues for residue analysis were taken from the walleye and larger trout after blood collection (trout only), liver removal, the necropsy, and gutting. Duplicate cross sectional pieces of the carcass were cut out with a scalpel and weighed. These tissues were then dried overnight at 95^{0}C and reweighed for the determination of moisture content. An additional cross-sectional piece was removed along with the head for histopathological assessment. The remaining carcass was then wrapped in plastic wrap and immediately frozen (-20^{0}C). Disposable latex gloves were used by all individuals handling the tissues and livers. The frozen carcass remains were sent to EnviroTest Laboratories for analysis of tissue residues and lipid content.

3.3.3.4 Analysis of Fish Liver Mixed Function Oxidase Activity

The livers from all juvenile fish were removed, weighed, split in two pieces, wrapped in aluminum foil, labeled and immediately frozen in liquid nitrogen. The gall bladders were removed from the livers before weighing and processing. The livers were thoroughly rinsed in 10% KCl to remove bile from ruptured gall bladders. However, less than 1% of the gall bladders ruptured during surgery. In the 7 day test, the livers were placed into 1.5 mL microfuge tubes. These were later found to be unacceptable storage containers and were substituted with solvent rinsed, aluminum foil.

Analysis of liver mixed function oxidase activity were done by Dr. J. Parrott of the National Water Research Institute, Burlington. The livers were transported frozen, in a fully charged dry shipper. Duplicate livers from the 28 day exposure were sent to EnviroTest Laboratories for Quality Assurance purposes.

3.3.3.5 Histopathological Assessment

This work was not included in the original study design and was added only days prior to test termination. The histopathological assessment was done by Dr. R. Muller and Dr. C. Rousseaux.

Tissues for histopathological assessment were collected from the juvenile walleye and trout from the 28 day test and preserved following instructions provided by GlobalTox International Consultants Inc. The tissues were taken after the removal of the blood and the liver, the necropsy, and samples for moisture content.

The gut contents, head, samples of muscle and liver were preserved in buffered formalin in 250 mL Nalgene containers. The formalin solution was prepared as per instructions received from GlobalTox International Consultants Inc. and follows:

- sodium phosphate monobasic ($NaH_2 PO_4 H_20$) 650 g
- sodium phosphate dibasic ($Na_2 HPO_4$) 1300 g
- formaldehyde (37%) 20 L
- tap water to a final volume of 200 L

Methanol was not added to the final mixture. The time required to process each fish was less than five minutes and the buffer volume was adjusted to give an approximate ten to one ratio of buffer to tissue. The preserved tissues were sent by Canadian Airlines International to GlobalTox International Consultants Inc. on November 24, 1995.

3.3.4 Challenge Tests on Larval Trout

Three hundred sac-fry were placed into the fry vessels located in the large tanks. These fish were 1 to 2 weeks from swim up, or actively feeding. Fry were used in both the short and long term exposures. They were not fed during the 7 day test. In the 28 day test, the fry were given a ration of roughly 5% body weight of starter chow per day. Mortality and the general condition of the fry were noted daily and the vessels were

also cleaned before and after feeding. The fry were used to assess effects on growth, disease resistance, and swimming stamina (challenge tests).

3.3.4.1 Growth

Three batches of 30 fish from each treatment were euthanized, fork lengths measured, weighed and then dried at 95^{0}C overnight and re-weighed. Final moisture contents and dry weights were used to assess growth. Body condition factors, calculated from the wet weight and lengths, were also compared to tables for hatchery reared fish.

3.3.4.2 Disease Resistance

Disease resistance was assessed by exposing fry to the pathogen, *Vibrio anguillarum* serotype 02, following the procedure of G. Olivier (Personal Communication) and Lall et al. (1989). The pathogen was obtained from G. Olivier in September, 1995. Cultures were maintained on Tryticase Soy Agar (TSA) supplemented with 2% NaCl (wt/v). *Vibrio anguillarum* was selected for this test because it is a marine pathogen and will not survive in freshwater. This precautionary step was intended to minimize the potential for contamination of existing fish stocks and other cultures in the test facility.

The challenge tests were done at the end of the 28 day exposure. Groups of thirty fry were exposed to a range of pathogen densities for 45 minutes. They were then removed, rinsed in clean freshwater, and placed into flow through holding tanks (laboratory dilution water). Mortality was scored daily and observations on fish condition and behavior noted. Dead fish were removed, the nets cleaned. The fry were fed a ration of starter chow daily (roughly equal to 5% of body weight).

The fry were contained in small nets with an internal plastic frame. They were exposed in large tubs (40 x 60 x 15 cm deep) containing 5 L of laboratory dilution water supplemented with 2% NaCl. The treatments included a control, and four pathogen densities each separated by order of magnitude (basic design illustrated in Figure 5).

The *Vibrio anguillarum* was grown in Tryticase Soy Broth (TSB) supplemented with 2% NaCl (wt/v) in preparation for the challenge test as follows. One week prior to the test, bacteria were removed from the plates and placed into 200 mL of TSB in a 250 mL Erlenmeyer flask (one flask per plate). This culture was allowed to grow at 20 ± 2°C for 48 h with occasional shaking. Two mL of this culture was then placed into 200 mL of new saline TSB. These cultures were grown for 24 h then subcultured. The optical densities of the cultures were measured at 750 nm after each transfer. Daily subcultures were done until the same 24 h optical density measurement was attained three days in a row (constant growth). The optical density increased from zero (TSB blank) to 0.4 units in one day.

The culture was adjusted to 0.3 absorbance units with fresh media for the challenge test. The following volumes were added to each treatment vessel containing 5 L of saline laboratory dilution water; 0.75, 7.5, 75, and 750 mL. A volume equal to the volume added was removed before the addition to keep a constant treatment volume of 5 L.

The treatment vessels were large enough to accommodate the nets from eight treatments. Hence, all fish were exposed to the same pathogen density at the same time under the same conditions. After exposure, the nets and fish were rinsed and placed back into recovery tanks (Figure 5). Samples from each treatment tank were collected, serially diluted, and 0.25 µL of each dilution drop plated on 2% NaCl TSA. The plates were incubated at 20 ± 2°C for 24 hours and the colonies counted. The applied dose was set to equal the number of colony forming units per mL of test solution (CFU/mL).

Disease mortalities can be confirmed by culturing the kidney of dead fish on saline TSA (Olivier, Personal Communication). Virulence can also be confirmed by injecting fish with the pathogen. These procedures were tried; however, it was too difficult to remove the kidney tissue from the fry.

The original method was developed with fish weighing 15 to 20 g. Virtually no work has been done on small and larval fish. Hence, the optimal post treatment time was determined by following mortality daily for ten days. Most deaths occurred 4 to 5 days after exposure. For this reason, a seven day post exposure period was deemed optimal for resolution and comparison of disease resistance effects.

3.3.4.3 Swimming Stamina

Stamina is an excellent, generic measure of the general condition and health of fish. This characteristic was assessed through swimming ability. The fry were placed into a current of fixed velocity and the number of fish able to remain swimming was scored over time.

A schematic of the fish swimming unit is shown in Figure 6. Water was pumped from a trough to a header tank equipped with an overflow to maintain a constant head. Three outflows in the tank bottom emptied into 4" diameter drain pipes. The top section of the pipes were removed in order to see the fish. Valves on the outflows permitted control over current flow. The upper end of each swimming tube was blocked with a net to prevent fish from swimming out and the lower end was open. A net (30 x 30 x 50 cm high) submerged in and attached to the lower end confined any fish that fell out of the tube. The tubes were photographed (slides) and videotaped at selected time intervals over a three hour swimming period. The fish in the tubes were counted by projecting the slides onto a white board.

The stamina tests were done as follows. The trough was first filled with fresh laboratory dilution water at the holding temperature suitable for the fish (15 ± 2^0C, the water was renewed for each test). Holding nets containing the fish were transferred from the holding tank to the trough and the top of the net was affixed to the end of the swimming tube (one test or treatment per tube). Flow was then started and measured using time of travel (float placed at top of tube and the time required to travel the length of the tube recorded). Adjustments were made to get 0.2 m/s. Higher flows were too overpowering and the fish could stay almost indefinitely in lower flows. After the flow

check and adjustments, the fish from one holding and capture net were netted and placed in the upper end of the trough. This was repeated for all tubes and the entire process was done three times. In preliminary studies, the maximum number of fish remaining in the tube was obtained after three successive placements. The remaining fish simply did not exhibit rheotaxis (desire to swim as opposed to limnophilia).

Loading the tubes took 15 minutes, after which the test was deemed started (t=0). Photographs, videotape, and manual counts were taken at regular intervals. Sometimes reliable manual counts were not possible with large numbers of fish. However, the manual counts were used to confirm slide counts. The test was terminated after three hours, and the fish returned to the resting or holding tanks.

The data tabulated included number of fish swimming at time zero as a percentage of the total number of exposed fish, and the percentage remaining at hourly intervals.

3.4 Chemical Characterization

A sample of the Tar Island Dyke water from the 28 day test was submitted to EnviroTest Laboratories for detailed chemical characterization. Tissue samples were also submitted for residue analyses of Oil Sands related compounds. Details of the analytical methods are referenced in the results (appended).

4.0 RESULTS AND DISCUSSIONS

This section is divided into five main components dealing with:

1. trophic effects
2a. fish health effects
2b. histopathological assessment
2c. mixed function oxidases
3. chemical characterization and tissue residue analyses

A complete battery of acute and chronic tests was applied to all large samples of Athabasca River and Tar Island Dyke water collected on three separate occasions. Fish health effects were assessed in two separate studies conducted on samples collected over a three month period. The 7 day short term study was done with fewer walleye and all fish were exposed in the same tank (fry in fry vessels, 5-10 g walleye and trout in nets, and 50-100 g trout free ranging). In the 28 day test, the walleye were exposed in separate tanks and only the fry and large trout were used.

Growth measurements, disease resistance and swimming stamina were not done on fry from the short term study. All data from both studies are presented here for comparative purposes. The reports produced by third parties are incorporated in this document but not interpreted. These are the histopathological assessment and the analyses of fish liver, mixed function oxidases.

The chemical data are presented in a separate section. This information is referred to in other sections but kept separate for organizational clarity.

4.1 Sample Collection, Transport and Storage

No difficulties were encountered in the collection, transport, storage and disposal of all samples. The second sample was obtained and transported back to the testing facility in a blizzard. However, the sample was not frozen at time of receipt.

Information on each sample is summarized in Table 7. There were some obvious differences amongst individual samples as a result of seasonal and climatic factors. This was more apparent in the Athabasca River water following storm events and ice formation.

The river water sample collected on 95/09/29 was extremely turbid, had a mild organic odour and the conductance was 25% higher than the previous sample (collected on 95/08/11). The pH of both the Tar Island Dyke and Athabasca River samples ranged from 8.2 to 8.5 which was similar to laboratory dilution water. Dissolved oxygen levels

were at saturation for the sample temperature. There was no clear indication of a significant chemical or biological oxygen demand. Ammonium levels were low but significant in all samples.

The high conductance levels in the Tar Island Dyke wastewaters indicated a potential salt effect on invertebrate survival and reproduction, and algal growth. However, there were no other extreme values of concern in the data collected at sample receipt. It should be noted that the Tar Island Dyke sample for the 7 day test had a large population of chironomids and a distinct algal bloom (bluegreens). All Tar Island Dyke samples were cloudy and had distinct hydrocarbon odours.

4.2 Trophic Effects Assessment

A comprehensive acute and chronic battery of tests was applied to each Tar Island Dyke and Athabasca River sample. These tests included species representative of major trophic levels in aquatic systems. The methods were developed by Environment Canada as tools for assessment and management of toxic effects in freshwater aquatic systems for environmental conservation and protection.

The test battery consists of microbes, plants, invertebrate, and fish. Microbes and plants (algae) convert chemical energy and light (plants) into biomass and serve as major food sources for invertebrates. Invertebrates, such as the waterflea, feed on microbes, algae and detritus and they are a major food source for fish.

Individual test results are summarized in Table 8. Copies of all test reports are appended.

The Athabasca River water sample was not acutely toxic to trout, *Daphnia* or bacterial luminescence. Further, the river water had no effect on algal growth, and survival of *Ceriodaphnia*. A slight reduction in reproduction of *Ceriodaphnia* (roughly 30%) was noted in all samples. Athabasca River water was also acutely toxic to fathead minnows. The reasons for these marginal effects are unclear. *Ceriodaphnia* is

extremely sensitive to the many soluble salts. Fathead minnow is however, a relatively robust test species but appeared to be sensitive to constituents in Athabasca River water.

Tar Island Dyke water was more toxic to the test organisms than Athabasca River water. However, the toxicity was marginal to moderate as opposed to extreme. The alga, *Selenastrum*, and waterflea, *Daphnia magna*, were the most tolerant species with little or no effects measured. The concentration of Tar Island Dyke water reducing bacterial luminescence by 50% ranged from 42 to 65%. However, in the first sample of Tar Island Dyke water collected, only a screen test with bacteria was performed. This gave a result of 34% of the controls. The LC_{50} for trout and fathead minnow ranged from 27 to 62% and 64 to 74 % respectively without any clear pattern. The ammonia present in Tar Island Dyke water could be a factor contributing to the toxicity. It is interesting to note that similar effects were obtained for both fish species. This could indicate that there is one class of compounds or compound responsible for the observed lethal effects on fish.

Survival of *Ceriodaphnia* was marginally affected along with reproduction. Again there was no clear and consistent trends in the data. There effects could be due to high salt levels in the Tar Island Dyke water (sodium in particular).

The order of increasing species sensitivity to Tar Island Dyke water was:

Daphnia=*Selenastrum*<trout=fathead minnow=bacteria luminescence<*Ceriodaphnia*

A five to ten fold dilution of Tar Island Dyke water would probably render it non-toxic to all life forms in the test battery.

The toxicity was not strong enough to justify a low grade toxicity identification evaluation. The effects were considered marginal at best and there was little variability and no obvious trends in the test data.

4.3 Fish Health Effects

Low grade, long term exposure to non-acutely lethal levels of environmental contaminants can be stressful. Different life forms will respond in different ways to stress depending on the nature of the stressor (level and mode of interaction), duration and intensity. Stress has been defined as the cumulative effect of all biochemical and physiological responses related to an animals attempt to maintain or re-establish homeostasis in response to changing environmental conditions (a more complete discussion of stress can be found in Adams, 1990a).

Stress can impair the general health and condition of an organism through diversion of energy and disruption of normal physiological functions. This has a potential to effect basic processes such as growth and reproduction and ultimately survival. The later has more profound consequences at the level of populations and community structure of aquatic ecosystems. Most impacts are discovered after the fact through changes in populations. Sublethal, chronic related responses can be measured but it is extremely difficult to unequivocally resolve cause and effect relationships. For this reason, laboratory studies were commissioned to examine a broad range of sublethal responses in fish populations exposed to Suncor wastewaters. The tests were conducted under controlled conditions over a range of treatment levels. This was intended to provide greater resolution over cause and effect relationships for individual responses and the collective effects on the general condition and health of exposed fish. Most of the responses measured in the laboratory studies have been assessed in natural fish populations in the area around the Oil Sands operations. Hence, the laboratory data can provide a level of validation of field observations.

Fish health effects were divided into two major components, the first component was the tests on the larger juvenile trout and walleye. This included the necropsy, blood work, moisture contents, liver mixed function oxidases, and histopathological assessments. The second component included the challenge tests on the fry and included growth, disease resistance and swimming stamina. Growth is a good indicator of overall fish health and condition (performance). Disease resistance provides some

insight into immune system integrity and response to a pathogen. Finally, swimming stamina provides a direct measure of the bioenergetic cost for maintaining a homeostatic condition in response to environmental stresses.

Monitoring data and general observations made during each test will be discussed first. This will be followed by the results for the large juvenile trout and walleye, and the larval trout. The chemical characterization and tissue residue analysis will be presented in the final section.

4.3.1 General Test Conditions and Observations

Flows were checked and adjusted at least once daily, and a number of water quality parameters were measured daily (pH, conductance, temperature, dissolved oxygen, and ammonium). Survival, signs of stress, and unusual behavior were also noted. There were no signs of stress exhibited by the fish in the short term, 7 day exposure except in the higher treatment levels (10 and 50%). The 50% Tar Island Dyke was lethal to trout and walleye. The fish in 10% Tar Island Dyke water also appeared stressed in both tests (7 day and 28 day). They were dark in color and less active than fish in the other treatments. All fish exposed to naphthenic acids were also visibly stressed. Photographs of walleye and trout in laboratory dilution water in the 28 day test are presented in Figure 7.

During the end of the 28 day exposure, it was noted that in some tanks one of the larger trout would become dominant. This fish would aggressively occupy the center of the tank. The remaining fish would remain near the bottom or at one end of the tank. Dominance was not noticed in the short term tests or with the walleye and fry.

All water quality monitoring data are appended for both tests. The mean and ranges are summarized in Table 9. All parameters were relatively constant on a day to day basis. Ammonia levels were consistently less than 1.0 -N/L. At the treatment pH, the proportion of NH_3 was below that known to be harmful to fish.

Over all treatments the pH ranged from 7.5 to 8.0. In the 7 day test the conductance ranged from 253 to 426 μS/cm and in the 28 day test in all treatments from 307 to 499 μS/cm. The temperature averaged 15 ± 2°C throughout the 28 day test. Dissolved oxygen levels were at saturation in the smaller, walleye tanks. However, levels were roughly 70 to 80% saturation in the larger tanks. This was due to an oxygen demand created by a build up of detrital materials on the nets holding the SPMDs. Dissolved oxygen levels quickly increased to saturation after the SPMDs were removed.

In the 28 day exposure, all large trout in the 0.01% Tar Island Dyke treatment were lost on day 20. The reason for this was not determined, although it persisted in the tank. Daily screening tests were done on the tank water with larval trout. Survival increased over time indicating that the substance was being diluted out. It should be noted that all inflows were diverted through the fry vessels and then into the tank. The fry were not affected and the walleye in the same treatment but in a different tank were not affected. This suggested that the source of the material was confined to this tank (possibly associated with the SPMD). A possible disease outbreak was also suspected but could not be confirmed. Although each treatment was equipped with separate nets, buckets and other cleaning implements, the walleye were not affected. Further, there was no mortality observed in adjacent tanks.

The large trout in the laboratory dilution water appeared unduly stressed on day 26. This was a sudden and highly visible change in behavior. For this reason, the fish were processed two days before test take down. The condition and appearance of the fish were similar to those that died in the adjacent tank (0.01% Tar Island Dyke). No signs or symptoms of disease were detected and the lethal agent appeared to be chemical in nature. It was suspected but not confirmed that it may have also been connected with the SPMD.

Most of the fry in the 10% Tar Island Dyke treatment were lost on day 14. The influent line fell out of the fry vessel into the tank and most of the fry suffocated due to lack of flow. Surviving fry were used for growth assessments and one disease challenge test.

Survival of walleye, trout and larval trout in the 7 day and 28 day tests is presented in Table 10. Although visibly stressed, all fish survived the 10% Tar Island Dyke, but not 50% (7 day test only). Some walleye mortality was observed across the test but this was not considered significant and very likely due to the handling of the fish. In general the fish in Athabasca River water appeared more active and they grew faster than in other treatments. It should be noted that only three 5 - 10 g walleye and trout were exposed in the 7 day test along with fry and larger trout. Ten walleye were exposed in the 28 day test and the smaller 5 - 10 g trout were omitted. The larval trout mortalities for the 7 day test were approximated from daily observations and fish counts.

4.3.2 Effects Assessment in Trout and Walleye

4.3.2.1 Necropsy

The necropsy data for the short and long term tests are summarized in Tables 11 and 12. The data on individual fish are appended. All trout were hatchery reared and in reasonably good condition at test initiation. The walleye had been reared by hand for roughly two months and they were also in excellent condition at the start of both tests. Hence, most internal and external features examined in the autopsy procedure were within normal ranges (Table 11). All fish were immature, there was little hemorrhaging or inflammation of body organs and glands.

There were no significant differences amongst final average fish weights for walleye in Tar Island Dyke treatments compared to controls. Although not significant, it is intriguing to note the higher average weights for walleye in Athabasca River water. Similar results were obtained for the larger trout although there was less of an increase in Athabasca River water due to the larger fish size and short duration of the test (28 days).

Condition factors are often used to compare growth amongst different treatments and against values established for fish reared under controlled conditions. Factors affecting feeding to the conversion of food into biomass (growth) will affect the body condition

factor. Hence, differences in condition factor need to be cautiously interpreted in light of other morphological and anatomical observations and measurements.

Body condition factors and liver somatic indices were derived from the fish and liver weights (Table 11). Condition factors were also calculated for the larval fry from the 28 day test. Few differences in body condition factors were noted between the 7 and 28 day test and amongst treatments, for all fish (juvenile walleye and trout, and larval trout). The juvenile trout exposed to naphthenic acids in the 28 day test had the lowest condition factor (0.8 compared to 1.4 for controls). These fish also appeared stressed and were not eating as well as the fish in other treatments. The liver somatic index is the ratio of liver weight to body weight. There were no obvious and consistent trends in the ratios for trout exposed in the 7 day test. The LSI for fish exposed in naphthenic acids in the 28 day test was the highest (twice the controls). A lower body weight from less active feeding will give a higher LSI and lower body condition factor.

The body condition factors were consistent with the trends in weight and length amongst all treatments. All trout were hatchery reared and in relatively good condition. The walleye had been hand reared for roughly two months and were all in good condition at test initiation. There was little to no erosion of fins and opercula. All fish were immature, and there was some swelling and inflammation of the pseudobranch.

The liver performs a number of functions including food metabolism, glycogen storage, bile and plasma protein synthesis, and metabolism and removal of materials from the blood. The size and colour of this organ can change relatively quickly in response to metabolic requirements.

The ratio of liver weight to body weight or liver somatic index (LSI also known as hepatosomatic indices or HSI) has been widely used in studies on stress. A change in liver weight in response to stress have been generally attributed to changes in glycogen levels. Liver weights can also increase due to increases in cell size and numbers (hypertrophy and hyperplasia)

There were no trends apparent in LSI's derived for the walleye. Values were general higher in the 28 day test compared to the 7 day test. Fish exposed to Athabasca River water had the lowest LSI in the 28 day test. This probably reflects the fact that these fish appear to do better than those in the other treatments.

The necropsy results did not reveal any individual features or group of characteristics that could be linked with the exposure conditions. This could indicate that the many stressors present in Tar Island Dyke water do not effect the endpoints examined or that the exposure duration was too short to observe these effects.

4.3.2.1 Hematology

The blood related parameters examined included hematocrit, hemoglobin, glucose, protein, lactic acid and differential blood cell counts. Hematocrit is the percent volume of cells in the blood (mostly red blood cells). Changes in hematocrit could indicate impairment of normal blood cell development. Lowered hematocrit could affect endurance, ultimately growth and survival, through restricted oxygen transport. However, hemoglobin levels provide additional information on the potential oxygen binding capacity.

Hemoglobin is responsible for the binding and transport of oxygen. Lower levels may indicate some impairment of normal blood cell development and it could affect stamina and endurance. Measured levels in the exposed fish ranged from 5 to 10 g/dL in the 7 day test and 6 to 9 g/dL in the 28 day test (Table 11). There were no differences amongst treatments.

Hematocrits ranged from 28 to 41% and 28 to 40% in the 7 and 28 day test respectively (Table 11). Levels were lower in the highest Tar Island Dyke treatments tested (50% in the 7 day and 10% in the 28 day test). However, all values were within the range considered normal for rainbow trout (24-43%; Wedemeyer et al., 1990).

The use of plasma protein levels as an indicator of stress is questionable. Reductions in some proteins are often offset by increases in other classes. Hence, this response needs interpretation in light of suitable control responses. Major functions of blood proteins are osmoregulatory, clotting factors, binding of hemoglobin and metals, and as enzymes and hormones (trace levels).

Plasma protein levels in hatchery reared trout ranged from 1 to 4 g/dL (Wedemeyer et al., 1990). The levels measured in the 7 day test ranged from 4 to 7 g/dL with no apparent correlation with the treatment conditions. Similar results were obtained for the 28 day exposure (4 to 6 g/dL, Table 11).

Lactic acid is a by-product of carbohydrate metabolism. High levels are produced in muscles under severe stress or due to fright (anaerobic metabolism). Lactic acid is removed from the blood by the liver. Hence, changes in plasma lactic acid levels are indicators of production and metabolism. Prolonged high levels of lactic acid can lead to weakness, fatigue and ultimately death.

Lactic acid levels ranged from 73 to 141 mg/dL and 27 to 69 mg/dL in fish from the 7 and 28 day exposures. The highest level was measured in severely stressed fish exposed to 50% Tar Island Dyke in the 7 day test (141 mg/dL). These ranges are higher than that reported for trout (20-30 mg/dL, Wedemeyer et al., 1990). However, many factors can affect lactic acid levels and it is essential to have a proper test control for interpretation of the results. In all cases, the variance in levels was relatively high within test treatment groups (roughly 20 to 50%).

It was interesting to not that lactic acid levels were lower in fish exposed for longer periods of time. This could reflect an adaptive response to the initial stress of placement in the system and exposure to the test conditions. There also appeared some correlation between observed levels of inactivity and lower lactic acid levels. This was evident in the fish exposed to naphthenic acids and 10% Tar Island Dyke. They were the most sedentary and did not feed as well as the other fish.

Glucose is a nutrient (energy source) in blood utilized by all cells. Plasma glucose levels are controlled by hormonal responses and intrinsically linked with carbohydrate metabolism in the liver (glycogen levels). Any factors affecting liver glycogen stores including feeding, diet, life stage, etc. will influence glucose levels. High levels (hyperglycemia) relative to a suitable control, can indicate hyperactivity of endocrine glands, and short term adaptive response to environmental stress. Low levels (hypoglycemia) control results from liver dysfunction, starvation or hormonal imbalance.

Blood glucose levels ranged from 67 to 116 mg/dL in the 7 day test and 85 to 155 mg/dL in the 28 day test (Table 11). Lower levels were evident in fish exhibiting signs of stress. The mean values for 50% Tar Island Dyke (7 day test) and 10% Tar Island Dyke (28 day test) were 67 and 76 mg/dL respectively. The fish exposed to naphthenic acids in the 28 day test also had lower plasma glucose levels (85 mg/dL).

Blood cell counts were done to obtain a white to red blood ratio. Differential white cell counts were not made. The relative proportion of white to red blood cells is a good indicator of immunological condition. Depressed levels may be associated with stress related factors including disease, exposure to xenobiotics, and spleenic disorders. White blood cells have major functions in coagulation to minimize blood loss from injury and phagocytosis and immune responses to infection.

There were no clear differences in white blood cell ratios amongst all treatments (Table 11)

4.3.2.3 Induction of Liver Mixed Function Oxidases

Recent work by Dr. J. Parrott on effluents discharged to the Athabasca River indicated that Suncor effluent induced high levels of EROD, notably in hepatic cell cultures. EROD, 7-ethoxyresorufin-O-deethylase is one of a class of hepatic monooxygenases or MFO. MFO are synthesized in response to the presence of foreign substances (xenobiotics). Many xenobiotics are not easily excreted in the parent form. MFO break these compounds down into derivatives that are more easily removed by natural bodily

processes. During metabolism, some compounds can be altered in such a fashion that they become more reactive. Some by-products can even react with DNA leading to tumor formation, although the frequency of this is extremely small and occurs over long time periods. The presence of elevated MFO has been used as an indicator of exposure to foreign substances. However, the ecological relevance of induction is not well understood.

The work of Dr. J. Parrott raised two issues 1) what is the relationship between SPMD induced tissue culture EROD activity compared to live fish and 2) what in Suncor effluent induces MFO. The original work was done on extracts of semipermeable membrane devices or SPMD's. The devices were deployed in the Athabasca River above and below effluent discharges. They were then extracted and the extracts tested with a cell culture line derived from fish livers.

To address the questions raised by this study, trout and walleye were exposed to the wastewater in the presence of SPMD's (deployment of SPMD illustrated in Figure 8). This permitted a direct comparison of induction in whole fish with that of cell cultures in response to extracts of SPMD's. The later will concentrate hydrophobic materials enhancing detection limits.

Some test results are presented in Table 13 and a copy of Dr. J. Parrott's report is appended. In the 7 day exposure, EROD levels in the walleye and small trout (5 - 10 g) did not increase with increasing wastewater concentrations (up to 10%). EROD was not induced in the larger trout surviving the 50% treatment. These fish were visibly stressed at test termination, and the condition was lethal to the walleye and small trout and 50% of the large trout. The positive control, β-naphthoflavone, effectively induced EROD in the large trout (the β-naphthoflavone was injected into these fish). Short term exposures to 1 mg/L naphthenic acids did not induce EROD in walleye and both the small and large trout.

At the time of writing this report, data had not been received from Dr. J. Parrott for the SPMD extracts (7 and 28 day) and livers from the 28 day test.

Data for the 28 day test are summarized in Table 13 and the reports are appended. Two enzyme systems were assayed by EnviroTest Laboratories, 7-ethoxyresorufin-O-deethylase (EROD) and aryl hydrocarbon hydroxylase (AHH). A three fold increase in activity was noted in fish exposed to 10% Tar Island Dyke. Similar results were obtained from AHH in livers of fish exposed to β-naphthoflavone. However, EROD activity in these livers was almost eight times higher than in livers from fish exposed to Athabasca River water.

4.3.2.4 Histopathological Assessment

A histopathological assessment of trout exposed to the Athabasca River water, 10% Tar Island Dyke and naphthenic acids was conducted by GlobalTox International Consultants Inc. Only fish from the 28 day exposure were assessed. The results are briefly summarized here and the report appended.

"The findings ranged from incidental changes that could be attributed to the method of euthanism or fixation to hepatic lipidosis and mild renal degeneration and regeneration. The findings associated with exposure to naphthenic acids consisted of mainly hepatic lipidosis. This hepatic lipidosis was more sever than that seen in 10% Tar Island Dyke treatment group. However, the findings in the kidney, indicative of mild renal toxicity were only found in this group. The findings on the gills could not be attributed directly to toxicity, but warrant further investigation."

The large trout exposed to naphthenic acids and 10% Tar Island Dyke were visibly stressed at test termination. Further, of all biomarkers examined, effects were only detected in these two treatment groups (plasma glucose levels were also low in fish exposed to β-naphthoflavone). The laboratory controls were not examined in the histopathological assessment.

4.3.2.5 Assessment of Growth, Disease Resistance, and Swimming Stamina in Larval Fish

The 7 day exposure was too short to merit investigation of growth, disease resistance, and stamina. Hence, all challenge tests were only done on larval fry from the long term, 28 day exposure.

Environmental stress can impair normal fish development, growth and condition by diverting energy resources and interruption of normal physiological functions (immune and reproduction systems, biochemical processes, etc.). These types of effects are extremely difficult to assess from selected measurements of biochemical, physiological and non-physiological indicators. However, challenge tests can provide insight into the capacity, performance and overall condition of an organism. These tests were designed to assess disease resistance, stamina and growth.

Growth is a measure of an organisms ability to convert food into biomass; an integration of a number of behavioral, biochemical and physiological processes critical to survival. Growth of fry was measured as an increase in dry weight and length. Condition factors were also derived based on length and wet weight data.

The fry exposed in Athabasca River water were significantly larger than fry from other treatments. Weight gain in the β-naphthoflavone treatment was the lowest. The Tar Island Dyke treatments were similar to or exceeded the controls (Table 14).

Condition factors for the fry indicated that they were all in reasonably good health compared to hatchery reared fish (Table 12).

Stress induced alteration of normal immunological functions are easily quantified. Many fish are asymptomatic carriers of pathogens. these are normally kept under control, but impairment can result in growth of the pathogen to lethal levels.

The disease challenge test was designed to asses the "health" of the immune system. Disease resistance is an integrated, whole organism response involving the functioning of numerous physiological systems (Schreck, 1990). The larval fish were reared in the

wastewater and Athabasca River water for 28 days. The fish were exposed to a range of pathogen densities and allowed to recover. Mortality was then scored over time. The actual mechanism of infection is not well understood. However, the test was designed to give a range of responses, from no effect to lethality.

Little mortality was noticed one to ten days after exposure to the pathogen. The greatest incipient mortality occurred after 3 to 4 days. The entire challenge test was repeated on fish that were held for 17 days following the 28 day exposure period. The results from those tests were qualitatively similar although the indices of mortality were less across all treatments (Table 14).

Mortality was highest in the exposure to Athabasca River water, followed by β-naphthoflavone and then laboratory controls. All the mortality observed in fry exposed to Tar Island Dyke treatments and unexposed laboratory fry (externally reared controls) were lower but similar.

The results from the second test indicated that abilities of the fry to resist disease increased after a prolonged period of growth in laboratory dilution water. However, the fry from the Athabasca River water treatment did not fair as well as the other treatments.

Swimming stamina is a good general measure of fish condition and health. Stress related bioenergenic demands and disruption of physiological processes can affect stamina. Recovery following exercise can also provide insights on fish health.

The fry were placed into swimming tubes; in a constant flow condition. The number of fry exhibiting rheotoxis at test initiation and over time were recorded. The test was repeated after a 24 hour recovery period and again after a 72 hour recovery period. Fry reared in the laboratory and not in the fry vessels were also included as an additional control group (external controls reared in a separate system).

The number of fish exhibiting rheotoxis from the Tar Island Dyke and Athabasca River water exposures and controls were similar (Table 14). However, the fry from the β-naphthoflavone treatment performed poorly with less than 2% exhibiting rheotoxis. Most fry could maintain swimming for 60 minutes, but numbers tended to drop by the end of three hours. In previous tests, it was found that fish remaining after three hours could continue swimming for much longer time periods. Hence, the tests were terminated after three hours.

The number of fish exhibiting rheotoxis at test termination increased after the 24 hour recovery period. However, the same pattern in the data was noted. The fry exposed to Athabasca River water had less endurance than fry from other treatments. Similar results were obtained after the three day recovery period.

The fry from the Athabasca River water exposure were larger and appeared in better condition than fry from the other treatments. The difference in endurance could not be attributed to the metabolic diversion of energy into growth at the expense of overall stamina. This was consistent with reduced ability of these fish to resist disease. The size of the fish relative to crowding in the swimming tube could be an additional factor.

4.4 Chemical Characterization of Tar Island Dyke Water and Fish Analysis

A sample of Tar Island Dyke water was sent to EnviroTest Laboratories and Chemex for a complete chemical characterization. The fish carcasses from the 28 day exposure were also sent to EnviroTest Laboratories for residue analysis of target Oil Sands related compounds.

At the time of writing this report, only data for the chemical analysis of Tar Island Dyke water were available. These are appended.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

LABORATORY INVESTIGATIONS ON SUNCOR TAR ISLAND DYKE WASTEWATERS

Laboratory Investigations were conducted to assess potential trophic level and fish health effects of Suncor Tar Island Dyke water. Experimental controls included standard reference toxicants, laboratory dilution water, Athabasca River water (field control), and study specific positive controls (β-naphthoflavone, naphthenic acids). The findings were:

- Tar Island Dyke water was not acutely toxic to Daphnia and did not inhibit growth of *Selenastrum*; some toxicity was detected with trout, fathead minnow, bacterial luminescence and survival and reproduction of *Ceriodaphnia*. These effects were considered moderate and with slight dilution, Tar Island Dyke water will have little or no effect on species representative of major trophic levels in aquatic systems.
- Athabasca River water was generally not toxic. However, some marginal effects were detected for fathead minnow and trout, and *Ceriodaphnia.*
- Tar Island Dyke water was not toxic enough to permit implementation of a low grade TIE.
- The pattern of toxicity of Tar Island Dyke water to the test organisms indicated that one group or class of compounds was responsible for the observed effects.
- A histopathological assessment was done by GlobalTox International Consultants Inc. on fish from the long term test exposed to Athabasca River water, naphthenic acids and 10% Tar Island Dyke water, tissue from trout exposed to 10% Tar Island Dyke and naphthenic acids revealed some pathology consistent with but not diagnostic of toxicity. No conclusions were made on the condition of fish exposed to Athabasca river water.
- Challenge tests were done on fry reared in the test treatments and included disease resistance, swimming stamina and growth assessments. Tar Island Dyke water had little effect on the growth, and general health and condition of the fry. Although fry reared in Athabasca River water had better overall growth, they were more susceptible to the pathogen and had less endurance. Exposure to diluted Tar Island Dyke water will have little or no impact on fry performance, health and condition.
- Fish health effects were assessed after short and long term responses. Similar results were obtained for the 7 and 28 day exposures. The necropsy did not reveal

any significant difference amongst treatments. The hematological assessment revealed lower hematocrit, and glucose, protein, and hemoglobin levels in fish exposed to 10% Tar Island Dyke water. The fish exposed to naphthenic acids also had lower hematocrit and glucose levels. These fish were also visibly stressed at test termination.

- Levels of EROD activity were increased in fish exposed to Tar Island Dyke water (10%) relative to Athabasca River water in both the short and long term tests. Data were not available for the SPMD extracts.
- The walleye responded in a similar way to that of the trout. No induction of EROD was detected in fish exposed to Tar Island Dyke water and Athabasca River water compared to laboratory controls in the 7 day test. Survival and the general condition of the walleye were also similar to the exposed trout. Data were not available for the 28 day test.
- Tissue residue data were not available at the time of writing this report.

5.2 Recommendations

Some variation in the toxicity of Tar Island Dyke water was noted in the battery of acute and chronic tests. However, the sample to sample variability was not high and all species responded in a similar fashion. Hence, the test battery can be reduced for more frequent monitoring with some confirmatory testing with an expanded battery. Bacterial luminescence was well correlated with and was as sensitive as the other test species. This test could be used for monitoring purposes.

- The responses of walleye and trout were similar. Hence, one species can be used for future testing and assessment of fish impacts.
- Necropsy on hatchery reared and laboratory reared fish did not reveal any qualitative or quantitative differences amongst treatments. These procedures should be modified and reduced. The hematological assessment and analysis of blood parameters should be retained along with liver and fish weights.
- Treatment levels separated by an order of magnitude were best suited for resolution of sublethal effects. More closely spaced treatments would tend to confound the data. However, a larger sample size would decrease variability.

- The SPMD's enclosed in nets tended to accumulate debris and were difficult to clean. In future exposures, the SPMD's should be located in the influent or effluent stream and not the tank.
- The challenge tests were relatively economical and provided useful information on the general health and condition of the fry. These types of tests should be expanded. Further, other biochemical responses in smaller fish should be investigated. There are many benefits for using smaller fish, including a greater sample size.
- The histopathological assessment should be retained but needs to be incorporated into the initial study design. The assessment should also include the fry.

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TABLES

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Table 1. Study Specific Quality Assurance Practices

STUDY COMPONENT	QUALITY ASSURANCE PRACTICE
TROPHIC EFFECTS TESTING	
	• in-life audits • independent review and verification of reports • negative controls run with each test • reference toxicant tests and warning charts for each test species • replication of test treatments • controlled environmental conditions • standard operating procedures
FISH HEALTH EFFECTS ASSESSMENT	
	• negative and positive controls (lab dilution water, BNF and NAP) • daily chemical analysis and flow checks • test repeated (short and long term) • in-life audits • controlled environmental conditions • access to test area restricted
Necropsy	• checklists used to ensure all data recorded • samples preserved and clearly labeled immediately after processing • training • photographs (filem and videotape)
Biochemical Analyses (blood)	• standard test methods • negative and positive controls • duplicates and certified reference standard
Biochemical Analyses (MFO)	• chain of custody forms • split sample • negative and positive controls • third party quality assurance practices
Histopathological Assessment	• chain of custody forms • third party quality assurance practices • independent review

STUDY COMPONENT	QUALITY ASSURANCE PRACTICE
Disease Resistance	• tests repeated • uniform exposure conditions • large sample size • broad range of treatment conditions • external controls • dose verification • negative controls
Swimming Stamina	• tests repeated • replication of selected treatments • external controls • flows calibrated at least daily in swimming tubes • negative controls • fish introduced to tubes three times to give all fish an equal chance to swim • water in tubes renewed after each test to maintain temperature at 15 ± 2^0C
CHEMICAL CHARACTERIZATION	
	• chain of custody forms • internal data review • split samples • laboratory specific QA practices

Table 2. Sample Collection Dates and List of Tests Performed

REF	SAMPLE DATE	TYPE	DA(D)	TR(D)	BL(S)	BL(D)	AG(D)	CD(D)	FM(D)
Tar Island Dyke Water									
95293	95/07/25	small		✓	✓				
95320-1	95/08/11	large	✓	✓	✓		✓	✓	✓
95393	95/09/20	small		✓		✓			
95404-1	95/09/29	large	✓	✓		✓	✓	✓	✓
95465-1	95/10/27	large	✓	✓		✓	✓	✓	✓
Athabasca River			DA(S)	TR(S)	BL(S)		AG(S)	CD(S)	FM(S)
95320-2	95/08/11	large	✓	✓	✓		✓	✓	✓
95404-2	95/09/29	large	✓	✓	✓		✓	✓	✓
95465-2	95/10/27	large	✓	✓	✓		✓	✓	✓

NOTES: DA, Daphnia; TR, Trout; BL, Bacterial Luminescence; AG, Algae; CD, Ceriodaphnia; FM, Fathead Minnows; D, definitive test with five treatment levels and a control; S, screening test on undiluted sample; small, 60 L; large > 1 m^3

Table 3. Battery of acute and Chronic Tests Applied to Suncor Wastewater and Athabasca River Water

ORGANISM	SPECIES	RESPONSE	REFERENCE
	ACUTE TESTS		
Microbe	*Vibrio fischeri*	light inhibition	EPSI/RM/24 Nov 1992
Invertebrate	*Daphnia magna*	survival	EPSI/RM/14 July 1990
Fish	*Oncorhynchus mykiss*	survival	EPSI/RM/13 July 1990
	CHRONIC TESTS		
Plant	*Selenastrum capricornutum*	growth inhibition	EPSI/RM/25 Nov 1992
Invertebrate	*Ceriodaphnia dubia*	survival and reproduction	EPSI/RM/21 Feb 1992
Fish	*Pimephales promelas*	survival and growth	EPSI/RM/22 Feb 1992

Table 4. Test Specific Quality Control Criteria

Test Organism	Reference Toxicant	Historical Mean	Frequency of Testing	Other Test Validaty Criteria
Vibrio fischeri	Zn^{2+}	0.9 mg/L	each reagent vial	• co-efficient of variation ≤ or = 30% • regression co-efficient ≥ or = 0.995
Daphnia magna	NaCl	6.0 g/L	every 2 to 4 weeks	• control survival ≥ or = 90% • test must be conducted at 20 ± 2°C
Oncorhynchus mykiss	phenol	9.3 mg/L	every 2 to 4 weeks	• control survival ≥ or = 90% • test must be conducted at 15 ± 1°C
Selenastrum capricornutum	Zn^{2+}	73 µg/L	every 2 to 4 weeks	• co-efficient of variation in the control treatment ≤ or = 20% • number of cells must increase by a factor of more than 16 in 72 hours
Ceriodaphnia dubia	NaCl	LC50 - 2.6 g/L IC50 - 1.3 g/L	every 2 to 4 weeks	• survival in controls must be ≥ or = 80% • reproduction of neonates in controls must be ≥ or = 15 live young per surviving adult • co-efficient of variation in results must be ≤ or = 30%
Pimephales promelas	NaCl	LC50 - 0.8 g/L IC50 - 1.5 g/L	every 2 to 4 weeks	• survival in control ≥ or = 80% • final dry weights of control fish ≥ or = 230 µg/fish

Table 5. Dilution Water Chemistry (ANALYZED 95/09/18)

GENERAL PARAMETERS	alkalinity (as CaCO3)	154
	conductance (uS/cm)	371
	dissolved oxygen	saturated
	hardness (as CaCO3)	199
	pH (units)	7.5
	total dissolved soilds	216
	total organic carbon	2
	total residual chlorine	<0.1
	turbidity (NTU)	nd
CATIONS	calcium	54
	magnesium	16
	potassium	0.7
	sodium	3.1
ANIONS	bromide	<0.05
	chloride	3.4
	fluoride	0.8
	sulfate	47
	bicarbonate	188
NUTRIENTS	ammonium	<0.001
	nitrate	<0.05
	nitrite	<0.05
	phosphate	<0.05

TRACE METALS	aluminum	0.14
	antimony	0.003
	arsenic	<0.0009
	barium	0.066
	beryllium	<0.0001
	bismuth	0.022
	cadmium	<0.0001
	cobalt	<0.0009
	copper	0.003
	chromium	<0.0003
	iron	<0.002
	lead	<0.001
	lithium	0.004
	manganese	<0.0004
	molybdenum	0.003
	nickel	0.001
	phosphorus	0.008
	selenium	0.004
	silver	<0.0002
	silicon	<0.002
	strontium	0.35
	sulphur	16
	thallium	0.005
	thorium	0.0012
	tin	nd
	titanium	0.003
	vanadium	0.001
	zinc	0.006
	zirconium	<0.0003

Table 6. Parameter List for Fish Autopsy Procedure

PARAMETER	FEATURES
EXTERNAL	
length	n/a
weight	n/a
fins	evidence of and levels of erosion
operculum	evidence of and levels of shortening
eyes	normal, exopthalmic, hemorrhagic, blind, missing or other
gills	normal frayed, clubbed, marginate, pale or other
INTERNAL	
sex	male, female or immature
pseudobranch	normal, swollen, lithic, inflamed or other
thymus	evidence of and levels of hemorrhaging
mesentary fat	percent internal body fat
spleen	black, red, granular, nodular, enlarged or other
hind gut	evidence of and level of inflammation
stomach	empty or full
kidney	normal, swollen, mottled, granular, crolithic or other
liver	red, light red, cream (fatty), nodules, focal discoloration, general discoloration or other
bile	yellow empty bladder, yellow full bladder, light green or dark green

Table 7. Selected Water Quality Data and Other Information on Test Samples

PARAMETER	TAR ISLAND DYKE			ATHABASCA RIVER		
	1	2	3	1	2	3
collected on	95/08/11	95/09/29	95/10/27	95/08/11	95/09/29	95/10/29
lab ref. no.	95320-1	95404-1	95465-1	95320-2	95404-2	95465-2
pH (units)	8.3	8.5	8.3	8.2	8.5	8.2
dissolved oxygen (mg/L)			**SATURATED**			
conductance (uS/cm)	1256	1462	1211	243	317	247
ammonium (mg-N/L)	0.3	0.8	0.7	0.2	0.1	0.1
hardness (mg-$CaCO_3$/L)	80	156	150	110	146	150
colour	yellow	yellow	brown	colourless	brown	pale yellow
odour	hydrocarbon	hydrocarbon	organic	odourless	mild organic	odourless

Table 8. Summary of Acute and Chronic Test Results for Tar Island Dyke and Athabasca River Water Samples

	TAR ISLAND DYKE (LC50, IC50, or EC50)			ATHABASCA RIVER (% controls)		
SAMPLE REFERENCE	95320-1	95404-1	95465-1	95320-2	95404-2	95465-2
ACUTE TESTS						
bacterial luminescence	34	42	65	not toxic	not toxic	not toxic
48 h Daphnia survival	not toxic	not toxic	not toxic	not toxic	not toxic	not toxic
96 h Trout survival	62	27	62	not toxic	not toxic	not toxic
CHRONIC TESTS						
72 h algal growth inhibition	not toxic	not toxic	46	not toxic	65	not toxic
7 d Ceriodaphnia survival	18	78	75	not toxic	not toxic	not toxic
reproduction	20	48	18	67	69	78
7 d fathead minnow survival	74	64	69	57	not toxic	60
growth		48	67	80	91	107

Table 9. Water Quality Data Summary for 7 and 28 Day Tests

Parameter	Small Tanks (1-8) Avg	min	max	Large Tanks (9-16) Avg	min	max
			7 Day Test			
pH (units)				7.8	7.5	8.2
conductance (uS/cm)				357	253	426
dissolved oxygen (mg/L)				7.1	6.0	8.3
temperature (oC)				19	18	22
			28 Day Test			
pH (units)	8.3	8.3	8.3	7.9	7.7	8.0
conductance (uS/cm)	393	307	499	393	313	475
dissolved oxygen (mg/L)	9.0	8.6	9.1	7.4	6.4	8.0
temperature (oC)	15	14	18	14	14	16
ammonium (mg-N/L)	0.3	0.1	0.7	0.6	0.4	0.9

Table 10. Survival of Walleye, Trout, and Larval Trout Following the 7 and 28 Day Exposures

Parameter		Percent Mortality								
		Lab Controls	Tar Island Dyke Water (%)					Athabasca River	Naphthenic Acids	Beta-Naphthoflavc
			0.01	0.1	1	10	50			
50-100 g trout	7-day	0		0	0	0	60	0	0	0
	28-day	0	100[a]	0	8	0		0	0	0
5-10 g trout	7-day	0		67	0	0	100	33	0	
larval trout	7-day	<5		<5	<5	<5	100	<5	<5	<5
	28-day	10	8	4	1	92[b]		8	3	13
walleye	7-day	0		0	0	0	100	0	0	
	28-day	8	0	0	23	0		8	13	0

Notes:
a. this was a sudden event that occurred on day 21 of the test
b. accidental mortality due to a faulty influent line
c. only three small walleye and trout (5 to 10 g) were used in the 7 day test

Table 11. Summary of Necropsy Results on the Large Trout from the 7 and 28 Day Exposures

Parameter	lab controls	Tar Island Dyke Water (%)					Athabasca River	Naphthenic Acids	Beta-Naphthoflavon
		0.01	0.1	1	10	50			
EXTERNAL FEATURES									
fin, operculum, eye, gill	all normal in all treatments from both the short and long term tests								
INTERNAL FEATURES									
sex, pseudobranch, thymus, fat, spleen, gut, stomach, kidney, liver sex	no major differences or trends were noted; all fish were immature, there was little hemorrhaging or inflammation of the thymus and hind gut the spleens and kidneys were normal and the livers were not discolored or malformed								
HEMATOLOGY - 7 DAY									
hematocrit	39		41	38	37	28	39	35	33
hemoglobin (g/dL)	8		10	5	7	6	9	7	9
protein (g/dL)	5		7	5	4	5	6	7	6
lactic acid (mg/dL)	88		94	92	73	141	96	97	77
glucose (mg/dL)	107		109	96	102	67	97	106	116
HEMATOLOGY - 28 DAY									
hematocrit	40		36	38	28		39	29	35
hemoglobin (g/dL)	8		8	9	6		7	6	8
protein (g/dL)	6		5	6	3		5	5	5
lactic acid (mg/dL)	62		45	52	32		69	27	48
glucose (mg/dL)	139		155	112	76		122	85	85
white blood cells (%)	0.6		3.8	0.7	4.8		4.5	2.9	1.5

Table 12. Body Condition Factors and Liver Somatic Indices for Trout and Walleye from the 7 and 28 Day Tests and Body Condition Factors for Larval Trout (28 day Test)

Parameter		Lab Controls	Tar Island Dyke Water					Athabasca River	Naphthenic Acids	Beta-Naphthoflavo
			0.01	0.1	1	10	50			
Body Condition Factor (klt; x10^3)										
trout	7-day	1.4		1.2	1.2	1.2	1.4	1.2	1.3	1.3
	28-day	1.4	1.1	1.1	1.0	1.1		1.1	0.8	1.2
walleye	7-day	0.9		0.8	0.8	0.7		0.8	0.8	
	28-day	0.8		0.8	0.8	0.8		0.9	0.8	0.8
larval trout	28-day	0.9		1.0	1.0	0.9		1.1	1.0	0.9
Liver Somatic Index (LSI, x100)										
trout	7-day	1.6		1.1	1.1	0.9	1.1	1.2	1.2	1.5
	28-day	1.1		1.5	1.2	1.6		1.1	2.3	1.6
walleye	7-day	1.1		1.7	1.5	1.3		1.3	1.7	
	28-day	2.2	2.2	2.0	2.0	2.0		1.5	2.0	2.0

Table 13. Induction of Liver Mixed Function Oxidase Activity in Trout from the 7 and 28 Day Exposures (all activities expressed as a ratio to rates obtained from the river water exposures)

Condition	National Water Research Institute[1]		EnviroTest Laboratories[2]	
	EROD-7 d Test	EROD-28 d Test	AHH	EROD
lab control	1.2			
Tar Island Dyke Wastewater (%)				
0.01				
0.1	1.5			
1	2.1			
10	2.5		3.5	3.3
50	1.4			
Athabasca River Water	1.0		1.0	1.0
Naphthenic Acids	1.3			
Beta-naphthoflavone	12.4		3.1	7.6

Notes: 1. base rates of 29 pmol/min/mg for AHH and 64 pmol/mg/min for EROD
2. base rate of 1.3 pmol/min/mg for EROD
3. AHH, aryl hydrocarbon hydroxylase; EROD, 7-thoxyresorufin-O-deethylase
4. values missing were not done or reported

Table 14. Summary of Challenge Test Results on Larval Trout from the 28 Day Exposure

Condition	Growth[1] (mg)	Disease Resistance[2] (% mortality)	Swimming Stamina[3] (% remaining at 3 h)
lab control	0.3	40	21
Tar Island Dyke Wastewater (%)			
0.01	0.4	33	13
0.1	0.5	20	35
1	0.4	27	27
10	not done	27	not done
Athabasca River Water	0.6	53	14
Naphthenic Acids	0.5	25	26
Beta-naphthoflavone	0.2	27	3

Notes: 1. growth is based on final dry weight at test termination
2. diseases resistance data from highest treatment (1 to 2 x 10^6 CFU per mL)
3. swimming stamina data are from the first swim after 3 hours

FIGURES

LIST OF FIGURES

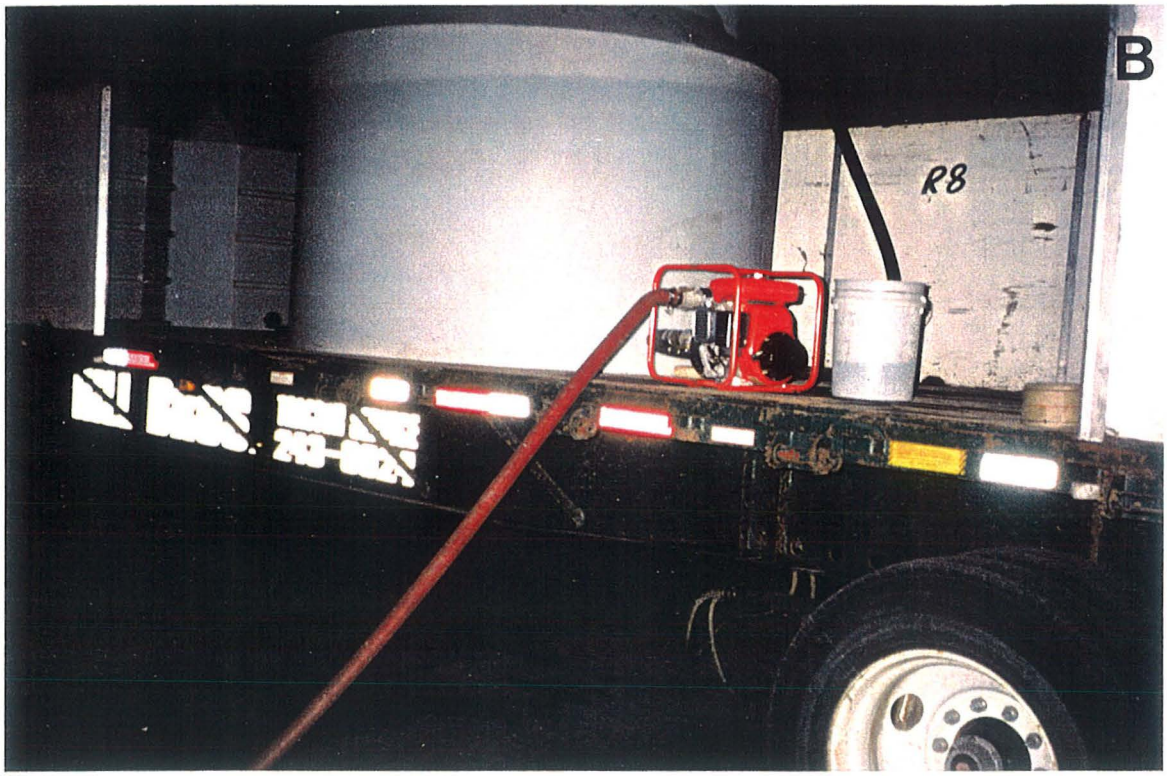


Figure 1. Method for the Transport and Handling of Large Samples
a. Flatbed and tractor; b. Off loading sample

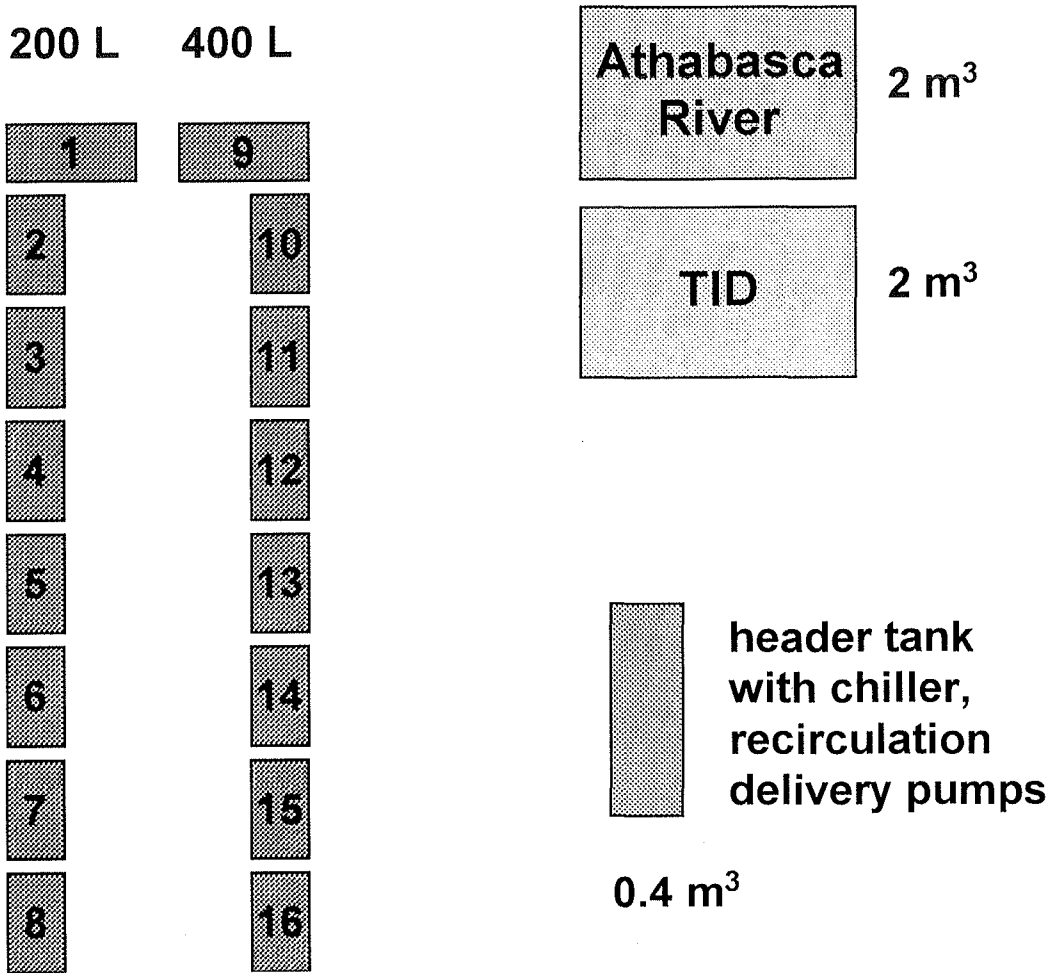


Figure 2. General Overview of Fish Exposure Unit (FEU)

(tank numbers are as indicated; the walleye were exposed in tanks 1 to 8 and the trout in tanks 9 to 16)

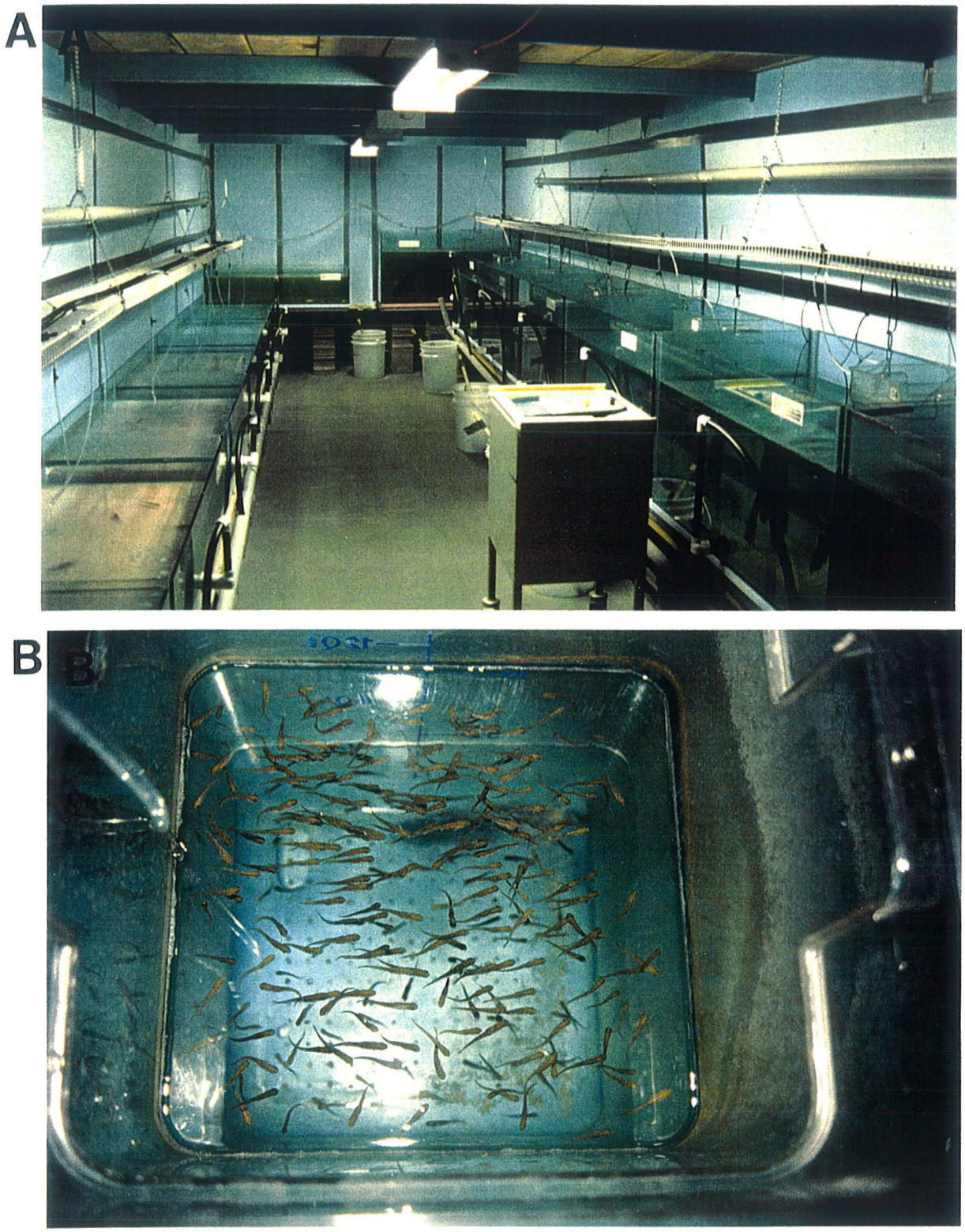


Figure 3. Photographs of the Fish Exposure Unit (FEU)

a. Tanks 1 to 8 are on the left (200 L) and tanks 9 to 16 on the right (400 L); note the fry vessels (b) and SPMD,s suspended in the large tanks on the left

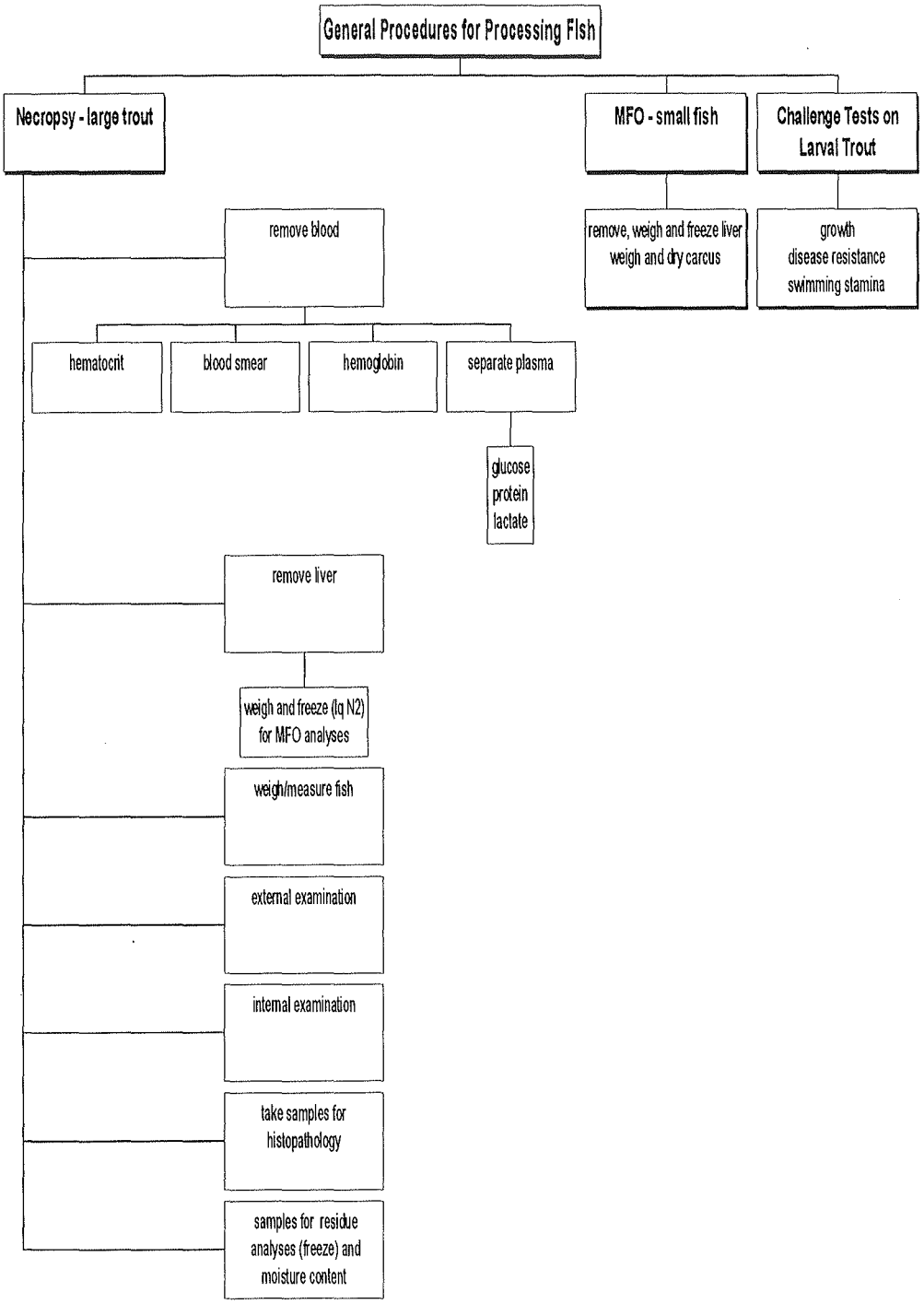


Figure 4. Fish Processing Flow Chart

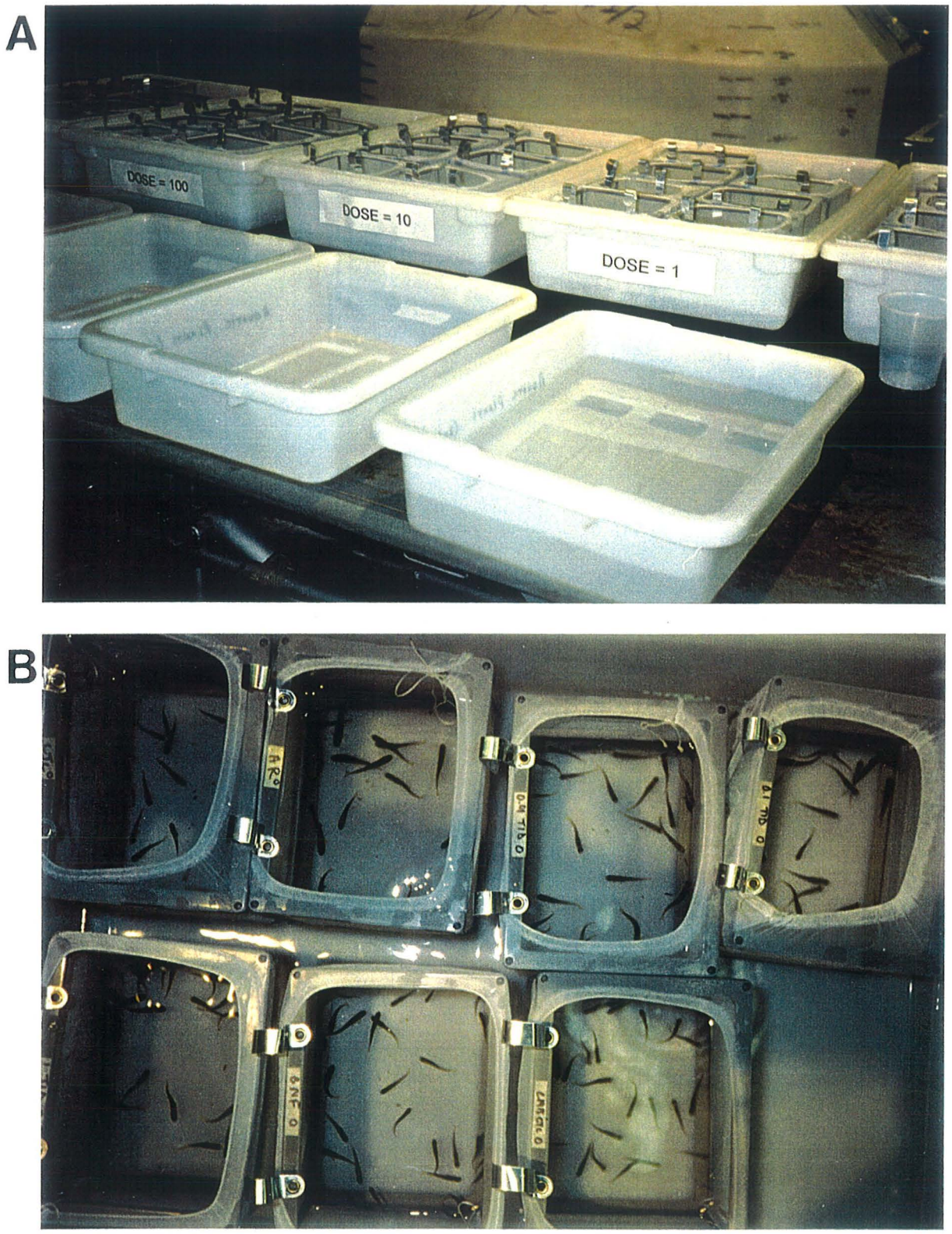


Figure 5. Disease Resistance Challenge Test

a. Fry are being exposed to the pathogen, rinse baths in foreground
b. Close up of fry in box cages

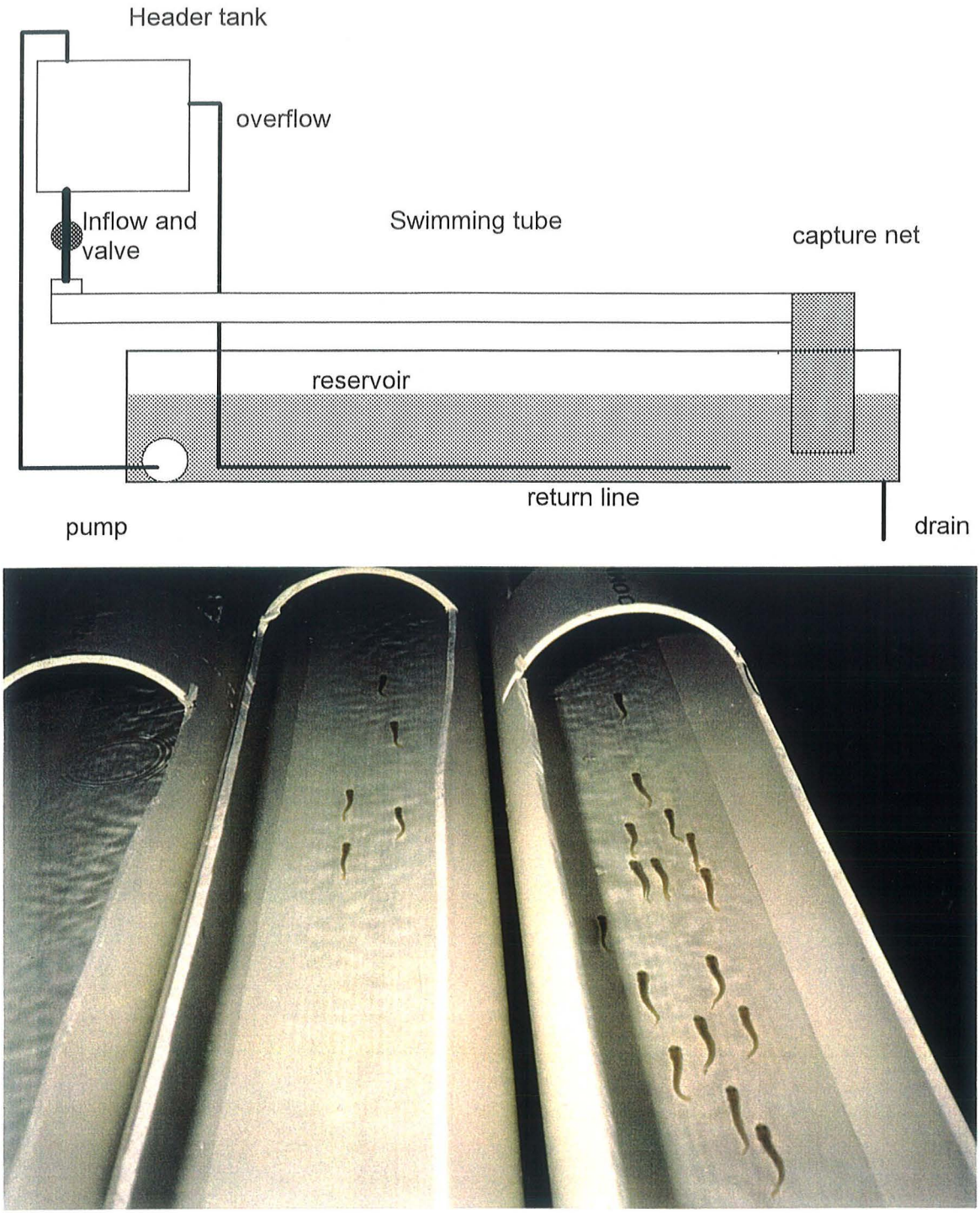


Figure 6. Swimming Stamina Challenge Test

a. Schematic of test apparatus
b. Close up of fish in swimming tubes

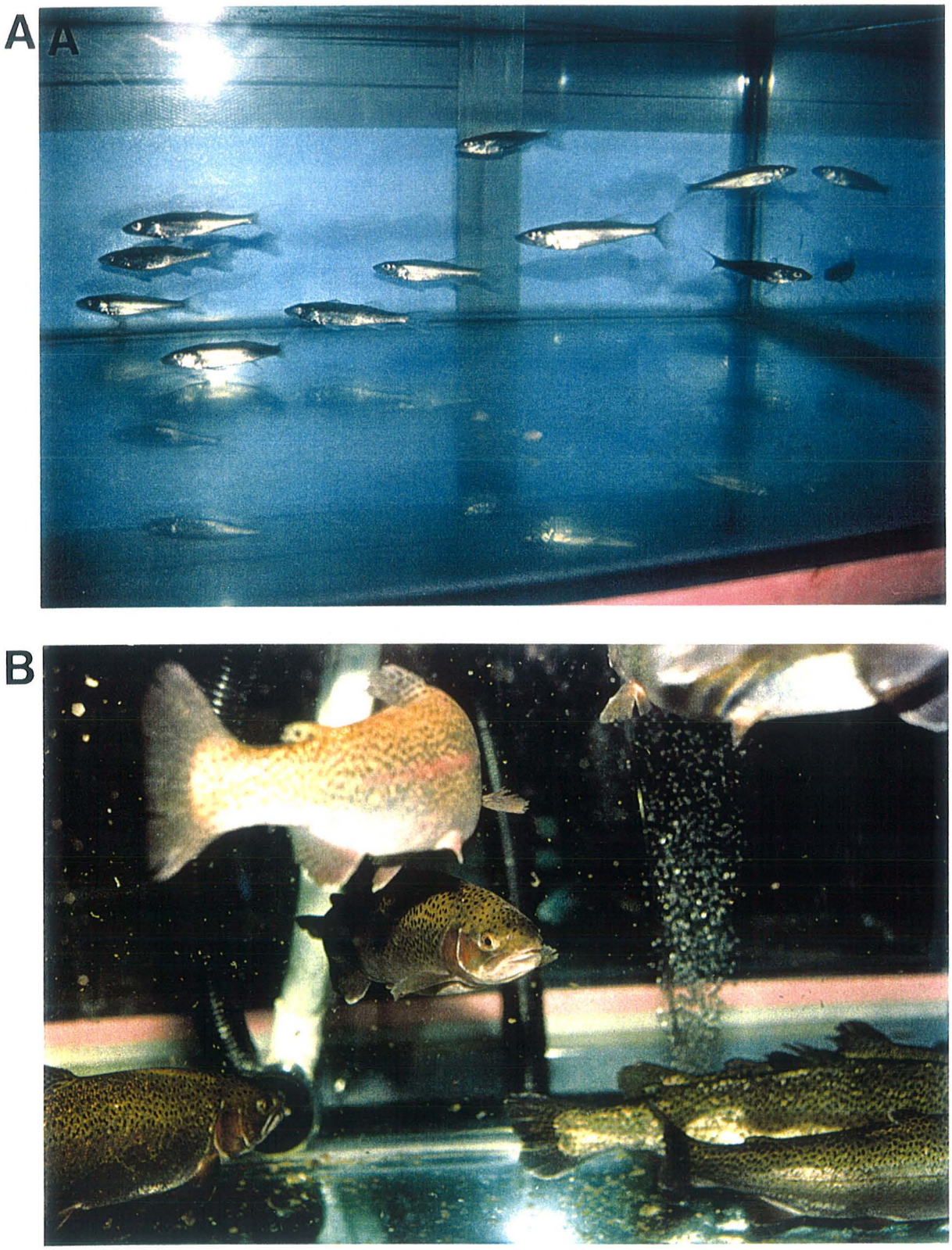


Figure 7. Photographs of the Walleye (a) and Trout in the Laboratory Control Tanks

Figure 8. Photograph of a SPMD Deployed in a Tank (a) and Removal from the Holding Net (b)

APPENDICES

APPENDICES

- Trophic effects test reports
- Water quality data for 7 and 28 day exposures
- Summary data sheets for 7 and 28 day exposures
- Necropsy summary data sheets
- Liver mixed function oxidases results for 7 and 28 day tests
- Histopathological assessment by GlobalTox International Inc.
- Challenge test data sheets
- Chemical analysis of Tar Island Dyke water

Trophic effects test reports

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95293

CLIENT INFORMATION

Client:	Suncor Inc., Oil Sands Group
Operation:	Ft. McMurray
Address:	P.O. Box 4001
City:	Ft. McMurray
Province/State:	Alberta
Country:	Canada
Postal/ZIP Code:	T9H 3E3
Billing Information:	lease 86 reclamation program - task 6127 (invoice to Suncor)
Contact:	Trina Hoffarth
Tel:	403-743-6715
Fax:	403-791-8339

SAMPLE INFORMATION

Sample Type:	water - Tar Island (site: RW128, number: T004)		
Collected On:	95/07/25	At:	not given
Collected By:	not given		
Shipped On:	95/07/26		
Shipped By:	Grimshaw Trucking		
Received On:	95/07/26	At:	0900
Received By:	T. Befus		
Container:	20 L plastic carboys		
Seals:	not sealed		
Initials on Seals:	not applicable		

INITIAL CHEMISTRY

pH (units)	8.1	ammonium (mg-N/L)	not done
Conductance (uS/cm)	1302	residual chlorine (mg/L)	not done
Dissolved Oxygen (mg/L)	5.5	Colour:	yellow
Temperature (oC)	21	Odour:	organic
Alkalinity (mg-CaCO3/L)	not done		
Hardness (mg-CaCO3/L)	68		

COMMENTS

data sent to Chris Fordham with copies to John Gulley/Trina Hoffarth at Suncor Environmental Affairs (fax: 403-791-8399)

SAMPLE HISTORY

Storage Conditions: 5oC in darkness

Disposed On: _____ by _____ Method: _____

TEST LOG

Test Type	TR(D)	BL(S)				
Number	950593	950594				
Started	95/07/28	95/07/27				
Ended	95/08/01	95/07/27				
Reported	95/08/10	95/08/10				
Faxed						

NOTES: TR, trout; FM, fathead minnows; DA, Daphnia; CD, Ceriodaphnia; AG, Selenastrum; BL, bacterial luminescence; D, definitive test; S, screening test

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95293	Test: 950593

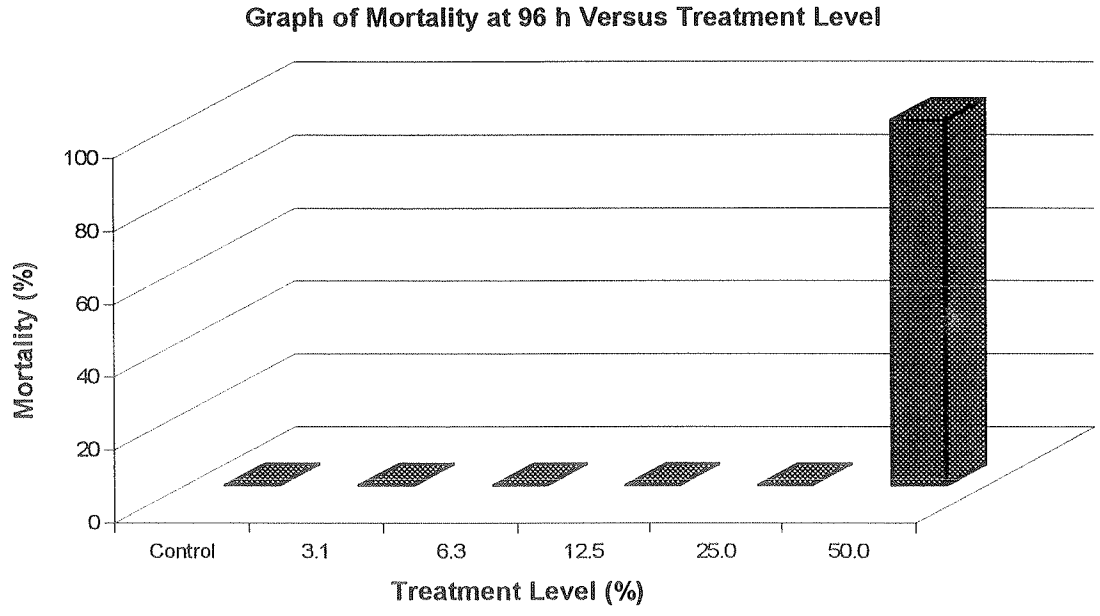
Test Method: Trout 96h Static Acute Test (LC50, five or more treatment levels plus a control)
Reference: Biological Test method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, 1990. Environment Canada, EPS 1/RM/13.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:
Description: water - Tar Island (site: RW128, number: T004)
Collected On: 95/07/25 At: not given By: not given
Received On: 95/07/26 At: 0900 By: T. Befus

Test Information:
Started On: 95/07/28 At: 1315 By: JR/JF
Ended On: 95/08/01 At: 1130 By: JR/JF
Reported On: 95/08/10 By: MG

Test Result:	Value	Confidence Limits		Units	Method Calculated
LC25				%	
LC50	35.4	25	50	%	Binomial
NOEC				%	
LOEC				%	



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95293	Test: 950593

PREAERATION	not required				
time (h)	0	0.5	1	1.5	2
DO (mg/L)					
comments	none				

	CHEMISTRY				BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)		Cond.(uS/cm)	DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/07/28			Time: 1315		Initials: JR/JF				Temp (oC): 14.7					
Control	8.0		350	8.6	10									
3.13	8.1		382	8.6	10									
6.25	8.1		413	8.6	10									
12.5	8.2		495	8.4	10									
25	8.2		582	8.3	10									
50	8.3		867	7.8	10									
Date: 95/07/29			Time: 1230		Initials: DM/JF				Temp (oC): 14.9					
Control	8.1		348	7.7	10									
3.13	8.1		388	7.5	10									
6.25	8.1		420	7.4	10									
12.5	8.2		504	7.4	10									
25	8.3		588	7.4	10									
50	8.4		872	6.6	10									
Date: 95/07/30			Time: 1145		Initials: DM/JF				Temp (oC): 14.5					
Control	7.4		354	7.4	10									
3.13	7.6		389	7.0	10									
6.25	7.7		422	6.8	10									
12.5	7.9		505	6.8	10									
25	8.1		592	6.9	10									
50	8.3		878	6.5	0									
Date: 95/07/31			Time: 1010		Initials: DM/JR				Temp: 14.4					
Control	8.1		355	7.7	10									
3.13	8.1		392	7.4	10									
6.25	8.1		426	7.1	10									
12.5	8.2		511	6.9	10									
25	8.3		598	6.8	10									
50	8.5		882	6.6	0									

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95293	Test: 950593

CHEMISTRY

Treatment (%)	pH (units)		Cond.(uS/cm)		DO (mg/L)	
Control	8.1		360		7.6	
3.13	8.0		396		7.6	
6.25	8.0		430		7.1	
12.5	8.1		513		7.0	
25	8.1		599		6.5	
50						

BIOLOGY - NUMBER ALIVE

REPLICATE									
1	2	3	4	5	6	7	8	9	10
10	10	10	10	10	0				

Date: 95/08/01	Time: 1130	Initials: JR/JF	Temp: 14.4

SUMMARY TABLE

TREATMENT (%)	MORTALITY (%)	mg NH4-N/L t=0	mg NH4-N/L t=96 h
Control	0	<0.1	0.5
3.1	0	nd	nd
6.3	0	nd	nd
12.5	0	nd	nd
25.0	0	nd	nd
50.0	100	1.2	1.4

Control
3.1
6.3
12.5
25.0
50.0

REPLICATE										
	1	2	3	4	5	6	7	8	9	10
avg	individual fish weights (g)									
avg	individual fish fork lengths (cm)									

COMMENTS: Fish added at: 1210 Batch number:TR950711 No. days held: 17

Time (h)	Test done in 10L volumes using small fish.
24	
48	
72	
96	All fish in 25% highly stressed (lying on sides at bottom of pail). Remaining fish appear normal.

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95293	Test: 950594

Test Method: Bacterial luminescence Test. Screening test (one treatment level plus a control)
Reference: Biological Test Method: Toxicity Test Using Luminescent Bacteria (*Photobacterium phosphoreum*), 1992. Environment Canada, EPS 1/RM/24.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:

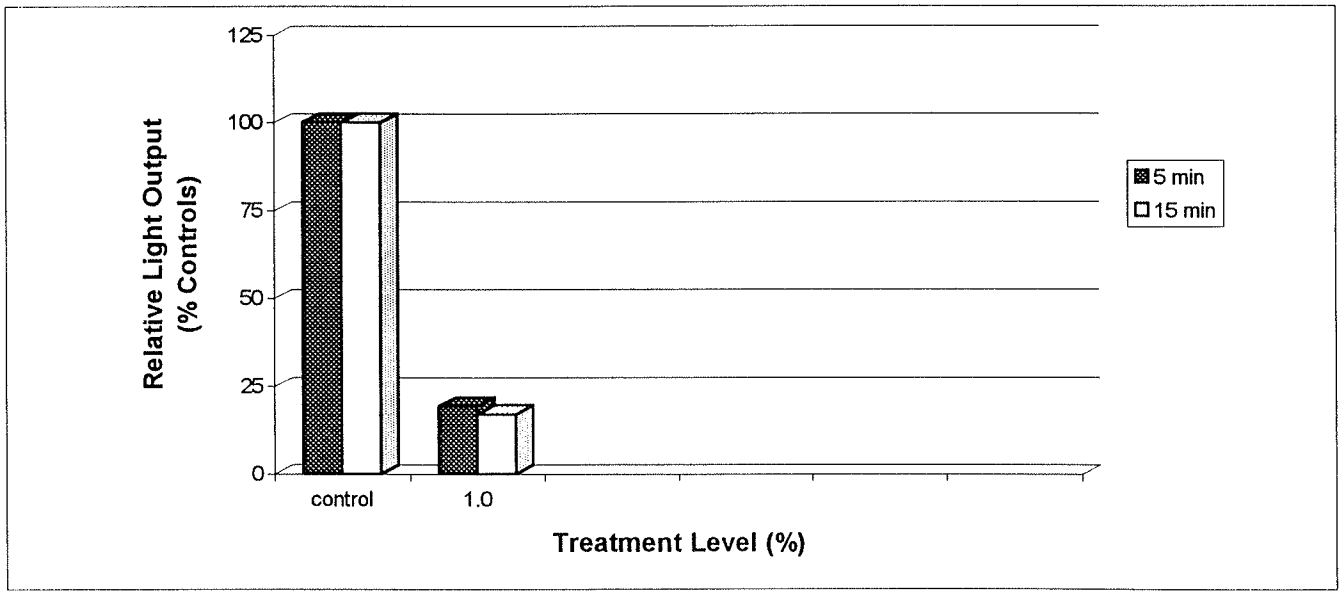
Description:	water - Tar Island (site: RW128, number: T004)				
Collected On:	95/07/25	At:	not given	By:	not given
Received On:	95/07/26	At:	0900	By:	T. Befus

Test Information:

Started On:	95/07/27	At:	1530	By:	JR
Ended On:	95/07/27	At:		By:	JR
Reported On:	95/08/10			By:	MG

Test Result: 15% expressed as a percentage of the controls.

Graph of Light Ouput Relative to Controls at 5 and 15 Minutes



Notes: IC20 & IC50, concentrations that inhibit light output relative to controls by 20 and 50%

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95293	Test: 950594

SAMPLE PRETREATMENT

pH adjustment	not required
preaeration	not required
turbidity	not centrifuged/filtered
other	none

LIGHT READINGS

	Time (min)		
Treatment Level (%)	0	5	15
control	85	88	88
1.0	22	17	15

INHIBITION (%CTLS)	
5 min	15 min
100	100
19	17

COMMENTS

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-1

CLIENT INFORMATION

Client:	Suncor Inc., Oil Sands Group
Operation:	Ft. McMurray
Address:	P.O. Box 4001
City:	Ft. McMurray
Province/State:	Alberta
Country:	Canada
Postal/ZIP Code:	T9H 3E3
Billing Information:	
Contact:	Trina Hoffarth
Tel:	403-743-6715
Fax:	403-791-8331

SAMPLE INFORMATION

Sample Type:	effluent (Tar Island dyke)		
Collected On:	95/08/11	At:	not given
Collected By:	not given		
Shipped On:	95/08/11		
Shipped By:	Grimshaw Trucking		
Received On:	95/08/11	At:	2010
Received By:	S. Goudey		
Container:	3 x 500 gal. containers		
Seals:	not sealed		
Initials on Seals:	not applicable		

INITIAL CHEMISTRY

pH (units)	8.3	ammonium (mg-N/L)	not done
Conductance (uS/cm)	1256	residual chlorine (mg/L)	not done
Dissolved Oxygen (mg/L)	8.4	Colour:	yellow
Temperature (oC)	19	Odour:	hydrocarbon
Alkalinity (mg-CaCO3/L)	not done		
Hardness (mg-CaCO3/L)	80		

COMMENTS sample container leaked in shipment

SAMPLE HISTORY

Storage Conditions: 5oC in darkness

Disposed On: _____ by _____ Method: _____

TEST LOG

Test Type	DA(D)	TR(D)	BL(S)	AG(D)	CD(D)	FM(D)	
Number	950913	950679	950914	950671	950670	950672	
Started	95/09/27	95/08/15	95/08/14	95/08/14	95/08/12	95/08/14	
Ended	95/09/29	95/08/19	95/08/14	95/08/17	95/08/19	95/08/21	
Reported	95/10/03	95/10/03	95/10/03	95/10/03	95/10/03	95/10/03	
Faxed							

NOTES: TR, trout; FM, fathead minnows; DA, Daphnia; CD, Ceriodaphnia; AG, Selenastrum; BL, bacterial luminescence; D, definitive test; S, screening test

HydroQual
Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-1	Test: 950913

Test Method: *Daphnia* 48h Static Acute Test (LC50, five or more treatments plus a control)
Reference: Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to *Daphnia magna*, 1990. Environment Canada, EPS 1/RM/14.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:

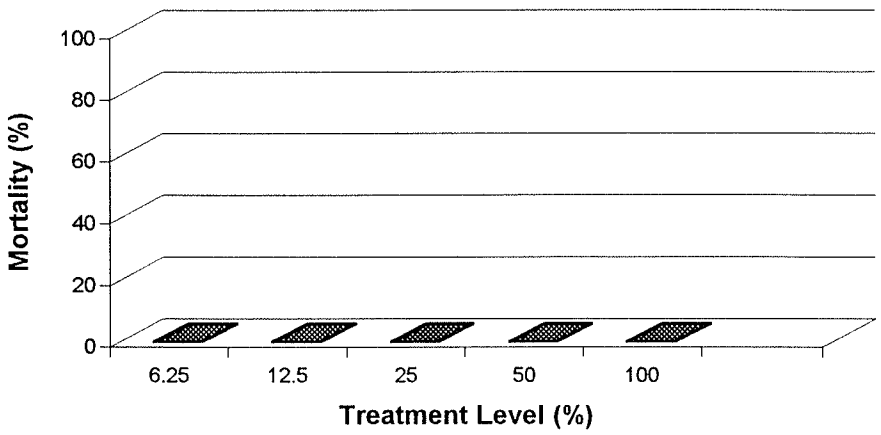
Description:	effluent (Tar Island dyke)				
Collected On:	not given	At:	not given	By:	not given
Received On:	95/08/11	At:	2010	By:	S. Goudey

Test Information:

Started On:	95/09/27	At:	1330	By:	SF/DM
Ended On:	95/09/29	At:	1420	By:	DM
Reported On:	95/10/03			By:	CG

Test Result:	Value	Confidence Limits	Units	
LC25	>100		%	
LC50	>100		%	Not Toxic
NOEC	100		%	
LOEC	>100		%	

Graph of Mortality at 48 h Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95320-1	Test: 950913

	CHEMISTRY					BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)		Cond.(uS/cm)		DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/09/27			Time: 1330		Initials: SF/DM			Temp (oC): 20							
Control	8.4		354		8.2	5	5								
6.25	8.4		416		8.2	5	5								
12.5	8.5		471		8.2	5	5								
25	8.4		584		8.1	5	5								
50	8.4		810		7.7	5	5								
100	8.4		1252		6.7	5	5								
Date: 95/09/28			Time: 1020		Initials: DM/SF			Temp (oC): 20							
Control						5	5								
6.25						5	5								
12.5						5	5								
25						5	5								
50						5	5								
100						5	5								
Date: 95/09/29			Time: 1420		Initials: DM			Temp (oC): 20							
Control	8.6		371		7.7	5	5								
6.25	8.6		425		7.6	5	5								
12.5	8.7		485		7.4	5	5								
25	8.7		597		7.4	5	5								
50	8.9		819		7.2	5	5								
100	9.0		1283		7.2	5	5								

SUMMARY TABLE	
TREATMENT (%)	MORTALITY (%)
Control	0
6.25	0
12.5	0
25	0
50	0
100	0

young :	hardness (mg-CaCO3/L) : 180
water : bucket 4	Adjustment: none

COMMENTS:
no comments

Notes: F, floating; I, immobile; B, stuck on bubbles; D, caught in debris

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-1	Test: 950679

Test Method: Trout 96h Static Acute Test (LC50, five or more treatment levels plus a control)
Reference: Biological Test method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, 1990. Environment Canada, EPS 1/RM/13.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:

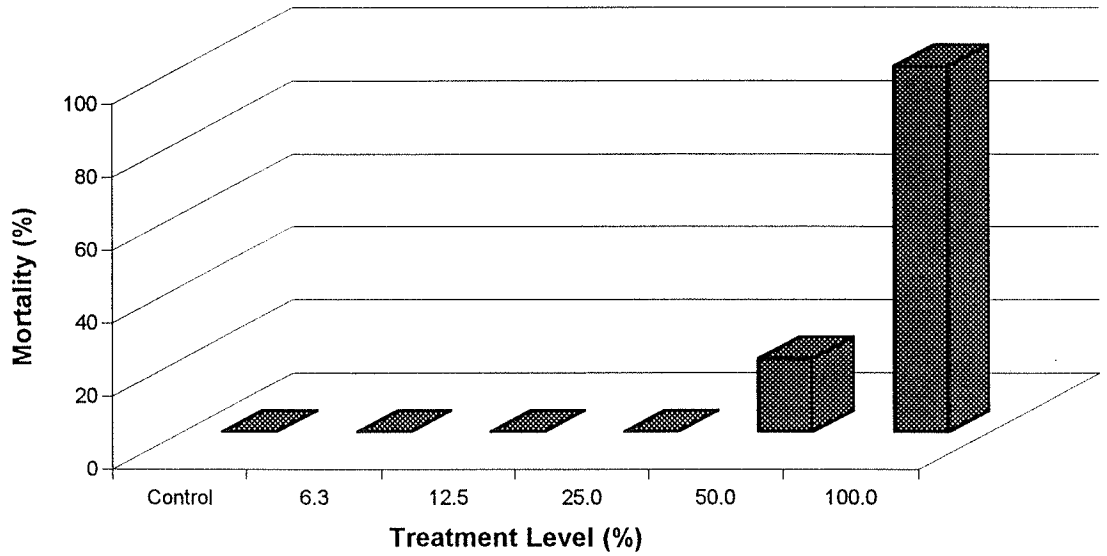
Description:	effluent (Tar Island dyke)				
Collected On:	not given	At:	not given	By:	not given
Received On:	95/08/11	At:	2010	By:	S. Goudey

Test Information:

Started On:	95/08/15	At:	1130	By:	JF
Ended On:	95/08/19	At:	1130	By:	DL
Reported On:	95/10/03			By:	CG

Test Result:	Value	Confidence Limits		Units	Method Calculated
LC25				%	
LC50	62	25	100	%	Binomial
NOEC				%	
LOEC				%	

Graph of Mortality at 96 h Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95320-1	Test: 950679

PREAERATION	not required				
time (h)	0	0.5	1	1.5	2
DO (mg/L)					
comments	none				

	CHEMISTRY			BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)	Cond.(uS/cm)	DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/08/15		Time: 1130		Initials: GD/JF		Temp (oC): 17.3							
Control	8.0	363	8.6	10									
6.25	7.7	426	8.6	10									
12.5	7.8	478	8.5	10									
25	8.2	574	8.4	10									
50	8.4	846	7.9	10									
100	8.5	1294	7.5	10									
Date: 95/08/16		Time: 1500		Initials: DM/JF		Temp (oC): 15.7							
Control	8.6	358	8.9	10									
6.25	8.7	423	9.0	10									
12.5	8.8	476	9.0	10									
25	8.8	570	9.0	10									
50	9.0	843	8.9	10									
100	9.0	1285	8.9	0									
Date: 95/08/17		Time: 1500		Initials: DM/JF		Temp (oC): 15.0							
Control	8.4	357	8.9	10									
6.25	8.3	418	8.9	10									
12.5	8.5	471	8.7	10									
25	8.6	565	8.9	10									
50	8.7	828	8.9	10									
100				0									
Date: 95/08/18		Time: 1030		Initials: JF/DM		Temp: 15.3							
Control	8.5	359	8.9	10									
6.25	8.6	421	8.9	10									
12.5	8.6	475	8.9	10									
25	8.7	571	9.0	10									
50	8.9	837	9.0	9									
100				0									

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-1	Test: 950679

CHEMISTRY / **BIOLOGY - NUMBER ALIVE**

Treatment (%)	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/08/19			Time: 1130				Initials: DL						Temp: 14.8			
Control	8.3		347		9.2		10									
6.25	8.5		414		9.2		10									
12.5	8.5		470		9.2		10									
25	8.6		567		9.2		10									
50	8.8		834		9.1		8									
100							0									

SUMMARY TABLE

TREATMENT (%)	MORTALITY (%)	mg NH4-N/L t=0	t=96 h		REPLICATE 1	2	3	4	5	6	7	8	9	10
				avg	individual fish weights (g)									
Control	0	nd	nd	0.44	0.38	0.49	0.62	0.36	0.48	0.36	0.47	0.44	0.45	0.34
6.3	0	nd	nd	0.44	0.37	0.35	0.48	0.47	0.61	0.37	0.44	0.51	0.35	0.43
12.5	0	nd	nd	0.40	0.53	0.39	0.45	0.35	0.32	0.34	0.43	0.42	0.30	0.42
25.0	0	nd	nd	0.44	0.51	0.32	0.43	0.42	0.37	0.43	0.50	0.43	0.50	0.50
50.0	20	nd	nd	0.57	0.43	0.55	0.43	0.81	0.65	0.50	0.68	0.53	0.62	0.46
100.0	100	nd	nd	0.55	0.49	0.46	0.57	0.67	0.46	0.52	0.75	0.40	0.74	0.47
				avg	individual fish fork lengths (cm)									
Control				3.7	3.4	3.7	4.1	3.5	3.8	3.5	3.9	3.6	3.6	3.4
6.3				3.6	3.7	3.5	4.0	3.6	3.2	4.0	3.7	3.6	3.3	3.5
12.5				3.5	3.9	3.5	3.6	3.3	3.4	3.4	3.7	3.6	3.6	3.2
25.0				3.5	3.9	3.1	3.5	3.5	3.1	3.5	3.8	3.7	3.2	3.8
50.0				3.5	3.6	3.5	3.4	3.9	3.8	3.4	3.1	3.7	3.4	3.6
100.0				3.8	3.7	3.6	3.7	3.8	3.8	3.7	4.1	3.5	4.2	3.6

COMMENTS: Fish added at: 1100 Batch number:TR950726 No. days held: 20

Time (h)	
24	
48	one fish on side in 50%, remaining fish appear normal
72	one dead in 50% (rest of 50's sluggish); remaining fish appear normal
96	one dead, 3 swimming on side in 50%

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-1	Test: 950914

Test Method: Bacterial luminescence Test (screening test, one treatment level plus a control)
Reference: Biological Test Method: Toxicity Test Using Luminescent Bacteria (*Photobacterium phosphoreum*), 1992. Environment Canada, EPS 1/RM/24.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:

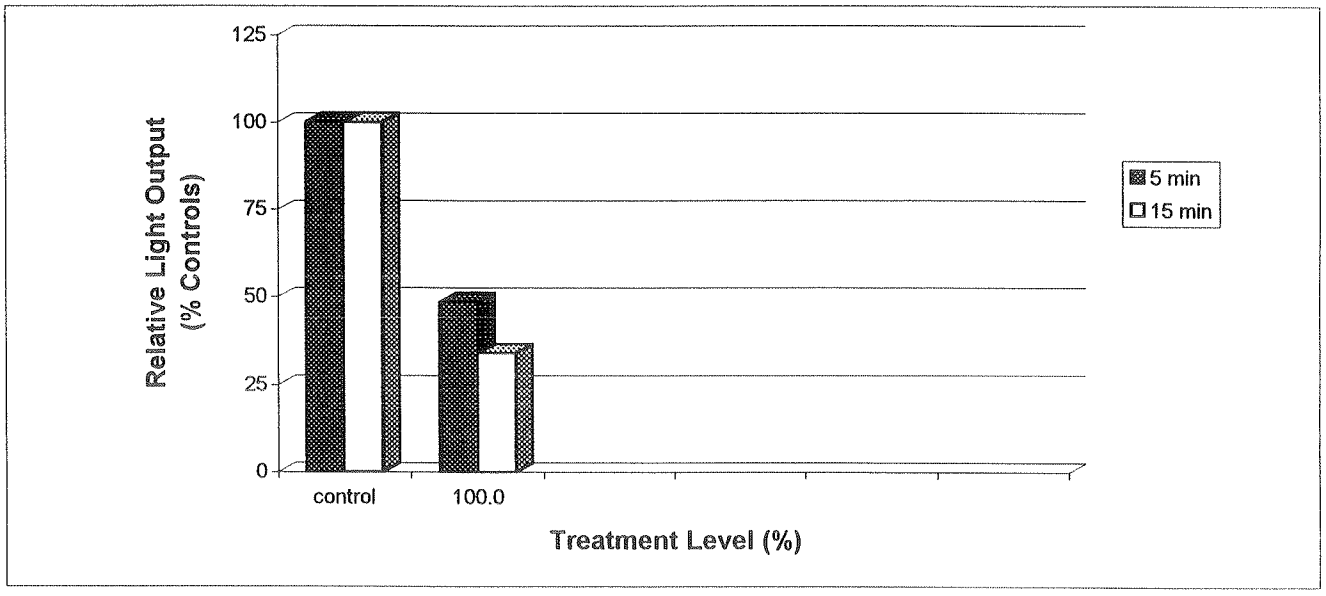
Description:	effluent (Tar Island dyke)				
Collected On:	not given	At:	not given	By:	not given
Received On:	95/08/11	At:	2010	By:	S. Goudey

Test Information:

Started On:	95/08/14	At:		By:	DL
Ended On:	95/08/14	At:		By:	DL
Reported On:	95/10/03			By:	CG

Test Result: 34% expressed as a percentage of the control.

Graph of Light Ouput Relative to Controls at 5 and 15 Minutes



HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95320-1	Test: 950914

SAMPLE PRETREATMENT

pH adjustment	not required
preaeration	not required
turbidity	not centrifuged/filtered
other	none

LIGHT READINGS

	Time (min)		
Treatment Level (%)	0	5	15
control	94	95	91
100.0	67	46	31

INHIBITION (%CTLS)	
5 min	15 min
100	100
48	34

COMMENTS

HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-1	Test: 950671

Test Method: 72h Algal Growth Inhibition Test (IC50, five or more treatments plus a control)
Reference: Biological Test Method: Growth Inhibition Test Using the Freshwater Alga *Selenastrum capricornutum*, 1992. Environment Canada, EPS 1/RM/25.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:

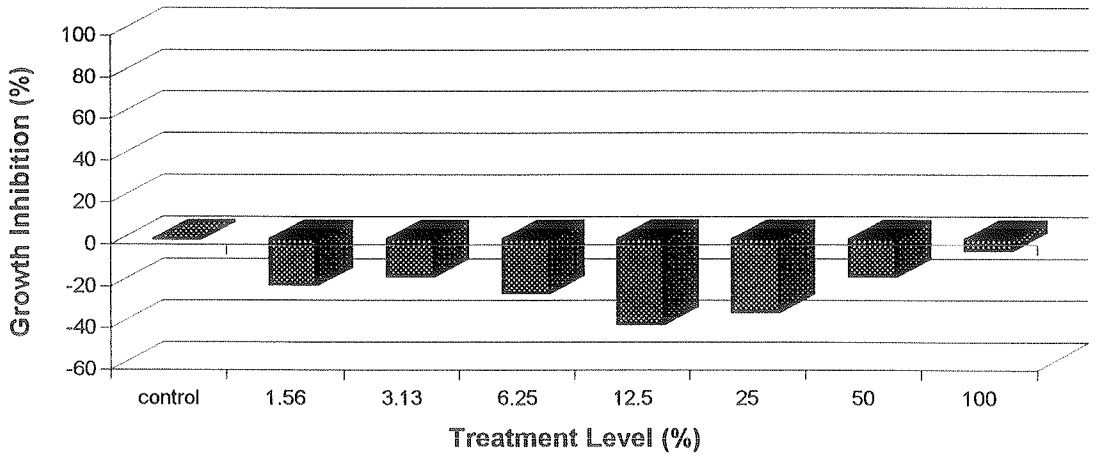
Description:	effluent (Tar Island dyke)				
Collected On:	not given	At:	not given	By:	not given
Received On:	95/08/11	At:	2010	By:	S. Goudey

Test Information:

Started On:	95/08/14	At:	1230	By:	JR
Ended On:	95/08/17	At:	1430	By:	DL
Reported On:	95/10/03			By:	SA

Test Results:	Value	Confidence Limits	Units	
IC25	>100		%	
IC50	>100		%	Not Toxic
NOEC	100		%	
LOEC	>100		%	

Graph of Percent Inhibition Versus Treatment Level



HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030 Sample: 95320-1 Test: 950671

SAMPLE PRETREATMENT	
pH adjustment	not required
preaeration	not required
turbidity	not centrifuged
other	none

TEST DATA

FINAL CELL DENSITIES (cells/mL)

Treatment (%)	Replicate A	B	C	Average AVG	Standard Deviation	CV (%)	Percent Controls	Inhibition (%Ctls)
control	1256877	1358769	1295693	1303780	51425	4	100	0
1.56	1298928	1619160	1832648	1583579	268633	17	121	-21
3.13	1468748	1531824	1594900	1531824	63076	4	117	-17
6.25	1468748	1837500	1604604	1636951	186492	11	126	-26
12.5	1638568	2026728	1827796	1831031	194100	11	140	-40
25	1568000	1916000	1772000	1752000	174860	10	134	-34
50	1400000	1644000	1556000	1533333	123569	8	118	-18
100	1168000	1514667	1422667	1368444	179581	13	105	-5

COMMENTS

- all cell numbers were based on particle counts
- the initial cell density was 11,452 cells/mL

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-1	Test: 950670

Test Method: 7 d Ceriodaphnia Survival and Reproduction Test (5 treatment levels plus a control)
Reference: Biological Test Method: Test of Reproduction and Survival Using the Cladoceran *Ceriodaphnia dubia*, 1992. Environment Canada, EPS 1/RM/21.

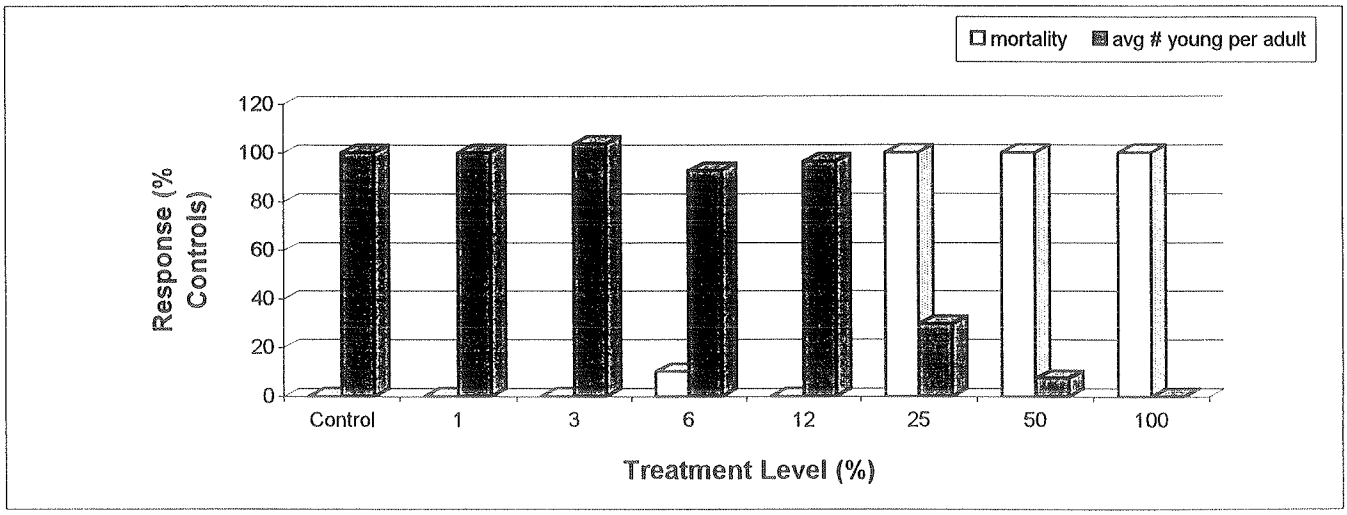
Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:
Description: effluent (Tar Island dyke)
Collected On: not given At: not given By: not given
Received On: 95/08/11 At: 2010 By: S. Goudey

Test Information:
Started On: 95/08/12 At: 1245 By: DM
Ended On: 95/08/19 At: 1000 By: DL
Reported On: 95/10/03 By: CG

Test Result:		Value	Confidence Limits		Units	Method Calculated
MORTALITY	LC25	15	14	15	%	Bootstrap
	LC50	18	17	19	%	Bootstrap
	NOEC	12.5			%	Estimated
	LOEC	25			%	Estimated
REPRODUCTION						
	IC25	16	13	17	%	Bootstrap
	IC50	20	18	21	%	Bootstrap
	NOEC	12.5			%	Steel's Many-One
	LOEC	25			%	Steel's Many-One

Graph of Mortality and Reproduction at Seven Days Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; IC25 & IC50, concentrations inhibiting reproduction by 25 and 50%; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95320-1	Test: 950670

PREAERATION not required

FILTRATION not required

Comments none

Treatment (%)	CHEMISTRY pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	BIOLOGY - NUMBER OF YOUNG REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 0 95/08/12			Time: 1245				Initials: DM		Temp (oC): 25.0							
Control	8.3		350		7.5		0	0	0	0	0	0	0	0	0	0
1	8.3		368		7.8		0	0	0	0	0	0	0	0	0	0
3	8.4		383		7.8		0	0	0	0	0	0	0	0	0	0
6	8.4		412		7.8		0	0	0	0	0	0	0	0	0	0
12	8.4		467		7.7		0	0	0	0	0	0	0	0	0	0
25	8.4		583		7.7		0	0	0	0	0	0	0	0	0	0
50	8.4		800		7.8		0	0	0	0	0	0	0	0	0	0
100	8.5		1247		8.4		0	0	0	0	0	0	0	0	0	0
DAY 1 95/08/13			Time: 1215				Initials: DM		Temp (oC): 25.0							
Control	8.4	8.4	358	370	7.8	7.8	0	0	0	0	0	0	0	0	0	0
1	8.4	8.3	371	383	7.6	7.7	0	0	0	0	0	0	0	0	0	0
3	8.4	8.4	385	397	7.6	7.8	0	0	0	0	0	0	0	0	0	0
6	8.5	8.4	419	426	7.9	7.9	0	0	0	0	0	0	0	0	0	0
12	8.5	8.5	475	489	7.8	8.0	0	0	0	0	0	0	0	0	0	0
25	8.6	8.7	590	602	7.7	7.8	0	0	0	0	0	0	0	0	0	0
50	8.6	8.8	822	820	7.7	7.7	0	0	0	0	0	0	0	0	0	0
100	8.7	9.0	1278	1243	7.5	7.8		0			0	0	0			0
DAY 2 95/08/14			Time: 1200				Initials: DM		Temp (oC): 25.0							
Control	8.3	8.3	358	362	7.6	7.8	0	0	0	0	0	0	0	0	0	0
1	8.2	8.2	366	371	7.7	7.5	0	0	0	0	0	0	0	0	0	0
3	8.3	8.3	383	386	7.6	7.5	0	0	0	0	0	0	0	0	0	0
6	8.3	8.3	420	417	7.7	7.5	0	0	0	0	0	0	0	0	0	0
12	8.4	8.5	472	493	7.7	7.4	0	0	0	0	0	0	0	0	0	0
25	8.5	8.6	585	608	7.5	7.6	0	0	0	0	0	0	0	0	0	0
50	8.5	8.7	816	814	7.4	7.6	0	0	0	0	0	0	0	0	0	0
100		8.8		1212		7.4										
DAY 3 95/08/15			Time: 1415				Initials: DM		Temp: 25.0							
Control	8.3	8.4	358	376	7.6	7.8	0	0	0	4	5	6	4	5	6	4
1	8.3	8.5	373	383	7.5	7.8	0	0	0	6	6	5	3	5	6	7
3	8.4	8.4	389	403	7.6	7.8	0	0	0	6	6	6	6	0	5	6
6	8.4	8.4	421	438	7.5	7.9	0	0	5	5	7	6	4	5	6	0
12	8.5	8.5	478	496	7.5	7.9	0	0	0	3	6	6	6	6	6	6
25	8.6	8.6	598	596	7.5	7.7	4	0	4	5	0	0	2	6	4	5
50	8.6	8.6	840	827	7.5	7.5	2	1	2	0	1	0	2	0	0	2
100																

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-1	Test: 950670

	CHEMISTRY						BIOLOGY - NUMBER OF YOUNG									
Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 4	95/08/16		Time: 1345			Initials: DM			Temp: 25.0							
Control	8.3	8.4	362	371	7.6	8.0	6	5	6	0	0	0	1	2	1	1
1	8.3	8.3	374	380	7.6	8.0	5	3	4	0	0	1	0	0	1	0
3	8.3	8.4	390	398	7.6	8.0	5	5	5	0	1	2	0	0	0	0
6	8.4	8.4	423	429	7.7	7.8	4	4	0	0	1	1	0	1	1	0
12	8.5	8.5	482	487	7.4	7.7	5	5	5	0	1	1	1	1	1	0
25	8.6	8.6	597	630	7.6	8.0	4		4	6		1	2	6	6	5
50	8.7	8.9	837	856	7.5	7.8	1				1					2
DAY 5	95/08/17		Time: 1345			Initials: DM			Temp: 25.0							
Control	8.2	8.4	348	368	7.7	7.7	1	11	12	9	10	7	9	10	11	7
1	8.3	8.5	353	378	7.8	7.5	10	9	7	12	12	11	8	10	10	11
3	8.5	8.5	367	392	7.7	7.6	7	13	8	9	13	11	10	11	12	10
6	8.5	8.5	397	425	7.8	7.5	10	8	12	10	12	11	11	10	9	4
12	8.5	8.5	460	478	7.7	7.5	12	9	10	7	12	9	9	8	10	10
25		8.6		588		7.4										
50																
DAY 6	95/08/18		Time: 1015			Initials: DM			Temp: 25.0							
Control	8.2	8.4	351	344	7.8	8.3	0	0	0	2	1	13	14	0	16	14
1	8.3	8.4	353	358	7.7	8.0	1	0	0	0	13	0	0	0	13	20
3	8.3	8.5	372	374	7.7	7.9	0	1	0	12	13	15	16	13	14	14
6	8.4	8.5	401	405	7.6	8.2	0	1	1	14	12	14	0	15	16	0
12	8.5	8.6	462	462	7.5	8.0	0	0	0	5	14	12	8	5	14	11
25																
50																
DAY 7	95/08/19		Time: 1000			Initials: DL			Temp: 25.0							
Control		8.4		356		7.3	12	11	18	12	12	0	0	1	0	0
1		8.4		355		7.1	14	9	12	0	0	7	10	15	0	0
3		8.5		380		7.3	9	8	9	0	0	0	0	0	0	0
6		8.9		411		7.2	10	5	15	1	0	0	6	0	0	
12		8.7		481		7.2	12	9	12	0	0	0	0	0	1	1
25																

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-1	Test: 950670

SUMMARY TABLE

Treatment (%)	Mortality (%)	Reproduction Young/Adult	Reproduction % controls	Daily Cumulative Young Production 0	1	2	3	4	5	6	7
Control	0	27	100	0	0	0	34	56	143	203	269
1	0	27	100	0	0	0	38	52	152	199	266
3	0	28	104	0	0	0	35	53	157	255	281
6	10	25	93	0	0	0	38	50	147	220	257
12	0	26	96	0	0	0	39	59	155	224	259
25	100	8	30	0	0	0	30	64	64	64	64
50	100	2	7	0	0	0	10	14	14	14	14
100	100	0	0	0	0	0	0	0	0	0	0

COMMENTS:

source of young: in-house culture media: Bow river water food lots: 08/03, 08/10

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-1	Test: 950672

Test Method: 7 d Fathead Minnow Survival and Growth Test (five treatments plus a control)
Reference: Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnow, 1992. Environment Canada, EPS 1/RM/22.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:

Description: effluent (Tar Island dyke)

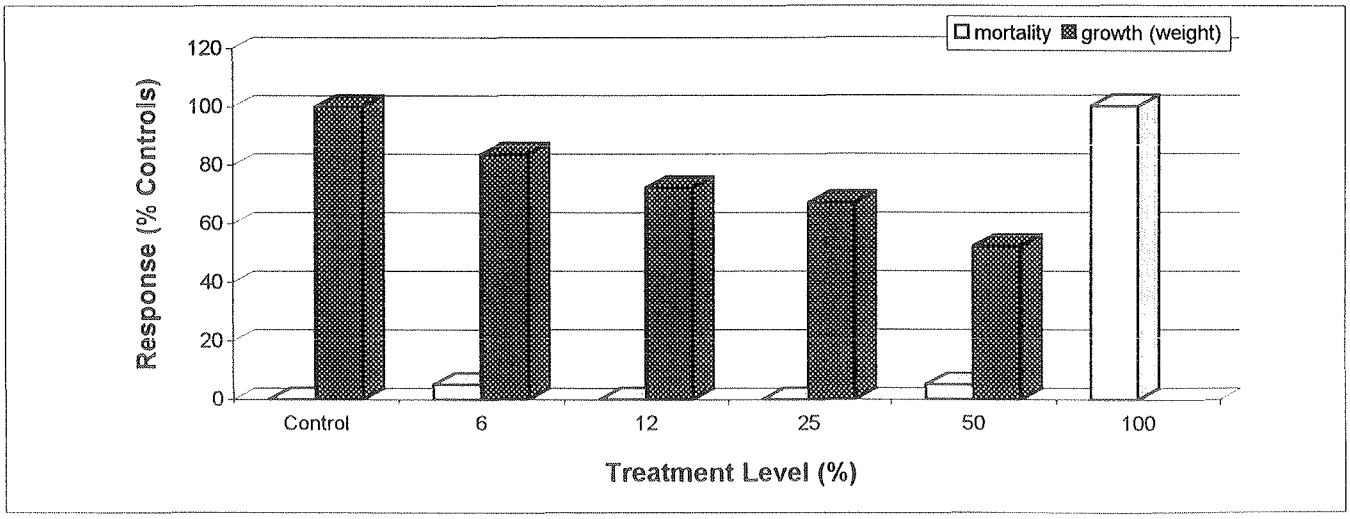
Collected On:	not given	At:	not given	By:	not given
Received On:	95/08/11	At:	2010	By:	S. Goudey

Test Information:

Started On:	95/08/14	At:	1500	By:	DM/JF
Ended On:	95/08/21	At:	1000	By:	DM
Reported On:	95/10/03			By:	CG

Test Result:		Value	Confidence Limits		Units	Method Calculated
MORTALITY	LC25	61	59	62	%	ICPIN
	LC50	74	72	75	%	ICPIN
	NOEC	50			%	Dunnett's
	LOEC	100			%	Dunnett's
GROWTH						
	IC25	11	8	24	%	Bootstrap
	IC50	52	47	58	%	Bootstrap
	NOEC	<6.25			%	Dunnett's
	LOEC	6.25			%	Dunnett's

Graph of Mortality and Growth at Seven Days Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95320-1	Test: 950672

PREAERATION not required

FILTRATION not required

Comments none

Treatment	CHEMISTRY						BIOLOGY - NUMBER ALIVE					
	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE					
(%)	new	used	new	used	new	used	1	2	3	4	5	6
DAY 0	95/08/14		Time: 1500			Initials: DM/JF			Temp (oC):	25.0		
Control	7.9		360		7.7		10	10	10	10		
6.25	8.1		412		7.7		10	10	10	10		
12.5	8.2		470		7.7		10	10	10	10		
25	8.3		582		7.4		10	10	10	10		
50	8.5		829		7.2		10	10	10	10		
100	8.6		1246		6.9		10	10	10	10		
DAY 1	95/08/15		Time: 1100			Initials: JF			Temp (oC):	25.0		
Control	7.9	8.1	367	371	7.7	6.6	10	10	10	10		
6.25	8.1	8.2	413	420	7.6	6.9	10	10	10	10		
12.5	8.1	8.2	463	470	7.8	6.3	10	10	10	10		
25	8.2	8.3	579	593	7.6	6.7	10	10	10	10		
50	8.4	8.5	801	832	7.3	6.7	10	10	10	10		
100	8.6	8.6	1239	1239	7.0	6.5	2	0	1	0		
DAY 2	95/08/16		Time: 1400			Initials: JF			Temp (oC):	25.0		
Control	8.0	8.1	366	377	7.6	5.9	10	10	10	10		
6.25	8.2	8.0	421	419	7.6	5.5	10	10	10	10		
12.5	8.2	8.2	478	468	7.4	5.3	10	10	10	10		
25	8.4	8.4	590	604	7.3	5.1	10	10	10	10		
50	8.5	8.5	825	807	7.1	5.2	10	10	10	10		
100	8.7	8.8	1281	1326	6.7	6.7	1		0			

12.5D one fish very small and pale

DAY 3	95/08/17		Time: 1430			Initials: DL			Temp:	25.0		
Control	8.1	8.1	365	387	7.7	6.0	10	10	10	10		
6.25	8.2	8.0	423	424	7.6	6.1	10	10	10	10		
12.5	8.3	8.2	483	491	7.6	6.1	10	10	10	10		
25	8.5	8.5	593	616	7.5	6.1	10	10	10	10		
50	8.6	8.7	809	838	7.4	6.9	10	9	9	10		
100		8.9		1321		7.3	0					

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-1	Test: 950672

	CHEMISTRY						BIOLOGY - NUMBER ALIVE									
Treatment	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE									
(%)	new	used	new	used	new	used	1	2	3	4	5	6	7	8	9	10
DAY 4	95/08/18		Time: 1130			Initials: JF			Temp: 25.0							
Control	8.0	8.0	369	383	7.7	5.2	10	10	10	10						
6.25	8.1	8.0	422	435	7.8	5.2	10	10	10	10						
12.5	8.3	8.1	482	498	7.8	4.7	10	10	10	10						
25	8.4	8.3	586	610	7.6	4.8	10	10	10	10						
50	8.6	8.5	816	835	7.4	4.8	10	9	9	10						
100																
DAY 5	95/08/19		Time: 1030			Initials: DL			Temp: 25.0							
Control	7.9	8.1	638	402	7.7	5.8	10	10	10	10						
6.25	8.3	8.0	395	430	7.7	5.3	10	10	10	10						
12.5	8.3	8.4	497	490	7.4	6.6	10	10	10	10						
25	8.5	8.4	620	596	7.4	6.4	10	10	10	10						
50	8.6	8.6	837	835	7.2	5.6	10	9	9	10						
100																
DAY 6	95/08/20		Time: 1030			Initials: DL			Temp: 25.0							
Control	7.4	8.0	374	376	7.7	5.5	10	10	10	10						
6.25	8.0	7.9	429	433	7.4	5.9	10	8	10	10						
12.5	8.2	8.3	484	503	7.1	6.7	10	10	10	10						
25	8.3	8.4	604	621	6.9	6.6	10	10	10	10						
50	8.4	8.4	828	842	6.3	5.4	10	9	9	10						
100																
DAY 7	95/08/21		Time: 1600			Initials: JR/GD			Temp: 16.0							
Control		8.3		387		6.2	10	10	10	10						
6.25		8.3		441		6.1	10	8	10	10						
12.5		8.4		507		6.1	10	10	10	10						
25		8.5		624		5.9	10	10	10	10						
50		8.6		847		5.3	10	9	9	10						
100																

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-1	Test: 950672

SUMMARY TABLE		Average Fish Weights	
Treatment (%)	Mortality (%)	mg/fish	% controls
Control	0	0.61	100
6	5	0.51	84
12	0	0.44	72
25	0	0.41	67
50	5	0.32	52
100	100		

COMMENTS:
source of young: in house

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-2

CLIENT INFORMATION

Client:	Suncor Inc., Oil Sands Group
Operation:	Ft. McMurray
Address:	P.O. Box 4001
City:	Ft. McMurray
Province/State:	Alberta
Country:	Canada
Postal/ZIP Code:	T9H 3E3
Billing Information:	
Contact:	Trina Hoffarth
Tel:	403-743-6715
Fax:	403-791-8331

SAMPLE INFORMATION

Sample Type:	Athabasca River water		
Collected On:	95/08/11	At:	not given
Collected By:	not given		
Shipped On:	95/08/11		
Shipped By:	Grimshaw Trucking		
Received On:	95/08/11	At:	2010
Received By:	G. Daniels		
Container:	3 x 500 gal. containers		
Seals:	not sealed		
Initials on Seals:	not applicable		

INITIAL CHEMISTRY

pH (units)	8.2	ammonium (mg-N/L)	not done
Conductance (uS/cm)	243	residual chlorine (mg/L)	not done
Dissolved Oxygen (mg/L)	8.8	Colour:	colourless
Temperature (oC)	18	Odour:	odourless
Alkalinity (mg-CaCO3/L)	not done		
Hardness (mg-CaCO3/L)	110		

COMMENTS

sample container leaked in shipment

SAMPLE HISTORY

Storage Conditions: 5oC in darkness

Disposed On: _____ by _____ Method: _____

TEST LOG

Test Type	DA(S)	TR(S)	BLS	AG(S)	CD(S)	FM(S)	
Number	950913	950679	950914	950674	950673	950675	
Started	95/09/27	95/08/15	95/08/14	95/08/14	95/08/12	95/08/14	
Ended	95/09/29	95/08/19	95/08/14	95/08/17	95/08/19	95/08/21	
Reported	95/10/04	95/10/04	95/10/04	95/10/04	95/10/04	95/10/04	
Faxed							

NOTES: TR, trout; FM, fathead minnows; DA, Daphnia; CD, Ceriodaphnia; AG, Selenastrum; BL, bacterial luminescence; D, definitive test; S, screening test

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-2	Test: 950913

Test Method: *Daphnia* 48h Static Acute Test (LC50, five or more treatments plus a control)
Reference: Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to *Daphnia magna*, 1990. Environment Canada, EPS 1/RM/14.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:

Description:	Athabasca River water				
Collected On:	not given	At:	not given	By:	not given
Received On:	95/08/11	At:	2010	By:	G. Daniels

Test Information:

Started On:	95/09/27	At:	1330	By:	SF/DM
Ended On:	95/09/29	At:	1420	By:	DM
Reported On:	95/10/04			By:	CG

Test Result:

	% Mortality
Control	0
100%	0

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95320-2	Test: 950913

	CHEMISTRY						BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/09/27			Time: 1330			Initials: SF/DM			Temp (oC): 20							
control	8.4		354		8.2		5	5								
100	8.1		277		9.0		5	5								
Date: 95/09/28			Time: 1020			Initials: DM/SF			Temp (oC): 20							
control							5	5								
100							5	5								
Date: 95/09/29			Time: 1420			Initials: DM			Temp (oC): 20							
control	8.6		371		7.7		5	5								
100	8.5		281		7.5		5	5								

SUMMARY TABLE	
TREATMENT (%)	MORTALITY (%)
control	0
100	0

young :	hardness (mg-CaCO3/L) : 180
water : bucket 4	Adjustment: none

COMMENTS:
no comments

Notes: F, floating; I, immobile; B, stuck on bubbles; D, caught in debris

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-2	Test: 950679

Test Method: Trout 96h Static Acute Test (LC50, five or more treatment levels plus a control)
Reference: Biological Test method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, 1990. Environment Canada, EPS 1/RM/13.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:

Description:	Athabasca River water				
Collected On:	not given	At:	not given	By:	not given
Received On:	95/08/11	At:	2010	By:	G. Daniels

Test Information:

Started On:	95/08/15	At:	1130	By:	JF
Ended On:	95/08/19	At:	1130	By:	DL
Reported On:	95/10/04			By:	CG

Test Result:

	% Mortality
Control	0
100%	0

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95320-2	Test: 950679

PREAERATION	not required				
time (h)	0	0.5	1	1.5	2
DO (mg/L)					
comments	none				

	CHEMISTRY			BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)	Cond.(uS/cm)	DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/08/15		Time: 1130		Initials: GD/JF					Temp (oC): 17.3				
Control	8.0	363	8.6	10									
100	8.2	256	8.6	10									
Date: 95/08/16		Time: 1500		Initials: DM/JF					Temp (oC): 15.7				
Control	8.6	358	8.9	10									
100	8.5	244	9.0	10									
Date: 95/08/17		Time: 1500		Initials: DM/JF					Temp (oC): 15.0				
Control	8.4	357	8.9	10									
100	8.3	245	8.9	10									
Date: 95/08/18		Time: 1030		Initials: JF/DM					Temp: 15.3				
Control	8.5	359	8.9	10									
100	8.4	245	8.9	10									

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-2	Test: 950679

	CHEMISTRY				BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)		Cond.(uS/cm)	DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/08/19		Time: 1130		Initials: DL		Temp: 14.8								
Control	8.3		347	9.2	10									
100	8.3		244	9.1	10									

SUMMARY TABLE					REPLICATE									
TREATMENT (%)	MORTALITY (%)	mg NH4-N/L t=0	t=96 h	avg	1	2	3	4	5	6	7	8	9	10
					individual fish weights (g)									
Control	0	nd	nd	0.44	0.38	0.49	0.62	0.36	0.48	0.36	0.47	0.44	0.45	0.34
100.0	0	nd	nd	0.45	0.47	0.52	0.49	0.49	0.48	0.40	0.34	0.37	0.37	0.52
					individual fish fork lengths (cm)									
Control				3.7	3.4	3.7	4.1	3.5	3.8	3.5	3.9	3.6	3.6	3.4
100.0				3.8	3.6	3.7	5.6	3.7	3.5	3.3	3.4	3.6	3.6	3.8

COMMENTS: Fish added at: 1100	Batch number:TR950726	No. days held: 20
Time (h)		
24		
48		
72		
96		

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-2	Test: 950914

Test Method: Bacterial luminescence Test (screening test, one treatment level plus a control)
Reference: Biological Test Method: Toxicity Test Using Luminescent Bacteria (*Photobacterium phosphoreum*), 1992. Environment Canada, EPS 1/RM/24.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:

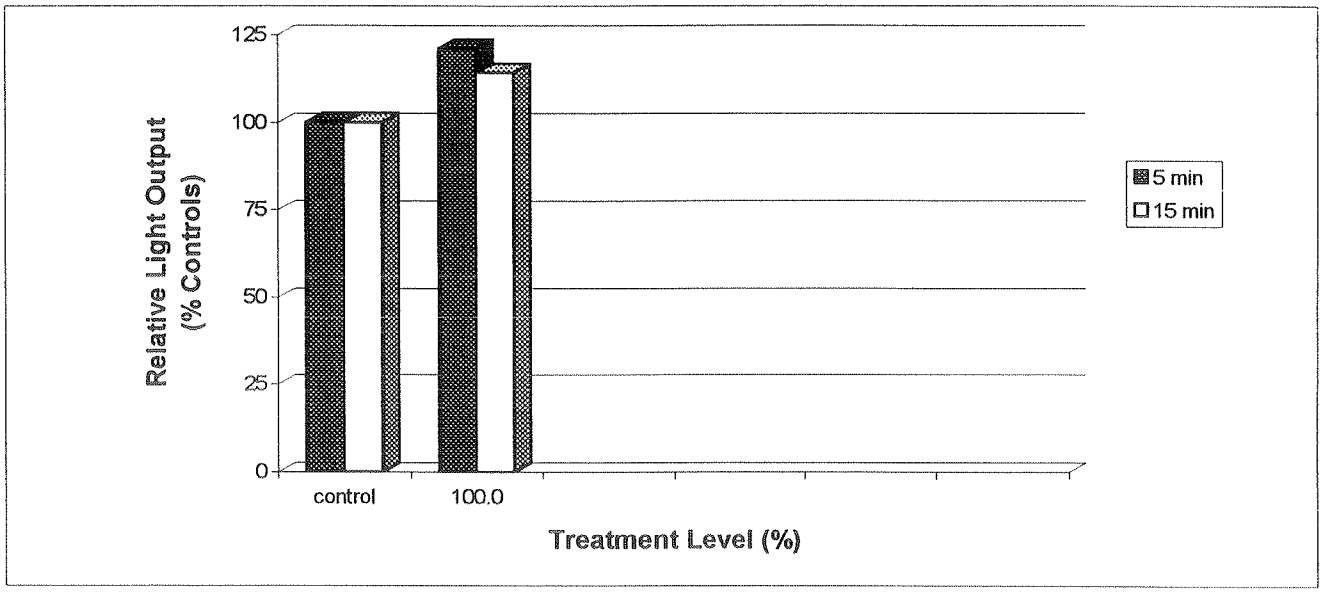
Description:	Athabasca River water				
Collected On:	not given	At:	not given	By:	not given
Received On:	95/08/11	At:	2010	By:	G. Daniels

Test Information:

Started On:	95/08/14	At:	1400	By:	DL
Ended On:	95/08/14	At:		By:	DL
Reported On:	95/10/04			By:	CG

Test Result: 114% expressed as a percentage of the control.

Graph of Light Ouput Relative to Controls at 5 and 15 Minutes



HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95320-2	Test: 950914

SAMPLE PRETREATMENT

pH adjustment	not required
preaeration	not required
turbidity	not centrifuged/filtered
other	none

LIGHT READINGS

	Time (min)		
Treatment Level (%)	0	5	15
control	94	95	91
100.0	114	115	104

INHIBITION (%CTLS)	
5 min	15 min
100	100
121	114

COMMENTS

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-2	Test: 950674

Test Method: 72h Algal Growth Inhibition Test (IC50, five or more treatments plus a control)
Reference: Biological Test Method: Growth Inhibition Test Using the Freshwater Alga *Selenastrum capricornutum*, 1992. Environment Canada, EPS 1/RM/25.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:
Description: Athabasca River water
Collected On: not given At: not given By: not given
Received On: 95/08/11 At: 2010 By: G. Daniels

Test Result: 4% inhibition compared to control growth.

HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030 Sample: 95320-2 Test: 950674

SAMPLE PRETREATMENT	
pH adjustment	not required
preaeration	not required
turbidity	not centrifuged
other	none

TEST DATA

FINAL CELL DENSITIES (cells/mL)

Treatment (%)	Replicate A	B	C	Average AVG	Standard Deviation	CV (%)	Percent Controls	Inhibition (%Ctls)
control	1648272	1395968	1298928	1447723	180331	12	100	0
100.00	1376560	1337744	1473600	1395968	69977	5	96	4

COMMENTS

- all cell numbers were based on particle counts
- the initial cell density was 11,452 cells/mL

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-2	Test: 950673

Test Method: 7 d Ceriodaphnia Survival and Reproduction Test (5 treatment levels plus a control)
Reference: Biological Test Method: Test of Reproduction and Survival Using the Cladoceran *Ceriodaphnia dubia*, 1992. Environment Canada, EPS 1/RM/21.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:
Description: Athabasca River water
Collected On: not given At: not given By: not given
Received On: 95/08/11 At: 2010 By: G. Daniels

Test Information:
Started On: 95/08/12 At: 1245 By: DM
Ended On: 95/08/19 At: 1000 By: DL
Reported On: 95/10/04 By: CG

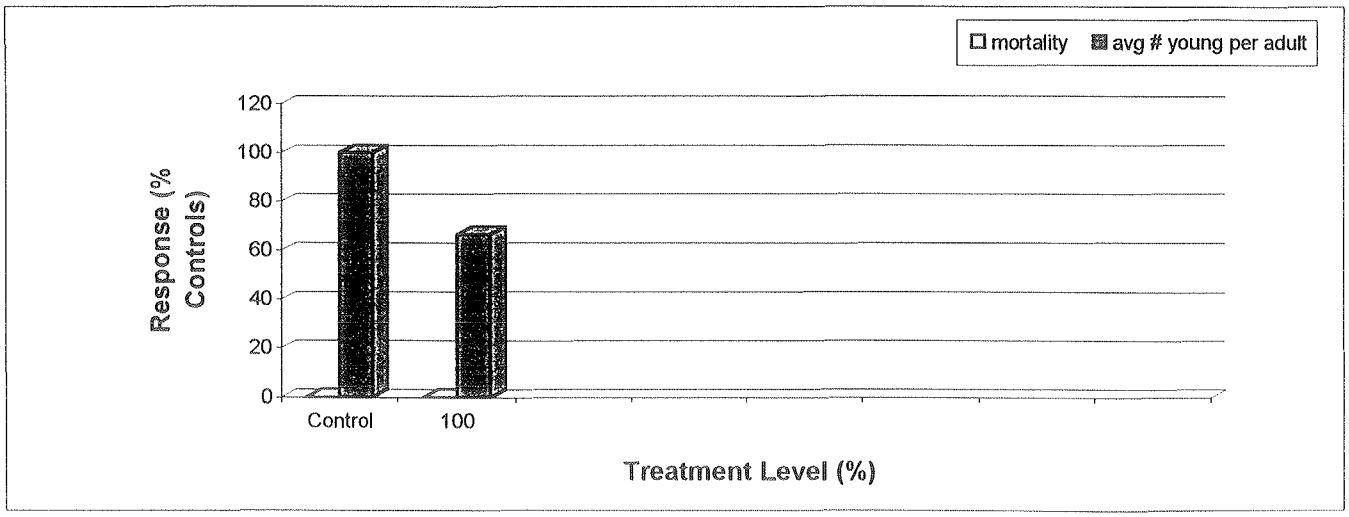
Test Result:

MORTALITY

	% Mortality
Control	0
100%	0

REPRODUCTION 67% expressed as a percentage of the control.

Graph of Mortality and Reproduction at Seven Days Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; IC25 & IC50, concentrations inhibiting reproduction by 25 and 50%; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95320-2	Test: 950673

PREAERATION not required

FILTRATION not required

Comments none

CHEMISTRY / **BIOLOGY - NUMBER OF YOUNG**

Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 0 95/08/12			Time: 1245			Initials: DM			Temp (oC): 25.0							
Control	8.3		350		7.5		0	0	0	0	0	0	0	0	0	0
100	8.2		246		8.5		0	0	0	0	0	0	0	0	0	0
DAY 1 95/08/13			Time: 1215			Initials: DM			Temp (oC): 25.0							
Control	8.4	8.4	358	370	7.8	7.8	0	0	0	0	0	0	0	0	0	0
100	8.4	8.4	250	265	7.8	7.7	0	0	0	0	0	0	0	0	0	0
DAY 2 95/08/14			Time: 1200			Initials: DM			Temp (oC): 25.0							
Control	8.3	8.3	358	362	7.6	7.8	0	0	0	0	0	0	0	0	0	0
100	8.3	8.3	251	255	7.7	7.9	0	0	0	0	0	0	0	0	0	0
DAY 3 95/08/15			Time: 1415			Initials: DM			Temp: 25.0							
Control	8.3	8.4	358	376	7.6	7.8	0	0	0	4	5	6	4	5	6	4
100	8.3	8.4	257	265	7.1	7.8	0	0	5	2	4	5	5	3	2	4

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-2	Test: 950673

	CHEMISTRY						BIOLOGY - NUMBER OF YOUNG									
Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 4 95/08/16			Time: 1345			Initials: DM			Temp: 25.0							
Control	8.3	8.4	362	371	7.6	8.0	6	5	6	0	0	0	1	2	1	1
100	8.3	8.4	259	270	7.4	7.8	6	3	0	0	1	0	0	0	0	0
DAY 5 95/08/17			Time: 1345			Initials: DM			Temp: 25.0							
Control	8.2	8.4	348	368	7.7	7.7	1	11	12	9	10	7	9	10	11	7
100	8.2	8.4	261	263	7.5	7.6	12	6	9	9	7	3	0	7	6	1
DAY 6 95/08/18			Time: 1015			Initials: DM			Temp: 25.0							
Control	8.2	8.4	351	344	7.8	8.3	0	0	0	2	1	13	14	0	16	14
100	8.1	8.4	258	266	7.1	8.1	0	1	0	0	0	0	0	0	0	12
DAY 7 95/08/19			Time: 1000			Initials: DL			Temp: 25.0							
Control		8.4		356		7.3	12	11	18	12	12	0	0	1	0	0
100		8.4		262		7.3	15	9	15	9	0	1	0	10	12	0

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-2	Test: 950673

SUMMARY TABLE

Treatment (%)	Mortality (%)	Reproduction		Daily Cumulative Young Production							
		Young/Adult	% controls	0	1	2	3	4	5	6	7
Control	0	27	100	0	0	0	34	56	143	203	269
100	0	18	67	0	0	0	30	40	100	113	184

COMMENTS:

source of young: in-house culture media: Bow river water food lots: 08/03, 08/10

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-2	Test: 950675

Test Method: 7 d Fathead Minnow Survival and Growth Test (five treatments plus a control)
Reference: Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnow, 1992. Environment Canada, EPS 1/RM/22.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:

Description: Athabasca River water

Collected On:	not given	At:	not given	By:	not given
Received On:	95/08/11	At:	2010	By:	G. Daniels

Test Information:

Started On:	95/08/14	At:	1500	By:	DM/JF
Ended On:	95/08/21	At:	1000	By:	DM
Reported On:	95/10/04			By:	CG

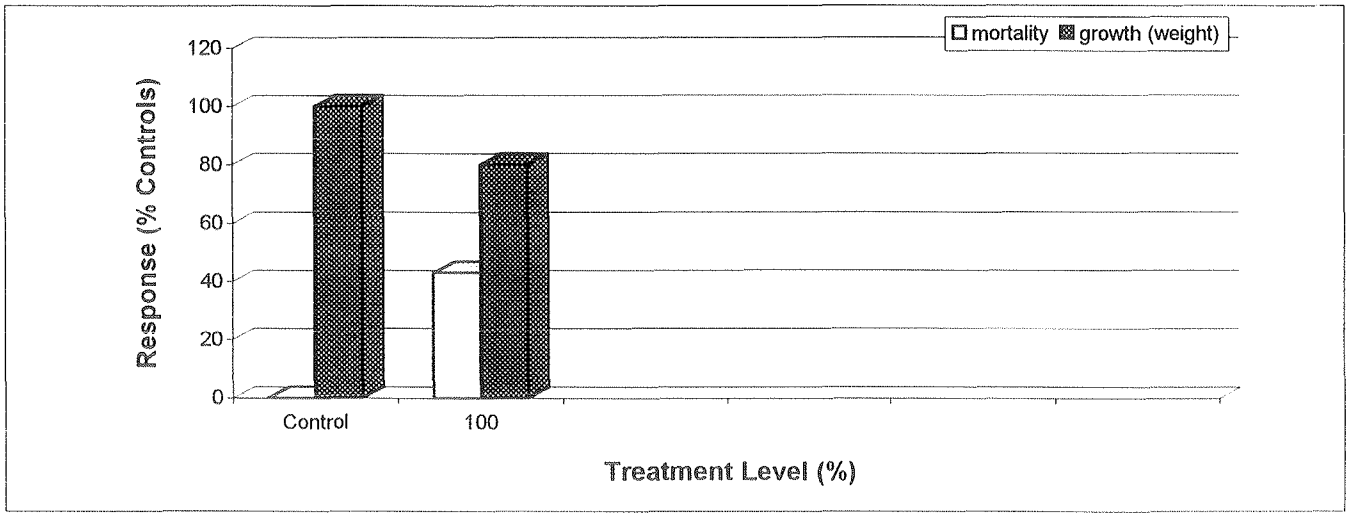
Test Result:

MORTALITY

	% Mortality
control	0
100%	43

GROWTH 80% expressed as a percentage of the controls

Graph of Mortality and Growth at Seven Days Versus Treatment Level



HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95320-2	Test: 950675

PREAERATION not required	**FILTRATION** not required
Comments none	

CHEMISTRY **BIOLOGY - NUMBER ALIVE**

Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6
DAY 0 95/08/14			Time: 1500			Initials: DM/JF			Temp (oC): 25.0			
Control	7.9		360		7.7		10	10	10	10		
100	8.3		242		7.4		10	10	10	10		
DAY 1 95/08/15			Time: 1100			Initials: JF			Temp (oC): 25.0			
Control	7.9	8.1	367	371	7.7	6.6	10	10	10	10		
100	8.2	8.0	253	260	7.4	6.6	10	10	10	10		
DAY 2 95/08/16			Time: 1400			Initials: JF			Temp (oC): 25.0			
Control	8.0	8.1	366	377	7.6	5.9	10	10	10	10		
100	8.2	8.1	250	265	7.1	5.3	10	10	10	10		

12.5D one fish very small and pale

DAY 3 95/08/17			Time: 1430			Initials: DL			Temp: 25.0			
Control	8.1	8.1	365	387	7.7	6.0	10	10	10	10		
100	8.2	8.1	256	271	7.3	6.2	10	9	10	10		

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-2	Test: 950675

	CHEMISTRY						BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 4 95/08/18			Time: 1130			Initials: JF			Temp: 25.0							
Control	8.0	8.0	369	383	7.7	5.2	10	10	10	10						
100	8.3	7.8	253	266	7.6	5.0	10	9	10	10						
DAY 5 95/08/19			Time: 1030			Initials: DL			Temp: 25.0							
Control	7.9	8.1	638	402	7.7	5.8	10	10	10	10						
100	8.3	7.9	253	262	7.3	5.7	10	9	10	10						
DAY 6 95/08/20			Time: 1030			Initials: DL			Temp: 25.0							
Control	7.4	8.0	374	376	7.7	5.5	10	10	10	10						
100	8.1	7.9	247	261	7.2	6.1	7	4	9	9						
DAY 7 95/08/21			Time: 1600			Initials: JR/GD			Temp: 16.0							
Control		8.3		387		6.2	10	10	10	10						
100		8.1		289		6.1	7	0	9	7						

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TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95320-2	Test: 950675

SUMMARY TABLE		Average Fish Weights	
Treatment (%)	Mortality (%)	mg/fish	% controls
Control	0	0.61	100
100	43	0.49	80

COMMENTS:
source of young: in house

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95393

CLIENT INFORMATION

Client:	Suncor Inc., Oil Sands Group
Operation:	Ft. McMurray
Address:	P.O. Box 4001
City:	Ft. McMurray
Province/State:	Alberta
Country:	Canada
Postal/ZIP Code:	T9H 3E3
Billing Information:	Tar Island Reclamation (Lease 86)
Contact:	John Gulley/Trina Hoffarth
Tel:	403-743-6715
Fax:	403-791-8331

SAMPLE INFORMATION

Sample Type:	water (project task number 6127, site: RW127, number: T059)		
Collected On:	95/09/20	At:	not given
Collected By:	Trina Hoffarth		
Shipped On:	95/09/20		
Shipped By:	Grimshaw Trucking		
Received On:	95/09/21	At:	1200
Received By:	GD		
Container:	2 x 20L Jugs		
Seals:	not sealed		
Initials on Seals:	not applicable		

INITIAL CHEMISTRY

pH (units)	8.2	ammonium (mg-N/L)	not done
Conductance (uS/cm)	1251	residual chlorine (mg/L)	not done
Dissolved Oxygen (mg/L)	8.4	Colour:	yellow
Temperature (oC)	13	Odour:	hydrocarbon (strong)
Alkalinity (mg-CaCO3/L)	not done		
Hardness (mg-CaCO3/L)	118		

COMMENTS

SAMPLE HISTORY

Storage Conditions: 5oC in darkness

Disposed On: _____ by _____ Method: _____

TEST LOG

Test Type		TR(D)	BL(D)				
Number		950853	950915				
Started		95/09/22	95/09/21				
Ended		95/09/26	95/09/21				
Reported		95/10/05	95/10/05				
Faxed							

NOTES: TR, trout; FM, fathead minnows; DA, Daphnia; CD, Ceriodaphnia; AG, Selenastrum; BL, bacterial luminescence; D, definitive test; S, screening test

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95393	Test: 950853

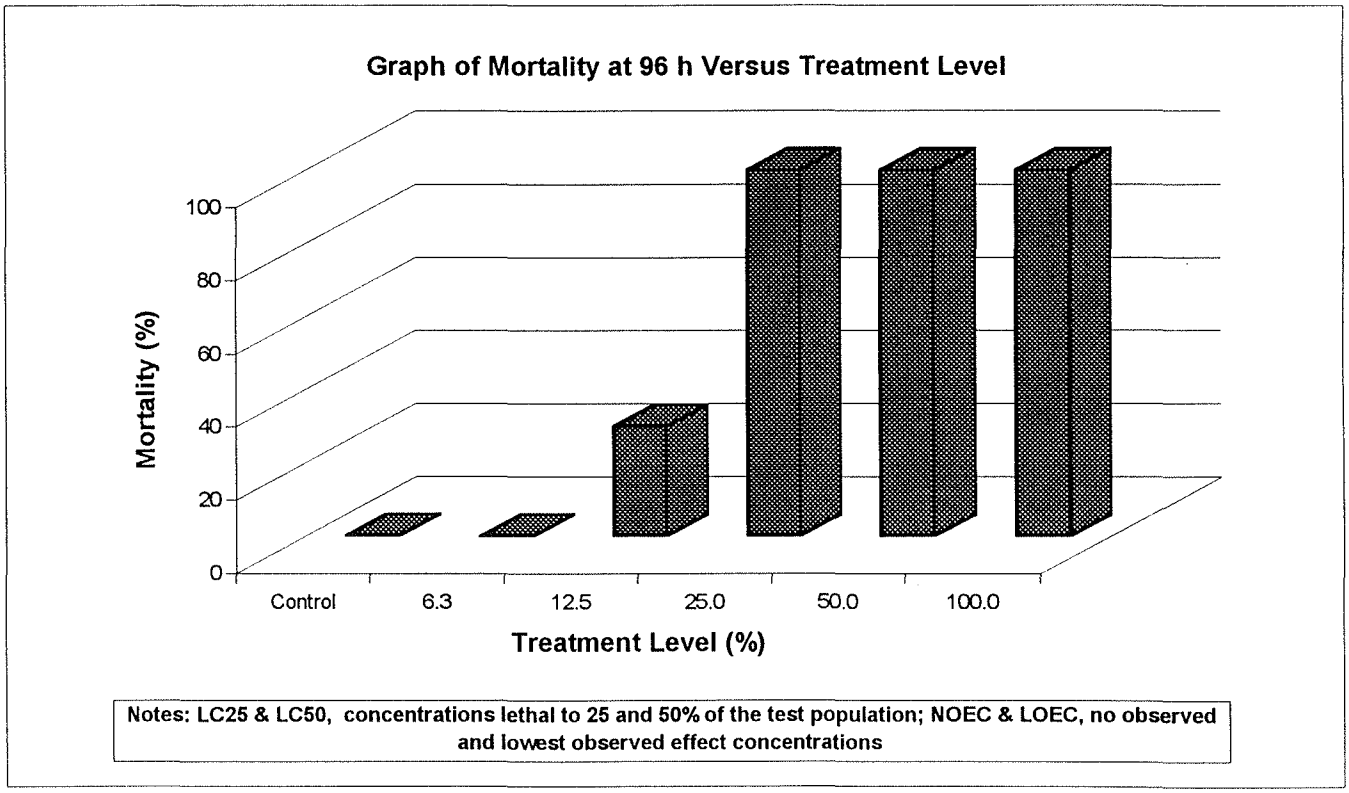
Test Method: Trout 96h Static Acute Test (LC50, five or more treatment levels plus a control)
Reference: Biological Test method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, 1990. Environment Canada, EPS 1/RM/13.

Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:
Description: water (project task number 6127, site: RW127, number: T059)
Collected On: 95/09/20 At: not given By: Trina Hoffarth
Received On: 95/09/21 At: 1200 By: GD

Test Information:
Started On: 95/09/22 At: 1200 By: DM/SF
Ended On: 95/09/26 At: 1200 By: DM/SF
Reported On: 95/10/05 By: CG

Test Result:	Value	Confidence Limits		Units	Method Calculated
LC25				%	
LC50	15	6.25	25	%	Binomial
NOEC				%	
LOEC				%	



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; NOEC & LOEC, no observed and lowest observed effect concentrations

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#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95393	Test: 950853

PREAERATION	not required				
time (h)	0	0.5	1	1.5	2
DO (mg/L)					
comments	none				

	CHEMISTRY			BIOLOGY - NUMBER ALIVE										
Treatment (%)	pH (units)	Cond.(uS/cm)	DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/09/22		Time: 1200		Initials: DM/SF		Temp (oC): 13.7							
Control	8.2	372	8.8	10									
6.25	8.1	434	8.9	10									
12.5	8.2	490	8.8	10									
25	8.2	672	8.7	10									
50	8.3	862	8.3	10									
100	8.3	1320	7.5	10									
Date: 95/09/23		Time: 1130		Initials: GD/DL		Temp (oC): 13.8							
Control	7.9	376	7.2	10									
6.25	8.0	436	7.1	10									
12.5	8.1	493	6.9	10									
25	8.2	626	6.8	10									
50	8.2	865	6.1	0									
100	8.3	1329	5.1	0									
Date: 95/09/24		Time: 1130		Initials: DL/GD		Temp (oC): 14.7							
Control	7.9	277	7.3	10									
6.25	8.0	440	6.9	10									
12.5	8.1	495	6.4	9									
25	8.2	629	6.4	2									
50				0									
100				0									
Date: 95/09/25		Time: 1030		Initials: DM/MG		Temp: 15.6							
Control	8.0	376	7.2	10									
6.25	8.2	438	6.8	10									
12.5	8.2	496	5.8	8									
25	8.2	628	6.0	0									
50			8.9	0									
100				0									

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95393	Test: 950853

CHEMISTRY

Treatment (%)	pH (units)		Cond.(uS/cm)		DO (mg/L)	
Control	8.0		378		6.5	
6.25	8.0		440		6.4	
12.5	8.0		499		5.7	
25	8.1		631		5.7	
50						
100						

BIOLOGY - NUMBER ALIVE

REPLICATE									
1	2	3	4	5	6	7	8	9	10
10									
10									
7									
0									
0									
0									

Date: 95/09/26	Time: 1200	Initials: DM/SF	Temp: 15.8

SUMMARY TABLE

TREATMENT (%)	MORTALITY (%)	mg NH4-N/L t=0	mg NH4-N/L t=96 h
Control	0	nd	nd
6.3	0	nd	nd
12.5	30	nd	nd
25.0	100	nd	nd
50.0	100	nd	nd
100.0	100	nd	nd

	REPLICATE									
	1	2	3	4	5	6	7	8	9	10
avg	individual fish weights (g)									
0.71	0.66	0.78	0.71	0.96	0.85	0.68	0.53	0.38	1.05	0.46
0.67	0.67	0.80	0.59	0.43	0.51	0.84	1.01	0.64	0.49	0.67
0.71	0.92	0.47	0.65	0.93	0.54	0.98	0.73	0.31	0.89	0.65
0.69	0.77	0.60	0.87	0.91	0.51	0.62	0.65	0.52	0.77	0.65
0.75	0.67	0.77	0.76	0.74	0.77	0.77	0.95	0.69	0.57	0.77
0.77	0.87	0.90	0.75	0.67	0.84	0.93	0.66	0.43	0.92	0.72
avg	individual fish fork lengths (cm)									
4.2	4.2	4.5	4.3	4.7	4.4	4.1	3.9	3.6	4.8	3.8
4.1	4.1	4.4	3.9	3.7	3.8	4.4	4.6	4.1	3.7	4.1
4.1	4.5	3.7	4.1	4.4	3.9	4.8	4.2	3.1	4.5	4.2
3.9	4.0	4.0	4.1	4.2	3.5	3.6	3.9	3.5	3.9	3.9
3.9	3.8	3.9	3.8	4.0	3.8	4.0	4.0	3.7	3.7	3.9
4.0	4.3	4.0	3.9	4.2	4.2	4.4	3.8	3.4	4.1	3.9

Control
6.3
12.5
25.0
50.0
100.0

COMMENTS: Fish added at: 1130 Batch number:TR950911 No. days held: 11

Time (h)	
24	1 swimming on side in 12.5%. All fish on side on bottom in 25%.
	All dead in 50 & 100%.
48	2 survivors in 25% are black and laying on side on bottom
72	
96	

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95393	Test: 950915

Test Method: Bacterial luminescence Test (IC50, four or more treatment levels plus a control)
Reference: Biological Test Method: Toxicity Test Using Luminescent Bacteria (*Photobacterium phosphoreum*), 1992. Environment Canada, EPS 1/RM/24.

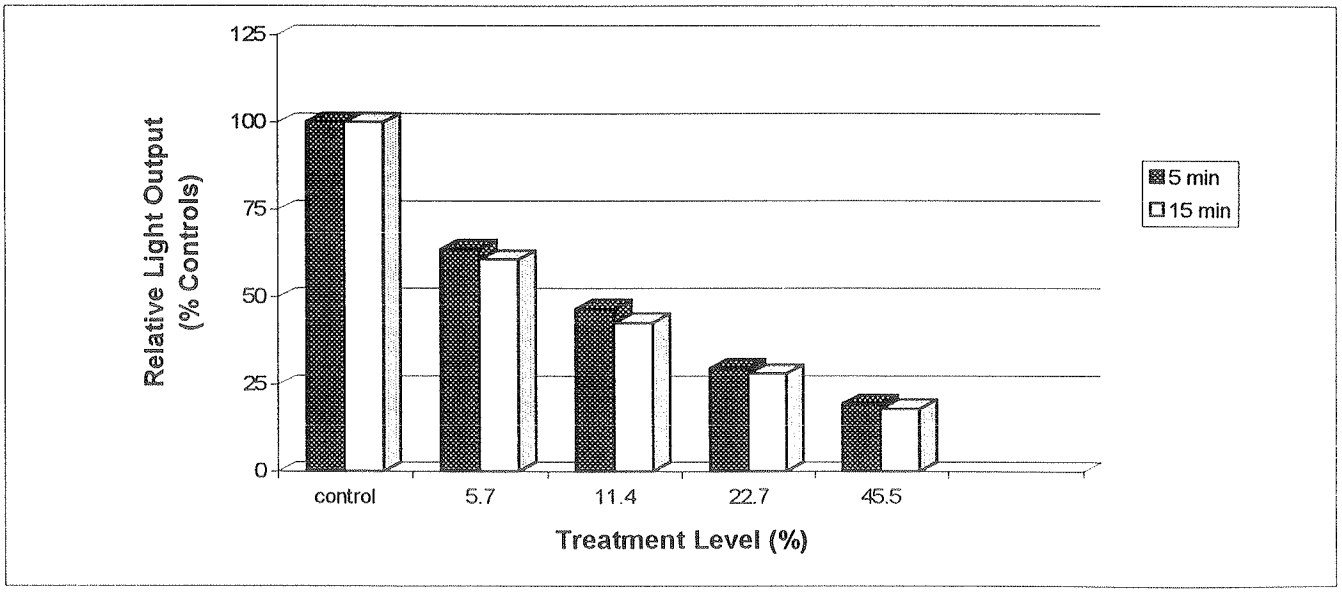
Client Information: Suncor Inc., Oil Sands Group
Ft. McMurray

Sample Information:
Description: water (project task number 6127, site: RW127, number: T059)
Collected On: 95/09/20 At: not given By: Trina Hoffarth
Received On: 95/09/21 At: 1200 By: GD

Test Information:
Started On: 95/09/21 At: PM By: JR
Ended On: 95/09/21 At: PM By: JR
Reported On: 95/10/05 By: CG

Test Result:	Value	Confidence Limits		Units	Method Calculated
IC20 @ 5 min	2.8	1.0	4.5	%	regresssion analysis
IC50 @ 5 min	10.9	9.1	12.7	%	regresssion analysis
IC20 @ 15 min	2.3	1.3	3.3	%	regresssion analysis
IC50 @ 15 min	9.5	8.5	10.5	%	regresssion analysis

Graph of Light Ouput Relative to Controls at 5 and 15 Minutes



Notes: IC20 & IC50, concentrations that inhibit light output relative to controls by 20 and 50%

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA	Client: 95030	Sample: 95393	Test: 950915

SAMPLE PRETREATMENT	
pH adjustment	not required
preaeration	not required
turbidity	not centrifuged/filtered
other	none

LIGHT READINGS

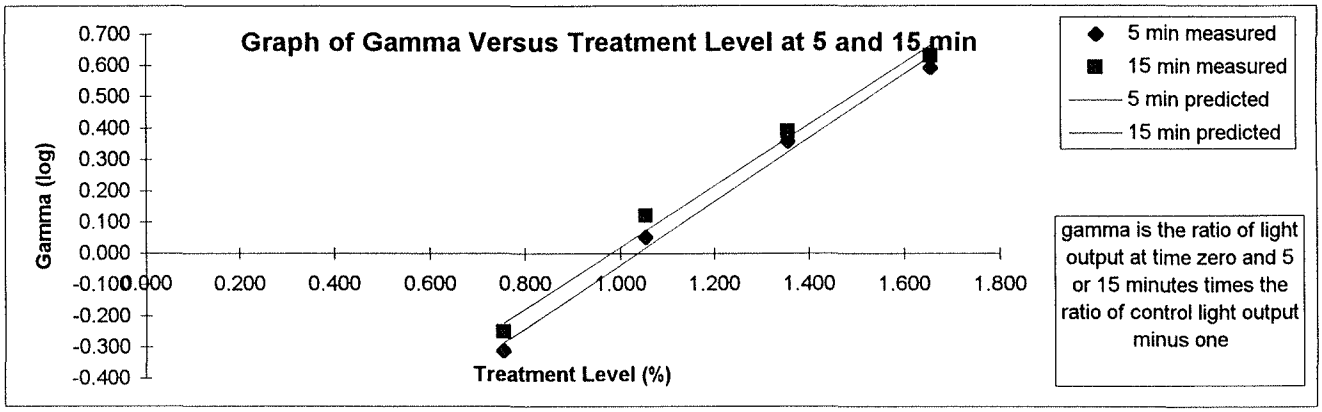
	Time (min)		
Treatment Level (%)	0	5	15
control	93	88	89
5.7	88	56	54
11.4	92	41	38
22.7	90	26	25
45.5	88	17	16

INHIBITION (%CTLS)	
5 min	15 min
100	100
64	61
47	43
30	28
19	18

ENDPOINTS [log(concentration) = a * log(gamma) + b]

@ 5 min		Confidence Limits	
	Value	Lower	Upper
IC50	10.9	9.1	12.7
IC25	3.7	1.8	5.5
IC20	2.8	1.0	4.5
IC10	1.2	-0.6	3.1
IC5	0.6	-1.7	2.9
IC1	0.1	-7.3	7.6
r^2	0.9909	b =	1.036
		a =	0.989

@ 15 min		Confidence Limits	
	Value	Lower	Upper
IC50	9.5	8.5	10.5
IC25	3.1	2.1	4.1
IC20	2.3	1.3	3.3
IC10	1.0	0.0	2.0
IC5	0.5	-0.5	1.5
IC1	0.1	-0.9	1.1
r^2	0.9894	b =	0.980
		a =	1.022



COMMENTS

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-1

CLIENT INFORMATION

Client:	Suncor Inc. Oil Sands Group
Operation:	Ft. McMurray
Address:	P.O. Box 4001
City:	Ft. McMurray
Province/State:	Alberta
Country:	Canada
Postal/ZIP Code:	T9H 3E3
Billing Information:	
Contact:	John Gulley/Trina Hoffarth
Tel:	403-743-6715
Fax:	403-791-8339

SAMPLE INFORMATION

Sample Type:	effluent (Tar Island Dyke)		
Collected On:	95/09/29	At:	not given
Collected By:	not given		
Shipped On:	95/09/29		
Shipped By:	not given		
Received On:	95/09/29	At:	2030
Received By:	S. Goudy		
Container:	2 containers		
Seals:	not sealed		
Initials on Seals:	not applicable		

INITIAL CHEMISTRY

pH (units)	8.5	ammonium (mg-N/L)	not done
Conductance (uS/cm)	1462	residual chlorine (mg/L)	not done
Dissolved Oxygen (mg/L)	7.8	Colour:	brown
Temperature (oC)	18.0	Odour:	strong hydrocarbon
Alkalinity (mg-CaCO3/L)	not done		
Hardness (mg-CaCO3/L)	not done		

COMMENTS

SAMPLE HISTORY

Storage Conditions:	4°C				
Disposed On:	n/a	by	n/a	Method:	n/a

TEST LOG

Test Type	DA(D)	TR(D)	BL(D)	AG(D)	CD(D)	FM(D)	
Number	950901	950902	950904	950905	950900	950906	
Started	95/10/03	95/10/02	95/10/03	95/10/03	95/10/03	95/10/04	
Ended	95/10/05	95/10/06	95/10/03	95/10/06	95/10/10	95/10/11	
Reported	95/10/11	95/10/12	95/10/11	95/10/18	95/10/13	95/10/12	
Faxed							

NOTES: TR, trout; FM, fathead minnows; DA, Daphnia; CD, Ceriodaphnia; AG, Selenastrum; BL, bacterial luminescence; D, definitive test; S, screening test

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-1	Test: 950901

Test Method: *Daphnia* 48h Static Acute Test (LC50, five or more treatments plus a control)
Reference: Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to *Daphnia magna*, 1990. Environment Canada, EPS 1/RM/14.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

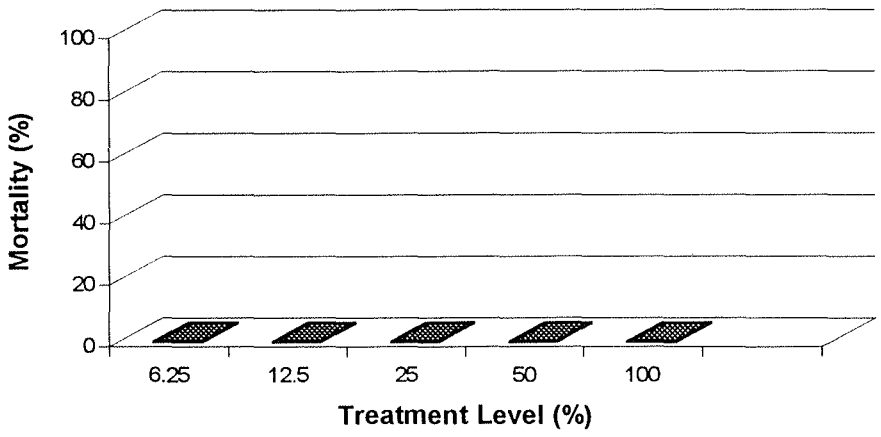
Description:	effluent (Tar Island Dyke)				
Collected On:	95/09/29	At:	not given	By:	not given
Received On:	95/09/29	At:	2030	By:	S. Goudy

Test Information:

Started On:	95/10/03	At:	1525	By:	DM
Ended On:	95/10/05	At:	1640	By:	SF
Reported On:	95/10/11			By:	CG

Test Result:	Value	Confidence Limits	Units	
LC25	>100		%	Not Toxic
LC50	>100		%	
NOEC	100		%	
LOEC	>100		%	

Graph of Mortality at 48 h Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95404-1	Test: 950901

	CHEMISTRY			BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)	Cond.(uS/cm)	DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/10/03		Time: 1525		Initials: DM						Temp (oC): 20			
Control	8.4	346	8.1	5	5								
6.25	8.5	412	8.0	5	5								
12.5	8.6	482	8.0	5	5								
25	8.6	617	8.0	5	5								
50	8.7	889	7.9	5	5								
100	8.7	1409	7.1	5	5								
Date: 95/10/04		Time: 1550		Initials: SF						Temp (oC): 20			
Control				5	5								
6.25				5	5								
12.5				5	5								
25				5	5								
50				5	5								
100				5	5								
Date: 95/10/05		Time: 1640		Initials: SF						Temp (oC): 20			
Control	8.4	347	7.8	5	5								
6.25	8.4	420	7.9	5	5								
12.5	8.5	498	7.9	5	5								
25	8.6	619	7.9	5	5								
50	8.6	840	7.9	5	5								
100	8.7	1315	7.8	5	5								

SUMMARY TABLE	
TREATMENT (%)	MORTALITY (%)
Control	0
6.25	0
12.5	0
25	0
50	0
100	0

young : jar C3	hardness (mg-CaCO3/L) : 180
water : bucket 3	Adjustment: none

COMMENTS:
no comments

Notes: F, floating; I, immobile; B, stuck on bubbles; D, caught in debris

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-1	Test: 950902

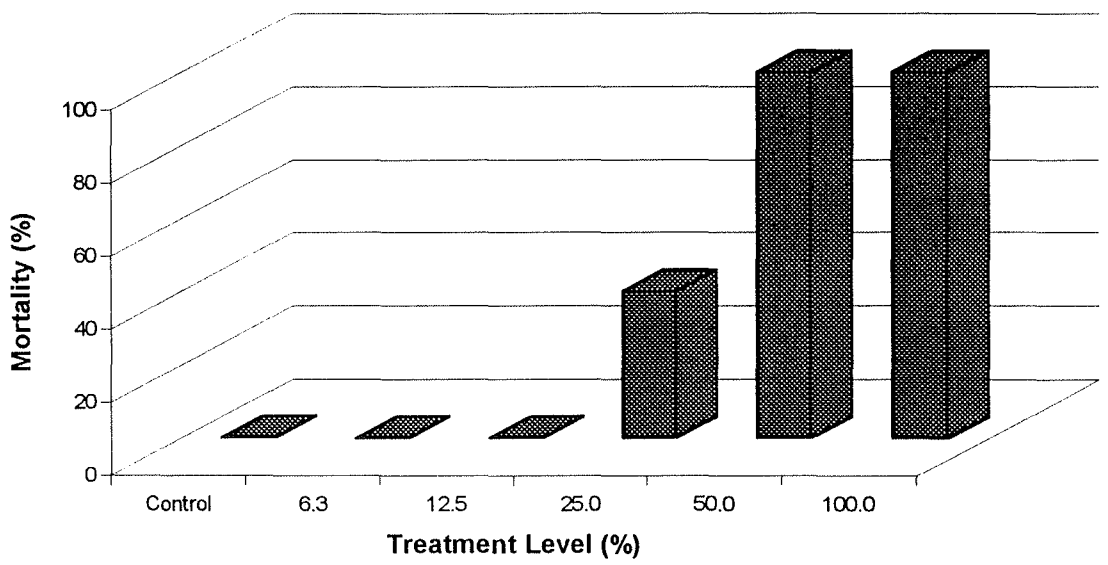
Test Method: Trout 96h Static Acute Test (LC50, five or more treatment levels plus a control)
Reference: Biological Test method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, 1990. Environment Canada, EPS 1/RM/13.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:
Description: effluent (Tar Island Dyke)
Collected On: 95/09/29 At: not given By: not given
Received On: 95/09/29 At: 2030 By: S. Goudy

Test Information:
Started On: 95/10/02 At: 1240 By: JR/DM
Ended On: 95/10/06 At: 1731 By: SF/DM
Reported On: 95/10/12 By: CG

Test Result:	Value	Confidence Limits		Units	Method Calculated
LC25				%	
LC50	27	18	44	%	Logit
NOEC				%	
LOEC				%	



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95404-1	Test: 950902

PREAERATION	not required				
time (h)	0	0.5	1	1.5	2
DO (mg/L)					
comments	none				

	CHEMISTRY			BIOLOGY - NUMBER ALIVE										
Treatment (%)	pH (units)	Cond.(uS/cm)	DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/10/02		Time: 1240		Initials: JR/DM		Temp (oC): 15.0							
Control	8.2	373	9.0	10									
6.25	8.2	445	9.0	10									
12.5	8.3	506	9.0	10									
25	8.4	646	8.9	10									
50	8.5	948	8.6	3									
100	8.5	1462	7.8	0									
Date: 95/10/03		Time: 1520		Initials: JR/SF		Temp (oC): 14.1							
Control	8.2	379	7.0	10									
6.25	8.2	453	6.7	10									
12.5	8.2	514	6.4	10									
25	8.4	647	6.3	10									
50	8.4	932	5.7	0									
100	8.5	1407	4.8	0									
Date: 95/10/04		Time: 1700		Initials: SF		Temp (oC): 15.2							
Control	7.6	383	6.1	10									
6.25	7.7	459	5.6	10									
12.5	7.7	522	5.4	10									
25	7.9	656	5.5	9									
50	8.1	938	5.2	0									
100	8.1	1420	4.0	0									
Date: 95/10/05		Time: 1705		Initials: GD/SF		Temp: 15.1							
Control	7.7	383	5.0	10									
6.25	7.8	459	4.9	10									
12.5	7.8	521	4.4	10									
25	8.0	654	5.1	7									
50				0									
100				0									

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-1	Test: 950902

	CHEMISTRY					BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)		Cond.(uS/cm)		DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/10/06			Time: 1731			Initials: SF/DM				Temp: 15.1					
Control	7.8		390		4.8	10									
6.25	7.8		465		5.2	10									
12.5	7.8		529		4.7	10									
25	7.9		660		5.3	6									
50						0									
100						0									

SUMMARY TABLE					REPLICATE 1	2	3	4	5	6	7	8	9	10
TREATMENT (%)	MORTALITY (%)	mg NH4-N/L t=0	t=96 h		avg	individual fish weights (g)									
Control	0	nd	nd		0.64	0.79	0.51	0.45	0.81	0.67	0.75	0.64	0.51	0.82	0.42
6.3	0	nd	nd		0.69	0.86	0.83	0.97	0.39	0.68	0.65	0.45	0.57	0.56	0.96
12.5	0	nd	nd		0.77	0.72	0.55	0.63	0.83	0.63	0.99	0.87	0.68	0.71	1.05
25.0	40	nd	nd		0.75	0.34	0.89	0.70	0.75	1.09	0.86	0.45	0.92	0.75	0.70
50.0	100	nd	nd		0.73	0.82	0.63	0.55	0.63	0.78	0.53	0.66	1.16	0.89	0.65
100.0	100	nd	nd		0.76	0.85	0.78	0.39	0.65	1.07	0.99	0.80	0.70	0.66	0.71
					avg	individual fish fork lengths (cm)									
Control					4.1	4.1	3.9	3.8	4.5	4.4	4.3	4.2	3.8	4.4	3.8
6.3					4.2	4.5	4.5	4.6	3.6	4.2	4.2	3.8	3.9	4.0	4.5
12.5					4.5	4.3	3.9	4.3	4.6	4.4	4.9	4.6	4.4	4.4	5.0
25.0					4.2	3.4	4.3	4.0	4.1	4.2	4.5	4.0	4.6	4.4	4.3
50.0					4.3	4.2	4.2	4.1	4.2	4.0	3.8	4.0	4.8	4.9	4.4
100.0					4.4	4.5	4.4	3.7	4.3	4.6	4.7	4.7	4.2	4.1	4.4

COMMENTS: Fish added at: 1215	Batch number:TR950911	No. days held: 22
Time (h)		
24	all dead in 50% & 100%, fish in 25% stressed, remainder appear normal	
48	one dead in 25%, other 25% fish on sides at pail bottom. Remaining fish appear normal	
72	two dead in 25%; other 25% fish on side at bottom. Remaining fish appear normal.	
96	fish in 12.5% disoriented, 6.25% & control fish appear normal	

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-1	Test: 950904

Test Method: Bacterial luminescence Test (IC50, four or more treatment levels plus a control)
Reference: Biological Test Method: Toxicity Test Using Luminescent Bacteria (*Photobacterium phosphoreum*), 1992. Environment Canada, EPS 1/RM/24.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

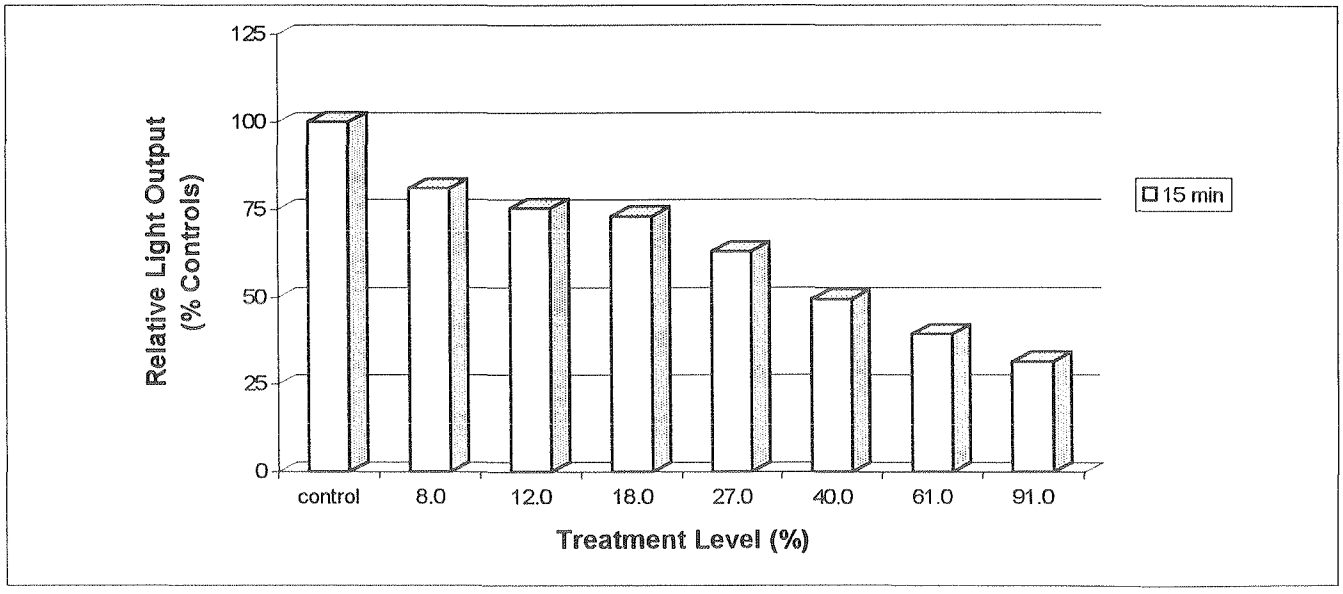
Description:	effluent (Tar Island Dyke)				
Collected On:	95/09/29	At:	not given	By:	not given
Received On:	95/09/29	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/10/03	At:	am	By:	JR
Ended On:	95/10/03	At:	am	By:	JR
Reported On:	95/10/11			By:	CG

Test Result:	Value	Confidence Limits		Units	Method Calculated
IC20 @ 15 min	10.0	8.0	12.0	%	regression analysis
IC50 @ 15 min	42.0	38.0	45.0	%	regression analysis

Graph of Light Ouput Relative to Controls at 5 and 15 Minutes



Notes: IC20 & IC50, concentrations that inhibit light output relative to controls by 20 and 50%

HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95404-1	Test: 950904

SAMPLE PRETREATMENT

pH adjustment	not required
preaeration	not required
turbidity	not centrifuged/filtered
other	none

LIGHT READINGS

	Time (min)		
Treatment Level (%)			15
control			89
8.0			72
12.0			67
18.0			65
27.0			56
40.0			44
61.0			35
91.0			28

INHIBITION (%CTLS)

15 min
100
81
75
73
63
49
39
31

COMMENTS

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-1	Test: 950905

Test Method: 72h Algal Growth Inhibition Test (IC50, five or more treatments plus a control)
Reference: Biological Test Method: Growth Inhibition Test Using the Freshwater Alga *Selenastrum capricornutum*, 1992. Environment Canada, EPS 1/RM/25.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

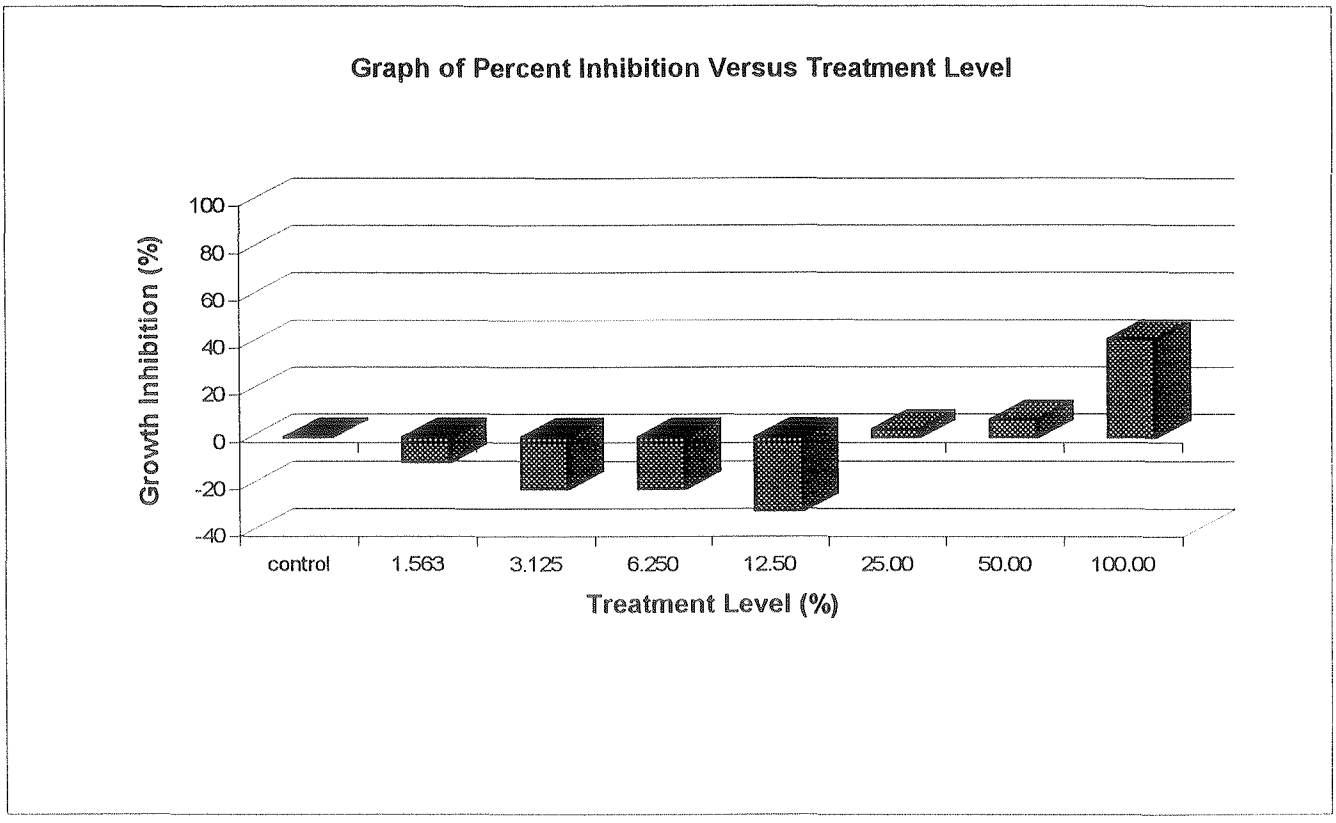
Description: effluent (Tar Island Dyke)

Collected On:	95/09/29	At:	not given	By:	not given
Received On:	95/09/29	At:	2030	By:	S. Goudy

Test Information:

Started On:	95/10/03	At:	PM	By:	DL
Ended On:	95/10/06	At:	PM	By:	DM
Reported On:	95/10/18			By:	CG

Test Result:	Value	Confidence Limits		Units	Method Calculated
IC25	57	38	69	%	ICPIN
IC50	>100			%	ICPIN
NOEC	50			%	Dunnett's Test
LOEC	100			%	Dunnett's Test



HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA	Client: 95030	Sample: 95404-1	Test: 950905

SAMPLE PRETREATMENT	
pH adjustment	not required
preaeration	not required
turbidity	not centrifuged/filtered
other	none

TEST DATA

FINAL CELL DENSITIES (cells/mL)

Treatment (%)	Replicate A	B	C	Average AVG	Standard Deviation	CV (%)	Percent Controls	Inhibition (%Ctls)
control	1788384	1756384	1895051	1813273	72606	4	100	0
1.563	2001717	1831051	2172384	2001717	170667	9	110	-10
3.125	2343051	2001717	2268384	2204384	179441	8	122	-22
6.250	2567051	1980384	2065717	2204384	316963	14	122	-22
12.50	2599051	2545717	1991051	2378606	336691	14	131	-31
25.00	1735051	1745717	1777717	1752828	22204	1	97	3
50.00	1468384	1564384	2001717	1678162	284289	17	93	7
100.00	1009717	1052384	1116384	1059495	53688	5	58	42

COMMENTS
- all cell numbers based on optical density readings obtained with a microplate reader
- the initial cell density was 9,312 cells/mL.

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-1	Test: 950900

Test Method: 7 d Ceriodaphnia Survival and Reproduction Test (5 treatment levels plus a control)
Reference: Biological Test Method: Test of Reproduction and Survival Using the Cladoceran *Ceriodaphnia dubia*, 1992. Environment Canada, EPS 1/RM/21.

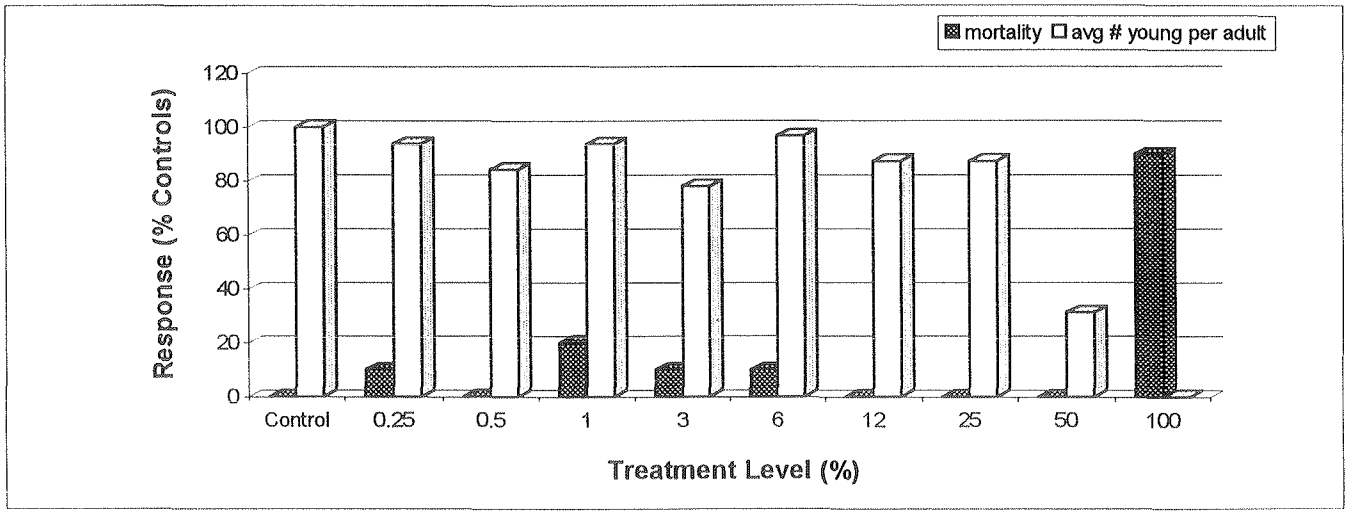
Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:
Description: effluent (Tar Island Dyke)
Collected On: not given At: not given By: not given
Received On: 95/09/29 At: 2030 By: S. Goudy

Test Information:
Started On: 95/10/03 At: 1400 By: DM
Ended On: 95/10/10 At: 900 By: DM
Reported On: 95/10/13 By: CG

Test Result:		Value	Confidence Limits		Units	Method Calculated
MORTALITY	LC25	67	63	68	%	ICPIN
	LC50	78	75	86	%	ICPIN
	NOEC	50			%	Fisher's Exact
	LOEC	100			%	Fisher's Exact
REPRODUCTION						
	IC25	32	26	34	%	ICPIN
	IC50	48	43	50	%	ICPIN
	NOEC	25			%	Steel's Many One
	LOEC	50			%	Steel's Many One

Graph of Mortality and Reproduction at Seven Days Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; IC25 & IC50, concentrations inhibiting reproduction by 25 and 50%; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95404-1	Test: 950900

PREAERATION not required

FILTRATION not required

Comments none

CHEMISTRY / **BIOLOGY - NUMBER OF YOUNG**

Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 0 95/10/03			Time: 1400			Initials: DM			Temp (oC): 25.0							
Control	8.4		374		7.5		0	0	0	0	0	0	0	0	0	0
0.25	8.4		373		8.0		0	0	0	0	0	0	0	0	0	0
0.5	8.4		379		7.9		0	0	0	0	0	0	0	0	0	0
1	8.4		383		7.8		0	0	0	0	0	0	0	0	0	0
3	8.4		400		7.9		0	0	0	0	0	0	0	0	0	0
6	8.4		434		7.9		0	0	0	0	0	0	0	0	0	0
12	8.5		499		7.9		0	0	0	0	0	0	0	0	0	0
25	8.6		629		7.7		0	0	0	0	0	0	0	0	0	0
50	8.6		877		7.6		0	0	0	0	0	0	0	0	0	0
100	8.6		1379		7.5		0	0	0	0	0	0	0	0	0	0
DAY 1 95/10/04			Time: 1600			Initials: DL			Temp (oC): 25.0							
Control	8.4	8.4	371	428	8.4	8.2	0	0	0	0	0	0	0	0	0	0
0.25	8.4	8.4	372	391	8.3	8.2	0	0	0	0	0	0	0	0	0	0
0.5	8.4	8.4	377	394	8.3	8.2	0	0	0	0	0	0	0	0	0	0
1	8.4	8.4	383	404	8.3	8.4	0	0	0	0	0	0	0	0	0	0
3	8.4	8.4	399	417	8.2	8.4	0	0	0	0	0	0	0	0	0	0
6	8.4	8.5	433	464	8.0	8.3	0	0	0	0	0	0	0	0	0	0
12	8.4	8.5	500	520	8.0	8.2	0	0	0	0	0	0	0	0	0	0
25	8.5	8.6	640	643	7.9	8.1	0	0	0	0	0	0	0	0	0	0
50	8.5	8.7	896	832	7.8	8.1	0	0	0	0	0	0	0	0	0	0
100	8.5	8.7	1368	1289	7.4	8.1			0	0		0	0	0		0
DAY 2 95/10/05			Time: 1600			Initials: DL			Temp (oC): 25.0							
Control	8.3	8.3	372	432	7.8	8.2	0	0	0	0	0	0	0	0	0	0
0.25	8.2	8.4	371	389	7.6	8.1	0	0	0	0	0	0	0	0	0	0
0.5	8.2	8.3	376	393	7.4	8.0	0	0	0	0	0	0	0		0	0
1	8.2	8.3	384	403	7.3	8.1	0	0	0	0	0	0	0	0	0	0
3	8.2	8.3	399	418	7.2	8.1	0	0	0	0	0	0	0		0	0
6	8.3	8.3	435	453	7.1	7.9	0	0	0	0	0	0	0		0	0
12	8.3	8.4	502	516	7.0	7.9	0	0	0	0	0	0	0	0	0	0
25	8.4	8.6	631	648	6.9	7.9	0	0	0	0	0	0	0	0	0	0
50	8.4	8.7	878	862	6.7	7.8	0	0	0	0	0	0	0	0	0	0
100	8.5	8.9	1378	1340	6.8	7.7			0	0		0	0	0		

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-1	Test: 950900

	CHEMISTRY						BIOLOGY - NUMBER OF YOUNG									
Treatment	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE									
(%)	new	used	new	used	new	used	1	2	3	4	5	6	7	8	9	10
DAY 3 95/10/06			Time: 1000			Initials: DM			Temp (oC): 25.0							
Control	8.0	8.2	369	417	7.5	8.1	0	0	0	0	0	0	0	0	0	0
0.25	8.1	8.2	371	393	7.8	8.1	0	0	0	0	0	0	0	0	0	0
0.5	8.1	8.2	378	400	7.9	8.1	0	0	0	0	0	0	0		0	0
1	8.1	8.2	384	395	7.8	8.1	0	0	0	0	0	0	0	0	0	0
3	8.2	8.3	399	408	7.9	8.1	0	0	0	0	0	0	0		0	0
6	8.2	8.3	439	464	7.9	8.1	0	0	0	0	0	0	0		0	0
12	8.3	8.4	501	510	8.0	8.0	0	0	0	0	0	0	0	0	0	0
25	8.4	8.5	631	637	7.9	7.7	0	0	0	0	0	0	0	0	0	0
50	8.5	8.6	893	874	7.9	7.6	0	0	0	0	0	0	0	0	0	0
100	8.5	8.7	1380	1327	7.3	7.9				0		0		0		
DAY 4 95/10/07			Time: 1105			Initials: JR			Temp (oC): 25.0							
Control	8.3	8.3	380	395	7.4	6.6	5	5	3	5	4	4	4	6	6	6
0.25	8.3	8.3	382	384	7.6	7.2	6	4	6	2	5	6	6		6	6
0.5	8.3	8.3	388	380	7.5	7.3	5	4	5	0	4	2	6	4	2	3
1	8.3	8.3	394	397	7.5	7.1	6	6	7	4	4	5	4		5	5
3	8.4	8.3	413	411	7.5	7.1	0	3	5	0	6	5	4		0	0
6	8.4	8.4	447	466	7.2	6.8	4	6	5	5	0	4	6	6	5	5
12	8.4	8.5	510	522	7.1	7.0	5	4	5	7	0	5	5	2	0	5
25	8.5	8.6	639	648	7.2	7.7	6	5	6	6	3	3	6	5	4	7
50	8.5	8.7	897	866	7.1	7.1	2	0	0	0	0	2	0	0	0	0
100	8.6	8.9	1405	1325	6.3	7.1				0		0		0		
DAY 5 95/10/08			Time: 1230			Initials: JR			Temp (oC): 25.0							
Control	8.5	8.5	400	402	8.3	7.3	5	10	12	9	12	10	9	11	8	10
0.25	8.5	8.6	391	391	8.0	7.2	9	13	11	9	9	10	10		9	7
0.5	8.5	8.5	395	396	7.3	7.2	12	10	10	9	7	8	10	9	10	6
1	8.5	8.6	398	403	7.4	7.2	9	8	11	12	11	9	9		8	9
3	8.5	8.6	415	419	7.6	7.2	8	6	8	9	9	12	7		3	10
6	8.5	8.6	447	462	7.6	7.1	10	10	12	12	9	12	11	7	11	13
12	8.6	8.6	512	513	7.3	7.1	12	10	9	12	5	13	10	12	8	9
25	8.6	8.8	638	640	7.3	7.0	9	9	7	13	9	8	14	9	11	10
50	8.7	8.9	894	864	7.0	7.0	5	4	2	5	2	0	5	2	5	2
100	8.8	9.0	1386	1334	6.8	6.8								0		

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-1	Test: 950900

DAY 6 95/10/09			Time: 1100			Initials: JR			Temp (oC): 25.0							
Control	8.4	8.4	375	405	6.9	7.7	0	0	0	0	0	0	0	2	0	0
0.25	8.4	8.5	378	392	7.0	6.9	0	17	0	13	12	0	0		15	12
0.5	8.4	8.4	382	393	7.0	7.0	0	0	15	14	0	0	0	12	12	15
1	8.5	8.5	391	400	7.0	6.9	0	15	14	15	16	0	0		9	15
3	8.5	8.5	409	417	7.0	6.9	14	12	13	11	17	0	11		13	18
6	8.5	8.5	442	452	7.0	6.9	0	0	0	0	0	0	0	0	0	0
12	8.5	8.6	504	508	7.0	6.8	0	0	0	0	16	0	6	16	12	18
25	8.5	8.7	629	638	6.9	6.9	0	0	0	0	8	12	14	0	8	15
50	8.5	8.8	880	870	6.9	6.9	0	0	7	9	5	8	3	0	0	7
100	8.5	9.1	1355	1340	6.2	6.9								0		

DAY 7 95/10/10			Time: 900			Initials: DM			Temp (oC): 25.0							
Control		8.5		403		7.4	16	18	21	16	16	18	19	18	18	17
0.25		8.6		390		7.2	13	1	16	1	0	17	18		0	1
0.5		8.6		393		7.1	16	15	0	0	16	15	16	2	0	0
1		8.6		408		6.8	13	1		1	1	16	16		2	1
3		8.6		421		6.8	1	0	0	0	0	15	0		0	1
6		8.6		458		6.8	11	19	16	18		18	22	18	16	19
12		8.7		513		6.7	16	13	10	18	1	11	3	0	0	2
25		8.8		638		6.8	18	11	13	18	0	0	1	11	0	1
50		8.9		862		6.7	9	9	0	0	0	0	0	11	0	0
100		9.0		1283		6.9								0		

SUMMARY TABLE		Reproduction		Daily Cumulative Young Production							
Treatment (%)	Mortality (%)	Young/Adult	% controls	0	1	2	3	4	5	6	7
Control	0	32	100	0	0	0	0	48	144	146	323
0.25	10	30	94	0	0	0	0	47	134	203	270
0.5	0	27	84	0	0	0	0	35	126	194	274
1	20	30	94	0	0	0	0	46	132	216	267
3	10	25	78	0	0	0	0	23	95	204	221
6	10	31	97	0	0	0	0	46	153	153	310
12	0	28	88	0	0	0	0	38	138	206	280
25	0	28	88	0	0	0	0	51	150	207	280
50	0	10	31	0	0	0	0	4	36	75	104
100	90	0	0	0	0	0	0	0	0	0	0

COMMENTS:

source of young: in house culture media: Bow River Water food lots: 21/09 & 28/09

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-1	Test: 950906

Test Method: 7 d Fathead Minnow Survival and Growth Test (five treatments plus a control)
Reference: Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnow, 1992. Environment Canada, EPS 1/RM/22.

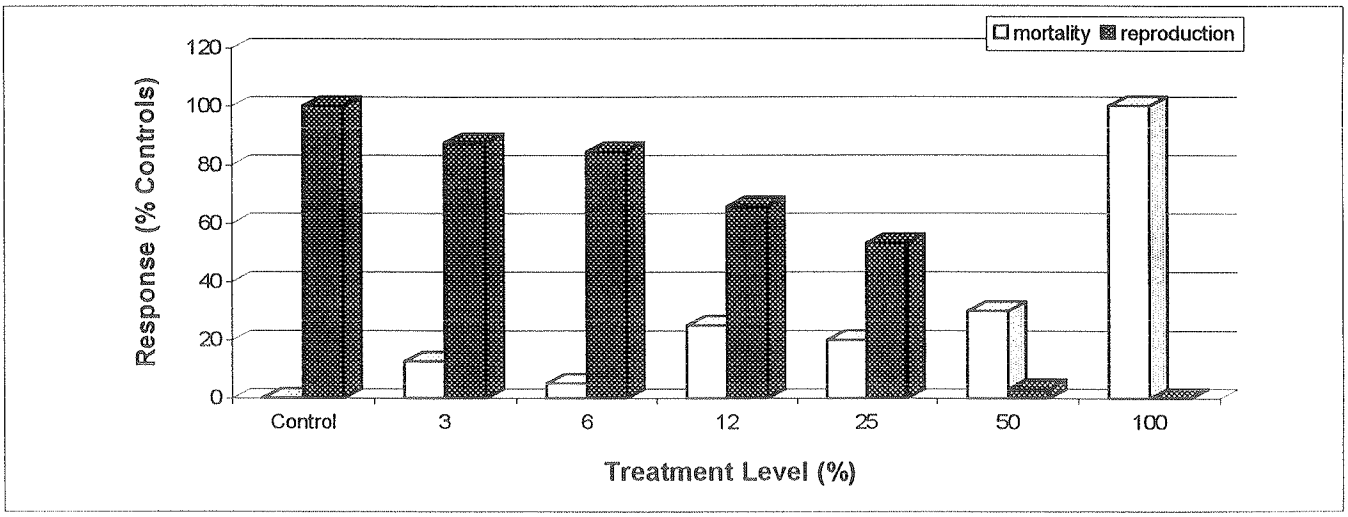
Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:
Description: effluent (Tar Island Dyke)
Collected On: not given At: not given By: not given
Received On: 95/09/29 At: 2030 By: S. Goudy

Test Information:
Started On: 95/10/04 At: 1420 By: SF
Ended On: 95/10/11 At: 1200 By: DM
Reported On: 95/10/12 By: CG

Test Result:		Value	Confidence Limits		Units	Method Calculated
MORTALITY	LC25	33	10	55	%	Bootstrap
	LC50	64	55	70	%	Bootstrap
	NOEC	50			%	Steel's Many-One
	LOEC	100			%	Steel's Many-One
GROWTH						
	IC25	9	6	12	%	Bootstrap
	IC50	29	12	36	%	Bootstrap
	NOEC	6.25			%	William's
	LOEC	12.5			%	William's

Graph of Mortality and Growth at Seven Days Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95404-1	Test: 950906

PREAERATION not required

FILTRATION not required

Comments none

	CHEMISTRY						BIOLOGY - NUMBER ALIVE					
Treatment	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE					
(%)	new	used	new	used	new	used	1	2	3	4	5	6
DAY 0	95/10/04		Time: 1420			Initials: SF			Temp (oC):	25.0		
Control	7.6		376		8.7		10	10	10	10		
3	8.0		408		8.2		10	10	10	10		
6	8.0		444		8.3		10	10	10	10		
12	8.1		503		8.4		10	10	10	10		
25	8.2		640		8.4		10	10	10	10		
50	8.3		904		8.0		10	10	10	10		
100	8.4		1387		7.2		10	10	10	10		
DAY 1	95/10/05		Time: 1500			Initials: GD			Temp (oC):	25.0		
Control	7.8	8.2	379	398	7.8	7.3	10	10	10	10		
3	8.0	8.1	409	422	7.8	6.5	10	10	10	10		
6	8.0	8.2	441	457	7.8	6.7	10	10	10	10		
12	8.1	8.3	509	509	7.7	6.7	10	10	10	10		
25	8.2	8.4	623	635	7.5	6.5	10	10	10	10		
50	8.3	8.5	859	887	7.3	6.6	10	10	10	10		
100		8.6		1320		6.4	0	0	0	0		
DAY 2	95/10/06		Time: 1500			Initials: SF			Temp (oC):	25.0		
Control	7.9	7.9	381	386	7.6	5.8	10	10	10	10		
3	8.0	7.9	403	415	7.4	5.9	10	10	10	10		
6	8.0	8.0	431	442	7.5	6.0	10	10	10	9		
12	8.0	8.1	489	512	7.3	5.9	10	10	10	10		
25	8.1	8.3	599	630	7.0	6.2	10	10	10	10		
50	8.2	8.4	835	834	6.2	5.9	10	9	10	10		
100							0	0	0	0		
DAY 3	95/10/07		Time: 1100			Initials: SF			Temp:	25.0		
Control	8.1	8.2	387	400	8.0	5.7	10	10	10	10		
3	8.2	8.1	413	413	7.8	5.6	10	10	9	10		
6	8.2	8.2	445	446	7.7	5.7	10	10	10	9		
12	8.3	8.3	509	509	7.8	5.9	10	10	10	10		
25	8.3	8.4	620	617	7.4	6.3	10	10	9	10		
50	8.4	8.5	866	869	6.6	5.4	9	9	10	10		
100							0	0	0	0		

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-1	Test: 950906

	CHEMISTRY						BIOLOGY - NUMBER ALIVE									
Treatment	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE									
(%)	new	used	new	used	new	used	1	2	3	4	5	6	7	8	9	10
DAY 4	95/10/08		Time:	1210		Initials: SF			Temp:	25.0						
3	8.3	8.1	386	409	7.8	5.1	10	10	10	10						
6	8.4	8.2	410	430	7.5	5.3	10	10	9	10						
12	8.4	8.3	449	462	7.7	6.0	10	10	10	9						
25	8.4	8.3	509	535	7.4	5.6	10	10	10	10						
50	8.4	8.5	636	644	7.1	5.1	10	10	8	10						
100	8.5	8.5	871	880	6.6	5.0	9	8	9	10						
							0	0	0	0						
DAY 5	95/10/09		Time:	1155		Initials: SF			Temp:	25.0						
Control	8.0	8.3	386	402	7.9	6.3	10	10	10	10						
3	8.2	8.2	406	428	7.5	6.2	10	10	8	10						
6	8.1	8.3	438	465	7.7	5.6	10	10	10	9						
12	8.2	8.4	481	529	7.5	6.5	7	10	10	10						
25	8.2	8.4	636	643	7.2	5.6	9	10	7	9						
50	8.3	8.5	886	870	6.4	5.6	8	7	8	10						
100							0	0	0	0						
DAY 6	95/10/10		Time:	1132		Initials: SF			Temp:	25.0						
Control	7.4	8.3	436	407	8.0	6.0	10	10	10	10						
3	8.2	8.3	411	439	7.7	6.2	7	10	8	10						
6	8.3	8.4	440	446	7.7	6.7	10	10	10	8						
12	8.3	8.5	508	497	7.7	6.2	5	10	10	8						
25	8.4	8.5	630	641	7.2	5.9	9	10	6	8						
50	8.5	8.6	886	866	6.3	5.4	8	5	7	10						
100							0	0	0	0						
DAY 7	95/10/11		Time:	1200		Initials: DM			Temp:	25.0						
Control		7.9		435		6.6	10	10	10	10						
3		7.9		439		6.7	7	10	8	10						
6		8.0		456		7.1	10	10	10	8						
12		8.1		530		6.3	3	10	10	7						
25		8.1		648		5.7	9	10	5	8						
50		8.1		890		5.2	7	4	7	10						

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-1	Test: 950906

SUMMARY TABLE		Average Fish Weights	
Treatment (%)	Mortality (%)	mg/fish	% controls
Control	0	0.32	100
3	12.5	0.28	88
6	5	0.27	84
12	25	0.21	66
25	20	0.17	53
50	30	0.01	3
100	100		

COMMENTS:

source of young: in house

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-2

CLIENT INFORMATION

Client:	Suncor Inc. Oil Sands Group
Operation:	Ft. McMurray
Address:	P.O. Box 4001
City:	Ft. McMurray
Province/State:	Alberta
Country:	Canada
Postal/ZIP Code:	T9H 3E3
Billing Information:	
Contact:	John Gulley/Trina Hoffarth
Tel:	403-743-6715
Fax:	403-791-8339

SAMPLE INFORMATION

Sample Type:	Athabasca River Water		
Collected On:	95/09/29	At:	not given
Collected By:	not given		
Shipped On:	not given		
Shipped By:	not given		
Received On:	95/09/29	At:	2030
Received By:	S. Goudey		
Container:	3 x 5600L containers		
Seals:	not sealed		
Initials on Seals:	not applicable		

INITIAL CHEMISTRY

pH (units)	8.5	ammonium (mg-N/L)	not done
Conductance (uS/cm)	317	residual chlorine (mg/L)	not done
Dissolved Oxygen (mg/L)	8.9	Colour:	brown
Temperature (oC)	18.0	Odour:	mild organic
Alkalinity (mg-CaCO3/L)	not done		
Hardness (mg-CaCO3/L)	not done		

COMMENTS

SAMPLE HISTORY

Storage Conditions:

Disposed On: _____ by _____ Method: _____

TEST LOG

Test Type	DA(S)	TR(S)	BL(S)	AG(S)	CD(S)	FM(S)	
Number	950876	950903	950881	950886	950871	950891	
Started	95/10/03	95/10/02	95/10/03	95/10/03	95/10/03	95/10/04	
Ended	95/10/05	95/10/06	95/10/03	95/10/06	95/10/10	95/10/11	
Reported	95/10/11	95/10/12	95/10/11	95/10/18	95/10/18	95/10/12	
Faxed							

NOTES: TR, trout; FM, fathead minnows; DA, Daphnia; CD, Ceriodaphnia; AG, Selenastrum; BL, bacterial luminescence; D, definitive test; S, screening test

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-2	Test: 950876

Test Method: *Daphnia* 48h Static Acute Test (LC50, five or more treatments plus a control)
Reference: Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to *Daphnia magna*, 1990. Environment Canada, EPS 1/RM/14.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

Description:	Athabasca River Water				
Collected On:	95/09/29	At:	not given	By:	not given
Received On:	95/09/29	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/10/03	At:	1525	By:	DM
Ended On:	95/10/05	At:	1640	By:	SF
Reported On:	95/10/11			By:	CG

Test Result:

	% Mortality
Control	0
100%	0

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95404-2	Test: 950876

	CHEMISTRY					BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)		Cond.(uS/cm)		DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/10/03			Time: 1525			Initials: DM				Temp (oC): 20					
Control	8.4		346		8.1	5	5								
100	8.6		307		7.8	5	5								
Date: 95/10/04			Time: 1550			Initials: SF				Temp (oC): 20					
Control						5	5								
100						5	5								
Date: 95/10/05			Time: 1640			Initials: SF				Temp (oC): 20					
Control	8.4		347		7.8	5	5								
100	8.4		305		7.9	5	5								

SUMMARY TABLE	
TREATMENT (%)	MORTALITY (%)
Control	0
100	0

young :	jar C3	hardness (mg-CaCO3/L) :	180
water :	bucket 3	Adjustment:	none

COMMENTS:
no comments

Notes: F, floating; I, immobile; B, stuck on bubbles; D, caught in debris

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-2	Test: 950903

Test Method: Trout 96h Static Acute Test (LC50, five or more treatment levels plus a control)
Reference: Biological Test method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, 1990. Environment Canada, EPS 1/RM/13.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

Description:	Athabasca River Water				
Collected On:	95/09/29	At:	not given	By:	not given
Received On:	95/09/29	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/10/02	At:	1230	By:	DM/JR
Ended On:	95/10/06	At:	1730	By:	SF/DM
Reported On:	95/10/12			By:	CG

Test Result:

	% Mortality
Control	0
100%	0

HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95404-2	Test: 950903

PREAERATION	not required				
time (h)	0	0.5	1	1.5	2
DO (mg/L)					
comments	none				

	CHEMISTRY			BIOLOGY - NUMBER ALIVE										
Treatment (%)	pH (units)		Cond.(uS/cm)	DO (mg/L)		REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/10/02			Time: 1230		Initials: DM/JR	Temp (oC): 14.0									
Control	8.2		381	9.1		10									
100	8.5		317	8.9		10									
Date: 95/10/03			Time: 1520		Initials: JR/SF	Temp (oC): 14.1									
Control	8.3		377	6.9		10									
100	8.3		301	5.9		10									
Date: 95/10/04			Time: 1200		Initials: SF/TB	Temp (oC): 14.8									
Control	8.4		380	9.6		10									
100	8.4		302	9.6		10									
Date: 95/10/05			Time: 1705		Initials: GD/SF	Temp: 15.6									
Control	8.4		371	8.9		10									
100	8.3		301	9.0		10									

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-2	Test: 950903

CHEMISTRY | **BIOLOGY - NUMBER ALIVE**

Treatment (%)	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/10/06			Time: 1730		Initials: SF/DM		Temp: 14.6									
Control	8.4		381		8.8		10									
100	8.4		307		8.8		10									

SUMMARY TABLE

TREATMENT (%)	MORTALITY (%)	mg NH4-N/L t=0	t=96 h
Control	0	nd	nd
100.0	0	nd	nd

		REPLICATE 1	2	3	4	5	6	7	8	9	10
avg	individual fish weights (g)										
0.88		1.27	1.03	0.76	0.92	0.87	0.89	0.83	0.86	0.39	0.94
0.72		0.83	0.73	0.75	0.78	0.57	0.57	0.82	0.83	0.58	0.70
avg	individual fish fork lengths (cm)										
4.6		5.0	4.8	4.4	4.8	4.4	4.7	4.6	4.8	3.8	5.0
4.3		4.4	4.2	4.3	4.6	4.3	4.0	4.2	4.3	4.0	4.3

Control
100.0

COMMENTS: Fish added at: 1215 Batch number:TR950911 No. days held: 22

Time (h)	
24	all fish appear normal
48	all fish appear normal
72	all fish appear normal
96	all fish appear normal

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-2	Test: 950881

Test Method: Bacterial luminescence Test (screening test, one treatment level plus a control)
Reference: Biological Test Method: Toxicity Test Using Luminescent Bacteria (*Photobacterium phosphoreum*), 1992. Environment Canada, EPS 1/RM/24.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

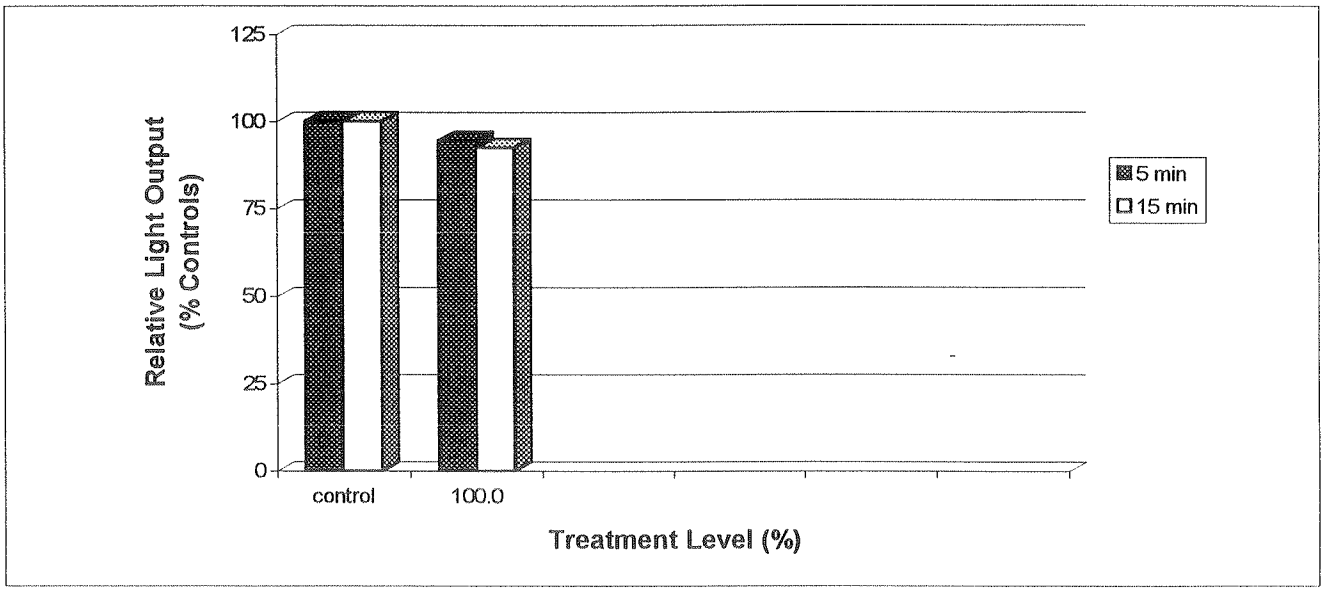
Description:	Athabasca River Water				
Collected On:	95/09/29	At:	not given	By:	not given
Received On:	95/09/29	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/10/03	At:	AM	By:	JR
Ended On:	95/10/03	At:	AM	By:	JR
Reported On:	95/10/11			By:	CG

Test Result: 92% expressed as a percentage of the control.

Graph of Light Ouput Relative to Controls at 5 and 15 Minutes



HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA	Client: 95030	Sample: 95404-2	Test: 950881

SAMPLE PRETREATMENT	
pH adjustment	not required
preaeration	not required
turbidity	not centrifuged/filtered
other	none

LIGHT READINGS

	Time (min)		
Treatment Level (%)	0	5	15
control	91	90	92
100.0	94	85	85

INHIBITION (%CTLS)	
5 min	15 min
100	100
94	92

COMMENTS

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-2	Test: 950886

Test Method: 72h Algal Growth Inhibition Test (IC50, five or more treatments plus a control)
Reference: Biological Test Method: Growth Inhibition Test Using the Freshwater Alga *Selenastrum capricornutum*, 1992. Environment Canada, EPS 1/RM/25.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

Description:	Athabasca River Water				
Collected On:	not given	At:	not given	By:	not given
Received On:	95/09/29	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/10/03	At:	PM	By:	DL
Ended On:	95/10/06	At:	PM	By:	DM
Reported On:	95/10/18			By:	CG

Test Result: 35% Inhibition compared to control growth
significant growth inhibition (student's t-test)

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA	Client: 95030	Sample: 95404-2	Test: 950886

SAMPLE PRETREATMENT	
pH adjustment	not required
preaeration	not required
turbidity	not centrifuged/filtered
other	none

TEST DATA

FINAL CELL DENSITIES (cells/mL)

Treatment (%)	Replicate A	B	C	Average AVG	Standard Deviation	CV (%)	Percent Controls	Inhibition (%Ctls)
control	2023051	1895051	1831051	1916384	97762	5	100	0
100.000	1425717	1265717	1073717	1255051	176242	14	65	35

COMMENTS

- all cell numbers based on optical density readings obtained with a microplate reader
- the initial cell density was 9,312 cells/mL.

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-2	Test: 950871

Test Method: 7 d Ceriodaphnia Survival and Reproduction Test (5 treatment levels plus a control)
Reference: Biological Test Method: Test of Reproduction and Survival Using the Cladoceran *Ceriodaphnia dubia*, 1992. Environment Canada, EPS 1/RM/21.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:
Description: Athabasca River Water
Collected On: not given At: not given By: not given
Received On: 95/09/29 At: 2030 By: S. Goudey

Test Information:
Started On: 95/10/03 At: 1400 By: DM
Ended On: 95/10/10 At: 0900 By: DM
Reported On: 95/10/18 By: CG

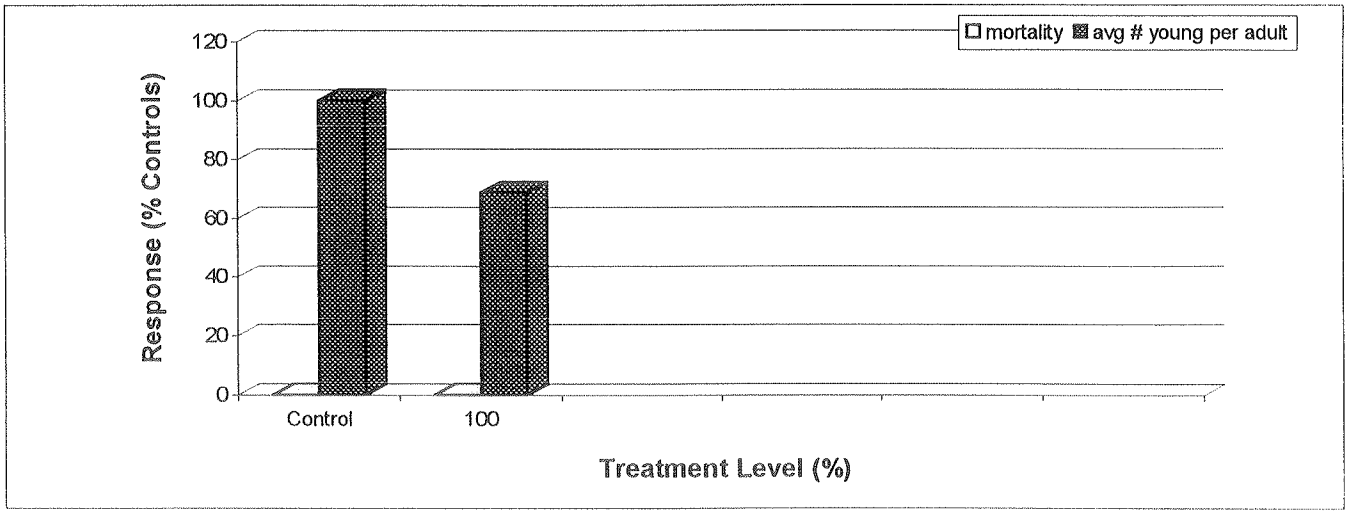
Test Result:

MORTALITY

	% Mortality
Control	0
100%	0

REPRODUCTION 69% expressed as a percentage of the control.

Graph of Mortality and Reproduction at Seven Days Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; IC25 & IC50, concentrations inhibiting reproduction by 25 and 50%; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95404-2	Test: 950821

PREAERATION not required

FILTRATION not required

Comments none

	CHEMISTRY						BIOLOGY - NUMBER OF YOUNG									
Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 0 95/10/03			Time: 1400				Initials: DM				Temp (oC): 25.0					
Control	8.4		374		7.5		0	0	0	0	0	0	0	0	0	0
100	8.4		309		8.0		0	0	0	0	0	0	0	0	0	0
DAY 1 95/10/04			Time: 1600				Initials: DL				Temp (oC): 25.0					
Control	8.4	8.4	371	428	8.4	8.2	0	0	0	0	0	0	0	0	0	0
100	8.4	8.4	313	330	8.3	8.3	0	0	0	0	0	0	0	0	0	0
DAY 2 95/10/05			Time: 1600				Initials: DL				Temp (oC): 25.0					
Control	8.3	8.3	372	432	7.8	8.2	0	0	0	0	0	0	0	0	0	0
100	8.3	8.4	386	339	7.4	8.3	0	0	0	0	0	0	0	0	0	0
DAY 3 95/10/06			Time: 1000				Initials: DM				Temp: 25.0					
Control	8.0	8.2	369	417	7.5	8.1	0	0	0	0	0	0	0	0	0	0
100	8.0	8.2	307	330	7.6	7.6	0	0	0	0	0	0	0	0	0	0

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-2	Test: 950871

		CHEMISTRY					BIOLOGY - NUMBER OF YOUNG									
Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 4 95/10/07			Time: 1105			Initials: JR					Temp: 25.0					
Control	8.3	8.3	380	395	7.4	6.6	5	5	3	5	4	4	4	6	6	6
100	8.4	8.3	314	320	7.8	7.0	4	6	5	3	5	6	6	4	3	5
DAY 5 95/10/08			Time: 1230			Initials: JR					Temp: 25.0					
Control	8.5	8.5	400	402	8.3	7.3	5	10	12	9	12	10	9	11	8	10
100	8.5	8.5	325	327	8.1	7.3	4	5	8	6	8	6	6	6	5	4
DAY 6 95/10/09			Time: 1100			Initials: JR					Temp: 25.0					
Control	8.4	8.4	375	405	6.9	7.7	0	0	0	0	0	0	0	2	0	0
100	8.5	8.5	310	326	6.8	7.2	0	0	0	0	0	0	0	0	0	0
DAY 7 95/10/10			Time: 0900			Initials: DM					Temp: 25.0					
Control		8.5		403		7.4	16	18	21	15	16	18	19	18	18	17
100		8.6		323		7.5	10	9	13	13	10	12	10	11	13	12

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-2	Test: 950821

SUMMARY TABLE		Reproduction		Daily Cumulative Young Production							
Treatment (%)	Mortality (%)	Young/Adult	% controls	0	1	2	3	4	5	6	7
Control	0	32	100	0	0	0	0	48	144	146	322
100	0	22	69	0	0	0	0	47	110	110	223

COMMENTS:

source of young: in house culture media: Bow River Water food lots: 21/09 & 28/09

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-2	Test: 950891

Test Method: 7 d Fathead Minnow Survival and Growth Test (five treatments plus a control)
Reference: Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnow, 1992. Environment Canada, EPS 1/RM/22.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

Description: Athabasca River Water

Collected On:	not given	At:	not given	By:	not given
Received On:	95/09/29	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/10/04	At:	1420	By:	SF
Ended On:	95/10/11	At:	1200	By:	DM
Reported On:	95/10/12			By:	CG

Test Result:

MORTALITY

	% Mortality
Control	0
100%	3

GROWTH 91% expressed as a percentage of the control.

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95404-2	Test: 950891

PREAERATION not required

FILTRATION not required

Comments none

		CHEMISTRY					BIOLOGY - NUMBER ALIVE					
Treatment	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE					
(%)	new	used	new	used	new	used	1	2	3	4	5	6
DAY 0	95/10/04		Time: 1420			Initials: SF			Temp (oC):	25.0		
Control	7.6		376		8.7		10	10	10	10		
100	8.1		305		7.8		10	10	10	10		
DAY 1	95/10/05		Time:			Initials: GD			Temp (oC):	25.0		
Control	7.8	8.2	379	398	7.8	7.3	10	10	10	10		
100	8.2	8.1	306	329	7.5	6.6	10	10	10	10		
DAY 2	95/10/06		Time: 1500			Initials: SF			Temp (oC):	25.0		
Control	7.9	7.9	381	386	7.6	5.8	10	10	10	10		
100	8.3	7.9	308	317	7.1	5.4	10	10	10	10		
DAY 3	95/10/07		Time: 1100			Initials: SF			Temp:	25.0		
Control	8.1	8.2	387	400	8.0	5.7	10	10	10	10		
100	8.3	8.2	308	344	7.4	5.8	10	10	10	10		

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-2	Test: 950891

	CHEMISTRY						BIOLOGY - NUMBER ALIVE									
Treatment	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE									
(%)	new	used	new	used	new	used	1	2	3	4	5	6	7	8	9	10
DAY 4	95/10/08		Time: 1210			Initials: SF			Temp: 25.0							
Control	8.3	8.1	386	409	7.8	5.1	10	10	10	10						
100	8.3	8.2	314	344	7.1	4.9	10	10	10	10						
DAY 5	95/10/09		Time: 1155			Initials: SF			Temp: 25.0							
Control	8.0	8.3	396	402	7.9	6.3	10	10	10	10						
100	8.1	8.3	310	382	7.0	6.0	10	10	10	10						
DAY 6	95/10/10		Time: 1132			Initials: SF			Temp: 25.0							
Control	7.4	8.3	436	407	8.0	6.0	10	10	10	10						
100	8.4	8.3	308	352	7.2	6.1	9	10	10	10						
DAY 7	95/10/11		Time: 1200			Initials: DM			Temp: 25.0							
Control		7.9		435		6.6	10	10	10	10						
100		7.9		329		6.8	9	10	10	10						

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95404-2	Test: 950891

SUMMARY TABLE		Average Fish Weights	
Treatment (%)	Mortality (%)	mg/fish	% controls
Control	0	0.32	100
100	3	0.29	91

COMMENTS:
source of young: in house

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-1

CLIENT INFORMATION

Client:	Suncor Inc. Oil Sands Group
Operation:	Ft. McMurray
Address:	P.O. Box 4001
City:	Ft. McMurray
Province/State:	Alberta
Country:	Canada
Postal/ZIP Code:	T9H 3E3
Billing Information:	
Contact:	John Gulley/Trina Hoffarth
Tel:	403-743-6715
Fax:	403-791-8339

SAMPLE INFORMATION

Sample Type:	Effluent (Tar Island Dyke)		
Collected On:	95/10/27	At:	not given
Collected By:	not given		
Shipped On:	95/10/27		
Shipped By:	not given		
Received On:	95/10/27	At:	2030
Received By:	S. Goudey		
Container:	not given		
Seals:	none		
Initials on Seals:	not applicable		

INITIAL CHEMISTRY

pH (units)	8.3	ammonium (mg-N/L)	not done
Conductance (uS/cm)	1211	residual chlorine (mg/L)	not done
Dissolved Oxygen (mg/L)	8.4	Colour:	brown
Temperature (oC)	18	Odour:	organic
Alkalinity (mg-CaCO3/L)	not done		
Hardness (mg-CaCO3/L)	150		

COMMENTS

SAMPLE HISTORY

Storage Conditions:	5°C				
Disposed On:	n/a	by	n/a	Method:	n/a

TEST LOG

Test Type	DA(D)	TR(D)	BL(D)	AG(D)	CD(D)	FM(D)	
Number	951020	951021	951022	951023	951024	951025	
Started	95/10/31	95/10/30	95/11/01	95/11/03	95/10/31	95/11/06	
Ended	95/11/02	95/11/03	95/11/01	95/11/06	95/11/07	95/11/13	
Reported	95/11/03	95/11/06	95/11/03	95/11/07	95/11/07	95/11/15	
Faxed							

NOTES: TR, trout; FM, fathead minnows; DA, Daphnia; CD, Ceriodaphnia; AG, Selenastrum; BL, bacterial luminescence; D, definitive test; S, screening test

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-1	Test: 951020

Test Method: *Daphnia* 48h Static Acute Test (LC50, five or more treatments plus a control)
Reference: Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to *Daphnia magna*, 1990. Environment Canada, EPS 1/RM/14.

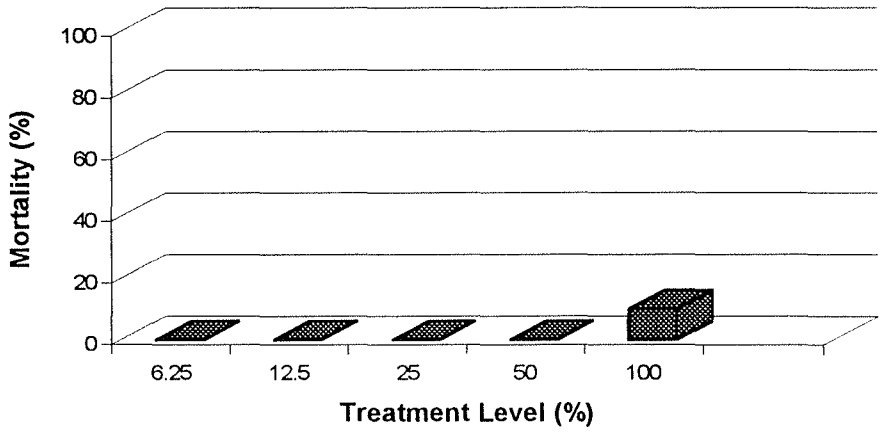
Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:
Description: Effluent (Tar Island Dyke)
Collected On: 95/10/27 At: not given By: not given
Received On: 95/10/27 At: 2030 By: S. Goudey

Test Information:
Started On: 95/10/31 At: 1500 By: DM
Ended On: 95/11/02 At: 1450 By: SF
Reported On: 95/11/03 By: CG

Test Result:	Value	Confidence Limits	Units	
LC25	>100		%	Not Toxic
LC50	>100		%	
NOEC	100		%	
LOEC	>100		%	

Graph of Mortality at 48 h Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95465-1	Test: 951020

	CHEMISTRY			BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)	Cond.(uS/cm)	DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/10/31		Time: 1500		Initials: DM					Temp (oC): 20				
Control	8.2	329	7.9	5	5								
6.25	8.3	390	7.8	5	5								
12.5	8.3	443	7.7	5	5								
25	8.3	560	7.8	5	5								
50	8.4	781	7.9	5	5								
100	8.4	1219	7.9	5	5								
Date: 95/11/01		Time: 1325		Initials: SF					Temp (oC): 20				
Control				5	5								
6.25				5	5								
12.5				5	5								
25				5	5								
50				5	5								
100				5	5								
Date: 95/11/02		Time: 1450		Initials: SF					Temp (oC): 20				
Control	8.4	369	8.3	5	5								
6.25	8.4	419	8.4	5	5								
12.5	8.4	481	8.3	5	5								
25	8.5	612	8.3	5	5								
50	8.7	838	8.3	5	5								
100	8.8	1299	8.2	4	5								

SUMMARY TABLE	
TREATMENT (%)	MORTALITY (%)
Control	0
6.25	0
12.5	0
25	0
50	0
100	10

young : jar D4	hardness (mg-CaCO3/L) : 190
water : bucket 4	Adjustment: none

COMMENTS:
no comments

Notes: F, floating; I, immobile; B, stuck on bubbles; D, caught in debris

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-1	Test: 951021

Test Method: Trout 96h Static Acute Test (LC50, five or more treatment levels plus a control)
Reference: Biological Test method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, 1990. Environment Canada, EPS 1/RM/13.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

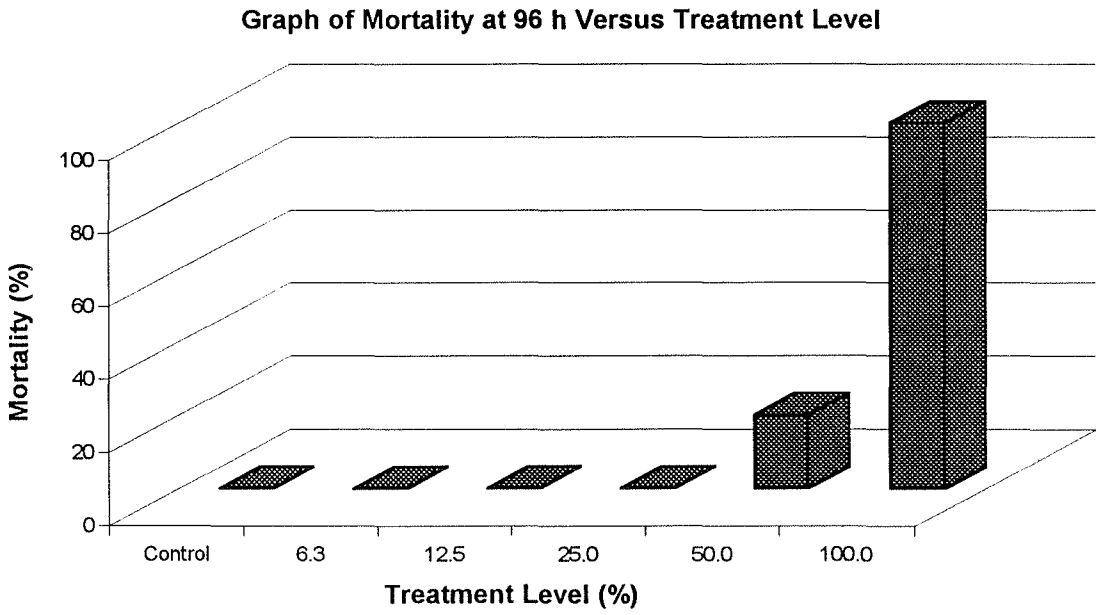
Sample Information:

Description:	Effluent (Tar Island Dyke)				
Collected On:	95/10/27	At:	not given	By:	not given
Received On:	95/10/27	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/10/30	At:	1200	By:	JR/SF
Ended On:	95/11/03	At:	1200	By:	SF
Reported On:	95/11/06			By:	CG

Test Result:	Value	Confidence Limits		Units	Method Calculated
LC25				%	
LC50	62	25	100	%	Binomial
NOEC				%	
LOEC				%	



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95465-1	Test: 951021

PREAERATION	30 minutes				
time (h)	0	0.5	1	1.5	2
DO (mg/L)					
comments	none				

	CHEMISTRY			BIOLOGY - NUMBER ALIVE										
Treatment (%)	pH (units)	Cond.(uS/cm)	DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/10/30		Time: 1200		Initials: JR/SF		Temp (oC): 14.0								
Control	8.0	376	9.6	10										
6.25	8.1	440	9.9	10										
12.5	8.1	496	9.8	10										
25	8.2	612	9.8	10										
50	8.4	875	9.8	10										
100	8.5	1306	9.7	10										
Date: 95/10/31		Time: 1030		Initials: JR/DM		Temp (oC): 14.0								
Control	8.1	382	8.3	10										
6.25	8.1	445	8.0	10										
12.5	8.6	495	9.1	10										
25	8.6	607	9.1	10										
50	8.6	852	8.7	10										
100	8.7	1265	9.1	0										
Date: 95/11/01		Time: 1355		Initials: DM/SF		Temp (oC): 14.8								
Control	8.1	392	8.8	10										
6.25	8.0	458	7.9	10										
12.5	8.5	505	10.0	10										
25	8.6	622	10.0	10										
50	8.7	880	9.6	10										
100	8.8	1301	9.5	0										
Date: 95/11/02		Time: 1030		Initials: GD/SF		Temp: 14.6								
Control	8.3	393	8.9	10										
6.25	8.1	462	8.2	10										
12.5	8.5	515	9.1	10										
25	8.7	634	9.2	10										
50	8.7	891	9.1	9										
100				0										

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-1	Test: 951021

CHEMISTRY

Treatment (%)	pH (units)		Cond.(uS/cm)		DO (mg/L)	
Control	8.4		395		8.8	
6.25	8.2		462		7.0	
12.5	8.6		542		9.0	
25	8.7		629		8.9	
50	8.7		882		8.7	
100	8.7		1230		8.7	

BIOLOGY - NUMBER ALIVE

REPLICATE									
1	2	3	4	5	6	7	8	9	10
10	10	10	10	8	0				

Date: 95/11/03	Time: 1200	Initials: SF	Temp: 14.7

SUMMARY TABLE

TREATMENT (%)	MORTALITY (%)	mg NH4-N/L t=0	mg NH4-N/L t=96 h
Control	0	nd	nd
6.3	0	nd	nd
12.5	0	nd	nd
25.0	0	nd	nd
50.0	20	nd	nd
100.0	100	nd	nd

		REPLICATE									
		1	2	3	4	5	6	7	8	9	10
	avg	individual fish weights (g)									
Control	0.69	1.09	0.44	0.58	0.67	0.36	0.55	0.86	0.72	0.87	0.79
6.3	0.62	0.60	0.43	0.30	0.46	0.63	0.63	0.62	0.94	0.48	1.15
12.5	0.73	0.87	1.22	0.43	0.67	0.83	1.17	0.61	0.61	0.58	0.33
25.0	0.68	0.71	0.62	0.86	0.30	0.71	0.59	1.02	0.69	0.75	0.57
50.0	0.56	0.41	0.54	0.30	1.04	0.49	0.53	0.70	0.61	0.53	0.41
100.0	0.48	0.50	0.37	0.50	0.30	0.41	0.47	0.50	0.41	0.54	0.76
		avg	individual fish fork lengths (cm)								
Control	4.2	4.9	3.6	4.3	3.9	3.4	4.0	4.7	4.3	4.4	4.2
6.3	4.1	4.2	3.8	3.6	3.7	4.2	4.2	4.1	4.4	3.8	5.1
12.5	4.3	4.8	4.8	3.8	4.2	4.7	4.8	4.1	4.2	4.3	3.5
25.0	4.3	4.3	4.2	4.5	3.6	4.4	4.2	4.8	4.3	4.4	4.0
50.0	4.1	3.6	4.1	3.5	4.8	4.1	4.1	4.3	4.2	4.1	3.8
100.0	4.0	4.0	3.8	4.1	3.6	3.9	4.1	4.2	3.6	3.8	4.5

COMMENTS: Fish added at: 1130 Batch number:TR950919 No. days held: 41

Time (h)	
24	all dead in 100%, fish dark in 50%, one in 50% flushing, remaining fish appear normal
48	50% fish very dark, 3 are swimming upside down. Fish in other concentrations appear normal
72	one dead, 7 swimming on side in 50%. All remaining fish appear normal.
96	in 50% fish swimming on sides. All other fish appear normal

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-1	Test: 951022

Test Method: Bacterial luminescence Test (IC50, four or more treatment levels plus a control)
Reference: Biological Test Method: Toxicity Test Using Luminescent Bacteria (*Photobacterium phosphoreum*), 1992. Environment Canada, EPS 1/RM/24.

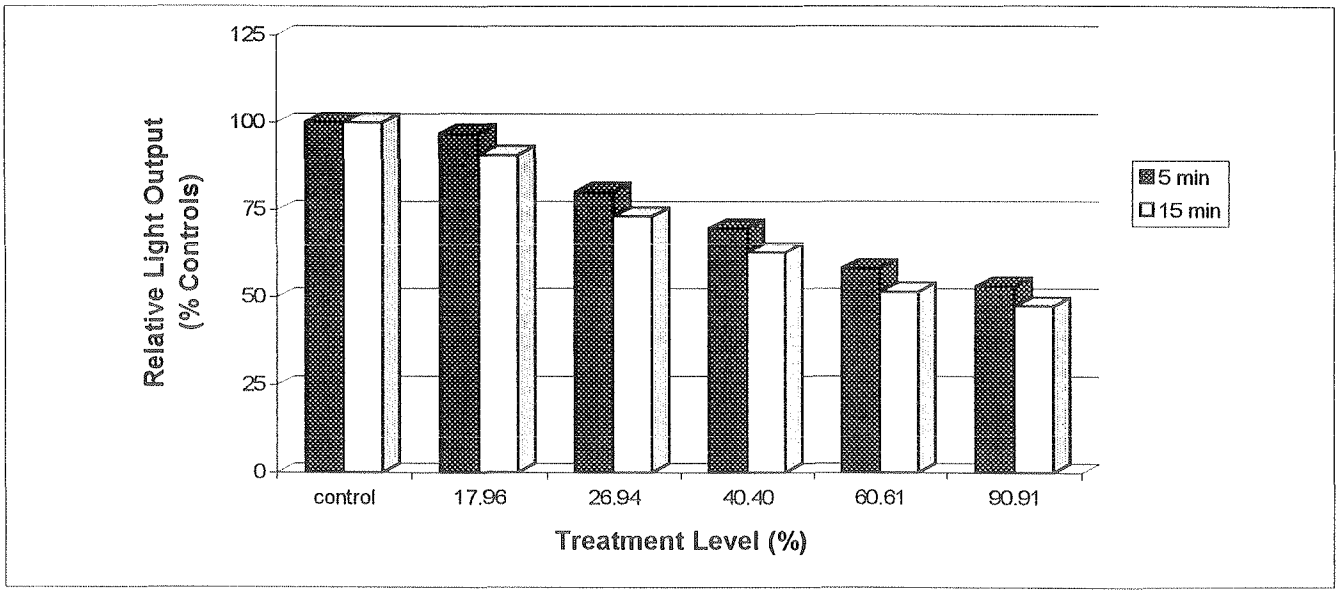
Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:
Description: Effluent (Tar Island Dyke)
Collected On: 95/10/27 At: not given By: not given
Received On: 95/10/27 At: 2030 By: S. Goudey

Test Information:
Started On: 95/11/01 At: AM By: DL
Ended On: 95/11/01 At: AM By: DL
Reported On: 95/11/03 By: CG

Test Result:	Value	Confidence Limits		Units	Method Calculated
IC20 @ 5 min				%	
IC50 @ 5 min				%	
IC20 @ 15 min	28	18	42	%	regresssion analysis
IC50 @ 15 min	65	41	105	%	regresssion analysis

Graph of Light Ouput Relative to Controls at 5 and 15 Minutes



Notes: IC20 & IC50, concentrations that inhibit light output relative to controls by 20 and 50%

HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA	Client: 95030	Sample: 95465-1	Test: 951022

SAMPLE PRETREATMENT	
pH adjustment	not required
preaeration	not required
turbidity	not centrifuged/filtered
other	none

LIGHT READINGS

	Time (min)			INHIBITION (%CTLS)	
Treatment Level (%)	0	5	15	5 min	15 min
control	90	96	97	100	100
17.96	91	93	88	97	91
26.94	82	77	71	80	73
40.40	73	67	61	70	63
60.61	64	56	50	58	52
90.91	65	51	46	53	47

COMMENTS

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-1	Test: 951023

Test Method: 72h Algal Growth Inhibition Test (IC50, five or more treatments plus a control)
Reference: Biological Test Method: Growth Inhibition Test Using the Freshwater Alga *Selenastrum capricornutum*, 1992. Environment Canada, EPS 1/RM/25.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

Description: Effluent (Tar Island Dyke)

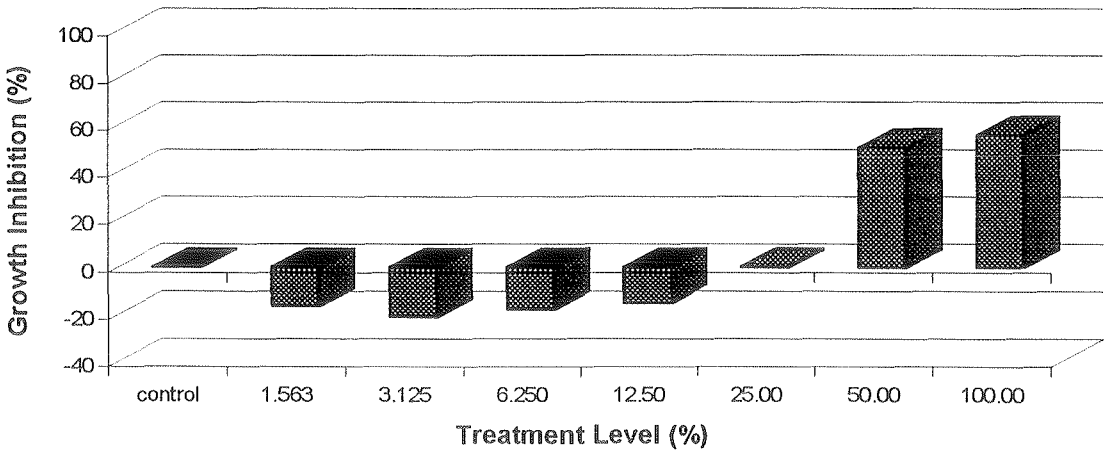
Collected On:	95/10/27	At:	not given	By:	not given
Received On:	95/10/27	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/11/03	At:	1600	By:	JR
Ended On:	95/11/06	At:	1100	By:	DM
Reported On:	95/11/07			By:	CG

Test Result:	Value	Confidence Limits		Units	Method Calculated
IC25	32	27	36	%	Bootstrap
IC50	46	43	49	%	Bootstrap
NOEC	25			%	Dunnett's Test (square root trans.)
LOEC	50			%	Dunnett's Test (square root trans.)

Graph of Percent Inhibition Versus Treatment Level



HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95465-1	Test: 951023

SAMPLE PRETREATMENT

pH adjustment	not required
preaeration	not required
turbidity	not centrifuged/filtered
other	none

TEST DATA

FINAL CELL DENSITIES (cells/mL)

Treatment (%)	Replicate A	B	C	Average AVG	Standard Deviation	CV (%)	Percent Controls	Inhibition (%Ctls)
control	1319051	1308384	1649717	1425717	194063	14	100	0
1.563	1585717	1479051	1905717	1656828	222044	13	116	-16
3.125	1404384	1628384	2140384	1724384	377274	22	121	-21
6.250	1521717	1617717	1895051	1678162	193867	12	118	-18
12.50	1681717	1436384	1799051	1639051	185060	11	115	-15
25.00	1297717	1361717	1607051	1422162	163285	11	100	0
50.00	679051	668384	775051	707495	58747	8	50	50
100.00	689717	657717	540384	629273	78625	12	44	56

COMMENTS

- final pH was 8 in the highest treatment level (control pH was 7)
- all cell numbers based on optical density readings obtained with a microplate reader
- the initial cell density was 11,267 cells/mL.

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-1	Test: 951024

Test Method: 7 d Ceriodaphnia Survival and Reproduction Test (5 treatment levels plus a control)
Reference: Biological Test Method: Test of Reproduction and Survival Using the Cladoceran *Ceriodaphnia dubia* , 1992. Environment Canada, EPS 1/RM/21.

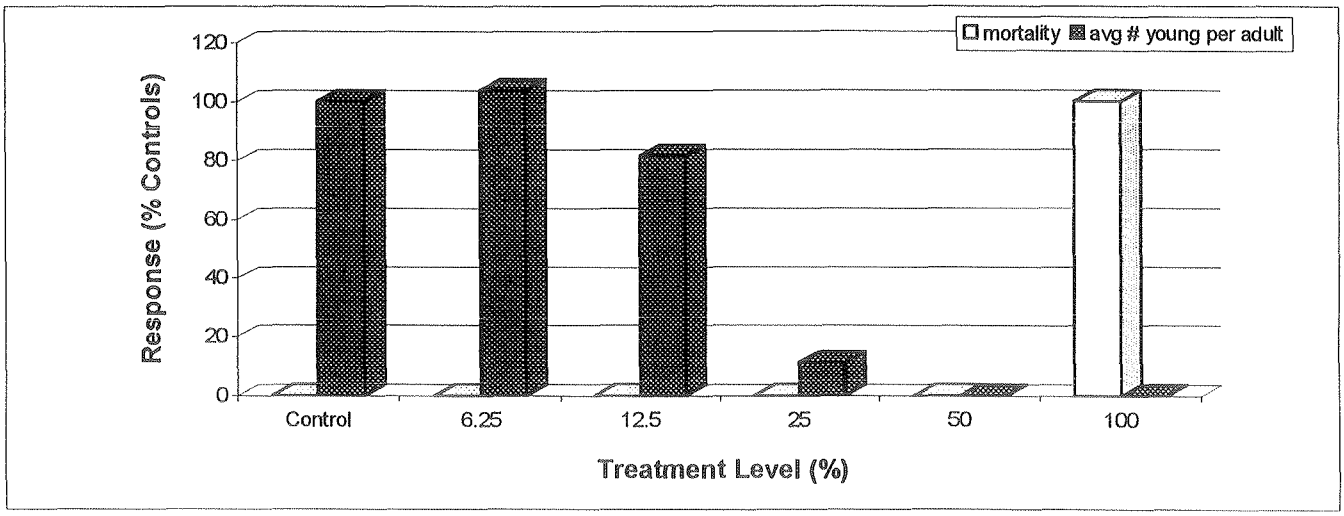
Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:
Description: Effluent (Tar Island Dyke)
Collected On: 95/10/27 At: not given By: not given
Received On: 95/10/27 At: 2030 By: S. Goudey

Test Information:
Started On: 95/10/31 At: 1330 By: DM
Ended On: 95/11/07 At: 0815 By: DM
Reported On: 95/11/07 By: CG

Test Result:		Value	Confidence Limits		Units	Method Calculated
MORTALITY	LC25	63			%	Fisher's exact
	LC50	75			%	Fisher's exact
	NOEC	50			%	ICPIN
	LOEC	100			%	ICPIN
REPRODUCTION						
	IC25	14	12	15	%	Steel's many-one
	IC50	18	17	19	%	Steel's many-one
	NOEC	12.5			%	ICPIN
	LOEC	25			%	ICPIN

Graph of Mortality and Reproduction at Seven Days Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; IC25 & IC50, concentrations inhibiting reproduction by 25 and 50%; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95465-1	Test: 951024

PREAERATION not required

FILTRATION not required

Comments none

Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	CHEMISTRY		BIOLOGY - NUMBER OF YOUNG REPLICATE							
							1	2	3	4	5	6	7	8	9	10
DAY 0 95/10/31			Time: 1330			Initials: DM			Temp (oC): 25.0							
Control	8.4		354		7.5		0	0	0	0	0	0	0	0	0	0
6.25	8.4		408		7.6		0	0	0	0	0	0	0	0	0	0
12.5	8.4		465		7.5		0	0	0	0	0	0	0	0	0	0
25	8.4		568		7.6		0	0	0	0	0	0	0	0	0	0
50	8.4		784		7.8		0	0	0	0	0	0	0	0	0	0
100	8.4		1200		8.2		0	0	0	0	0	0	0	0	0	0
DAY 1 95/11/01			Time: 1145			Initials: DM			Temp (oC): 25.0							
Control	8.5	8.4	372	387	7.6	7.9	0	0	0	0	0	0	0	0	0	0
6.25	8.5	8.5	428	440	7.6	7.8	0	0	0	0	0	0	0	0	0	0
12.5	8.5	8.6	486	502	7.4	7.6	0	0	0	0	0	0	0	0	0	0
25	8.6	8.7	602	606	7.4	7.5	0	0	0	0	0	0	0	0	0	0
50	8.7	8.9	849	841	7.6	7.6	0	0	0	0	0	0	0	0	0	0
100	8.7	8.9	1280	1279	7.4	7.5		0	0	0	0	0		0		0
DAY 2 95/11/02			Time: 1330			Initials: DM			Temp (oC): 25.0							
Control	8.3	8.4	375	390	7.7	7.8	0	0	0	0	0	0	0	0	0	0
6.25	8.4	8.5	434	444	7.7	7.8	0	0	0	0	0	0	0	0	0	0
12.5	8.5	8.5	495	507	7.8	7.8	0	0	0	0	0	0	0	0	0	0
25	8.5	8.7	613	624	7.6	7.9	0	0	0	0	0	0	0	0	0	0
50	8.6	8.8	850	866	7.5	7.9	0	0	0	0	0	0	0	0	0	0
100		8.9		1271		7.7										
DAY 3 95/11/03			Time: 1100			Initials: DM			Temp: 25.0							
Control	8.3	8.5	371	396	7.7	7.9	0	0	0	0	0	0	0	0	0	0
6.25	8.5	8.6	434	448	7.9	7.9	0	0	0	0	0	0	0	0	5	0
12.5	8.6	8.6	492	509	7.8	7.8	0	0	0	0	0	0	0	0	0	0
25	8.7	8.7	613	625	7.8	7.6	0	0	0	0	0	0	0	0	0	0
50	8.7	8.9	845	867	7.8	7.6	0	0	0	0	0	0	0	0	0	0
100																

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-1	Test: 951024

	CHEMISTRY						BIOLOGY - NUMBER OF YOUNG									
Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 4 95/11/04			Time: 0930			Initials: DM			Temp: 25.0							
Control	8.5	8.5	389	391	7.8	7.5	6	6	6	6	6	6	6	6	6	6
6.25	8.6	8.6	442	446	7.7	7.3	6	7	5	4	6	5	5	5	0	0
12.5	8.6	8.7	498	509	7.6	7.4	4	4	3	3	4	5	4	5	5	5
25	8.6	8.8	616	628	7.6	8.5	1	0	0	2	0	1	3	0	0	0
50	8.7	9.0	850	864	7.4	7.3	0	0	0	0	0	0	0	0	0	0
100																
DAY 5 95/11/05			Time: 0945			Initials: DM			Temp: 25.0							
Control	8.5	8.5	374	398	7.8	7.8	0	0	0	1	1	0	0	11	9	12
6.25	8.5	8.6	433	444	7.9	7.9	0	12	9	12	10	0	11	11	12	10
12.5	8.6	8.7	493	512	7.8	7.9	0	6	8	6	4	0	1	8	10	9
25	8.7	8.8	614	626	7.9	7.9	0	0	0	7	0	0	2	0	2	0
50	8.7	8.9	853	860	7.7	7.8	0	0	0	0	0	0	0	0	0	0
100																
DAY 6 95/11/06			Time: 1030			Initials: DM			Temp: 25.0							
Control	8.4	8.5	384	401	7.8	7.8	11	12	12	12	10	7	9	1	1	0
6.25	8.5	8.6	444	448	7.7	7.7	12	0	1	0	0	13	0	0	1	0
12.5	8.6	8.7	501	517	7.6	7.6	8	0	0	1	0	9	6	0	0	2
25	8.7	8.8	626	630	7.6	7.8	4	0	0	1	0	0	0	0	0	0
50	8.8	8.9	863	837	7.5	7.7	0	0	0	0	0	0	0	0	0	0
100																
DAY 7 95/11/07			Time: 0815			Initials: DM			Temp: 25.0							
Control		8.5		413		7.6	10	15	0	0	12	10	15	12	14	13
6.25		8.6		458		7.4	0	19	6	13	15	16	10	16	9	11
12.5		8.7		524		7.4	10	13	9	11	10	12	6	9	10	11
25		8.8		638		7.5	0	0	0	2	2	1	1	0	2	0
50		8.9		864		7.4	0	0	0	0	0	0	0	0	0	0
100																

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-1	Test: 951024

SUMMARY TABLE		Reproduction		Daily Cumulative Young Production							
Treatment (%)	Mortality (%)	Young/Adult	% controls	0	1	2	3	4	5	6	7
Control	0	27	100	0	0	0	0	60	94	169	270
6.25	0	28	104	0	0	0	5	48	135	162	277
12.5	0	22	81	0	0	0	0	42	94	120	221
25	0	3	11	0	0	0	0	7	18	23	31
50	0	0	0	0	0	0	0	0	0	0	0
100	100	0	0	0	0	0	0	0	0	0	0

COMMENTS:

source of young: in house culture media: Bow River water food lots: 10/27

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-1	Test: 951025

Test Method: 7 d Fathead Minnow Survival and Growth Test (five treatments plus a control)
Reference: Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnow, 1992. Environment Canada, EPS 1/RM/22.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

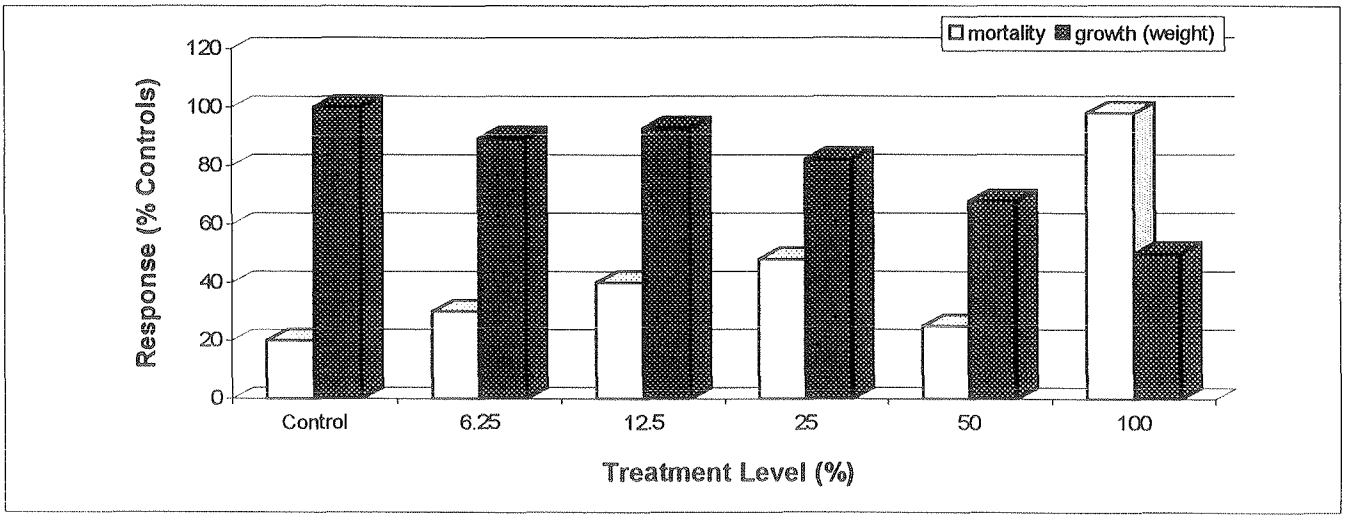
Description:	Effluent (Tar Island Dyke)				
Collected On:	95/10/27	At:	not given	By:	not given
Received On:	95/10/27	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/11/06	At:	1500	By:	DM/SF
Ended On:	95/11/13	At:	1330	By:	SF
Reported On:	95/11/15			By:	CG

Test Result:		Value	Confidence Limits		Units	Method Calculated
MORTALITY	LC25	52	6	60	%	ICPIN
	LC50	69	61	75	%	ICPIN
	NOEC	50			%	Fisher's Exact
	LOEC	100			%	Fisher's Exact
GROWTH						
	IC25	41	32	56	%	ICPIN
	IC50	67	59	80	%	ICPIN
	NOEC	25			%	Dunnett's
	LOEC	50			%	Dunnett's

Graph of Mortality and Growth at Seven Days Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95465-1	Test: 951025

PREAERATION not required

FILTRATION not required

Comments none

	CHEMISTRY						BIOLOGY - NUMBER ALIVE					
Treatment	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE					
(%)	new	used	new	used	new	used	1	2	3	4	5	6
DAY 0	95/11/06		Time: 1500			Initials: DM/SF			Temp (oC):	25.0		
Control	8.2		346		8.1		10	10	10	10		
6.25	8.3		405		8.0		10	10	10	10		
12.5	8.3		460		7.8		10	10	10	10		
25	8.3		580		7.1		10	10	10	10		
50	8.3		820		6.0		10	10	10	10		
100	8.3		1287		5.5		10	10	10	10		
DAY 1	95/11/07		Time: 1450			Initials: SF			Temp (oC):	25.0		
Control	8.0	8.2	394	384	8.1	5.3	10	10	10	10		
6.25	8.1	8.3	461	418	7.2	5.3	10	10	10	10		
12.5	8.2	8.3	523	467	6.9	5.3	10	10	10	10		
25	8.2	8.4	640	597	6.3	5.2	10	10	10	10		
50	8.3	8.5	848	823	5.0	5.2	9	10	10	10		
100	8.3	8.5	1294	1257	2.0	5.4	6	9	8	6		
DAY 2	95/11/08		Time: 1450			Initials: SF			Temp (oC):	25.0		
Control	8.1	8.4	401	398	8.0	6.7	10	10	10	10		
6.25	8.3	8.5	456	458	7.7	6.7	10	10	10	10		
12.5	8.3	8.5	515	513	7.6	6.5	10	10	10	9		
25	8.4	8.6	634	647	7.4	6.2	9	10	10	10		
50	8.5	8.7	845	851	7.0	5.8	9	10	10	9		
100	8.7	8.8	1305	1316	6.0	5.7	4	5	6	3		
DAY 3	95/11/09		Time: 1500			Initials: GD			Temp:	25.0		
Control	8.3	8.4	399	401	8.2	7.3	7	10	10	10		
6.25	8.5	8.5	453	461	8.0	7.1	7	9	9	9		
12.5	8.5	8.6	514	515	8.0	7.2	8	9	9	9		
25	8.5	8.7	636	633	7.6	7.3	8	10	9	9		
50	8.6	8.7	852	829	6.9	7.1	9	9	9	7		
100	8.6	8.8	1303	1266	5.7	6.6	3	2	4	3		

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-1	Test: 951025

	CHEMISTRY						BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 4	95/11/10		Time: 1525			Initials: SF				Temp: 25.0						
Control	8.0	8.2	401	424	8.0	6.0	7	10	9	10						
6.25	8.2	8.4	419	473	7.8	6.1	7	8	8	7						
12.5	8.2	8.3	476	538	7.8	5.5	7	8	8	9						
25	8.3	8.4	587	656	7.6	5.3	6	7	5	8						
50	8.4	8.6	772	864	7.0	5.4	8	8	10	7						
100	8.6	8.7	1343	1314	5.2	5.0	1	1	0	1						
DAY 5	95/11/11		Time: 1130			Initials: GD				Temp: 20.3						
Control	8.2	8.4	394	405	8.2	6.7	7	8	9	10						
6.25	8.3	8.5	451	442	7.7	6.6	7	9	8	6						
12.5	8.4	8.5	508	495	7.7	6.4	7	7	8	9						
25	8.4	8.5	617	604	7.4	6.3	6	6	4	8						
50	8.5	8.6	858	772	6.6	6.0	8	7	10	7						
100	8.6	8.7	1310	1283	5.1	4.9	1	0		0						
DAY 6	95/11/12		Time: 1100			Initials: SF				Temp: 25.0						
Control	7.9	8.3	401	412	7.9	6.7	7	7	9	10						
6.25	8.0	8.3	459	462	7.6	6.5	7	9	7	6						
12.5	8.1	8.3	516	514	7.5	6.3	6	7	7	8						
25	8.1	8.4	640	626	7.3	6.2	5	6	4	8						
50	8.2	8.4	878	855	6.6	5.9	7	7	10	7						
100	8.4	8.6	1319	1318	4.9	5.8	1	0	0	0						
DAY 7	95/11/13		Time: 1330			Initials: SF				Temp: 16.0						
Control		8.1		406		6.7	7	6	9	10						
6.25		8.2		469		6.6	7	8	7	6						
12.5		8.2		522		6.4	6	4	6	8						
25		8.3		646		6.5	3	6	4	8						
50		8.5		877		6.4	7	7	9	7						
100		8.6		1332		5.3	1	0	0	0						

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-1	Test: 951025

SUMMARY TABLE		Average Fish Weights	
Treatment (%)	Mortality (%)	mg/fish	% controls
Control	20	0.28	100
6.25	30	0.25	89
12.5	40	0.26	93
25	48	0.23	82
50	25	0.19	68
100	98	0.14	50

COMMENTS:

source of young: in house

HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-2

CLIENT INFORMATION

Client:	Suncor Inc. Oil Sands Group
Operation:	Ft. McMurray
Address:	P.O. Box 4001
City:	Ft. McMurray
Province/State:	Alberta
Country:	Canada
Postal/ZIP Code:	T9H 3E3
Billing Information:	
Contact:	John Gulley/Trina Hoffarth
Tel:	403-743-6715
Fax:	403-791-8339

SAMPLE INFORMATION

Sample Type:	Athabasca River Water		
Collected On:	95/10/27	At:	not given
Collected By:	not given		
Shipped On:	95/10/27		
Shipped By:	not given		
Received On:	95/10/27	At:	2030
Received By:	S. Goudey		
Container:	not given		
Seals:	none		
Initials on Seals:	not applicable		

INITIAL CHEMISTRY

pH (units)	8.2	ammonium (mg-N/L)	not done
Conductance (uS/cm)	247	residual chlorine (mg/L)	not done
Dissolved Oxygen (mg/L)	9.0	Colour:	pale yellow
Temperature (oC)	18	Odour:	odourless
Alkalinity (mg-CaCO3/L)	not done		
Hardness (mg-CaCO3/L)	150		

COMMENTS

SAMPLE HISTORY

Storage Conditions: 5°C

Disposed On: n/a by n/a Method: n/a

TEST LOG

Test Type	DA(S)	TR(S)	BL(S)	AG(S)	CD(S)	FM(S)	
Number	951026	951027	951028	951029	951030	951031	
Started	95/10/31	95/11/03	95/11/01	95/11/03	95/10/31	95/11/06	
Ended	95/11/02	95/11/07	95/11/01	95/11/06	95/11/07	95/11/13	
Reported	95/11/07	95/11/07	95/11/02	95/11/17	95/11/09	95/11/15	
Faxed							

NOTES: TR, trout; FM, fathead minnows; DA, Daphnia; CD, Ceriodaphnia; AG, Selenastrum; BL, bacterial luminescence; D, definitive test; S, screening test; n/a, not applicable

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-2	Test: 951026

Test Method: *Daphnia* 48h Static Acute Test (LC50, five or more treatments plus a control)
Reference: Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to *Daphnia magna*, 1990. Environment Canada, EPS 1/RM/14.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

Description:	Athabasca River Water				
Collected On:	95/10/27	At:	not given	By:	not given
Received On:	95/10/27	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/10/31	At:	1500	By:	DM
Ended On:	95/11/02	At:	1450	By:	SF
Reported On:	95/11/07			By:	CG

Test Result:

	% Mortality
Control	0
100%	0

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95465-2	Test: 951026

	CHEMISTRY					BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)		Cond.(uS/cm)		DO (mg/L)	REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/10/31			Time: 1500			Initials: DM						Temp (oC): 20			
Control	8.2		329		7.9	5	5								
100	8.2		254		9.0	5	5								
Date: 95/11/01			Time: 1325			Initials: SF						Temp (oC): 20			
Control						5	5								
100						5	5								
Date: 95/11/02			Time: 1450			Initials: SF						Temp (oC): 20			
Control	8.4		369		8.3	5	5								
100	8.3		283		8.4	5	5								

SUMMARY TABLE	
TREATMENT (%)	MORTALITY (%)
Control	0
100	0

young :	jar D4	hardness (mg-CaCO3/L) :	200
water :	bucket 4	Adjustment:	none

COMMENTS:
no comments

Notes: F, floating; I, immobile; B, stuck on bubbles; D, caught in debris

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TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-2	Test: 951027

Test Method: Trout 96h Static Acute Test (LC50, five or more treatment levels plus a control)
Reference: Biological Test method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, 1990. Environment Canada, EPS 1/RM/13.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

Description:	Athabasca River Water				
Collected On:	95/10/27	At:	not given	By:	not given
Received On:	95/10/27	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/11/03	At:	1620	By:	JR/SF
Ended On:	95/11/07	At:	0850	By:	JR/SF
Reported On:	95/11/07			By:	CG

Test Result:

	% Mortality
Control	0
100%	0

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TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95465-2	Test: 951027

PREAERATION	not required				
time (h)	0	0.5	1	1.5	2
DO (mg/L)					
comments	none				

	CHEMISTRY				BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/11/03			Time: 1620				Initials: JR/SF			Temp (oC): 14.2						
Control	7.8		378		9.4		10									
100	8.1		274		9.6		10									
Date: 95/11/04			Time: 1030				Initials: GD/DM			Temp (oC): 15.0						
Control	8.4		382		8.7		10									
100	8.4		268		8.8		10									
Date: 95/11/05			Time: 1200				Initials: GD/DM			Temp (oC): 14.5						
Control	8.5		385		9.0		10									
100	8.4		270		9.1		10									
Date: 95/11/06			Time: 1615				Initials: JR/DM			Temp: 14.7						
Control	8.5		392		9.0		10									
100	8.4		272		9.1		10									

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#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-2	Test: 951027

	CHEMISTRY						BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE 1	2	3	4	5	6	7	8	9	10
Date: 95/11/07			Time: 0850			Initials: JR/SF			Temp: 16.0							
Control	8.6		394		8.9		10									
100	8.4		274		8.9		10									

SUMMARY TABLE					REPLICATE									
TREATMENT (%)	MORTALITY (%)	mg NH4-N/L t=0	t=96 h		1	2	3	4	5	6	7	8	9	10
				avg	individual fish weights (g)									
Control	0	nd	nd	0.8	0.6	0.6	1.2	1.5	0.7	0.7	0.5	0.8	0.6	0.4
100.0	0	nd	nd	0.8	0.7	1.2	0.8	0.8	0.6	0.6	0.6	0.8	0.6	1.0
				avg	individual fish fork lengths (cm)									
Control				4.2	4.1	4.0	4.8	5.3	4.0	4.2	3.8	4.4	3.9	3.6
100.0				4.5	4.2	5.1	4.2	4.6	4.2	4.4	4.2	4.5	4.3	4.8

COMMENTS: Fish added at: 1530	Batch number:TR950919	No. days held: 45
Time (h)		
24	all fish appear normal	
48	all fish appear normal	
72	all fish appear normal	
96	all fish appear normal	

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#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-2	Test: 951028

Test Method: Bacterial luminescence Test (screening test, one treatment level plus a control)
Reference: Biological Test Method: Toxicity Test Using Luminescent Bacteria (*Photobacterium phosphoreum*), 1992. Environment Canada, EPS 1/RM/24.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

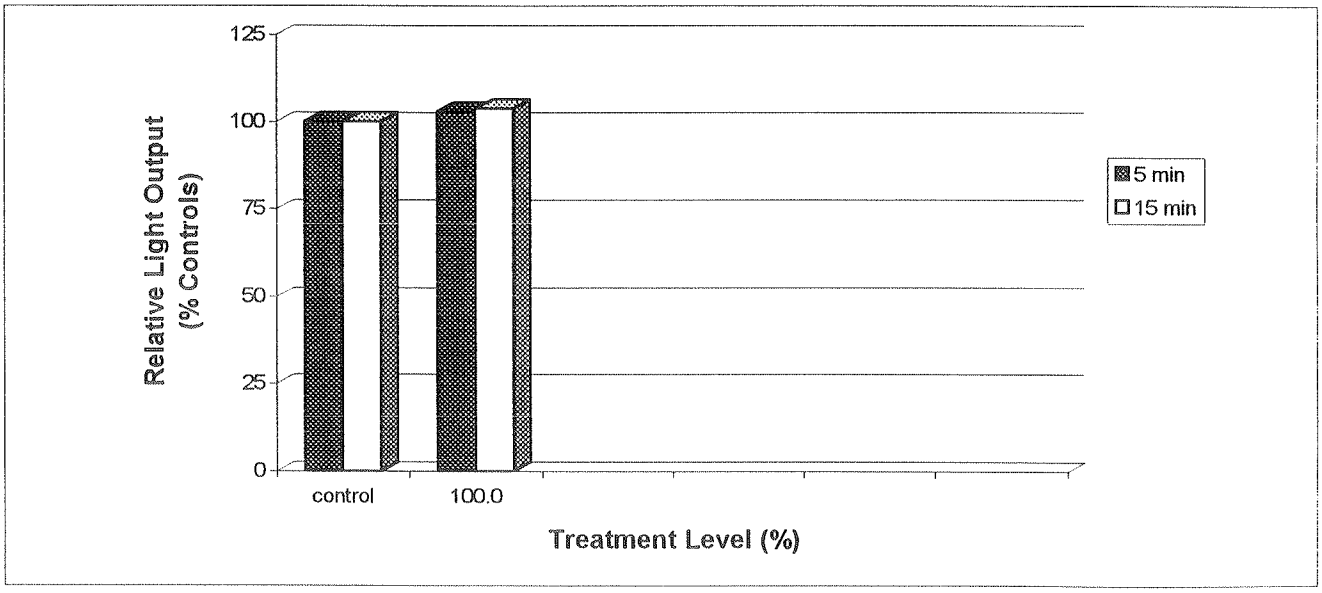
Description:	Athabasca River Water				
Collected On:	95/10/27	At:	not given	By:	not given
Received On:	95/10/27	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/11/01	At:	AM	By:	DL
Ended On:	95/11/01	At:	AM	By:	DL
Reported On:	95/11/02			By:	CG

Test Result: 104% expressed as a percentage of the control.

Graph of Light Ouput Relative to Controls at 5 and 15 Minutes



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TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95465-2	Test: 951028

SAMPLE PRETREATMENT	
pH adjustment	not required
preaeration	not required
turbidity	not centrifuged/filtered
other	none

LIGHT READINGS

	Time (min)		
Treatment Level (%)	0	5	15
control	101	104	106
100.0	102	107	110

INHIBITION (%CTLS)	
5 min	15 min
100	100
103	104

COMMENTS

HydroQual Laboratories Ltd.

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TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-2	Test: 951029

Test Method: 72h Algal Growth Inhibition Test (IC50, five or more treatments plus a control)
Reference: Biological Test Method: Growth Inhibition Test Using the Freshwater Alga *Selenastrum capricornutum*, 1992. Environment Canada, EPS 1/RM/25.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

Description:	Athabasca River Water				
Collected On:	95/10/27	At:	not given	By:	not given
Received On:	95/10/27	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/11/03	At:	1600	By:	D. Lintott
Ended On:	95/11/06	At:	1100	By:	D. Lintott
Reported On:	95/11/17			By:	D. Lintott

Test Result: 8% inhibition compared to control growth.

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TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95465-2	Test: 951029

SAMPLE PRETREATMENT	
pH adjustment	not required
preaeration	not required
turbidity	not centrifuged/filtered
other	none

TEST DATA

FINAL CELL DENSITIES (cells/mL)

Treatment (%)	Replicate A	B	C	Average AVG	Standard Deviation	CV (%)	Percent Controls	Inhibition (%Ctls)
control	1479051	1308384	1223051	1336828	130349	10	100	0
100	1404384	1180384	1105717	1230162	155431	13	92	8

COMMENTS

- all cell numbers based on optical density readings obtained with a microplate reader
- the initial cell density was 11,000 cells/mL.

HydroQual Laboratories Ltd.

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TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-2	Test: 951030

Test Method: 7 d Ceriodaphnia Survival and Reproduction Test (5 treatment levels plus a control)
Reference: Biological Test Method: Test of Reproduction and Survival Using the Cladoceran *Ceriodaphnia dubia*, 1992. Environment Canada, EPS 1/RM/21.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:
Description: Athabasca River Water
Collected On: 95/10/27 At: not given By: not given
Received On: 95/10/27 At: 2030 By: S. Goudey

Test Information:
Started On: 95/10/31 At: 1330 By: DM
Ended On: 95/11/07 At: 0815 By: DM
Reported On: 95/11/09 By: CG

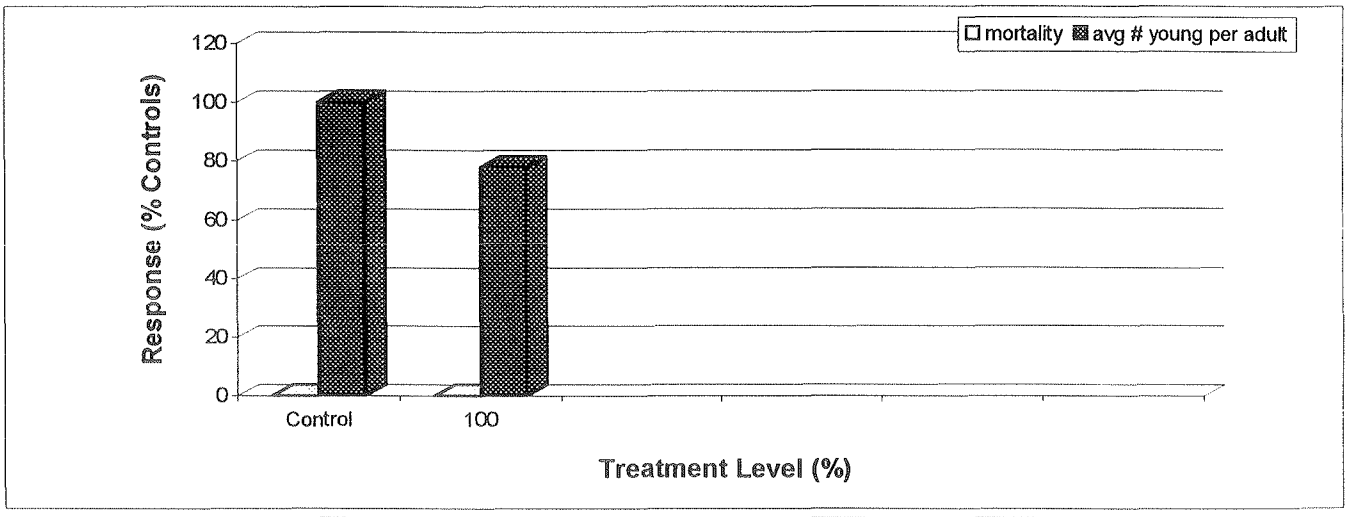
Test Result:

MORTALITY

	% Mortality
Control	0
100%	0

REPRODUCTION 78% expressed as a percentage of the control.

Graph of Mortality and Reproduction at Seven Days Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; IC25 & IC50, concentrations inhibiting reproduction by 25 and 50%; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95465-2	Test: 951030

PREAERATION not required

FILTRATION not required

Comments none

	CHEMISTRY						BIOLOGY - NUMBER OF YOUNG									
Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 0 95/10/31			Time: 1330			Initials: DM			Temp (oC): 25.0							
Control	8.4		354		7.5		0	0	0	0	0	0	0	0	0	0
100	8.2		258		9.0		0	0	0	0	0	0	0	0	0	0
DAY 1 95/11/01			Time: 1145			Initials: DM			Temp (oC): 25.0							
Control	8.5	8.4	372	387	7.6	7.9	0	0	0	0	0	0	0	0	0	0
100	8.3	8.5	260	306	8.2	7.8	0	0	0	0	0	0	0	0	0	0
DAY 2 95/11/02			Time: 1330			Initials: DM			Temp (oC): 25.0							
Control	8.3	8.4	375	390	7.7	7.8	0	0	0	0	0	0	0	0	0	0
100	8.3	8.4	275	326	8.0	7.4	0	0	0	0	0	0	0	0	0	0
DAY 3 95/11/03			Time: 1100			Initials: DM			Temp: 25.0							
Control	8.3	8.5	371	396	7.7	7.9	0	0	0	0	0	0	0	0	0	0
100	8.4	8.5	279	305	8.0	7.6	0	0	0	0	0	0	0	0	0	0

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#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-2	Test: 951030

	CHEMISTRY						BIOLOGY - NUMBER OF YOUNG									
Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 4 95/11/04			Time: 0930			Initials: DM			Temp: 25.0							
Control	8.5	8.5	389	391	7.8	7.5	6	6	6	6	6	6	6	6	6	6
100	8.4	8.5	280	308	7.8	7.3	4	4	2	2	2	2	3	4	4	5
DAY 5 95/11/05			Time: 0945			Initials: DM			Temp: 25.0							
Control	8.5	8.5	374	398	7.8	7.8	0	0	0	1	1	0	0	11	9	12
100	8.5	8.5	287	312	7.9	7.9	0	0	5	8	7	0	0	0	0	10
DAY 6 95/11/06			Time: 1030			Initials: DM			Temp: 25.0							
Control	8.4	8.5	384	401	7.8	7.8	11	12	12	12	10	7	9	1	1	0
100	8.5	8.5	318	322	7.6	7.6	8	8	0	0	0	9	9	10	0	0
DAY 7 95/11/07			Time: 0815			Initials: DM			Temp: 25.0							
Control		8.5		413		7.6	10	15	0	0	12	10	15	12	14	13
100		8.6		323		7.0	15	12	13	6	14	0	0	13	10	16

HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-2	Test: 951030

SUMMARY TABLE

Treatment (%)	Mortality (%)	Reproduction Young/Adult	Reproduction % controls	Daily Cumulative Young Production 0	1	2	3	4	5	6	7
Control	0	27	100	0	0	0	0	60	94	169	270
100	0	21	78	0	0	0	0	32	62	106	205

COMMENTS:

source of young: in house culture media: Bow River water food lots: 10/27

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-2	Test: 951031

Test Method: 7 d Fathead Minnow Survival and Growth Test (five treatments plus a control)
Reference: Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnow, 1992. Environment Canada, EPS 1/RM/22.

Client Information: Suncor Inc. Oil Sands Group
Ft. McMurray

Sample Information:

Description: Athabasca River Water

Collected On:	95/10/27	At:	not given	By:	not given
Received On:	95/10/27	At:	2030	By:	S. Goudey

Test Information:

Started On:	95/11/06	At:	1500	By:	DM/SF
Ended On:	95/11/13	At:	1330	By:	SF
Reported On:	95/11/15			By:	CG

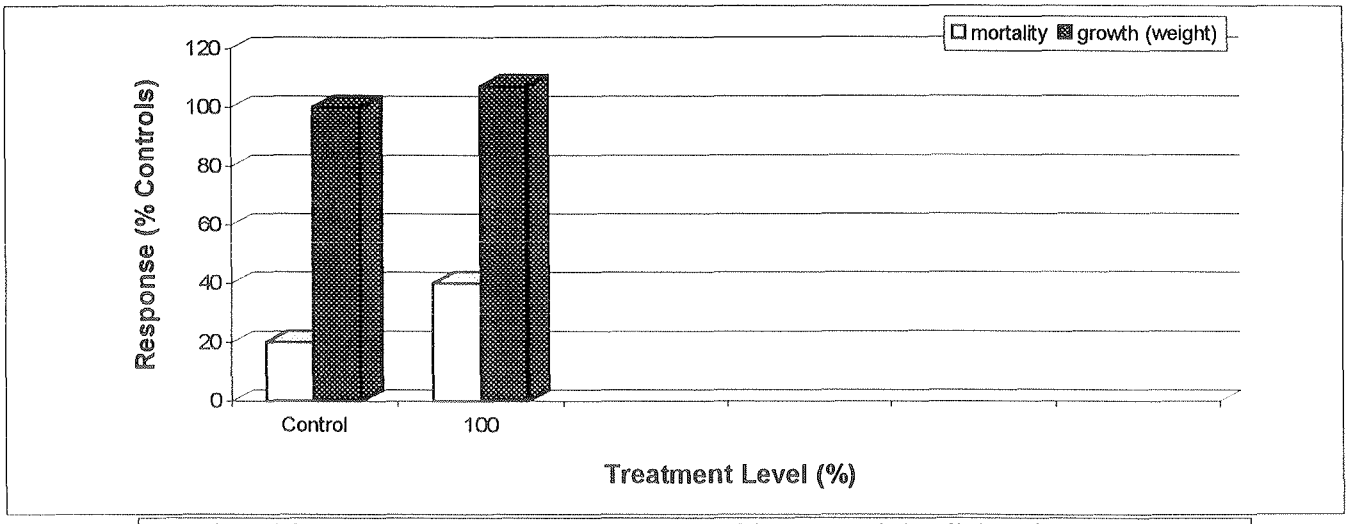
Test Result:

MORTALITY

	% Mortality
Control	20
100%	40

GROWTH 107% expressed as a percentage of the control.

Graph of Mortality and Growth at Seven Days Versus Treatment Level



Notes: LC25 & LC50, concentrations lethal to 25 and 50% of the test population; NOEC & LOEC, no observed and lowest observed effect concentrations

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

TEST DATA

Client: 95030	Sample: 95465-2	Test: 951031

PREAERATION not required

FILTRATION not required

Comments none

		CHEMISTRY						BIOLOGY - NUMBER ALIVE					
Treatment	pH (units)		Cond.(uS/cm)		DO (mg/L)		REPLICATE					
(%)	new	used	new	used	new	used	1	2	3	4	5	6
DAY 0	95/11/06		Time: 1500			Initials: DM/SF			Temp (oC):	25.0		
Control	8.2		346		8.1		10	10	10	10		
100	8.3		320		8.2		10	10	10	10		
DAY 1	95/11/07		Time: 1315			Initials: SF			Temp (oC):	25.0		
Control	8.0	8.2	394	384	8.1	5.3	10	10	10	10		
100	8.3	8.3	335	355	8.1	5.7	10	10	10	10		
DAY 2	95/11/08		Time: 1450			Initials: SF			Temp (oC):	25.0		
Control	8.1	8.4	401	398	8.0	6.7	10	10	10	10		
100	8.5	8.5	350	351	7.3	6.7	9	10	10	10		
DAY 3	95/11/09		Time: 1500			Initials: GD			Temp:	25.0		
Control	8.3	8.4	399	401	8.2	7.3	7	10	10	10		
100	8.5	8.5	347	355	8.0	7.4	6	6	7	8		

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-2	Test: 951031

	CHEMISTRY						BIOLOGY - NUMBER ALIVE									
Treatment (%)	pH (units) new	pH (units) used	Cond.(uS/cm) new	Cond.(uS/cm) used	DO (mg/L) new	DO (mg/L) used	REPLICATE 1	2	3	4	5	6	7	8	9	10
DAY 4	95/11/10		Time: 1525			Initials: SF				Temp: 25.0						
Control	8.0	8.2	401	424	8.0	6.0	7	10	9	10						
100	8.4	8.3	331	370	7.4	6.1	6	6	7	7						
DAY 5	95/11/11		Time: 1130			Initials: GD				Temp: 25.0						
Control	8.2	8.4	394	405	8.2	6.7	7	8	9	10						
100	8.5	8.5	341	343	7.2	6.7	6	6	7	6						
DAY 6	95/11/12		Time: 1100			Initials: SF				Temp: 25.0						
Control	7.9	8.3	401	412	7.9	6.7	7	7	9	10						
100	8.3	8.3	363	355	7.2	6.5	6	6	7	6						
DAY 7	95/11/13		Time: 1330			Initials: SF				Temp: 25.0						
Control		8.1		406		6.7	7	6	9	10						
100		8.1		366		6.5	6	6	6	6						

HydroQual Laboratories Ltd.

#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

Client: 95030	Sample: 95465-2	Test: 951031

SUMMARY TABLE

Treatment (%)	Mortality (%)	Average Fish Weights mg/fish	% controls
Control	20	0.28	100
100	40	0.30	107

COMMENTS:

source of young: in house

HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

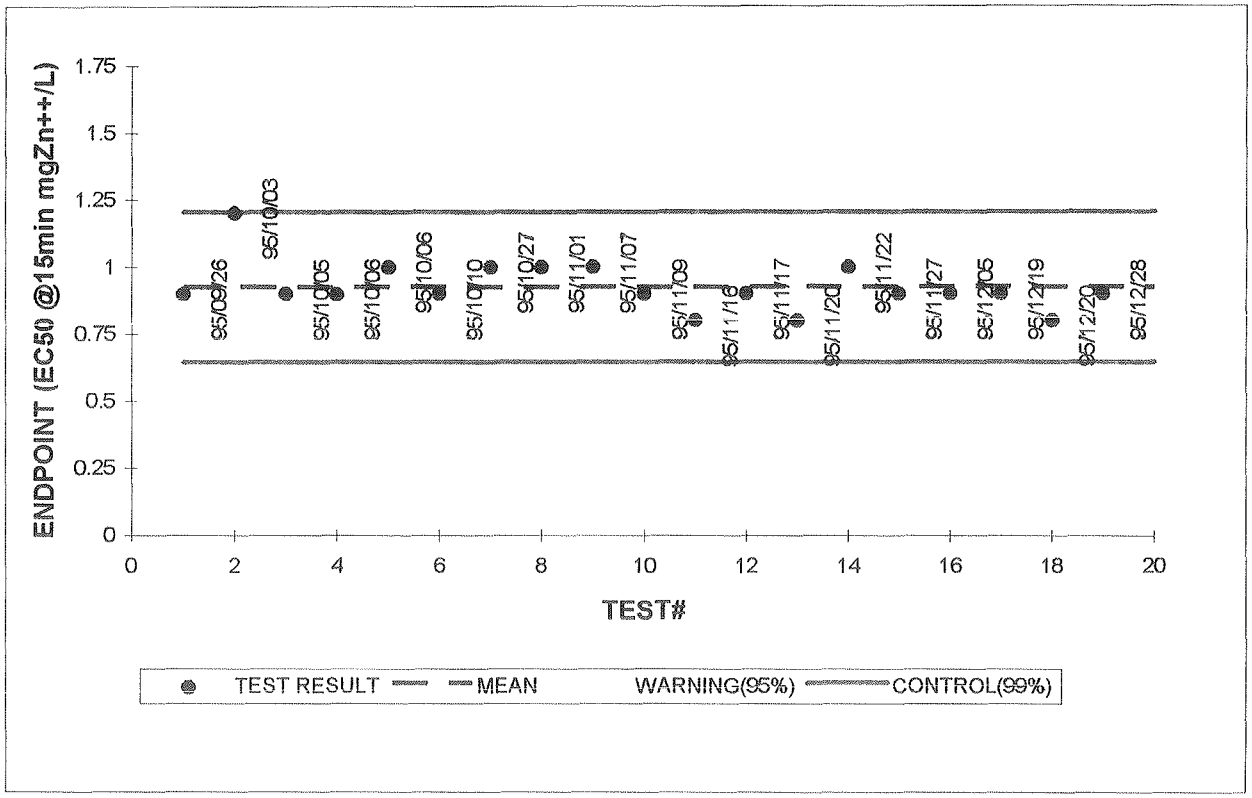
QUALITY ASSURANCE INFORMATION

test species	*Photobacterium phosphoreum*
batch number	AMO37A
date obtained	95/05/24
holding temp.	-20 to -25oC
analyzer model no.	model 500 analyzer
incubation section temp.	15oC

Quality Assurance Information:
All criteria have been met for a valid test and the test data and result are verified correct.

Mary Keaney

TOXICANT:	Zinc - as zinc sulphate (ZnSO4*7H2O)					
CURRENT TEST:	**started:**	95/12/28		**ended:**	95/12/28	
RESULT:	0.9	mgZn++/L				
HISTORICAL MEAN:	0.9	**std.dev:**	0.1	**CV(%):**	10	
CHART LIMITS:	**warning:**	0.7	1.1	**control:**	0.6	1.2
	(95% - 2SD)			(99% - 3SD)		



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#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

QUALITY ASSURANCE INFORMATION

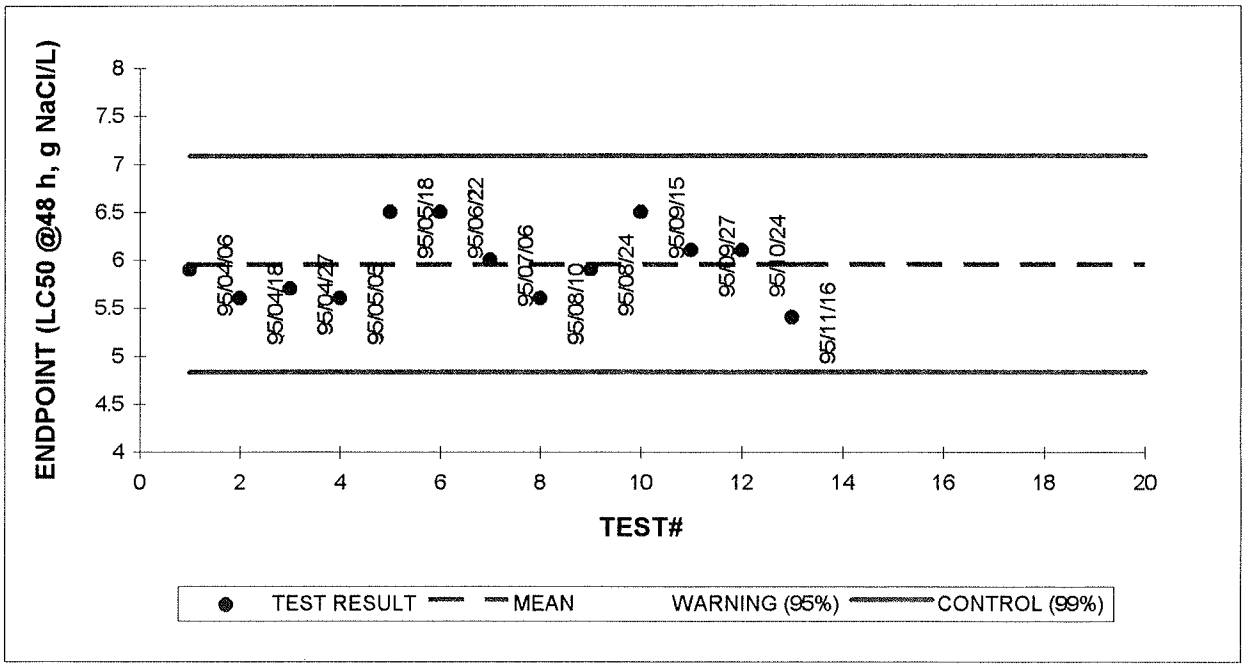
TEST ORGANISM		TEST DESIGN AND CONDITIONS	
test species	*Daphnia magna*	**vol. of test vessel (ml)**	120
culture source	in-house	**test volume (ml)**	90
days to first brood	9	**replicates per treatment**	2
mean no. neonates / brood	28	**neonates per replicate**	5
ephippia in stock culture	no	**volume per neonate (ml)**	18
age of test organisms	< 24 hrs	**sample preaerated**	yes
temperature (oC)	20	**hardness adjustment**	no
photoperiod	16h light:8h dark	**dilution water hardness**	200

Dilution water source - dechlorinated tap water

Quality Assurance Unit:
All criteria have been met for a valid test and the test data and result are verified correct.

WARNING CHART

TOXICANT	Sodium - as Sodium chloride (NaCl)					
CURRENT TEST:	**started :**	95/11/16		**ended:**	95/11/18	
RESULT:	5.4	g NaCl/L				
HISTORICAL MEAN:	6.0	**std. dev:**	0.4	**CV (%):**	6	
CHART LIMITS:	**warning:**	5.2	6.7	**control:**	4.8	7.1
	(95% - 2SD)			(99% - 3SD)		



HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

QUALITY ASSURANCE INFORMATION

TEST ORGANISM	
test species	*Oncorhynchus mykiss*
culture source	Rocky Mountain Brood Stock
holding system	flow through
temperature (oC)	15
dissolved oxygen	saturated
stock mortality (last 7d)	< 1%

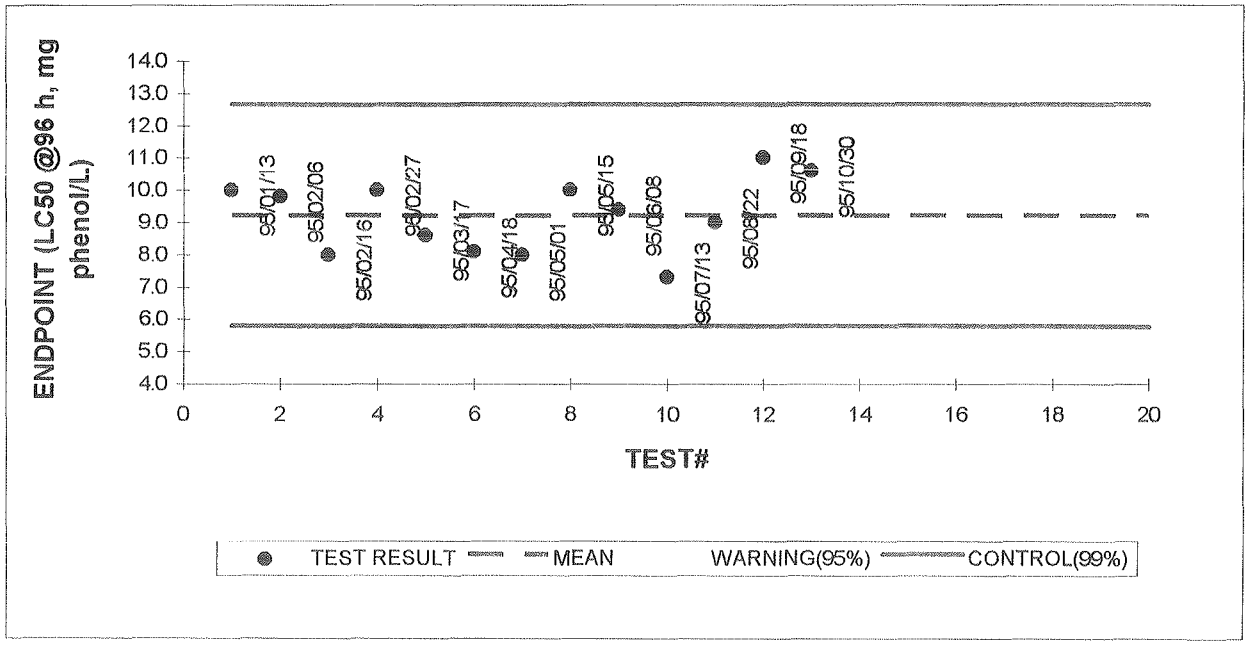
TEST DESIGN AND CONDITIONS	
vol test vessel (L)	22
test volume (L)	20
replicates per treatment	1
fingerlings per replicate	10
loading (g fish/L/4days)	< 0.5
temperature (oC)	15
photoperiod	16h light: 8h dark
light level (water surface)	< 500lux
dilution water	dechlor. tap water

Qualty Assurance Unit:
All criteria have been met for a valid test and the test data and result are verified correct.

WARNING CHART

TOXICANT: phenol - C6H5OH
CURRENT TEST: **started:** 95/10/30 **ended:** 95/11/03
RESULT: 10.6 mg/L

HISTORICAL MEAN:	9.2	**std. dev:**	1	**CV (%):**	12	
CHART LIMITS:	**warning:**	7	11	**control:**	6	13
	(95% - 2SD)			(99% - 3SD)		



HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta Canada T2H 2K1
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

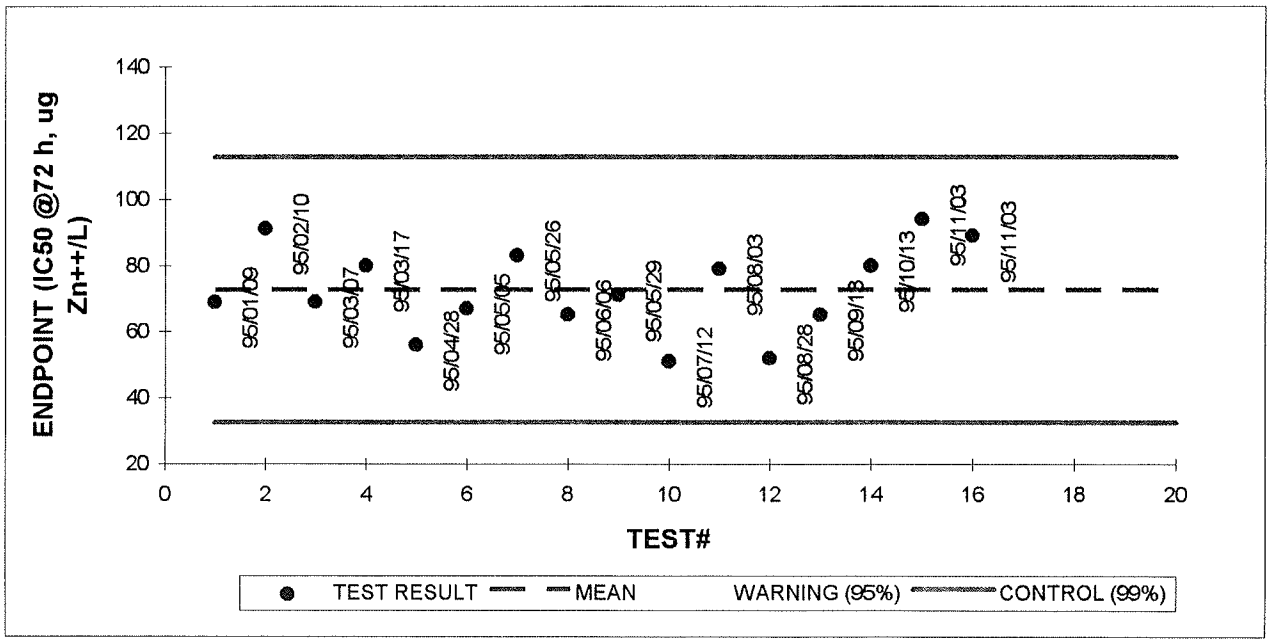
QUALITY ASSURANCE INFORMATION

TEST ORGANISM		TEST DESIGN AND CONDITIONS	
test species	*Selenastrum capricornutum*	**culture age**	exponential
culture source	in-house	**test vessel**	96 well microplate
culture vessels	4L glass jars	**no. of replicates**	3
dilution water	deionized water	**test volume (uL)**	200
growth medium	nutrient solution	**temperature (oC)**	24 - 26
cultivation method	continuous light (>4000 lux) 25oC, filtered, oil free air	**lighting**	4-5000 lux

Quality Assurance Unit:
All criteria have been met for a valid test and the test data and result are verified correct.

WARNING CHART

TOXICANT:	Zinc - as zinc sulphate (ZnSO4*7H2O)					
CURRENT TEST:	**started:**	95/11/03		**ended:**	95/11/06	
RESULT:	89	ugZn++/L				
HISTORICAL MEAN:	73	**std.dev:**	13	**CV(%):**	18	
CHART LIMITS:	**warning:**	46	99	**control:**	33	113
	(95% - 2SD)			(99% - 3SD)		



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QUALITY ASSURANCE INFORMATION

TEST ORGANISM

test species	*Ceriodaphnia dubia*
culture source	in-house
ephippia in stock culture	none
mortality in culture (last 7d)	< 1.0%
culture fecundity (last 7d)	23
age of test organisms	< 24h
food source	yeast/alfalfa/ trout chow

TEST DESIGN AND CONDITIONS

vol of test vessel (ml)	30
test volume (ml)	15
test cover	clear glass
replicates per treatment	10
organisms per replicate	1
test solution renewal	daily
temperature (oC)	24-26
photoperiod	16h light:8h dark
light level (water surface)	< 600 lux
light source	cool white fluorescent
sample preaerated	yes
hardness adjustment	no

DILUTION WATER CHEMISTRY

not used

source	mod. hard reconstituted water	**source**	Bow river water
pH (units)		**pH (units)**	8.2
conductance (uS/cm)		**conductance (uS/cm)**	376
dissolved oxygen (mg/L)		**dissolved oxygen (mg/L)**	7.6
NH4+ (mg/L)		**NH4+ (mg/L)**	< 0.1
hardness (mg CaCO3/L)		**hardness (mg CaCO3/L)**	148
total residual chlorine (mg/L)		**total residual chlorine (mg/L)**	< 0.1

Quality Assurance Unit:
All criteria have been met for a valid test and the test data and result are verified correct.

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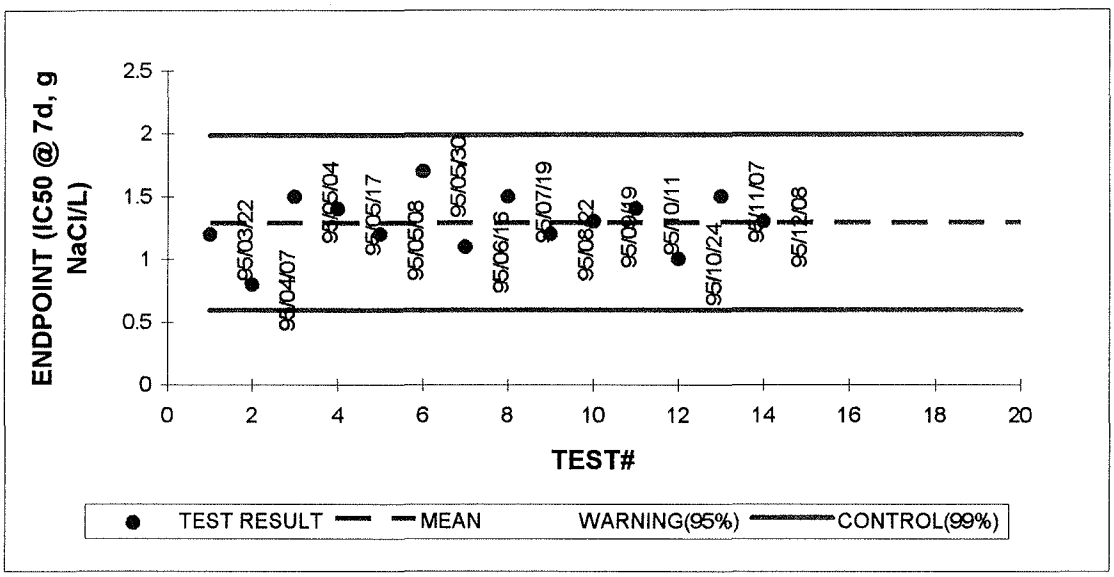
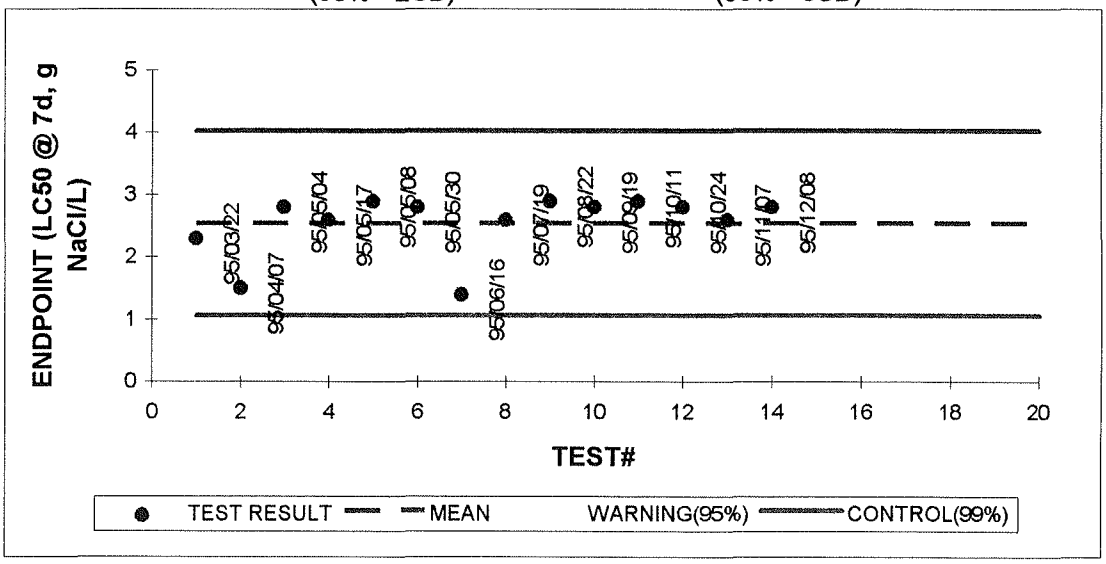
WARNING CHART (fecundity - IC50 at 7 days)

TOXICANT:	Sodium - as Sodium Chloride (NaCl)						
CURRENT TEST:	**started:**	95/12/08		**ended:**	95/12/15		
RESULT:	1.3	gNaCl/L					
HISTORICAL MEAN:	1.3	**std. dev:**	0.2	**CV (%):**	18		
CHART LIMITS:	**warning:**	0.8	1.8	**control:**	0.6	2.0	
	(95% - 2SD)			(99% - 3SD)			



WARNING CHART (mortality - LC50 at 7 days)

TOXICANT:	Sodium - as Sodium Chloride (NaCl)						
CURRENT TEST:	**started:**	95/12/08		**ended:**	95/12/15		
RESULT:	2.8	gNaCl/L					
HISTORICAL MEAN:	2.6	**std. dev:**	0.5	**CV (%):**	19		
CHART LIMITS:	**warning:**	1.6	3.5	**control:**	1.1	4.0	
	(95% - 2SD)			(99% - 3SD)			



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QUALITY ASSURANCE INFORMATION

TEST ORGANISM

test species	*Pimphales promelas*
culture source	in - house
water source	treated city water
temp of breeding aquaria	23 - 26 oC
food type	frozen brine shrimp
frequency of feeding	daily
breeding colony mortality	<1 (% last 7d)
hatching success (%)	80
age of test organisms	<24 hours

DILUTION WATER CHEMISTRY

water source	treated city water
pH (units)	7.8
conductance (uS/cm)	405
dissolved oxygen (mg/L)	9.6
NH4+ (mg/L)	<0.1
alkalinity (mg CaCO3/L)	120
hardness (mg/CaCO3/L)	200
total residual chlorine (mg/L)	<0.1

TEST DESIGN AND CONDITIONS

test type	static renewal
volume of test vessel (ml)	450
test volume (ml)	250
depth of test vessel (cm)	>3
replicates per treatment level	4
no. of animals per replicate	10
renewal of test solution	daily
feeding	twice daily
temp. (oC)	24 - 26
photoperiod	16 light : 8 dark
light level (water surface)	<500 lux
light source	"cool white" fluorescent

Quality Assurance Unit:
All criteria have been met for a valid test and the test data and result are verified correct.

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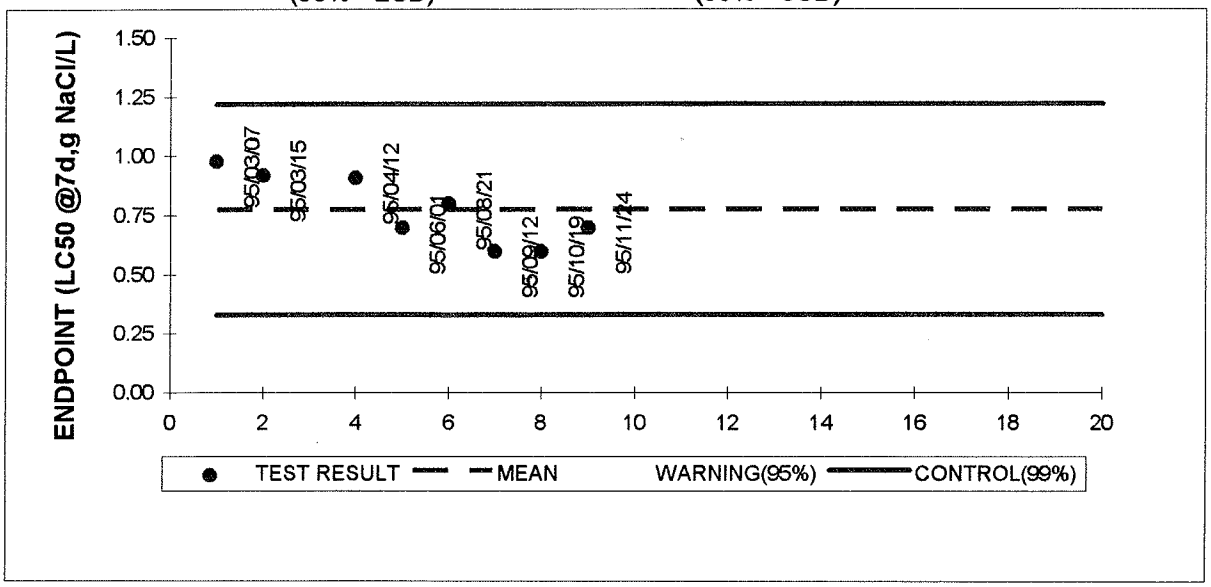
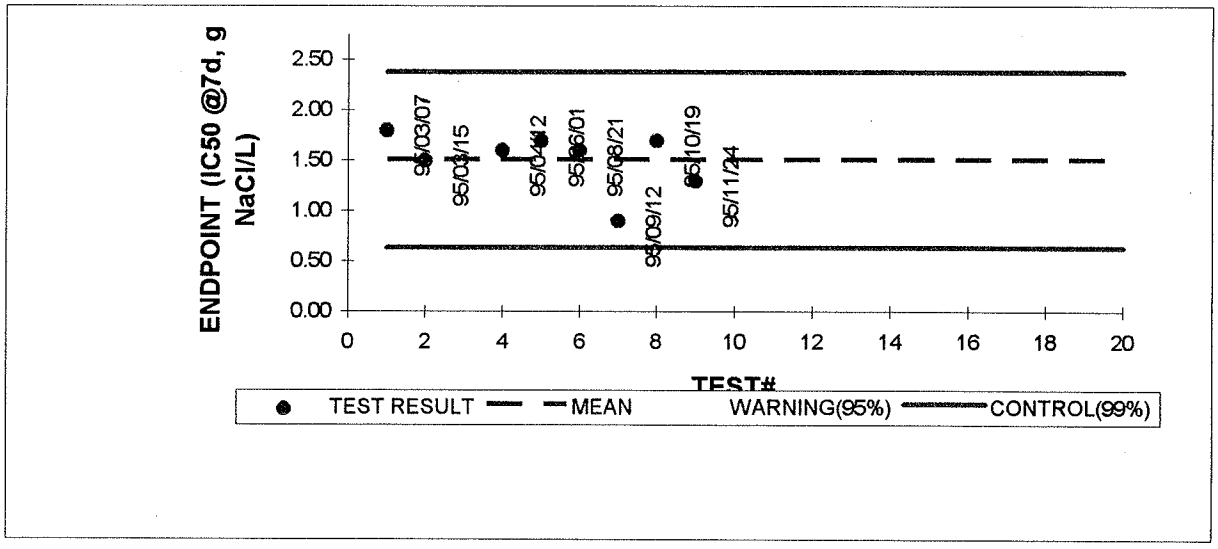
WARNING CHART (mortality LC50 at 7 days)

TOXICANT:	Sodium - Sodium Chloride (NaCl)						
CURRANT TEST:	**started:**	95/11/24	**ended:**	95/12/01			
RESULT:	0.7	g NaCl/L					
HISTORICAL MEAN:	0.8	**std dev:**	0.15	**CV (%):**	19		
CHART LIMITS:	**warning:**	0.5	1.1	**control:**	0.3	1.2	
	(95% - 2SD)			(99% - 3SD)			



WARNING CHART (growth IC50 at 7 days)

TOXICANT:	Sodium - Sodium Chloride (NaCl)						
CURRANT TEST:	**started:**	95/11/24	**ended:**	95/12/01			
RESULT:	1.3	g NaCl/L					
HISTORICAL MEAN:	1.5	**std dev:**	0.3	**CV (%):**	19		
CHART LIMITS:	**warning:**	0.9	2.1	**control:**	0.6	2.4	
	(95% - 2SD)			(99% - 3SD)			



Water quality data for 7 and 28 day exposures

Table 1. Summary of Water Quality Monitoring Data for the 7 Day Test

DAY	TANK							
	9	10	11	12	13	14	15	16
pH (units)								
1	7.7	7.8	7.8	7.9	8.0	7.9	7.9	7.9
2	7.6	7.7	7.7	7.8	8.0	8.3	nd	nd
3	7.6	7.6	7.8	7.8	8.0	8.2	nd	nd
4	7.6	7.8	7.8	7.8	8.1	8.3	nd	nd
5	7.5	7.5	7.8	7.5	7.8	8.1	nd	nd
6	7.3	7.6	7.7	7.7	7.9	8.3	nd	nd
7	7.5	7.6	7.8	7.7	7.9	8.2	nd	nd
avg	7.5	7.6	7.8	7.7	7.9	8.2	7.9	7.9
min	7.7	7.8	7.8	7.9	8.1	8.3	7.9	7.9
max	7.3	7.5	7.7	7.5	7.8	7.9	7.9	7.9
Dissolved Oxygen (mg/L)								
1	7.2	8.3	8.5	8.7	9.0	8.1	8.3	8.0
2	5.5	6.6	6.2	6.8	7.2	5.6	nd	nd
3	6.1	6.9	6.8	6.8	7.4	6.3	nd	nd
4	6.2	7.1	7.4	6.9	7.7	5.9	nd	nd
5	5.6	6.4	6.8	6.2	7.1	4.1	nd	nd
6	5.1	6.4	6.3	6.2	7.2	6.2	nd	nd
7	5.7	6.4	6.8	6.3	7.2	6.1	nd	nd
avg	5.9	6.9	7.0	6.8	7.5	6.0	8.3	8.0
min	5.1	6.4	6.2	6.2	7.1	4.1	8.3	8.0
max	7.2	8.3	8.5	8.7	9.0	8.1	8.3	8.0

DAY	TANK							
	9	10	11	12	13	14	15	16
Conductance (uS/cm)								
1	255	356	358	360	359	360	359	362
2	252	349	365	377	443	nd	nd	nd
3	266	358	356	378	433	nd	nd	nd
4	247	363	365	380	435	nd	nd	nd
5	257	367	359	381	439	nd	nd	nd
6	250	360	364	381	440	nd	nd	nd
7	247	355	360	373	432	nd	nd	nd
avg	253	358	361	376	426	360	359	362
min	247	349	356	360	359	360	359	362
max	266	367	365	381	443	360	359	362
Temperature (oC)								
1	22	19	18	18	18	18	18	19
2	22	19	18	18	18	19	nd	nd
3	22	19	19	18	18	20	nd	nd
4	22	19	18	18	18	20	nd	nd
5	21	19	19	18	18	20	nd	nd
6	22	20	19	19	18	20	nd	nd
7	23	20	19	18	19	21	nd	nd
avg	22	19	19	18	18	20	18	19
min	21	19	18	18	18	18	18	19
max	23	20	19	19	19	21	18	19

Table 1. Water Quality Monitoring Data for 28 Day Test: pH (units)

DAY	TANK															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	8.7	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.1	8.3	8.4	8.3	8.3	8.4	8.2	8.2
2	8.0	8.1	8.1	8.2	8.2	8.2	8.2	8.2	7.8	7.8	7.9	7.8	7.8	7.9	8.0	7.9
3	8.4	8.4	8.4	8.4	8.4	8.5	8.4	8.4	7.9	8.0	8.0	7.9	7.9	8.2	8.1	8.0
4	8.5	8.6	8.6	8.6	8.6	8.7	8.6	8.6	8.2	8.4	8.4	8.2	8.2	8.5	8.4	8.4
5	8.1	8.2	8.2	8.2	8.3	8.3	8.3	8.2	7.9	8.0	8.0	7.9	7.9	8.1	8.2	8.0
6	8.3	8.2	8.2	8.3	8.3	8.3	8.2	8.2	7.9	7.8	7.8	7.8	7.7	7.8	7.8	7.8
7	8.3	8.3	8.3	8.3	8.3	8.4	8.3	8.3	7.7	8.0	8.0	8.0	7.9	8.1	8.1	8.0
8	8.2	8.1	8.2	8.2	8.2	8.3	8.2	8.2	7.7	7.9	7.9	7.8	7.8	8.0	8.0	7.8
9	8.2	8.1	8.2	8.1	8.2	8.2	8.1	8.1	7.6	7.7	7.7	7.6	7.7	7.8	7.9	7.6
10	8.1	8.0	8.1	8.0	8.1	8.3	8.0	8.0	7.6	7.6	7.6	7.6	7.6	7.8	7.7	7.6
11	8.3	8.2	8.3	8.2	8.3	8.3	8.3	8.2	7.8	7.9	7.9	7.8	7.8	7.9	8.0	7.8
12	8.3	8.2	8.3	8.3	8.3	8.3	8.2	8.3	7.8	7.9	7.9	7.8	7.8	7.9	8.0	7.8
13	8.3	8.3	8.3	8.2	8.3	8.3	8.3	8.3	7.8	7.9	7.9	7.8	7.8	8.0	8.0	7.8
14	8.3	8.3	8.3	8.2	8.3	8.3	8.3	8.3	7.8	7.9	7.9	7.8	7.8	8.0	8.0	7.8
15	8.2	8.2	8.3	8.2	8.3	8.3	8.3	8.2	7.7	7.8	7.9	7.8	7.8	8.0	7.9	7.8
16	8.2	8.3	8.3	8.2	8.3	8.3	8.3	8.3	7.7	7.8	7.9	7.7	7.8	8.1	7.9	7.8
17	8.2	8.2	8.2	8.2	8.3	8.3	8.3	8.3	7.7	7.8	8.0	7.7	7.8	8.1	7.9	7.8
18	8.2	8.2	8.3	8.2	8.3	8.3	8.3	8.2	7.7	7.8	8.0	7.7	7.8	8.1	7.9	7.8
19	8.2	8.3	8.3	8.3	8.3	8.4	8.3	8.2	7.6	7.8	8.0	7.9	7.9	8.0	7.9	7.8
20	8.3	8.3	8.4	8.3	8.4	8.3	8.3	8.3	7.6	7.8	8.0	7.9	8.0	8.0	7.9	7.9
21	8.3	8.4	8.4	8.4	8.4	8.3	8.3	8.3	7.7	7.8	8.2	7.9	8.0	8.0	7.9	7.8
22	8.3	8.4	8.4	8.4	8.4	8.3	8.4	8.3	7.8	7.9	8.3	8.0	8.0	8.0	7.9	7.9
23	8.3	8.3	8.4	8.3	8.4	8.3	8.3	8.3	7.7	7.9	8.3	7.9	8.0	8.0	8.0	7.8
24	8.1	8.3	8.2	8.3	8.3	8.3	8.3	8.2	7.6	7.8	8.2	7.9	7.9	8.0	8.0	7.8
25	8.3	8.4	8.4	8.4	8.4	8.4	8.4	8.3	7.7	8.0	8.3	7.9	8.0	8.0	8.1	7.9
26	8.3	8.4	8.4	8.4	8.4	8.4	8.4	8.3	7.8	8.0	8.3	7.9	8.0	8.0	8.0	7.8
27	8.3	8.4	8.4	8.4	8.4	8.4	8.3	8.3	7.7	8.2	8.3	7.9	8.0	8.0	8.0	7.8
28	8.3	8.4	8.4	8.4	8.4	8.4	8.3	8.4	7.6	8.2	8.3	7.9	8.1	8.0	7.9	7.9
avg	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	7.7	7.9	8.0	7.8	7.9	8.0	8.0	7.8
min	8.7	8.6	8.6	8.6	8.6	8.7	8.6	8.6	8.2	8.4	8.4	8.3	8.3	8.5	8.4	8.4
max	8.0	8.0	8.1	8.0	8.1	8.2	8.0	8.0	7.6	7.6	7.6	7.6	7.6	7.8	7.7	7.6

Table 2. Water Quality Monitoring Data for 28 Day Test: Conductance (uS/cm)

DAY	TANK															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	353	368	369	377	380	470	372	374	326	345	346	360	364	456	365	368
2	312	359	376	388	393	468	385	382	323	366	374	389	389	484	384	388
3	298	358	378	396	400	498	379	376	306	375	386	400	396	485	385	383
4	300	376	386	399	400	511	387	383	306	378	383	396	393	484	387	381
5	303	363	364	380	391	495	381	379	324	378	379	392	390	485	382	381
6	303	361	360	374	385	484	371	373	328	372	372	386	383	476	376	381
7	320	372	368	386	388	489	378	379	331	371	373	385	383	477	376	382
8	305	388	386	401	386	512	386	385	315	383	389	403	398	486	389	391
9	311	380	382	396	399	488	390	391	325	390	390	401	406	484	391	392
10	328	388	388	402	391	505	393	389	334	382	396	394	397	484	398	391
11	303	388	387	399	400	473	391	390	313	392	393	405	402	485	399	396
12	298	389	387	400	400	527	389	388	309	393	393	406	404	467	397	393
13	299	390	388	400	398	502	395	388	310	391	392	404	398	471	394	392
14	298	391	386	396	397	505	404	388	286	386	381	402	398	473	401	393
15	279	393	392	383	407	532	394	392	279	385	384	404	401	471	396	394
16	272	393	392	403	406	507	397	392	278	396	396	409	405	493	397	398
17	275	389	389	398	406	547	396	390	280	390	392	408	406	477	397	396
18	277	387	387	396	407	584	404	392	278	387	391	402	401	454	403	395
19	280	385	390	401	400	541	395	395	289	394	396	407	407	442	401	398
20	283	382	385	394	391	460	394	380	285	387	393	410	407	423	395	396
21	303	383	387	396	397	452	397	392	313	392	392	406	407	469	396	397
22	311	380	388	398	391	472	407	397	316	389	390	403	408	474	401	401
23	311	381	385	398	397	475	394	394	325	394	394	407	408	479	399	403
24	318	388	390	402	404	485	396	395	324	394	391	411	409	485	399	402
25	331	395	390	403	403	492	399	400	338	397	395	409	409	480	401	400
26	336	389	391	401	410	491	397	396	345	391	389	407	410	478	397	401
27	339	389	391	402	403	494	399	397	342	381	389	406	405	489	397	401
28	343	398	399	409	406	510	413	402	346	392	395	410	410	485	402	404
avg	307	382	384	396	398	499	392	389	313	385	387	401	400	475	393	393
min	272	358	360	374	380	452	371	373	278	345	346	360	364	423	365	368
max	353	398	399	409	410	584	413	402	346	397	396	411	410	493	403	404

Table 3. Water Quality Monitoring Data for 28 Day Test: DO (mg/L)

DAY	TANK															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	8.2	8.8	8.9	9.1	8.8	9.0	8.8	9.2	4.7	6.8	7.8	7.4	7.0	7.8	6.9	6.3
2	8.0	8.7	8.9	9.0	9.1	8.8	9.0	9.0	6.4	7.5	7.8	6.7	6.9	7.7	7.9	7.7
3	7.9	8.5	8.7	8.8	8.9	8.8	8.9	8.8	6.5	7.1	7.4	6.5	7.1	7.9	7.8	7.3
4	7.8	8.7	8.8	8.7	8.8	8.6	8.8	8.8	6.6	7.3	7.5	6.9	7.2	8.1	7.9	7.5
5	7.8	8.7	8.7	8.8	8.8	8.8	8.8	8.9	7.0	7.8	7.9	7.2	7.3	8.1	8.9	7.5
6	8.2	8.9	8.9	9.0	8.9	9.0	8.8	8.9	6.8	7.7	7.6	7.8	7.2	7.8	8.0	7.2
7	8.4	8.9	9.0	9.0	9.0	9.0	9.0	9.0	6.9	7.8	7.8	6.7	7.4	7.9	8.4	6.6
8	8.2	9.1	9.1	9.2	9.1	9.0	9.0	9.0	6.1	7.8	7.7	5.9	6.5	7.6	8.1	6.7
9	7.9	8.7	8.7	8.6	8.8	8.7	8.7	8.7	5.9	7.2	7.3	5.8	6.4	7.2	7.6	6.6
10	8.2	9.1	9.1	9.1	9.0	9.1	8.9	8.9	5.6	6.7	7.2	5.6	6.8	7.8	7.4	6.5
11	8.2	9.1	9.1	8.9	9.1	9.1	8.9	8.9	6.3	7.4	7.6	6.2	6.8	7.5	7.9	6.4
12	8.9	9.3	9.2	9.2	9.2	9.2	9.1	9.0	7.7	7.6	7.8	6.4	6.7	7.9	8.2	6.9
13	8.6	9.2	9.1	9.1	9.1	9.2	9.0	9.1	6.9	7.2	7.6	6.2	6.6	7.7	7.9	6.9
14	8.9	9.2	9.2	9.2	9.1	9.2	9.0	9.0	7.1	7.3	7.8	6.4	6.6	7.6	7.9	6.7
15	9.1	9.2	9.2	9.2	9.1	9.1	9.0	9.0	7.2	7.3	7.9	6.4	6.7	8.1	7.9	6.9
16	9.1	9.3	9.2	9.2	9.1	9.1	9.0	9.0	7.2	7.4	7.9	6.3	7.1	8.1	8.0	7.0
17	9.1	9.3	9.2	9.2	9.1	9.2	9.0	9.0	6.8	7.2	8.0	6.1	6.8	8.1	8.1	6.8
18	9.1	9.3	9.2	9.2	9.1	9.1	9.0	8.9	6.8	7.2	8.0	6.2	6.7	8.2	8.0	7.1
19	9.2	9.4	9.4	9.4	9.4	9.4	9.3	9.1	5.6	6.9	8.2	7.9	7.7	8.2	8.0	6.9
20	9.0	9.3	9.3	9.3	9.3	9.3	9.2	9.1	5.9	6.6	8.5	7.6	7.7	7.9	7.9	6.6
21	9.2	9.3	9.3	9.3	9.3	9.3	9.2	9.1	6.4	7.2	9.0	7.9	7.9	7.9	8.0	6.9
22	9.2	9.3	9.3	9.3	9.3	9.3	9.3	9.2	6.9	7.3	9.2	7.9	7.9	7.9	8.0	7.1
23	9.0	9.2	9.2	9.2	9.2	9.1	9.1	9.0	6.3	7.2	9.1	7.6	7.9	7.7	7.9	6.6
24	8.9	9.2	9.1	9.1	9.1	9.0	9.0	9.0	6.0	7.6	9.0	7.5	7.7	7.6	7.9	6.5
25	9.0	9.2	9.1	9.2	9.2	9.2	9.2	9.14	6.7	7.9	9.0	7.7	7.8	7.8	8.2	7.0
26	8.8	9.2	9.1	9.1	9.1	9.0	9.1	9.0	6.0	7.7	9.0	7.6	7.8	7.7	8.0	6.8
27	8.9	9.3	9.2	9.2	9.3	9.1	9.2	9.0	6.1	8.9	9.0	7.7	8.2	7.9	8.0	7.0
28	8.9	9.3	9.2	9.2	9.2	9.1	9.2	9.2	6.0	9.2	9.1	7.9	8.3	8.0	8.1	7.6
avg	8.6	9.1	9.1	9.1	9.1	9.1	9.0	9.0	6.4	7.5	8.1	6.9	7.2	7.8	8.0	6.9
min	7.8	8.5	8.7	8.6	8.8	8.6	8.7	8.7	4.7	6.6	7.2	5.6	6.4	7.2	6.9	6.3
max	9.2	9.4	9.4	9.4	9.4	9.4	9.3	9.2	7.7	9.2	9.2	7.9	8.3	8.2	8.9	7.7

Table 4. Water Quality Monitoring Data for 28 Day Test: Temperature (oC)

DAY	TANK															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	18	15	15	15	15	15	15	15	17	15	15	15	15	15	15	15
2	19	14	13	14	14	14	15	15	20	13	13	14	14	13	15	15
3	19	14	14	14	14	14	15	15	20	13	13	13	13	13	15	15
4	19	13	14	14	14	14	15	15	19	13	13	13	13	13	15	15
5	18	15	15	15	15	15	15	15	18	15	15	15	15	15	15	15
6	18	14	14	114	14	14	14	14	18	14	14	14	14	14	14	14
7	18	15	15	15	15	15	15	15	18	15	14	15	14	14	14	14
8	18	14	13	14	13	14	14	13	19	13	13	13	13	13	13	13
9	17	14	14	14	14	14	14	14	18	14	14	14	14	14	14	14
10	18	14	14	14	14	14	14	14	18	14	14	14	14	14	14	14
11	17	14	14	14	14	14	14	14	17	14	13	14	14	14	13	14
12	15	14	13	13	14	14	14	14	15	13	13	14	14	14	13	13
13	16	15	14	14	14	14	14	14	16	14	14	14	14	14	14	14
14	15	14	14	14	14	14	14	14	15	14	14	14	14	14	14	14
15	15	14	14	14	14	14	14	14	15	14	13	14	14	14	14	14
16	14	13	13	14	14	14	14	14	14	13	13	13	13	13	13	13
17	14	13	13	13	13	13	13	13	14	13	13	13	13	13	13	13
18	14	13	13	13	13	14	13	13	14	13	13	13	13	13	13	13
19	14	13	13	13	13	13	13	13	14	13	13	13	13	13	13	13
20	14	14	13	13	13	13	13	13	15	13	13	13	13	13	13	13
21	14	13	13	13	13	13	13	13	14	13	13	13	13	13	13	13
22	14	14	13	13	13	13	13	13	14	13	13	13	13	13	13	13
23	15	13	13	13	13	13	13	13	15	13	13	13	13	13	13	13
24	15	14	14	14	14	14	14	14	15	14	14	14	14	14	14	14
25	15	14	14	14	14	14	14	14	15	14	14	14	14	14	14	14
26	15	14	14	14	14	14	14	14	15	14	14	14	14	14	14	14
27	15	14	14	14	14	14	14	14	16	14	14	14	14	14	14	14
28	15	14	14	14	14	14	14	14	15	14	14	14	14	14	14	14
avg	16	14	14	18	14	14	14	14	16	14	14	14	14	14	14	14
min	14	13	13	13	13	13	13	13	14	13	13	13	13	13	13	13
max	19	15	15	114	15	15	15	15	20	15	15	15	15	15	15	15

Table 5. Water Quality Monitoring Data for 28 Day Test: Ammonium (mg NH4+-N/L)

DAY	TANK															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1																
2																
3	0.6	0.2	0.2	0.3	0.3	0.8	0.2	0.2	0.7	0.6	0.6	0.5	0.6	0.7	0.5	0.5
4	0.5	0.3	0.3	0.3	0.3	0.6	0.2	0.2	0.7	0.5	0.5	0.4	0.7	0.4	0.4	0.2
5	0.6	0.3	0.3	0.3	0.4	0.8	0.1	0.2	0.8	0.5	0.6	0.6	0.6	0.8	0.3	0.3
6	0.4	0.2	0.2	0.2	0.3	1.1	0.2	0.1	0.6	0.3	0.3	0.3	0.4	1.3	0.3	0.2
7	0.5	0.3	0.2	0.2	0.3	1.0	0.3	0.2	0.7	0.6	0.5	0.5	0.5	1.5	0.3	0.3
8	1.0	0.3	0.4	0.4	0.4	1.1	0.3	0.2	1.6	0.5	0.6	0.6	0.6	1.4	0.5	0.4
9	1.3	0.3	0.3	0.4	0.4	1.3	0.4	0.3	2.2	0.9	0.9	0.8	0.8	1.8	0.7	0.5
10	0.7	0.2	0.2	0.2	0.3	0.8	0.3	0.2	1.3	0.6	0.6	0.4	0.4	1.0	0.4	0.3
11	0.6	0.2	0.2	0.2	0.2	0.6	0.2	0.2	1.2	0.5	0.6	0.5	0.5	1.0	0.4	0.4
12	0.4	0.2	0.2	0.1	0.2	0.6	0.2	0.1	1.0	0.5	0.4	0.4	0.5	0.7	0.4	0.4
13	0.6	0.2	0.2	0.2	0.3	0.4	0.2	0.1	1.4	0.6	0.6	0.6	0.6	0.9	0.6	0.4
14	0.4	0.2	0.2	0.2	0.2	0.4	0.2	0.1	0.8	0.6	0.6	0.7	0.6	0.8	0.6	0.6
15	0.8	0.3	0.4	0.3	0.3	0.6	0.3	0.2	1.0	0.6	0.6	0.6	0.8	1.0	0.6	0.7
16	0.5	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.6	0.4	0.4	0.4	0.4	0.6	0.4	0.4
17	0.4	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.3
18	0.4	0.2	0.3	0.2	0.2	0.1	0.3	0.2	0.6	0.5	0.4	0.4	0.5	0.5	0.4	0.4
19	0.2	0.2	0.2	0.2	0.2	0.9	0.2	0.1	0.8	0.6	0.6	0.6	0.6	0.5	0.4	0.4
20	0.5	0.2	0.2	0.2	0.2	0.9	0.2	0.1	1.1	0.6	0.6	0.6	0.7	0.9	0.6	0.6
21	0.5	0.4	0.3	0.3	0.4	1.1	0.3	0.1	1.7	0.8	0.4	0.8	1.0	1.8	0.8	0.9
22	0.2	0.1	0.1	0.1	0.1	0.5	0.1	0.1	0.4	0.4	0.1	0.4	0.5	0.6	0.5	0.4
23	0.1	0.1	0.1	0.2	0.2	0.5	0.1	0.1	0.4	0.5	0.1	0.6	0.6	0.6	0.4	0.5
24	0.1	0.2	0.2	0.2	0.3	0.7	0.2	0.1	0.1	0.5	0.1	0.6	0.6	0.7	0.4	0.5
25	0.2	0.2	0.2	0.2	0.2	0.8	0.2	0.1	0.3	0.7	0.1	0.7	0.6	0.7	0.5	0.6
26	0.3	0.2	0.2	0.2	0.2	0.7	0.2	0.1	0.6	0.5	0.2	0.5	0.6	0.7	0.4	0.5
27	0.1	0.2	0.2	0.2	0.3	1.3	0.2	0.1	0.3	0.3	0.2	0.6	0.6	1.0	0.5	0.5
28	0.1	0.1	0.2	0.2	0.2	0.9	0.2	0.2	0.3	0.3	0.3	0.3	0.5	0.9	0.5	0.5
avg	0.5	0.2	0.2	0.2	0.3	0.7	0.2	0.1	0.9	0.5	0.4	0.5	0.6	0.9	0.5	0.4
min	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.1	0.3	0.4	0.4	0.3	0.2
max	1.3	0.4	0.4	0.4	0.4	1.3	0.4	0.3	2.2	0.9	0.9	0.8	1	1.8	0.8	0.9

Summary data sheets for 7 and 28 day exposures

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/09/06	TIME: 11:50-12:15	INITIALS: GB/SS/SG/MG	FISH SOURCE: Rocky Mtn.	TREATMENT: Athabasca River Ctl	TANK: 9
					EXPOSURE PERIOD: 7 days

				NECROPSY (see below for explanation of codes)														OTHER DATA												
				EXTERNAL				INTERNAL																						
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	hind gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactate (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)	
21	196	93	1.24	0	0	N	N	IM	N	0	2	B	0	F	N	B	0				0.88	ND	46	1	8.3	47	81	9.2		
22	199	90	1.14	0	0	N	N	IF	S	0	4	B	0	ND	N	B	1				0.68	ND	34	1	6.2	37	83	9.2		
23	167	55	1.18	0	0	N	N	IF	S	0	3	R	0	F	N	B	0				0.61	ND	41	1	7.2	93	88	10.3		
24	192	84	1.19	1	0	N	N	IM	S	0	1	B	0	F	N	B	0				0.7	ND	28	<1	5.6	81	103	7.6		
25	184	75	1.20	0	0	N	N	IF	S	0	3	R	0	F	N	B	1				0.67	ND	36	1	6.6	115	99	8.0		
26	194	91	1.25	1	0	N	N	IF	S	0	4	B	0	ND	N	B	3				0.58	ND	43	1	7.7	82	91	8.7		
27	188	96	1.44	0	0	N	N	M	S	0	4	R	0	F	N	B	1				1.35	ND	43	<1	8.9	112	95	12.9		
28	169	58	1.20	0	0	N	N	IM	S	0	4	B	0	E	N	B	1				0.53	ND	36	<1	5.2	119	97	6.8		
29	191	85	1.22	0	0	N	N	I	N	0	2	R	0	F	N	B	1				1.08	ND	42	1	4.6	132	99	11.6		
30	196	85	1.13	1	0	N	N	IM	N	0	4	B	0	F	N	B	1				0.62	ND	38	<1	3.7	142	134	6.3		
97	56	1.4	0.80															1.15	0.23	80	0.019									
98	75	4.5	1.07															4.18	1.15	72	0.053									
99	85	4.4	0.72															4.23	0.90	79	0.054									
100	84	4.8	0.81															4.64	1.02	78	0.076									
101	84	4.5	0.76															4.30	0.94	78	0.051									

Comments: 21-30, large trout; 97-98, small trout; 99-101 walleye

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other	ND, not determined	

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/09/07	TIME: 13:25-14:10	INITIALS: GB/SS/SG/MG	FISH SOURCE: Rocky Mtn	TREATMENT: diltuion water control	TANK: 10
					EXPOSURE PERIOD: 7 days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	hind gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (g/dL)	lactate (mg/dL)	glucose (mg/dL)	hemoglobin (g/dL)	white blood cells (%)
81	195	93	1.25	O	O	N	N	IF	S	O	2	R	O	E	N	B	0				0.88	1.6	39	<1	7.1	84	101	8.9	
82	162	49	1.15	O	O	N	N	IF	I	O	3	BGE	O	E	N	A	2				0.39	1.1	34	<1	5.3	39	84	10.0	
83	168	54	1.14	O	O	N	N	IF	S	O	3	BG	O	E	N	B	1				0.37	1.0	33	<1	5.9	55	99	7.3	
84	167	53	1.14	O	O	N	N	M	I	O	4	BG	O	E	N	B	0				0.45	0.1	40	<1	ND	ND	ND	7.5	
85	203	110	1.31	O	O	N	N	IF	S	O	2	R	O	F	N	B	0				1.52	1.0	36	<1	5.0	113	120	8.4	
86	155	56	1.50	O	O	N	N	M	N	O	4	R	O	F	N	B	0				0.61	1.1	40	<1	4.4	107	104	7.7	
87	165	49	1.09	O	O	N	N	M	I	O	2	BG	O	E	N	C	3				0.32	0.8	31	<1	4.0	77	84	5.8	
88	182	88	1.46	O	O	N	N	I	I	O	3	R	O	F	N	A	0				1.37	ND	35	<1	6.1	139	95	8.2	
89	133	61	2.59	O	O	N	N	M	S	O	2	R	O	F	N	B	1				0.51	0.5	43	<1	4.7	ND	134	8.4	
90	138	29	1.10	O	O	N	N	IF	I	O	2	R	O	E	N	B	2				0.24	0.5	30	<1	4.8	ND	138	4.5	
91	55	2.0	1.20															3.59	0.82	77	0.026								
92	90	9.0	1.23															1.44	0.32	78	0.078								
93	75	4.0	0.95															8.59	2.36	73	0.072								
94	89	7.0	0.99															5.88	1.32	78	0.068								
95	85	5.0	0.81															4.52	1.00	78	0.049								
96	85	5.0	0.81															4.48	0.95	79	0.069								

Comments: 81-90, large trout; 91-93, small trout; 94-96, walleye

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other	ND, not determined	

WRITTEN BY MG ON 95/08/28 | REVISED BY SG ON 95/09/13 | FILE: FORMO35.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/09/07	TIME: 09:15-10:05	INITIALS: GB/SS/SG/MG	FISH SOURCE: Rocky Mtn	TREATMENT: 0.1% TID	TANK: 11
					EXPOSURE PERIOD: 7 days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	hind gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactate (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
51	185	88	1.39	0	0	N	N	IF	N	0	2	R	0	ND	N	B	0				1.11	ND	38	1	7.3	65	98	9.5	
52	188	77	1.16	0	0	N	N	M	S	0	1	R	0	F	N	B	1				0.5	1.5	41	<1	6.7	74	104	9.5	
53	196	93	1.24	0	0	N	N	M	S	0	4	R	0	F	N	B	1				1.26	1.6	37	<1	6.9	95	106	10.5	
54	163	53	1.22	0	1	N	N	IF	S	0	3	RE	0	F	N	B	1				0.32	0.9	37	1	7.0	91	93	6.1	
55	220	128	1.20	0	0	N	N	IF	N	0	1	R	0	F	N	B	1				1.5	2.2	42	1	10.7	128	108	13.8	
56	178	76	1.35	1	0	N	N	IF	S	0	4	R	0	F	N	B	1				1.5	1.4	39	<1	5.5	103	92	8.8	
57	210	97	1.05	1	0	N	N	IF	N	0	1	R	0	E	N	B	1				0.61	1.9	36	<1	6.8	98	96	8.1	
58	177	79	1.42	0	0	N	N	IF	S	0	4	R	0	F	N	B	1				1.13	1.3	44	<1	8.2	94	127	12.5	
59	182	63	1.05	0	1	N	N	IF	S	0	3	R	0	E	N	B	2				0.53	1.4	48	1	5.5	80	127	12.3	
60	168	49	1.03	0	0	N	N	IF	S	0	4	BE	0	E	N	B	1				0.34	1.0	48	<1	7.1	107	134	4.3	
102	66	3.5	1.22															3.12	0.74	76	0.06								
103	75	2.9	0.69															3.38	0.71	79	0.02								
104	87	5.9	0.90															5.58	1.25	78	0.11								
105	75	3.6	0.85															2.71	0.60	78	0.08								

Comments: 51-60, large trout; 102, small trout; 103-105, walleye

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other	ND, not determined	

WRITTEN BY MG ON 95/08/28

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/09/07	TIME: 10:25-11:10	INITIALS: GB/SS/SG/MG	FISH SOURCE: Rocky Mtn	TREATMENT: 1% TID	TANK: 12
					EXPOSURE PERIOD: 7 days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	hind gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactate (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)	
61	160	44	1.07	0	0	N	N	IF	S	0	2	B	0	F	N	B	2				0.61	0.8	32	<1	6.1	66	85	3.6	
62	180	67	1.15	1	1	N	N	M	N	0	4	BNOE	0	F	N	B	1				0.57	1.5	36	1	5.1	62	99	6.4	
63	210	115	1.32	1	0	N	N	M	S	0	2	B	0	F	N	B	2				1.19	1.1	41	1	6.3	79	90	7.8	
64	190	67	0.98	1	1	N	N	IF	I	0	4	BG	0	F	N	B	1				0.56	0.7	42	<1	5	67	95	6.2	
65	160	58	1.42	0	0	N	N	M	I	0	3	R	0	F	N	B	2				0.84	0.9	44	<1	7.2	124	91	7.2	
66	170	83	1.60	1	0	N	N	M	S	0	4	R	0	F	N	B	0				1.31	1.3	44	1	4.2	122	108	3.9	
67	170	55	1.22	1	0	N	N	IF	I	0	1	B	0	F	N	B	1				0.68	0.9	39	<1	7.2	131	84	4.1	
68	180	53	0.96	0	1	N	N	IF	I	0	3	BGE	0	E	N	B	1				0.46	1.4	36	<1	3.5	82	102	9.5	
69	120	19	1.10	0	1	N	N	I	I	0	1	B	0	E	N	B	1				0.18	0.4	30	<1	4.4	ND	123	2.9	
70	170	51	1.10	1	1	N	N	M	I	0	4	R	0	E	N	B	1				0.35	1.2	32	<1	2.5	94	86	3.3	
106	82	6.9	1.25															3.28	0.79	76	0.06								
107	61	2.6	1.15															2.41	0.55	77	0.04								
108	70	3.5	1.02															6.45	1.80	72	0.05								
109	90	6.4	0.88															6.03	1.39	77	0.11								
110	83	4.3	0.75															2.84	0.61	79	0.05								
111	74	3.0	0.74															3.77	0.84	78	0.04								

Comments: 61-70, large trout; 106-108, small trout; 109-111, walleye

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other	ND, not determined	

WRITTEN BY MG ON 95/08/28 | REVISED BY SG ON 95/09/13 | FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/09/07	TIME: 11:30-11:50	INITIALS: GB/SS/SG/MG	FISH SOURCE: Rocky Mtn	TREATMENT: 10% TID	TANK: 13
					EXPOSURE PERIOD: 7 days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	hind gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactate (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
71	176	63	1.16	0	0	N	N	I	I	0	1	BG	0	F	N	B	1				0.51	1.2	34	1	4.9	22	77	3.1	
72	168	68	1.43	0	0	N	N	M	I	0	3	B	0	F	N	B	0				0.91	0.6	41	1	1.8	51	92	6.9	
73	190	70	1.02	0	0	N	N	IF	S	0	1	B	0	E	N	B	2				0.45	1.5	32	1	3.4	98	117	6.6	
74	187	78	1.19	0	1	N	N	IF	I	0	2	BGE	0	F	N	B	0				0.64	1.9	43	1	3.9	41	76	3.8	
75	190	81	1.18	0	0	N	N	IF	S	0	2	B	0	E	N	B	2				0.68	1.6	39	1	5.8	61	120	10.6	
76	166	53	1.16	0	0	N	N	IF	I	0	4	R	0	E	N	B	1				0.51	1.1	42	1	4.7	55	99	4.8	
77	155	50	1.34	0	0	N	N	IF	I	0	1	B	0	F	N	B	2				0.68	0.9	41	>1	5.8	92	86	10.2	
78	175	76	1.42	0	0	N	N	IM	I	0	4	R	0	F	N	B	0				1.11	1.4	34	<1	6.6	132	112	5.5	
79	155	44	1.18	0	0	N	N	M	N	0	3	R	0	E	N	C	1				0.29	1.1	30	<1	4.2	93	121	9.6	
80	165	57	1.27	0	1	N	N	IF	I	0	3	R	0	F	N	B	1				0.62	1.2	34	>1	3.8	83	117	7.2	
112	64	2.5	0.95															3.02	0.71	76	ND								
113	70	3.2	0.93															6.03	1.70	72	0.05								
114	80	6.3	1.23															2.26	0.48	79	0.08								
115	80	4.1	0.80															3.85	0.85	78	0.07								
116	72	2.5	0.67															4.57	0.99	78	0.03								
117	88	4.8	0.70															2.29	0.49	79	0.04								

Comments: 71-80, large trout; 112-114, small trout; 115-117, walleye

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	**OPERCULA (shortening)**	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	**HIND GUT (inflammation)**	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	**FINS (erosion)**	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other	ND, not determined	

WRITTEN BY MG ON 95/08/28

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/09/06	TIME: 10.30-10.45	INITIALS: GB/SS/SG/MG	FISH SOURCE: Rocky Mtn	TREATMENT: 50% TID	TANK: 14
					EXPOSURE PERIOD: 6 days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (cm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	hind gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (mg)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (g/dL)	lactate (mg/dL)	glucose (mg/dL)	hemoglobin (g/dL)	white blood cells (%)
11	19.6	86	1.14	0	0	N	P	IF	N	N	4	B	0	E	N	B	3				980	ND	27	<1	6.5	103	56	8.0	
12	14.9	45	1.36	0	0	N	P	IF	S	N	3	B	0	E	N	B	3				540	ND	37	<1	8.4	119	56	3.7	
13	18.8	83	1.25	0	0	N	N	IF	S	N	4	B	0	E	N	B	3				1010	ND	26	<1	3.6	186	69	6.2	
14	14.1	49	1.75	0	0	N	N	IF	S	N	3	B	0	E	N	B	3				393	ND	21	<1	2.6	155	88	6.4	
Comments	no small walleye or trout survived																												
	11-14, large trout																												

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration	ND, not determined	F, full
							OT, other		

WRITTEN BY MG ON 95/08/28

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/09/06	TIME: 13:50-14:30	INITIALS: GB/SS/SG/MG	FISH SOURCE: Rocky Mtn	TREATMENT: NAPH	TANK: 15
					EXPOSURE PERIOD: 7 days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (cm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	hind gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (mg)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (g/dL)	lactate (mg/dL)	glucose (mg/dL)	hemoglobin (g/dL)	white blood cells (%)
31	16.6	60	1.31	0	0	N	N	IM	N	0	4	B	0	F	N	A	1				801	ND	33	<1	6.4	92	108	6.8	
32	18.6	87	1.35	0	0	N	N	M	N	0	4	R	0	F	PALE	B	0				1012	ND	40	<1	9.7	100	97	7.8	
33	17.7	62	1.12	0	0	N	N	I	N	0	1	BG	0	F	PALE	B	1				613	ND	36	<1	7.0	126	144	7.3	
34	17.4	60	1.14	0	0	N	N	M	N	0	2	B	0	E	N	A	1				375	ND	34	<1	8.3	51	100	6.4	
35	17.8	68	1.21	0	0	N	N	I	N	0	1	R	0	F	N	A	1				750	ND	36	<1	6.5	132	128	6.6	
36	16.7	57	1.22	0	0	N	N	IF	N	0	2	B	0	E	N	A	1				899	ND	37	<1	6.8	94	108	7.5	
37	16.7	68	1.46	0	0	N	N	IF	S	0	1	BG	0	E	N	B	1				546	ND	36	2	4.7	50	99	7.5	
38	17.0	71	1.45	0	0	N	N	IF	S	0	4	B	0	F	N	B	0				1267	ND	30	<1	6.6	137	88	7.9	
39	19.5	96	1.29	0	0	N	N	M	N	0	1	R	0	F	N	B	2				996	ND	39	<1	7.8	95	108	6.9	
40	13.5	31	1.26	0	0	N	N	IM	S	0	4	B	0	E	N	B	ND				416	ND	33	<1	7.5	96	84	6.4	
118	5.3	1.5	1.01															1.29	0.29	78	ND								
119	5.6	1.9	1.08															1.75	0.30	83	31								
120	6.8	2.7	0.86															2.49	0.47	81	36								
121	7.6	3.7	0.84															4.77	1.05	78	99								
122	8.5	5.0	0.81															3.28	0.68	79	48								
123	8.8	5.8	0.85															5.50	1.25	77	83								

Comments: 31-40, large trout; 118-120, small trout; 121-123, walleye

tested at 33 ppm

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	**OPERCULA (shortening)**	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	**HIND GUT (inflammation)**	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	**FINS (erosion)**	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	**Stomach**
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other	ND, not determined	

WRITTEN BY MG ON 95/08/28

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/09/06	TIME: 14:45-15:30	INITIALS: GB/SS/SG/MG	FISH SOURCE: Rocky Mtn	TREATMENT: BNF	TANK: 16
					EXPOSURE PERIOD: 7 days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (cm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	hind gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (mg)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (g/dL)	lactate (mg/dL)	glucose (mg/dL)	hemoglobin (g/dL)	white blood cells (%)	
41	18.4	76	1.22	0	0	N	N	I	S	0	2	B	0	F	N	B	2				1158	ND	33	<1	8.0	51	115	6.3	
42	16.9	65	1.35	0	0	N	N	IM	S	0	4	B	0	ND	N	B	0				889	ND	33	<1	6.5	55	101	11.6	
43	18.5	80	1.26	0	0	N	N	IF	N	0	1	BGE	0	F	N	B	0				1451	ND	36	<1	7.5	82	120	10.1	
44	17.4	77	1.46	0	0	N	N	M	S	0	1	GE	0	F	N	B	0				1317	ND	39	<1	8.6	61	100	11.5	
45	14.8	62	1.91	0	0	N	N	I	N	0	1	B	0	E	N	B	3				239	ND	36	<1	3.6	39	77	7.2	
46	19.3	88	1.22	0	0	N	N	IM	S	0	4	BG	0	F	N	B	0				1439	ND	23	<1	5.6	78	133	9.5	
47	17.0	54	1.10	0	0	N	N	IF	S	0	2	R	0	E	N	B	1				768	ND	35	<1	4.0	97	136	11.0	
48	17.5	75	1.40	0	0	N	N	IF	S	0	4	B	0	F	N	B	1				1201	ND	32	<1	8.6	138	120	8.2	
49	13.3	26	1.11	0	0	N	N	IF	S	0	2	R	0	E	N	B	1				295	ND	30	<1	3.5	96	138	6.0	

Comments: 41-49, large trout; no small trout tested
trout injected with 10 ug BNF in corn oil

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male, F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other	ND, not determined	

WRITTEN BY MG ON 95/08/28 | REVISED BY SG ON 95/09/13 | FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/08/28	TIME: 13:45-14:45	INITIALS: GB/SS/SG/MG	FISH SOURCE: Rocky Mtn	TREATMENT: time zero control fish	TANK: none
					EXPOSURE PERIOD: 0 days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (cm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	hind gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (mg)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (g/dL)	lactate (mg/dL)	glucose (mg/dL)	hemoglobin (g/dL)	white blood cells (%)
1	17.5	51	0.95	0	0	N	N	I	N	0	2	B	0	ND	N	A	3				400	1.3	35	1	3.4	23	80	7.1	
2	17.5	55	1.03	0	0	N	N	I	N	0	2	B	0	ND	N	A	3				380	1.2	36	<1	10.3	50	110	4.3	
3	19.7	77	1.01	0	0	N	N	IF	N	0	1	B	0	ND	N	A	3				650	1.7	24	<1	6.3	57	78	2.5	
4	15.1	32	0.93	0	1	N	N	I	S	0	2	B	0	ND	N	A	3				320	0.7	43	<1	10.6	64	118	7.7	
5	17.0	42	0.85	0	0	N	N	I	N	0	2	B	0	ND	N	A	3				330	0.8	39	<1	9.3	56	73	7.2	
6	19.7	70	0.92	0	0	N	N	IF	S	0	2	B	0	ND	N	C	1				650	1.4	38	<1	7.8	85	87	7.1	
7	18.6	66	1.03	0	0	N	N	IF	N	0	2	B	0	ND	N	B	1				600	1.3	39	1	6.6	73	108	7.5	
Comments																													

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	**OPERCULA (shortening)**	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	**HIND GUT (inflammation)**	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	**FINS (erosion)**	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	**Stomach**
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other	ND, not determined	

WRITTEN BY MG ON 95/08/28

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/14	TIME: 10:30-11:45	INITIALS: MG	FISH SOURCE: Rocky Mtn. Seafoods	TREATMENT: Athabasca River	TANK: 1
					EXPOSURE PERIOD: 28 Days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	100	8.4	0.84	0.0	0.0	N	N	IM	N	0	1	B	0	E	N	A	3	1.4	0.33	76	0.18								
2	90	7.6	1.04	0.0	0.0	N	N	IM	N	0	1	B	0	E	N	A	3	1.6	0.35	78	0.09								
3	120	13.5	0.78	0.0	0.0	N	N	IM	N	0	1	B	0	E	N	A	3	2.9	0.65	78	0.19								
4	110	10.7	0.80	0.0	0.0	N	N	IM	N	0	1	B	0	E	N	A	3	2.2	0.50	77	0.17								
5	105	10.4	0.90	0.0	0.0	N	N	IM	N	0	1	B	0	E	N	A	3	2.6	0.58	78	0.14								
6	90	6.5	0.89	0.0	0.0	N	N	IM	N	0	1	B	0	E	N	A	3	1.4	0.29	79	0.11								
7	105	10.1	0.87	0.0	0.0	N	N	IM	N	0	1	B	0	E	N	A	3	2.3	0.52	77	0.13								
8	100	8.7	0.87	0.0	0.0	N	N	IM	N	0	1	B	0	E	N	A	3	2.2	0.49	78	0.11								
9	110	12.2	0.92	0.0	0.0	N	N	IM	N	0	1	B	0	E	N	A	3	2.5	0.58	77	0.16								
10	110	9.9	0.74	0.0	0.0	N	N	IM	N	0	1	B	0	E	N	A	3	2.3	0.52	77	0.12								
11	105	10.2	0.88	0.0	0.0	N	N	IM	N	0	1	B	0	E	N	A	3	2.5	0.58	77	0.17								
12	100	9.0	0.90	0.0	0.0	N	N	IM	N	0	1	B	0	E	N	A	3	2.4	0.54	78	0.17								

Comments

Fish #2 - whole liver preserved (no A & B)

Fish #5 - only 1 liver preserved

Fish # 6 & 7 - liver not cut up (ie. in half)

Fish #8 - not split

Fish #10 - liver not split

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

WRITTEN BY MG ON 95/08/28

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/13	TIME: 18:50	INITIALS: MG	FISH SOURCE: Sask. Fisheries	TREATMENT: Control	TANK: 2
					EXPOSURE PERIOD: 28 days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	90	6.5	0.89	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.25	0.271	78	0.15								
2	90	6.2	0.85	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.19	0.264	78	0.16								
3	90	6.5	0.89	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.48	0.324	78	0.2								
4	105	9.7	0.84	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.35	0.516	78	0.24								
5	100	7.6	0.76	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.77	0.395	78	0.15								
6	105	10.5	0.91	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.57	0.575	78	0.31								
7	100	8.5	0.85	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.76	0.393	78	0.19								
8	95	7.4	0.86	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.78	0.390	78	0.14								
9	100	7.8	0.78	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.8	0.388	78	0.14								
10	90	6.5	0.89	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.38	0.299	78	0.18								
11	100	7.4	0.74	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.53	0.322	79	0.06								
Comments																													

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/13	TIME: 18:45-19:30	INITIALS: MG	FISH SOURCE: Sask. Fisheries	TREATMENT: 0.01% TID	TANK: 3
					EXPOSURE PERIOD: 28 days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	95	7.5	0.87	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.46	0.325	78	0.19								
2	95	8	0.93	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.57	0.344	78	0.17								
3	100	8.8	0.88	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.07	0.459	78	0.18								
4	95	6.9	0.8	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.65	0.361	78	0.15								
5	90	5.9	0.81	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.29	0.277	79	0.15								
6	90	5.8	0.8	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.32	0.282	79	0.11								
7	100	7.6	0.76	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.74	0.369	79	0.17								
8	95	6.9	0.8	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.57	0.344	78	0.14								
9	95	6.5	0.76	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.45	0.312	78	0.18								
10	90	4.9	0.67	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	0.893	0.195	78	0.10								
11	100	9.1	0.91	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.89	0.418	78	0.22								
12	95	8.2	0.96	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.75	0.385	78	0.17								

Comments

fish 11-2 to 11-5 all were dead prior to chemistry

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/14	TIME: 13:15-14:05	INITIALS: MG	FISH SOURCE: Sask. Fisheries	TREATMENT: 0.1% TID	TANK: 4
					EXPOSURE PERIOD: 28 Days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL0	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	100	7.3	0.73	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.8	0.41	77	0.13								
2	95	6.9	0.8	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.86	0.42	77	0.12								
3	95	7.4	0.86	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.85	0.41	78	0.15								
4	100	7.8	0.78	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.92	0.43	78	0.13								
5	110	10.6	0.8	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.25	0.52	78	0.26								
6	100	8.5	0.85	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.06	0.46	78	0.13								
7	85	4.9	0.8	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.02	0.22	78	0.10								
8	95	7.8	0.91	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.61	0.37	77	0.17								
9	95	8.3	0.97	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.9	0.43	77	0.20								
10	95	7.6	0.89	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.79	0.40	78	0.18								
11	100	7.4	0.74	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.79	0.41	77	0.16								
12	90	6.8	0.93	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.32	0.29	78	0.11								

Comments
All livers pale
Fish livers not split: fish #7 & #12
Frame no: 10

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/14	TIME: 14:10-14:40	INITIALS: MG	FISH SOURCE: Sask. Fisheries	TREATMENT: 1% TID	TANK: 5
					EXPOSURE PERIOD: 28 days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	90	6.1	0.84	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.24	0.289	77	0.10								
2	85	5.7	0.93	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.17	0.266	77	0.11								
3	100	7.7	0.77	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.53	0.371	76	0.14								
4	95	6.6	0.77	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.21	0.295	76	0.13								
5	95	6.6	0.77	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.31	0.307	77	0.08								
6	95	6.2	0.72	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.14	0.277	76	0.13								
7	95	6.8	0.79	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.25	0.304	76	0.18								
8	95	6.0	0.7	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.15	0.277	76	0.11								
9	95	7.2	0.84	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.43	0.336	77	0.14								
10	90	6.1	0.84	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.24	0.290	77	0.15								

Comments

Livers not divided - #1, #2, #5

Livers very red/some pale

Frames 11-15

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

WRITTEN BY MG ON 95/08/28

* REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/13	TIME: 19:30-20:15	INITIALS: MG	FISH SOURCE: Sask. Fisheries	TREATMENT: 10% TID	TANK: 6
					EXPOSURE PERIOD: 28 days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	100	8.9	0.89	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.17	0.453	79	0.18								
2	100	7.7	0.77	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.5	0.295	80	0.15								
3	85	3.6	0.59	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	0.728	0.135	81	0.06								
4	90	4.1	0.56	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	0.785	0.159	80	0.09								
5	90	5.3	0.73	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.22	0.254	79	0.09								
6	90	5.7	0.78	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.29	0.249	81	0.15								
7	105	8.7	0.75	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.2	0.477	78	0.12								
8	90	5	0.69	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.2	0.237	80	0.09								
9	105	9.4	0.81	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.17	0.464	79	0.16								
10	100	8.7	0.87	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.13	0.457	79	0.18								
11	85	5.5	0.9	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.32	0.274	79	0.11								

Comments

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	**OPERCULA (shortening)**	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male, F, female
E1/E2, exopthalmia	F, frayed	S, swollen	**HIND GUT (inflammation)**	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	**FINS (erosion)**	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

WRITTEN BY MG ON 95/08/28

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/22	TIME: 16:00	INITIALS: MG	FISH SOURCE: Sask. Fisheries	TREATMENT: NAP	TANK: 7
					EXPOSURE PERIOD: 28 Days

				NECROPSY (see below for explanation of codes)														OTHER DATA											
				EXTERNAL				INTERNAL																					
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (mg)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL0	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	90	4.2	0.58	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	0.813	0.166	80	0.07								
2	95	6.0	0.70	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.16	0.249	79	0.08								
3	95	6.8	0.79	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.26	0.293	77	0.17								
4	100	7.6	0.76	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.32	0.472	80	0.16								
5	110	12.0	0.90	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.38	0.55	77	0.19								
6	110	11.0	0.83	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.32	0.45	80	0.19								
7	100	7.1	0.71	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.53	0.285	81	0.13								
8	90	7.0	0.96	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.57	0.342	78	0.19								
9	90	4.9	0.67	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	0.892	0.185	79	0.18								
10	95	6.8	0.79	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.54	0.345	78	0.15								
11	105	9.4	0.81	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.19	0.478	78	0.16								
12	95	7.2	0.84	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.53	0.317	79	0.15								
13	100	8.3	0.83	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.96	0.437	78	0.16								

Comments: fish # 11 - liver is cream colour

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/14	TIME: 14:40 - 15:30	INITIALS: MG	FISH SOURCE: Sask. Fisheries	TREATMENT: BNF	TANK: 8
					EXPOSURE PERIOD: 28 days

				NECROPSY (see below for explanation of codes)														INTERNAL											
				EXTERNAL																									
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	90	6.7	0.92	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.28	0.306	76	0.18								
2	100	8.3	0.83	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.01	0.475	76	0.15								
3	100	7.9	0.79	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.46	0.347	76	0.16								
4	95	7.0	0.82	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.36	0.314	77	0.15								
5	100	7.6	0.76	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.53	0.366	76	0.17								
6	105	9.7	0.84	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.00	0.472	76	0.23								
7	95	6.7	0.78	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.50	0.344	77	0.16								
8	90	6.2	0.85	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.23	0.280	77	0.15								
9	100	8.7	0.87	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.00	0.470	77	0.19								
10	100	7.8	0.78	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.86	0.416	78	0.18								
11	90	5.7	0.78	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.47	0.326	78	0.13								
12	100	8.8	0.88	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.77	0.410	77	0.17								

Comments: All livers were red with yellow lobes. Evidence of hemoraging.

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	F, general discoloration		F, full
						OT, other		

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/13	TIME: 15:50-17:10	INITIALS: MG	FISH SOURCE: Rocky Mountain Seafoods	TREATMENT: Athabasca River	TANK: 9
					EXPOSURE PERIOD: 28 days

				NECROPSY (see below for explanation of codes)														OTHER DATA														
				EXTERNAL				INTERNAL																									
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g) A	wet weight (g) B	dry weight (g) A	dry weight (g) B	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)	
1	205	90	1.04	0	0	N	N	F(I)	N	0	1	B	0	E	N	A	3	3.0	2.4	0.77	0.63	74	1.2	0.5	43	1	12.2	37	65	8.1	6	
2	200	90	1.13	0	0	N	N	M(I)	1	0	1	B	0	E	N	A	3	2.6	1.7	0.70	0.48	73	1.1	1.6	37	>1	8.1	15	83	7.4	8	
3	155	40	1.07	0	1	N	N	M(I)	N	0	1	B	0	E	N	A	2	1.5	0.4	0.36	0.12	73	0.4	0.7	40	>1	8.1	47	115	5.6	6	
4	190	70	1.02	0	0	N	N	M(I)	N	0	2	B	0	E	M	A	3	1.8	1.6	0.47	0.43	74	0.7	1.2	33	1	8.1	41	95	6.8	5	
5	185	70	1.11	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	2	1.9	1.4	0.49	0.38	74	0.7	1.0	40	<1	10.5	62	105	6.2	4	
6	170	55	1.12	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	1	1.4	0.9	0.38	0.26	72	0.6	0.8	33	<1	7.3	70	135	6.2	3	
7	215	120	1.21	0	0	N	N	M(I)	N	0	2	B	0	E	N	A	3	1.6	2.3	0.44	0.63	73	1.2	1.7	37	<1	10.5	87	140	6.4	3	
8	165	50	1.11	0	1	N	N	M(I)	N	0	2	B	0	E	N	A	3	1.5	1.3	0.39	0.35	74	0.5	0.8	38	<1	8.9	115	150	8.6	4	
9	175	55	1.03	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	1	1.8	1.2	0.47	0.31	74	0.5	0.6	42	1	11.4	101	155	8.3	7	
10	185	60	0.95	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	1	2.3	1.4	0.57	0.38	74	1.0	0.7	40	>1	9.7	114	185	7.9	1	
11	215	115	1.16	0	0	N	N	M(I)	N	0	2	B	0	E	N	A	1	1.8	1.6	0.51	0.44	74	1.1	2.0	40	1	13.8	72	115	6.2	3	

Comments

Fish #2 - photo of swollen psudobranch — Livers in compartment 5B

Fish #3 - no formalic sample taken of liver because too small

Fishe #10 - liver rinsed in KCL - ruptured gall blatter

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

WRITTEN BY MG ON 95/08/28

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/11	TIME: 0800	INITIALS: SG	FISH SOURCE: Rocky Mtn. Seafoods	TREATMENT: Controls	TANK: 10
					EXPOSURE PERIOD: 26 Days

				NECROPSY (see below for explanation of codes)														OTHER DATA													
				EXTERNAL				INTERNAL																							
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	wet weight (g)	dry weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	148	100	3.1	0	0	N	N	IM	N	0	2	B	0	E	N	A	3	1.350	0.677	0.353	0.201	72	1.4	0.5	55	<1	17.0	95	65	9.9	0
2	200	110	1.4	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.510	0.801	0.417	0.238	71	0.9	0.5	50	<1	ND	65	80	8.5	1
3	205	110	1.3	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.080	1.390	0.552	0.378	73	1.2	0.5	39	>1	14.6	100	130	7.0	1
4	195	85	1.2	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	2.170	0.972	0.581	0.284	72	0.9	1.0	38	>1	8.9	65	140	8.1	0
5	170	55	1.1	0	0	N	N	IM	N	0	2	B	0	E	N	A	3	0.661	0.431	0.183	0.128	72	0.4	0.8	31	>1	9.7	54	130	5.1	1
6	200	85	1.1	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	0.905	0.673	0.254	0.194	72	0.8	1.0	42	>1	8.9	78	170	9.9	0
7	235	150	1.2	0	0	N	N	IM	N	0	2	B	0	E	N	A	3	1.500	1.030	0.429	0.294	71	2.0	2.0	32	1	10.5	33	225	6.1	1
8	205	110	1.3	0	0	N	N	IM	N	0	1	B	0	E	N	A	3	1.930	1.250	0.520	0.349	73	1.0	1.0	37	>1	13.8	69	60	8.1	0
9	220	125	1.2	0	0	N	N	IM	N	0	2	B	0	E	N	A	3	1.910	1.330	0.568	0.415	70	1.4	1.7	39	<1	15.4	32	150	10.1	0
10	230	150	1.2	0	0	N	N	IM	N	0	2	B	0	E	N	A	2	1.880	1.160	0.537	0.386	69	2.0	2.0	39	<1	13.0	31	235	8.7	1

Comments

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

WRITTEN BY MG ON 95/08/28

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/05	TIME: 10:00	INITIALS: SG/TB	FISH SOURCE: Rocky Mtn. Seafoods	TREATMENT: 0.01% TID	TANK: 11
					EXPOSURE PERIOD: 20 days

				NECROPSY (see below for explanation of codes)													OTHER DATA												
				EXTERNAL				INTERNAL																						
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	wet weight (g)	dry weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	185	50	0.79															1.19	0.385	0.313	0.109	73									
2	205	90	1.04															1.75	0.705	0.473	0.202	72									
3	205	90	1.04															1.52	0.416	0.420	0.122	72									
4	200	90	1.13															1.89	1.310	0.531	0.373	72									
5	220	110	1.03															2.54	1.210	0.655	0.339	73									
6	240	180	1.30															2.79	0.868	0.767	0.26	72									
7	205	100	1.16															1.85	0.980	0.471	0.262	74									
8	220	130	1.22															1.49	1.270	0.440	0.356	71									
9	200	70	0.88															1.71	0.617	0.445	0.176	73									
																		1.12	0.774	0.332	0.236	70									
																		1.20	0.675	0.369	0.214	69									
																		1.11	1.110	0.441	0.323	72									

Comments

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male, F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

WRITTEN BY MG ON 95/08/28

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/13	TIME: 13:23-14:20	INITIALS: MG	FISH SOURCE: Rocky Mountain Seafoods	TREATMENT: 0.1% TID	TANK: 12
					EXPOSURE PERIOD: 28 Days

				NECROPSY (see below for explanation of codes)														OTHER DATA													
				EXTERNAL				INTERNAL																							
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g) A	wet weight (g) B	dry weight (g) A	dry weight (g) B	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	200	85	1.06	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	2	1.91	1.84	0.50	0.48	74	1.3	1.5	27	1	10.5	7	325	6.8	3
2	215	115	1.16	0	0	N	N	M(I)	N	0	2	B	0	E	N	A	2	2.31	2.43	0.60	0.63	74	1.8	1.2	34	1	9.7	32	105	8.1	1
3	185	70	1.11	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	0	1.69	1.06	0.43	0.28	75	0.7	0.7	39	1	7.3	31	125	7.4	8
4	200	95	1.19	0	0	N	N	M(I)	N	0	2	B	0	E	N	A	2	2.67	1.74	0.69	0.43	75	1.4	1.5	35	>1	8.9	37	115	8.3	6
5	220	120	1.13	0	0	N	N	M(I)	N	0	2	B	0	E	N	A	2	2.96	2.12	0.79	0.56	74	2.2	0.7	36	1	8.1	21	105	6.2	5
6	205	95	1.10	0	0	N	N	M(I)	N	0	2	B	0	E	N	A/B	2	2.32	2.26	0.57	0.56	75	1.4	1.5	37	>1	5.7	50	110	8.1	5
7	200	85	1.06	0	0	N	N	M(I)	N	0	2	B	0	E	N	B	2	2.18	1.86	0.57	0.49	74	1.4	1.4	37	<1	21.1	47	215	8.3	2
8	205	90	1.04	0	0	N	N	M(I)	N	0	2	B	0	E	N	A	2	2.81	1.65	0.70	0.41	75	1.2	1.3	43	<1	10.5	78	175	9.4	2
9	150	30	0.89	0	0	N	N	M(I)	N	0	1	B	0	E	N	B	2	0.79	0.52	0.20	0.14	74	0.6	0.6	32	1	6.5	78	105	7.4	3
10	180	60	1.03	0	1	N	N	M(I)	N	0	1	R	0	E	N	A	0	1.94	1.24	0.47	0.31	76	0.9	0.9	41	<1	7.3	73	173	14.1	2

Comments

Livers stored in compartment 3A	Liver # 8 washed in KCL due to burst gall bladder
Fish #3 - some haemoraging in pseudobranch due to blow to the head	Fish #9 too small for liver sample to be taken for preservation
Photo taken of liver 6 (fish 6)	

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	**OPERCULA (shortening)**	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	**HIND GUT (inflammation)**	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	**FINS (erosion)**	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

WRITTEN BY MG ON 95/08/28 | REVISED BY SG ON 95/09/13 | FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/11	TIME: 0900	INITIALS: SG, MG	FISH SOURCE: Rocky Mountain Seafoods	TREATMENT: 1% TID	TANK: 13
					EXPOSURE PERIOD: 28 Days

				NECROPSY (see below for explanation of codes)														OTHER DATA															
				EXTERNAL				INTERNAL																											
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	wet weight (g)	dry weight (g)	dry weight (g)	moisture (%)	liver weight (mg)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)				
																		A	B	A	B													
1	205	120	1.39																															
2	190	60	0.87	0	0	N	N	M(I)	N	0	1	B	0	E	U	A	3	0.90	1.55	0.265	0.424	72	0.9	0.9	29	1	7.3	40	120	6.5	1				
3	235	140	1.08	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	3	2.90	1.89	0.785	0.524	73	1.4	0.9	40	<1	13.8	56	90	8.6	0				
4	180	55	0.94	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	3	1.52	1.07	0.369	0.294	74	0.9	0.8	40	>1	15.4	54	170	8.3	1				
5	215	105	1.06	0	0	N	N	M(I)	I	0	1	B	0	E	N	A	3	1.68	1.28	0.451	0.355	73	1.2	1.5	39	<1	6.5	40	100	11.4	1				
6	190	70	1.02	0	0	N	N	M(I)	S	0	1	B	0	E	N	A	3	1.59	1.75	0.415	0.476	74	0.8	0.8	39	<1	12.2	56	95	8.5	0				
7	200	85	1.06	0	0	N	N	M(I)	N	0	2	B	0	E	N	A	3	1.88	2.41	0.470	0.647	74	1.0	1.0	38	<1	10.5	54	160	9.4	1				
8	215	110	1.11	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	2	3.12	2.73	0.790	0.703	74	1.3	1.2	39	<1	10.5	54	70	9.9	0				
9	205	80	0.93	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	3	3.46	2.02	0.848	0.511	75	1.1	1.3	39	<1	11.3	39	95	8.5	0				
10	180	55	0.94	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	3	2.06	0.97	0.513	0.241	75	0.6	0.8	36	<1	9.7	56	115	8.5	0				
11	200	80	1.0	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	3	2.10	1.75	0.535	0.407	75	1.1	1.2	34	<1	13	52	95	6.6	1				
12	155	35	0.94	0	1	N	N	M(I)	N	0	1	B	0	E	N	A	3	1.13	0.53	0.272	0.129	76	0.4	0.5	40	<1	13.8	72	125	16.2	2				

Comments

Fish #9 - liver rinsed in 10% KCL

Livers - Compartment 28

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male, F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

WRITTEN BY MG ON 95/08/28

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/13	TIME: 14:30	INITIALS: MG	FISH SOURCE: Rocky Mountain Seafood	TREATMENT: 10% TID	TANK: 14
					EXPOSURE PERIOD: 28 days

				NECROPSY (see below for explanation of codes)														OTHER DATA													
				EXTERNAL				INTERNAL																								
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	wet weight (g)	dry weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	220	120	1.13	0	0	N	N	M(I)	N	0	1	B	0	E	N	B	2	2.10	1.58	0.498	0.384	76	1.9	2.0	25	<1	10.5	6	60	5.9	4
2	165	50	1.11	0	0	N	N	M(I)	N	0	2	B	0	E	N	A	2	1.30	0.88	0.306	0.220	76	0.9	0.7	23	1.0	1.6	8	70	4.6	7
3	195	90	1.21	0	0	N	N	M(I)	N	0	2	B	0	E	N	A	1	1.67	1.65	0.441	0.422	74	1.3	1.4	26	1.0	8.9	8	60	5.7	7
4	190	65	0.95	0	0	N	OT	M(I)	N	0	1	B	0	E	N	B	2	1.65	0.94	0.403	0.240	75	1.3	1.2	26	1.0	4.9	18	85	5.5	4
5	165	45	1.0	0	0	N	N	M(I)	N	0	1	B	0	E	M	C	1	1.35	0.74	0.321	0.183	76	0.9	0.9	23	<1	4.1	24	60	4.4	1
6	190	90	1.31	0	1	N	N	M(I)	N	0	1	B	0	E	N	B	1	2.36	1.94	0.555	0.425	77	1.4	1.0	27	>1	4.9	32	50	6.8	8
7	190	60	0.87	0	0	N	N	M(I)	I	0	2	B	0	E	N	A	1	1.77	1.33	0.427	0.340	76	0.6	0.8	28	1.0	7.3	12	70	7.2	3
8	220	110	1.03	0	0	N	N	M(I)	N	0	2	B	0	E	N	A	1	3.23	2.33	0.826	0.630	74	2.0	2.0	30	<1	0.0	68	115	7.7	4
9	195	80	1.08	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	1	2.54	1.61	0.623	0.408	75	1.3	1.2	38	1.0	7.3	82	90	7.2	4
10	200	100	1.25	0	0	N	N	M(I)	N	0	1	B	0	E	M	A	1	3.24	1.97	0.787	0.506	76	1.7	1.5	29	>1	9.7	46	95	7.4	5
11	205	90	1.04	0	0	N	N	M(I)	N	0	1	B	0	E	M	A	3	2.15	1.93	0.555	0.510	74	1.0	1.6	34	<1	11.8	52	75	7.1	4

Comments: Fish #6 - gall bladder burst; liver washed in KCl

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

WRITTEN BY MG ON 95/08/28

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/22	TIME: 13:45	INITIALS: MG	FISH SOURCE: Rocky Mtn. Seafoods	TREATMENT: NAP	TANK: 15
					EXPOSURE PERIOD: 28 Days

				NECROPSY (see below for explanation of codes)														OTHER DATA													
				EXTERNAL				INTERNAL																							
SAMPLE ID	length (mm)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	wet weight (g)	dry weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	160	35	0.85	0	0	N	N	M(I)	N	0	1	R	0	F	M	A	0	0.626	0.902	0.148	0.198	77	1.0	1.0	30	>1	16.9	15	65	6.2	5.0
2	140	20	0.72	0	0	N	N	M(I)	N	0	1	B	0	F	M	A	0	0.397	0.285	0.091	0.060	78	0.7	0.5	29	>1	45.0	20	81	5.0	3.0
3	200	80	1	0	1(L)	N	N	M(I)	N	0	2	B	0	F	M	A	0	1.120	0.814	0.285	0.206	75	1.8	1.2	28	>1	46.0	18	81	5.3	3.0
4	175	40	0.75	0	1(R)	N	N	M(I)	N	0	1	B	0	F	M	A	1	0.417	0.824	0.109	0.214	74	1.1	1.2	27	<1	72.0	16	108	5.6	3.0
5	190	70	1.0	0	0	N	N	M(I)	N	0	1	B	0	F	N	A	1	1.360	1.220	0.340	0.307	75	1.7	1.5	28	>1	70.0	17	65	5.6	3.0
6	165	35	0.78	0	1(R)	N	N	I	N	0	1	R	0	F	N	A	0	0.763	0.654	0.185	0.168	75	0.7	0.8	28	>1	60.0	22	77	5.0	3.0
7	160	25	0.61	0	0	N	N	I	N	0	1	R	0	F	N	A	0	0.734	0.809	0.159	0.183	78	0.9	<0.5	34	<1	16.0	59	87	6.4	1.0
8	200	70	0.88	0	0	N	N	F(I)	N	0	1	B	0	F	N	A	1	1.330	1.140	0.337	0.278	76	1.2	1.7	29	<1	12.0	6	81	6.0	3.0
9	250	125	0.8	0	0	N	N	M(I)	N	0	1	B	0	F	N	A	1	1.040	1.700	0.282	0.439	74	2.2	1.7	31	<1	7.5	28	110	6.1	2.0
10	170	40	0.81	0	1(L)	N	N	I	I	0	1	R	0	F	M	A	0	0.556	0.696	0.123	0.158	78	0.9	0.6	28	>1	25.3	36	85	5.6	2.0
11	205	75	0.87	0	0	N	N	M(I)	N	0	2	B	0	E	N	C	1	0.821	1.160	0.196	0.316	75	1.9	1.5	30	1	32.0	54	93	6.2	3.0
12	130	10	0.45																				0.2								
13	115	10	0.66																				0.3								

Comments: Fish #6 - gall bladder burst; liver washed in KCl

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male, F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflammed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

WRITTEN BY MG ON 95/08/23

REVISED BY SG ON 95/09/13

FILE: FORM035.XLS

HYDROQUAL LABORATORIES LTD. - DATA SUMMARY SHEET

DATE: 95/11/13	TIME: 17:20	INITIALS: MG	FISH SOURCE: Rocky Mtn. Seafoods	TREATMENT: BNF	TANK: 16
					EXPOSURE PERIOD: 28 Days

				NECROPSY (see below for explanation of codes)														OTHER DATA													
				EXTERNAL				INTERNAL																							
SAMPLE ID	length (m)	weight (g)	body condition	fin	operculum	eye	gill	sex (M, F, I)	pseudobranch	thymus	fat	spleen	gut	stomach	kidney	liver	bile	wet weight (g)	wet weight (g)	dry weight (g)	dry weight (g)	moisture (%)	liver weight (g)	blood volume (mL)	hematocrit (%)	leucocrit (%)	protein (mg/dL)	lactic acid (mg/dL)	glucose (mg/dL)	hemoglobin (mg/dL)	white blood cells (%)
1	190	80	1.17	0	0	N	N	M(I)	N	0	2	B	0	E	N	C	1	1.86	1.93	0.485	0.492	75	1.4	1.1	32	>1	8.9	30	70	8.3	3
2	220	130	1.22	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	1	2.53	2.46	0.654	0.653	74	1.6	2	37	<1	10.5	18	65	8.8	1
3	185	80	1.26	0	0	N	N	M(I)	N	0	1	B	0	E	N	A	1	2.59	1.44	0.595	0.387	75	1.3	1.2	34	1	11.4	30	65	7.0	2
4	170	60	1.22	0	0	N	N	M(I)	N	0	1	B	0	E	N	B	1	1.79	1.42	0.415	0.34	77	0.7	0.7	47	<1	6.5	34	80	5.5	3
5	210	110	1.19	0	0	N	N	M(I)	N	0	2	B	0	E	N	B	1	3.07	2.89	0.752	0.693	76	2.1	1.5	34	<1	9.7	34	75	7.0	1
6	225	130	1.14	0	0	N	N	M(I)	N	0	2	B	0	E	N	C	1	2.63	1.93	0.693	0.522	74	1.9	2	30	<1	8.1	42	75	7.4	2
7	205	90	1.04	0	0	N	N	M(I)	N	0	1	B	0	E	N	B	1	1.9	1.6	0.477	0.413	75	1.4	1.2	35	<1	9.7	56	80	7.5	1
8	200	95	1.19	0	0	N	N	M(I)	N	0	1	B	0	E	N	C	1	2.12	2.1	0.519	0.527	76	1.6	1.5	31	<1	8.1	68	105	6.2	1
9	210	115	1.24	0	0	N	N	M(I)	N	0	2	B	0	E	N	B	1	2.47	2.33	0.609	0.603	75	2.2	1.5	33	<1	9.7	76	85	7.0	1
10	195	90	1.21	0	0	N	N	M(I)	N	0	1	B	0	E	N	B	1	2.49	1.83	0.645	0.474	74	1.1	0.6	40	<1	14.6	52	110	9.0	2
11	185	70	1.11	0	0	N	N	M(I)	N	0	1	B	0	E	N	B	1	2.18	1.3	0.549	0.341	75	1.2	1.2	29	<1	9.3	92	123	9.1	1

Comments

Fish #2 - evidence of bleeding in Pectoral and dorsal fins and tail fin

most fish in BNF - mild hemorrhaging around anal vent

Livers in compartment 1B

EYES	GILLS	PSEUDOBRANCH	THYMUS (hemorrhage)	MESENTARY FAT	SPLEEN	KIDNEY	LIVER	BILE	SEX
N, normal	N, normal	N, normal	OPERCULA (shortening)	0, none	B, black	N, normal	A, red	0, yellow empty bladder	M, male; F, female
E1/E2, exopthalmia	F, frayed	S, swollen	HIND GUT (inflammation)	1, <50%	R, red	S, swollen	B, light red	1, yellow full bladder	I, immature
H1/H2, hemorrhagic	C, clubbed	L, lithic	FINS (erosion)	2, 50%	G, granular	M, mottled	C, cream (fatty)	2, light green	
B1/B2, blind	M, marginate	I, inflamed	0, none	3, >50%	NO, nodular	G, granular	D, nodules	3, dark green	Stomach
M1/M2, missing	P, pale	OT, other	1, mild	4, 100%	E, enlarged	U, urolithic	E, focal discoloration		E, empty
OT, other	OT, other		2, severe		OT, other	OT, other	F, general discoloration		F, full
							OT, other		

Necropsy summary data sheets

Table 2.1 Fish Length (mm) Data Summary for Walleye in the Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	86	2	85	89	97	6	90	105
Tar Island Dyke (%)								
0.01	-	-	-	-	95	4	90	100
0.1	79	7	75	87	97	6	85	110
1.0	82	8	74	90	94	4	85	100
10	80	8	72	88	95	8	85	105
Athabasca River	84	1	84	85	104	9	90	120
naphthenic acids (1 mg/L)	83	6	76	88	98	7	90	110
β-naphthoflavone (10 μg/L)	-	-	-	-	97	5	90	105

NOTE: Missing values were not done or included in the test design

Table 2.2 Fish Weight (g), Data Summary for Walleye in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	5.7	1.0	5.0	7.07	7.7	1.4	6.2	10.5
Tar Island Dyke (%)								
0.01	-	-	-	-	7.2	1.3	4.9	9.1
0.1	4.1	1.6	2.9	5.9	7.6	1.3	4.9	10.6
1.0	4.6	1.7	3.0	6.4	6.5	0.6	5.7	7.7
10	3.8	1.2	2.5	4.8	6.6	2.1	3.6	9.4
Athabasca River	4.6	0.2	4.4	4.8	9.8	2.0	6.5	12.2
naphthenic acids (1 mg/L)	4.8	1.1	3.7	5.8	7.6	2.2	4.2	12.0
β-naphthoflavone (10 μg/L)	-	-	-	-	7.6	1.2	5.7	9.7

NOTE: Missing values were not done or included in the test design

Table 2.3 Body Condition Data Summary for Walleye in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	0.9	0.1	0.8	1.0	0.8	0.1	0.7	0.9
Tar Island Dyke (%)								
0.01	-	-	-	-	0.8	0.1	0.7	1.0
0.1	0.8	0.1	0.7	0.9	0.8	0.1	0.7	1.0
1.0	0.8	0.1	0.7	0.9	0.8	0.1	0.7	0.9
10	0.7	0.1	0.7	0.8	0.8	0.1	0.6	0.9
Athabasca River	0.8	0.1	0.7	0.8	0.9	0.1	0.7	0.9
naphthenic acids (1 mg/L)	0.8	0.1	0.8	0.9	0.8	0.1	0.6	1.0
β-naphthoflavone (10 μg/L)	-	-	-	-	0.8	0.1	0.8	0.9

NOTE: Missing values were not done or included in the test design

Table 2.4 Liver Weight (g), Data Summary for Walleye in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	0.06	0.01	0.05	0.07	0.17	0.06	0.06	0.31
Tar Island Dyke (%)								
0.01	-	-	-	-	0.16	0.03	0.10	0.22
0.1	0.07	0.05	0.02	0.11	0.15	0.04	0.11	0.26
1.0	0.07	0.04	0.04	0.11	0.13	0.03	0.08	0.18
10	0.05	0.02	0.03	0.07	0.13	0.04	0.06	0.18
Athabasca River	0.06	0.01	0.05	0.08	0.15	0.03	0.09	0.19
naphthenic acids (1 mg/L)	0.08	0.03	0.05	0.10	0.15	0.04	0.07	0.19
β-naphthoflavone (10 μg/L)	-	-	-	-	0.17	0.03	0.15	0.23

NOTE: Missing values were not done or included in the test design

Table 2.5 Percent Moisture, Data Summary for Walleye in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	78	0.6	78	79	78	0.3	78	79
Tar Island Dyke (%)								
0.01	-	-	-	-	78	0.5	78	79
0.1	78	0.7	77	79	78	0.5	77	78
1.0	78	0.8	77	79	77	0.5	76	77
10	78	0.3	78	79	80	0.9	78	81
Athabasca River	78	0.4	78	79	78	0.8	76	79
naphthenic acids (1 mg/L)	78	1.0	77	79	79	1.2	77	81
β-naphthoflavone (10 μg/L)	-	-	-	-	77	0.8	76	78

NOTE: Missing values were not done or included in the test design

Table 2.6 Fish Length (mm), Data Summary for Trout in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	167	22	133	203	201	26	148	235
Tar Island Dyke (%)								
0.01	-	-	-	-	209	16	185	240
0.1	187	18	163	220	196	20	150	220
1.0	171	23	120	210	198	21	155	235
10	173	13	155	190	194	18	165	220
50% TID	169	28	141	196	-	-	-	-
Athabasca River	188	11	167	199	187	20	155	215
naphthenic acids (1 mg/L)	172	16	135	195	183	30	160	250
β-naphthoflavone (10 μg/L)	170	19	133	193	200	17	170	225

NOTE: Missing values were not done or included in the test design

Table 2.7 Fish Weight (g), Data Summary for Trout in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	64	25	29	110	108	29	55	150
Tar Island Dyke (%)								
0.01	-	-	-	-	101	37	50	180
0.1	80	23	49	128	85	26	30	120
1.0	61	25	19	115	83	31	35	140
10	64	13	44	81	82	24	45	120
50% TID	66	22	45	86	-	-	-	-
Athabasca River	81	14	55	96	74	26	40	120
naphthenic acids (1 mg/L)	66	18	31	96	56	31	20	125
β-naphthoflavone (10 μg/L)	67	19	26	88	96	23	60	130

NOTE: Missing values were not done or included in the test design

Table 2.8 Body Condition Data Summary for Trout in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	1.4	0.5	1.1	2.6	1.4	0.6	1.1	3.1
Tar Island Dyke (%)								
0.01	-	-	-	-	1.1	0.2	0.03	1.3
0.1	1.2	0.1	1.0	1.4	1.1	0.1	1.0	1.2
1.0	1.2	0.2	1.0	1.6	1.0	0.1	0.9	1.4
10	1.2	0.1	1.0	1.4	1.1	0.1	1.0	1.3
50% TID	1.4	0.3	1.1	1.8	-	-	-	-
Athabasca River	1.2	0.1	1.1	1.4	1.1	0.1	1.0	1.2
naphthenic acids (1 mg/L)	1.3	0.1	1.1	1.5	0.8	0.1	0.6	1.0
β-naphthoflavone (10 µg/L)	1.3	0.3	1.1	1.9	1.2	0.1	1.0	1.3

NOTE: Missing values were not done or included in the test design

Table 2.9 Percent Moisture, Data Summary for Trout in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	-	-	-	-	72	1.3	69	73
Tar Island Dyke (%)								
0.01	-	-	-	-	72	1.4	69	74
0.1	-	-	-	-	75	0.7	74	76
1.0	-	-	-	-	74	1.1	72	76
10	-	-	-	-	75	1.0	74	77
50% TID	-	-	-	-	-	-	-	-
Athabasca River	-	-	-	-	74	0.7	72	74
naphthenic acids (1 mg/L)	-	-	-	-	76	1.6	74	78
β-naphthoflavone (10 μg/L)	-	-	-	-	75	0.1	74	77

NOTE: Missing values were not done or included in the test design

Table 2.10 Liver Weight (g), Data Summary for Trout in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	1.0	0.4	0.2	1.5	1.2	0.5	0.9	1.4
Tar Island Dyke (%)								
0.01	-	-	-	-	-	-	-	-
0.1	0.9	0.5	0.3	1.5	1.3	0.5	0.6	2.2
1.0	0.7	0.4	0.2	1.3	1.0	0.3	0.4	1.4
10	0.6	0.2	0.3	1.1	1.3	0.4	0.6	1.9
50% TID	0.7	0.3	0.4	1.0	-	-	-	-
Athabasca River	1.0	0.3	0.5	1.4	0.8	0.3	0.4	1.2
naphthenic acids (1 mg/L)	0.8	0.3	0.4	1.3	1.3	0.5	0.7	2.2
β-naphthoflavone (10 μg/L)	1.0	0.5	0.2	1.5	1.5	0.4	0.7	2.2

NOTE: Missing values were not done or included in the test design

Table 2.11 Plasma Protein Levels (g/dL), Data Summary for Trout in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	5	1	4	7	6	2	4	9
Tar Island Dyke (%)								
0.01	7	2	6	11	-	-	-	-
0.1	7	2	6	11	5	2	3	11
1.0	5	2	3	7	6	1	3	8
10	4	1	2	7	3	2	1	6
50% TID	5	3	3	8	-	-	-	-
Athabasca River	6	2	4	9	5	1	4	7
naphthenic acids (1 mg/L)	7	1	5	10	7	5	2	14
β-naphthoflavone (10 μg/L)	6	2	4	9	5	1	3	7

NOTE: Missing values were not done or included in the test design

Table 2.12 Plasma Lactic Acid Levels (mg/dL), Data Summary for Trout in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	88	35	39	139	62	25	31	235
Tar Island Dyke (%)								
0.01	-	-	-	-	-	-	-	-
0.1	94	18	65	128	45	25	7	78
1.0	92	27	62	131	52	10	40	72
10	73	33	22	132	32	26	6	85
50% TID	141	37	103	186	-	-	-	-
Athabasca River	96	35	37	142	69	33	15	115
naphthenic acids (1 mg/L)	97	30	50	137	27	17	6	59
β-naphthoflavone (10 μg/L)	77	30	39	138	48	23	18	92

NOTE: Missing values were not done or included in the test design

Table 2.13 Plasma Glucose Levels (mg/dL), Data Summary for Trout in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	107	20	84	138	139	61	60	235
Tar Island Dyke (%)								
0.01	-	-	-	-	-	-	-	-
0.1	109	15	92	134	155	71	105	325
1.0	96	12	84	123	112	30	70	170
10	102	18	76	121	76	19	50	115
50% TID	67	15	56	88	-	-	-	-
Athabasca River	97	15	81	134	122	35	65	185
naphthenic acids (1 mg/L)	106	18	84	144	85	15	65	110
β-naphthoflavone (10 μg/L)	116	20	77	138	85	19	65	123

NOTE: Missing values were not done or included in the test design

Table 2.14 Blood Hemoglobin Levels (g/dL), Data Summary for Trout in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	8	1.6	5	10	8	2	5	10
Tar Island Dyke (%)								
0.01	-	-	-	-	-	-	-	-
0.1	10	2.9	4	14	8	2	6	14
1.0	5	2.2	3	10	9	3	7	16
10	7	2.6	3	11	6	1	4	8
50% TID	6	1.8	4	8	-	-	-	-
Athabasca River	9	2.1	6	13	7	1	6	9
naphthenic acids (1 mg/L)	7	0.6	6	8	6	1	5	6
β-naphthoflavone (10 μg/L)	9	2.2	6	12	8	1	6	9

NOTE: Missing values were not done or included in the test design

Table 2.15 Hematocrit Values (%), Data Summary for Trout in Short and Long Term Tests

TREATMENT	7 DAY				28 DAY			
	avg	SD	low	high	avg	SD	low	high
lab control	39	4	30	43	40	7	31	55
Tar Island Dyke (%)								
0.01	-	-	-	-	-	-	-	-
0.1	41	4	36	48	36	5	27	43
1.0	38	5	30	44	38	3	29	40
10	37	5	30	43	28	5	23	38
50% TID	28	7	21	37	-	-	-	-
Athabasca River	39	5	28	46	39	3	33	43
naphthenic acids (1 mg/L)	35	3	30	40	29	2	27	34
β-naphthoflavone (10 μg/L)	33	5	23	39	35	5	29	47

NOTE: Missing values were not done or included in the test design

Liver mixed function oxidases results for 7 and 28 day tests

TO : **Steve Goudey,**
HydroQual

FAX # : **(403) 252 - 9363**
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FROM: **Joanne Parrott,**
National Water Research Institute
FAX # : **(905) 336 - 6430**
PHONE # : **(905) 336 - 4551**

NUMBER OF PAGES INCLUDING THIS ONE : 10

September 18, 1995

Hi Steve,

Hot off the press... the EROD results. Unfortunately I've rarely seen as disappointing a data set! (Though, probably Suncor will not be disappointed!)

I'm puzzled by the finding of high EROD activities in the large trout (internal control fish). Dilution water and Athabasca River water exposed fish (large and small trout and small walleye) had high EROD activities too. In our 4 d tests of unfed small (1-3 g) rainbow trout, control EROD activities in our lab water (dechlorinated, charcoal filtered Burlington city water) are usually about 0.6 to 1 pmol/mg/min.

The positive controls responded within the expected region; we usually see ERODs of 7-15 pmol/mg/min for BNF exposed small rainbow trout (4 d, unfed).

The best dose-response was seen in the large trout, though the absolute activities are lower than the small trout or walleye.

On review of the EROD kinetic data which were used to calculate slopes - my technician found nice smooth slopes that were easy to assess - so I don't think the problem was with the assay.

I'll be in Norman Wells, NWT, doing SPMD stuff 'til the 22nd of September - you can reach me at the Rayuka Inn (403) 587 - 2354 if you have questions regarding the data.

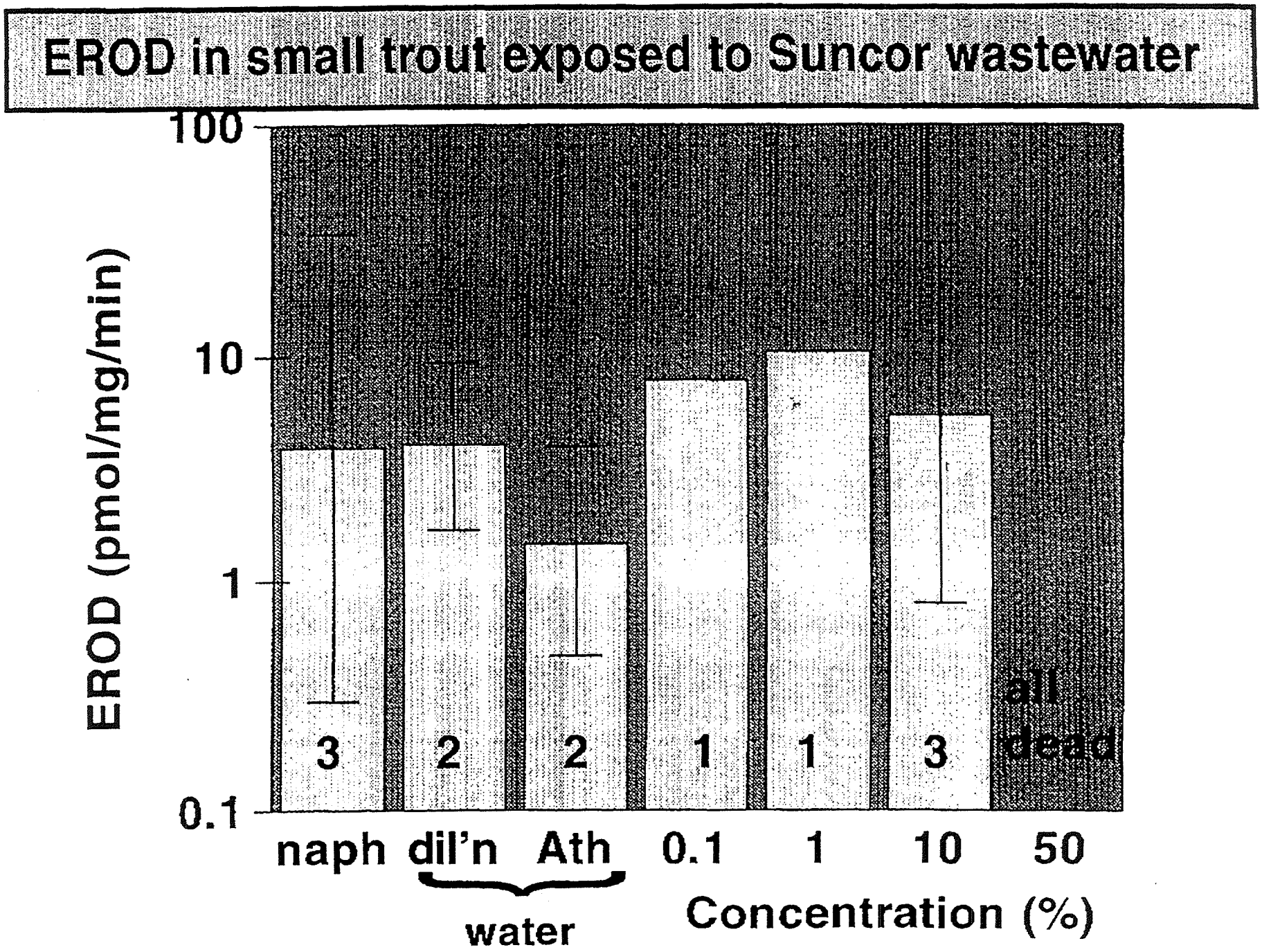
See you at the meeting on the 25th.

Joanne

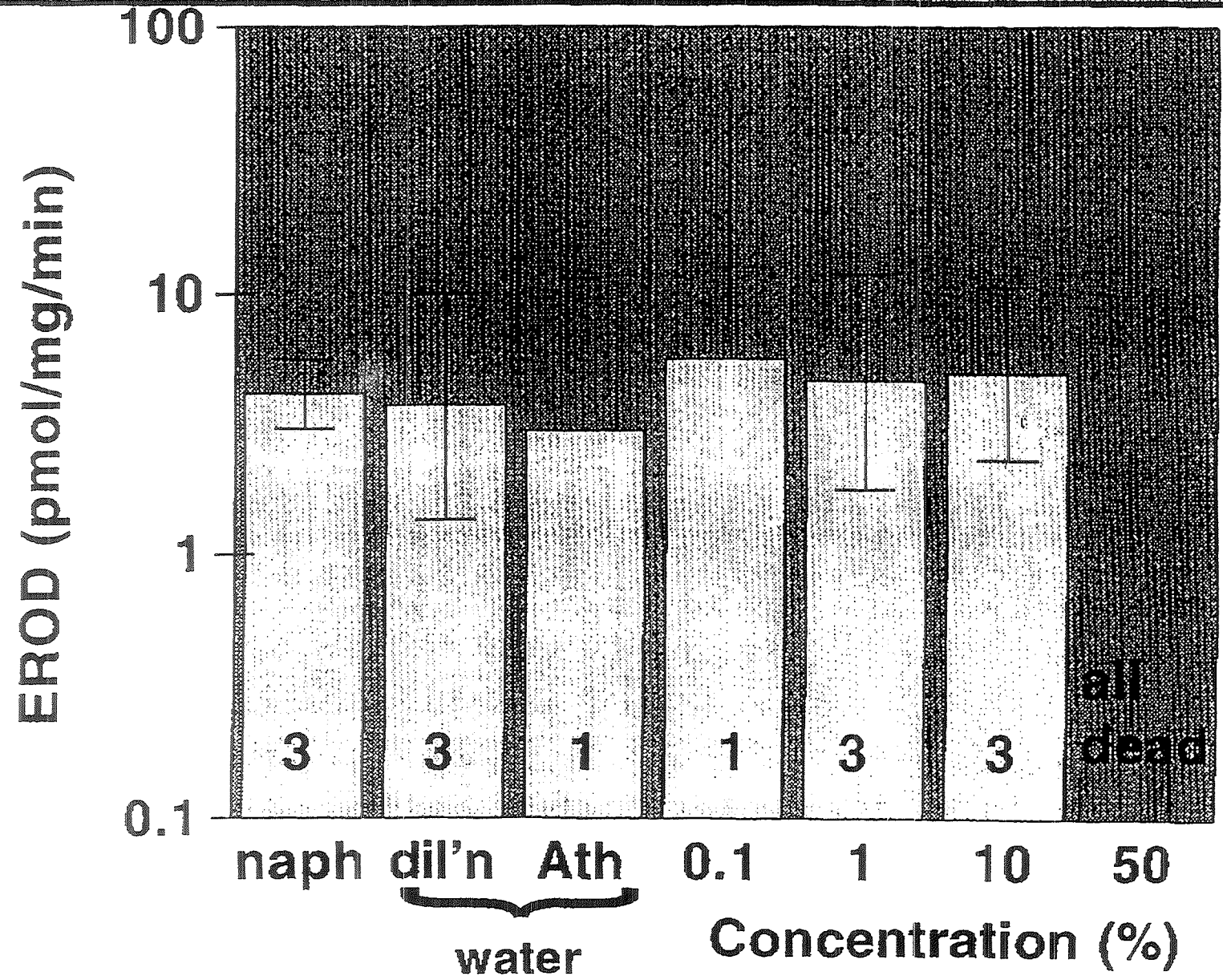
Results ..... Date: 09-16-1995 ... Root: SEP12-95 .... Path: C:\I\SEP12-95\

CALGARY SAMPLES

TREATMENT	MEAN ACTIVITY (pmol/min/mg protein)	N	CONFIDENCE LIMITS LOWER	UPPER
INTERNAL CONTROLS				
L-CTRL	1.30846688	7	0.524633	2.940172
L-BNF	16.1317984	9	8.396097	30.82892
DILUTION WATER				
W-DWAT	3.79046267	3	1.355871	10.03465
S-DWAT	4.08795689	2	1.708349	9.434807
L-DWAT	1.47472139	8	0.944404	2.250787
ATHABASCA RIVER WATER				
W-AR	2.9963608	1	-1	-1
S-AR	1.46860437	2	0.467539	3.970905
L-AR	1.2899558	10	0.756766	2.120284
NAPH				
W-NAPH	4.19909265	3	3.069479	5.718992
S-NAPH	3.92675793	3	0.298888	33.93618
L-NAPH	1.65689044	10	1.102615	2.447016
TAR ISLAND DYKE - WALLEYE				
W-0.1%TID	5.70311618	1	-1	-1
W-1%TID	4.68807243	3	1.768262	11.93927
W-10%TID	5.0049273	3	2.298339	10.64371
TAR ISLAND DYKE - SMALL TROUT				
S-0.1%TID	7.81583288	1	-1	-1
S-1%TID	10.3799951	1	-1	-1
S-10%TID	5.39971237	3	0.800852	31.1301
TAR ISLAND DYKE - LARGE TROUT				
L-0.1%TID	1.87685753	10	1.245453	2.784073
L-1%TID	2.69964639	10	1.789055	4.027108
L-10%TID	3.28874857	10	2.041451	5.230128
L-50%TID	1.80683093	4	0.232606	9.10955
EXTERNAL CONTROLS				
BNFX	21.1554986	1	-1	-1
CTLX	0.845062929	1	-1	-1



EROD in small walleye exposed to Suncor wastewater



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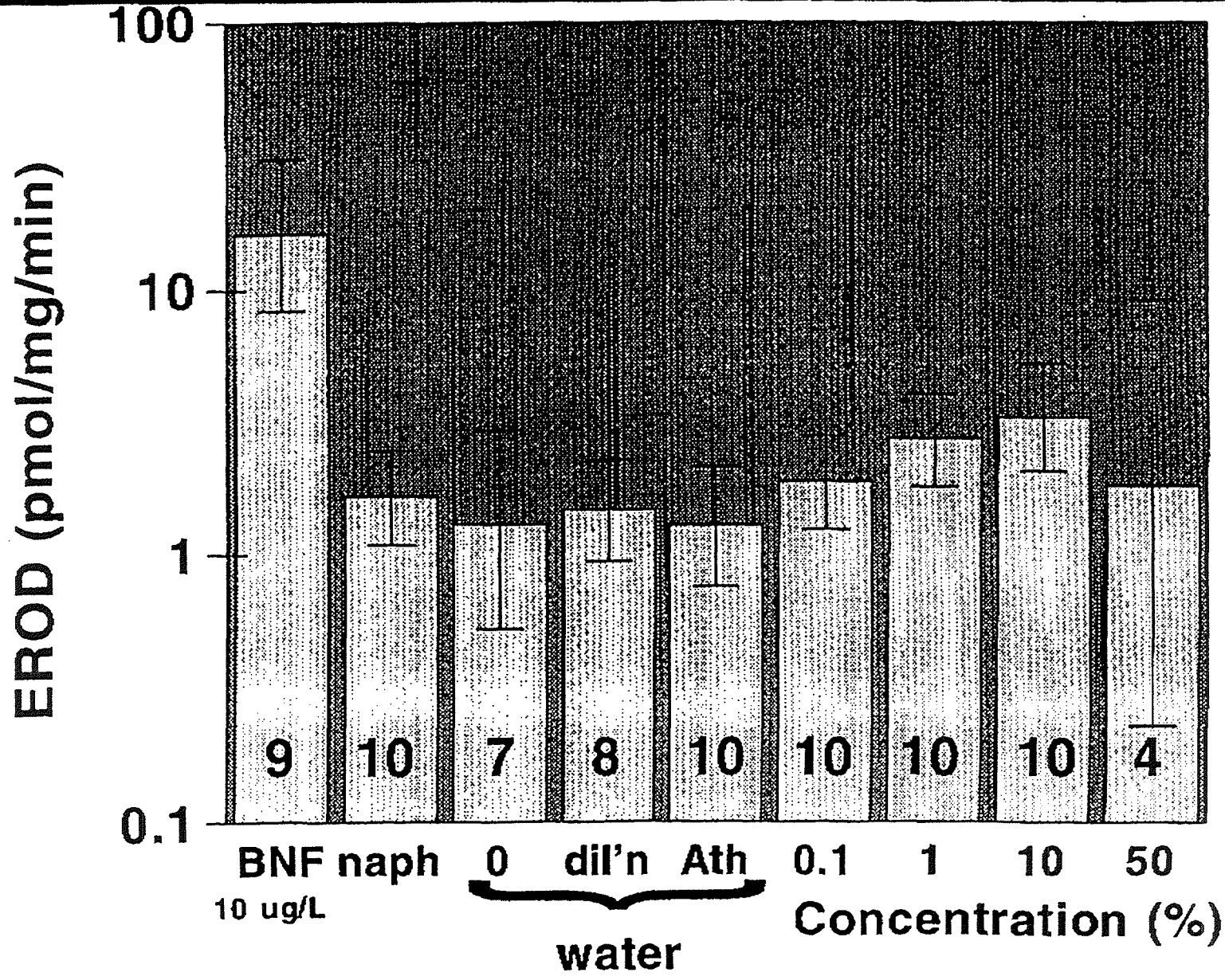
EROD in large trout exposed to Suncor wastewater



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Your Sample ID

geometric mean EROD activity + 95% Ci for mean

EROD activities

[redacted]

Treatment	Conc	Sample	nF	meanF	sdF	nP	meanP	sdP	Activity
L-10%TID	0	73	3	.000087139	.000008526	3	.230207423	.04685904	1.88246374
L-10%TID	0	71	3	.000191602	.000005240	3	.223765692	039644099	3.85691149
L-10%TID	0	72	3	.000311402	.000014056	3	.187262777	.01724763	7.26947377
L-10%TID	0	75	3	.000129160	.000007877	3	.181546011	.01156048	3.22487272
L-10%TID	0	76	3	.000100471	.000003539	3	.143164993	.005292043	3.18377334
L-10%TID	0	74	3	.000058115	.000004905	3	.166860282	.03686959	1.68089693
L-10%TID	0	77	3	.000196440	.000011800	3	.156455743	.01308155	5.53844111
L-10%TID	0	78	3	.000037808	.000010333	3	.153278921	.006533969	2.24873940
L-10%TID	0	79	3	.000254491	.000010136	3	.191685871	.003584821	5.84476919
L-10%TID	0	80	3	.000297177	.000016325	3	.179108475	.03060886	7.25444576
Mean: 3.28874857		10	Lower: 2.04145108		Upper: 5.23012813				
L-1%TID	0	66	3	.000253715	.000006447	3	.256219904	.01227057	4.41014360
L-1%TID	0	63	3	.000139207	.000008755	3	.189901849	.008561660	3.31670710
L-1%TID	0	68	3	.000028871	.000001427	3	.165499953	.01361142	.941721485
L-1%TID	0	67	3	.000161863	.000022660	3	.212729429	.01417394	3.43506561
L-1%TID	0	65	3	.000085841	.000003763	3	.185966059	.004832373	2.18256550
L-1%TID	0	70	3	.000110344	.000009646	3	.177168809	.03275692	2.84563824
L-1%TID	0	62	3	.000188498	.000012088	3	.160398429	.02190169	5.19653916
L-1%TID	0	69	3	.000060016	.000002122	3	.172142630	.002726795	1.65693783
L-1%TID	0	64	3	.000136529	.000010968	3	.191323686	.008624750	3.23560935
L-1%TID	0	61	3	.000164092	.000010325	3	.140102630	.011366347	5.17973449
Mean: 2.69964639		10	Lower: 1.78905454		Upper: 4.02710843				
BNFX	0	BNDX	3	.003755688	.000638541	3	.754795000	.009748776	31.3554986
Mean: 21.3554986		1	Lower: -1		Upper: -1				
W-AR	0	99	3	.000240116	.000002927	3	.210171165	.01436438	3.19636080
Mean: 2.99636080		1	Lower: -1		Upper: -1				
L-CTRL	0	2	3	.000027900	.000002394	3	.215878060	.000681699	.946450426
L-CTRL	0	4	3	.000011478	.000001675	3	.224159467	.003877039	.417675838
L-CTRL	0	1	3	.000069236	.000002838	3	.190770352	.007658781	1.74307185
L-CTRL	0	3	3	.000035060	.000005762	3	.232981061	.01366868	.839828056
L-CTRL	0	6	3	.000154043	.000013273	3	.192514135	.04273418	4.48545345
L-CTRL	0	7	3	.000092786	.000021019	3	.177603254	.009637768	2.42134049
L-CTRL	0	5	3	.000115865	.000003855	3	.187460146	.004106359	2.82789810
Mean: 1.30846688		7	Lower: .524632925		Upper: 3.94017244				
S-10%TID	0	113	3	.000146863	.000009526	3	.268334062	.005293405	2.52798790
S-10%TID	0	114	3	.000852903	.000030298	3	.233392324	.002662118	15.7393033
S-10%TID	0	112	3	.000180660	.000005775	3	.182292636	.06860086	4.41364101
Mean: 5.39971237		3	Lower: .800851613		Upper: 31.1300975				
L-DMAT	0	83	3	.000169224	.000001121	3	.238705640	.007334204	3.03602538
L-DMAT	0	85	3	.000049680	.000005883	3	.140704479	.008959866	1.70121772
L-DMAT	0	86	3	.000029897	.000007343	3	.189435743	.016998100	.950232466
L-DMAT	0	90	3	.000034440	.000003582	3	.165698743	.02028368	1.08372551
L-DMAT	0	87	3	.000034866	.000004926	3	.163566286	.004062132	1.00760471
L-DMAT	0	88	3	.000112111	.000010142	3	.168600778	.008715794	3.02717318
L-DMAT	0	84	3	.000069694	.000008225	3	.158869119	.008166375	2.06494440
L-DMAT	0	89	3	.000052856	.000001345	3	.176440856	.002450968	1.84709944
Mean: 1.47472139		8	Lower: .944406462		Upper: 2.28078715				
S-DMAT	0	91	3	.000197690	.000009786	3	.280705799	.01272149	3.55256238
S-DMAT	0	92	3	.000250591	.000025834	3	.214134133	.019936572	5.17558112
Mean: 4.08795689		2	Lower: 1.70634909		Upper: 9.43480657				
S-NAPH	0	119	3	.000056131	.000002900	3	.233784143	.01371172	1.31639164

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E-NAPH	0	120	3	.000515867	.000030613	3	.202571191	.009757226

Mean: 3.92675793 3 Lower: .298887976 Upper: 22.9261833

L-BNF	0	42	3	.000902552	.000121535	3	.168845374	.01126351
L-BNF	0	47	3	.001257625	.000128491	3	.104483045	.001553057
L-BNF	0	49	3	.000143455	.000031733	3	.125376321	.01491014
L-BNF	0	46	3	.000444841	.000052956	3	.209777586	.006529734
L-BNF	0	44	3	.001010807	.000017146	3	.231574979	.009392201
L-BNF	0	48	3	.000234752	.000042086	3	.151535133	.006762419
L-BNF	0	43	3	.002875671	.000285780	3	.197496353	.006679260
L-BNF	0	46	3	.000548248	.000067763	3	.197222366	.005825398
L-DNF	0	41	3	.000632997	.000078110	3	.172286204	.01117521

Mean: 16.1317884 9 Lower: 8.39609675 Upper: 30.8289249

W-1%TID	0	111	3	.000532851	.000004097	3	.287503010	.009742570
W-1%TID	0	109	3	.000145050	.000004924	3	.220404218	.01399257
W-1%TID	0	110	3	.000159772	.000033568	3	.146789346	.004784179

Mean: 4.68807243 3 Lower: 1.76826166 Upper: 11.9392661

W-10%TID	0	117	3	.000152332	.000003855	3	.207532360	.003357614
W-10%TID	0	115	3	.000310971	.000012372	3	.190730625	.008755300
W-10%TID	0	116	3	.000283100	.000012379	3	.209196699	.02250915

Mean: 5.00192730 3 Lower: 2.29833936 Upper: 10.8437102

L-0.1%TID	0	60	3	.000060169	.000001616	3	.195524675	.002961127
L-0.1%TID	0	66	3	.000051624	.000005172	3	.148177268	.01262523
L-0.1%TID	0	57	3	.000042258	.000005530	3	.257731732	.02224610
L-0.1%TID	0	56	3	.000071112	.000010234	3	.154125932	.005385439
L-0.1%TID	0	54	3	.000075632	.000003886	3	.114677584	.015827800
L-0.1%TID	0	53	3	.000114495	.000010558	3	.192165382	.01089440
L-0.1%TID	0	51	3	.000088726	.000004110	3	.176820052	.008800513
L-0.1%TID	0	59	3	.000042342	.000002052	3	.145993309	.005513110
L-0.1%TID	0	52	3	.000079719	.000015338	3	.212666510	.01890283
L-0.1%TID	0	58	3	.000250475	.000008288	3	.162133419	.004333838

Mean: 1.87685753 10 Lower: 1.24545282 Upper: 2.78407333

W-0.1%TID	0	104	3	.000366603	.000006467	3	.273304706	.008821718

Mean: 5.70311618 1 Lower: -1 Upper: -1

L-NAPH	0	39	3	.000065348	.000003428	3	.134624796	.02896016
L-NAPH	0	34	3	.000024502	.000007593	3	.301250793	.01016331
L-NAPH	0	32	3	.000076858	.000006425	3	.223727036	.009215714
L-NAPH	0	37	3	.000211605	.000017007	3	.222944953	.02026252
L-NAPH	0	33	3	.000095215	.000005177	3	.183446444	.01819220
L-NAPH	0	35	3	.000132779	.000028495	3	.202453728	.006361227
L-NAPH	0	28	3	.000099689	.000002848	3	.166463228	.013564136
L-NAPH	0	36	3	.000041753	.000004328	3	.153453299	.017082888
L-NAPH	0	31	3	.000052577	.000005086	3	.148221937	.01315490
L-NAPH	0	40	3	.000067202	.000006218	3	.257354464	.006503844

Mean: 1.65689044 10 Lower: 1.10361492 Upper: 2.44701368

L-50%TID	0	13	3	.000019151	.000007790	3	.172585201	.007051195
L-50%TID	0	11	3	.000582066	.000037684	3	.276215939	.008304630
L-50%TID	0	12	3	.000062278	.000001751	3	.232446873	.005495006
L-50%TID	0	14	3	.000085072	.000001345	3	.204646273	.01265681

Mean: 1.80683093 4 Lower: .232606354 Upper: 9.10954973

L-AR	0	32	3	.000074248	.000001601	3	.201976658	.000821271
L-AR	0	26	3	.000036757	.000001024	3	.175094226	.008048589
L-AR	0	27	3	.000107218	.000000006	3	.177782471	.007339116
L-AR	0	28	3	.000037922	.000005483	3	.165834191	.01500772
L-AR	0	24	3	.000011647	.000004924	3	.105378136	.009811166

L-AR	0	21	3	.000066457	.000003157	3	.210937468	.01159793	1.94266437
L-AR	0	29	3	.000054701	.000002895	3	.155197087	.004944457	1.69858264
L-AR	0	25	3	.000080792	.000011816	3	.233098116	.01543325	1.68000036
L-AR	0	23	3	.000191135	.000030470	3	.193195056	.02508194	4.40676789
Mean: 1.28925580	10	Lower: .756768923		Upper: 2.12028361					
CTLX	0	CTLX	3	.000136033	.000010659	3	.684363255	.04183744	1.04806393
Mean: .845062929	1	Lower: -1		Upper: -1					
9-18TID	0	107	3	.000731705	.000038358	3	.299710379	.02823973	10.5799361
Mean: 10.3799951	1	Lower: -1		Upper: -1					
8-9.18TID	0	102	3	.000406250	.000040961	3	.220934687	.004808378	8.01583389
Mean: 7.81583288	1	Lower: -1		Upper: -1					
W-DMAT	0	94	3	.000271876	.000034162	3	.201397530	.002757655	5.93956183
W-DMAT	0	95	3	.000173965	.000004186	3	.161436639	.007506428	4.78166697
W-DMAT	0	96	3	.000085436	.000009522	3	.180382136	.007735913	2.33736081
Mean: 3.73046267	3	Lower: 1.35587075		Upper: 10.0346498					
W-NAPH	0	121	3	.000134190	.000002092	3	.149018252	.007891620	4.02886182
W NAPH	0	122	3	.000148031	.000023960	3	.166212665	.01613346	3.98628191
W-NAPH	0	123	3	.000179345	.000007716	3	.149435874	.02235661	5.30082685
Mean: 4.19909266	3	Lower: 3.06947860		Upper: 5.71899152					
S-AR	0	98	3	.000081966	.000008673	3	.186909645	.005568359	2.06451660
S-AR	0	97	3	.000029505	.000013676	3	.109216364	.005576010	1.34861621
Mean: 1.46860437	2	Lower: .467536738		Upper: 3.97090484					
BLK	0	BLK		__no_fluorescence_sample__					

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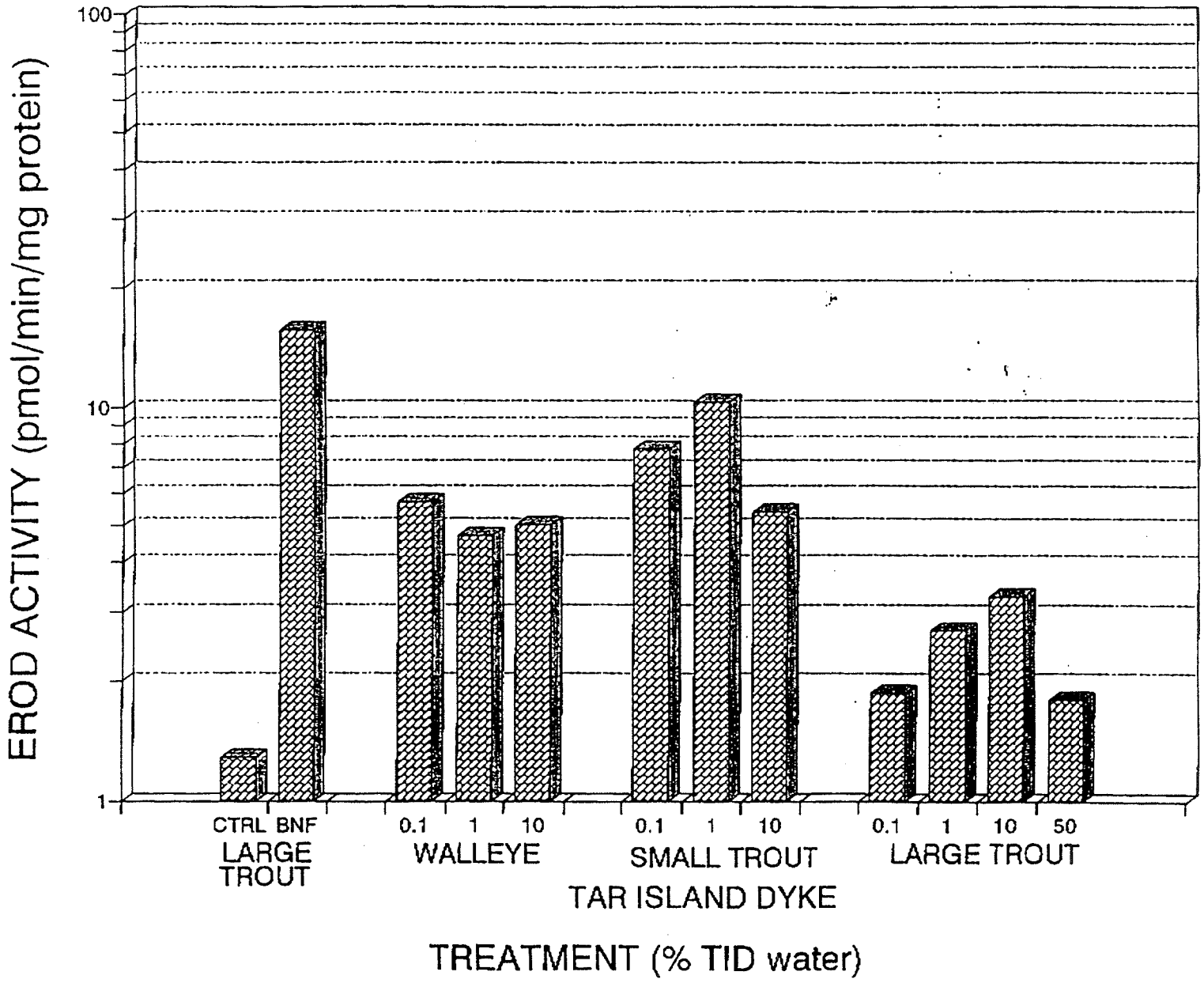
TAR ISLAND DYKE (TID)
Calgary samples (Sept. 12, 1995)



Histopathological assessment by GlobalTox International Inc.

GLOBAL TOX
INTERNATIONAL CONSULTANTS INC.

Colin G. Rousseaux BVSc., PhD
Diplomate of the American Board of Toxicology MRC Path
PRINCIPAL

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December 18, 1995

Dr. Randall D. Shaw
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Dear Randy:

re: EXPOSED RAINBOW TROUT TO SUNCOR MATERIALS

Please find enclosed the pathology report for the rainbow trout exposed to the material from Suncor and the naphthenic acid.

You will note that we have some positive findings, hence I would suggest that we look at some of the lower doses to determine a no effect level. I would also appreciate receiving the findings from some of the other studies. For example, EROD levels will help a lot with the interpretation of the liver findings.

I shall be in touch with you in the New Year to see where we go from here.

I wish you and the staff at Golder all the best for the festive season!

Yours sincerely,
GLOBAL TOX INTERNATIONAL CONSULTANTS

C. G. Rousseaux, BVSc, PhD, DABT, MRCPath.
Principal

CGR/dt

GLOBAL TOX
INTERNATIONAL CONSULTANTS INC.

FINAL REPORT

SUNCOR FISH HEALTH STUDY

Histopathology of Rainbow Trout exposed to Athabasca River water, 10% TID and Naphthenic acid, November 1995.

December 15, 1995

SUNCOR FISH

HEALTH STUDIES

Histopathology of Rainbow Trout exposed to Athabasca River Water, 10% TID, and Naphthenic acid, November, 1995.

December 15, 1995

for

Dr. Randall Shaw
Golder Associates Ltd.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Overview: This report contains the pathological evaluation of Rainbow Trout exposed to water from the Athabasca river, diluted Suncor material and Naphthenic acid, submitted by Golder Associates Ltd to **GLOBALTOX INTERNATIONAL CONSULTANTS INC.** in November 1995.

Findings: The findings ranged from incidental changes that could be attributed to the method of euthanasia or fixation to hepatic lipidosis and mild renal degeneration and regeneration. The findings associated with exposure to Naphthenic acid consisted of mainly hepatic lipidosis. This hepatic lipidosis was more severe than that seen in the 10% TID treated group. However, the findings in the kidney, indicative of mild renal toxicity were only found in this group. The findings in the gills could not be attributed directly to toxicity, but warrant further investigation.

Conclusions:

Better fixation will help **GLOBALTOX** define the changes in muscles better. The autolysis can be reduced by decreasing the time to formalin immersion and using 10% vol:vol formalin solutions. There were changes consistent with toxicity in both treatment and positive control group. No threshold for the TID was established form the lesions seen so far.

Recommendations:

The dose-response of the TID lesions needs to be fully evaluated. The cause of the gill changes needs to be further investigated.

I INTRODUCTION

This report contains the results of the pathological evaluation of Rainbow Trout exposed at HydroQual Laboratories Ltd to Athabasca river water and other materials, as requested by Dr. Randall Shaw of Golder Associates Ltd on behalf of their client Suncor Ltd. These samples were taken at the time that the fish were terminated following a 28 day flow-through exposure to pure chemical compounds, such as Naphthenic acid, and leachate from the site. The Athabasca river water was used as a control. Each sample contained fish parts preserved in 3-5% buffered neutral formalin in small Nalgene bottles. A chain of custody form was included, but a copy of the experimental protocol was not. The pathological terminology used in this report is that used by the American College of Veterinary Pathology and the Armed Forces Institute of Pathology. Following a summary morphological diagnosis (a statement of standardised altered morphology with respect to process, duration, exudate and other findings), a comment section has been inserted to explain the observations. It should be noted that the order of the morphological diagnoses does not reflect the order of importance.

Photographs of lesions and parasites, taken with Ektachrome 100 diapositive film, can be found at the end of the report.

II METHODOLOGY

II.A SAMPLING

Samples were taken by Golder Associates Ltd. All tissues sampled were trimmed, routinely processed, sectioned at 5 μm, stained with hematoxylin and eosin, and mounted. Where necessary special stains were used to highlight specific lesions or causative agents. All samples were well packaged and arrived with a chain of custody form, which has been attached to this report as Appendix A.

II.B Quality Assurance

Drs. R. Müller and C.G. Rousseaux were the pathologists who read all aspects of the work. Samples were trimmed by Dr. Müller, and then processed. Each sub-sample was labelled and records kept using the method outlined in Section II. E. Samples and pathological interpretations were double checked. All blocks were resealed and stored in water-resistant material for archiving.

II.C Comments on Samples Submitted

Samples were received in sealed small Nalgene containers (triple protected) that would not allow exposure of third parties to the formalin. The were sent via Canadian Airline (waybill # 018052679675). The rigid outer containers (large plastic Coleman coolers) prevented damage to the primary container.

MATERIAL SUBMITTED TO GLOBALTOX: Head, various organs fixed in formalin;
GROUPS : **Group No. 9 (9-1, 9-2, 9-3, 9-4, 9-5, 9-6)**
Group No.14 (14-1, 14-2, 14-4, 14-5, 14-6, 14-7, 14-8, 14-9, 14-10, 14-11)
Group No.15 (15-1, 15-2, 15-3, 15-5, 15-8)

GT HISTO ID : 95NGT93 etc. or 95NGT141 etc. or 95NGT151 etc.

GROSS OBSERVATIONS: No gross observations recorded at time of necropsy;

SAMPLES: Muscle (cross section through neck area)
Heart (two longitudinal sections)
Kidney (two samples of abdominal part, one sample head kidney)
Spleen (longitudinal section)
Liver (small sample provided)
Oesophagus (cross sections at various levels)
Oral cavity (samples at various levels)
Intestines, stomach, including pyloric ceca(sections at random)
Gill arches (various samples)
Eyes (eyeballs bilateral)
Brain (longitudinal section)

II.D Suggestions for Improving Future Samples

There were obvious problems with fixation of large pieces of tissue. Especially large masses of muscle showed uninhibited postmortem changes. The removal of the brain from the head that was immersed in the fixative probably caused the artifacts described (neurons with changes resembling hypoxia).

Several fish were difficult to process in part (14-10) or as a whole (9-1, 9-2), and histologic studies were compromised in these cases.

The correct concentration of neutral buffered formalin should be no less than 10% volume: volume. Please note that the material supplied by Fisher is 40% in its concentrated form.

II.E Sampling Method

The standardised codes used for cassette identification can be found in Table 1. in the future, recall from the archives for comparison purposes can be made using this coding system.

Table 1. Identification Codes for Cassettes Containing Fish Tissues.

A	Hypophysis (pituitary)			B	Brain	C	Spinal Cord
D	Eyes	D1	Right	E	Nerves (marked on side of cassette)		
		D2	Left				
F	Oral cavity mucosa			G	Thyroid	H	Aorta
I	Tongue			J	Mesentery	K	Heart
L	Gills	L1	cranial right		L4 cranial left		
		L2	middle right		L5 middle left		
		L3	caudal right		L6 caudal left		
M	Stomach	M1	esophagus	M3	fundus		
		M2	cardia	M4	pylorus, pyloric caeca		
N	Upper intestine			O	Lower intestine		
P	Liver (lobes marked on cassettes)			Q	Open		
R	Urinary system	R4	Cloaca	(other parts marked on the cassette)			
S	Spleen	T	Ovaries and Testes			T1	Testis right
						T2	Testis left
U	Open	V	Bone marrow			W	Bone (specify on the cassette)
X	Muscle (specify on the cassette)						
Y	Skin, fin etc. (specify on the cassette)					Z	Miscellaneous

All special areas of sampling other than the coded ones are marked on the side of the cassettes

III COMMENTS and CONCLUSIONS

III.A Comments:

The three groups can be differentiated mainly on the basis of the changes in the hepatocytes. Exposure to the xenobiotic used in group 14- appears to cause marked changes within the compartments of the cytoplasm, which resemble observations after proliferation of the endoplasmatic reticulum. Lipidosis in the group 15- is rather remarkable. When trimming the fixed tissue it was obvious that stomachs of fish in group 15 were rather full. It is possible that these fish were eating better than the other or that they were killed right after feeding. The state of nutrition may at any time affect the lipid content in the hepatocytes. No lesions of overt hepatotoxity were seen, but the lipidosis and basophilia of hepatocytes could be related to subtle toxicity. The kidney changes may indicate mild toxicity to the renal system. Changes in the Gill apparatus are suggestive of chronic, subclinical disease that have no relationship to the test articles in question.

III.B. Conclusions:

Both treatment groups, the positive Naphthenic acid and the 10% TID showed pathology consistent with, but not diagnostic of toxicity. Either these changes indicate that the fish were near the edge of de-adaptation (using the adaptation, de-adaptation/toxicity, toxicity, and death dose response), or nutritional and other individual growth-related changes were distributed in the same distribution as the treatment groups.

III.C. Recommendations:

It is recommended that a no-dose-level be determined for the reported liver and kidney pathology. Further investigation of the gill lesions is encouraged.

IV INDIVIDUAL REPORTS

95NGT91

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature leading to artefacts such as loss of internal structure of fibres in distinguishable from acute degeneration; acute hyalin degeneration along lines of muscle bundles; occasional parasitic cyst; skin surface normal; (No pathology associated with toxicity).
HEART:	Normal;
KIDNEY:	Foci with pigmented macrophages; (This is a normal finding).
SPLEEN:	Congestion; nests of melanocytes; (This is a normal finding).
LIVER:	Mild congestion; dilated sinusoids; (This finding is within the realm of normality).
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Marked accumulation of inflamatory cell at base of gill arches; (This finding is not abnormal as these cells tend to accumulate here as they do in the lungs of mammals).
EYES:	Normal;
BRAIN:	Marked congestion; occasional neurons with eosinophilic changes near

midbrain; (These changes are artefactual)

MORPHOLOGICAL DIAGNOSIS:

Autolysis of musculature, an artefactual change.

COMMENTS:

The changes in the brain and the muscle are most likely related to postmortem degeneration (autolysis).

95NGT92

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; acute hyalin degeneration along lines of muscle bundles (autolysis); skin surface normal;
HEART:	Normal;
KIDNEY:	Foci with pigmented macrophages;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Mild congestion; dilated sinusoids;
OSOPHAG.:	Normal;
ORAL CAVITY:	Normal;
INTEST. STOMACH:	Normal;
GILLS:	Marked accumulation of inflamatory cell at base of gill arches;
EYES:	Normal;
BRAIN:	Marked congestion; occasional neurons with hypoxic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

Autolysis in body musculature;

COMMENTS:

The changes in the brain and musculature are related to postmortem (autolytic) degeneration.

95NGT93

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature leading to artefacts such as loss of internal structure of fibres in distinguishable from acute degeneration; skin surface normal;
HEART:	Normal;
KIDNEY:	Foci with pigmented macrophages;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Missing;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Small granuloma in pyloric ceca;
GILLS:	Normal:
EYES:	Normal;
BRAIN:	Marked congestion; occasional neurons with hypoxic changes;

MORPHOLOGICAL DIAGNOSIS:

Normal

COMMENTS:

The changes in the brain may be autolysis or cause when the brain was removed from the head.

95NGT94

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature leading to artefacts such as loss of internal structure of fibres in distinguishable from acute degeneration; occasional parasitic cyst; skin surface normal;
HEART:	Normal;
KIDNEY:	Foci with pigmented macrophages;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Mild congestion; dilated sinusoids;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Marked accumulation of inflamatory cell at base of gill arches;
EYES:	Normal;
BRAIN:	Marked congestion; occasional neurons with hypoxic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

Autolysis in body musculature;

COMMENTS:

The changes in the brain and the muscle result from postmortem degeneration.

95NGT95

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature leading to artefacts such as loss of internal structure of fibres in distinguishable from acute degeneration; skin surface normal;
HEART:	Normal;
KIDNEY:	Foci with pigmented macrophages;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Mild congestion; severely dilated veins;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Accumulation of inflamatory cell at base of gill arches associated with thickening of epithelium;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with eosinophilic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

Autolysis in body musculature;

COMMENTS:

The thickening of the base of the gill arches may be the result of mild bacterial gill disease.

95NGT96

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area: marginal fixation of musculature leading to artefacts such as loss of internal structure of fibres in distinguishable from acute degeneration; occasional parasitic cyst; skin surface normal;
HEART:	Normal;
KIDNEY:	Foci with pigmented macrophages;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Mild congestion; dilated sinusoids; incomplete fixation;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Multiple nodules, with granulomatous and epithelial proliferation along gill arches; (This change is significant, but not treatment-related)
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with eosinophilic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

Autolysis in body musculature;

COMMENTS:

The changes in the gills are indicative of stimulation by some irritant, most likely bacteria. This is most likely a natural disease process rather than associated with the experiment.

95NGT141

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature leading to artefacts such as loss of internal structure of fibres indistinguishable from acute degeneration; skin surface normal;
HEART:	Normal;
KIDNEY:	Foci with pigmented macrophages; segments of proximal tubules, increased vacuolation of cytoplasm;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Mild congestion; increased size of hepatocytes associated with higher density of cytoplasm, and increased basophilia; large vacuoles(lipids); mild, variable degrees of pericholangitis;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Fusion of lamellae, formation of occasional granuloma;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with hypoxic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis, moderate
2. Brachiitis, granulomatous, focal, mild
3. Hepatic lipidosis, difuse, mild
4. Renal tubular nephrosis, mild

COMMENTS:

There is lack of glycogen accompanied by increased cytoplasmic density in the enlarged hepatocytes. The large vacuoles are most likely created by lipid aggregation. This change could be due to excess mobilization of fat, increased fat uptake, interference with fat transport, or toxicity. The renal tubular changes are too mild to be of significance. The cause of the focal chronic banchiitis (inflammation of the gills) was not apparent.

95NGT142

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; extensive acute hyalin degeneration with complete loss of structure accentuated along lines of muscle bundles; skin surface normal;
HEART:	Occasional muscle fibre bundle with myolysis;
KIDNEY:	Foci with pigmented macrophages; basophilia in segments of proximal tubules, accompanied by vacuolation of cytoplasm; apoptosis of tubular epithelium;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Mild congestion; increased size of hepatocytes associated with higher density of cytoplasm, and increased basophilia; lipid vacuoles;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Thickening of epithelium at base of gill arches accompanied by mainly mononuclear inflamatory infiltration; (branchiitis)
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with eosinophilic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Branchiitis, moderate, focal
3. Tubular nephrosis, moderate, segmental with apoptosis
4. Hepatic lipidosis, moderate, with bsoaphilia

COMMENTS:

There was postmortem autolysis seen in these sections, as with others, indictive of poor fixation. However, the findings in the kidneys and liver are probably associated with a low level toxic insult. The lack of glycogen, increased cytoplasmic density in the enlarged hepatocytes along with the accumulation of fat indicates that these hepatocytes were producing more protein and were unable to handle the normal fat load. Biochemically one would expect that EROD levels would be higher in this. The kidney findings are indicative of specific subtle damage to the renal tubules. The basophilia indicates recovery, whereas the apoptosis, or individual cell death indicates active damage to the cells. Vacuolation indicates non-fatal cell damage. Biochemical changes would probably be limited to altered creatinine levels, but it is unlikely that other indicators of renal function would be altered.

95NGT144

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; acute hyalin degeneration with complete loss of structure accentuated along lines of muscle bundles; skin surface normal;
HEART:	Occasional muscle fibre bundle with granular myolysis;
KIDNEY:	Foci with pigmented macrophages; basophilia in segments of proximal tubules, accompanied by vacuolation of cytoplasm; apoptosis, mitotic figures in tubular epithelium;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Mild congestion; increased size of hepatocytes associated with higher density and eosinophilia of cytoplasm, increased basophilia of cell margins; lipid vacuoles;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Thickening of epithelium at base of gill arches accompanied by mainly mononuclear inflamatory infiltration;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with eosinophilic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Branchiitis, moderate, focal, non-exudative
3. Renal tubular nephrosis, moderate, with regeneration and apoptotic bodies
4. Hepatic lipidosis, mild diffuse

COMMENTS:

Autolytic changes inhibited the interpretation of the slides; however, there do appear to be changes in the renal tubules and the hepatocytes that are likely associated with some toxic insult. The changes in the brain and the myolysis may be either be related to capture and euthanasia, but are more likely a result of postmortem degeneration.

95NGT145

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; acute hyalin degeneration with complete loss of structure accentuated along lines of muscle bundles; skin surface normal;
HEART:	Occasional muscle fibre bundles with myolysis;
KIDNEY:	Basophilia in segments of proximal tubules, accompanied by vacuolation of cytoplasm;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Mild congestion; increased size of hepatocytes associated with higher density of cytoplasm, increased basophilia of cell margins; well demarcated lipid vacuoles;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Thickening of epithelium at base of gill arches accompanied by mainly mononuclear inflamatory infiltration; occasional fusion of secondary lamellae;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with hypoxic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Branchiitis, mild, focal
3. Renal segmental tubular nephrosis
4. Hepatic lipidosis and bsophilia, mild diffuse

COMMENTS:

This is a milder expression of the changes seen in 95NGT144.

95NGT146

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; acute hyalin degeneration with complete loss of structure accentuated along lines of muscle bundles, accompanied by edema; skin surface normal;
HEART:	Occasional muscle fibre bundle with myolysis;
KIDNEY:	Foci with pigmented macrophages; basophilia in segments of proximal tubules; occasional apoptotic figure in tubular epithelium;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Mild congestion; increased size of hepatocytes associated with higher eosinophilic density of cytoplasm, and increased basophilia of cell margins; large lipid vacuoles; disseminated areas with pericholangial infiltration.
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Mild thickening of epithelium at base of gill arches accompanied by mainly mononuclear inflamatory infiltration;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with eosinophilic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Branchiitis, mild, multifocal
3. Hepatic lipidosis, moderate, diffuse
4. Renal tubular regeneration, with mitotic figures

COMMENTS:

These changes are similar to other members of this treatement group. The kidney did not show any degenerative changes, rather regenerative changes.

95NGT147

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; extensive acute hyalin degeneration accompanied by interstitial edema accentuated along lines of muscle bundles; skin surface normal;
HEART:	Occasional muscle fibre bundle with myolysis;
KIDNEY:	Foci with pigmented macrophages; basophilia in segments of proximal tubules;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Increased size of hepatocytes associated with higher density of eosinophilic cytoplasm, and increased basophilia of cell margins; large lipid vacuoles;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Base of gill arches thickened with mainly mononuclear inflamatory infiltration; occasional fusion of secondary lamellae;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with eosinophilic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Branchiitis, moderate, multifocal, chronic
3. Hepatic lipidosis, diffuse, moderate
4. Renal tubular regeneration, mild, diffuse

COMMENTS:

These findings are similar to those found in other fish of this same group.

95NGT148

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; extensive acute hyalin degeneration accompanied by interstitial edema accentuated along lines of muscle bundles (electrofishing ?); skin surface normal;
HEART:	Occasional muscle fibre bundle with myolysis;
KIDNEY:	Foci with pigmented macrophages; basophilia in segments of proximal tubules;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Normal size of hepatocytes; small lipid vacuoles;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Base of gill arches thickened with mainly mononuclear inflamatory infiltration; occasional fusion of secondary lamellae;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with eosinophilic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Bachiitis, mild, focal, chronic
3. Renal tubular regeneration, mild, segmental

COMMENTS:

The findings are similar to other fish in this group

95NGT149

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; acute hyalin degeneration accompanied by interstitial edema, accentuated along lines of muscle bundles; skin surface normal;
HEART:	Occasional muscle fibre bundle with myolysis;
KIDNEY:	Foci with pigmented macrophages; basophilia in segments of proximal tubules;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Increased size of hepatocytes associated with higher density of eosinophilic cytoplasm, and increased basophilia of cell margins; large lipid vacuoles;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal:
GILLS:	Base of gill arches thickened with mainly mononuclear inflamatory infiltration; occasional fusion of secondary lamellae;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with eosinophilic changes near midbrain:

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Branchiitis, mild, multifocal, chronic
3. Renal tubular regeneration, mild, segmental
4. Hepatic lipidosis, moderate, diffuse

COMMENTS:

The findings in this fish are the same for others of the group.

95NGT1410

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; very marginal fixation of musculature; extensive degeneration accompanied by interstitial edema accentuated along lines of muscle bundles; skin surface normal;
HEART:	Occasional muscle fibre bundle with myolysis;
KIDNEY:	Autolysis; basophilia in segments of proximal tubules;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Autolysis; hepatocytes with condensed nuclei appearing very pale, and vacuolated;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Base of gill arches thickened with mainly mononuclear inflamatory infiltration; occasional fusion of secondary lamellae;
EYES:	Normal;
BRAIN:	Marked congestion; lack of fixation; numerous neurons with eosinophilic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis leading to many artefacts

COMMENTS:

The autolysis is probably due to lack of fixation or prolonged time spent on the bench before being placed into fixative

95NGT1411

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; extensive acute hyalin degeneration accompanied by interstitial edema accentuated along lines of muscle bundles; skin surface normal;
HEART:	Occasional muscle fibre bundle with myolysis;
KIDNEY:	Foci with pigmented macrophages; basophilia in segments of proximal tubules; rare apoptotic figures;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Increased size of hepatocytes associated with higher density of eosinophilic cytoplasm, and increased basophilia of cell margins; large lipid vacuoles; disseminated areas with pericholangitis (mainly mononuclear infiltration);
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Base of gill arches with thickened epithelium infiltrated with mainly mononuclear inflamatory infiltration; occasional fusion of secondary lamellae;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with eosinophilic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Branchiitis, moderate, multifocal, chronic
3. Chollangiohepatitis, mild, multifocal, chronic with moderate hepatic lipidosis
4. Renal tubular nephrosis, mild, segmental with apoptotic bodies and regeneration

COMMENTS:

The changes in this fish are similar to those in the remainder of the group

95NGT151

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; extensive acute hyalin degeneration accompanied by interstitial edema accentuated along lines of muscle bundles; skin surface normal;
HEART:	Occasional muscle fibre bundle with myolysis;
KIDNEY:	Foci with pigmented macrophages; mild basophilia in segments of proximal tubules;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Increased size of hepatocytes associated with marked lipidosis (medium sized vacuoles); foci with hemopoesis; vacuoles;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Base of gill arches with mild, mainly mononuclear inflamatory infiltration; rare fusion of secondary lamellae;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with eosinophilic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Branchiitis, very mild, focal, chronic
3. Hepatic lipidosis, severe
4. Renal tubular regeneration, mild, segmental

COMMENTS:

This fish has changes that are more severe in the liver, but less severe in the kidney and gills that the fish from the 10% TID-treated group.

95NGT152

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; extensive acute hyalin degeneration accompanied by interstitial edema accentuated along lines of muscle bundles; skin surface normal;
HEART:	Occasional muscle fibre bundle with myolysis;
KIDNEY:	Foci with pigmented macrophages; mild basophilia in segments of proximal tubules;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Increased size of hepatocytes associated with marked lipidosis (medium sized vacuoles); foci with hemopoesis; vacuoles;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Base of gill arches with mild, mainly mononuclear inflamatory infiltration; rare fusion of secondary lamellae;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with eosinophilic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Branchiitis, very mild, multifocal
3. Hepatic lipidosis, severe, diffuse
4. Renal tubular regeneration, mild, segmental

COMMENTS:

This fish has a similar appearance to the other fish in this group

95NGT153

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; extensive acute hyalin degeneration accompanied by interstitial edema accentuated along lines of muscle bundles; skin surface normal;
HEART:	Occasional muscle fibre bundle with myolysis;
KIDNEY:	Foci with pigmented macrophages; mild basophilia in segments of proximal tubules;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Increased size of hepatocytes associated with marked lipidosis (medium sized vacuoles); foci with hemopoesis; vacuoles;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Base of gill arches with mild, mainly mononuclear inflamatory infiltration; rare fusion of secondary lamellae;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with hypoxic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Branchiitis, very mild, multifocal
3. Hepatic lipidosis, severe, diffuse
4. Renal tubular regeneration, mild, segmental

COMMENTS:

This fish has a similar appearance to the other fish in this group

95NGT155

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; extensive acute hyalin degeneration accompanied by interstitial edema accentuated along lines of muscle bundles; skin surface normal;
HEART:	Occasional muscle fibre bundle with myolysis;
KIDNEY:	Foci with pigmented macrophages; mild basophilia in segments of proximal tubules;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Increased size of hepatocytes associated with marked lipidosis (medium sized vacuoles); foci with hemopoesis; vacuoles;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Base of gill arches with mild, mainly mononuclear inflamatory infiltration; rare fusion of secondary lamellae;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with hypoxic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Branchiitis, very mild, multifocal
3. Hepatic lipidosis, severe, diffuse
4. Renal tubular regeneration, mild, segmental

COMMENTS:

This fish has a similar appearance to the other fish in this group

95NGT158

HISTOPATHOLOGY:

MUSCLE:	Cross section through neck area; marginal fixation of musculature; extensive acute hyalin degeneration accompanied by interstitial edema accentuated along lines of muscle bundles; skin surface normal;
HEART:	Occasional muscle fibre bundle with myolysis;
KIDNEY:	Foci with pigmented macrophages; mild basophilia in segments of proximal tubules;
SPLEEN:	Congestion; nests of melanocytes;
LIVER:	Increased size of hepatocytes associated with marked lipidosis (medium sized vacuoles); foci with hemopoesis; vacuoles;
OSOPHAG.:	Normal
ORAL CAVITY:	Normal
INTEST. STOMACH:	Normal;
GILLS:	Base of gill arches with mild, mainly mononuclear inflamatory infiltration; rare fusion of secondary lamellae;
EYES:	Normal;
BRAIN:	Marked congestion; numerous neurons with eosinophilic changes near midbrain;

MORPHOLOGICAL DIAGNOSIS:

1. Autolysis
2. Branchiitis, very mild, multifocal
3. Hepatic lipidosis, severe, diffuse
4. Renal tubular regeneration, mild, segmental

COMMENTS:

This fish has a similar appearance to the other fish in this group

V PHOTOMICROGRAPHS

No. 1 (Muscle)

Cross section through muscle showing degenerative changes, most likely autolysis. Original magnification 10 X; H&E stain.

No. 2 (Muscle)

Cross section through muscle showing degenerative changes, most likely autolysis. Original magnification 10 X; H&E stain.

No. 3 (Muscle, fast and slow twitch)

Cross section through muscle showing degenerative changes, most likely autolysis. Note the fast and slow twitch muscles. Original magnification 10 X; H&E stain.

No. 4 (95NGT96 - Gill)

Gills showing focal nodules. Original magnification 20 X H&E stain.

No. 5 (95NGT96 - Gill)

Gills showing focal nodules (granulomata). Original magnification 40 X H&E stain.

No. 6 (95NGT95 - Liver)

Liver showing diffuse lipidosis. Original magnification 10 X H&E stain.

No. 7 (95NGT141 - Liver)

Liver showing hepatic lipidosis. Note the cytoplasmic changes and the mitotic figures. Original magnification 40 X H&E stain.

No. 8 (95NGT153 - Liver)

Liver section showing hepatic lipidosis. Original magnification 20 X H&E stain.

No. 9 (95NGT149 - Kidney)

Kidney section showing regenerative tubular epithelium. Note the mitotic figure. Original magnification 40 X H&E stain.

No. 10 (95NGT144 - Gills)

Interesting individual lesion. Focal granuloma with fibrin - probably an emobus or thrombus. Original magnification 40 X H&E stain

HydroQual Laboratories Ltd.
#3, 6125 - 12 Street S.E. Calgary, Alberta
TEL: (403) 253-7121 FAX: (403) 252-9363 1-800-808-6942

FILE: 951107DL.DOC

95-R-~~87~~96
96R-87

TRANSMITTAL

DATE: November 24, 1995

FROM: J. Stephen Goudey, Ph.D., P.Biol.
General Manager

TO: Dr. Colin Rousseaux

TEL: (613) 798-0808
FAX: (613) 798-1100

TEL: (403) 253-7121
FAX: (403) 252-9363

RE: SUNCOR FISH HEALTH STUDY

Please fill out the date, time, and sign this transmittal upon receipt of the cooler and FAX it back to me at (403) 252-9363.

DATE RECEIVED: 29th Nov 95

TIME RECEIVED: 14:45

RECEIVED BY:

Cold but not frozen

WRITTEN BY: SG ON 95/03/16 REVISED BY: SG ON: 95/03/16 FILE: 95007.DOC

ORIGINAL 3 (FOR SHIPPER)

EXTRA COPY FOR CARRIER
COPIE SUPPLÉMENTAIRE POUR LE TRANSPORTEUR

TRANSMITTAL

DATE: November 24, 1995

FROM: J. Stephen Goudey, Ph.D., P.Biol.
General Manager

TO: Dr. Colin Rousseaux

TEL: (613) 798-0808
FAX: (613) 798-1100

TEL: (403) 253-7121
FAX: (403) 252-9363

RE: SUNCOR FISH HEALTH STUDY

Please fill out the date, time, and sign this transmittal upon receipt of the cooler and FAX it back to me at (403) 252-9363.

DATE RECEIVED: 29th Nov '95

TIME RECEIVED: 14:20

RECEIVED BY: [signature]

Cold but received not frozen

Challenge test data sheets

Table 3a. Challenge Test Results Summary of Larval Growth Data

Treatment	Length (mm)				Wet Weight (g)				Moisture Content	Body Condition
	Avg	SD	low	high	Avg	SD	low	high	(%)	(Klt, x10^3)
lab control	30	3	25	35	0.2	0.1	0.1	0.4	80	0.9
Tar Island Dyke (%)										
0.01	34	3	29	40	0.4	0.1	0.2	0.6	82	1
0.1	37	3	30	43	0.5	0.1	0.3	0.9	80	1
1	36	2	30	40	0.4	0.1	0.3	0.6	80	0.9
Athabasca River	38	4	30	44	0.6	0.2	0.3	1.0	78	1.1
naphthenic acids	37	4	25	43	0.5	0.2	0.2	0.7	80	1
beta-naphthoflavone	30	4	22	42	0.2	0.1	0.1	0.5	75	0.9
external control	30	3	25	36	0.3	0.1	0.1	0.5	83	0.9

Table 3b. Disease Challenge Test Results on Larval Fry from 28 Day Exposure (number of dead fry; applied dose x10^3 CFU)

Test 1: November 13, 1995

Day	Lab Control					Tar Island Dyke Water																					Naphthenic Acids					External Controls				
						0.01					0.1					1					10					Athabasca River					Beta-Naphthoflavon									
	0	2	17	170	1700	0	2	17	170	1700	0	2	17	170	1700	0	2	17	170	1700	0	2	17	170	1700	0	2	17	170	1700	0	2	17	170	1700	0	2	17	170	1700
1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0						0	0	0	0	0						1	4	0	2	1	0	0	0	0	0
2	0	0	1	0	6	0	0	0	0	2	0	0	0	0	1	0	0	0	0	1						0	0	0	0	1						0	1	0	1	1	0	0	0	0	0
3	0	1	2	1	3	0	0	0	0	4	0	0	0	1	0	0	0	0	1	5						0	0	0	2	2						0	0	3	1	1	0	0	0	4	6
4	0	3	2	2	1	0	0	1	3	3	0	0	0	0	3	0	1	0	1	0						0	0	1	1	8						1	2	0	1	4	0	1	1	0	0
5	0	1	1	1	2	0	0	1	1	1	0	0	0	0	1	0	1	0	0	1						0	0	2	3	4						0	1	0	2	0	0	0	0	0	0
6	0	1	1	1	0	0	0	1	0	0	0	1	1	0	1	0	0	0	1	1						0	0	2	3	1						0	0	0	0	1	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0						0	0	1	1	0						0	0	1	0	0	0	1	0	0	0

Test 2: November 30, 1995

Day	Lab Control					Tar Island Dyke Water																					Naphthenic Acids					External Controls				
						0.01					0.1					1					10					Athabasca River					Beta-Naphthoflavon									
	0	1	11	110	1100	0	1	11	110	1100	0	1	11	110	1100	0	1	11	110	1100	0	1	11	110	1100	0	1	11	110	1100	0	1	11	110	1100	0	1	11	110	1100
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0					
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1					
4	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	3	0	0	0	0	3	0	0	0	0	1					
5	0	0	1	1	0	0	0	0	0	2	0	0	1	2	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0								
6	0	0	0	0	0	0	0	0	1	0	0	0	2	0	1	0	0	0	0	2	0	2	0	0	1	1	1	0	1	0	0	1	0	0	0	0	1			
7	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	5	1	3	0	0	0	0	0	0	0	0	1	1		

Notes: 1. Larval fry were exposed to four different pathogen densities. There were 30 fish in the first test and 20 fish in the second test in each group exposed to each pathogen density.
2. There was only enough surviving fish from the 10% TID treatment to run two exposures with 11 fish in each exposure (control and the highest pathogen density).

Table 3c. Swimming Stamina Challenge Test Results Summary

Treatment		Percent of Initial Fish Swimming Over Time (hours) 0.5	1	3
Test 1: November 16, 1995				
lab control		30	31	21
Tar Island Dyke Water (%)	0.01	38	30	13
	0.1	59	57	35
	1	54	41	27
Athabasca River Water		46	38	14
beta-naphthoflavone		6	5	3
external control		60	53	
Test 2: November 17, 1995				
lab control		27	24	21
Tar Island Dyke Water (%)	0.01		18	17
	0.1		39	14
	1	60	54	50
Athabasca River Water		41	31	7
beta-naphthoflavone			22	22
external control		44	31	
Test 3: November 20, 1995				
lab control		30	30	22
Tar Island Dyke Water (%)	0.01	43	37	17
	0.1	49	44	17
	1	39	46	25
Athabasca River Water		36	31	7
beta-naphthoflavone		34	33	30
external control		54	44	
Test 4: November 27, 1995	rep a	54	34	22
naphthenic acids	rep b	52	27	21
	rep c	45	28	19
Test 5: November 28, 1995	rep a	54	31	23
naphthenic acids	rep b	66	55	33
	rep c	37	23	17

Chemical analysis of Tar Island Dyke water

TID - Wastewater Characterisation

CHEMEX Labs Alberta Inc.

Calgary · 2021 · 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton · 9331 · 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

HYDRO-QUAL LABORATORIES LIMITED
MARY GREGORY

DATE : November 16, 1995
CHEMEX PROJECT NO. : HYDR010-0501-95-04108
CLIENT REFERENCE : 95030
CLIENT JOB NO. : PROJ.#952-2307

Analytical Data Reviewed By : _____

QA/QC Reviewed By : _____

The above signatures indicate that the individuals identified have reviewed the enclosed documents.

NOTE : Soil samples and water samples (for stable parameters) will be retained for a period of 60 days after completion of analysis.
Retention beyond this period can be arranged for a fee.

CHEMEX Labs Alberta Inc. is accredited by both the Canadian Association for Environmental Analytical Laboratories and the Standards Council of Canada for specific parameters registered with the Association and the Council.

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

HYDRO-QUAL LABORATORIES LIMITED
ATTENTION : MARY GREGORY
95129
95030
PROJ.#952-2307

Sample Description : 95447 EFFLUENT
Sample Date & Time : 01-11-95 1045
Sampled By : MG
Sample Type : GRAB
Sample Received Date: November 02, 1995
Sample Station Code :

Chemex Worksheet Number : 95-04108-1
Chemex Project Number : HYDR010-0501
Sample Access :
Sample Matrix : WATER
Report Date : November 16, 1995

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	RESULTS	DETECTION LIMIT
Calcium - (ICP) Dissolved	20111L	mg/L	42.5	0.01
Magnesium - (ICP) Dissolved	12111L	mg/L	9.50	0.01
Sodium - (ICP) Dissolved	11111L	mg/L	315.	0.01
Potassium -(ICP) Dissolved	19111L	mg/L	9.50	0.02
Chloride - Dissolved	17206L	mg/L	16.4	0.5
Sulphate - Dissolved	16306L	mg/L	93.0	0.5
PP Alkalinity (as CaCO3)	10151L	mg/L	< 0.1	0.1
Total Alkalinity (as CaCO3)	10111L	mg/L	705.	0.5
pH	10301L	Units	8.20	0.01
Carbonate	06301L	mg/L	< 0.5	0.5
Bicarbonate	06201L	mg/L	859.	0.5
Total Hardness (as CaCO3)	10602L	mg/L	145.	0.5
Hydroxide	08501L	mg/L	< 0.5	0.5
Silicon - Dissolved (ICP)		mg/L	6.55	0.02
Fluoride	09105L	mg/L	2.16	0.05
Specific Conductance	02041L	umhos/Cm	1460.	0.02
Total Cyanide		mg/L	0.005	0.001
Phenols	06537L	mg/L	0.005	0.001
Total Dissolved Solids	00201L	mg/L	919.	1.
Dissolved Organic Carbon	06104L	mg/L	39.1	0.2
Total Ammonia Nitrogen	07505L	mg/L	6.66	0.01
Nitrite plus Nitrate Nitrogen as N	07110L	mg/L	0.703	0.003
Total Phosphorus as P	15406L	mg/L	1.85	0.003
Sulphur - (ICP) - Dissolved		mg/L	36.3	0.2
Aluminum - Dissolved (ICP-AES)	13109L	mg/L	0.02	0.01
Antimony - Dissolved (AA)	51003L	mg/L	< 0.0002	0.0002
Arsenic - Dissolved (AA)	33109L	mg/L	0.0012	0.0002
Barium - Dissolved (ICP-AES)	56109L	mg/L	0.08	0.01
Beryllium - Dissolved (ICP-AES)	04103L	mg/L	0.001	0.001
Boron - Dissolved (ICP-AES)	05111L	mg/L	1.91	0.01
Cadmium - Dissolved (ICP-MS)		mg/L	< 0.0002	0.0002
Chromium - Dissolved (ICP-AES)	24360L	mg/L	0.008	0.002
Cobalt - Dissolved (ICP-MS)		mg/L	0.0005	0.0003

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4. Telephone (403) 465-9877, FAX (403) 466-3332

HYDRO-QUAL LABORATORIES LIMITED
ATTENTION : MARY GREGORY
95129
95030
PROJ.#952-2307

Sample Description : 95447 EFFLUENT
Sample Date & Time : 01-11-95 1045
Sampled By : MG
Sample Type : GRAB
Sample Received Date: November 02, 1995
Sample Station Code :

Chemex Worksheet Number : 95-04108-1
Chemex Project Number : HYDR010-0501
Sample Access :
Sample Matrix : WATER
Report Date : November 16, 1995

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	R E S U L T S		DETECTION LIMIT
Copper - Dissolved (ICP-AES)	29109L	mg/L	<	0.001	0.001
Iron - Dissolved (ICP-AES)	26109L	mg/L		0.02	0.01
Lead - Dissolved (ICP-MS)		mg/L	<	0.0003	0.0003
Lithium - Dissolved (ICP-AES)	03109L	mg/L		0.134	0.001
Manganese - Dissolved (ICP-AES)	25109L	mg/L		0.124	0.001
Mercury - Dissolved (CVAA)	80101L	ug/L	<	0.05	0.05
Molybdenum - Dissolved (ICP-AES)	42330L	mg/L		0.014	0.003
Nickel - Dissolved (ICP-MS)		mg/L		0.0065	0.0005
Phosphorus - Dissolved (ICP-AES)	15450L	mg/L	<	0.1	0.1
Selenium - Dissolved (AA)	34105L	mg/L		0.0005	0.0002
Silver - Dissolved (ICP-MS)		mg/L		0.0003	0.0002
Strontium - Dissolved (ICP-AES)	38111L	mg/L		0.307	0.002
Titanium - Dissolved (ICP-AES)	22111D	mg/L		0.003	0.003
Uranium - Dissolved (ICP-MS)		mg/L		0.0004	0.0002
Vanadium - Dissolved (ICP-AES)	23330D	mg/L	<	0.002	0.002
Zinc - Dissolved (ICP-AES)	30501D	mg/L		0.003	0.001
Ion Balance		Balance		1.05	0.01

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107 - 111 Research Drive, Saskatoon, Saskatchewan S7N 3R2 Telephone: (306) 668-8370 Fax: (306) 668-8383
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CHEMICAL ANALYSIS REPORT

HYDROQUAL LABORATORIES LTD.
#3, 6125 12 STREET S.E.
CALGARY, ALBERTA
T2H 2K1

DATE: November 30, 1995

ATTN: MARY GREGORY

Lab Work Order #:	E511114	**Sampled By:**	CLIENT
Project Reference:	LAB QUO C95-073/952-2307	**Date Received:**	11/04/95
Project P.O.#:	95135		

Comments:

Detection limits for the target phenolics have been adjusted due to co-extractive interferences.

APPROVED BY:

Doug Johnson
Project Manager

ACCREDITED BY: (Edmonton)	**CANADIAN ASSOCIATION OF ENVIRONMENTAL ANALYTICAL LABORATORIES (CAEAL)** - For specific tests registered with the Association **STANDARDS COUNCIL OF CANADA** - Organic & Industrial Hygiene analysis as registered with the Council **AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)** - Industrial Hygiene analysis registered by AIHA **AGRICULTURE CANADA** - Pesticide in Fruits and Vegetables, pesticides and PCP in meat
CERTIFIED BY: (Calgary)	**CANADIAN ASSOCIATION OF ENVIRONMENTAL ANALYTICAL LABORATORIES (CAEAL)** - For specific tests registered with the Association

ENVIRO-TEST CHEMICAL ANALYSIS REPORT

LAB ID	SAMPLE ID	TEST DESCRIPTION	RESULT	D.L.	UNITS	EXTRACTED	ANALYZED	BY
E511114-01	95447							
Sample Type:WATER								
Collected:11/03/95								
		Hydrocarbons,Recoverable	12	1	mg/L	11/16/95	11/17/95	RG
		PAH & Alkylated PAH's						
		Naphthalene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Acenaphthylene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Acenaphthene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Fluorene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Dibenzothiophene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Phenanthrene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Anthracene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Fluoranthene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Pyrene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Benzo(a)anthracene/Chrysene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Benzo(b&k)fluoranthene	0.04	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Benzo(a)pyrene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Indeno(c,d-123)pyrene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Dibenzo(a,h)anthracene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Benzo(ghi)perylene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		Methyl naphthalene	N.D.	0.04	ug/L (ppb)	11/17/95	11/25/95	MJL
		C2 sub'd naphthalene	0.17	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		C3 sub'd naphthalene	0.16	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		C4 sub'd naphthalene	0.14	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		Biphenyl	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		Methyl biphenyl	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		C2 sub'd biphenyl	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		Methyl acenaphthene	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		Methyl fluorene	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		C2 sub'd fluorene	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		Methyl phenanthrene/anthracene	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		C2 sub'd phenanthrene/anth.	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		C3 sub'd phenanthrene/anth.	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		C4 sub'd phenanthrene/anth.	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		1-Methyl-7-isopropylphenanth.	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		Methyl dibenzothiophene	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		C2 sub'd dibenzothiophene	0.18	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		C3 sub'd dibenzothiophene	0.17	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		C4 sub'd dibenzothiophene	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		Methyl fluoranthene/pyrene	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		Methyl B(a)A/chrysene	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		C2 sub'd B(a)A/chrysene	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		Methyl B(b&k)F/B(a)P	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		C2 sub'd B(b&k)F/B(a)P	N.D.	0.08	ug/L (ppb)	11/17/95	11/25/95	MJL
		Phenolic Compounds in H2O						
		Phenol	N.D.	0.1	ug/L (ppb)	11/17/95	11/20/95	MBM
		o-Cresol	N.D.	0.1	ug/L (ppb)	11/17/95	11/20/95	MBM
		m-Cresol	N.D.	0.1	ug/L (ppb)	11/17/95	11/20/95	MBM
		p-Cresol	N.D.	0.1	ug/L (ppb)	11/17/95	11/20/95	MBM
		2,4-Dimethylphenol	N.D.	0.1	ug/L (ppb)	11/17/95	11/20/95	MBM
		2-Nitrophenol	N.D.	0.2	ug/L (ppb)	11/17/95	11/20/95	MBM
		4-Nitrophenol	N.D.	20	ug/L (ppb)	11/17/95	11/20/95	MBM
		2,4-Dinitrophenol	N.D.	20	ug/L (ppb)	11/17/95	11/20/95	MBM
		4,6-Dinitro-2-methylphenol	N.D.	20	ug/L (ppb)	11/17/95	11/20/95	MBM
		PANH & Alkylated PANH's						
		Quinoline	N.D.	0.02	ug/L (ppb)	11/17/95	11/24/95	MJL
		7-Methyl quinoline	N.D.	0.02	ug/L (ppb)	11/17/95	11/24/95	MJL
		C2 Alkyl subst'd quinolines	N.D.	0.02	ug/L (ppb)	11/17/95	11/24/95	MJL
		C3 Alkyl subst'd quinolines	N.D.	0.02	ug/L (ppb)	11/17/95	11/24/95	MJL
		Acridine	N.D.	0.02	ug/L (ppb)	11/17/95	11/24/95	MJL
		Methyl acridine	N.D.	0.02	ug/L (ppb)	11/17/95	11/24/95	MJL
		Phenanthridine	N.D.	0.02	ug/L (ppb)	11/17/95	11/24/95	MJL
		Carbazole	N.D.	0.02	ug/L (ppb)	11/17/95	11/24/95	MJL
		Methyl carbazoles	N.D.	0.02	ug/L (ppb)	11/17/95	11/24/95	MJL
		C2 Alkyl subst'd carbazoles	N.D.	0.02	ug/L (ppb)	11/17/95	11/24/95	MJL
		Volatile Organics (MS):H20						
		Dichlorodifluoromethane	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Chloromethane	N.D.	50	ug/L (ppb)	11/17/95	11/17/95	MAA
		Vinyl chloride	N.D.	100	ug/L (ppb)	11/17/95	11/17/95	MAA
		Bromomethane	N.D.	50	ug/L (ppb)	11/17/95	11/17/95	MAA
		Chloroethane	N.D.	50	ug/L (ppb)	11/17/95	11/17/95	MAA
		Ethanol	N.D.	500	ug/L (ppb)	11/17/95	11/17/95	MAA
		Trichlorofluoromethane	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Acrolein	N.D.	500	ug/L (ppb)	11/17/95	11/17/95	MAA
		Acetone	N.D.	500	ug/L (ppb)	11/17/95	11/17/95	MAA
		1,1-Dichloroethene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Iodomethane	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Carbon disulfide	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Methylene chloride	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA

ENVIRO-TEST CHEMICAL ANALYSIS REPORT

LAB ID	SAMPLE ID	TEST DESCRIPTION	RESULT	D.L.	UNITS	EXTRACTED	ANALYZED	BY
E511114-01	95447							
Sample Type:WATER								
Collected:11/03/95								
		Acrylonitrile	N.D.	500	ug/L (ppb)	11/17/95	11/17/95	MAA
		trans-1,2-Dichloroethene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Vinyl acetate	N.D.	500	ug/L (ppb)	11/17/95	11/17/95	MAA
		1,1-Dichloroethane	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		2-Butanone (MEK)	N.D.	500	ug/L (ppb)	11/17/95	11/17/95	MAA
		Chloroform	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		1,1,1-Trichloroethane	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Carbon tetrachloride	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Benzene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		1,2-Dichloroethane	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Trichloroethene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		1,2-Dichloropropane	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Bromodichloromethane	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Dibromomethane	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		2-Chloroethylvinylether	N.D.	25	ug/L (ppb)	11/17/95	11/17/95	MAA
		4-Methyl-2-pentanone (MIBK)	N.D.	1000	ug/L (ppb)	11/17/95	11/17/95	MAA
		cis-1,3-Dichloropropene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Toluene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Ethyl methacrylate	N.D.	1000	ug/L (ppb)	11/17/95	11/17/95	MAA
		trans-1,3-Dichloropropene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		2-Hexanone	N.D.	1000	ug/L (ppb)	11/17/95	11/17/95	MAA
		1,1,2-Trichloroethane	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Tetrachloroethylene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Dibromochloromethane	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Ethylene dibromide	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Chlorobenzene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Ethylbenzene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		m+p-Xylenes	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		o-Xylene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		Styrene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		cis-1,4-Dichloro-2-butene	N.D.	10	ug/L (ppb)	11/17/95	11/17/95	MAA
		Bromoform	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		1,1,2,2-Tetrachloroethane	N.D.	25	ug/L (ppb)	11/17/95	11/17/95	MAA
		1,2,3-Trichloropropane	N.D.	10	ug/L (ppb)	11/17/95	11/17/95	MAA
		trans-1,4-Dichloro-2-butene	N.D.	25	ug/L (ppb)	11/17/95	11/17/95	MAA
		1,3-Dichlorobenzene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		1,4-Dichlorobenzene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA
		1,2-Dichlorobenzene	N.D.	5	ug/L (ppb)	11/17/95	11/17/95	MAA

N.D. - NOT DETECTED, LESS THAN THE DETECTION LIMIT

THIS IS THE FINAL PAGE OF THE REPORT

ENVIRO-TEST QA/QC REPORT

PAH & Alkylated PAH's

Surrogate Recovery for E51111401A	%
Nitrobenzene d5	90
2-Fluorobiphenyl	86
p-Terphenyl d14	121

PANH & Alkylated PANH's

Average Surrogate Recovery for E511114	%
Quinoline d7	97

Phenolic Compounds in H2O

Average Surrogate Recovery for E511114	%
2-Fluorophenol	44
Phenol d5	33
2,4,6-Tribromophenol	90

Volatile Organics (MS):H20

Average Surrogate Recovery for E511114	%
1,2-Dichloroethane d4	111
Toluene d8	86
4-Bromofluorobenzene	97

Relative percent difference is expressed as RPD.
Percent Recovery is expressed as %.
THIS IS THE LAST PAGE OF THE QAQC REPORT

Appendix A Test Methodologies

Hydrocarbons,Recoverable

Preparation Method: Separatory funnel extraction with 80% to 20% Hexane to MTBE; silica gel addition.
Instrumental Method: Gravimetric analysis
Method Reference: H/C ENVIRODAT 6579 APHA 5520F

PAH & Alkylated PAH's

Preparation Method: Liquid/liquid extraction with DCM, methylation

Instrument Method: GC/MSD analysis

Method Reference: Extraction Method: EPA 3540 (modified)
Analytical Method: EPA 8270 (modified)

Phenolic Compounds in H2O

Preparation Method: Liquid/liquid extraction with DCM, acetylation

Instrument Method: GC/MSD analysis

Method Reference: Extraction Method: EPA 3510 (modified)
Analytical Method: EPA 8270 (modified)

PANH & Alkylated PANH's

Volatile Organics (MS):H2O

Preparation Method: Automated headspace

Instrument Method: GC/MSD analysis

Method Reference: Extraction Method: EPA 3810 (modified)
Analytical Method: EPA 8240 (modified)

THIS IS THE LAST PAGE OF THE METHODOLOGY APPENDIX.

Attn: Shelley Prendergast

88

GOLDER ASSOCIATES LTD.
CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Field Sampler: (Signature) Mary Gregory
Phone No: (403) 253-7121

Shipment Date: 95/11/03 ES11114
Carrier: ETL
Weigh Bill No.: N/A

Ship To: EnviroTest Laboratories Ltd,
9936-67th Ave,
Edmonton, AB.
T6E 0P5

Send Results To: HydroQual Laboratories Ltd,
#3, 6125-12 Street S.E,
Calgary AB. T2H 2K1.
Attn: Mary Gregory

Project Name: 95030

Project No. 952-2307
P.O. No.: 95135

Relinquished by: (Signature)	Received at lab by: (Signature)	Date	Time
Mary Gregory	Michael Kelly	Nov. 3/95	12:00 p.m.
Michael Kelly	[illegible]	Nov. 4/95	a.m.
Relinquished by: (Signature)	Received at lab by: (Signature)	Date	Time
Relinquished from lab by: (Signature)	Received by: (Signature)	Date	Time

SAMPLES LEFT IN CALG.
YES ____ (NO) *

ANALYSIS REQUEST

Sample ID No.	Sample Description	Date/Time Sampled	Analysis Requested	Sample Condition Upon Receipt	
95447	Effluent	95/11/03	PAH/Alkylated PAH Analysis	ES11114	PAH7WI
"			PANH Analysis		PNH3WI
"			Total extractables analysis		PHEN1WI
"			Non-chlorinated phenols		HOG1WI
"			8240/624 volatile organics		VOC1WI

Special Instructions/Comments: Lab Quotation no: C95-073

Rush (surcharge): _____ Standard Turnaround Time: ✓

[signature] Nov 6/95

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CHEMICAL ANALYSIS REPORT

SUNCOR INC. OSG
P.O. BOX 4001
FORT MCMURRAY, AB
T9H 3E3

DATE: November 22, 1995

ATTN: JOHN GULLEY

Lab Work Order #: E510770 **Sampled By:** L.P.

Project Reference: 95DJ04.QUO **Date Received:** 10/30/95

Project P.O.#: NOT SUBMITTED

Comments:

APPROVED BY:

Doug Johnson
Project Manager

ACCREDITED BY: (Edmonton)
CANADIAN ASSOCIATION OF ENVIRONMENTAL ANALYTICAL LABORATORIES (CAEAL) - For specific tests regist with the Association
STANDARDS COUNCIL OF CANADA - Organic & Industrial Hygiene analysis as registered with the Council
AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA) - Industrial Hygiene analysis registered by AIHA
AGRICULTURE CANADA - Pesticide in Fruits and Vegetables, pesticides and PCP in meat

CERTIFIED BY: (Calgary)
CANADIAN ASSOCIATION OF ENVIRONMENTAL ANALYTICAL LABORATORIES (CAEAL) - For specific tests regis with the Association

ENVIRO-TEST CHEMICAL ANALYSIS REPORT

LAB ID	SAMPLE ID	TEST DESCRIPTION	RESULT	D.L.	UNITS	EXTRACTED	ANALYZED	BY
E510770-01	6153-254-4							
Sample Type:WATER								
Collected:10/27/95								
		PAH & Alkylated PAH's						
		Naphthalene	N.D.	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Acenaphthylene	N.D.	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Acenaphthene	N.D.	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Fluorene	N.D.	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Dibenzothiophene	0.09	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Phenanthrene	N.D.	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Anthracene	N.D.	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Fluoranthene	0.04	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Pyrene	0.15	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Benzo(a)anthracene/Chrysene	0.24	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Benzo(b&k)fluoranthene	0.04	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Benzo(a)pyrene	0.05	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Indeno(c,d-123)pyrene	N.D.	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Dibenzo(a,h)anthracene	N.D.	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Benzo(ghi)perylene	0.03	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Methyl naphthalene	0.08	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		C2 sub'd naphthalene	1.1	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		C3 sub'd naphthalene	0.44	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		C4 sub'd naphthalene	0.26	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		Biphenyl	N.D.	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		Methyl biphenyl	0.04	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		C2 sub'd biphenyl	0.08	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		Methyl acenaphthene	0.20	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		Methyl fluorene	N.D.	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		C2 sub'd fluorene	0.09	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		Methyl phenanthrene/anthracene	0.06	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		C2 sub'd phenanthrene/anth.	0.32	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		C3 sub'd phenanthrene/anth.	1.1	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		C4 sub'd phenanthrene/anth.	0.82	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		1-Methyl-7-isopropylphenanth.	N.D.	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		Methyl dibenzothiophene	0.14	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		C2 sub'd dibenzothiophene	0.46	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		C3 sub'd dibenzothiophene	1.1	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		C4 sub'd dibenzothiophene	1.1	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		Methyl fluoranthene/pyrene	0.38	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		Methyl B(a)A/chrysene	0.57	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		C2 sub'd B(a)A/chrysene	0.70	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		Methyl B(b&k)F/B(a)P	0.24	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		C2 sub'd B(b&k)F/B(a)P	0.23	0.04	ug/L (ppb)	11/07/95	11/10/95	MJL
		Phenolic Compounds in H2O						
		Phenol	N.D.	0.1	ug/L (ppb)	11/07/95	11/14/95	MBM
		o-Cresol	N.D.	0.1	ug/L (ppb)	11/07/95	11/14/95	MBM
		m-Cresol	N.D.	0.1	ug/L (ppb)	11/07/95	11/14/95	MBM
		p-Cresol	N.D.	0.1	ug/L (ppb)	11/07/95	11/14/95	MBM
		2,4-Dimethylphenol	N.D.	0.1	ug/L (ppb)	11/07/95	11/14/95	MBM
		2-Nitrophenol	N.D.	0.2	ug/L (ppb)	11/07/95	11/14/95	MBM
		4-Nitrophenol	N.D.	2	ug/L (ppb)	11/07/95	11/14/95	MBM
		2,4-Dinitrophenol	N.D.	2	ug/L (ppb)	11/07/95	11/14/95	MBM
		4,6-Dinitro-2-methylphenol	N.D.	2	ug/L (ppb)	11/07/95	11/14/95	MBM
		PANH & Alkylated PANH's						
		Quinoline	N.D.	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		7-Methyl quinoline	4.4	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		C2 Alkyl subst'd quinolines	4.3	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		C3 Alkyl subst'd quinolines	2.5	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Acridine	0.51	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Methyl acridine	0.59	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Phenanthridine	0.39	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Carbazole	N.D.	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Methyl carbazoles	1.0	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		C2 Alkyl subst'd carbazoles	0.68	0.02	ug/L (ppb)	11/07/95	11/10/95	MJL
		Volatile Organics (MS):H20						
		Dichlorodifluoromethane	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Chloromethane	N.D.	10	ug/L (ppb)	11/15/95	11/15/95	MAA
		Vinyl chloride	N.D.	20	ug/L (ppb)	11/15/95	11/15/95	MAA
		Bromomethane	N.D.	10	ug/L (ppb)	11/15/95	11/15/95	MAA
		Chloroethane	N.D.	10	ug/L (ppb)	11/15/95	11/15/95	MAA
		Ethanol	N.D.	100	ug/L (ppb)	11/15/95	11/15/95	MAA
		Trichlorofluoromethane	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Acrolein	N.D.	100	ug/L (ppb)	11/15/95	11/15/95	MAA
		Acetone	N.D.	100	ug/L (ppb)	11/15/95	11/15/95	MAA
		1,1-Dichloroethene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Iodomethane	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Carbon disulfide	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Methylene chloride	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Acrylonitrile	N.D.	100	ug/L (ppb)	11/15/95	11/15/95	MAA

ENVIRO-TEST CHEMICAL ANALYSIS REPORT

LAB ID	SAMPLE ID	TEST DESCRIPTION	RESULT	D.L.	UNITS	EXTRACTED	ANALYZED	BY
E510770-01	6153-254-1							
Sample Type:WATER								
Collected:10/27/95								
		trans-1,2-Dichloroethene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Vinyl acetate	N.D.	100	ug/L (ppb)	11/15/95	11/15/95	MAA
		1,1-Dichloroethane	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		2-Butanone (MEK)	N.D.	100	ug/L (ppb)	11/15/95	11/15/95	MAA
		Chloroform	3	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		1,1,1-Trichloroethane	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Carbon tetrachloride	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Benzene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		1,2-Dichloroethane	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Trichloroethene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		1,2-Dichloropropane	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Bromodichloromethane	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Dibromomethane	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		2-Chloroethylvinylether	N.D.	5	ug/L (ppb)	11/15/95	11/15/95	MAA
		4-Methyl-2-pentanone (MIBK)	N.D.	200	ug/L (ppb)	11/15/95	11/15/95	MAA
		cis-1,3-Dichloropropene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Toluene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Ethyl methacrylate	N.D.	200	ug/L (ppb)	11/15/95	11/15/95	MAA
		trans-1,3-Dichloropropene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		2-Hexanone	N.D.	200	ug/L (ppb)	11/15/95	11/15/95	MAA
		1,1,2-Trichloroethane	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Tetrachloroethylene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Dibromochloromethane	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Ethylene dibromide	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Chlorobenzene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Ethylbenzene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		m+p-Xylenes	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		o-Xylene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		Styrene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		cis-1,4-Dichloro-2-butene	N.D.	2	ug/L (ppb)	11/15/95	11/15/95	MAA
		Bromoform	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		1,1,2,2-Tetrachloroethane	N.D.	5	ug/L (ppb)	11/15/95	11/15/95	MAA
		1,2,3-Trichloropropane	N.D.	2	ug/L (ppb)	11/15/95	11/15/95	MAA
		trans-1,4-Dichloro-2-butene	N.D.	5	ug/L (ppb)	11/15/95	11/15/95	MAA
		1,3-Dichlorobenzene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		1,4-Dichlorobenzene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA
		1,2-Dichlorobenzene	N.D.	1	ug/L (ppb)	11/15/95	11/15/95	MAA

N.D. - NOT DETECTED, LESS THAN THE DETECTION LIMIT

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NOT INCLUDING APPENDICES

ENVIRO-TEST QA/QC REPORT

PAH & Alkylated PAH's

Average Surrogate Recovery for E510770	%
Nitrobenzene d5	105
2-Fluorobiphenyl	78
p-Terphenyl d14	87

PANH & Alkylated PANH's

Average Surrogate Recovery for E510770	%
Quinoline d7	116

Phenolic Compounds in H2O

Average Surrogate Recovery for E510770	%
2-Fluorophenol	26
Phenol d5	25
2,4,6-Tribromophenol	92

Volatile Organics (MS):H20

Average Surrogate Recovery for E510770	%
1,2-Dichloroethane d4	99
Toluene d8	87
4-Bromofluorobenzene	104

Relative percent difference is expressed as RPD.
Percent Recovery is expressed as %.
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Appendix A Test Methodologies

PAH & Alkylated PAH's

Preparation Method:	Liquid/liquid extraction with DCM, methylation
Instrument Method:	GC/MSD analysis
Method Reference:	Extraction Method: EPA 3540 (modified) Analytical Method: EPA 8270 (modified)

Phenolic Compounds in H2O

Preparation Method:	Liquid/liquid extraction with DCM, acetylation
Instrument Method:	GC/MSD analysis
Method Reference:	Extraction Method: EPA 3510 (modified) Analytical Method: EPA 8270 (modified)

PANH & Alkylated PANH's

Volatile Organics (MS):H20

Preparation Method:	Automated headspace
Instrument Method:	GC/MSD analysis
Method Reference:	Extraction Method: EPA 3810 (modified) Analytical Method: EPA 8240 (modified)

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