



UNIVERSITY
OF MANITOBA

**Churchill Marine Observatory
Manitoba Environment Act Proposal**
FINAL

KGS Group 15-1736-008
November 2015

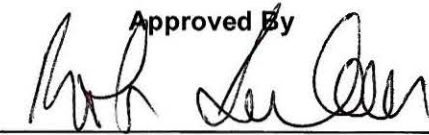
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November 6, 2015

File No. 15-1736-008

Environmental Approvals Branch
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ATTENTION: Ms. Tracey Braun, M.Sc.
Director

RE: Environment Act Proposal
Churchill Marine Observatory
Final Report

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Dear Ms. Braun:

On behalf of the University of Manitoba, KGS Group is pleased to submit four (4) paper and one (1) electronic copy of the final Environment Act Proposal submission to obtain a licence to construct and operate the Churchill Marine Observatory, a Class 1 development under the Classes of Development Regulation (Reg. 164/88). The CMO will use natural saltwater and ambient Arctic conditions to grow sea ice in order to conduct experiments relating to the impacts of oil, liquefied natural gas and other contaminants on the Arctic marine environment.

As part of the licensing process, a Manitoba Conservation Environment Act Proposal Form with the \$1,000.00 application fee has been included with the Environmental Assessment report.

Please do not hesitate to contact the undersigned if you have any questions or require additional information.

Yours truly,

Shaun Moffatt, M.Sc.
Senior Environmental Scientist

SM/gs/jr
Enclosure

cc: David Barber, University of Manitoba
Melissa McAlister, Prairie Architects

EXECUTIVE SUMMARY

Kontzamanis Graumann Smith MacMillan Inc. (KGS Group) was retained by Prairie Architects Inc. to prepare a Manitoba Environment Act Proposal (EAP) to obtain the necessary Environment Act Licence (EAL) for the proposed University of Manitoba Churchill Marine Observatory (CMO). In accordance with the *Environment Act* (C.C.M.S. c. E125) this project is considered a Class 1 Development under Manitoba Regulation 164/88, as indicated by Manitoba Conservation and Water Stewardship, Environmental Approvals Branch.

The University of Manitoba, Centre for Earth Observation Science, plans to construct and operate a globally unique, highly innovative, multidisciplinary research facility located in Churchill, Manitoba, adjacent to Canada's only Arctic deep-water port (Figure 1). The CMO will use natural saltwater and ambient Arctic conditions (cold) to grow sea ice for use in experiments relating to the impacts of oil, liquefied natural gas and other contaminants on the Arctic marine environment.

The development will be constructed just south of Cape Merry National Historic Site and include an Oil in Sea Ice Mesocosm (OSIM) facility (Figure 2); a logistics base with Environmental Observatory (EO) equipment, atmospheric container, meteorological station and labs; and a storage garage. The OSIM facility will have a retractable roof and walls and contain two water tanks designed to simultaneously accommodate contaminated and control experiments on various scenarios of oil spills in sea ice. The OSIM tanks will hold a combined total of approximately 500,000 L of water and ice. The logistics base will include EO equipment for ocean, estuary and atmospheric observations along with labs and will underpin all CMO research. The garage will be used for storage of vehicles (tractors, trucks, quads and boats) and large scientific equipment. Research buildings will be designed to be energy efficient, environmentally friendly and target LEED Silver certification. The area surrounding the OSIM facility, logistics base and storage garage will be lighted and fenced for safety. A boat ramp and dock will be installed west of the main development site on the shore of the Churchill River.

Pipelines running from the OSIM facility to the Churchill River estuary will supply saltwater for production of sea ice. The pipelines along with heat traces and fibre optic cable will be housed and protected within an overland utility box ("utilidor") (Figure 3). The utilidor will be run at surface from the OSIM facility to the pump house at the shoreline of the estuary at which point the pipelines and cables will be directed downward (directionally drilled) through the shoreline material to the river bottom. The intake pipeline, cables and monitoring components of an EO system will be located along the bottom of the main shipping channel across Hudson Bay and Strait.

Within one of the OSIM tanks, oil-in-ice and oil-burn-on-ice experiments will be conducted to simulate the conditions of a natural spill in nature. A mobile fume hood will be used to capture emissions from the oil-burn-on-ice experiments. Following research experiments, contaminated water will be processed on site to remove oil and other contaminants which will be disposed of at a local soil farm. When testing confirms that the treated effluent from the system meets criteria, it will be drained back to the estuary.

Project-environment interactions were assessed to identify potential environmental effects associated with the project activities. There are no major environmental constraints such as rare species or archaeological resources on the site. Mitigation and follow-up measures were

identified for potential adverse environmental effects including, air quality, soils, groundwater, surface water, fish and fish habitat, wildlife and vegetation, health and well-being, and worker safety.

Based on the available information on the project and the environment, the assessment of environmental effects outlined in this environmental assessment report, and the application of proposed mitigation measures and the conduct of required follow-up, the proposed CMO will not likely result in any significant residual adverse environmental effects.

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1.0 INTRODUCTION

Kontzamanis Graumann Smith MacMillan Inc. (KGS Group) was retained by Prairie Architects Inc. to prepare a Manitoba Environment Act Proposal (EAP) to obtain the necessary Environment Act Licence (EAL) for the proposed University of Manitoba Churchill Marine Observatory (CMO). In accordance with the *Environment Act (C.C.M.S. c. E125)* Manitoba Conservation and Water Stewardship, Environmental Approvals Branch has indicated that the project is considered a Class 1 Development under the Classes of Development Regulation (Reg. 164/88).

The University of Manitoba, Centre for Earth Observation Science, plans to construct and operate a research facility located in Churchill, Manitoba, adjacent to Canada's only Arctic deep-water port (Figure 1). The CMO will use natural saltwater and ambient Arctic conditions to grow sea ice in order to conduct experiments relating to the impacts of oil, liquefied natural gas and other contaminants on the Arctic marine environment. The development will include an Oil in Sea Ice Mesocosm (OSIM) facility; a logistics base with Environmental Observatory (EO) equipment and labs; and a storage garage located on a 1.2 hectare parcel of land (Figure 2) south of Cape Merry National Historic Site.

The OSIM facility will have a retractable roof and walls and contain two water tanks designed to simultaneously accommodate contaminated and control experiments on various scenarios of oil spills in sea ice. The OSIM tanks will hold a combined total of approximately 500,000 L of water and ice. Within one of the OSIM tanks, oil-in-ice and oil-burn-on-ice experiments will be conducted. The oil-in-ice experiments will be done to simulate a natural spill in nature. A mobile fume hood will be used to capture emissions from the oil-burn-on-ice experiments. Water contaminated during the experiments will be processed on site to remove oil and other contaminants. Treated effluent that meets appropriate criteria will be drained back to the estuary and the contaminants will be disposed of at a local soil farm.

The logistics base will include EO equipment for simultaneous ocean, estuary and atmospheric observations along with labs and will underpin all CMO research. The garage will be used for storage of vehicles (tractors, trucks quads and boats) and large scientific equipment. Research buildings will meet the Manitoba Energy Code for Building requirements, be energy efficient,

environmentally friendly and the design will target LEED Silver certification. The area surrounding the OSIM facility, logistics base and storage garage, including a parking area will be lighted and fenced for safety.

A boat ramp and dock will be installed west of the main development site on the shore of the Churchill River. Hydroelectricity will be extended to the site and potable water will be brought in from the town and stored on site in a cistern. Solid waste and sewage will be collected and disposed at the appropriate local facilities. Access to the site will be by means of an existing public road which may be upgraded and have additional lighting installed and will be maintained (snow clearing) by the Town of Churchill.

An important component of the development will be water supply lines running from the OSIM facility to the Churchill River estuary from which saltwater will be drawn for production of sea ice. An insulated and heat-traced overland utility box (“utilidor”) will house and protect the pipelines as well as power and fibre optic cable (Figure 3). The utilidor will be constructed along a granular bed from the OSIM facility to the pump house at the shoreline of the Churchill River at which point the pipelines and cables will be directed downward (directionally drilled) through the shoreline material to the river bottom. The intake pipeline and components of an EO system will be located along the main shipping channel across Hudson Bay and Strait.

This document provides the information required for the University of Manitoba to obtain a Class 1 Development Licence under the *Environment Act* for the construction and operation of the proposed CMO.

2.0 DESCRIPTION OF DEVELOPMENT

The following sections have been structured to address the requirements of the Description of Development as outlined in the Environment Act Proposal Form.

2.1 CERTIFICATE OF TITLE

The proposed project site is located primarily on provincial Crown Land, with a portion on land privately owned by OmniTRAX. A Status of Title for the Crown Land was obtained from the Property Registry of Manitoba for Title Number 2433362/3 (Appendix A). The University of Manitoba has received an Interim General Permit (No. 70363) which will allow for use of the site for the CMO, noting that a lease agreement will be determined following completion of a land survey (Appendix A). The University of Manitoba is in negotiations with OmniTRAX to allow the construction of the utilidor, pump house, boat ramp and dock on OmniTRAX land in order to access the Churchill River.

The water pipes and cables protected by the utilidor will extend past the shoreline and will lay on the bottom of the Churchill River estuary along with environmental monitoring equipment as part of the EO system. The ownership of the bed of the river at this location is under federal jurisdiction and a Notice of Works Form has been submitted to the Navigation Protection Program of Transport Canada.

2.2 MINERAL RIGHTS

The owner of the mineral rights beneath the site location for the OSIM facility and logistics base is currently and will remain with the Province of Manitoba. The present owner of the mineral rights beneath the OmniTRAX land will remain unchanged by the project.

2.3 EXISTING AND ADJACENT LAND USE

The site is located on provincial Crown Land within the limits of the Town of Churchill, immediately southeast of Cape Merry National Historic Site (Appendix B, Photo 1) and north of private land owned by OmniTRAX. Cape Merry is named after Captain John Merry, Deputy

Governor of the Hudson's Bay Company from 1712-1718, and is home to a stone battery that was constructed in 1746. Located at the mouth of the Churchill River, Cape Merry is used by whale and bird watchers and for the panoramic view.

South of the site is the Town of Churchill which grew from a remote outpost to a bustling seaport with the construction of the Hudson Bay Railroad and the Port of Churchill in the late 1920s. Through much of the 1950s and 1960s, the town was a thriving military community ⁽¹⁾.

The Port of Churchill, south of the project site, is an important link for the export of Canadian grain to European markets and it is Canada's principal seaport on the Arctic Ocean (Photo 2). Water depths in the harbor vary as a result of tidal fluctuations in the range of 4.5 m. The width of the Churchill River opposite the wharf face is about 2.6 km, whereas, the navigation channel is approximately 350 m wide at the harbor entrance. Compulsory pilotage, assistance by tugboats, is required for all merchant ships entering and exiting the harbor and is provided by the Port of Churchill. Under Canada's Arctic Waters Shipping Safety Control Zone regime, navigation in Hudson Bay is permitted from July 20 to October 31. Ice-strengthened vessels have a longer season and vessels bearing a type "A" classification are authorized to navigate between 25 June and 30 November.

2.4 LAND USE DESIGNATION AND ZONING

The proposed project site, as previously noted, is located on provincial Crown Land that under the Town of Churchill Zoning By-Law (714/01) is presently zoned as "M" Industrial. The Town of Churchill approved an amendment to the bylaw (773/2015), passed on September 10, 2015, which adds "Research Facilities" as a Conditional Use in areas zoned "M" Industrial (Appendix A).

2.5 PREVIOUS STUDIES AND ACTIVITIES

Two sites were considered for construction of the CMO. Site "A" was initially selected due to the combination of an appropriately flat site (Figure 2) and proximity to the water at a position on the estuary with appropriate salinity. A new site had to be found when OmniTRAX, the property owners of Site "A," decided that they did not want to pursue construction of the CMO on their

property. A site investigation for Site “B”, the current proposed project site, was conducted in June 2015 in order to determine if the site would be suitable for the project. A brief summary of the investigation of Site “B” and additional engineering considerations is given below.

2.5.1 CMO - Engineering Services Site Selection Report

A site visit was completed on June 10, 2015 to investigate the site proposed for construction of the CMO. The site is dominated by exposed and ice-eroded bedrock which consists of elongated ridges of Churchill Quartzite. There is no overburden or soil on site and, from a civil engineering perspective, the bedrock is considered to be sound and competent. Site drainage is irregular with water ponding in low spots and depressions in the bedrock (Photo 3). There was no visible indication of any pre- or post-European contact historic resources or development.

There was no topographic information available for the site at the time of the inspection and it was noted that a detailed topographic survey will be required in order for layout and design of the facility. This topographic survey has since been completed as recommended. Designers will need to consider whether the OSIM tanks are to be above ground or in ground for this terrain, for this climate, and recognizing the end use of the tanks.

Two alternate routes for the pipeline were under consideration at the time of the site inspection. The first route, which is the shortest route, follows a gravel surface trail crossing OmniTRAX Land westward to the Churchill River. The second route, which is longer, would go north on federal and provincial crown land and then turn west toward the river. Either route is technically feasible but the OmniTRAX route is shorter and follows gentler terrain. The OmniTRAX crossing would require some form of agreement with OmniTRAX which was not in place at the time of the inspection.

Each route is dominated by shallow rock or very shallow rock and based upon ground thermal monitoring data near the Churchill Airport, it is suspected that the bedrock terrain on site may be frozen at great depth with a seasonally active layer near surface. It is assumed therefore that it is not practical to either directionally drill or trench a pipeline on land and place it deeper than the depth of frost penetration (conventional pipe design) unless an allowance for heating the line forms part of the design. At this stage the simpler and preferred option would appear to be a

heated above grade utility corridor. Any consideration for burial or directional drilling should consider that permafrost in this region goes quite deep and subsurface installation would require heat tracing.

2.6 PROPOSED DEVELOPMENT

2.6.1 Schedule

Assuming the necessary approvals and licence are obtained construction will begin in 2016 as soon as seasonable conditions allow in Churchill, likely June 2016. The University of Manitoba is working with Manitoba Hydro to extend the electricity to the site, which will also occur in 2016 around the same time as project construction. Construction is expected to last for one full summer construction season with some possible overrun into 2017.

Operations will begin upon completion of construction and acquisition and installation of key pieces of equipment, targeted no later than June 2017. No date for decommissioning has been set.

2.6.2 Project Components

The development will include an OSIM facility, a logistics base with EO equipment and labs and a storage garage as shown in Figure 2 and described in the following sections. The entire facility will be fenced with flood lighting bright enough to spot a polar bear in a snowstorm and the buildings will include bear deterrents should a bear get inside the fence. Leveling of the site will require some bedrock blasting depending on the final design. A utility corridor for water pipelines, power and fibre optic cables will run from the OSIM facility along the south side of the access road to a pump house at the shore of the Churchill River. At the shoreline, directional drilling will be used to install the pipelines and cables through the shoreline material and into the river below ice level. A boat launch will be constructed and seasonal dock will be installed at the cobble beach shore of the Churchill River (Photo 4). A small pump house will be constructed above the high tide line in order to house saltwater and freshwater pumping equipment. Access to the main development site and shoreline infrastructure will be by means of an existing public road from the Town of Churchill to the Cape Merry National Historic Site (Photo 5).

OSIM Facility

The OSIM facility will have a retractable roof and walls, two 250,000 L water tanks for OSIM experiments and a mechanical room / storage area to store scientific instruments when they are not in use. Preliminary design drawings showing the plan and elevations of the OSIM facility are provided in Appendix C. Lighting will be provided in the OSIM facility to allow work in all weather conditions. At tank level, the deck will be cement all around and there will be no permanent obstructions within 2.5 m of the tank to allow placement of research equipment and movement of personnel. 115V and 220V electrical service will be provided at regular (1.5 m) intervals around the deck perimeter and on the upper observation deck. The upper deck will be approximately 3 m above the surface of the tanks and will include the capacity to mount an overhead cable system for aerial remote sensing studies.

The OSIM tanks will each have inside dimensions of approximately 9.15 x 9.15 x 3 metres and hold a combined total of approximately 500,000 L of water and ice. There is a potential that the OSIM tanks will be slightly embedded, which would require additional bedrock blasting, but this will be decided upon during final design. There will be a permanent division between the two tanks in order to create two independent tanks. One tank will be used for contaminant experiments and the other will be kept “clean” as a control. The walls of the tanks will be insulated. A water heater will be included in the design to thaw the OSIM between experiments and to conduct experiments with ocean heat fluxes. This will be achieved using circulation of heated water as in a swimming pool. Circulation pumps will simulate ocean currents, dynamic forcing of sea ice, and to help limit freezing for some experiments. The tank design will include moon pools to allow entry into the tank below water and ice level. Underwater lighting and the capacity to mount an underwater cable system or to install underwater sensors for underwater remote sensing experiments will be provided and the design will include provisions for installation of a wave generator mounted between the two tanks.

OSIM Pipeline and Utilidor

OSIM infrastructure will include pipelines to fill and drain the tanks. The pipeline alignment will be run south of the Cape Merry access road along a gravel surface trail that crosses OmniTRAX land to a pump house and then along the bottom of the Churchill River out into the estuary. The

pipelines as well as aquatic components of the EO system including power and fibre optic cables will be housed and protected within a heated overland utility corridor (“utilidor”) which will be approximately 0.75 m x 0.5 m. The utilidor will run along the ground from the OSIM facility to the pump house at the shoreline of the river at which point the pipelines and cables will be directionally drilled through the shoreline material to the river bottom below ice level. Directional drilling is proposed to protect the pipelines and cables to a depth where they cannot be affected by ice scouring along the shoreline (Photo 6). As an alternative to directional drilling the utilidor could run along the surface of the shoreline down to the river bottom, however this would need to be appropriately armoured or shielded to protect against ice scour.

The intake pipeline will bring ocean water approximately 1,500 m from the estuary to the OSIM. The intake pipeline diameter will be approximately 100 mm and the pump will be sized to allow the OSIM tanks to be filled within 48 hours. The system design will include the ability to fill the OSIM tanks with fresh water using a temporary line which couples to the utilidor and can be towed by boat in order to retrieve freshwater from the surface of the Churchill River. A separate pipeline will allow uncontaminated and treated water to be drained from the OSIM tanks to a place below the water line near the shore of the river.

The pipelines, power and fibre optic cable will be moored along the bottom of the estuary and once installed will have no effect on shipping vessels, other water craft or fish. Concrete weights will be used to hold down the pipeline and the cables will be attached to the weights. Similar installations in other areas of the world exist without interference to shipping or negative effects on the marine environment. Equipment that will be part of the aquatic EO system will be situated at the end of the intake pipe along the main shipping channel across Hudson Bay and Strait. The EO system will be a state-of-the-art monitoring system and will be used to scale process studies conducted in the OSIM to Hudson Bay and the larger Arctic environment.

The water intake will be screened to prevent entrainment or impingement of fish in accordance with the DFO measures to avoid causing harm to fish and fish habitat when water is withdrawn from fish-bearing waters. Water withdrawal from the Churchill River has the potential to affect fish species representing both the subcarangiform and anguilliform groups. Because the fish species found in the river include those of the anguilliform group (Appendix D), smaller screen sizes and more stringent maximum through-screen velocity criteria have been applied to the

water intakes. The water intake screen design will fulfill the requirements described in the DFO Freshwater Intake End-of-Pipe Fish Screen Guideline ⁽²⁾.

Logistics Base and Labs

The Logistics Base and labs will directly support all parts of the research conducted at the CMO. The space will be subdivided into a logistics room, data acquisition and server room and three labs which will be used to prepare and maintain electronic equipment, prepare, analyze and store samples from the OSIM tanks and coordinate activities.

A logistics room (approximately 3 x 6 m) will be provided with a folding table and chairs, data projector, screen and high speed internet connection. This space will be used to accommodate larger groups (10-15) for scientific equipment preparation and/or maintenance, planning and coordination of research activities. A basic kitchen including microwave, fridge, kettle and sink will be provided and may be co-located with the logistics room.

A data acquisition room, approximately 19 m² in size will be included as part of the Logistics Base and will receive the data streams coming from the aquatic and atmospheric EO equipment. The data acquisition room will have weatherproof portals for connecting external sensors to the EO system and support for telecom, data storage and the server electronics required to support the EO.

Separate wet and dry labs will each be approximately 46 m² and accommodate up to seven people at a time. They will include a fume hood, counter and storage space, ventilation, running water, power etc. for analytical instrumentations (e.g. roto and nitrogen evaporators, freeze dryers, ovens, mass spectrometers, microwaves). A cold lab (approximately 28 m²) will include three nested walk-in freezers (approximately 9 m² each) with a temperature range from -5 to -30 °C. The cold lab will use natural cold.

Atmospheric Environmental Observatory

The atmospheric environmental observatory includes a basic surface meteorological station and a container laboratory. The surface meteorological station measures air temperature, wind

speed/direction, etc. using a cluster of sensors. The station will be located away from any obstructions due to the sensitive nature of the sensors (Figure 2). The container laboratory is a metal container (approximately 3.7 x 6 m) with a reinforced roof to monitor other meteorological parameters (e.g., precipitation, water content, fog), as well as atmospheric chemistry and air quality (e.g., ozone, sulfur oxides, nitrogen oxides, mercury, aerosols). The sensors and air inlets will be located on the roof. A tall tower (approximately 20 m) will be set up adjacent to the container to fix additional sensors at higher elevations. The cables of all of the sensors and air sample lines will run into the container where a suite of analytical instruments will be housed. The data will be transferred by telemetry to the data acquisition room that is part of the Logistics Base. The atmospheric environmental observatory will be supplied with 115 volt AC and will be heated. Several gas cylinders (nitrogen, argon) will be installed in the container.

Garage

A garage is required for storage of boats, vehicles and the large scientific equipment that is part of the EO (moorings will include steel cabling, weights, instruments, etc.). The garage will be constructed in the same area as the OSIM facility and Logistics Base as shown in Figure 2. The garage will be approximately 12 m x 18 m, have metal siding and be insulated throughout. Ceilings will be just over four metres and a third of the building will include a loft (storage on top and workshop below). The garage will be supplied with 115 and 220 volt AC. Parking at the garage will include electrical service for four vehicles. A parking area will be provided across the road from the OSIM facility and garage for up to six boats.

Dock, Boat Ramp and Pump House

The CMO will have a research boat up to 9 m (30 ft) long that will accommodate research in the Churchill River estuary and at the mouth of the Nelson River. A floating dock will be installed at the shore and will extend approximately 12 m into the estuary at low tide in order to accommodate the research boat. A structural gangplank approximately 40 m long will be anchored on the shore and will provide access to the floating dock through the full tidal cycle. The structural gangplank will securely anchor the floating dock to prevent drifting from the river current and during tide changes. The gangplank and dock will be removed each fall. A boat ramp approximately 4 m wide will be constructed near the dock. The ramp will be long enough

to allow launching of research boats during high tide and potentially the upper range of the tide cycle. The ramp may be constructed of concrete, although alternative non-permanent ramp options are still being investigated. It will be constructed in such a way as to avoid the need for a cofferdam large enough to accommodate the 5 m tidal fluctuations to construct in dry conditions. As previously noted a pump house will be constructed above the high tide line on a 3.5 x 3.5 m concrete pad in order to house saltwater and freshwater pumping equipment and hoses. The building will be clad in appropriate building material based on final design requirements.

2.6.3 Operation and Maintenance

The number of people at any given time at the CMO would range from two to twenty people. The facility will be open year round with at least two technicians on site to monitor water/ weather/environmental equipment and experiments. Normal working days will apply when OSIM experiments are not being run, but during experiments it may operate 24 hours per day, 7 days per week.

OSIM Experiments

The OSIM tanks will be filled up to five times per season with saltwater from the estuary (approximately 2,500,000 L) and likely only once per season with fresh water (approximately 500,000 L). Discussions with MCWS, Water Stewardship Division (Mr. Rob Matthews) have indicated that a Water Rights Licence will not be required for the proposed water withdrawal location and volumes. Maintenance between experiments in the OSIM will run between three and seven days depending on what was used in the experiment and how much cleaning is required.

The retractable roof and walls of the OSIM facility will allow control over the freeze/thaw environment in order to control impacts from wind and snow on the ice formation in the OSIM tanks. Some of the equipment that will be used on site for testing and sampling ice, snow and water from the tanks will include a manual ice core sampler, temperature probes, pH monitors, salinity monitors and an air analyzer with scrubbers. None of the instruments noted require chemicals or contain hazardous materials. Most of the chemistry work with the samples will be done at the Churchill Northern Studies Centre lab located east of Churchill, or will be shipped down to the University of Manitoba in Winnipeg. There will be some very basic chemistry done

at the OSIM lab, although it will be very minimal. The Material Safety Data Sheets (MSDS) for the crude oil, chemicals and herding agents that may be used in experiments at the CMO are included in Appendix E.

Two general types of experiments will be conducted in the OSIM: oil-in-ice and oil-burn-on-ice. The oil-in-ice experiments will be done to simulate a natural spill in nature and oil will be applied to the water and ice at a thickness of 5 mm. For the oil-burn-on-ice experiments the oil thickness will be 20 mm and a corral will be used to contain the oil to an approximate 1.5 m x 1.5 m area. A mobile 1.5 m x 1.5 m fume hood will be used to capture air emissions from the oil-burn-on-ice experiments. It is estimated that each oil-in-ice experiment could require up to approximately 419 L of oil per experiment and that the oil-burn-on-ice experiments would use approximately 45 L of oil. Given that a barrel of oil contains 159 L it is estimated that the CMO would require between 11 and 12 barrels of crude oil per year between the various experiments. The amount of herding agent and other chemicals used will depend on the experiment design. The fuels and hazardous materials used for these experiments will be handled and appropriate storage constructed in accordance with appropriate acts, regulations and fire codes, in particular *The Dangerous Goods Handling and Transportation Act* and regulations.

Wastewater Treatment System

An on-site wastewater treatment system is required to treat oil-impacted wastewater flows following testing in the OSIM. The turnaround time for treatment of contaminated water will be three days, or less, to accommodate the experiment schedule. The volume of water in the OSIM tank where the oil-in-ice and burn tests will be conducted is expected to be approximately 250,000 L (55,000 Imp. gallons), which is assumed to be the volume of wastewater that will require treatment.

The wastewater treatment system will include a 3-phase system to remove oil from water:

1. Boom/vacuum – A boom will be placed in the tank to push floating oil to one corner of the tank, where a vacuum will be used to remove floating product. The vacuum container will be emptied into waste oil barrels.

2. Oil and Water Separator with Coalescing Plates – The water from the tank will be pumped through an oil and water separator, which would remove remaining free oil using coalescing plate technology.
3. Carbon Filter – Following the oil and water separator process, the wastewater will flow through a carbon filter for final polishing of effluent to meet surface water discharge criteria.

The flow rate through the system is estimated at 75 L/minute (20 GPM), with a total treatment time of approximately two to three days. Prior to discharge, project effluent will be tested to ensure that it meets the Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Marine Aquatic Life and the Manitoba Water Quality Standards, Objectives and Guidelines and the limits specified in the *Environment Act* licence. Treated effluent would flow in a pipe inside the utilidor and discharge below the low tide water level in the estuary. Since the CMO will specifically be looking at the effect of petroleum hydrocarbons on sea ice, contaminants found in petroleum and volatile organic compounds (VOCs) found in crude oil will be specifically monitored as the treated water from the OSIM is drained back to the estuary. Crude oil and other contaminants removed from the water will be stored in appropriately sized containers and transported for disposal at the Churchill soil farm.

OSIM Tank Cleaning

After the OSIM tanks have been drained, they will be cleaned using a light detergent, brushes and a pressure washer to remove any contaminant residue. Appropriate personal protective equipment will be worn by cleaning staff.

Air Scrubber System

A 1.5 m x 1.5 m moveable fume hood is proposed to capture emissions from the oil-burn-on-ice experiments. The fume hood system will use replaceable HEPA and carbon filters to remove unburnt hydrocarbons, formaldehyde, VOCs, particulates and other contaminants from the emissions. Contaminated filters will be disposed in the local landfill. The system will be appropriately designed to ensure that the air effluent satisfies the applicable Canada and Manitoba air quality criteria and the limits specified in the *Environment Act* licence.

Fencing

Periodic inspection and maintenance (twice annually) of the fencing will be conducted to ensure that unauthorized persons and bears cannot access the site.

Roads

The access road may require minor upgrades and will need to be maintained throughout the year to ensure safe transportation of people, equipment and materials to and from the project site. The University of Manitoba has entered into talks with the Town of Churchill to conduct any upgrades and extend maintenance of the existing access road throughout the winter months.

Operational Records

Operational records kept for the CMO will include records of experiment constituents (amount and type of oil used, herding agents, etc.) as well as an annual record of saltwater and freshwater used by the facility. Records will also be kept relating to general operation checks of pumps, valves and pipes for required maintenance and/or replacement.

General Safety Considerations

Consideration of the hazards presented at the site requires some general safety guidelines:

- Clean equipment and tools after usage, wear rubber gloves and other personal protective equipment when working with hydrocarbons or other hazardous materials, see a doctor if injured on the job-site.
- No smoking on-site.
- Ensure all persons with access to the site are aware of the health and safety hazards on the site.
- Personnel should be properly trained and aware of the dangers of working on or near water.
- Stay off the ice unless ice thickness is known. Ice thickness may be highly variable, due to the nature of the experiments being performed.

2.6.4 Funding

The University of Manitoba has been awarded \$12.3M from the Canada Foundation for Innovation as well as \$9.69M from the Province of Manitoba and \$2.5M from Alberta Innovation and Advanced Education. These funds will cover the costs of construction as well as a large part of equipment costs. The total costs for construction will be split approximately 50/50 between the CFI and provincial funds.

2.7 STORAGE OF GASOLINE AND ASSOCIATED PRODUCTS

Gasoline and associated products will likely be temporarily used and stored at the site during construction of the proposed project, in particular to fuel generators if hydro power has not yet been extended to the site. Oil, liquefied natural gas, or other contaminants used for experiments in the OSIM during operation will be stored in an insulated fuel storage shed in appropriate containers and will be handled according to appropriate safety guidelines and the University of Manitoba Controlled Products Standard ⁽³⁾. MSDS sheets are included in Appendix E.

3.0 PHYSICAL ENVIRONMENT

3.1 LOCATION, PHYSIOGRAPHIC SETTING AND CLIMATE

The Town of Churchill is located in northeast Manitoba on the southwest shore of Hudson Bay at the mouth of the Churchill River (Figure 1). Churchill is approximately 966 km by air and 1,697 km by rail from Winnipeg. The town is within the Hudson Bay Lowlands on the Canadian tundra at approximately 58° 46' latitude and 94° 10' longitude. With the exception of winter roads, the only land access to the town is by rail. The elevation of the Town is approximately 10 to 25 m above sea level. The Churchill River borders the western edge of the town, while Hudson Bay is located to the north. The proposed project site is located just south of Cape Merry National Historic Site and would cover approximately 1.2 hectares.

The project area is located within the York Factory Ecodistrict of the Coastal Hudson Bay Lowland Ecoregion ⁽⁴⁾. Topographically, the York Factory Ecodistrict is a level to gently sloping marine plain ranging in elevation from about 30 m above sea level along its southern margin to sea level to the north, decreasing at the rate of about 0.5 m per km. Relief of the ecodistrict has been affected considerably by post-glacial marine submergence and isostatic rebound of the land surface. The plain is marked with many subdued beach ridges and strandlines. The beaches are separated by shallow fens and marshes in the intervening depressions. The tidal range for the Port of Churchill is around 5 metres and the ecodistrict's eastern and northern boundaries with Hudson Bay are marked by extensive tidal flats that, at low tide, extend for many kilometres into the bay.

The Churchill Ecodistrict lies in the High Subarctic Ecoclimatic Region and the climate is marked by short, cool summers and long, very cold winters ⁽⁴⁾. Climate statistics presented below are from the Churchill Airport station which is characterized by an annual daily maximum, average and minimum temperatures of -2.3 °C, -6.5 °C and -10.7 °C, respectively. The monthly daily average temperature ranges from 12.7 °C in July to -26.0 °C in January ⁽⁵⁾. The average annual total precipitation is 452.5 mm, with 276.0 mm falling as rain and the rest as snow. August has the highest average rainfall (69.3 mm) and November has the highest average snowfall (39.2 cm).

3.2 GEOLOGY

The Town of Churchill is located in the geologic region of the Churchill Province. Bedrock in the Churchill area is Precambrian in age, consisting of metasedimentary rocks, gneiss and schist derived from greywacke mudstone and siltstone. The dark gray quartzite occurring on both sides of the mouth of the Churchill River, including Cape Merry and the coastal cliffs, are outcrops of Precambrian rock known as “Churchill Quartzite” (Photo 3). This rock is usually hidden in the Churchill area by younger Ordovician and Silurian limestones and dolomites. The younger limestones and dolomites are exposed along the western shores of the Churchill River and Hudson Bay ⁽⁶⁾.

In the Cape Merry and project area, the rocks are Precambrian quartzites and greywackes whose original sedimentary structures (mainly crossbeds) are still visible in some places. The east-west cracks are rock joints. Younger Paleozoic rocks lie directly offshore. The rocks at Cape Merry have been polished and trimmed by glaciers, mainly from the Keewatin ice center, which flowed southwards across this area, creating a sequence of striae (scratches), grooves and crescentric fractures trending southwards. There are also faint scratches in some places that indicate an earlier flow westwards by ice from Hudson Bay. Rocks were swept clean of glacial debris by waves when the sea level was higher. Evidence for isostasy is found in the fossil island beach ridges, and in areas such as Sloop’s Cove where ships once anchored. This area is now too shallow to serve as a harbor.

The area east of Churchill is characterized by outcrops of Precambrian Shield, gravel ridges, lakes, old beach lines that were part of the former coast of Hudson Bay and lowlands ⁽⁶⁾. South of the Churchill area, and throughout most of the Churchill River basin, bedrock consists of Paleozoic Ordovician Age sedimentary deposits of the Red Head Rapids formation, which consist of primarily limestones and dolomites with a basal sandstone and shale. The bedrock is overlain by calcareous tills and marine sediments of Tertiary age, and swamp deposits formed in recent times. The surficial deposits present in the immediate vicinity of the Town of Churchill include highly calcareous tills derived from the regional bedrock, and ranging in thickness from one to ten metres. The tills show evidence of glacial wave washing ⁽⁷⁾.

3.3 SURFICIAL MATERIALS

3.3.1 Soils

There are no developed or true soils in the Churchill region. As a result of poor surface drainage in the area, the principle surface deposit formed since the last glacial retreat is organic peat. Peat depths are generally shallow, often less than one metre, below which is subsoil consisting of gravel, sand or clay, or combinations of these. Peat deposits up to two metres deep overlay most aggregate deposits. They have developed in conjunction with poorly-drained Gleysolic mineral soils. Soil in the Churchill area and along the immediate coastal area is mainly Gleysolic and Regosolic ⁽⁶⁾.

Surficial deposits in the vicinity of the lower Churchill River are alluvium of cross-stratified sand and rounded gravel that are less than three metres thick and occur as terraces and abandoned flood plains, point bars, river islands and deltas. These deposits typically consist of about three metres of sand, gravel and silty sand above four metres of silty clay till which overlies dolomitic limestone bedrock. River banks are mainly composed of granular materials which are relatively low and have mild slopes.

3.3.2 Permafrost

Permafrost is frozen ground that persists throughout the summer. It is climatically controlled and an important feature in the area as the Town of Churchill lies in a zone of continuous permafrost. Permafrost is about 80 m thick at Churchill, thickens inland and disappears offshore. Ice has been found in bedrock cracks as deep as 44.5 m. Churchill is one of the most southerly locations in North America to be within this zone. Permafrost is closest to the surface under areas of organic soils because of their insulating qualities. It prevents water from draining away thus causing the development of muskegs and bogs. It is deeper or absent under well-drained areas such as wet fens, beach ridges and along rivers and in tidal areas next to the bay where moving water occurs. Permafrost greatly influences the landscape and vegetation of the Hudson Bay Lowlands, except inland from the coast, and creates problems for development in the region.

Soils in the Churchill area are underlain by varying depths of permafrost. The depth of seasonal surface thawing of the soil depends on several factors such as air temperature, physical properties and soil moisture. The active layer may range in thickness from 2.4 m to 3.7 m for sandy soils, and 0.9 m to 2.4 m for clay, clay-sand or clay-gravel soils. Under water or in areas of saturated soil, the permafrost layer may begin 1.1 m to 2.3 m below the surface. The maximum depth of thaw of the active layer is reached between mid-August and mid-October ⁽⁶⁾.

3.4 GROUNDWATER

The regional hydrogeology of the Churchill area is controlled topographically by the main drainage channel along the Churchill River towards Hudson Bay. Groundwater flow within this area is controlled by the presence of calcareous sandy gravel till, which is present throughout the Hudson Bay Lowlands. Much of the Hudson Bay Lowlands is characterized by the presence of wetlands which have formed due to the relatively flat topography and the poor drainage within the area. Groundwater flow within wetland areas is generally concentrated within the upper one metre or through deeper underlying sediments beneath peat deposits.

Groundwater flow within the Churchill area is controlled by the presence and thickness of the till unit, variation in till composition, as well as local topography and bedrock topography. Exposed shallow bedrock shows shallow minimal jointing, and therefore groundwater flow within the bedrock is not expected to be significant. Tides alter water levels within the harbour by 0.2 to 0.4 m, and may also have minor cyclical effects on the groundwater flow regime.

3.5 SURFACE WATER

Water flow data was obtained from the Churchill River monitoring station above Red Head Rapids (Station: 06FD001, Latitude: 58° 07' 07" N Longitude: 94° 37' 20" W). The gross drainage area for the Churchill River at this location is 289,000 km² ⁽⁸⁾. The low mean monthly flow for the period of record (1971-2015) is April with 218 m³/s while the high mean monthly flow is September with 711 m³/s and the yearly average is 479 m³/s.

Water quality data for the Churchill River as collected by Manitoba Conservation and Water Stewardship (MCWS), Water Science and Management Branch at Churchill River at Goose

Creek Pumphouse (Churchill Intake) (Station MB06FDS001) is provided in Appendix D ⁽⁹⁾. The Churchill River water quality data was compared to the CCME Water Quality Guidelines for the Protection of Marine Aquatic Life. According to the water quality data, the only parameter that was above CCME guidelines was Total Mercury, although sample data from January 1975 through September 2014, did not show any measureable values until June 2012. Samples where Total Mercury values were above the CCME criteria of 0.016 µg/L were taken in both summer and winter months. Four of the eight samples that were above criteria were taken in the month of June. Values for those above-criteria measurements range from 1.0 to 2.3 µg/L.

3.6 FISH AND FISH HABITAT

Mr. Wade Biggin of MCWS, Fisheries Branch conducted a review of the Fisheries Inventory and Habitat Classification System (FIHCS) for the Churchill River at the estuary and provided a copy of species recorded (Appendix D) ⁽¹⁰⁾. The FIHCS lists 37 fish species within the Churchill River with lake whitefish, northern pike, pearl dace, white sucker listed as abundant, arctic char, cisco, goldeye, lake chub, ninespine stickleback, sauger, slimy sculpin, trout perch, walleye identified as common and another 6 species potentially found near the intake site. In-water work will be conducted in accordance with the Department of Fisheries and Oceans, Measures to Avoid Causing Harm to Fish and Fish Habitat, to protect spawning fish and developing eggs and fry ⁽¹¹⁾.

3.7 WILDLIFE, HABITAT AND VEGETATION

Churchill is a unique place where the natural environment extends from tundra to boreal forest and marine ecosystems. A tundra zone characterized by subarctic shrubs and scattered spruce covers the northeastern part of the region. Sphagnum and sedge peatlands supporting heath lichen and moss vegetation are widespread in coastal lowlands. The treeline region is dominated by white spruce, although pine, birch, tamarack and alder are also common. Land is continually emerging from Hudson Bay through isostatic uplift and permafrost intrusion at a rate of about 40 cm per century. The topography on the coastal side is flat and well drained while inland peat accumulation appears associated with the development of hummocks and thermokarst ponds ⁽¹²⁾.

Vegetation is virtually lacking on the tidal flats extending into Hudson Bay however tidal marshes do occur along the shore. Inland beaches and strandlines support vegetation of low shrubs and sedges. Away from the coast, the vegetation is dominated by mosses, sedges and low shrubs associated with the various peatlands. Islands in the mouths of the Hayes and Nelson rivers and on the piece of land separating the two rivers support black spruce, white spruce and balsam poplar stands ⁽⁴⁾.

Wildlife that may be found in the Churchill area includes mammals such as moose, woodland caribou and barren ground caribou, muskrats and beaver in fresh water. The red bat and porcupine are present in low numbers. Two species of hare live in the region including the snowshoe and arctic hare. The arctic hare is the more common of the two. The arctic fox is increasing in number and the red fox is also present. Mink, martens, fishers, ermine and the least weasel are present and the gray wolf is resident in low numbers. Although they are seldom seen, wolverines and lynx are also present. Black bears are occasionally seen some distance from town and the polar bear population is reported to be stable with about 1,200 bears ⁽¹³⁾.

In the Cape Merry area, sand and rock are the predominant physiographic features and are also responsible for the types of plant communities in the area. Data gathered during the site assessment conducted in June 2015 by KGS Group indicate that the plant communities on the upper flat tops of the bedrock ridges in the project area were a heath type and include a variety of scrubby shrubs, mosses, lichens and grasses (Photos 2, 3 and 5). There were almost no trees on the site, with the exception of a few stunted white spruce observed in the lower sheltered area adjacent the road. The Manitoba Conservation Data Centre (CDC) was contacted to determine if there are any species of concern in the project area. Mr. Chris Friesen of MCWS, CDC completed a search of the rare species database and found no occurrences at this time in the project area (Appendix D) ⁽¹⁴⁾.

3.8 SOCIOECONOMIC

The economy of Churchill is predominately service-oriented. The Hudson Bay Port Company, Churchill Airport, railway and hospital are the main employers. Private businesses, including tourism operators, contractors and service providers are also important components of the local economy.

3.8.1 History

In 1608, Henry Hudson became the first European to explore “The Bay” and in the late 1600s, the Hudson Bay Company established a trading post approximately 5 miles from the mouth of the Churchill River. In the mid 1700's the Prince of Wales Fort was built, which still sits just across the river from the site location. Between the two world wars, construction of a railway was completed connecting Churchill to the rest of the province. A grain elevator was also constructed at this time and the town was moved to the east side of the Churchill River ⁽¹⁵⁾. In 1942 the United States Air force established Fort Churchill, eight kilometres east of Churchill to support overseas air operations in Europe. After the Second World War, Canada and the US jointly sponsored a training and experimental centre. The base was officially closed in 1980.

3.8.2 Amenities and Infrastructure

The Town of Churchill possesses a number of amenities, many of which were built for the former military presence. These amenities and facilities have been kept up to date and improved over the years in order to support Churchill's tourism industry. The Town Centre Complex is a large building that was built in the 1970's and provides important resources for those living in the north. It currently houses the Regional Health Authority, Duke of Marlborough School, public library, swimming pool, curling rink, arena, gym, indoor playground, the Town of Churchill Administration office, and a video rental store. Groceries and household goods can be purchased at the Northern Store, Home Hardware, and through the local Sears outlet. Banking services are provided by the Royal Bank of Canada.

The Town has nine operating hotels with a total of 295 guest rooms, six restaurants and a number of bed and breakfasts. Tourists can rent a car to explore the area or use one of the two taxi companies. Other services available include a gas station, propane provider, museum, jewelry store, insurance provider, travel agent, flooring company and three churches.

The Town of Churchill obtains its potable water supply from a pumping station along the Churchill River located approximately 12 kilometres up-gradient from the Town. There are no known well water users in the study area ⁽⁷⁾. The Town of Churchill sewage plant is located approximately 3 km southeast of the town. The Town of Churchill landfill is located

approximately 5.5 km east of the airport and the soil farm, which was originally used for the remediation of contaminated soil from the Churchill rocket range, is located near the Churchill Northern Studies Centre, approximately 15 km east of the airport.

At the soil farm, contaminated soils are mixed with soil amendments such as soil bulking agents and nutrients, and then mixed with uncontaminated soil and tilled into the earth in order to promote bioremediation. The material is periodically tilled for aeration and contaminants are degraded, transformed, and immobilized by microbiological processes and oxidation. Soil conditions are controlled to optimize the rate of contaminant degradation. Moisture content, frequency of aeration, and pH are all conditions that may be controlled.

3.8.3 Population

The Town of Churchill had a population of 813 people living in 351 of its 524 private dwellings according to the 2011 census ⁽¹⁶⁾. Population in the Town decreased by 11.9% between 2006 and 2011.

3.8.4 Tourism and Research

The Churchill area supports two national historic sites including the Prince of Wales Fort and the Cape Merry Battery. Construction of the massive stone outpost began in 1732 on the bare, windswept coast of Hudson Bay across from the Town. The Fort remains as a monument to the fur trade era and over time has served as a base for northern exploration, whaling, and the search for precious metals ⁽¹⁷⁾. The Cape Merry Battery (Photo 1), located at the mouth of the Churchill River, is presently home to a stone battery originally constructed in 1746 to supplement the defenses of Prince of Wales Fort. The Cape Merry area provides a panoramic view of the Churchill River estuary at Hudson Bay and is a favoured location for observing waterfowl, migrating birds and beluga whales ⁽¹⁸⁾.

Many of the most popular tourist attractions in the Churchill area focus on wildlife which varies depending on the season. In the spring, bird watching is a popular attraction and in July and August, more than 3,000 beluga whales make their home in the icy waters near Churchill. Polar Bears are perhaps the biggest attraction in the Town and from October to mid-November they

gather in the area to wait for Hudson Bay to freeze so they can get out on the ice to hunt seals. The annual bear migration has led to the Town being nicknamed the "Polar Bear Capital of the World" and has contributed to a growing tourism industry.

Wapusk National Park is a 11,475 km² subarctic wilderness at the transition between boreal forest and arctic tundra. The park is one of the largest polar bear maternity denning areas in the world and protects approximately 935 bears. Access to Wapusk is via authorized commercial tour operators in Churchill which provide people with the opportunity to see arctic foxes, arctic hares, wolves, caribou and wolverine as well as more than 200 bird species ⁽¹⁹⁾.

Scientists from around the world go to Churchill to study the northern lights in the active night sky and the Town is one of the top 3 places on the planet to see them. Researchers visiting the northern community often use the Churchill Northern Studies Centre which was founded in 1976 as an independent, non-profit research and education facility located 23 km east of the Town. The Centre is ideally situated along the Hudson Bay seacoast at the meeting of marine, northern boreal forest, and tundra biomes. Scientific researchers use the centre to study a diverse range of topics and are provided with accommodations, meals, equipment rentals, and logistical support. In addition to research, the Centre facilitates a wide range of educational programming ranging from general interest courses for the visiting public to university credit courses for students ⁽²⁰⁾.

3.9 HERITAGE RESOURCES

Archaeology in the area shows evidence of human presence dating back 4,000 years as Aboriginal groups used the Churchill area to harvest animal resources during migrations of large mammals ⁽¹⁷⁾. Ms. Heather McClean of the Historic Resources Branch of the department of Tourism, Culture, Heritage, Sport and Consumer Protection examined Branch records and indicated that there are no known heritage resources located within the project area (Appendix D) ⁽²¹⁾.

4.0 POTENTIAL ENVIRONMENTAL EFFECTS ASSESSMENT

An environmental effect includes any change that the project may cause to the environment (biological, physical, social and economic). Environmental effects were identified from interactions between proposed project activities and environmental components. The project has been given a high level review by personnel at Manitoba CWS and it is anticipated that there are no major environmental constraints that would be affected by the project (Appendix F). Likewise construction of the proposed project will have a positive effect on the community by providing employment and additional research in the area will help to stimulate the economy. Mitigation measures and follow-up activities were identified for environmental effects determined to be adverse.

4.1 AIR QUALITY

Construction of the proposed project may result in temporary increased fugitive dust levels in the local area. Dust may be generated during construction activities such as blasting bedrock and placing and shaping fill to support the OSIM tanks and construction of other infrastructure as well as from vehicle and construction equipment on the gravel access road. It is unlikely that Manitoba's air quality guidelines would be exceeded during construction, the project area is relatively isolated and any effects would be very short term. Therefore the potential adverse effects on air quality were assessed to be minor. The effects may be mitigated by using an approved dust suppressant such as water, controlling construction vehicle speeds and limiting construction activities during high wind events.

Increased volatile organic carbon (VOC) levels may result from fuels and other hazardous substances used during construction and operation activities. During construction it is anticipated that the contractor will transport fuel to the site using a fueling truck in order to fuel equipment on-site, in particular generators in the event hydro is not extended to the site prior to the start of construction. During operation, boats will be refueled using jerry cans and support vehicles will be refueled at the gas station. Oil-in-ice experiments will require the use of crude oil and Oil-burn-on-ice will also include the use of burning agents. Both experiment types have the potential to increase VOC emission levels in the project area. VOC releases during construction will be small and short term in duration. While VOC releases during operation will be on an

annual basis this will be limited to the approximately 5 or 6 experiments per year and it is estimated that each oil-in-ice experiment could require up to approximately 419 L of oil and that the oil-burn-on-ice experiments would use approximately 45 L of oil.. Additionally the project area is relatively isolated to residential receptors and in close proximity to the Port of Churchill which likely has a greater potential impact. As such the potential adverse effects on air quality in the local area were assessed to be minor. Proposed mitigation measures include requiring a high standard of maintenance for construction equipment and vehicles, limiting unnecessary long-term idling, using low sulphur-containing fuels, using appropriate dispensing equipment and limiting fueling of vehicles and equipment. Mitigation of oil-burn experiments will be achieved with an air filtration system including a mobile fume hood, HEPA and carbon filters to remove contaminants from the air.

4.2 SOILS

Soils in the project area may become impacted during construction and operation from leaks and accidental spills or releases of fuels or other hazardous substances and waste. There is potential for spills as a result of improper storage, negligent fueling or from leaking vehicles and equipment both during construction (short-term) and operation (long-term). However, a potential spill will likely be localized and easily contained and cleaned-up. As such, the potential adverse effects on soil quality were assessed to be minor. Proposed mitigation includes preventing leaks, spills and releases by providing secondary containment for fuel storage, requiring drip trays for equipment, providing fuel handling training for operators, providing spill clean-up equipment and materials, complying with provincial fuel storage and dispensing regulations, storing hazardous materials in approved containers, providing an emergency (spill) response plan and periodic inspection for leaks, spills and releases. If a spill should occur the responsible party will notify the MCWS Emergency Response Program (204-944-4888). The appropriate clean-up would be determined according to the size of spill and quantity of contamination and larger spills would be assessed and delineated following Phase III Environmental Site Assessment standards and a remediation program would be developed to ensure that the site is cleaned to meet MCWS soil remediation criteria.

4.3 GROUNDWATER

Groundwater in the project area may become impacted during site preparation and construction and operation activities from leaks, accidental spills, or releases of fuels or other hazardous substances. The site consists of very shallow soils over bedrock and areas of exposed bedrock that shows minimal jointing, and therefore groundwater flow within the bedrock at the site is not expected to be significant. Additionally as any potential spill would be immediately cleaned up it is not likely that any spill would seep into groundwater.. Therefore the potential adverse effects on groundwater quality were assessed to be negligible. Proposed mitigation includes preventing leaks, spills and releases by providing secondary containment for fuel storage, requiring drip trays for equipment, providing fuel handling training for operators, providing spill clean-up equipment and materials, complying with provincial fuel storage and dispensing regulations, storing hazardous materials in approved containers, providing an emergency (spill) response plan and periodic inspection for leaks, spills and releases.

4.4 SURFACE WATER

Surface water in the project area may become impacted during construction and operation from leaks and accidental spills or releases of fuels or other hazardous substances. While there is very little surface water on the project site, it generally slopes northwards toward the road and then west towards the Churchill River. As such any spill at the site has the potential to impact the Churchill River, however, as the site is over 100 m distance from the river any spill will likely be contained and cleaned up prior to reaching the river. At the water front, however, any potential spills at the pump house, boat ramp or dock are in close proximity to the Churchill River. The potential adverse effects on water quality were assessed to be moderate. Proposed mitigation includes preventing leaks, spills and releases by providing secondary containment for fuel storage, refueling vehicles and equipment at least 30 m away from the Churchill River, requiring drip trays for equipment, providing fuel handling training for operators, providing spill clean-up equipment and materials, complying with provincial fuel storage and dispensing regulations, storing hazardous materials in approved containers, providing an emergency (spill) response plan and periodic inspection for leaks, spills and releases.

During operation, impacted water from OSIM experiments will only be discharged back to the Churchill River after it has been treated by the proposed oil and water separation process. Water quality samples will be collected and submitted to the on-site laboratory and effluent discharge only if the water quality meets CCME and MWQSOG criteria and licence requirements for discharge. Therefore the potential effect of the project on surface water quality during operation was assessed to be negligible. Proposed mitigation includes requiring regular maintenance of the oil and water separation system during operation and ensuring release of only treated effluent that meets criteria.

4.5 FISH AND FISH HABITAT

Construction activities such as placing and shaping fill will be occurring within approximately 100 m of the Churchill River and directional drilling for the pipelines and construction of the boat launch will occur at the shore of the estuary. These activities can result in wind-carried dust and exposed soils that are more easily eroded with surface water run-off and disturbance to the shoreline and bed of the river may elevate the levels of suspended sediment which can reduce water quality, interfere with fish spawning, navigation, and the ability to locate food and escape predators. Settling suspended particles can potentially smother and kill fish eggs or larvae. Installation of the pipeline along the bottom of the estuary may also disturb fish habitat. The project does not include in filling and adverse effects on fish and fish habitat were assessed to be minor to moderate. Proposed mitigation includes minimizing dust levels during construction by using an approved dust suppressant such as water, installing and maintaining silt fences, constructing the boat launch during low tide and using underwater concrete to reduce the size of the project impact, respecting fisheries timing windows so as not to disturb spawning fish and conducting in-water work in accordance with the Department of Fisheries and Oceans, Measures to Avoid Causing Harm to Fish and Fish Habitat, to protect spawning fish and developing eggs and fry ⁽¹¹⁾.

During project operation, effluent will be discharged from the OSIM tank into the Churchill River estuary after treatment. A wastewater treatment system will remove oil and other contaminants from the effluent in order to meet Canadian and provincial surface water discharge criteria and licence limits. There is expected to be no effect from project operation on water chemistry and associated impacts to fish and therefore no additional mitigation is proposed beyond regular

maintenance of the system and testing the effluent to ensure criteria is met before discharging. The waste oil product removed during treatment will be stored in barrels on-site until disposal at a local soil farm facility.

4.6 WILDLIFE, HABITAT AND VEGETATION

Construction of the proposed project will result in loss and disturbance of vegetation and potential wildlife habitat. There is very little vegetation present at the project site which only provides marginal wildlife habitat and it is unlikely that any wildlife sensitive to human disturbance would be present (Photo1). Additionally, the CDC found no occurrences or rare or endangered plant and wildlife species at the project area. As such effects on wildlife, habitat and vegetation as a result of the project are expected to be negligible. Mitigation measures to implement include minimizing loss and disturbance of vegetation and wildlife habitat by limiting the area cleared and limiting construction activities to designated areas.

4.7 EMPLOYMENT/ECONOMY

The proposed project will create temporary construction employment opportunities and increase the economy in the local and surrounding areas associated through the purchase of construction materials, fuel, supplies and lodgings. Additionally, the facility will have operational requirements which will require employment of personnel to maintain some of the equipment and buildings. The potential effects of the project on employment and economy were assessed as positive. No mitigation or follow-up is proposed.

4.8 HUMAN HEALTH AND WELL BEING

Soil, surface water and groundwater in the project area may become impacted during construction and operation activities, as previously noted, from leaks and accidental spills or releases of fuels or other hazardous substances, which could adversely affect human health. The potential adverse effects of the project on human health were assessed to be minor to moderate. Proposed mitigation measures include preventing leaks, spills and releases by providing secondary containment for fuel storage, requiring drip trays for equipment, providing spill clean-up equipment and materials, providing fuel handling training for operators, complying

with provincial fuel storage and dispensing regulations, storing hazardous materials in approved containers, and providing an emergency (spill) response plan. Mitigation of effects from contaminants released during burning experiments includes the use of the fume hood and air filtration system to control air emissions and regular maintenance of that equipment.

4.9 PUBLIC AND WORKER SAFETY

The public will not have access to the CMO site which will be fenced and gated and the project should not have any effect on public safety. This fence will also provide the required worker safety from polar bears during operation. Prior to this fence being completed if there is construction occurring during the polar bear migration period (October to mid-November) then additional safety measures will be required for worker safety. During construction, the handling and storage of fuels and hazardous materials, such as greases and lubricants, pose a threat to construction worker health and safety. Additionally while conducting the oil-in-ice and oil-burn-on-ice experiments researchers will be exposed to hazardous materials. Most experiments will be conducted with the roof open and therefore will not result in an indoor air quality concern and the fume hood will be used during burning experiments to capture the smoke. The potential hazard to public and worker (researchers) safety was assessed as negligible and moderate, respectively. Proposed mitigation includes providing fuel handling training, complying with provincial fuel storage and dispensing regulations, storing hazardous materials in approved containers, complying with Manitoba Workplace Safety and Health regulations, following University of Manitoba Health and Safety procedures, referring to MSDS for appropriate personnel protective equipment, conducting safety briefings with workers and providing employee training.

4.10 HERITAGE RESOURCES

Ms. Heather McClean at the Historic Resources Branch of Manitoba Tourism, Culture, Heritage, Sport and Consumer Protection examined Branch records to determine if there are any known archaeological sites in the project area. It was found that no known sites exist within the area of the project footprint. The potential adverse effects of the project on heritage resources were assessed to be negligible and no specific mitigation measures or follow-up are proposed.

5.0 ENVIRONMENTAL MANAGEMENT PRACTICES

Environmental management practices proposed to be employed to prevent or mitigate environmental effects that were determined to be adverse, as described in Section 4, are summarized in the following sections. Mitigation is defined under the *Canadian Environmental Assessment Act* as the elimination, reduction and control of the adverse effects of a project and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means. Mitigation measures must be technically and economically feasible, and implemented.

5.1 AIR QUALITY

Applying an approved dust suppressant such as water, controlling construction vehicle speeds and limiting construction activities during high wind events can mitigate increased fugitive dust levels generated during construction of the project. By controlling fugitive dust levels it is unlikely that Manitoba's air quality guidelines would be exceeded by construction activities.

Requiring a high standard of maintenance for construction equipment and vehicles, limiting unnecessary long-term idling, using low sulphur-containing fuels, using appropriate dispensing equipment and limiting fueling, can mitigate increased levels of greenhouse gases and vehicle emissions from equipment and increased VOC levels from fuels and other substances during construction and operation activities.

Maintaining the fume hood and air scrubber system according to the manufacturers guidelines and monitoring the air quality of the system exhaust will help to ensure that operation of the project does not introduce any unnecessary contaminants to the environment.

5.2 SOILS

Preventing leaks, spills and releases by providing secondary containment for fuel storage, requiring drip trays for equipment, providing fuel handling training for operators, providing spill clean-up equipment and materials, complying with provincial fuel storage and dispensing regulations, storing hazardous materials in approved containers, providing an emergency (spill)

response plan and periodic inspection for leaks, spills and releases can mitigate potential soil contamination from leaks and accidental spills during construction and operation.

5.3 GROUNDWATER

The mitigation measures outlined in Section 5.2 to prevent leaks, spills and releases to soil can mitigate potential groundwater contamination from leaks and accidental spills during construction and operation.

5.4 SURFACE WATER

The mitigation measures outlined in Section 5.2 to preventing leaks, spills and releases to soil can mitigate potential surface water contamination from leaks and accidental spills during construction and operation. Additionally, vehicles and equipment will be refueled at least 30 m away from the Churchill River.

Regular maintenance of the proposed system for removing oil and other contaminants from OSIM tank effluent and ensuring effluent meets the applicable criteria prior to draining it to the Churchill River estuary will mitigate potential surface water contamination from operational experiments.

5.5 FISH AND FISH HABITAT

The Fisheries Act requires that projects must avoid causing serious harm to fish unless authorized by the Minister of Fisheries and Oceans Canada. As such, the appropriate Department of Fisheries and Oceans measures to avoid causing harm to fish and fish habitat, in particular timing, erosion and sediment control and fish protection will be implemented. Specifically, minimizing dust levels during construction by using a dust suppressant such as water, using and maintaining silt fences, constructing the boat launch during low tide and using underwater concrete to reduce the size of the project impact, and respecting fisheries timing windows so as not to disturb spawning fish will mitigate potential impacts to fish and fish habitat.

Regular maintenance of the proposed system for removing oil and other contaminants from OSIM tank effluent and ensuring effluent meets the applicable criteria prior to draining it to the Churchill River estuary will mitigate potential surface water contamination and associated impacts to fish from operational experiments.

5.6 WILDLIFE, HABITAT AND VEGETATION

Limiting clearing and construction activities to designated areas can minimize loss and disturbance of vegetation and wildlife habitat and mitigate effects on wildlife and vegetation.

5.7 HUMAN HEALTH AND WELL BEING

Preventing leaks, spills and releases by following the mitigation measures outlined in Section 5.2 and 5.4 can mitigate potential soil, groundwater and surface water contamination during construction and operation that could otherwise affect human health. Additionally, use of and regular maintenance of an appropriately designed fume hood and air filtration system will mitigate the potential effects to human health from contaminants released during burning experiments.

5.8 PUBLIC AND WORKER SAFETY

The fence and gate which limits public access to the CMO will prevent any effect on public safety as long as it is properly maintained. Providing fuel handling training, complying with provincial fuel storage and dispensing regulations, storing hazardous materials in approved containers, complying with Manitoba Workplace Safety and Health regulations, following University of Manitoba Health and Safety procedures, referring to MSDS for appropriate personnel protective equipment, conducting safety briefings with workers and providing employee training can mitigate the threat to worker (researcher) health and safety during construction and operation.

5.9 RESIDUAL ENVIRONMENTAL EFFECTS

The significance of residual environmental effects, the effects remaining after the implementation of mitigation measures, was evaluated following procedures outlined in the Canadian Standards Association Draft environmental assessment standard ⁽²²⁾. Significance was evaluated based on the criteria below:

- **Societal value** of the affected environmental components – includes nature and degree of protection provided
- **Ecological value** – includes rarity and uniqueness, fragility, importance within ecosystem, importance to scientific studies
- **Duration** – length of time the project activity will last
- **Frequency** – rate of reoccurrence of the project activity causing the effect
- **Geographic extent** – area over which the effect will occur
- **Magnitude** – predicted disturbance compared to existing conditions
- **Reversibility** – time the environmental component will take to recover after the source of the effect ceases

Based on the available information on the project and the environment, the assessment of environmental effects outlined in this environmental assessment report, and the application of proposed mitigation measures and the conduct of required follow-up, the proposed project will not likely result in any significant residual adverse environmental effects.

6.0 FOLLOW-UP ACTIVITIES

Follow-up is defined under the *Canadian Environmental Assessment Act* as a program to verify the accuracy of the environmental assessment of a project and determine the effectiveness of measures taken to mitigate the adverse environmental effects of the project. Follow-up activities include monitoring, surveillance, inspection, and may include data collection, analysis, evaluation, and reporting. For the proposed CMO project standard mitigation and best practices will be applied and therefore, a formal follow-up program is not required. Monitoring of implementation of the standard mitigation measures identified for environmental effects determined in Section 4.0 to be adverse are described in the following sections.

6.1 AIR QUALITY

Proposed follow-up during construction involves periodic observations for fugitive dust levels, inspections of the local area for accumulated dust, monitoring of complaints, adherence to contract specifications, and periodic inspection for VOC sources, and testing/monitoring of air quality from exhaust system as required. During the Oil-burn-on-ice experiments the fume hood will be used to capture and monitor the air quality.

6.2 SOILS

Follow-up proposed during construction and operation includes periodic inspections of equipment and storage containers for leaks, spills and releases, periodic observation for potential soil contamination, and ensuring adherence to contract specifications. The MCWS Emergency Response Program (204 944-4888) will be notified in the event of a reportable spill with the appropriate clean-up determined according to the size of spill and quantity of contamination. Specifically, larger spills would be assessed and delineated following Phase III Environmental Site Assessment standards and a remediation program would be developed to ensure that the site is cleaned to meet MCWS soil remediation criteria.

6.3 GROUNDWATER

Follow-up proposed includes periodic inspection during construction and operation for leaks, spills and releases, ensuring adherence to contract specifications, and remediating any spills following the appropriate clean up measures.

6.4 SURFACE WATER

Proposed follow-up includes periodic inspection for leaks, spills and releases during construction and operation, ensuring adherence to contract specifications and remediating any spills following the appropriate clean up measures. To confirm effluent quality satisfies the MWQSOG and CCME Criteria and licence limits, monitoring and reporting of project effluent will be completed in accordance with the licence terms and conditions.

6.5 FISH AND FISH HABITAT

Proposed follow-up involves periodic observations during construction for fugitive dust levels, inspections of the local area for accumulated dust and sediment run-off and adherence to contract specifications. During operation, follow-up will include monitoring of effluent and contaminant levels as treated water is drained back to the estuary.

6.6 WILDLIFE, HABITAT AND VEGETATION

Proposed follow-up during construction involves periodic observations of disturbance levels to vegetation, periodic inspections of the local area for accumulated dust on vegetation and adherence to contract specifications.

6.7 HUMAN HEALTH AND WELL BEING

Follow-up proposed during construction includes periodic inspections of equipment and storage containers for leaks, spills and releases, periodic observation for potential soil or surface water contamination, monitoring of soil or surface water quality as required, and ensuring adherence to contract specifications.

6.8 PUBLIC AND WORKER SAFETY

Follow-up proposed includes recording any occurrence of workplace accidents, confirming compliance with provincial fuel storage and dispensing regulations and updating training and safety guidelines as required.

7.0 PUBLIC CONSULTATION

On June 25, 2015 MCWS held a conference call in order to conduct an expedited review of the Churchill Marine Observatory to support the issuance of an interim general permit to facilitate the planning and design phase of the project (Appendix F). During the conference call the water intake / discharge pipelines and sensing equipment to be placed on the bed of the Churchill River was discussed. It was determined that the Environment Approvals Branch would review the project in further detail with the University to determine if an EAL was required.

Beyond the potential EAL requirements, all other branches of MCWS, that participated in the provincial review of the CMO project and site indicated that they had no concerns with the project. Likewise, Manitoba Infrastructure and Transportation, Aboriginal and Northern Affairs and Manitoba Mineral Resources who participated indicated that they had no concerns.

The Town of Churchill indicated their full support of the application and in discussions with local residents it was determined that the site is not utilized for ceremonial or berry picking/gathering purposes. On July 6, 2015, a town hall meeting was held in the community and was attended by approximately 50 members of the public as well as members of the project team. The meeting was used to disseminate information about the project. No one indicated any concerns with the project ⁽²³⁾.

An interdepartmental working group has been formed which includes members of the Churchill town council, the University of Manitoba, Parks Canada, Prairie Architects, KGS Group, and Government of Manitoba Agencies and Departments including Civil Legal Services, Conservation and Water Stewardship, Crown Lands and Property Agency, Infrastructure and Transportation, Municipal Government, and Jobs and the Economy. The working group generally meets on a monthly basis to discuss the progress of the project with the intention of facilitating project completion.

In addition to the consultation with various provincial departments, on August 7, 2015 Letters of Notification were sent to three First Nations and one Metis organization to request comments on the proposed project. Those contacted included York Factory First Nation, Sayisi Dene First

Nation, Kivalliq Inuit Association and Churchill Metis Local. No comments or requests for additional information were received in response to the letters.

8.0 STATEMENT OF LIMITATIONS

8.1 THIRD PARTY USE OF REPORT

This report has been prepared for the University of Manitoba to whom this report has been addressed and any use a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. KGS Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions undertaken based on this report.

8.2 GEO-ENVIRONMENTAL STATEMENT OF LIMITATIONS

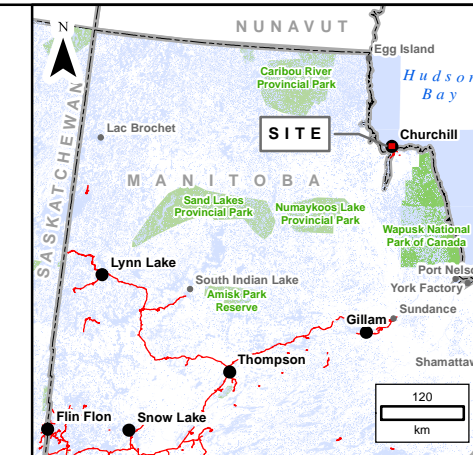
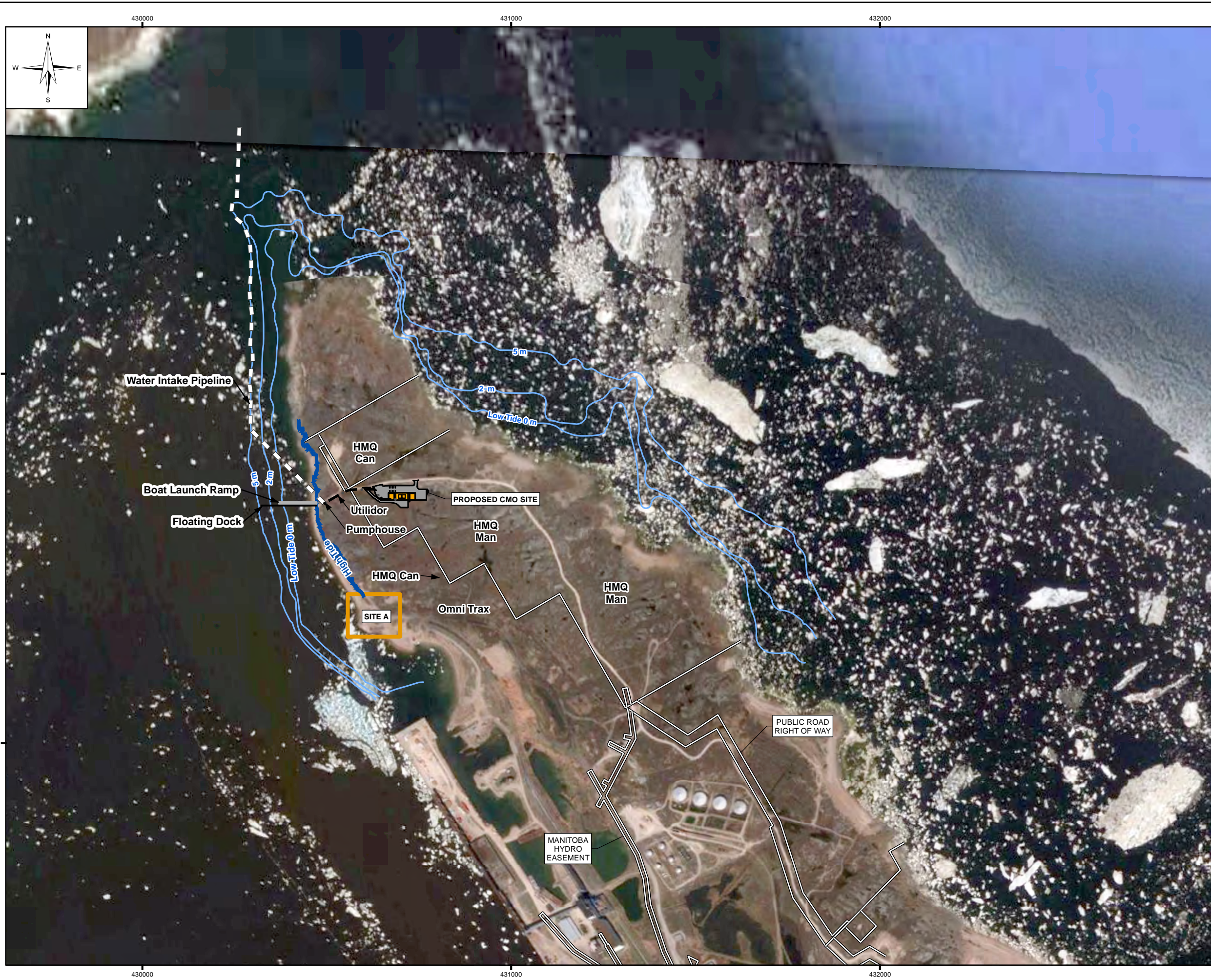
KGS Group prepared the geo-environmental conclusions and recommendations for this report in a professional manner using the degree of skill and care exercised for similar projects under similar conditions by reputable and competent environmental consultants. The information contained in this report is based on the information that was made available to KGS Group during the investigation and upon the services described, which were performed within the time and budgetary requirements of the University of Manitoba. As the report is based on the available information, some of its conclusions could be different if the information upon which it is based is determined to be false, inaccurate or contradicted by additional information. KGS Group makes no representation concerning the legal significance of its findings or the value of the property investigated.

9.0 REFERENCES

1. Everything Churchill. 2015. Website visited September 2015 at <http://www.everythingchurchill.com/about-churchill/town-of-churchill/>.
2. Department of Fisheries and Oceans Canada. 1995. Freshwater Intake End-of-Pipe Fish Screen Guideline.
3. University of Manitoba, Environmental Health and Safety Office. 2012. Controlled Product Standard (Updated November 27, 2012). Website visited September 2015 at http://umanitoba.ca/admin/vp_admin/risk_management/ehso/geninfo/cps.html
4. Smith, R.E., H. Veldhuis, G.F. Mills, R.G. Eilers, W.R. Fraser, and G.W. Lelyk. 1998. Terrestrial Ecozones, Ecoregions and Ecodistricts: An Ecological Stratification of Manitoba's Natural Landscapes. Technical Bulletin 98-9E. Land Resource Unit, Brandon Research Centre, Research Branch, Agriculture and Agri-Food Canada, Winnipeg, Manitoba.
5. Environment Canada. Canadian Climate Normals 1981-2010, Churchill, Manitoba. Visited September 2015 at http://climate.weather.gc.ca/climate_normals/index_e.html.
6. KGS Group. 1998. Port of Churchill Environmental Evaluation. Final Report.
7. KGS Group. 1998. Phase III Environmental Site Investigation, CN Churchill Yard, Churchill, Manitoba. Final Report.
8. Government of Canada, Water Office. 2015. Hydrometric Statistics Data Search. Website access September 2015 at (http://wateroffice.ec.gc.ca/search/search_e.html?sType=stat).
9. Manitoba Conservation and Water Stewardship, Water Science and Management Branch. September 2015. Personal Communication with Kevin Jacobs, Senior Water Protection Officer.
10. Manitoba Conservation and Water Stewardship, Fisheries Branch. October 2015. Personal Communication with Wade Biggin, Commercial Database Specialist.
11. Department of Fisheries and Oceans Canada. 2013. Measures to Avoid Causing Harm to Fish and Fish Habitat. Website visited October 2015: <http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/index-eng.html>
12. Xiang Liu. 2009. Modelling Evaporation from Wetland Lichen and Moss Tundra in Churchill, Manitoba. Masters Thesis, Memorial University of Newfoundland.
13. Churchill Northern Studies Centre. 2015. Wildlife in the Churchill Area. Website visited September 2015 at <https://www.churchillscience.ca/about/churchill-wildlife.cfm>
14. Manitoba Conservation Data Centre. September 2015. Personal Communication with Chris Friesen, Coordinator.

15. Town of Churchill. 2015. Website visited September 2015 at http://churchill.cimnet.ca/cim/75C122_207T4906T278T8353T413T16694.dhtm
16. Government of Canada, Statistics Canada. 2012. Website visited September 2015 at : <https://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=4623056&Geo2=PR&Code2=46&Data=Count&SearchText=&SearchType=Begins&SearchPR=01&B1=All&Custom=&TABID=1>
17. Parks Canada. 2011. Prince of Wales Fort National Historic Site of Canada. Website visited September 2015 at <http://www.pc.gc.ca/eng/lhn-nhs/mb/prince/natcul/natcul1.aspx>
18. Everything Churchill. Park Areas. 2015. Website visited September 2015 at <http://www.everythingchurchill.com/about-churchill/park-areas/>
19. Parks Canada. Wapusk National Park. 2015. Website visited September 2015 at <http://www.pc.gc.ca/eng/pn-np/mb/wapusk/index.aspx>
20. Churchill Northern Studies Centre. 2015. Wildlife in the Churchill Area. Website visited September 2015 at <https://www.churchillscience.ca/about/the-centre.cfm>
21. Manitoba Culture, Heritage, and Tourism, Historic Resources Branch. September 2015. Personal Communication with Heather McClean, Heritage Resources Registrar.
22. Canadian Standards Association, 1999, Preliminary Draft Standard: Environmental Assessment, produced for: The Working Group of the EIA Technical Committee, Draft #14, July 26.
23. University of Manitoba. October 2015. Personal Communication with C.J. Mundy, CMO EO/Garage Lead.

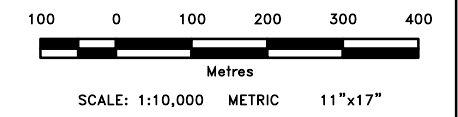
FIGURES



LEGEND:

- Proposed Water Intake Pipeline
- Utilidor (Proposed)
- High Tide Level (Estimated)
- Bathymetry Contour
- Limits of Crown Land (approximate)
- Floating Dock (Proposed)
- Pumphouse (Proposed)
- Boat Launch Ramp (Proposed)
- Access Roadways (Proposed)
- CMO Building (Proposed)

- Notes:**
1. Imagery as shown supplied by Google Earth.
 2. Bathymetry shown obtained from Fisheries and Oceans chart 5640 dated May 10, 2013.
 3. Linework displayed is approximate only.
 4. Limits of Her Majesty the Queen (HMQ) at this time are approximate based on information received from the Province of Manitoba.
 5. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 15. Elevations are in metres above sea level (MSL).



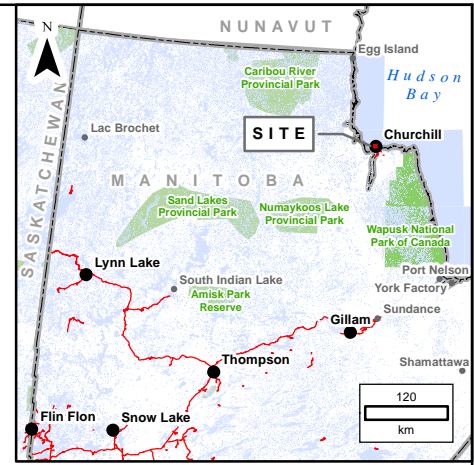
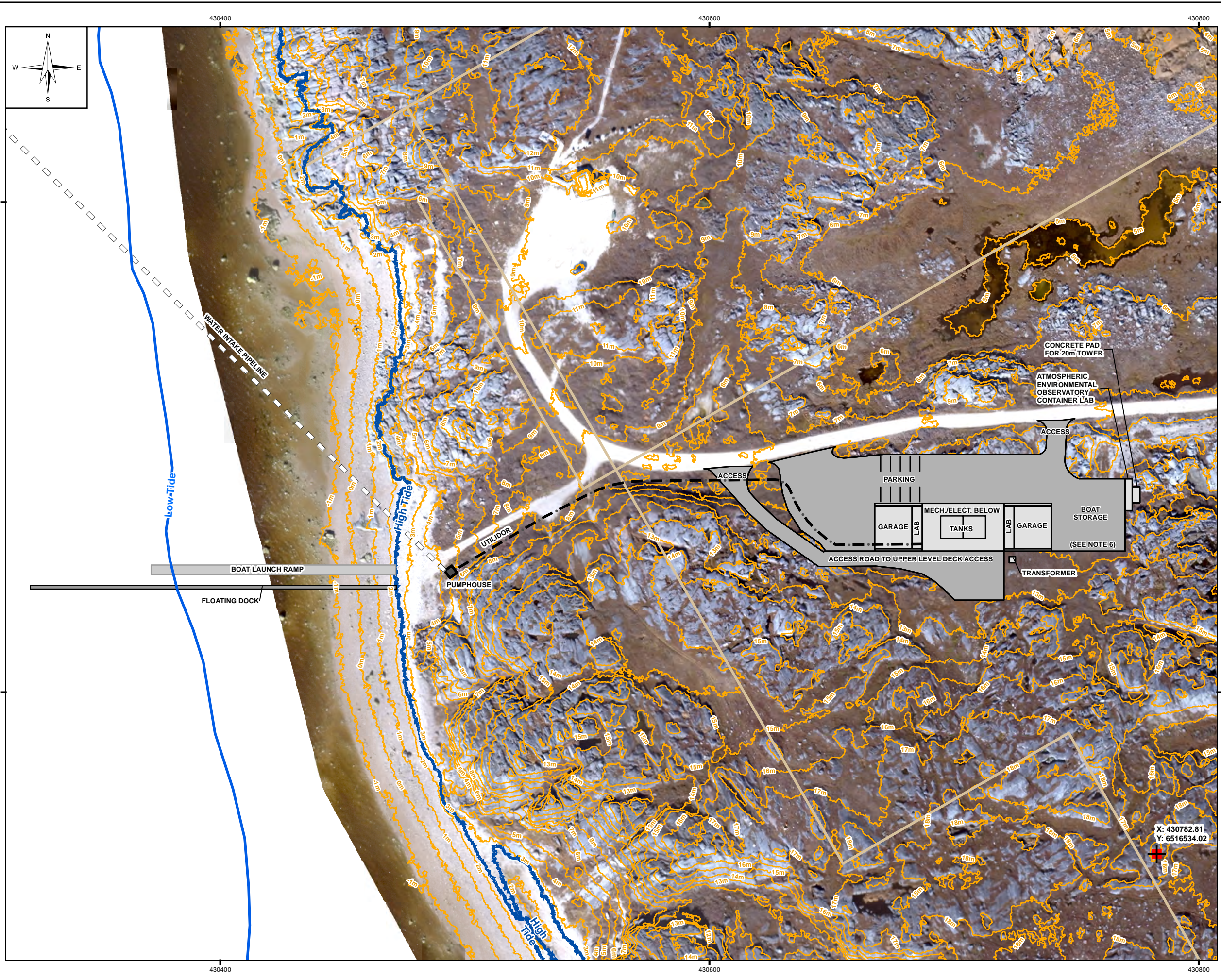
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REVISIONS / ISSUE

**CHURCHILL MARINE OBSERVATORY
 ENVIRONMENT ACT PROPOSAL**

SITE LOCATION PLAN

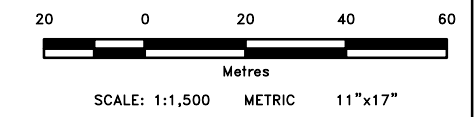
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| NOVEMBER 2015 | FIGURE 01 | REV: 0 |
|---------------|-----------|--------|



LEGEND:

- Control Point
- High Tide Level (Estimated)
- Low Tide Level (Estimated)
- 1m UAV Contour
- Utilidor (Proposed)
- Proposed Water Intake Pipeline
- Limits of Crown Land (approximate)
- Floating Dock (Proposed)
- Pumphouse (Proposed)
- Boat Launch Ramp (Proposed)
- CMO Building (Proposed)

- Notes:**
1. Topography information shown was captured by KGS Group on October 1, 2015 by Unmanned Aerial Vehicle (UAV).
 2. Imagery information shown was captured by KGS Group on October 1, 2015 by UAV.
 3. Bathymetry shown obtained from Fisheries and Oceans chart 5640 dated May 10, 2013.
 4. Control Point ID 664000 Brass Tablet.
 5. Limits of HMQ at this time are approximate based on information received from the Province of Manitoba.
 6. Base elevation for Site Infrastructure is 8m.
 7. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 15. Elevations are in metres above sea level (MSL).

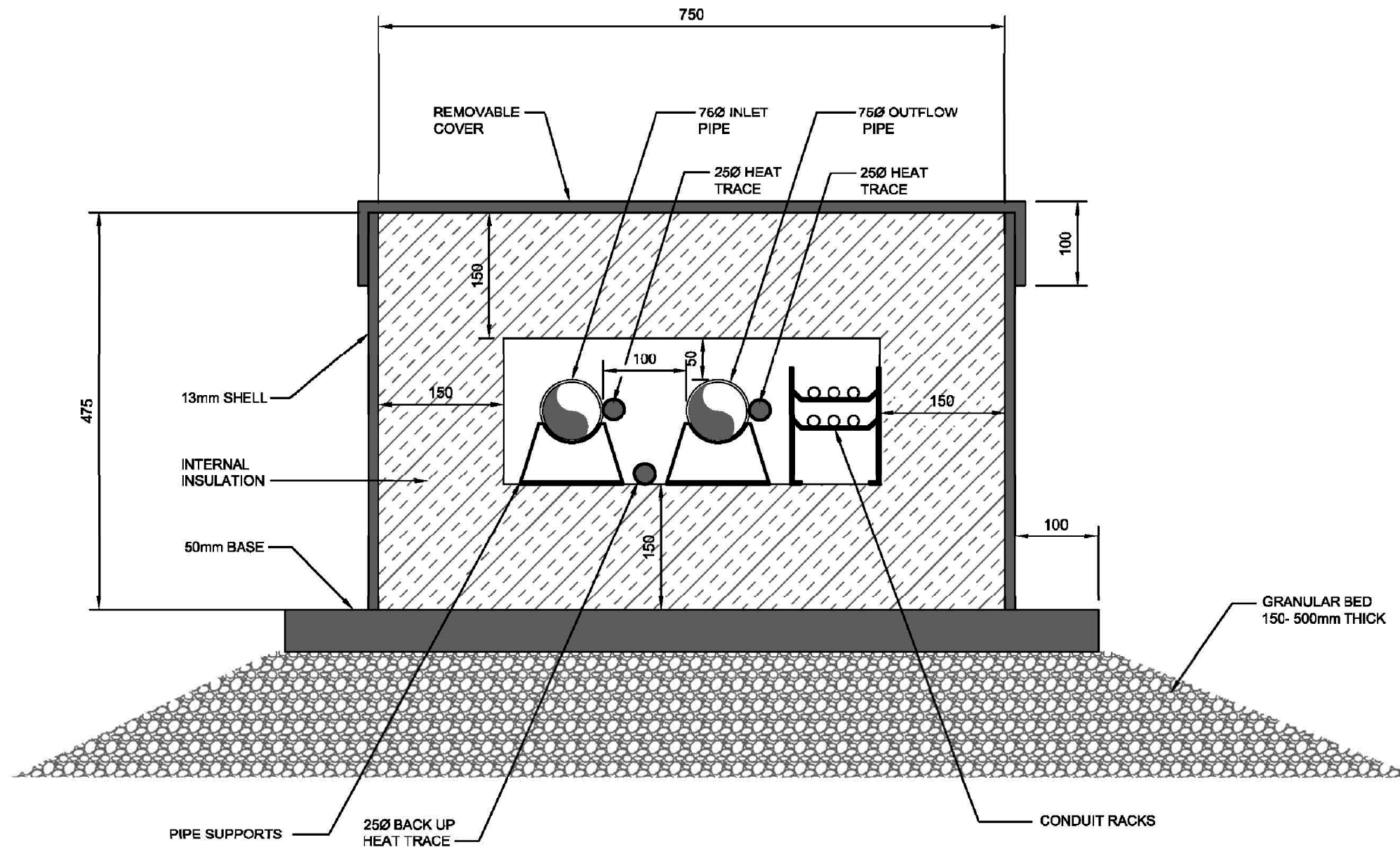


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REVISIONS / ISSUE

**CHURCHILL MARINE OBSERVATORY
 ENVIRONMENT ACT PROPOSAL**

LAYOUT PLAN



| | | | | |
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| CHURCHILL MARINE OBSERVATORY ENVIRONMENT ACT PROPOSAL | | | | |
| UTILIDOR CONCEPTUAL CROSS SECTION | | | | |
| NOVEMBER 2015 | | FIGURE 03 | REV: 0 | |

APPENDICES

APPENDIX A
PROPERTY INFORMATION

STATUS OF TITLE

Title Number **2433362/3**
Title Status **Accepted**
Client File **Churchill**

The Property Registry

A Service Provider for the Province of Manitoba



1. REGISTERED OWNERS, TENANCY AND LAND DESCRIPTION

HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF MANITOBA

IS REGISTERED OWNER, SUBJECT TO SUCH ENTRIES RECORDED HEREON
IN THE FOLLOWING DESCRIBED LAND:

AT CHURCHILL AND BEING

ALL THOSE PORTIONS OF PLANS 495 PLTO (N DIV) AND 496 PLTO (N DIV)
NOW CANCELLED, WHICH ARE NOW CONTAINED WITHIN THE LIMITS

OF PLAN NO. 2716 PLTO (N DIV), EXC

FIRSTLY: PARCEL E, PLAN 6091 PLTO (N DIV)

SECONDLY: LOT 1 PLAN 49707 PLTO AND

THIRDLY: ALL THAT PORTION OF CANCELLED PLAN 496 PLTO (N DIV)

IN 112-20 EPM NOW CONTAINED WITHIN THE LIMITS OF SAID

PLAN 2716 PLTO (N DIV) DESCRIBED AS FOLLOWS:

ON THE SW BY THE SOUTHWESTERN LIMIT OF "B" STREET WEST AND

IT'S PRODUCTION SELY, ON THE NE BY A STRAIGHT LINE DRAWN NE

OF, PARALLEL WITH AND PERPENDICULARLY DISTANT 100 FEET FROM

THE SAID SOUTHWESTERN LIMIT, ON THE SE BY THE SOUTHEASTERN

LIMIT OF FOURTH AVENUE AND IT'S STRAIGHT PRODUCTION S WLY,

AND ON THE NW BY A STRAIGHT LINE DRAWN NW OF, PARALLEL WITH

AND PERP. DISTANT 200 FEET FROM THE SAID SOUTHEASTERN LIMIT

OF FOURTH AVENUE, AS SAID STREET AND AVENUE ARE SHOWN ON

PLAN 496 PLTO (N DIV)

IN 112-20 EPM AND 113-20 EPM

The land in this title is, unless the contrary is expressly declared, deemed to be subject to the reservations and restrictions set out in section 58 of *The Real Property Act*.

2. ACTIVE INSTRUMENTS

No active instruments

3. ADDRESSES FOR SERVICE

DEPT. OF JUSTICE (WINNIPEG MB)

DIRECTOR /CIVIL LEGAL SERVICES

7TH FLOOR 405 BROADWAY

WINNIPEG MB

R3C 3L6

| |
|---|
| 4. TITLE NOTES |
| No title notes |
| 5. LAND TITLES DISTRICT |
| Portage la Prairie |
| 6. DUPLICATE TITLE INFORMATION |
| Duplicate not produced |
| 7. FROM TITLE NUMBERS |
| 1910482/3 Balance |
| 8. REAL PROPERTY APPLICATION / CROWN GRANT NUMBERS |
| No real property application or grant information |
| 9. ORIGINATING INSTRUMENTS |
| Instrument Type: Request To Issue Title |
| Registration Number: 1132377/3 |
| Registration Date: 2010-02-19 |
| From/By: HER MAJESTY THE QUEEN IN RIGHT OF THE PROV. OF MANITOBA |
| To: |
| Amount: |
| 10. LAND INDEX |
| Plan 495 N DIV 112-20E/113-20E PART EXC LOT 1 PLAN 49707 |
| Plan 496 N DIV 112-20E & 113-20E PART EXC LOT 1 PLAN 49707 |
| Plan 2716 N DIV 112 & 113-20E PART EXC PL 6091 & LOT 1 PLN 49707 |

CERTIFIED TRUE EXTRACT PRODUCED FROM THE LAND TITLES DATA STORAGE SYSTEM OF TITLE NUMBER 2433362/3

Crown Land Permit



EFFECTIVE FROM 23-Sep-2015 TO 31-Dec-2015

Taxing Authority CHURCHILL REGION NE

00118600 UNIVERSITY OF MANITOBA OTHER CLIENTS
DR. DAVID BARBER
576 WALLACE BUILDING
UNIVERSITY OF MANITOBA
WINNIPEG MB
R3T 2N2 CD

| |
|---------------|
| Permit Number |
| GP 70363 |

Sys ID: 00070363

IS AUTHORIZED UNDER THE CROWN LAND ACT AND REGULATIONS THEREUNDER, SUBJECT TO CONDITIONS ON THE REVERSE SIDE, HEREUNDER OR ATTACHED, TO THE FOLLOWING DESCRIBED LAND FOR THE PURPOSE STATED BELOW.

LEGAL DESCRIPTION OF LAND

P NE 05-113-20 E
Plan 2716 NLTO CHURCHILL

DISPOSITION PARTICULARS

THIS INTERIM GENERAL PERMIT IS FOR MISCELLANEOUS LEASE NO. 69999

LEGAL DESCRIPTION: PT. PLAN 2716 NLTO CHURCHILL IN PT. NE 05-113-20 EPM - NORTH OF OMNI TRAX PRIVATE LAND AND EAST OF CAPE MERRY NATIONAL HISTORIC SITE

SPECIFIC USE: STATE-OF-THE-ART SCIENTIFIC RESEARCH CENTRE (CHURCHILL MARINE OBSERVATORY)

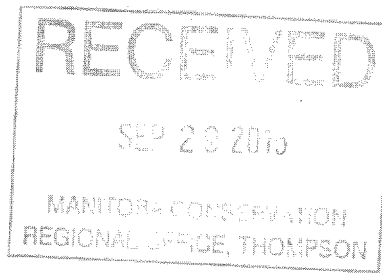
AREA: +/- 3.0 ACRES

As shown on Sketch/Plan/map on file in the Crown Lands Office.

SPECIFIED USE: MARINA

AUTHORIZED USE: To maintain and/or operate a(n):

SPECIAL CONDITIONS: THIS PERMIT MUST BE POSTED ON BUILDING, READILY VISIBLE, FOR INSPECTION PURPOSES. ANNUAL RENTAL IS SET ACCORDING TO THE CROWN LANDS ACT. RENTAL FEES ARE REVIEWED ANNUALLY AND SUBJECT TO CHANGE.



308-25 Tupper Street North
Portage la Prairie, MB R1N 3K1
P. (204) 239-3510 F. (204) 239-3560
Toll Free 1-866-210-9589

Writer's direct line – (204) 239-3810
Email: kelsey.little@gov.mb.ca

September 23, 2015

University of Manitoba
Attention: Dr. David Barber
576 Wallace Building
University of Manitoba
Winnipeg MB R3T 2N2

Dear Mr. Barber:

**Re: Pt. Plan 2716 NLTO Churchill in Pt. NE 05-113-20 EPM – North of Omni Trax Private Land and East of Cape Merry National Historic Site
Crown Land Miscellaneous Lease No. 69999
Crown Land Interim General Permit No. 70363
Specific Use: State-of-the-Art Scientific Research Centre (Churchill Marine Observatory)**

Please be advised that Interim General Permit No. 70363 has been approved as of today's date. Therefore, please find enclosed Interim General Permit No. 70363 which will allow for use of the site for the Churchill Marine Observatory.

Also, please note that the lease agreement will be determined following the survey completion at a later date.

If you have any questions or require further information, please contact me at the above-noted number.

Yours truly,

Kelsey Little
Land Administrator
Crown Lands Act Dispositions

KAL/kal

cc. Dave Hastman, Regional Land Manager
Lori Stevenson, Manitoba Conservation & Water Stewardship
Town of Churchill

Town of Churchill
By-Law No. 773/2015

Being a By-Law of the Town of Churchill to amend the Town of Churchill Zoning By-Law No.714-01, as amended.

Whereas Section 80(1) of *The Planning Act* of Manitoba C.C.S.M. c. P80 provides authority for municipalities to initiate an amendment to a Zoning By-Law;

And Whereas, Council of the Town of Churchill deems it necessary to amend By-Law No.714/01, being the Town of Churchill Zoning By-Law.

Now Therefore the Council of the Town of Churchill in regular session duly assembled enact that By-Law 773/2015 is amended as follows:

That Table 3: *Commercial and Industrial Uses and Bulk Requirements* (pg.40), attached to and being part of the Town of Churchill Zoning By-Law No. 714/01 is hereby amended by adding "*Research Facilities*" as a *Conditional Use in areas zoned "M" Industrial*.

That the proper officers are hereby authorized to execute and deliver the above By-Law;

That this By-Law shall come into full force and effect upon receipt of third reading.

Done and passed in Council duly assembled this 10th day of September 2015 A.D.

Mayor


Executive Director

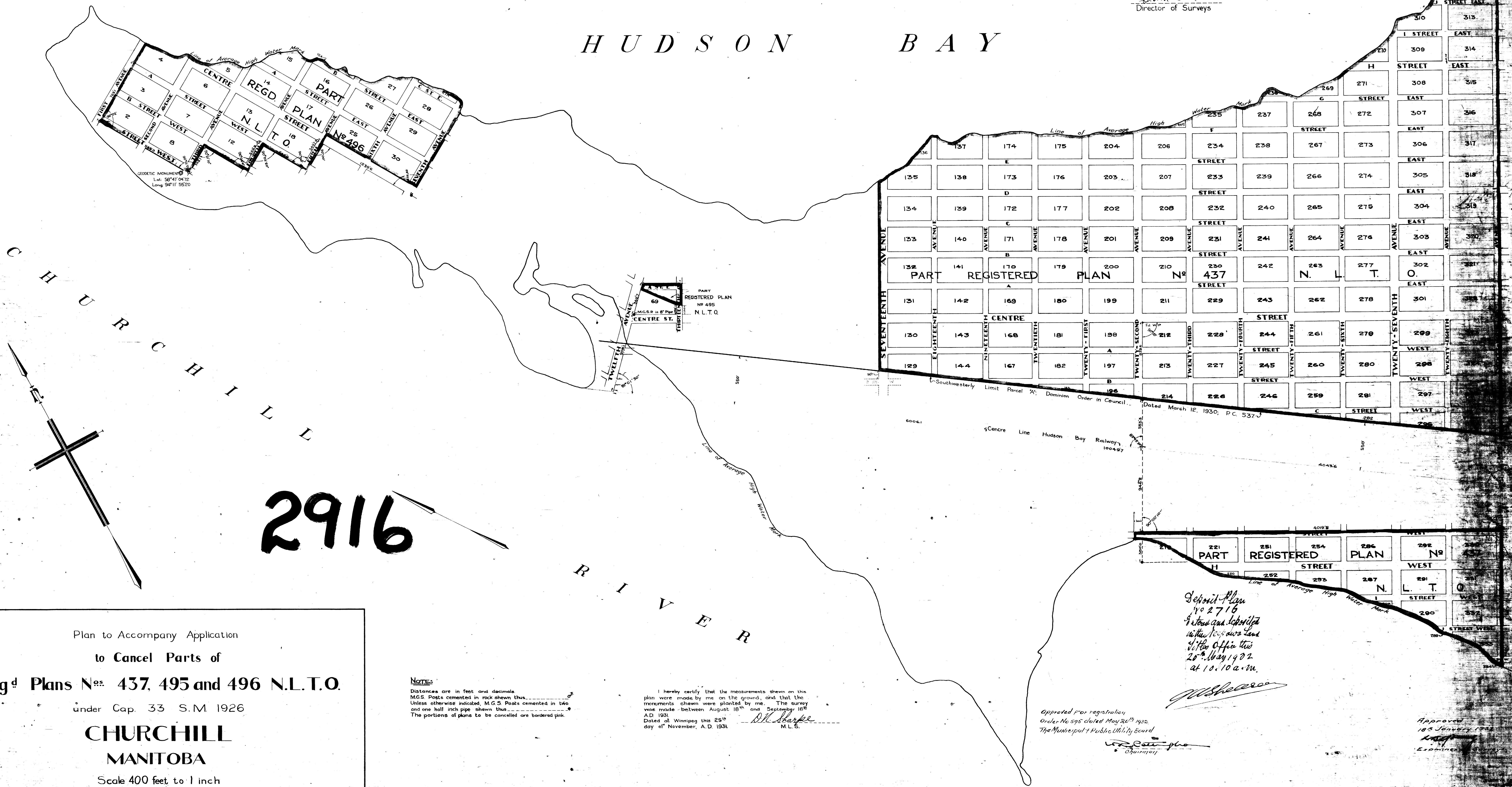
Read a first time this 30th day of July, 2015

Read a second time this 10th day of September, 2015

Read a third and final time this 10th day of September, 2015



Approved and confirmed
 Nov. 26th 1931
J. W. Bell
 Director of Surveys

HUDSON BAY



2916

Plan to Accompany Application
 to Cancel Parts of
Reg^d Plans Nos. 437, 495 and 496 N.L.T.O.
 under Cap. 33 S.M. 1926
CHURCHILL
MANITOBA
 Scale 400 feet to 1 inch

Note:
 Distances are in feet and decimals.
 M.G.S. Posts cemented in rock shown thus 
 Unless otherwise indicated, M.G.S. Posts cemented in two
 and one half inch pipe shown thus 
 The portions of plans to be cancelled are bordered pink.

I hereby certify that the measurements shown on this
 plan were made by me on the ground, and that the
 monuments shown were planted by me. The survey
 was made between August 18th and September 16th
 A.D. 1931.
 Dated at Winnipeg this 25th
 day of November, A.D. 1931.
D. H. Sharpe
 M.L.S.

Deposit Plan
 No 2716
 between and deposited
 in the Registrar's Office
 at this Office this
 25th day 1932
 at 10.10 a.m.
M. Sheppard

Approved For registration
 Order No 595 dated May 20th 1930.
 The Municipal & Public Utility Board
Chairman

Approved
 18th January 1932
Examined

APPENDIX B
SITE PHOTOGRAPHS



Photo 1 – Looking north from project site toward Cape Merry National Historic Site.



Photo 2 – The Port of Churchill, Canada's principal seaport on the Arctic Ocean.



Photo 3 – Churchill quartzite and water ponding in a depression.



Photo 4 – Cobbles and material along the shoreline of the Churchill River.

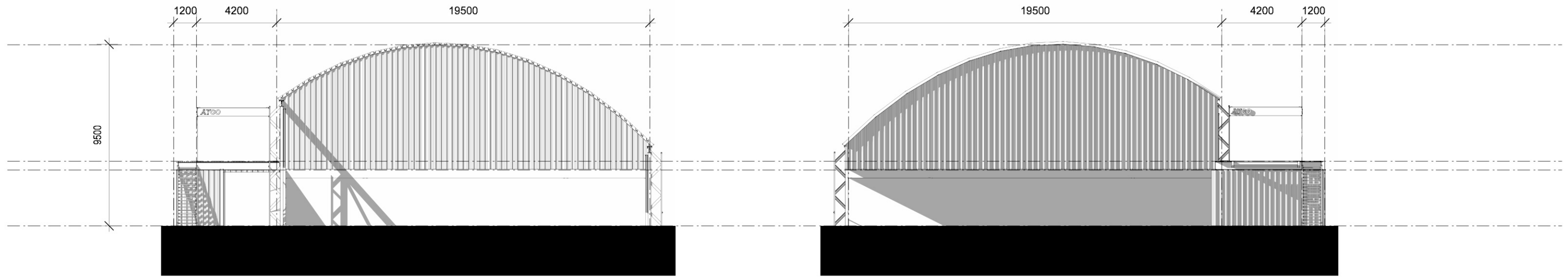


Photo 5 – Access road to Churchill River.



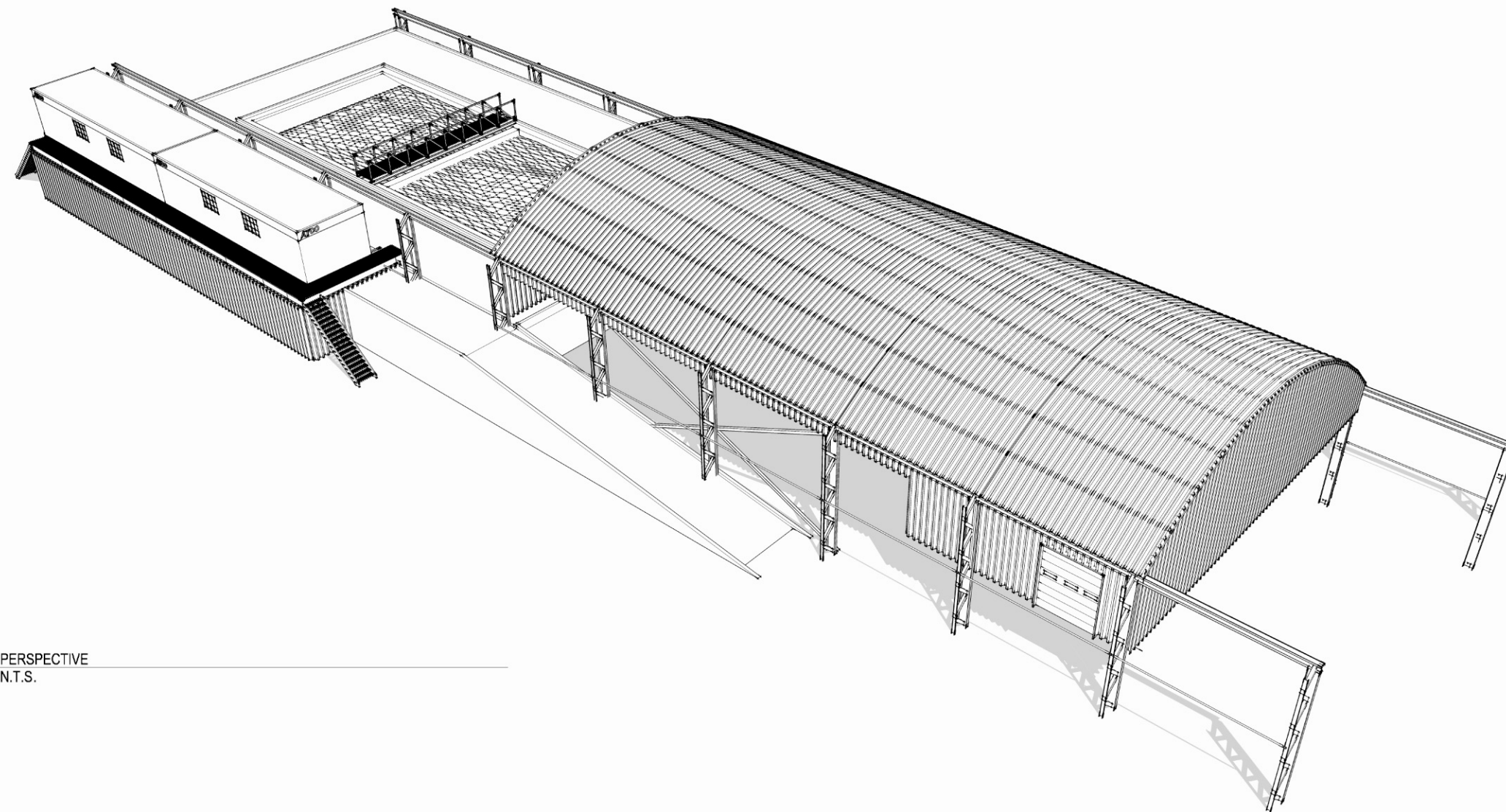
Photo 6 – Directional drilling will be required to install pipelines to a point where ice scouring won't be a factor.

APPENDIX C
CHURCHILL MARINE OBSERVATORY DESIGN DRAWINGS

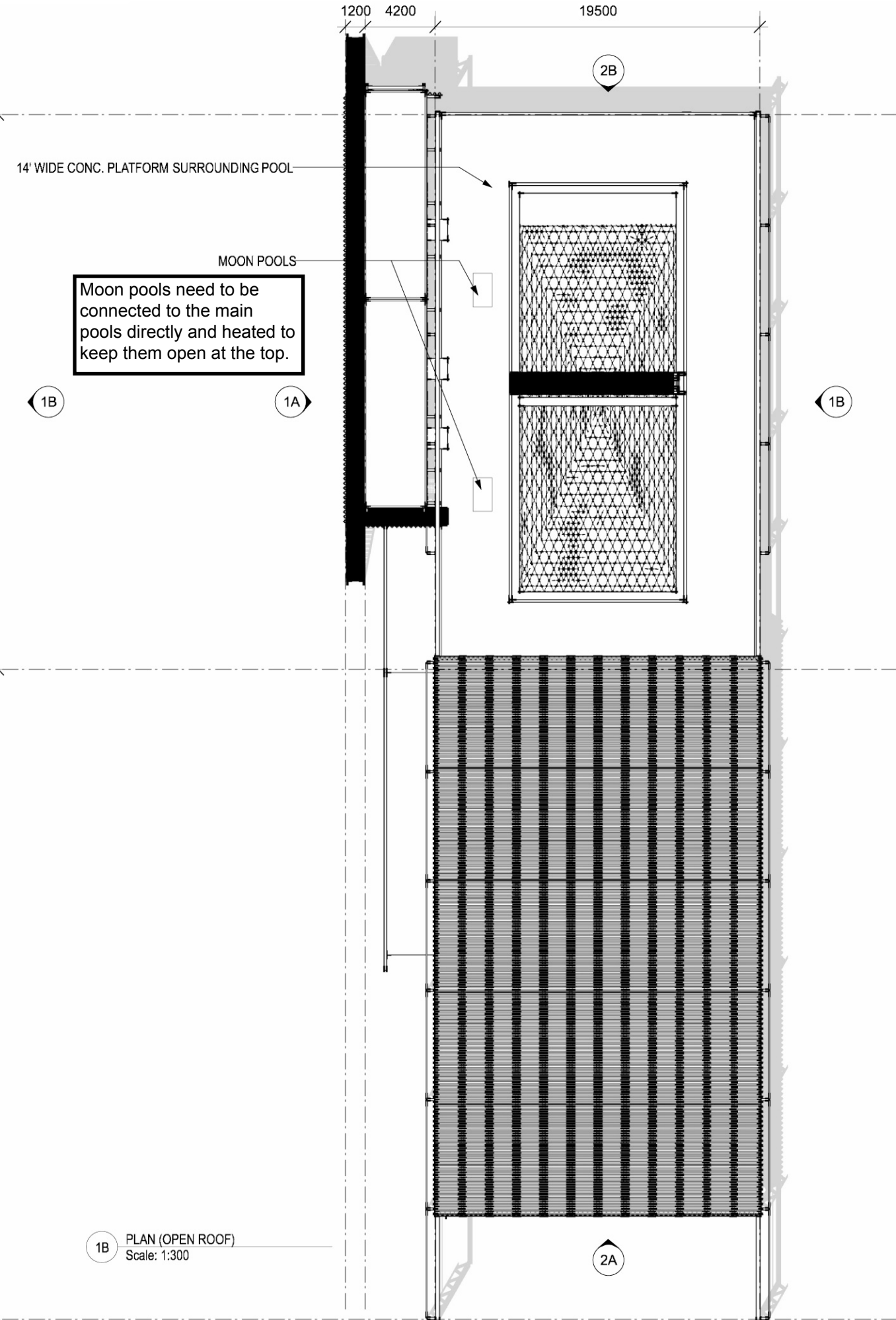
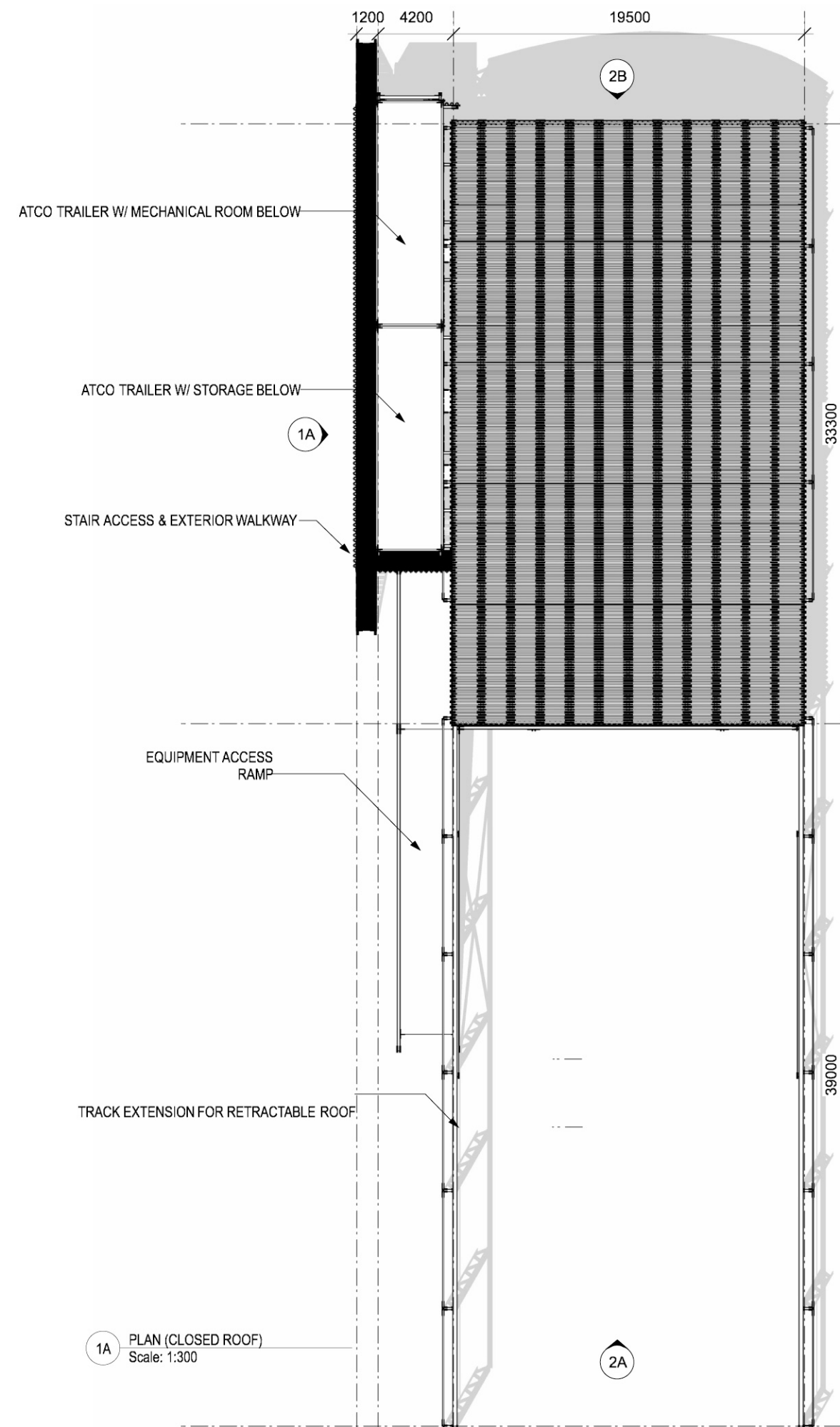


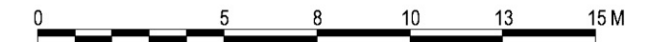
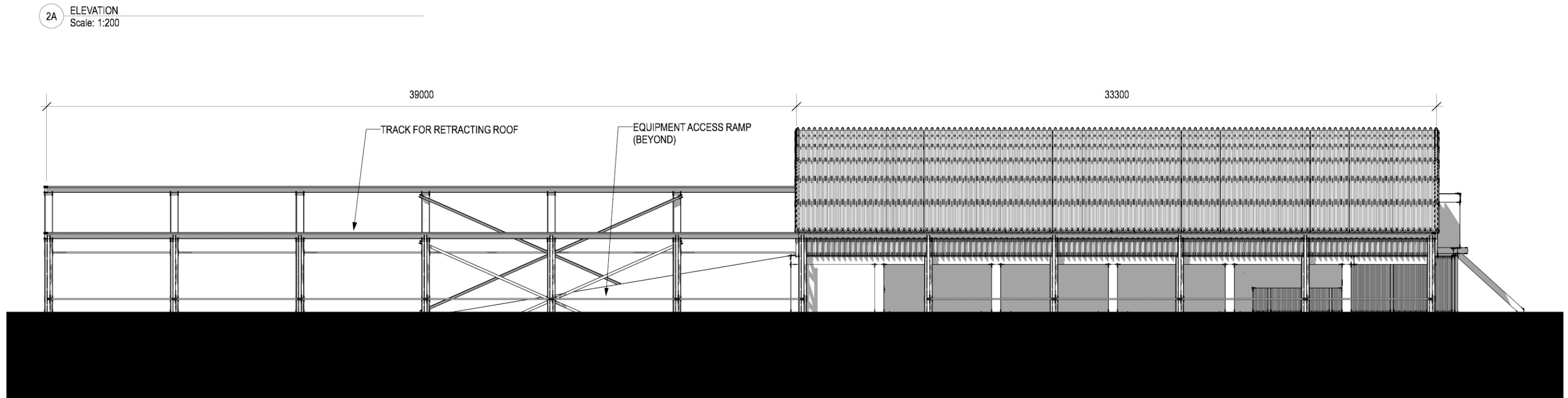
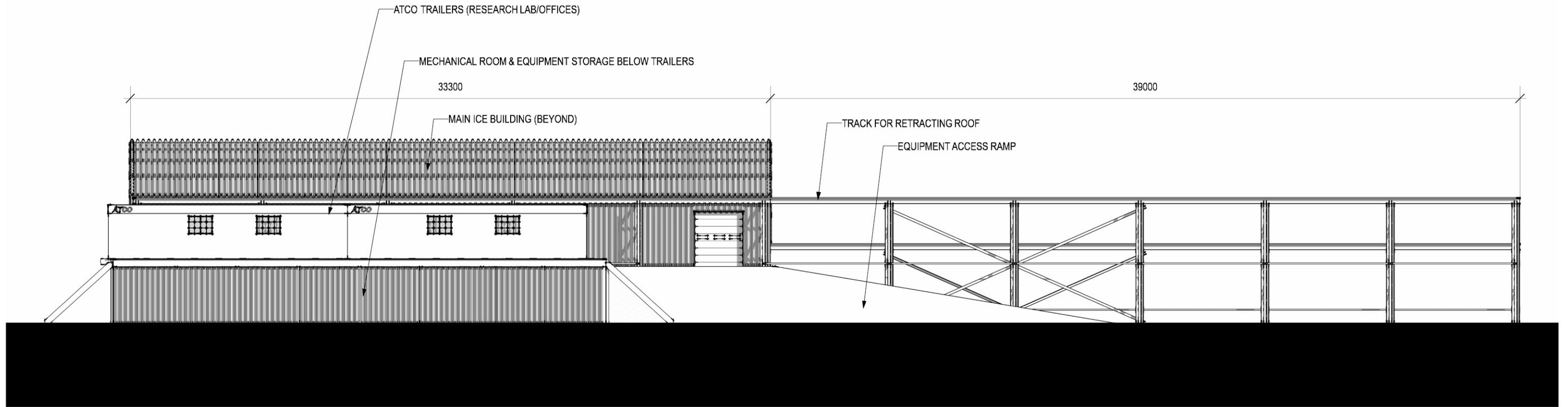
3A ELEVATION
Scale: 1:200

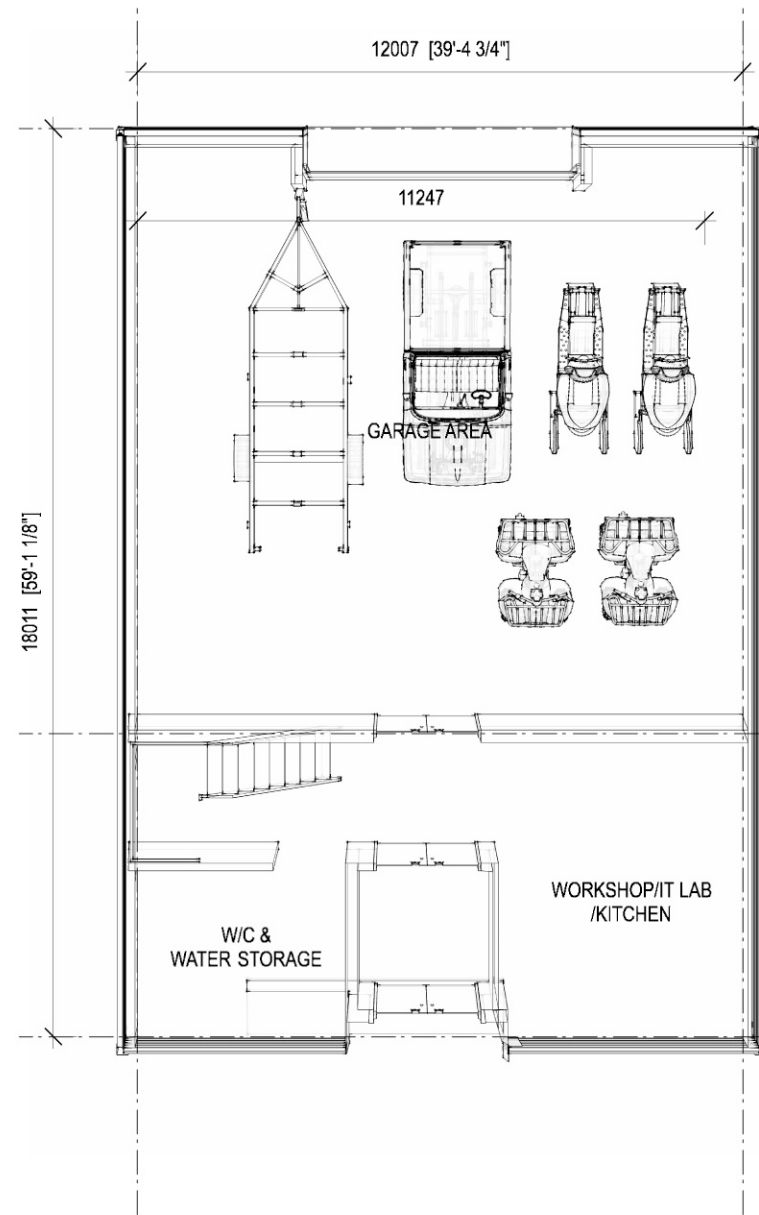
3B ELEVATION
Scale: 1:200



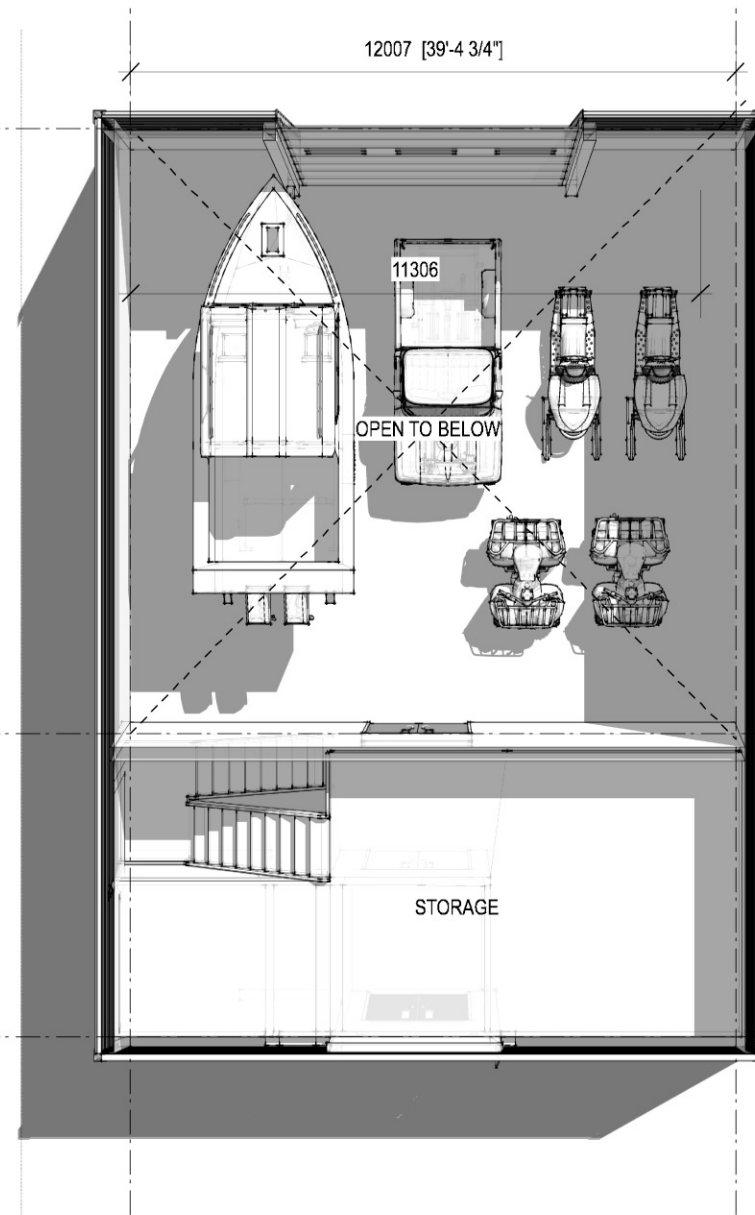
3C PERSPECTIVE
N.T.S.



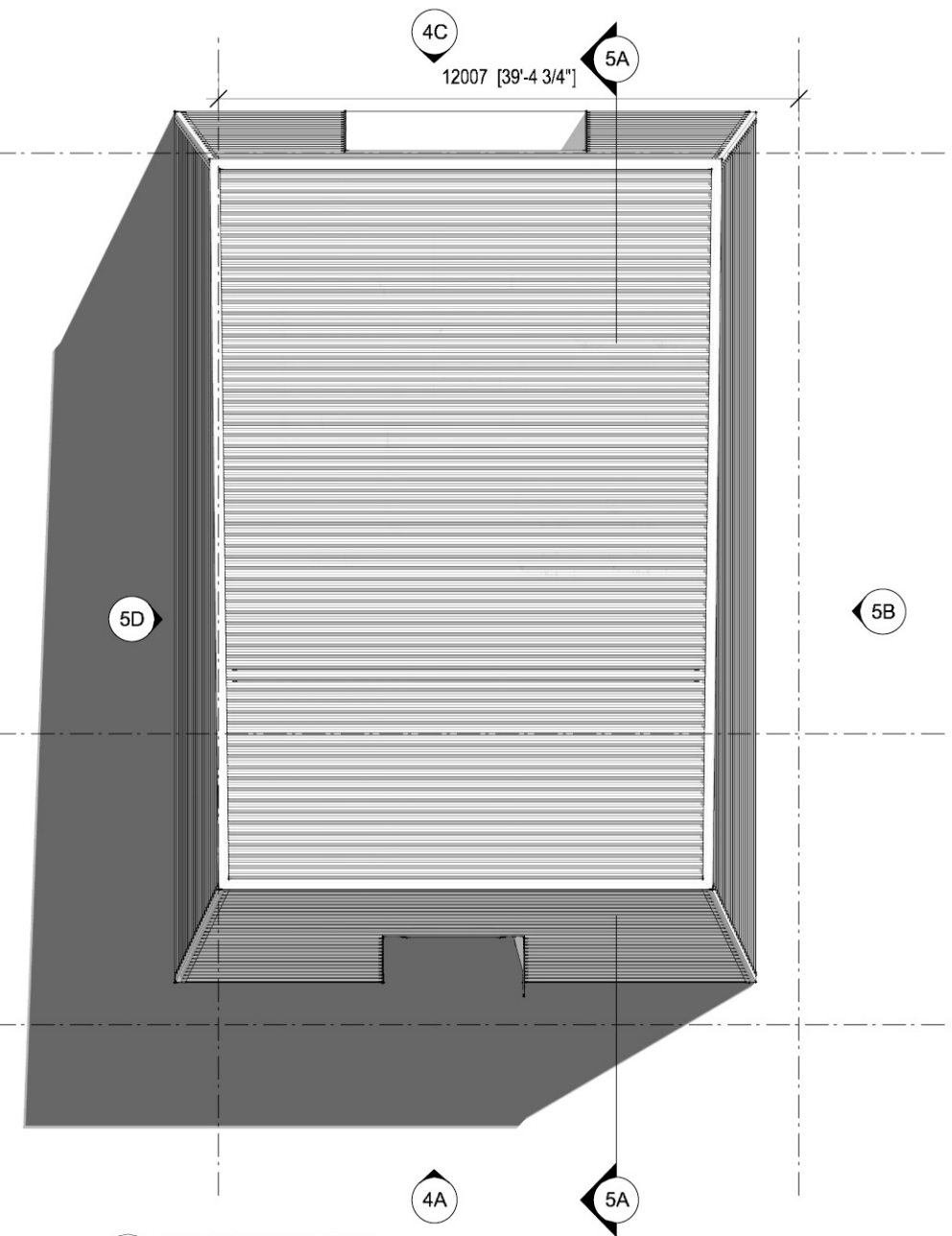




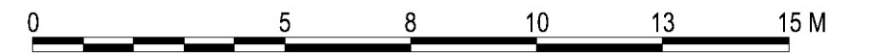
4A BOAT HOUSE MAIN FLR
Scale: 1:150

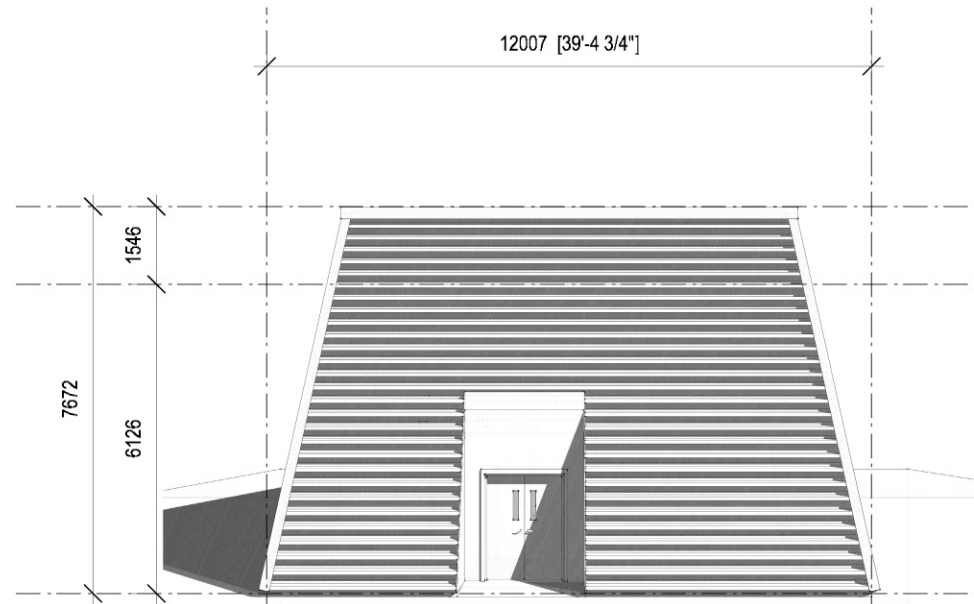


4B BOAT HOUSE SECOND FLR
Scale: 1:150

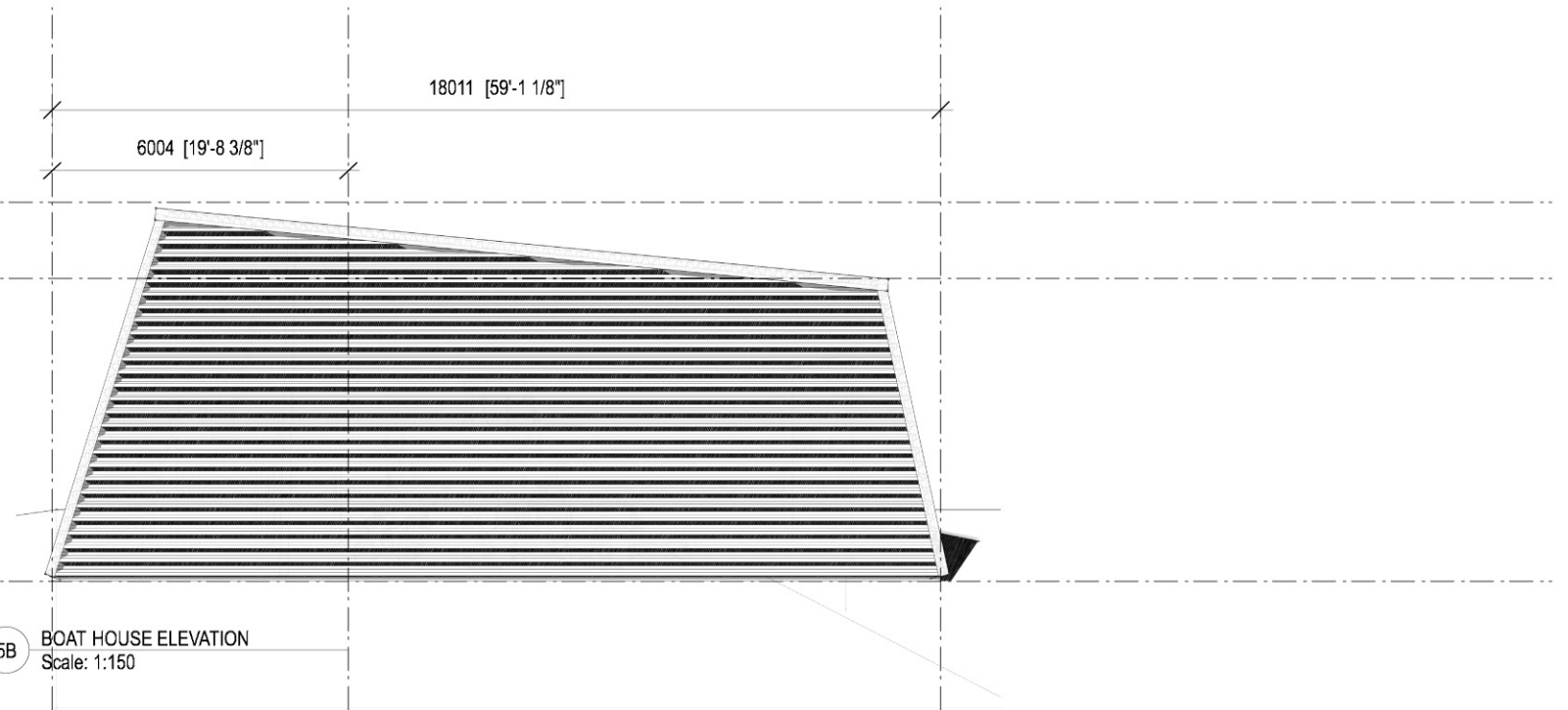


4C BOAT HOUSE ROOF PLAN
Scale: 1:150

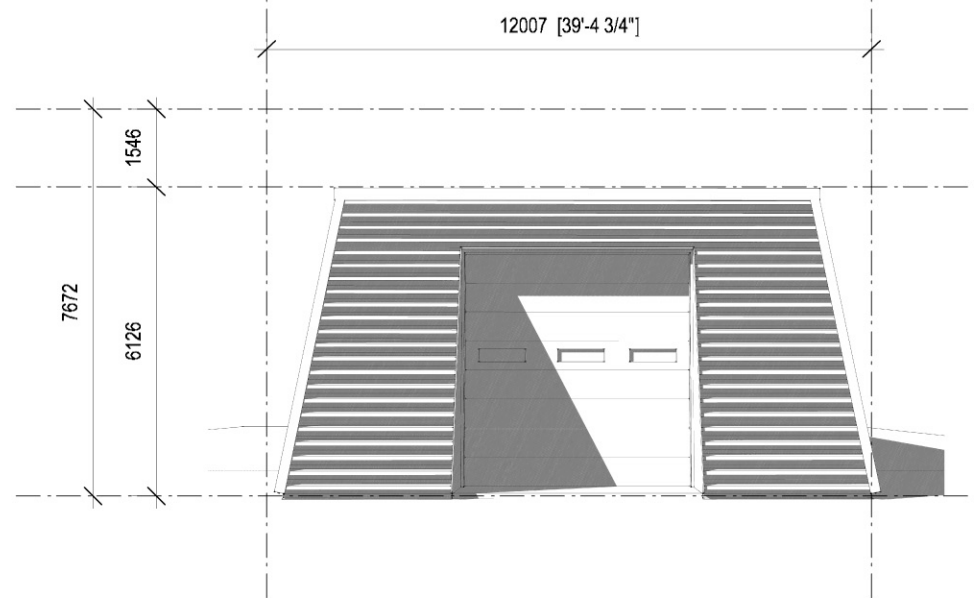




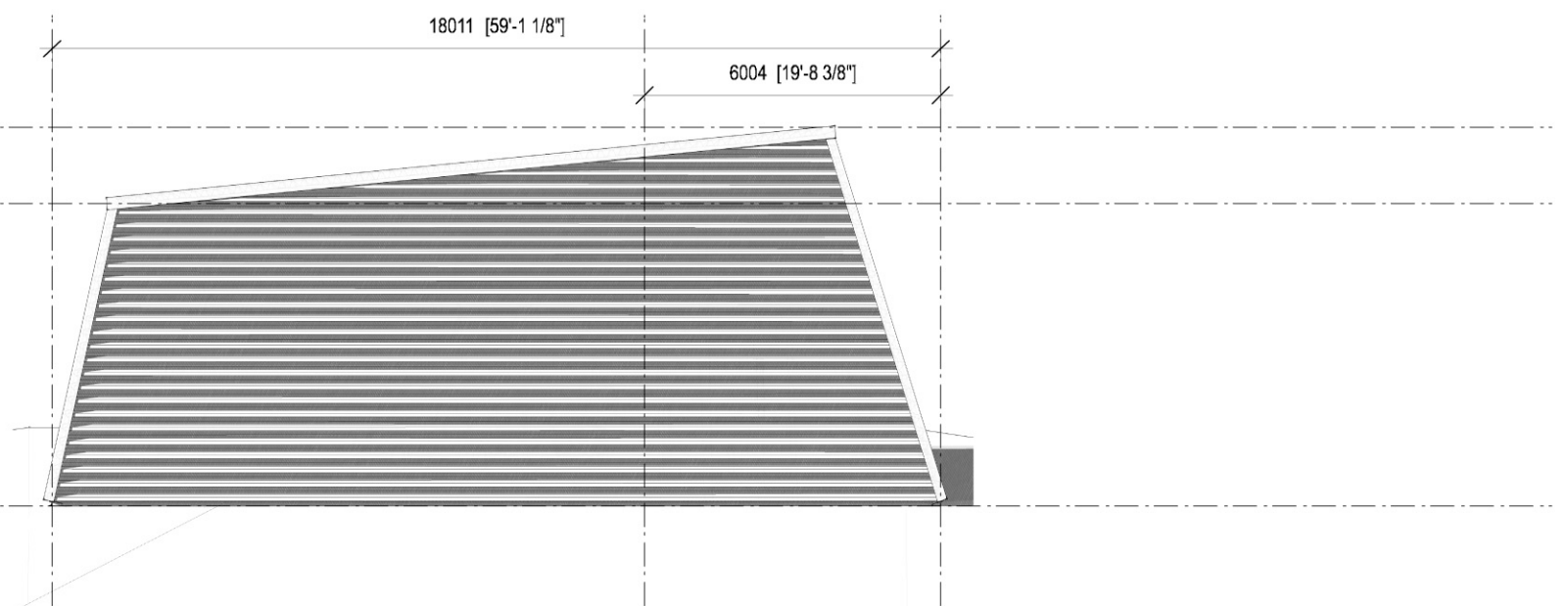
5A BOAT HOUSE ELEVATION
Scale: 1:150



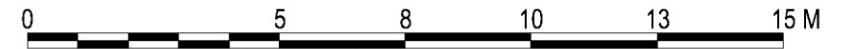
5B BOAT HOUSE ELEVATION
Scale: 1:150

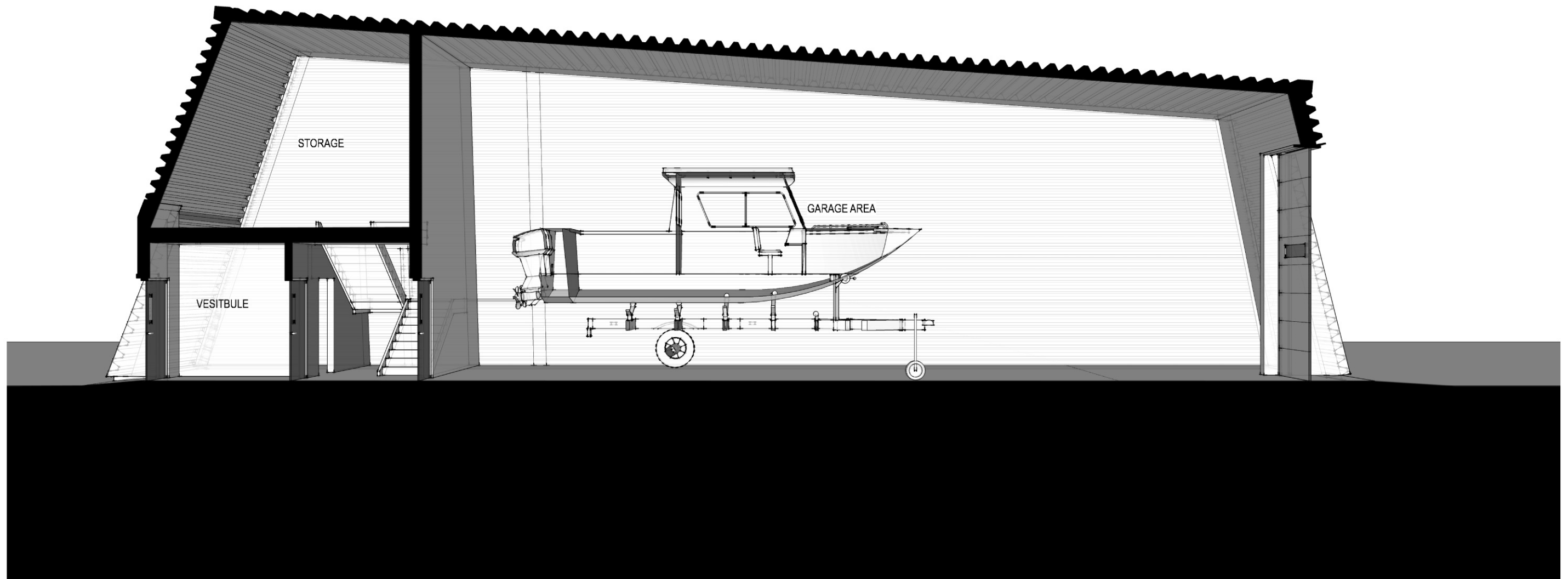


5C BOAT HOUSE ELEVATION
Scale: 1:150



5D BOAT HOUSE ELEVATION
Scale: 1:150





6A BOAT HOUSE SECTION
N.T.S.

APPENDIX D
GOVERNMENT CORRESPONDENCE



Water Science and Management Branch
Suite 160, 123 Main Street, Winnipeg, Manitoba, Canada R3C 1A5
T 204-945-4304 F 204-948-2357
www.manitoba.ca/conservation

September 15, 2015

Gene Senior
KGS Group
3rd Floor – 865 Waverley Street
Winnipeg MB R3T 5P4

Dear Mr. Senior,

WATER QUALITY DATA: Churchill River

In accordance with your request, please find attached water quality data for the Churchill River near Churchill. Although we have taken all reasonable measures to ensure that the enclosed data are correct and free of errors, it is recommended that you review these data carefully in the context of your intended application. Please note that concentrations preceded by an "L" were measured as less than the method detection limit.

Should these data be used in a report, technical manuscript, presentation, or other document, would you please reference as follows:

Water Quality Management Section
Manitoba Conservation and Water Stewardship
123 Main Street, Suite 160
Winnipeg MB R3C 1A5

Please provide a copy of any report or manuscript arising from the use of these data to the undersigned. Should you receive any requests for these data from a third party, please direct them to the undersigned.

Should you have any questions with regard to this information, or identify data that may be anomalous, please do not hesitate to contact our section at the above address, or by e-mail at kevin.jacobs@gov.mb.ca.

Sincerely,

Kevin Jacobs
Manitoba Conservation and Water Stewardship

From: Gene Senior [<mailto:GSenior@kgsgroup.com>]
Sent: September-15-15 9:17 AM
To: Jacobs, Kevin (CWS)
Subject: Churchill Marine Observatory - seeking water quality data for Churchill River

Kevin,
KGS Group is conducting an Environment Act Proposal for the proposed Churchill Marine Observatory.

The proposed project is to be developed just north of the Port of Churchill by the University of Manitoba. The project will use sea water obtained from the estuary of the Churchill River in Hudson Bay to grow sea ice in a controlled environment in order to conduct tests relating to the impacts of oil, liquefied natural gas, and other contaminants. Some tests will use fresh water obtained from the Churchill River. Upon completion of the tests, contaminated water will be processed to remove the contaminants and the uncontaminated water will be returned to the estuary.

Specifically, we are requesting available water quality data for the Churchill River near Hudson Bay, preferably within the last 10 years (2005 to 2015). The information obtained will be used to describe the existing environment in the project area and to assess potential project effects. If you have any questions or need clarification don't hesitate to contact me, thanks.

Gene Senior <gsenior@kgsgroup.com>
Environmental Scientist



865 Waverley Street
Winnipeg, Manitoba R3T 5P4
p. 204.896.1209 ext. 357
c. 204.218.3285
f. 204.896.0754
<http://www.kgsgroup.com>



Go Green:
Think before you print

This email and any attachments are for the sole use of the intended recipients and may be privileged or confidential. Any distribution, printing or other use by anyone else is prohibited. If you are not an intended recipient, please contact the sender immediately, and permanently delete this email and attachments.

| SAMPLE_NO | STATION_NO | STATION_NAME | STATION_DESCRIPTION | STATION_T YPE_CODE | SAMPLE_M ATRIX_COD E | SAMPLE_D ATETIME | TIME_USAB LE_FLAG | AGENCY_C ODE | SAMPLE_CL ASS_INDIC ATOR | ALKALINITY CO3(CALCD _) | ALKALINITY OH(CALCD_) | ALKALINITY TOTAL CACO3 |
|-----------|------------|-----------------|--|-----------------------|----------------------------|---------------------|----------------------|-----------------|--------------------------------|-------------------------------|------------------------------|------------------------------|
| | | | | | | | | | Variable Cod | 3534 | 3535 | 364 |
| | | | | | | | | | Unit Code | mg/L | mg/L | mg/L |
| M008368 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 2/25/1975 | N | 381 | A | 0 | 0 | 62 |
| M008369 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 4/25/1975 | N | 381 | A | 0 | 0 | 68 |
| M008370 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 5/22/1975 | N | 381 | A | 0 | 0 | 56 |
| M008371 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 6/10/1975 | N | 381 | A | 0 | 0 | 70 |
| M008372 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 8/1/1975 | N | 381 | A | 0 | 0 | 56 |
| M008373 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 10/8/1975 | N | 381 | A | 0 | 0 | 56 |
| M008374 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 10/22/1975 | N | 381 | A | 0 | 0 | 56 |
| M008375 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 11/4/1975 | N | 381 | A | 0 | 0 | 58 |
| M008376 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 12/2/1975 | N | 381 | A | 0 | 0 | 61 |
| M008377 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 1/5/1976 | N | 381 | A | 0 | 0 | 60 |
| M008378 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 2/9/1976 | N | 381 | A | 0 | 0 | 62 |
| M008379 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 3/1/1976 | N | 381 | A | 0 | 0 | 58 |
| M008380 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 5/4/1976 | N | 381 | A | 0 | 0 | 52 |
| M008381 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 6/3/1976 | N | 381 | A | 0 | 0 | 45 |
| M008382 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 7/5/1976 | N | 381 | A | 0 | 0 | 58 |
| M008383 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 8/17/1976 | N | 381 | A | 0 | 0 | 59 |
| M008384 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 11/1/1976 | N | 381 | A | 0 | 0 | 60 |
| M008385 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 11/30/1976 | N | 381 | A | 0 | 0 | 72 |
| M008386 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 1/5/1977 | N | 381 | A | 0 | 0 | 72 |
| M008387 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 1/31/1977 | N | 381 | A | 0 | 0 | 70 |
| M008388 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 3/7/1977 | N | 381 | A | 0 | 0 | 64 |
| M008389 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 4/12/1977 | N | 381 | A | 0 | 0 | 54 |
| M008390 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 5/2/1977 | N | 381 | A | 0 | 0 | 46 |
| M008391 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 6/1/1977 | N | 381 | A | 0 | 0 | 56 |
| M008392 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 7/4/1977 | N | 381 | A | 0 | 0 | 52 |
| M008393 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 8/2/1977 | N | 381 | A | 0 | 0 | 54 |
| M008394 | MB06FDS001 | CHURCHILL RIVER | CHURCHILL RIVER AT GOOSE CREEK PUMPHOUSE (CHURCHILL INTAKE) | 0 | 2 | 11/2/1977 | N | 381 | A | 0 | 0 | 66 |
| M019459 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 7/6/1972 | N | 381 | A | | | |
| M019460 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 7/31/1972 | N | 381 | A | | | 44 |
| M019461 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 9/5/1972 | N | 381 | A | | | 44.9 |
| M019462 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 9/29/1972 | N | 381 | A | | | |
| M019463 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 11/1/1972 | N | 381 | A | | | 46.9 |
| M019464 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 12/7/1972 | N | 381 | A | | | 49.2 |
| M019465 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 12/27/1972 | N | 381 | A | | | 48.2 |
| M019466 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 2/5/1973 | N | 381 | A | | | 50 |
| M019467 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 3/5/1973 | N | 381 | A | | | 50.6 |
| M019468 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 4/6/1973 | N | 381 | A | | | |
| M019469 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 5/3/1973 | N | 381 | A | | | |
| M019470 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 5/29/1973 | N | 381 | A | | | 44.8 |
| M019471 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 7/3/1973 | N | 381 | A | | | 48 |

| SAMPLE_NO | STATION_NO | STATION_NAME | STATION_DESCRIPTION | STATION_T YPE_CODE | SAMPLE_M ATRIX_COD E | SAMPLE_D ATETIME | TIME_USAB LE_FLAG | AGENCY_C ODE | SAMPLE_CL ASS_INDIC ATOR | ALKALINITY CO3(CALCD _) | ALKALINITY OH(CALCD_) | ALKALINITY TOTAL CACO3 |
|------------|------------|-----------------|--|-----------------------|----------------------------|---------------------|----------------------|-----------------|--------------------------------|-------------------------------|------------------------------|------------------------------|
| M019472 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 8/8/1973 | N | 381 | A | | | 44 |
| M019473 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 9/10/1973 | N | 381 | A | | | 43 |
| M019474 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 10/2/1973 | N | 381 | A | | | 42 |
| M019475 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 10/30/1973 | N | 381 | A | | | 42 |
| M019476 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 12/12/1973 | N | 381 | A | | | 41 |
| M019477 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 1/7/1974 | N | 381 | A | | | 44 |
| M019478 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 2/4/1974 | N | 381 | A | | | 45 |
| M019479 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 3/6/1974 | N | 381 | A | | | 48 |
| M019480 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 4/3/1974 | N | 381 | A | | | 51 |
| M019481 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 5/3/1974 | N | 381 | A | | | 52 |
| M019482 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 6/5/1974 | N | 381 | A | | | 47 |
| M019483 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 7/3/1974 | N | 381 | A | | | 51 |
| M019484 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 7/31/1974 | N | 381 | A | | | 55 |
| M019485 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 9/5/1974 | N | 381 | A | | | |
| M019486 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 9/19/1974 | N | 381 | A | | | 50 |
| M019487 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 10/5/1974 | N | 381 | A | | | 50 |
| M019488 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 10/7/1974 | N | 381 | A | | | 48 |
| M019489 | MB06FDS002 | CHURCHILL RIVER | CHURCHILL R. AT INTAKE OF GOOSE CR. PUMPHOUSE (CHURCHILL-NELSON) | 0 | 2 | 12/4/1974 | N | 381 | A | | | 55 |
| M020297 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 8/15/1978 | N | 381 | A | | | |
| M020298 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 10/6/1978 | N | 381 | A | | | |
| M020299 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 5/31/1979 | N | 381 | A | | | |
| M020300 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 7/25/1979 | N | 381 | A | | | |
| M020301 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 1/9/1980 | N | 381 | A | | | |
| M020302 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 6/13/1980 | N | 381 | A | 0 | 0 | 85 |
| M020303 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 8/28/1980 | N | 381 | A | 0 | 0 | 53 |
| M020304 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 10/8/1980 | N | 381 | A | 0 | 0 | 68 |
| M020305 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 1/8/1981 | N | 381 | A | 0 | 0 | 76 |
| M020306 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 4/2/1981 | N | 381 | A | 0 | 0 | 13 |
| M020307 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 9/10/1981 | N | 381 | A | 0 | 0 | 77 |
| M020308 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 10/5/1981 | N | 381 | A | 0 | 0 | 78 |
| M020309 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 1/6/1982 | N | 381 | A | 0 | 0 | 82 |
| M020310 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 3/23/1982 | N | 381 | A | 0 | 0 | 84 |
| M020311 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 6/1/1982 | N | 381 | A | 0 | 0 | 53 |
| M020312 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 8/24/1982 | N | 381 | A | 0 | 0 | 67 |
| M020313 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 9/28/1982 | N | 381 | A | 0 | 0 | 68 |
| M020314 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 1/14/1983 | N | 381 | A | 0 | 0 | 72 |
| 1108CL0047 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 8/2/2011 11 | Y | 381 | A | L0.6 | L0.4 | 71.9 |
| 1108CL0053 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 8/2/2011 11 | Y | 381 | A | | | |
| 1109CL0069 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 9/7/2011 11 | Y | 381 | A | L0.6 | L0.4 | 63.6 |
| 1109CL0076 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 9/7/2011 11 | Y | 381 | A | | | |
| 1202EW1038 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 2/28/2012 1 | Y | 381 | A | L12 | L6.8 | 100 |
| 1202EW1042 | MB06FDS003 | CHURCHILL RIVER | CHURCHILL RIVER AT RED HEAD RAPIDS (ENV. CANADA) | 0 | 2 | 2/28/2012 1 | Y | 381 | A | | | |

| SAMPLE_NO | STATION_NO | STATION_NAME | STATION_DESCRIPTION | STATION_T YPE_CODE | SAMPLE_M ATRIX_COD E | SAMPLE_D ATETIME | TIME_USAB LE_FLAG | AGENCY_C ODE | SAMPLE_CL ASS_INDIC ATOR | ALKALINITY CO3(CALCD _) | ALKALINITY OH(CALCD_) | ALKALINITY TOTAL CACO3 |
|------------|------------|-----------------|---|-----------------------|----------------------------|---------------------|----------------------|-----------------|--------------------------------|-------------------------------|------------------------------|------------------------------|
| 0806JHS709 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 7/1/2008 1:2 | Y | 381 | A | | | |
| 0806JHS809 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 7/1/2008 1:2 | Y | 381 | A | L0.6 | L0.4 | 63 |
| 0808JHS609 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/19/2008 1 | Y | 381 | A | L0.6 | L0.4 | 70 |
| 0808JHS759 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/19/2008 1 | Y | 381 | A | | | |
| 0809JHS209 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/21/2008 1 | Y | 381 | A | L0.6 | L0.4 | 70 |
| 0809JHS409 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/21/2008 1 | Y | 381 | A | | | |
| 0903JH0212 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 3/5/2009 10 | Y | 381 | A | L0.6 | L0.4 | 87 |
| 0903JH0227 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 3/5/2009 10 | Y | 381 | A | | | |
| 0903JH0243 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 3/5/2009 10 | Y | 381 | A | | | |
| 0906JH1088 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 7/1/2009 11 | Y | 381 | A | | | |
| 0906JH1016 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 7/1/2009 1:3 | Y | 381 | A | L0.6 | L0.4 | 57.9 |
| 0908JH1323 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/6/2009 11 | Y | 381 | A | L0.6 | L0.4 | 63.2 |
| 0908JH1388 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/6/2009 11 | Y | 381 | A | | | |
| 0909JH1572 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/9/2009 11 | Y | 381 | A | L0.6 | L0.4 | 61 |
| 0909JH1637 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/9/2009 11 | Y | 381 | A | | | |
| 1006JH0717 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 6/17/2010 1 | Y | 381 | A | L0.6 | L0.4 | 60.9 |
| 1006JH0760 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 6/17/2010 1 | Y | 381 | A | | | |
| 1008JS1335 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/9/2010 11 | Y | 381 | A | 1.44 | L0.4 | 72.1 |
| 1008JS1357 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/9/2010 11 | Y | 381 | A | | | |
| 1009JS1539 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/9/2010 10 | Y | 381 | A | L0.6 | L0.4 | 60.6 |
| 1009JS1723 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/9/2010 10 | Y | 381 | A | | | |
| 1102CL0171 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 2/21/2011 1 | Y | 381 | A | L0.6 | L0.4 | 74.7 |
| 1106CL0075 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 6/29/2011 4 | Y | 381 | A | 1.51 | L0.4 | 68.5 |
| 1106CL0076 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 6/29/2011 4 | Y | 381 | A | | | |
| 1108CL0046 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/2/2011 10 | Y | 381 | A | L0.6 | L0.4 | 67.4 |
| 1108CL0052 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/2/2011 10 | Y | 381 | A | | | |
| 1109CL0068 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/7/2011 10 | Y | 381 | A | L0.6 | L0.4 | 61.2 |
| 1109CL0075 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/7/2011 10 | Y | 381 | A | | | |
| 1202EW1039 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 2/28/2012 9 | Y | 381 | A | L12 | L6.8 | 84 |
| 1206CL0047 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 6/12/2012 9 | Y | 381 | A | L12 | L6.8 | 54 |
| 1206CL0052 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 6/12/2012 9 | Y | 381 | A | | | |
| 1208EW0029 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/8/2012 11 | Y | 381 | A | L12 | L6.8 | 67 |
| 1208EW0034 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/8/2012 11 | Y | 381 | A | | | |
| 1209EW0132 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/9/2012 2: | Y | 381 | A | | | |
| 1209RE0127 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/9/2012 2: | Y | 381 | A | L12 | L6.8 | 68 |
| 1209RE0130 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/9/2012 2: | Y | 381 | A | | | |
| 1302EW0108 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 2/22/2013 1 | Y | 381 | A | L12 | L6.8 | 79 |
| 1306EW4015 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 6/20/2013 1 | Y | 381 | A | | | |
| 1306EW4002 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 6/20/2013 3 | Y | 381 | A | L12 | L6.8 | 71 |
| 1308EW4002 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/5/2013 10 | Y | 381 | A | L12 | L6.8 | 71 |
| 1308EW4015 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/5/2013 10 | Y | 381 | A | | | |
| 1309EW4044 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/8/2013 10 | Y | 381 | A | L12 | L6.8 | 73 |

| SAMPLE_NO | STATION_NO | STATION_NAME | STATION_DESCRIPTION | STATION_T YPE_CODE | SAMPLE_M ATRIX_COD E | SAMPLE_D ATETIME | TIME_USAB LE_FLAG | AGENCY_C ODE | SAMPLE_CL ASS_INDIC ATOR | ALKALINITY CO3(CALCD _) | ALKALINITY OH(CALCD_) | ALKALINITY TOTAL CACO3 |
|------------|------------|-----------------|---|-----------------------|----------------------------|---------------------|----------------------|-----------------|--------------------------------|-------------------------------|------------------------------|------------------------------|
| 1309EW4057 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/8/2013 10 | Y | 381 | A | | | |
| 1405EW4044 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 6/24/2014 1 | Y | 381 | A | L12 | L6.8 | 70 |
| 1405EW4053 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 6/24/2014 1 | Y | 381 | A | | | |
| 1408EW4023 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/6/2014 8:5 | Y | 381 | A | L12 | L6.8 | 67 |
| 1408EW4031 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 8/6/2014 8:5 | Y | 381 | A | | | |
| 1409EW4044 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/7/2014 10 | Y | 381 | A | L12 | L6.8 | 67 |
| 1409EW4052 | MB06FDS004 | CHURCHILL RIVER | SLIGHTLY UPSTREAM OF CONFLUENCE WITH LITTLE CHURCHILL RIVER | 0 | 2 | 9/7/2014 10 | Y | 381 | A | | | |
| 1405EW4045 | MB06FDS005 | CHURCHILL RIVER | CHURCHILL WEIR | 0 | 2 | 6/24/2014 1 | Y | 381 | A | L12 | L6.8 | 71 |
| 1405EW4054 | MB06FDS005 | CHURCHILL RIVER | CHURCHILL WEIR | 0 | 2 | 6/24/2014 1 | Y | 381 | A | | | |
| 1408EW4024 | MB06FDS005 | CHURCHILL RIVER | CHURCHILL WEIR | 0 | 2 | 8/6/2014 10 | Y | 381 | A | L12 | L6.8 | 70 |
| 1408EW4032 | MB06FDS005 | CHURCHILL RIVER | CHURCHILL WEIR | 0 | 2 | 8/6/2014 10 | Y | 381 | A | | | |
| 1409EW4045 | MB06FDS005 | CHURCHILL RIVER | CHURCHILL WEIR | 0 | 2 | 9/7/2014 11 | Y | 381 | A | L12 | L6.8 | 72 |
| 1409EW4053 | MB06FDS005 | CHURCHILL RIVER | CHURCHILL WEIR | 0 | 2 | 9/7/2014 11 | Y | 381 | A | | | |

| SAMPLE_NO | ALKALINITY TOTAL HCO3(CALC D_) | ALUMINU M TOTAL | AMMONIA (NH3) | AMMONIA DISSOLVED | ANTIMONY TOTAL | ARSENIC EXTRACTAB LE | ARSENIC TOTAL | BARIUM TOTAL | BERYLLIUM TOTAL | BISMUTH TOTAL | BORON SOLUBLE | BORON TOTAL | CADMIUM EXTRACTAB LE | CADMIUM TOTAL | CALCIUM EXTRACTAB LE | CALCIUM TOTAL | CARBON DISSOLVED ORGANIC (CALCD_) | CARBON TOTAL INORGANIC |
|-----------|---|--------------------|------------------|----------------------|-------------------|----------------------------|------------------|-----------------|--------------------|------------------|------------------|----------------|----------------------------|------------------|----------------------------|------------------|--|------------------------------|
| | 3533 | 373 | 603 | 604 | 766 | 377 | 379 | 388 | 393 | 1049 | 3539 | 401 | 410 | 412 | 2692 | 408 | 479 | 485 |
| | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L |
| M008368 | 76 | | | | | | | | | | | | | | 15 | | | 11.5 |
| M008369 | 83 | | | | | | | | | | | | | | 15 | | | 10 |
| M008370 | 68 | | | | | | | | | | | | | | 17.5 | | | |
| M008371 | 85.4 | | | | | | | | | | | | | | 12.5 | | | 12.5 |
| M008372 | 68 | | | | | | | | | | | | | | 15 | | | 14 |
| M008373 | 68 | | | | | | | | | | | | | | 12.5 | | | 13.5 |
| M008374 | 68.3 | | | | | | | | | | | | | | 12.5 | | | 11.5 |
| M008375 | 70.8 | | | | | | | | | | | | | | 15 | | | 10.5 |
| M008376 | 74 | | | | | | | | | | | | | | 17.5 | | | 13.5 |
| M008377 | 73 | | | | | | | | | | | | | | 12.5 | | | |
| M008378 | 76 | | | | | | | | | | | | | | 17.5 | | | 12 |
| M008379 | 71 | | | | | | | | | | | | | | 15 | | | 13 |
| M008380 | 63.4 | | | | | | | | | | | | | | 12.5 | | | 9.5 |
| M008381 | 54.9 | | | | | | | | | | | | | | 12.5 | | | 12 |
| M008382 | 70.8 | | | | | | | | | | | | | | 20 | | | 14 |
| M008383 | 72 | | | | | | | | | | | | | | 20 | | | 18.5 |
| M008384 | 73.2 | | | | | | | | | | | | | | 15 | | | 13.5 |
| M008385 | 87.8 | | | | | | | | | | | | | | 20 | | | 16.5 |
| M008386 | 87.8 | | | | | | | | | | | | | | 20 | | | 16 |
| M008387 | 85.4 | | | | | | | | | | | | | | 15 | | | 15 |
| M008388 | 78 | | | | | | | | | | | | | | 15 | | | 15.5 |
| M008389 | 65.8 | | | | | | | | | | | | | | 15 | | | 15 |
| M008390 | 56.1 | | | | | | | | | | | | | | 7.5 | | | 8.5 |
| M008391 | 68.3 | | | | | | | | | | | | | | 15 | | | 12.5 |
| M008392 | 63.4 | | | | | | | | | | | | | | 12.5 | | | 12 |
| M008393 | 65.9 | | | | | | | | | | | | | | 15 | | | 13 |
| M008394 | 80.5 | | | | | | | | | | | | | | 18 | | | 12.5 |
| M019459 | | | | | | | | | | | | | | | | | | 7 |
| M019460 | | | | | | | | | | | | | | | 14.4 | | | |
| M019461 | | | | | | | | | | | | | | | 9.9 | | | 7 |
| M019462 | | | | | | | | | | | | | | | 11.2 | | | 7 |
| M019463 | | | | | | | | | | | | | | | 14.1 | | | 8 |
| M019464 | | | | | | | | | | | | | | | 14.4 | | | 12 |
| M019465 | | | | | | | | | | | | | | | 16.2 | | | 11 |
| M019466 | | | | | | | | | | | | | | | 14.8 | | | 12 |
| M019467 | | | | | | | | | | | | | | | 18.2 | | | 12 |
| M019468 | | | | | | | | | | | | | | | 14.6 | | | 9 |
| M019469 | | | | | | | | | | | | | | | | | | 9 |
| M019470 | | | | | | | | | | | | | | | 13.2 | | | 7 |
| M019471 | | | | | | | | | | | | | | | 15 | | | 8 |

| SAMPLE_NO | ALKALINITY TOTAL HCO3(CALC D_) | ALUMINU M TOTAL | AMMONIA (NH3) | AMMONIA DISSOLVED | ANTIMONY TOTAL | ARSENIC EXTRACTAB LE | ARSENIC TOTAL | BARIUM TOTAL | BERYLLIUM TOTAL | BISMUTH TOTAL | BORON SOLUBLE | BORON TOTAL | CADMIUM EXTRACTAB LE | CADMIUM TOTAL | CALCIUM EXTRACTAB LE | CALCIUM TOTAL | CARBON DISSOLVED ORGANIC (CALCD_) | CARBON TOTAL INORGANIC |
|------------|---|--------------------|------------------|----------------------|-------------------|----------------------------|------------------|-----------------|--------------------|------------------|------------------|----------------|----------------------------|------------------|----------------------------|------------------|--|------------------------------|
| M019472 | | | | | | | | | | | | | | | | 16 | | 10 |
| M019473 | | | | | | | | | | | | | | | | 13 | | 10 |
| M019474 | | | | | | | | | | | | | | | | 14 | | 9 |
| M019475 | | | | | | | | | | | | | | | | 12 | | 8 |
| M019476 | | | | | | | | | | | | | | | | 15 | | 10 |
| M019477 | | | | | | | | | | | | | | | | 12 | | 9 |
| M019478 | | | | | | | | | | | | | | | | 13 | | 10 |
| M019479 | | | | | | | | | | | | | | | | 14 | | 11 |
| M019480 | | | | | | | | | | | | | | | | 12.2 | | 12 |
| M019481 | | | | | | | | | | | | | | | | 17 | | 10 |
| M019482 | | | | | | | | | | | | | | | | 13 | | 10 |
| M019483 | | | | | | | | | | | | | | | | 14 | | 12 |
| M019484 | | | | | | | | | | | | | | | | 14 | | 9 |
| M019485 | | | | | | | | | | | | | | | | | | |
| M019486 | | | | | | | | | | | | | | | | 16 | | 11 |
| M019487 | | | | | | | | | | | | | | | | 15 | | 12 |
| M019488 | | | | | | | | | | | | | | | | 13 | | 19 |
| M019489 | | | | | | | | | | | | | | | | 14 | | 11 |
| M020297 | | | | | | L0.0005 | | | | | | | L0.001 | | | | | |
| M020298 | | | | | | | | | | | | | L0.001 | | | | | |
| M020299 | | | | | | | | | | | | | | | | | | |
| M020300 | | | | | | L0.0005 | | | | | | | L0.001 | | | | | |
| M020301 | | | | | | L0.0005 | | | | | | | 0.005 | | | | | |
| M020302 | 103.6 | | | | | | | | | | | | | | | | | |
| M020303 | 64.6 | | | | | | | | | | | | | | | | | |
| M020304 | 82.9 | | | | | | | | | | | | | | | | | |
| M020305 | 92.6 | | | | | | | | | | | | | | | | | |
| M020306 | 15.8 | | | | | 0.0005 | | | | | 0.03 | | 0.001 | | 4.5 | | | |
| M020307 | 93.9 | | | | | 0.0005 | | | | | 0.03 | | 0.001 | | 23 | | | |
| M020308 | 95.1 | | | | | 0.0005 | | | | | 0.07 | | 0.001 | | 25 | | | |
| M020309 | 100 | | | | | 0.0005 | | | | | 0.07 | | 0.001 | | 23.6 | | | |
| M020310 | 102.4 | | | | | 0.0005 | | | | | 0.07 | | 0.001 | | 24.9 | | | |
| M020311 | 64.6 | | | | | 0.0005 | | | | | 0.15 | | 0.001 | | 18.1 | | | |
| M020312 | 81.7 | | | | | 0.0005 | | | | | 0.06 | | 0.001 | | 21.7 | | | |
| M020313 | 82.9 | | | | | 0.0005 | | | | | 0.06 | | 0.001 | | 21.7 | | | |
| M020314 | 87.8 | | | | | 0.0005 | | | | | 0.06 | | 0.001 | | 22.2 | | | |
| 1108CL0047 | 87.7 | 0.148 | L0.01 | | L0.0002 | | 0.00043 | 0.0103 | L0.0002 | L0.0002 | | L0.01 | | 0.00001 | | 22 | 9.4 | 15.5 |
| 1108CL0053 | | | | | | | | | | | | | | | | | | |
| 1109CL0069 | 77.6 | 0.301 | L0.01 | | L0.0002 | | 0.00037 | 0.0118 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 19 | 7.4 | 14.8 |
| 1109CL0076 | | | | | | | | | | | | | | | | | | |
| 1202EW1038 | 122 | 0.0889 | L0.01 | | L0.0002 | | 0.00031 | 0.0115 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 26.5 | 8 | 23.6 |
| 1202EW1042 | | | | | | | | | | | | | | | | | | |

| SAMPLE_NO | ALKALINITY TOTAL HCO3(CALC D_) | ALUMINU M TOTAL | AMMONIA (NH3) | AMMONIA DISSOLVED | ANTIMONY TOTAL | ARSENIC EXTRACTAB LE | ARSENIC TOTAL | BARIUM TOTAL | BERYLLIUM TOTAL | BISMUTH TOTAL | BORON SOLUBLE | BORON TOTAL | CADMIUM EXTRACTAB LE | CADMIUM TOTAL | CALCIUM EXTRACTAB LE | CALCIUM TOTAL | CARBON DISSOLVED ORGANIC (CALCD_) | CARBON TOTAL INORGANIC |
|------------|---|--------------------|------------------|----------------------|-------------------|----------------------------|------------------|-----------------|--------------------|------------------|------------------|----------------|----------------------------|------------------|----------------------------|------------------|--|------------------------------|
| 0806JHS709 | | | | | | | | | | | | | | | | | | |
| 0806JHS809 | 77 | 0.089 | | 0.011 | L0.001 | | L0.0005 | 0.0074 | L0.001 | L0.0002 | | L0.03 | | L0.00001 | | 17.3 | 7 | 14 |
| 0808JHS609 | 85 | 0.308 | | 0.012 | L0.001 | | L0.0005 | 0.011 | L0.001 | L0.0002 | | L0.03 | | L0.00001 | | 18.9 | | 16 |
| 0808JHS759 | | | | | | | | | | | | | | | | | | |
| 0809JHS209 | 85 | 0.079 | | 0.005 | L0.001 | | L0.0005 | 0.0092 | L0.001 | L0.0002 | | L0.03 | | L0.00001 | | 17.9 | 6 | 17 |
| 0809JHS409 | | | | | | | | | | | | | | | | | | |
| 0903JH0212 | 106 | 0.078 | | 0.011 | 0.0005 | | 0.0005 | 0.0119 | L0.001 | L0.0002 | | 0.03 | | 0.00001 | | 23.8 | | 21 |
| 0903JH0227 | | | | | | | | | | | | | | | | | | |
| 0903JH0243 | | | | | | | | | | | | | | | | | | |
| 0906JH1088 | | | | | | | | | | | | | | | | | | |
| 0906JH1016 | 70.7 | 0.143 | | 0.004 | L0.0005 | | L0.0005 | 0.00905 | L0.001 | L0.0002 | | L0.03 | | 0.00002 | | 17.1 | 9.1 | 13.3 |
| 0908JH1323 | 77.1 | 0.267 | | L0.003 | L0.0005 | | L0.0005 | 0.0122 | L0.001 | L0.0002 | | L0.03 | | 0.00001 | | 20.2 | 6.7 | 14.8 |
| 0908JH1388 | | | | | | | | | | | | | | | | | | |
| 0909JH1572 | 74.4 | 0.25 | | 0.0078 | L0.0005 | | L0.0005 | 0.012 | L0.001 | L0.0002 | | L0.03 | | L0.00001 | | 17.3 | 7.7 | 12.9 |
| 0909JH1637 | | | | | | | | | | | | | | | | | | |
| 1006JH0717 | 74.2 | 0.11 | | 0.068 | L0.0002 | | 0.00029 | 0.00873 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 17.7 | 7.5 | 14.9 |
| 1006JH0760 | | | | | | | | | | | | | | | | | | |
| 1008JS1335 | 85.1 | 0.152 | 0.012 | | L0.0002 | | 0.00046 | 0.0106 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 21.5 | 8.2 | 15.9 |
| 1008JS1357 | | | | | | | | | | | | | | | | | | |
| 1009JS1539 | 74 | 0.485 | L0.01 | | L0.0002 | | 0.00035 | 0.0131 | L0.0002 | L0.0002 | | L0.01 | | 0.00002 | | 17.9 | 10.6 | 15.4 |
| 1009JS1723 | | | | | | | | | | | | | | | | | | |
| 1102CL0171 | 91.2 | 0.326 | L0.01 | | L0.0002 | | 0.00035 | 0.0132 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 22.7 | 8.8 | 18.1 |
| 1106CL0075 | 78.9 | 0.0784 | L0.01 | | L0.0002 | | 0.00036 | 0.00875 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 23.3 | 7.6 | 14 |
| 1106CL0076 | | | | | | | | | | | | | | | | | | |
| 1108CL0046 | 82.2 | 0.214 | L0.01 | | L0.0002 | | 0.0004 | 0.0112 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 21.6 | 7.9 | 14.5 |
| 1108CL0052 | | | | | | | | | | | | | | | | | | |
| 1109CL0068 | 74.7 | 0.311 | L0.01 | | L0.0002 | | 0.00035 | 0.0118 | L0.0002 | L0.0002 | | L0.01 | | 0.00001 | | 17.4 | 6.6 | 14.3 |
| 1109CL0075 | | | | | | | | | | | | | | | | | | |
| 1202EW1039 | 102 | 0.129 | L0.01 | | L0.0002 | | 0.00031 | 0.0117 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 23.8 | 7.8 | 19.7 |
| 1206CL0047 | 65 | 0.108 | L0.01 | | L0.0002 | | 0.00022 | 0.0083 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 17 | 7.4 | 13 |
| 1206CL0052 | | | | | | | | | | | | | | | | | | |
| 1208EW0029 | 82 | 0.158 | 0.042 | | L0.0002 | | 0.00038 | 0.0101 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 18.9 | 4.7 | 15 |
| 1208EW0034 | | | | | | | | | | | | | | | | | | |
| 1209EW0132 | | | | | | | | | | | | | | | | | | |
| 1209RE0127 | 83 | 0.112 | L0.01 | | L0.0002 | | 0.00038 | 0.00903 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 19.1 | 9.4 | 15 |
| 1209RE0130 | | | | | | | | | | | | | | | | | | |
| 1302EW0108 | 96 | 0.0898 | L0.01 | | L0.0002 | | 0.00029 | 0.0114 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 20.8 | 6.8 | 20.3 |
| 1306EW4015 | | | | | | | | | | | | | | | | | | |
| 1306EW4002 | 87 | 0.0921 | L0.01 | | L0.0002 | | 0.00031 | 0.00901 | L0.0002 | L0.0002 | | L0.01 | | 0.00001 | | 18.5 | 7.7 | 15.3 |
| 1308EW4002 | 87 | 0.2 | L0.01 | | L0.0002 | | 0.00041 | 0.0101 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 20.8 | 8.8 | 15.9 |
| 1308EW4015 | | | | | | | | | | | | | | | | | | |
| 1309EW4044 | 89 | 0.101 | L0.01 | | L0.0002 | | 0.00037 | 0.0094 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 20.4 | 7.8 | 16.4 |

| SAMPLE_NO | ALKALINITY TOTAL HCO3(CALC D_) | ALUMINU M TOTAL | AMMONIA (NH3) | AMMONIA DISSOLVED | ANTIMONY TOTAL | ARSENIC EXTRACTAB LE | ARSENIC TOTAL | BARIUM TOTAL | BERYLLIUM TOTAL | BISMUTH TOTAL | BORON SOLUBLE | BORON TOTAL | CADMIUM EXTRACTAB LE | CADMIUM TOTAL | CALCIUM EXTRACTAB LE | CALCIUM TOTAL | CARBON DISSOLVED ORGANIC (CALCD_) | CARBON TOTAL INORGANIC |
|------------|---|--------------------|------------------|----------------------|-------------------|----------------------------|------------------|-----------------|--------------------|------------------|------------------|----------------|----------------------------|------------------|----------------------------|------------------|--|------------------------------|
| 1309EW4057 | | | | | | | | | | | | | | | | | | |
| 1405EW4044 | 85 | 0.269 | L0.01 | | L0.0002 | | 0.00034 | 0.0115 | L0.0002 | L0.0002 | | 0.01 | | 0.00001 | | 19.2 | | 14 |
| 1405EW4053 | | | | | | | | | | | | | | | | | | |
| 1408EW4023 | 81 | 0.273 | L0.01 | | L0.0002 | | 0.00037 | 0.0114 | L0.0002 | L0.0002 | | 0.012 | | L0.00001 | | 18.5 | 7.4 | 14.3 |
| 1408EW4031 | | | | | | | | | | | | | | | | | | |
| 1409EW4044 | 82 | 0.219 | L0.01 | | L0.0002 | | 0.00035 | 0.0112 | L0.0002 | L0.0002 | | 0.013 | | L0.00001 | | 18.5 | 5.1 | 15.2 |
| 1409EW4052 | | | | | | | | | | | | | | | | | | |
| 1405EW4045 | 87 | 0.228 | L0.01 | | L0.0002 | | 0.00036 | 0.0105 | L0.0002 | L0.0002 | | L0.01 | | L0.00001 | | 19.1 | | 14.3 |
| 1405EW4054 | | | | | | | | | | | | | | | | | | |
| 1408EW4024 | 86 | 0.255 | 0.011 | | L0.0002 | | 0.00039 | 0.0116 | L0.0002 | L0.0002 | | 0.012 | | L0.00001 | | 19.8 | 7.8 | 15 |
| 1408EW4032 | | | | | | | | | | | | | | | | | | |
| 1409EW4045 | 88 | 0.167 | L0.01 | | L0.0002 | | 0.00039 | 0.00994 | L0.0002 | L0.0002 | | 0.011 | | 0.00002 | | 18.8 | 6.4 | 16.4 |
| 1409EW4053 | | | | | | | | | | | | | | | | | | |

| SAMPLE_NO | CARBON TOTAL ORGANIC (CALCD_) | CARBON TOTAL ORGANIC (TOC) | CESIUM TOTAL | CHLORIDE (CL) | CHLORIDE DISSOLVED | CHLORIDE SOLUBLE | CHLOROPHYLL A | CHROMIUM TOTAL (CR) | COBALT TOTAL | COLIFORMS FECAL | COLIFORMS TOTAL | COLIFORMS TOTAL | COLOUR TRUE | COLOUR TRUE | CONDUCTIVITY (AT 25C) | CONDUCTIVITY (FIELD) | COPPER EXTRACTABLE | COPPER TOTAL (CU) |
|-----------|-------------------------------|----------------------------|--------------|---------------|--------------------|------------------|---------------|---------------------|--------------|-----------------|-----------------|-----------------|-------------|-------------|-----------------------|----------------------|--------------------|-------------------|
| | 488 | 487 | 1003 | 422 | 426 | 3538 | 414 | 463 | 456 | 433 | 434 | 434 | 443 | 443 | 1038 | 1308 | 468 | 470 |
| | mg/L | mg/L | mg/L | MG/L | mg/L | mg/L | ug/L | mg/L | mg/L | MPN/100 ml | MPN/100 ml | MPN/100ML | CU | rel units | US/CM | uS/cm | mg/L | mg/L |
| M008368 | 9 | | | | | L2 | | | | | 0 | | 11 | | 153 | | | |
| M008369 | 12 | | | | | 2 | | | | 0 | 9 | | 5 | | 137 | | | |
| M008370 | | | | | | 2 | | | | | 0 | | | | 123 | | | |
| M008371 | 11.5 | | | | | 2 | | | | | | | | | 128 | | | |
| M008372 | | | | | | L2 | | | | 0 | 0 | | 12 | | 127 | | | |
| M008373 | 11 | | | | | 2 | | | | 0 | 0 | | L5 | | 116 | | | |
| M008374 | 12 | | | | | L2 | | | | | 0 | | 15 | | 116 | | | |
| M008375 | 10.5 | | | | | 2 | | | | | 0 | | 18 | | 119 | | | |
| M008376 | 9.5 | | | | | 3 | | | | | 9 | | 18 | | 128 | | | |
| M008377 | 11.5 | | | | | L2 | | | | 0 | 4 | | 18 | | 130 | | | |
| M008378 | 8.5 | | | | | 2 | | | | 0 | 0 | | 16 | | 127 | | | |
| M008379 | 5.5 | | | | | 2 | | | | 0 | 4 | | 16 | | 119 | | | |
| M008380 | 14.5 | | | | | 2 | | | | | 4 | | 18 | | 112 | | | |
| M008381 | 12.5 | | | | | L2 | | | | 0 | 9 | | 20 | | 96.1 | | | |
| M008382 | 12.5 | | | | | L2 | | | | 0 | 0 | | 20 | | 126 | | | |
| M008383 | 11 | | | | | 2 | | | | | | | 20 | | 131 | | | |
| M008384 | 8.5 | | | | | 3 | | | | | 0 | | 15 | | 135 | | | |
| M008385 | 10.5 | | | | | L2 | | | | | L240 | | 10 | | 144 | | | |
| M008386 | 10.5 | | | | | 2 | | | | | L240 | | 10 | | 142 | | | |
| M008387 | 11.5 | | | | | L2 | | | | | L240 | | 15 | | 141 | | | |
| M008388 | 15.5 | | | | | 2 | | | | | L240 | | 10 | | 143 | | | |
| M008389 | 12.5 | | | | | 3 | | | | | L240 | | 10 | | 134 | | | |
| M008390 | 14 | | | | | L2 | | | | | L240 | | 40 | | 97.8 | | | |
| M008391 | 14.5 | | | | | 4 | | | | 0 | 9 | | 15 | | 137 | | | |
| M008392 | 13 | | | | | L2 | | | | | L240 | | 15 | | 122 | | | |
| M008393 | 13 | | | | | L2 | | | | | 15 | | 15 | | 116 | | | |
| M008394 | 11.5 | | | | | 2 | | | | 0 | 4 | | 20 | | 122 | | | |
| M019459 | 11 | | | | | 1.6 | | | | | 4 | | 30 | | 109 | | 0.47 | |
| M019460 | | | | | | | | | | | 4 | | 30 | | 101 | | 0.098 | |
| M019461 | 13 | | | | | 3.6 | | | | | 0 | | 70 | | 112 | | 0.2 | |
| M019462 | 8 | | | | | 1.1 | | | | | 0 | | 25 | | 93.2 | | 0.77 | |
| M019463 | 10 | | | | | 1.2 | | | | | 0 | | 10 | | 100 | | 0.025 | |
| M019464 | 8 | | | | | 1.2 | | | | | 0 | | 15 | | 109 | | 0.043 | |
| M019465 | 8 | | | | | 1.9 | | | | | 4 | | 10 | | 105 | | 0.049 | |
| M019466 | 7 | | | | | 1 | | | | | 0 | | 20 | | 107 | | 0.054 | |
| M019467 | 7 | | | | | 1.1 | | | | | 0 | | 20 | | 105 | | 0.058 | |
| M019468 | 9 | | | | | 1.5 | | | | | 0 | | 20 | | 108 | | 0.034 | |
| M019469 | 8 | | | | | | | | | | 0 | | 25 | | 108 | | 0.044 | |
| M019470 | 8 | | | | | 1.2 | | | | | 0 | 23 | 40 | | 85 | | 0.043 | |
| M019471 | 26 | | | | | 1.1 | | | | | L240 | | | | 103 | | 0.021 | |

| SAMPLE_NO | CARBON TOTAL ORGANIC (CALCD_) | CARBON TOTAL ORGANIC (TOC) | CESIUM TOTAL | CHLORIDE (CL) | CHLORIDE DISSOLVED | CHLORIDE SOLUBLE | CHLOROPHYLL A | CHROMIUM TOTAL (CR) | COBALT TOTAL | COLIFORMS FECAL | COLIFORMS TOTAL | COLIFORMS TOTAL | COLOUR TRUE | COLOUR TRUE | CONDUCTIVITY (AT 25C) | CONDUCTIVITY (FIELD) | COPPER EXTRACTABLE | COPPER TOTAL (CU) |
|------------|-------------------------------|----------------------------|--------------|---------------|--------------------|------------------|---------------|---------------------|--------------|-----------------|-----------------|-----------------|-------------|-------------|-----------------------|----------------------|--------------------|-------------------|
| M019472 | 6 | | | | | 0.9 | | | | | | | 10 | | 90 | | 0.019 | |
| M019473 | 5 | | | | | 1.5 | | | | 0 | 0 | | 20 | | 87 | | 0.03 | |
| M019474 | 7 | | | | | 1.1 | | | | 0 | 9 | | 10 | | 88 | | 0.017 | |
| M019475 | 8 | | | | | 1.3 | | | | 0 | 0 | | 20 | | 86 | | L0.005 | |
| M019476 | 6 | | | | | 2.1 | | | | 0 | 0 | | 15 | | 88 | | 0.041 | |
| M019477 | 7 | | | | | 1.2 | | | | 0 | 4 | | 15 | | 89 | | 0.018 | |
| M019478 | 8 | | | | | 2.1 | | | | L240 | | | 15 | | 95 | | 0.034 | |
| M019479 | 8 | | | | | 1.3 | | | | 0 | 0 | | 15 | | 106 | | 0.028 | |
| M019480 | 9 | | | | | 1.2 | | | | | | | 15 | | 110 | | | |
| M019481 | 11 | | | | | 1.2 | | | | 0 | 0 | | 40 | | 117 | | 0.059 | |
| M019482 | 10 | | | | | 1.5 | | | | 0 | 0 | | 30 | | 100 | | 0.032 | |
| M019483 | 7 | | | | | 1.9 | | | | | 9 | | 10 | | 114 | | 0.019 | |
| M019484 | 7 | | | | | | | | | | 0 | | L5 | | 110 | | 0.038 | |
| M019485 | | | | | | | | | | | | | | | | | 0.054 | |
| M019486 | 5 | | | | | 1.5 | | | | | 0 | | 10 | | 100 | | 0.065 | |
| M019487 | 8 | | | | | 1.2 | | | | | | | L5 | | 106 | | 0.03 | |
| M019488 | 12 | | | | | 1.2 | | | | 0 | 0 | | 5 | | 106 | | 0.026 | |
| M019489 | 8 | | | | | 0.6 | | | | 0 | 0 | | 5 | | 111 | | 0.021 | |
| M020297 | 12.8 | | | | | | | | | | | | | | 119 | | 0.005 | |
| M020298 | 14.31 | | | | | | | | | | | | | | 142 | | L0.001 | |
| M020299 | | | | | | | | | | | | | | | 82.9 | | | |
| M020300 | 7.57 | | | | | | | | | | | | | | 115 | | 0.002 | |
| M020301 | 7.17 | | | | | | | | | | | | | | 173 | | 0.007 | |
| M020302 | 11 | | | | | | | | | | | | 80 | | 207 | | | |
| M020303 | 13 | | | | | | | | | | | | 100 | | 118 | | | |
| M020304 | 10 | | | | | | | | | | | | 60 | | 153 | 94 | | |
| M020305 | 10 | | | | | | | | | | | | 20 | | 177 | | | |
| M020306 | 0.25 | | | | | 0.5 | | | | | | | 20 | | 40 | | 0.003 | |
| M020307 | 8.63 | | | | | 1.7 | | | | | | | 30 | | 168 | | 0.002 | |
| M020308 | 9.11 | | | | | 2.2 | | | | | | | 40 | | 166 | | 0.001 | |
| M020309 | | | | | | 2.7 | | | | | | | 20 | | 178 | | 0.004 | |
| M020310 | 8.31 | | | | | 1.7 | | | | | | | 20 | | 173 | | 0.01 | |
| M020311 | 13.5 | | | | | 1.4 | | | | | | | 100 | | 125 | 105 | 0.002 | |
| M020312 | 9.68 | | | | | 1.3 | | | | | | | 50 | | 130 | 137 | 0.001 | |
| M020313 | 9.56 | | | | | 1.5 | | | | | | | 40 | | 137 | 139 | | |
| M020314 | 7.99 | | | | | 1.5 | | | | | | | 20 | | 148 | | 0.005 | |
| 1108CL0047 | 9.9 | | L0.0001 | 0.87 | | | | L0.001 | L0.0002 | | | | 32.3 | | 138 | | | 0.00103 |
| 1108CL0053 | | | | | | | 7.26 | | | | | | | | | | | |
| 1109CL0069 | 8 | | L0.0001 | 0.79 | | | | L0.001 | L0.0002 | | | | 24.4 | | 118 | | | 0.001 |
| 1109CL0076 | | | | | | | 4.77 | | | | | | | | | | | |
| 1202EW1038 | 8.1 | | L0.0001 | 1.33 | | | L0.6 | L0.001 | L0.0002 | | | | 22 | | 180 | | | 0.00087 |
| 1202EW1042 | | | | | | | | | | | | | | | | | | |

| SAMPLE_NO | CARBON TOTAL ORGANIC (CALCD_) | CARBON TOTAL ORGANIC (TOC) | CESIUM TOTAL | CHLORIDE (CL) | CHLORIDE DISSOLVED | CHLORIDE SOLUBLE | CHLOROPH YLL A | CHROMIU M TOTAL (CR) | COBALT TOTAL | COLIFORM S FECAL | COLIFORM S TOTAL | COLIFORM S TOTAL | COLOUR TRUE | COLOUR TRUE | CONDUCTI VITY (AT 25C) | CONDUCTI VITY (FIELD) | COPPER EXTRACTAB LE | COPPER TOTAL (CU) |
|------------|--|-------------------------------------|-----------------|------------------|-----------------------|---------------------|-------------------|----------------------------|-----------------|---------------------|---------------------|---------------------|----------------|----------------|------------------------------|-----------------------------|---------------------------|----------------------|
| 0806JHS709 | | | | | | | | | | | | | 95 | | | | | |
| 0806JHS809 | 7 | 7 | L0.0001 | | 0.9 | | 3 | 0.001 | L0.0002 | | | | | 20 | 122 | | | L0.001 |
| 0808JHS609 | | 8 | L0.0001 | | 0.9 | | 10 | L0.001 | 0.0015 | | | | | 15 | 135 | | | 0.001 |
| 0808JHS759 | | | | | | | | | | | | | | | | | | |
| 0809JHS209 | 7 | 7 | L0.0001 | | 1.1 | | 4 | 0.002 | L0.0002 | | | | | 15 | 137 | | | L0.001 |
| 0809JHS409 | | | | | | | | | | | | | | | | | | |
| 0903JH0212 | | 8 | L0.0001 | | 1.2 | | L1 | L0.001 | L0.0002 | | | | | 20 | 176 | | | 0.003 |
| 0903JH0227 | | | | | | | L1 | | | | | | | | | | | |
| 0903JH0243 | | | | | | | | | | | | | | | | | | |
| 0906JH1088 | | | | | | | | | | | | | | | | | | |
| 0906JH1016 | 8.9 | | L0.0001 | | 2.09 | | 3.1 | L0.001 | 0.00022 | | | | | 50 | 114 | | | L0.001 |
| 0908JH1323 | 6.6 | | L0.0001 | | 1.08 | | 1.9 | L0.001 | L0.0002 | | | | | 20 | 128 | | | 0.0013 |
| 0908JH1388 | | | | | | | | | | | | | | | | | | |
| 0909JH1572 | 7.9 | | L0.0001 | | 0.94 | | 3.8 | L0.001 | L0.0002 | | | | | 10 | 124 | | | L0.001 |
| 0909JH1637 | | | | | | | | | | | | | | | | | | |
| 1006JH0717 | 7.8 | | L0.0001 | | 0.95 | | | L0.001 | L0.0002 | | | | | 20 | 123 | | | 0.001 |
| 1006JH0760 | | | | | | | 1.2 | | | | | | | | | | | |
| 1008JS1335 | 8.3 | | L0.0001 | 1.11 | | | | L0.001 | L0.0002 | | | | 19.5 | | 143 | | | 0.00111 |
| 1008JS1357 | | | | | | | 2.99 | | | | | | | | | | | |
| 1009JS1539 | 10.3 | | L0.0001 | 0.77 | | | | L0.001 | L0.0002 | | | | 31.2 | | 124 | | | 0.00121 |
| 1009JS1723 | | | | | | | 1.49 | | | | | | | | | | | |
| 1102CL0171 | 9.5 | | L0.0001 | 0.87 | | | L0.6 | L0.001 | L0.0002 | | | | 20.4 | | 151 | | | 0.00253 |
| 1106CL0075 | 8.1 | | L0.0001 | 0.9 | | | | L0.001 | L0.0002 | | | | 19.7 | | 133 | | | 0.00095 |
| 1106CL0076 | | | | | | | 2.1 | | | | | | | | | | | |
| 1108CL0046 | 8.2 | | L0.0001 | 0.75 | | | | L0.001 | L0.0002 | | | | 18.4 | | 131 | | | 0.00118 |
| 1108CL0052 | | | | | | | 8.02 | | | | | | | | | | | |
| 1109CL0068 | 7.1 | | L0.0001 | 0.75 | | | | L0.001 | L0.0002 | | | | 16.8 | | 115 | | | 0.00108 |
| 1109CL0075 | | | | | | | 4.58 | | | | | | | | | | | |
| 1202EW1039 | 8 | | L0.0001 | 1.01 | | | L0.6 | L0.001 | L0.0002 | | | | 11.4 | | 157 | | | 0.0009 |
| 1206CL0047 | 7.6 | | L0.0001 | 0.65 | | | | L0.001 | L0.0002 | | | | 41.5 | | 108 | | | 0.00083 |
| 1206CL0052 | | | | | | | 3.82 | | | | | | | | | | | |
| 1208EW0029 | 4.7 | | L0.0001 | 0.79 | | | | L0.001 | L0.0002 | | | | 11.1 | | 130 | | | 0.00094 |
| 1208EW0034 | | | | | | | 3.47 | | | | | | | | | | | |
| 1209EW0132 | | | | | | | 4.01 | | | | | | | | | | | |
| 1209RE0127 | 9.4 | | L0.0001 | 0.8 | | | | L0.001 | L0.0002 | | | | 34.7 | | 129 | | | 0.00082 |
| 1209RE0130 | | | | | | | | | | | | | | | | | | |
| 1302EW0108 | 6.2 | | L0.0001 | 0.97 | | | L0.6 | L0.001 | L0.0002 | | | | 11.9 | | 153 | | | 0.00147 |
| 1306EW4015 | | | | | | | 3.05 | | | | | | | | | | | |
| 1306EW4002 | 7.5 | | L0.0001 | 0.82 | | | | L0.001 | L0.0002 | | | | 15.9 | | 138 | | | 0.00074 |
| 1308EW4002 | 9 | | L0.0001 | 0.81 | | | | L0.001 | L0.0002 | | | | 12.3 | | 135 | | | 0.00086 |
| 1308EW4015 | | | | | | | 4.96 | | | | | | | | | | | |
| 1309EW4044 | 7.8 | | L0.0001 | 0.94 | | | | L0.001 | L0.0002 | | | | 10.9 | | 143 | | | 0.00086 |

| SAMPLE_NO | CARBON TOTAL ORGANIC (CALCD_) | CARBON TOTAL ORGANIC (TOC) | CESIUM TOTAL | CHLORIDE (CL) | CHLORIDE DISSOLVED | CHLORIDE SOLUBLE | CHLOROPH YLL A | CHROMIU M TOTAL (CR) | COBALT TOTAL | COLIFORM S FECAL | COLIFORM S TOTAL | COLIFORM S TOTAL | COLOUR TRUE | COLOUR TRUE | CONDUCTI VITY (AT 25C) | CONDUCTI VITY (FIELD) | COPPER EXTRACTAB LE | COPPER TOTAL (CU) |
|------------|--|-------------------------------------|-----------------|------------------|-----------------------|---------------------|-------------------|----------------------------|-----------------|---------------------|---------------------|---------------------|----------------|----------------|------------------------------|-----------------------------|---------------------------|----------------------|
| 1309EW4057 | | | | | | | 2.29 | | | | | | | | | | | |
| 1405EW4044 | | 6.1 | L0.0001 | 0.78 | | | | L0.001 | L0.0002 | | | | 15 | | 138 | | | 0.00089 |
| 1405EW4053 | | | | | | | 2.67 | | | | | | | | | | | |
| 1408EW4023 | 7.2 | | L0.0001 | 0.84 | | | | L0.001 | L0.0002 | | | | 13.6 | | 128 | | | 0.00088 |
| 1408EW4031 | | | | | | | 2.41 | | | | | | | | | | | |
| 1409EW4044 | 5 | | L0.0001 | 0.87 | | | | L0.001 | L0.0002 | | | | 10.6 | | 134 | | | 0.00079 |
| 1409EW4052 | | | | | | | 2.1 | | | | | | | | | | | |
| 1405EW4045 | | 6.6 | L0.0001 | 0.98 | | | | L0.001 | L0.0002 | | | | 16.4 | | 141 | | | 0.00082 |
| 1405EW4054 | | | | | | | 2.86 | | | | | | | | | | | |
| 1408EW4024 | 7.9 | | L0.0001 | 0.98 | | | | L0.001 | L0.0002 | | | | 19.8 | | 134 | | | 0.00084 |
| 1408EW4032 | | | | | | | 2.94 | | | | | | | | | | | |
| 1409EW4045 | 6.7 | | L0.0001 | 1.16 | | | | L0.001 | L0.0002 | | | | 25.4 | | 144 | | | 0.00068 |
| 1409EW4053 | | | | | | | 1.72 | | | | | | | | | | | |

| SAMPLE_NO | DEPTH OF SAMPLING FROM SURFACE | ESCHERICHIA, COLI | ESCHERICHIA, COLI | FLUORIDE | HARDNESS TOTAL (CALCD_) CACO3 | HARDNESS TOTAL CACO3 | IRON (FE) EXTRACTABLE | IRON DISSOLVED | IRON TOTAL (FE) | LEAD EXTRACTABLE | LEAD TOTAL | LITHIUM TOTAL | MAGNESIUM EXTRACTABLE | MAGNESIUM TOTAL | MANGANESE EXTRACTABLE | MANGANESE TOTAL (MN) | MERCURY EXTRACTABLE | MERCURY TOTAL |
|-----------|--------------------------------|-------------------|-------------------|----------|-------------------------------|----------------------|-----------------------|----------------|-----------------|------------------|------------|---------------|-----------------------|-----------------|-----------------------|----------------------|---------------------|---------------|
| | 497 | 2710 | 2710 | 511 | 542 | 541 | 517 | 516 | 519 | 679 | 683 | 576 | 2693 | 2690 | 589 | 591 | 548 | 549 |
| | m | CFU/100ML | MPN/100ML | mg/L | MG/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | ug/L | mg/L |
| M008368 | 0 | | | 0.13 | | 58 | | | | | | | 5 | | | | | |
| M008369 | 0 | | | 0.15 | | 62.5 | | | | | | | 6 | | | | | |
| M008370 | 0 | | | | | 60.3 | | | | | | | 4 | | | | | |
| M008371 | 0 | | | | | 41.3 | | | | | | | L5 | | | | | |
| M008372 | 0 | | | 0.13 | | 62.5 | | | | | | | 6 | | | | | |
| M008373 | 0 | | | 0.16 | | 41.3 | | | | | | | L5 | | | | | |
| M008374 | 0 | | | | | 56 | | | | | | | 6 | | | | | |
| M008375 | 0 | | | | | 57.5 | | | | | | | 5 | | | | | |
| M008376 | 0 | | | 0.11 | | 54.1 | | | | | | | L5 | | | | | |
| M008377 | 0 | | | 0.13 | | 60 | | | | | | | 7 | | | | | |
| M008378 | 0 | | | 0.12 | | 63.8 | | | | | | | 5 | | | | | |
| M008379 | 0 | | | 0.13 | | 57.5 | | | | | | | 5 | | | | | |
| M008380 | 0 | | | | | 41.3 | | | | | | | L5 | | | | | |
| M008381 | 0 | | | | | 41.3 | | | | | | | L5 | | | | | |
| M008382 | 0 | | | 0.09 | | 79 | | | | | | | 7 | | | | | |
| M008383 | 0 | | | 0.08 | | 60.3 | | | | | | | L5 | | | | | |
| M008384 | 0 | | | 0.14 | | 62.5 | | | | | | | 6 | | | | | |
| M008385 | 0 | | | 0.11 | | 70 | | | | | | | 5 | | | | | |
| M008386 | 0 | | | 0.12 | | 75 | | | | | | | 6 | | | | | |
| M008387 | 0 | | | | | 47.8 | | | | | | | L5 | | | | | |
| M008388 | 0 | | | | | 57.5 | | | | | | | 5 | | | | | |
| M008389 | 0 | | | | | 47.8 | | | | | | | L5 | | | | | |
| M008390 | 0 | | | | | 29.1 | | | | | | | L5 | | | | | |
| M008391 | 0 | | | | | 47.8 | | | | | | | L5 | | | | | |
| M008392 | 0 | | | | | 41.3 | | | | | | | L5 | | | | | |
| M008393 | 0 | | | | | 62.5 | | | | | | | 6 | | | | | |
| M008394 | 0 | | | | | 65 | | | | | | | 5 | | | | | |
| M019459 | 0 | | | 0.07 | | | 0.02 | | | 0.006 | | | | | L0.01 | | | |
| M019460 | 0 | | | 0.13 | | 49.6 | L0.05 | | | 0.043 | | | | | L0.003 | | | |
| M019461 | 0 | | | 0.06 | | 37.1 | 0.52 | | | 0.006 | | | | | 0.014 | | | |
| M019462 | 0 | | | 0.06 | | 70.3 | L0.04 | | | 0.011 | | | | | 0.003 | | | |
| M019463 | 0 | | | 0.06 | | 47.5 | L0.04 | | | 0.01 | | | | | L0.01 | | | |
| M019464 | 0 | | | 0.08 | | 53.2 | 0.04 | | | L0.006 | | | | | L0.005 | | | |
| M019465 | 0 | | | 0.18 | | 58.5 | 0.01 | | | L0.008 | | | | | L0.005 | | | |
| M019466 | 0 | | | 0.07 | | 54.6 | 0.03 | | | L0.003 | | | | | L0.004 | | | |
| M019467 | 0 | | | 0.08 | | 52.7 | 0.03 | | | | | | | | L0.008 | | | |
| M019468 | 0 | | | 0.09 | | 50.6 | 0.05 | | | | | | | | L0.008 | | | |
| M019469 | 0 | | | 0.08 | | | 0.06 | | | L0.006 | | | | | L0.006 | | | |
| M019470 | 0 | | | 0.06 | | 45.9 | L0.04 | | | L0.009 | | | | | L0.006 | | | |
| M019471 | 0 | | | 0.09 | | 49 | L0.04 | | | L0.002 | | | | | L0.011 | | | |

| SAMPLE_NO | DEPTH OF SAMPLING FROM SURFACE | ESCHERICHIA, COLI | ESCHERICHIA, COLI | FLUORIDE | HARDNESS TOTAL (CALCD_) CACO3 | HARDNESS TOTAL CACO3 | IRON (FE) EXTRACTABLE | IRON DISSOLVED | IRON TOTAL (FE) | LEAD EXTRACTABLE | LEAD TOTAL | LITHIUM TOTAL | MAGNESIUM EXTRACTABLE | MAGNESIUM TOTAL | MANGANESE EXTRACTABLE | MANGANESE TOTAL (MN) | MERCURY EXTRACTABLE | MERCURY TOTAL |
|------------|--------------------------------|-------------------|-------------------|----------|-------------------------------|----------------------|-----------------------|----------------|-----------------|------------------|------------|---------------|-----------------------|-----------------|-----------------------|----------------------|---------------------|---------------|
| M019472 | 0 | | | 0.07 | | 45 | L0.04 | | | L0.004 | | | | | L0.008 | | | |
| M019473 | 0 | | | 0.07 | | 42 | 0.03 | | | L0.005 | | | | | L0.009 | | | |
| M019474 | 0 | | | 0.09 | | 45 | L0.04 | | | 0.005 | | | | | 0.031 | | | |
| M019475 | 0 | | | | | 46 | | | | | | | | | | | | |
| M019476 | 0 | | | 0.09 | | 43 | L0.04 | | | L0.004 | | | | | L0.008 | | | |
| M019477 | 0 | | | 0.09 | | 42 | L0.04 | | | L0.004 | | | | | L0.008 | | | |
| M019478 | 0 | | | 0.07 | | 44 | L0.04 | | | L0.003 | | | | | L0.02 | | | |
| M019479 | 0 | | | 0.06 | | 50 | L0.04 | | | 0.003 | | | | | L0.02 | | | |
| M019480 | 0 | | | 0.08 | | 49.8 | L0.03 | | | 0.004 | | | | | L0.008 | | | |
| M019481 | 0 | | | 0.09 | | 54 | 0.07 | | | 0.004 | | | | | L0.01 | | | |
| M019482 | 0 | | | L0.05 | | 45 | L0.04 | | | 0.005 | | | | | L0.01 | | | |
| M019483 | 0 | | | 0.08 | | 54.4 | 0.06 | | | L0.004 | | | | | 0.03 | | | |
| M019484 | 0 | | | 0.08 | | 49 | L0.04 | | | L0.004 | | | | | L0.01 | | | |
| M019485 | 0 | | | | | | 0.23 | | | 0.005 | | | | | 0.016 | | | |
| M019486 | 0 | | | 0.06 | | 48 | L0.04 | | | 0.009 | | | | | L0.01 | | | |
| M019487 | 0 | | | 0.08 | | 50 | L0.04 | | | L0.004 | | | | | L0.01 | | | |
| M019488 | 0 | | | L0.05 | | 48 | L0.04 | | | 0.004 | | | | | 0.016 | | | |
| M019489 | 0 | | | 0.11 | | 55 | L0.04 | | | L0.004 | | | | | L0.01 | | | |
| M020297 | 0 | | | | | | | | | L0.004 | | | | | | | | |
| M020298 | 0 | | | | | | | | | L0.004 | | | | | | | | |
| M020299 | 0 | | | | | | | | | | | | | | | | | |
| M020300 | 0 | | | | | | | | | L0.004 | | | | | | | L0.02 | |
| M020301 | 0 | | | | | | | | | 0.004 | | | | | | | 0.04 | |
| M020302 | 0 | | | | | 90.4 | | | | | | | | | | | | |
| M020303 | 0 | | | | | 66.5 | | | | | | | | | | | | |
| M020304 | 0 | | | | | 78.4 | 0.17 | | | | | | | | | | | |
| M020305 | 0 | | | | | 75.6 | | | | | | | | | | | | |
| M020306 | 0 | | | 0.05 | | 17.4 | 0.08 | | | 0.004 | | | 1.5 | | 0.01 | | | |
| M020307 | 0 | | | 0.07 | | 80.5 | 0.09 | | | 0.004 | | | 5.6 | | 0.02 | | | |
| M020308 | 0 | | | 0.06 | | 87.6 | 0.15 | | | 0.004 | | | 6.1 | | 0.02 | | | |
| M020309 | 0 | | | 0.1 | | 87.3 | 0.08 | | | 0.004 | | | 6.9 | | 0.01 | | | |
| M020310 | 0 | | | 0.09 | | 85.7 | 0.08 | | | 0.016 | | | 5.7 | | 0.01 | | | |
| M020311 | 0 | | | 0.05 | | 60 | 0.71 | | | 0.004 | | | 3.6 | | 0.03 | | | |
| M020312 | 0 | | | 0.09 | | 75.2 | 0.15 | | | 0.004 | | | 5.1 | | 0.03 | | | |
| M020313 | 0 | | | 0.05 | | 74.8 | 0.15 | | | 0.004 | | | 5 | | 5 | | | |
| M020314 | 0 | | | 0.05 | | 80.1 | 0.08 | | | 0.4 | | | 6 | | 0.01 | | | |
| 1108CL0047 | 0 | 9 | | 0.055 | 75.5 | | | | 0.18 | | 0.00012 | L0.002 | | 4.99 | | 0.0536 | | L0.00005 |
| 1108CL0053 | 0 | | | | | | | | | | | | | | | | | |
| 1109CL0069 | 0 | L1 | | 0.068 | 67.3 | | | | 0.28 | | 0.00018 | 0.0021 | | 4.8 | | 0.0256 | | L0.00005 |
| 1109CL0076 | 0 | | | | | | | | | | | | | | | | | |
| 1202EW1038 | 0 | L1 | | 0.084 | 92.2 | | | | 0.11 | | L0.00009 | 0.0025 | | 6.36 | | 0.00229 | | L0.00005 |
| 1202EW1042 | 0 | | | | | | | | | | | | | | | | | |

| SAMPLE_NO | DEPTH OF SAMPLING FROM SURFACE | ESCHERICHIA, COLI | ESCHERICHIA, COLI | FLUORIDE | HARDNESS TOTAL (CALCD_) CACO3 | HARDNESS TOTAL CACO3 | IRON (FE) EXTRACTABLE | IRON DISSOLVED | IRON TOTAL (FE) | LEAD EXTRACTABLE | LEAD TOTAL | LITHIUM TOTAL | MAGNESIUM EXTRACTABLE | MAGNESIUM TOTAL | MANGANESE EXTRACTABLE | MANGANESE TOTAL (MN) | MERCURY EXTRACTABLE | MERCURY TOTAL |
|------------|--------------------------------|-------------------|-------------------|----------|-------------------------------|----------------------|-----------------------|----------------|-----------------|------------------|------------|---------------|-----------------------|-----------------|-----------------------|----------------------|---------------------|---------------|
| 0806JHS709 | 0 | | 2 | | | | | | | | | | | | | | | |
| 0806JHS809 | 0 | | | | 59.8 | | | | 0.11 | | L0.0005 | | | 4.05 | | 0.0141 | | L0.00005 |
| 0808JHS609 | 0 | | | | 67.1 | | | | 0.3 | | L0.0005 | | | 4.83 | | 0.0411 | | L0.00005 |
| 0808JHS759 | 0 | 4 | | | | | | | | | | | | | | | | |
| 0809JHS209 | 0 | | | | 63.8 | | | | 0.07 | | L0.0005 | | | 4.64 | | 0.0118 | | L0.00005 |
| 0809JHS409 | 0 | L1 | | | | | | | | | | | | | | | | |
| 0903JH0212 | 0 | | | | 85.1 | | | | 0.06 | | L0.0005 | | | 6.21 | | 0.0041 | | L0.00005 |
| 0903JH0227 | 5.1 | | | | | | | | | | | | | | | | | |
| 0903JH0243 | 0 | L1 | | | | | | | | | | | | | | | | |
| 0906JH1088 | 0 | 5 | | | | | | | | | | | | | | | | |
| 0906JH1016 | 0 | | | | 61.2 | | | | 0.279 | | L0.0005 | | | 4.49 | | 0.0265 | | L0.00002 |
| 0908JH1323 | 0 | | | | 73.3 | | | | 0.237 | | L0.0005 | | | 5.58 | | 0.0152 | | L0.00002 |
| 0908JH1388 | 0 | 3 | | | | | | | | | | | | | | | | |
| 0909JH1572 | 0 | | | | 63.7 | | | | 0.188 | | L0.0005 | | | 5 | | 0.013 | | L0.00002 |
| 0909JH1637 | 0 | 4 | | | | | | | | | | | | | | | | |
| 1006JH0717 | 0 | L1 | | | 61.7 | | | | 0.055 | | 0.00022 | L0.002 | | 4.24 | | 0.00829 | | L0.00005 |
| 1006JH0760 | 0.3 | | | | | | | | | | | | | | | | | |
| 1008JS1335 | 0.3 | L1 | | | 76.3 | | | | 0.089 | | 0.00009 | 0.0026 | | 5.51 | | 0.0272 | | L0.00005 |
| 1008JS1357 | 2.6 | | | | | | | | | | | | | | | | | |
| 1009JS1539 | 0 | 4 | | | 63.7 | | | | 0.31 | | 0.00031 | 0.003 | | 4.62 | | 0.0199 | | L0.00005 |
| 1009JS1723 | 0.3 | | | | | | | | | | | | | | | | | |
| 1102CL0171 | 0 | 1 | | | 79.4 | | | | 0.18 | | 0.00025 | 0.0028 | | 5.53 | | 0.00439 | | L0.00005 |
| 1106CL0075 | 0 | | | 0.054 | 81.7 | | 0.059 | L0.1 | | | 0.00022 | 0.0029 | | 5.72 | | 0.0121 | | L0.00005 |
| 1106CL0076 | 0 | | | | | | | | | | | | | | | | | |
| 1108CL0046 | 0 | 12 | | 0.057 | 74.8 | | | | 0.19 | | 0.00013 | L0.002 | | 5.06 | | 0.0431 | | L0.00005 |
| 1108CL0052 | 0 | | | | | | | | | | | | | | | | | |
| 1109CL0068 | 0 | L1 | | 0.07 | 64.2 | | | | 0.21 | | 0.00013 | 0.003 | | 5.05 | | 0.0185 | | L0.00005 |
| 1109CL0075 | 0 | | | | | | | | | | | | | | | | | |
| 1202EW1039 | 0 | L1 | | 0.082 | 84.1 | | 0.06 | L0.1 | | | L0.00009 | 0.0022 | | 5.98 | | 0.00323 | | L0.00005 |
| 1206CL0047 | 0.3 | 3 | | 0.048 | 60 | | | | 0.15 | | L0.00009 | L0.002 | | 4.25 | | 0.00989 | | |
| 1206CL0052 | 0.3 | | | | | | | | | | | | | | | | | |
| 1208EW0029 | 0.3 | L1 | | 0.065 | 69.5 | | | | 0.1 | | L0.00009 | 0.0022 | | 5.44 | | 0.0154 | | L0.00002 |
| 1208EW0034 | 0.3 | | | | | | | | | | | | | | | | | |
| 1209EW0132 | 0.3 | | | | | | | | | | | | | | | | | |
| 1209RE0127 | 0.3 | 3 | | 0.055 | 68.8 | | | | 0.11 | | L0.00009 | 0.0022 | | 5.13 | | 0.0115 | | L0.00002 |
| 1209RE0130 | 0.3 | | | | | | | | | | | | | | | | | |
| 1302EW0108 | 0.3 | L1 | | 0.073 | 73.1 | | 0.073 | | | | L0.00009 | 0.0027 | | 5.16 | | 0.00426 | | L0.00002 |
| 1306EW4015 | 0.3 | | | | | | | | | | | | | | | | | |
| 1306EW4002 | 0.3 | 1 | | 0.06 | 67.3 | | 0.068 | | | | L0.00009 | 0.0022 | | 5.15 | | 0.014 | | L0.00002 |
| 1308EW4002 | 0.3 | 3 | | 0.065 | 74.1 | | | | 0.14 | | L0.00009 | 0.0023 | | 5.39 | | 0.0312 | | |
| 1308EW4015 | 0.3 | | | | | | | | | | | | | | | | | |
| 1309EW4044 | 0.3 | 2 | | 0.072 | 73.3 | | 0.07 | | | | L0.00009 | 0.0023 | | 5.42 | | 0.0176 | | |

| SAMPLE_NO | DEPTH OF SAMPLING FROM SURFACE | ESCHERICHIA, COLI | ESCHERICHIA, COLI | FLUORIDE | HARDNESS TOTAL (CALCD_) CACO3 | HARDNESS TOTAL CACO3 | IRON (FE) EXTRACTABLE | IRON DISSOLVED | IRON TOTAL (FE) | LEAD EXTRACTABLE | LEAD TOTAL | LITHIUM TOTAL | MAGNESIUM EXTRACTABLE | MAGNESIUM TOTAL | MANGANESE EXTRACTABLE | MANGANESE TOTAL (MN) | MERCURY EXTRACTABLE | MERCURY TOTAL |
|------------|--------------------------------|-------------------|-------------------|----------|-------------------------------|----------------------|-----------------------|----------------|-----------------|------------------|------------|---------------|-----------------------|-----------------|-----------------------|----------------------|---------------------|---------------|
| 1309EW4057 | 0.3 | | | | | | | | | | | | | | | | | |
| 1405EW4044 | 0.3 | 4 | | 0.073 | 69.1 | | | 0.18 | | 0.00013 | 0.0025 | | | 5.14 | | 0.0163 | | |
| 1405EW4053 | 0.3 | | | | | | | | | | | | | | | | | |
| 1408EW4023 | 0.3 | L1 | | 0.073 | 67.8 | | | 0.18 | | 0.0001 | 0.0026 | | | 5.27 | | 0.0158 | | |
| 1408EW4031 | 0.3 | | | | | | | | | | | | | | | | | |
| 1409EW4044 | 0.3 | 1 | | 0.07 | 66.8 | | | 0.13 | | 0.0001 | 0.0027 | | | 5.03 | | 0.0106 | | |
| 1409EW4052 | 0.3 | | | | | | | | | | | | | | | | | |
| 1405EW4045 | 0.3 | L1 | | 0.067 | 68.2 | | | 0.16 | | 0.0001 | 0.0022 | | | 5.01 | | 0.0213 | | |
| 1405EW4054 | 0.3 | | | | | | | | | | | | | | | | | |
| 1408EW4024 | 0.3 | 12 | | 0.071 | 71.4 | | | 0.21 | | 0.0001 | 0.0026 | | | 5.35 | | 0.0194 | | |
| 1408EW4032 | 2.4 | | | | | | | | | | | | | | | | | |
| 1409EW4045 | 0.3 | 2 | | 0.064 | 68.3 | | | 0.16 | | 0.00009 | 0.0022 | | | 5.22 | | 0.0114 | | |
| 1409EW4053 | 3.8 | | | | | | | | | | | | | | | | | |

| SAMPLE_NO | MERCURY TOTAL | MOLYBDENUM TOTAL | NICKEL EXTRACTABLE | NICKEL TOTAL | NITRATE (NO3-N) | NITRATE/NITRITE | NITRITE (NO2-N) | NITROGEN DISSOLVED KJELDAHL | NITROGEN DISSOLVED NO3 & NO2 | NITROGEN TOTAL KJELDAHL (TKN) | ODB/ODA (CHLOROPHYLL-A / PHEOPHYTIN-A RATIO) | OXYGEN BIOCHEMICAL DEMAND | OXYGEN DISSOLVED | PHEOPHYTIN A | PHOSPHORUS DISSOLVED ORTHO | PHOSPHORUS PARTICULATE (CALCD_) | PHOSPHORUS TOTAL (P) | PHOSPHORUS TOTAL DISSOLVED |
|-----------|---------------|------------------|--------------------|--------------|-----------------|-----------------|-----------------|-----------------------------|------------------------------|-------------------------------|--|---------------------------|------------------|--------------|----------------------------|---------------------------------|----------------------|----------------------------|
| | 549 | 595 | 608 | 610 | 9138 | 616 | 9139 | 625 | 628 | 626 | 4199 | 647 | 659 | 1109 | 716 | 725 | 730 | 731 |
| | ug/L | mg/L | mg/L | mg/L | MG/L | mg/L | MG/L | mg/L | mg/L | mg/L | NO UNITS | mg/L | mg/L | ug/L | mg/L | mg/L | mg/L | mg/L |
| M008368 | | | | | | | | | 2.4 | | | | | | | | 0.05 | |
| M008369 | | | | | | | | | 0.8 | | | | | | | | 0.03 | |
| M008370 | | | | | | | | | 0.43 | | | 1.6 | | | | | 0.03 | |
| M008371 | | | | | | | | | 0.09 | | | 0.5 | | | | | 0.05 | |
| M008372 | | | | | | | | | | | | L0.5 | | | | | L0.02 | |
| M008373 | | | | | | | | | 0.08 | | | | | | | | 0.02 | |
| M008374 | | | | | | | | | 0.03 | | | 2.5 | | | | | 0.02 | |
| M008375 | | | | | | | | | 0.04 | | | 0.2 | | | | | L0.04 | |
| M008376 | | | | | | | | | | | | 0.6 | | | | | L0.02 | |
| M008377 | | | | | | | | | | | | 1.5 | | | | | 0.02 | |
| M008378 | | | | | | | | | 0.21 | | | 1.9 | | | | | 0.04 | |
| M008379 | | | | | | | | | | | | 3.2 | | | | | 0.03 | |
| M008380 | | | | | | | | | 0.09 | | | 1.5 | | | | | L0.02 | |
| M008381 | | | | | | | | | 0.09 | | | 1 | | | | | 0.03 | |
| M008382 | | | | | | | | | | | | 1 | | | | | 0.02 | |
| M008383 | | | | | | | | | 0.93 | | | L0.1 | | | | | 0.02 | |
| M008384 | | | | | | | | | L0.01 | | | | | | | | 0.03 | |
| M008385 | | | | | | | | | 0.12 | | | | | | | | 0.04 | |
| M008386 | | | | | | | | | 0.15 | | | | | | | | 0.03 | |
| M008387 | | | | | | | | | 0.11 | | | | | | | | 0.08 | |
| M008388 | | | | | | | | | 0.1 | | | 0.7 | | | | | 0.04 | |
| M008389 | | | | | | | | | 0.1 | | | L1 | | | | | 0.05 | |
| M008390 | | | | | | | | | 0.04 | | | 1.7 | | | | | 0.05 | |
| M008391 | | | | | | | | | 0.02 | | | 1 | | | | | 0.04 | |
| M008392 | | | | | | | | | 0.01 | | | 0.8 | | | | | 0.02 | |
| M008393 | | | | | | | | | 0.01 | | | 2.3 | | | | | L0.02 | |
| M008394 | | | | | | | | | L0.01 | | | L1 | | | | | 0.02 | |
| M019459 | | | | | | | | | 0.03 | 0.37 | | | | | L0.003 | | 0.014 | |
| M019460 | | | | | | | | | 1.3 | 0.64 | | | | | L0.003 | | | |
| M019461 | | | | | | | | | 0.88 | 0.6 | | | | | 0.003 | | 0.018 | |
| M019462 | | | | | | | | | 0.26 | 0.64 | | | | | 0.007 | | 0.007 | |
| M019463 | | | | | | | | | L0.01 | 0.64 | | | | | 0.007 | | 0.019 | |
| M019464 | | | | | | | | | 0.05 | 0.75 | | | | | L0.003 | | 0.01 | |
| M019465 | | | | | | | | | 0.04 | 0.41 | | | | | 0.005 | | 0.011 | |
| M019466 | | | | | | | | | 0.1 | 0.78 | | | | | 0.005 | | 0.008 | |
| M019467 | | | | | | | | | 0.07 | 0.18 | | | | | 0.005 | | 0.016 | |
| M019468 | | | | | | | | | 0.05 | 0.39 | | | | | 0.004 | | 0.012 | |
| M019469 | | | | | | | | | 0.28 | 0.13 | | | | | L0.003 | | 0.011 | |
| M019470 | | | | | | | | | 0.18 | 0.35 | | | | | L0.003 | | 0.017 | |
| M019471 | | | | | | | | | 0.06 | 0.35 | | | | | L0.003 | | 0.007 | |

| SAMPLE_NO | MERCURY TOTAL | MOLYBDENUM TOTAL | NICKEL EXTRACTABLE | NICKEL TOTAL | NITRATE (NO3-N) | NITRATE/NITRITE | NITRITE (NO2-N) | NITROGEN DISSOLVED KJELDAHL | NITROGEN DISSOLVED NO3 & NO2 | NITROGEN TOTAL KJELDAHL (TKN) | ODB/ODA (CHLOROPHYLL-A / PHEOPHYTIN-A RATIO) | OXYGEN BIOCHEMICAL DEMAND | OXYGEN DISSOLVED | PHEOPHYTIN A | PHOSPHORUS DISSOLVED ORTHO | PHOSPHORUS PARTICULATE (CALCD_) | PHOSPHORUS TOTAL (P) | PHOSPHORUS TOTAL DISSOLVED |
|------------|---------------|------------------|--------------------|--------------|-----------------|-----------------|-----------------|-----------------------------|------------------------------|-------------------------------|--|---------------------------|------------------|--------------|----------------------------|---------------------------------|----------------------|----------------------------|
| M019472 | | | | | | | | | 0.38 | | | | | | 0.003 | | 0.008 | |
| M019473 | | | | | | | | | 0.31 | | | | | | | | | |
| M019474 | | | | | | | | | 0.01 | 0.4 | | | | | L0.003 | | 0.007 | |
| M019475 | | | | | | | | | | | | | | | L0.003 | | 0.044 | |
| M019476 | | | | | | | | | 0.04 | 0.5 | | | | | L0.003 | | L0.003 | |
| M019477 | | | | | | | | | 0.05 | 0.4 | | | | | L0.003 | | 0.011 | |
| M019478 | | | | | | | | | 0.07 | 0.4 | | | | | 0.003 | | 0.008 | |
| M019479 | | | | | | | | | 0.09 | 0.4 | | | | | 0.003 | | 0.009 | |
| M019480 | | | | | | | | | 0.1 | | | | | | 0.003 | | 0.009 | |
| M019481 | | | | | | | | | 0.19 | 0.5 | | | | | L0.003 | | 0.014 | |
| M019482 | | | | | | | | | 0.18 | 0.4 | | | | | L0.003 | | 0.031 | |
| M019483 | | | | | | | | | 0.09 | 0.5 | | | | | L0.003 | | 0.013 | |
| M019484 | | | | | | | | | L0.01 | 0.5 | | | | | L0.003 | | 0.006 | |
| M019485 | | | | | | | | | 0.3 | | | | | | | | | |
| M019486 | | | | | | | | | L0.01 | 0.4 | | | | | L0.003 | | 0.006 | |
| M019487 | | | | | | | | | | 0.5 | | | | | L0.003 | | 0.016 | |
| M019488 | | | | | | | | | 0.02 | 0.4 | | | | | L0.003 | | 0.008 | |
| M019489 | | | | | | | | | 0.02 | 0.3 | | | | | L0.003 | | 0.007 | |
| M020297 | | | | | | | | | 0.02 | 0.5 | | | | | | | 0.018 | |
| M020298 | | | L0.001 | | | | | | 0.14 | 0.39 | | | | | | | 0.014 | |
| M020299 | | | | | | | | | | | | | | | | | | |
| M020300 | | | | | | | | | 0.23 | | | | | | | | 0.021 | |
| M020301 | | | | | | | | | 0.09 | 0.31 | | | | | | | 0.004 | |
| M020302 | | | | | | | | | 0.02 | | | | | | | | 0.018 | |
| M020303 | | | | | | | | | L0.01 | | | | | | | | | |
| M020304 | | | | | | | | | L0.01 | | | | | | | | 0.015 | |
| M020305 | | | | | | | | | 0.13 | | | | | | | | | |
| M020306 | | | | | | | | | 0.09 | 0.31 | | | | | | | 0.025 | |
| M020307 | | | 0.002 | | | | | | 0.01 | 0.35 | | | | | | | 0.023 | |
| M020308 | | | 0.002 | | | | | | 0.02 | 0.35 | | | | | | | 0.008 | |
| M020309 | | | 0.006 | | | | | | | | | | | | | | 0.048 | |
| M020310 | | | 0.002 | | | | | | 0.15 | 0.98 | | | | | | | 0.083 | |
| M020311 | | | 0.002 | | | | | | 0.01 | 0.25 | | | | | | | 0.046 | |
| M020312 | | | 0.002 | | | | | | 0.01 | 0.32 | | | | | | | 0.018 | |
| M020313 | | | | | | | | | 0.01 | 0.28 | | | | | | | 0.07 | |
| M020314 | | | 0.002 | | | | | | 0.06 | 0.34 | | | | | | | 0.014 | |
| 1108CL0047 | | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.54 | | | | | | L0.014 | 0.011 | L0.01 |
| 1108CL0053 | | | | | | | | | | | 1.6 | | | 1.43 | | | | |
| 1109CL0069 | | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.47 | | | | | | 0.016 | 0.022 | L0.01 |
| 1109CL0076 | | | | | | | | | | | 1.5 | | | 2.04 | | | | |
| 1202EW1038 | | L0.0002 | | L0.002 | 0.0785 | 0.0785 | L0.001 | | | 0.29 | 1.3 | | | L1 | | L0.014 | L0.01 | L0.01 |
| 1202EW1042 | | | | | | | | | | | | | 12.1 | | | | | |

| SAMPLE_NO | MERCURY TOTAL | MOLYBDENUM TOTAL | NICKEL EXTRACTABLE | NICKEL TOTAL | NITRATE (NO3-N) | NITRATE/NITRITE | NITRITE (NO2-N) | NITROGEN DISSOLVED KJELDAHL | NITROGEN DISSOLVED NO3 & NO2 | NITROGEN TOTAL KJELDAHL (TKN) | ODB/ODA (CHLOROPHYLL-A / PHEOPHYTIN-A RATIO) | OXYGEN BIOCHEMICAL DEMAND | OXYGEN DISSOLVED | PHEOPHYTIN A | PHOSPHORUS DISSOLVED ORTHO | PHOSPHORUS PARTICULATE (CALCD_) | PHOSPHORUS TOTAL (P) | PHOSPHORUS TOTAL DISSOLVED |
|------------|---------------|------------------|--------------------|--------------|-----------------|-----------------|-----------------|-----------------------------|------------------------------|-------------------------------|--|---------------------------|------------------|--------------|----------------------------|---------------------------------|----------------------|----------------------------|
| 0806JHS709 | | | | | | | | | | | | | | | | | | |
| 0806JHS809 | | L0.0002 | | L0.002 | | | | | 0.03 | 0.4 | 1.47 | | | 1 | | 0.009 | 0.014 | 0.005 |
| 0808JHS609 | | L0.0002 | | 0.002 | | | | | 0.006 | 0.8 | 1.57 | | | 2 | | 0.02 | 0.031 | 0.011 |
| 0808JHS759 | | | | | | | | | | | | | | | | | | |
| 0809JHS209 | | L0.0002 | | L0.002 | | | | | 0.007 | 0.4 | 1.61 | | | L1 | | 0.007 | 0.015 | 0.009 |
| 0809JHS409 | | | | | | | | | | | | | | | | | | |
| 0903JH0212 | | 0.0003 | | 0.005 | | | | | 0.095 | 0.3 | 1 | | | L1 | | L0.001 | 0.008 | 0.007 |
| 0903JH0227 | | | | | | | | | | | 1 | | | 3 | | | | |
| 0903JH0243 | | | | | | | | | | | | | | | | | | |
| 0906JH1088 | | | | | | | | | | | | | | | | | | |
| 0906JH1016 | | L0.0002 | | L0.002 | | | | | L0.005 | 0.42 | 1.5 | | | 1.2 | | 0.0153 | 0.0252 | 0.0099 |
| 0908JH1323 | | L0.0002 | | L0.002 | | | | | L0.005 | 0.38 | 1.3 | | | 2.1 | | 0.0154 | 0.0214 | 0.006 |
| 0908JH1388 | | | | | | | | | | | | | | | | | | |
| 0909JH1572 | | L0.0002 | | L0.002 | | | | | L0.005 | 0.32 | 1.6 | | | L1 | | 0.0042 | 0.0145 | 0.0103 |
| 0909JH1637 | | | | | | | | | | | | | | | | | | |
| 1006JH0717 | | L0.0002 | | L0.002 | | | | | L0.05 | 0.28 | | | | | | 0.0076 | 0.0115 | 0.0039 |
| 1006JH0760 | | | | | | | | | | | | | | 0.418 | | | | |
| 1008JS1335 | | L0.0002 | | L0.002 | L0.001 | L0.005 | L0.001 | | | 0.25 | | | | | | L0.003 | 0.0165 | 0.0029 |
| 1008JS1357 | | | | | | | | | | | | | | 1.21 | | | | |
| 1009JS1539 | | L0.0002 | | L0.002 | L0.001 | L0.005 | L0.001 | | | 0.42 | | | | | | 0.0094 | 0.0228 | 0.0134 |
| 1009JS1723 | | | | | | | | | | | | | | 0.729 | | | | |
| 1102CL0171 | | L0.0002 | | L0.002 | 0.076 | 0.076 | L0.001 | | | 0.35 | 1.2 | | | 0.61 | | L0.014 | 0.02 | 0.013 |
| 1106CL0075 | | L0.0002 | | L0.002 | 0.0052 | 0.0052 | L0.001 | | | 0.49 | | | | | | L0.014 | 0.011 | L0.01 |
| 1106CL0076 | | | | | | | | | | | 1.4 | | | 1.37 | | | | |
| 1108CL0046 | | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.39 | | | | | | L0.014 | L0.01 | L0.01 |
| 1108CL0052 | | | | | | | | | | | 1.5 | | | 2.27 | | | | |
| 1109CL0068 | | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.46 | | | | | | L0.014 | 0.018 | L0.01 |
| 1109CL0075 | | | | | | | | | | | 1.5 | | | 1.83 | | | | |
| 1202EW1039 | | 0.0002 | | L0.002 | 0.0588 | 0.0588 | L0.001 | | | 0.27 | 1.3 | | | L1 | | L0.014 | L0.01 | L0.01 |
| 1206CL0047 | 2.3 | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.27 | | | | | | 0.01 | 0.014 | 0.0036 |
| 1206CL0052 | | | | | | | | | | | 1.6 | | | L0.6 | | | | |
| 1208EW0029 | L1 | 0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.32 | | | | | | 0.013 | 0.015 | 0.0019 |
| 1208EW0034 | | | | | | | | | | | 1.7 | | | L0.6 | | | | |
| 1209EW0132 | | | | | | | | | | | 1.6 | | | L0.6 | | | | |
| 1209RE0127 | L1 | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.38 | | | | | | L0.01 | 0.011 | 0.0033 |
| 1209RE0130 | | | | | | | | | | | | | 10 | | | | | |
| 1302EW0108 | 2 | 0.0002 | | L0.002 | 0.0679 | 0.0679 | L0.001 | | | 0.29 | 1.7 | | | L0.6 | | L0.014 | 0.0084 | 0.011 |
| 1306EW4015 | | | | | | | | | | | 1.5 | | | 0.95 | | | | |
| 1306EW4002 | 1.1 | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | L0.2 | | | | | | L0.01 | 0.013 | 0.0032 |
| 1308EW4002 | L1 | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.54 | | | | | | 0.013 | 0.017 | 0.004 |
| 1308EW4015 | | | | | | | | | | | 1.6 | | | 1.18 | | | | |
| 1309EW4044 | 1.3 | 0.00022 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.22 | | | | | | L0.01 | 0.011 | 0.0034 |

| SAMPLE_NO | MERCURY TOTAL | MOLYBDENUM TOTAL | NICKEL EXTRACTABLE | NICKEL TOTAL | NITRATE (NO3-N) | NITRATE/NITRITE | NITRITE (NO2-N) | NITROGEN DISSOLVED KJELDAHL | NITROGEN DISSOLVED NO3 & NO2 | NITROGEN TOTAL KJELDAHL (TKN) | ODB/ODA (CHLOROPHYLL-A / PHEOPHYTIN-A RATIO) | OXYGEN BIOCHEMICAL DEMAND | OXYGEN DISSOLVED | PHEOPHYTIN A | PHOSPHORUS DISSOLVED ORTHO | PHOSPHORUS PARTICULATE (CALCD_) | PHOSPHORUS TOTAL (P) | PHOSPHORUS TOTAL DISSOLVED |
|------------|---------------|------------------|--------------------|--------------|-----------------|-----------------|-----------------|-----------------------------|------------------------------|-------------------------------|--|---------------------------|------------------|--------------|----------------------------|---------------------------------|----------------------|----------------------------|
| 1309EW4057 | | | | | | | | | | | 1.5 | | | 0.92 | | | | |
| 1405EW4044 | 1.6 | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 4.25 | | | | | | 0.016 | 0.021 | 0.005 |
| 1405EW4053 | | | | | | | | | | | 1.5 | | | 0.8 | | | | |
| 1408EW4023 | 1.2 | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.25 | | | | | | 0.0081 | 0.0142 | 0.0061 |
| 1408EW4031 | | | | | | | | | | | 1.5 | | | 0.96 | | | | |
| 1409EW4044 | L1 | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.3 | | | | | | 0.008 | 0.0129 | 0.005 |
| 1409EW4052 | | | | | | | | | | | 1.4 | | | 1.24 | | | | |
| 1405EW4045 | 1 | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | L0.2 | | L0.2 | | | | | | 0.016 | 0.021 | 0.0049 |
| 1405EW4054 | | | | | | | | | | | 1.5 | | | 0.88 | | | | |
| 1408EW4024 | L1 | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.29 | | | | | | 0.009 | 0.0137 | 0.0048 |
| 1408EW4032 | | | | | | | | | | | 1.5 | | | 0.99 | | | | |
| 1409EW4045 | 1.2 | L0.0002 | | L0.002 | L0.005 | L0.0051 | L0.001 | | | 0.34 | | | | | | 0.0068 | 0.0109 | 0.0041 |
| 1409EW4053 | | | | | | | | | | | 1.5 | | | 0.95 | | | | |

| SAMPLE_NO | PH | POTASSIUM EXTRACTABLE | POTASSIUM TOTAL | RESIDUE FIXED NONFILTRABLE | RUBIDIUM TOTAL | SECCHI DISC | SELENIUM TOTAL | SILICA - SOLUBLE REACTIVE | SILICON TOTAL | SILVER TOTAL | SODIUM EXTRACTABLE | SODIUM TOTAL | SOLIDS TOTAL | STRONTIUM TOTAL | SULPHATE (S04) | SULPHATE DISSOLVED | TELLURIUM TOTAL | TEMPERATURE WATER (FIELD) |
|-----------|----------|-----------------------|-----------------|----------------------------|----------------|-------------|----------------|---------------------------|---------------|--------------|--------------------|--------------|--------------|-----------------|----------------|--------------------|-----------------|---------------------------|
| | 687 | 566 | 567 | 747 | 1008 | 3551 | 782 | 3540 | 2728 | 350 | 601 | 2691 | 1073 | 823 | 813 | 814 | 2737 | 3461 |
| | pH units | mg/L | mg/L | mg/L | mg/L | M | mg/L | mg/L | MG/L | mg/L | mg/L | mg/L | mg/L | mg/L | MG/L | MG/L | mg/L | Deg C |
| M008368 | 7.5 | L2 | | | | | | | | | L10 | | 100 | | | | | |
| M008369 | 7.8 | L2 | | | | | | | | | L10 | | 90 | | | | | |
| M008370 | 7.8 | L2 | | L5 | | | | | | | L10 | | 100 | | | | | |
| M008371 | 8 | L2 | | 25 | | | | | | | L10 | | 140 | | | | | |
| M008372 | 7.7 | L2 | | | | | | | | | L10 | | 90 | | | | | |
| M008373 | 7.8 | L2 | | | | | | | | | L10 | | 92 | | | | | |
| M008374 | 7.9 | L2 | | | | | | | | | L10 | | 84 | | | | | |
| M008375 | 7.85 | L2 | | | | | | | | | 45 | | 128 | | | | | |
| M008376 | 7.8 | L2 | | | | | | | | | L10 | | 104 | | | | | |
| M008377 | 7.7 | L2 | | | | | | | | | L10 | | 100 | | | | | |
| M008378 | 7.9 | L2 | | | | | | | | | L10 | | 98 | | | | | |
| M008379 | 7.5 | L5 | | | | | | | | | L10 | | 86 | | | | | |
| M008380 | 7.9 | L2 | | | | | | | | | L10 | | 94 | | | | | |
| M008381 | 7.75 | L2 | | | | | | | | | L10 | | 98 | | | | | |
| M008382 | 8.1 | | | | | | | | | | L10 | | 92 | | | | | |
| M008383 | 8.15 | L2 | | | | | | | | | L10 | | 104 | | | | | |
| M008384 | 8.2 | L2 | | | | | | | | | L10 | | 108 | | | | | |
| M008385 | 8 | L2 | | | | | | | | | L10 | | 76 | | | | | |
| M008386 | 7.95 | L2 | | | | | | | | | L10 | | 78 | | | | | |
| M008387 | 7.9 | L2 | | | | | | | | | L10 | | 100 | | | | | |
| M008388 | 7.7 | L2 | | | | | | | | | L10 | | 108 | | | | | |
| M008389 | 7.8 | L2 | | | | | | | | | L10 | | 104 | | | | | |
| M008390 | 7.8 | L2 | | | | | | | | | L10 | | 74 | | | | | |
| M008391 | 7.9 | L2 | | | | | | | | | L10 | | 64 | | | | | |
| M008392 | 8 | L2 | | | | | | | | | L10 | | 96 | | | | | |
| M008393 | 8.05 | L2 | | | | | | | | | L10 | | 76 | | | | | |
| M008394 | 7.95 | L2 | | | | | | | | | 10 | | 100 | | | | | |
| M019459 | | 1.1 | | | | | | 0.5 | | | 3 | | | | | | | |
| M019460 | 8 | | | L0.1 | | | | | | | | | | | | | | |
| M019461 | 7.8 | 1 | | 2 | | | | 2.2 | | | 3.5 | | | | | | | |
| M019462 | | 0.8 | | | | | | 1.1 | | | 2.2 | | | | | | | |
| M019463 | 7.8 | 1 | | | | | | 1 | | | 2.4 | | | | | | | |
| M019464 | 7.8 | 1.2 | | | | | | 1.5 | | | 2.7 | | | | | | | |
| M019465 | 7.8 | 1.2 | | | | | | 2 | | | 2.6 | | | | | | | |
| M019466 | 7.1 | 1.2 | | | | | | 3 | | | 2.9 | | | | | | | |
| M019467 | 7.9 | 1.2 | | | | | | 3.4 | | | 3 | | | | | | | |
| M019468 | 7.8 | 1.3 | | | | | | 3.4 | | | 2.7 | | | | | | | |
| M019469 | | | | | | | | | | | | | | | | | | |
| M019470 | 7.8 | 0.7 | | 1 | | | | 2.6 | | | 2 | | | | | | | |
| M019471 | 8 | 1 | | | | | | 1.2 | | | 2.5 | | | | | | | |

| SAMPLE_NO | PH | POTASSIUM EXTRACTABLE | POTASSIUM TOTAL | RESIDUE FIXED NONFILTRABLE | RUBIDIUM TOTAL | SECCHI DISC | SELENIUM TOTAL | SILICA - SOLUBLE REACTIVE | SILICON TOTAL | SILVER TOTAL | SODIUM EXTRACTABLE | SODIUM TOTAL | SOLIDS TOTAL | STRONTIUM TOTAL | SULPHATE (S04) | SULPHATE DISSOLVED | TELLURIUM TOTAL | TEMPERATURE WATER (FIELD) |
|------------|------|--------------------------|--------------------|----------------------------------|-------------------|----------------|-------------------|---------------------------------|------------------|-----------------|-----------------------|-----------------|-----------------|--------------------|-------------------|-----------------------|--------------------|---------------------------------|
| M019472 | 7.7 | 0.9 | | | | | | 1.6 | | | 2.6 | | | | | | | |
| M019473 | 7.9 | 1 | | | | | | 2.1 | | | 2.7 | | | | | | | |
| M019474 | 7.6 | 0.9 | | | | | | 1.8 | | | 2.4 | | | | | | | |
| M019475 | 7.5 | 0.8 | | | | | | 1.8 | | | 2.1 | | | | | | | |
| M019476 | 7.8 | 1.2 | | | | | | 2.6 | | | 2.9 | | | | | | | |
| M019477 | 7.4 | 1.1 | | | | | | 2.9 | | | 2.6 | | | | | | | |
| M019478 | 7.4 | 1 | | | | | | 2.9 | | | 2.8 | | | | | | | |
| M019479 | 7.7 | 1.1 | | | | | | 3 | | | 3.4 | | | | | | | |
| M019480 | 7.5 | 1.2 | | | | | | 3 | | | 3.4 | | | | | | | |
| M019481 | 7.8 | 1.1 | | | | | | 2.8 | | | 3 | | | | | | | |
| M019482 | 7.8 | 1 | | | | | | 1.5 | | | 2.7 | | | | | | | |
| M019483 | 7.6 | 1.1 | | | | | | 1.4 | | | 3.2 | | | | | | | |
| M019484 | 7.7 | | | | | | | | | | | | | | | | | |
| M019485 | | | | | | | | | | | | | | | | | | |
| M019486 | 8 | 1.1 | | | | | | 1.4 | | | 3.1 | | | | | | | |
| M019487 | 7.9 | 1.1 | | | | | | 2.2 | | | 3.1 | | | | | | | |
| M019488 | 8 | 1.1 | | | | | | 1.9 | | | 3 | | | | | | | |
| M019489 | 7.9 | 0.2 | | | | | | 3.8 | | | 0.4 | | | | | | | |
| M020297 | 7.7 | | | | | | | | | | | | | | | | | |
| M020298 | 7.7 | | | | | | | | | | | | | | | | | |
| M020299 | 7.5 | | | | | | | | | | | | | | | | | |
| M020300 | 8.1 | | | | | | | | | | | | | | | | | |
| M020301 | 7.6 | | | | | | | | | | | | | | | | | |
| M020302 | 7.7 | | | | | | | | | | | | | | | | | |
| M020303 | 7.5 | | | | | | | | | | | | | | | | | |
| M020304 | 8 | | | | | | | | | | | | | | | | | |
| M020305 | 7.6 | | | | | | | | | | | | | | | | | |
| M020306 | 7 | 0.8 | | | | | | | | | 1.2 | | | | | | | |
| M020307 | 8.2 | 0.7 | | | | | | | | | 1.9 | | | | | | | |
| M020308 | 7.8 | 0.6 | | | | | | | | | 2.2 | | | | | | | |
| M020309 | 7.3 | 1.5 | | | | | | | | | 2.8 | | | | | | | |
| M020310 | 7.4 | 1.2 | | | | | | | | | 2.6 | | | | | | | |
| M020311 | 7.6 | 0.5 | | | | | | | | | 1.4 | | | | | | | |
| M020312 | 8.1 | 0.5 | | | | | | | | | 1.7 | | | | | | | |
| M020313 | 8 | 0.6 | | | | | | | | | 1.6 | | | | | | | |
| M020314 | 8.1 | 0.9 | | | | | | | | | 1.8 | | | | | | | |
| 1108CL0047 | 8.24 | | 0.606 | | 0.00112 | | L0.001 | | 1.41 | L0.0001 | | 1.88 | | 0.0396 | 1.22 | | L0.0002 | 18.38 |
| 1108CL0053 | | | | | | | | | | | | | | | | | | |
| 1109CL0069 | 8.16 | | 0.93 | | 0.00138 | | L0.001 | | 3.23 | L0.0001 | | 2.08 | | 0.0328 | 1.56 | | L0.0002 | 14.54 |
| 1109CL0076 | | | | | | | | | | | | | | | | | | |
| 1202EW1038 | 7.94 | | 0.935 | | 0.00089 | | L0.001 | | 2.05 | L0.0001 | | 2.65 | | 0.044 | 2.01 | | L0.0002 | 0 |
| 1202EW1042 | | | | | | | | | | | | | | | | | | 0 |

| SAMPLE_NO | PH | POTASSIUM EXTRACTABLE | POTASSIUM TOTAL | RESIDUE FIXED NONFILTRABLE | RUBIDIUM TOTAL | SECCHI DISC | SELENIUM TOTAL | SILICA - SOLUBLE REACTIVE | SILICON TOTAL | SILVER TOTAL | SODIUM EXTRACTABLE | SODIUM TOTAL | SOLIDS TOTAL | STRONTIUM TOTAL | SULPHATE (S04) | SULPHATE DISSOLVED | TELLURIUM TOTAL | TEMPERATURE WATER (FIELD) |
|------------|------|--------------------------|--------------------|----------------------------------|-------------------|----------------|-------------------|---------------------------------|------------------|-----------------|-----------------------|-----------------|-----------------|--------------------|-------------------|-----------------------|--------------------|---------------------------------|
| 0806JHS709 | | | | | | | | | | | | | | | | | | |
| 0806JHS809 | 8.12 | | 0.7 | | 0.0008 | | L0.001 | | | L0.0001 | | 1.41 | | 0.0262 | L2 | | L0.001 | 16.9 |
| 0808JHS609 | 8.15 | | 0.8 | | 0.0015 | | 0.001 | | | L0.0001 | | 1.47 | | 0.0314 | L2 | | L0.001 | |
| 0808JHS759 | | | | | | | | | | | | | | | | | | |
| 0809JHS209 | 8.16 | | 0.9 | | 0.001 | | L0.001 | | | L0.0001 | | 2.24 | | 0.0339 | 2 | | L0.001 | |
| 0809JHS409 | | | | | | | | | | | | | | | | | | |
| 0903JH0212 | 8.2 | | 1.1 | | 0.0011 | | L0.001 | | | L0.0001 | | 2.46 | | 0.0449 | | 3 | L0.001 | |
| 0903JH0227 | | | | | | | | | | | | | | | | | | -0.06 |
| 0903JH0243 | | | | | | | | | | | | | | | | | | -0.05 |
| 0906JH1088 | | | | | | | | | | | | | | | | | | |
| 0906JH1016 | 8.22 | | 0.82 | | 0.00112 | | L0.001 | | 1.34 | L0.0001 | | 1.42 | | 0.0252 | | 3.7 | L0.001 | 10.76 |
| 0908JH1323 | 8.16 | | 1.14 | | 0.00141 | | L0.001 | | | L0.0001 | | 2.71 | | 0.0373 | | 6.1 | L0.001 | 13.12 |
| 0908JH1388 | | | | | | | | | | | | | | | | | | 13.12 |
| 0909JH1572 | 8.27 | | 1.09 | | 0.00143 | | L0.001 | | | L0.0001 | | 2.59 | | 0.0348 | | 5.6 | L0.001 | 14.16 |
| 0909JH1637 | | | | | | | | | | | | | | | | | | |
| 1006JH0717 | 8.19 | | 0.829 | | 0.00093 | | L0.001 | | 1.34 | L0.0001 | | 2.08 | | 0.0324 | | 6 | L0.0002 | 17.61 |
| 1006JH0760 | | | | | | | | | | | | | | | | | | 17.61 |
| 1008JS1335 | 8.34 | | 0.914 | | 0.00128 | 2.6 | L0.001 | | 1.41 | L0.0001 | | 2.33 | | 0.0394 | 1.92 | | L0.0002 | 18.58 |
| 1008JS1357 | | | | | | | | | | | | | | | | | | |
| 1009JS1539 | 8.08 | | 1.01 | | 0.00175 | | L0.001 | | 4.73 | L0.0001 | | 2.08 | | 0.0325 | 1.76 | | L0.0002 | 11.45 |
| 1009JS1723 | | | | | | | | | | | | | | | | | | |
| 1102CL0171 | 7.83 | | 1.13 | | 0.00141 | | L0.001 | | 2.45 | L0.0001 | | 2.43 | | 0.0412 | 1.83 | | L0.0002 | -0.09 |
| 1106CL0075 | 8.34 | | 0.97 | | 0.00104 | | L0.001 | | 1.44 | L0.0001 | | 2.36 | | 0.0373 | 1.72 | | L0.0002 | 17.32 |
| 1106CL0076 | | | | | | | | | | | | | | | | | | |
| 1108CL0046 | 8.21 | | 0.812 | | 0.00131 | | L0.001 | | 1.56 | L0.0001 | | 1.9 | | 0.0362 | 1.57 | | L0.0002 | 18.12 |
| 1108CL0052 | | | | | | | | | | | | | | | | | | |
| 1109CL0068 | 8.14 | | 1.01 | | 0.00141 | | L0.001 | | 2.01 | L0.0001 | | 2.39 | | 0.0333 | 1.7 | | L0.0002 | 14.81 |
| 1109CL0075 | | | | | | | | | | | | | | | | | | |
| 1202EW1039 | 8 | | 1.05 | | 0.00099 | | L0.001 | | 2.08 | L0.0001 | | 2.63 | | 0.04 | 2.02 | | L0.0002 | 0 |
| 1206CL0047 | 7.91 | | 0.766 | | 0.00084 | | L0.001 | | 1.26 | L0.0001 | | 1.29 | | 0.0268 | 0.98 | | L0.0002 | 8.97 |
| 1206CL0052 | | | | | | | | | | | | | | | | | | |
| 1208EW0029 | 8.22 | | 0.981 | | 0.0011 | | L0.001 | | 1.72 | L0.0001 | | 2.52 | | 0.0358 | 1.57 | | L0.0002 | 17.37 |
| 1208EW0034 | | | | | | | | | | | | | | | | | | |
| 1209EW0132 | | | | | | | | | | | | | | | | | | |
| 1209RE0127 | 8.23 | | 0.739 | | 0.00093 | | L0.001 | | 1.42 | L0.0001 | | 2.16 | | 0.0352 | 1.45 | | L0.0002 | 13.82 |
| 1209RE0130 | | | | | | | | | | | | | | | | | | 13.82 |
| 1302EW0108 | 7.9 | | 0.993 | | 0.00102 | | L0.001 | | 2.1 | L0.0001 | | 2.73 | | 0.0411 | 1.77 | | L0.0002 | -0.1 |
| 1306EW4015 | | | | | | | | | | | | | | | | | | 15.67 |
| 1306EW4002 | 8.28 | | 0.876 | | 0.00094 | | L0.001 | | 1.25 | L0.0001 | | 1.83 | | 0.0329 | 1.39 | | L0.0002 | 15.67 |
| 1308EW4002 | 8.16 | | 0.953 | | 0.00128 | | L0.001 | | 1.89 | L0.0001 | | 1.94 | | 0.0344 | 1.24 | | L0.0002 | 16.89 |
| 1308EW4015 | | | | | | | | | | | | | | | | | | 16.89 |
| 1309EW4044 | 8.14 | | 0.895 | | 0.00102 | | L0.001 | | 1.45 | L0.0001 | | 2.37 | | 0.0361 | 1.67 | | L0.0002 | 14.19 |

| SAMPLE_NO | PH | POTASSIUM EXTRACTABLE | POTASSIUM TOTAL | RESIDUE FIXED NONFILTRABLE | RUBIDIUM TOTAL | SECCHI DISC | SELENIUM TOTAL | SILICA - SOLUBLE REACTIVE | SILICON TOTAL | SILVER TOTAL | SODIUM EXTRACTABLE | SODIUM TOTAL | SOLIDS TOTAL | STRONTIUM TOTAL | SULPHATE (S04) | SULPHATE DISSOLVED | TELLURIUM TOTAL | TEMPERATURE WATER (FIELD) |
|------------|------|--------------------------|--------------------|----------------------------------|-------------------|----------------|-------------------|---------------------------------|------------------|-----------------|-----------------------|-----------------|-----------------|--------------------|-------------------|-----------------------|--------------------|---------------------------------|
| 1309EW4057 | | | | | | | | | | | | | | | | | | 14.19 |
| 1405EW4044 | 8.07 | | 1 | | 0.00131 | | L0.001 | | 1.51 | L0.0001 | | 2.42 | | 0.0341 | 1.55 | | L0.0002 | 15.24 |
| 1405EW4053 | | | | | | | | | | | | | | | | | | 15.24 |
| 1408EW4023 | 7.97 | | 1.05 | | 0.00143 | | L0.001 | | 1.59 | L0.0001 | | 2.57 | | 0.0351 | 1.69 | | L0.0002 | 19.06 |
| 1408EW4031 | | | | | | | | | | | | | | | | | | 19.06 |
| 1409EW4044 | 7.97 | | 0.998 | | 0.00134 | | L0.001 | | 1.64 | L0.0001 | | 2.69 | | 0.0369 | 1.65 | | L0.0002 | 12.63 |
| 1409EW4052 | | | | | | | | | | | | | | | | | | 12.63 |
| 1405EW4045 | 8.08 | | 0.913 | | 0.00123 | | L0.001 | | 1.24 | L0.0001 | | 2.26 | | 0.033 | 1.38 | | L0.0002 | 15.71 |
| 1405EW4054 | | | | | | | | | | | | | | | | | | 15.71 |
| 1408EW4024 | 8.05 | | 0.981 | | 0.00145 | | L0.001 | | 1.62 | L0.0001 | | 2.58 | | 0.0391 | 1.5 | | L0.0002 | 19.15 |
| 1408EW4032 | | | | | | | | | | | | | | | | | | 19.15 |
| 1409EW4045 | 8.02 | | 0.809 | | 0.00115 | | L0.001 | | 1.38 | L0.0001 | | 2.68 | | 0.0374 | 1.42 | | L0.0002 | 10.62 |
| 1409EW4053 | | | | | | | | | | | | | | | | | | 10.51 |

| SAMPLE_NO | TEMPERATURE WATER | THALLIUM TOTAL | THORIUM TOTAL | TIN TOTAL | TITANIUM TOTAL | TOTAL DISSOLVED SOLIDS | TOTAL DISSOLVED SOLIDS | TOTAL SUSPENDED SOLIDS | TUNGSTEN TOTAL | TURBIDITY | TURBIDITY | URANIUM TOTAL | VANADIUM TOTAL | ZINC EXTRACTABLE | ZINC TOTAL (ZN) | ZIRCONIUM TOTAL |
|-----------|-------------------|----------------|---------------|-----------|----------------|------------------------|------------------------|------------------------|----------------|-----------|-----------|---------------|----------------|------------------|-----------------|-----------------|
| | 840 | 861 | 854 | 812 | 858 | 836 | 836 | 1032 | 1013 | 864 | 864 | 2725 | 878 | 888 | 890 | 1015 |
| | deg C | mg/L | MG/L | mg/L | mg/L | MG/L @180 | mg/L | mg/L | mg/L | JTU | Ntu | mg/L | mg/L | mg/L | mg/L | mg/L |
| M008368 | | | | | | | 100 | L5 | | | 1.5 | | | | | |
| M008369 | | | | | | | 90 | L5 | | | 1.5 | | | | | |
| M008370 | | | | | | | 100 | L5 | | | | | | | | |
| M008371 | | | | | | | 110 | 35 | | | | | | | | |
| M008372 | | | | | | | 90 | L5 | | | 2.5 | | | | | |
| M008373 | | | | | | | 92 | L5 | | | 1 | | | | | |
| M008374 | | | | | | | 75 | 9 | | | 2.5 | | | | | |
| M008375 | | | | | | | 121 | 7 | | | 1.5 | | | | | |
| M008376 | | | | | | | 96 | 8 | | | 2 | | | | | |
| M008377 | | | | | | | 91 | 9 | | | 0.2 | | | | | |
| M008378 | | | | | | | 91 | 7 | | | 2.5 | | | | | |
| M008379 | | | | | | | 86 | L5 | | | 2 | | | | | |
| M008380 | | | | | | | 84 | 10 | | | 4 | | | | | |
| M008381 | | | | | | | 58 | 40 | | | 20 | | | | | |
| M008382 | | | | | | | 92 | L5 | | | 2 | | | | | |
| M008383 | | | | | | | 104 | L5 | | | 1.5 | | | | | |
| M008384 | | | | | | | 101 | 7 | | | 5 | | | | | |
| M008385 | | | | | | | 68 | 8 | | | 15 | | | | | |
| M008386 | | | | | | | 78 | L5 | | | 6 | | | | | |
| M008387 | | | | | | | 90 | 15 | | | 10 | | | | | |
| M008388 | | | | | | | 99 | 9 | | | 10 | | | | | |
| M008389 | | | | | | | 97 | 7 | | | 7.5 | | | | | |
| M008390 | | | | | | | 74 | L5 | | | 0.45 | | | | | |
| M008391 | | | | | | | 52 | 12 | | | 7 | | | | | |
| M008392 | | | | | | | 84 | 12 | | | 3.4 | | | | | |
| M008393 | | | | | | | 68 | 8 | | | 3.4 | | | | | |
| M008394 | | | | | | | 90 | 10 | | | 4.5 | | | | | |
| M019459 | 13.3 | | | | | | | | | 2.3 | | | | 0.01 | | |
| M019460 | 3.5 | | | | | | | | | | | | | 0.008 | | |
| M019461 | | | | | | | | | | 6 | | | | 0.012 | | |
| M019462 | | | | | | | | | | 2.7 | | | | 0.011 | | |
| M019463 | | | | | | | | | | 1.8 | | | | 0.004 | | |
| M019464 | | | | | | | | | | 2.1 | | | | L0.001 | | |
| M019465 | | | | | | | | | | 2.5 | | | | 0.001 | | |
| M019466 | | | | | | | | | | 2.6 | | | | L0.002 | | |
| M019467 | 5.6 | | | | | | | | | 2.5 | | | | 0.002 | | |
| M019468 | | | | | | | | | | 2.8 | | | | L0.002 | | |
| M019469 | 6.1 | | | | | | | | | 3.3 | | | | 0.002 | | |
| M019470 | | | | | | | | | | 9.4 | | | | L0.008 | | |
| M019471 | 5.5 | | | | | | | | | 3.8 | | | | L0.003 | | |

| SAMPLE_NO | TEMPERATURE WATER | THALLIUM TOTAL | THORIUM TOTAL | TIN TOTAL | TITANIUM TOTAL | TOTAL DISSOLVED SOLIDS | TOTAL DISSOLVED SOLIDS | TOTAL SUSPENDED SOLIDS | TUNGSTEN TOTAL | TURBIDITY | TURBIDITY | URANIUM TOTAL | VANADIUM TOTAL | ZINC EXTRACTABLE | ZINC TOTAL (ZN) | ZIRCONIUM TOTAL |
|------------|-------------------|----------------|---------------|-----------|----------------|------------------------|------------------------|------------------------|----------------|-----------|-----------|---------------|----------------|------------------|-----------------|-----------------|
| M019472 | 17.2 | | | | | | | | | 3.2 | | | | L0.001 | | |
| M019473 | | | | | | | | | | 2.1 | | | | 0.003 | | |
| M019474 | | | | | | | | | | 2 | | | | 0.047 | | |
| M019475 | | | | | | | | | | 3.2 | | | | | | |
| M019476 | | | | | | | | | | 1.8 | | | | 0.002 | | |
| M019477 | | | | | | | | | | 2.8 | | | | 0.002 | | |
| M019478 | 3.3 | | | | | | | | | 2.2 | | | | L0.002 | | |
| M019479 | | | | | | | | | | 2.8 | | | | L0.001 | | |
| M019480 | | | | | | | | | | 2 | | | | 0.003 | | |
| M019481 | | | | | | | | | | | 2 | | | 0.001 | | |
| M019482 | | | | | | | | | | | 14 | | | 0.003 | | |
| M019483 | | | | | | | | | | | 1.7 | | | 0.003 | | |
| M019484 | | | | | | | | | | | 1.7 | | | | | |
| M019485 | 7.7 | | | | | | | | | | | | | 0.007 | | |
| M019486 | 7.2 | | | | | | | | | | 0.9 | | | 0.003 | | |
| M019487 | 5.6 | | | | | | | | | | 4.3 | | | 0.003 | | |
| M019488 | 7 | | | | | | | | | | 1.9 | | | 0.003 | | |
| M019489 | 7.8 | | | | | | | | | | 0.8 | | | 0.004 | | |
| M020297 | | | | | | | | | | | | | | 0.004 | | |
| M020298 | | | | | | | | 3 | | | | | | 0.002 | | |
| M020299 | 2 | | | | | | | 5 | | | | | | | | |
| M020300 | 14 | | | | | | | 5 | | | | | | 0.008 | | |
| M020301 | | | | | | | | 4 | | | | | | 0.004 | | |
| M020302 | 0 | | | | | | 101 | 14 | | | 7.5 | | | | | |
| M020303 | 13 | | | | | | 64 | 18 | | | 8.5 | | | | | |
| M020304 | 4 | | | | | | 81 | 4 | | | 3.6 | | | | | |
| M020305 | 0 | | | | | | 86 | 7 | | | 6.2 | | | | | |
| M020306 | 0 | | | | | | 22 | 2 | | | 0.6 | | | | | |
| M020307 | 11 | | | | | | 84 | 1 | | | 1.5 | | | 0.004 | | |
| M020308 | | | | | | | 88 | 8 | | | 1.2 | | | 0.003 | | |
| M020309 | 0 | | | | | | 94 | 1 | | | 1.6 | | | 0.023 | | |
| M020310 | 0 | | | | | | 95 | 5 | | | 2.6 | | | 0.026 | | |
| M020311 | 4.5 | | | | | | 63 | 28 | | | 15 | | | 0.006 | | |
| M020312 | 10 | | | | | | 76 | 2 | | | 2.7 | | | 0.003 | | |
| M020313 | 5 | | | | | | 77 | 3 | | | 2 | | | | | |
| M020314 | 0 | | | | | | 83 | 3 | | | 3.4 | | | 0.012 | | |
| 1108CL0047 | | L0.0001 | L0.0001 | L0.0002 | 0.00491 | 90 | | 9.6 | L0.001 | | 6.6 | 0.00018 | 0.00053 | | L0.005 | L0.0004 |
| 1108CL0053 | | | | | | | | | | | | | | | | |
| 1109CL0069 | | L0.0001 | 0.00012 | L0.0002 | 0.00966 | 72 | | 14.8 | L0.001 | | 7.39 | 0.00013 | 0.00076 | | L0.005 | L0.0004 |
| 1109CL0076 | | | | | | | | | | | | | | | | |
| 1202EW1038 | | L0.0001 | L0.0001 | L0.0002 | 0.00198 | 114 | | L2 | L0.001 | | 2.18 | 0.00021 | 0.00026 | | L0.005 | L0.0004 |
| 1202EW1042 | | | | | | | | | | | | | | | | |

| SAMPLE_NO | TEMPERATURE WATER | THALLIUM TOTAL | THORIUM TOTAL | TIN TOTAL | TITANIUM TOTAL | TOTAL DISSOLVED SOLIDS | TOTAL DISSOLVED SOLIDS | TOTAL SUSPENDED SOLIDS | TUNGSTEN TOTAL | TURBIDITY | TURBIDITY | URANIUM TOTAL | VANADIUM TOTAL | ZINC EXTRACTABLE | ZINC TOTAL (ZN) | ZIRCONIUM TOTAL |
|------------|-------------------|----------------|---------------|-----------|----------------|------------------------|------------------------|------------------------|----------------|-----------|-----------|---------------|----------------|------------------|-----------------|-----------------|
| 0806JHS709 | | | | | | | | | | | | | | | | |
| 0806JHS809 | | L0.0001 | | L0.0006 | 0.0022 | 74 | | L2 | L0.0002 | | 1.8 | 0.0001 | L0.001 | | L0.01 | L0.0004 |
| 0808JHS609 | | L0.0001 | | L0.0006 | 0.0111 | 88 | | 20 | L0.0002 | | 10 | 0.0002 | L0.001 | | L0.01 | L0.0004 |
| 0808JHS759 | | | | | | | | | | | | | | | | |
| 0809JHS209 | | L0.0001 | | L0.0006 | 0.0014 | 96 | | 4 | L0.0002 | | 3.8 | 0.0001 | L0.001 | | L0.01 | L0.0004 |
| 0809JHS409 | | | | | | | | | | | | | | | | |
| 0903JH0212 | | L0.0001 | | L0.0006 | 0.0035 | 110 | | L2 | L0.0002 | | 1.8 | 0.0002 | L0.001 | | L0.01 | L0.0004 |
| 0903JH0227 | | | | | | | | | | | | | | | | |
| 0903JH0243 | | | | | | | | | | | | | | | | |
| 0906JH1088 | | | | | | | | | | | | | | | | |
| 0906JH1016 | | L0.0001 | | L0.0006 | 0.0077 | 84 | | 16.8 | L0.0002 | | 7 | 0.00021 | L0.001 | | L0.01 | L0.0004 |
| 0908JH1323 | | L0.0001 | | L0.0006 | 0.00938 | 88 | | 9.2 | L0.0002 | | 7.1 | 0.00016 | L0.001 | | L0.01 | L0.0004 |
| 0908JH1388 | | | | | | | | | | | | | | | | |
| 0909JH1572 | | L0.0001 | | L0.0006 | 0.0078 | 76 | | 5.6 | L0.0002 | | 6.2 | 0.00014 | L0.001 | | L0.01 | L0.0004 |
| 0909JH1637 | | | | | | | | | | | | | | | | |
| 1006JH0717 | | L0.0001 | L0.0001 | L0.0002 | 0.00305 | 88 | | 4.4 | L0.001 | | 2.9 | 0.00012 | 0.00037 | | L0.005 | L0.0004 |
| 1006JH0760 | | | | | | | | | | | | | | | | |
| 1008JS1335 | | L0.0001 | L0.0001 | L0.0002 | 0.00392 | 70 | | 2.4 | L0.001 | | 2.78 | 0.00022 | 0.00057 | | L0.005 | L0.0004 |
| 1008JS1357 | | | | | | | | | | | | | | | | |
| 1009JS1539 | | L0.0001 | 0.00015 | L0.0002 | 0.0131 | 108 | | 10 | L0.001 | | 8.78 | 0.00021 | 0.00079 | | L0.005 | 0.00047 |
| 1009JS1723 | | | | | | | | | | | | | | | | |
| 1102CL0171 | | L0.0001 | L0.0001 | 0.00038 | 0.00726 | 86 | | L2 | L0.001 | | 4.39 | 0.0002 | 0.00051 | | L0.005 | L0.0004 |
| 1106CL0075 | | L0.0001 | L0.0001 | L0.0002 | 0.00187 | 74 | | 4 | L0.001 | | 1.17 | 0.00022 | 0.00041 | | L0.005 | L0.0004 |
| 1106CL0076 | | | | | | | | | | | | | | | | |
| 1108CL0046 | | L0.0001 | L0.0001 | L0.0002 | 0.00698 | 82 | | 8.8 | L0.001 | | 5.64 | 0.00024 | 0.00062 | | L0.005 | L0.0004 |
| 1108CL0052 | | | | | | | | | | | | | | | | |
| 1109CL0068 | | L0.0001 | L0.0001 | L0.0002 | 0.00847 | 60 | | 8 | L0.001 | | 5.77 | 0.00012 | 0.00065 | | L0.005 | L0.0004 |
| 1109CL0075 | | | | | | | | | | | | | | | | |
| 1202EW1039 | | L0.0001 | L0.0001 | L0.0002 | 0.0026 | 86 | | L2 | L0.001 | | 2.67 | 0.00021 | 0.00037 | | L0.005 | L0.0004 |
| 1206CL0047 | | L0.0001 | L0.0001 | L0.0002 | 0.0034 | 72 | | 3.2 | L0.0001 | | 3.53 | 0.00015 | 0.00031 | | 0.0029 | L0.0004 |
| 1206CL0052 | | | | | | | | | | | | | | | | |
| 1208EW0029 | | L0.0001 | L0.0001 | L0.0002 | 0.00364 | 90 | | 4.3 | L0.0001 | | 3.93 | 0.00015 | 0.00042 | | L0.002 | L0.0004 |
| 1208EW0034 | | | | | | | | | | | | | | | | |
| 1209EW0132 | | | | | | | | | | | | | | | | |
| 1209RE0127 | | L0.0001 | L0.0001 | L0.0002 | 0.00259 | 94 | | 2.8 | L0.0001 | | 2.74 | 0.00015 | 0.00037 | | L0.002 | L0.0004 |
| 1209RE0130 | | | | | | | | | | | | | | | | |
| 1302EW0108 | | L0.0001 | L0.0001 | 0.00162 | 0.00188 | 94 | | 2 | L0.0001 | | 1.99 | 0.0002 | 0.00027 | | L0.002 | L0.0004 |
| 1306EW4015 | | | | | | | | | | | | | | | | |
| 1306EW4002 | | L0.0001 | L0.0001 | L0.0002 | 0.00263 | 96 | | L2 | L0.0001 | | 2 | 0.00018 | 0.00033 | | L0.002 | L0.0004 |
| 1308EW4002 | | L0.0001 | L0.0001 | L0.0002 | 0.00498 | 80 | | 6 | L0.0001 | | 4.14 | 0.00024 | 0.00048 | | L0.002 | L0.0004 |
| 1308EW4015 | | | | | | | | | | | | | | | | |
| 1309EW4044 | | L0.0001 | L0.0001 | L0.0002 | 0.00243 | 98.8 | | L2 | L0.0001 | | 1.9 | 0.0002 | 0.00037 | | L0.002 | L0.0004 |

| SAMPLE_NO | TEMPERATURE WATER | THALLIUM TOTAL | THORIUM TOTAL | TIN TOTAL | TITANIUM TOTAL | TOTAL DISSOLVED SOLIDS | TOTAL DISSOLVED SOLIDS | TOTAL SUSPENDED SOLIDS | TUNGSTEN TOTAL | TURBIDITY | TURBIDITY | URANIUM TOTAL | VANADIUM TOTAL | ZINC EXTRACTABLE | ZINC TOTAL (ZN) | ZIRCONIUM TOTAL |
|------------|-------------------|----------------|---------------|-----------|----------------|------------------------|------------------------|------------------------|----------------|-----------|-----------|---------------|----------------|------------------|-----------------|-----------------|
| 1309EW4057 | | | | | | | | | | | | | | | | |
| 1405EW4044 | | L0.0001 | L0.0001 | L0.0002 | 0.00766 | 94 | | 6.8 | L0.0001 | | 4.4 | 0.00018 | 0.0006 | | 0.0025 | L0.0004 |
| 1405EW4053 | | | | | | | | | | | | | | | | |
| 1408EW4023 | | L0.0001 | L0.0001 | L0.0002 | 0.00741 | 95 | | 6 | L0.0001 | | 6.5 | 0.00015 | 0.00049 | | L0.002 | L0.0004 |
| 1408EW4031 | | | | | | | | | | | | | | | | |
| 1409EW4044 | | L0.0001 | L0.0001 | L0.0002 | 0.0045 | 81 | | 3.2 | L0.0001 | | 3.5 | 0.00016 | 0.00041 | | L0.002 | L0.0004 |
| 1409EW4052 | | | | | | | | | | | | | | | | |
| 1405EW4045 | | L0.0001 | L0.0001 | L0.0002 | 0.00645 | 95 | | 5.6 | L0.0001 | | 3.9 | 0.00018 | 0.00061 | | L0.002 | L0.0004 |
| 1405EW4054 | | | | | | | | | | | | | | | | |
| 1408EW4024 | | L0.0001 | L0.0001 | L0.0002 | 0.00651 | 93 | | 6 | L0.0001 | | 4.8 | 0.00014 | 0.00052 | | L0.002 | L0.0004 |
| 1408EW4032 | | | | | | | | | | | | | | | | |
| 1409EW4045 | | L0.0001 | L0.0001 | L0.0002 | 0.00388 | 90 | | 2 | L0.0001 | | 3.5 | 0.00013 | 0.00036 | | L0.002 | L0.0004 |
| 1409EW4053 | | | | | | | | | | | | | | | | |

Gene Senior

From: Biggin, Wade (CWS) <Wade.Biggin@gov.mb.ca>
Sent: October-13-15 11:24 AM
To: 'Gene Senior'
Cc: 'Shaun Moffatt'
Subject: RE: CMO - FIHCS Churchill River
Attachments: CHURCHILL_RIVER_FIHCS.pdf

Sorry Gene and Shaun for the delay.

From: Gene Senior [<mailto:GSenior@kgsgroup.com>]
Sent: October-08-15 12:51 PM
To: Biggin, Wade (CWS)
Subject: FW: CMO - FIHCS Churchill River

Hi Wade,

I am following up on Shaun's email to see if you are able to provide the FIHCS or other available data regarding fish species and habitat that may be found in the Churchill River at Churchill Manitoba.

Thanks,
Gene

From: Shaun Moffatt [<mailto:SMoffatt@kgsgroup.com>]
Sent: September-25-15 11:45 AM
To: 'Biggin, Wade (CWS)'
Cc: 'Gene Senior'
Subject: FW: CMO - FIHCS Churchill River

Wade

I am following up on my email below to find out when we can anticipate receiving any information as the Client is asking for an update on when the EA report will be completed, thanks.

Shaun Moffatt, M.Sc.
Senior Environmental Scientist
KGS Group
3rd Floor - 865 Waverley St.
Wpg. MB. R3T 5P4

Phone: 204-896-1209 ext 467
Fax: 204-896-0754

From: Shaun Moffatt [<mailto:SMoffatt@kgsgroup.com>]
Sent: Wednesday, September 16, 2015 3:04 PM
To: 'Biggin, Wade (CWS)'
Cc: 'Gene Senior'
Subject: CMO - FIHCS Churchill River

Wade

KGS Group is preparing an Environmental Assessment for the University of Manitoba to obtain an Environment Act Licence for the proposed Churchill Marine Observatory (CMO). The CMO will be a globally unique, highly innovative, multidisciplinary research facility located in Churchill, Manitoba, adjacent to Canada's only Arctic deep-water port (as

shown in the attached figure). The CMO will directly address technological, scientific and economic issues pertaining to sea ice, Arctic marine transportation and oil and gas exploration and development throughout the Arctic and transform the ability to directly observe variability and change in the arctic eco-system.

As part of the project there will be a boat launch and (removable) floating dock along the shoreline of the Churchill River. Additionally a water intake will be installed on the bottom of the Churchill River at the mouth of the estuary to obtain salt water and to sample sea water quality. Likewise to obtain freshwater (if required) a temporary hose and intake will be pulled upstream on the Churchill River by boat during low tide.

Specifically we are requesting any available information through the FIHCS or other available sources regarding fish species and habitat that may be found in the Churchill River at Churchill Manitoba. The information obtained from the Fisheries Branch will be used to identify typical species composition and fish habitat in the area and develop mitigation measures for potential project impacts.

If you have any questions please let me know. Thank you.

Shaun Moffatt, M.Sc.
Senior Environmental Scientist
KGS Group
3rd Floor - 865 Waverley St.
Wpg. MB. R3T 5P4

Phone: 204-896-1209 ext 467
Fax: 204-896-0754

**FIHCS - Fisheries Inventory &
Habitat Classification System**

Habitat Suitability

Seasonal Habitat Suitability*

| | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| All | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | None |
| Y | | | | | | | | | | | | | |

*The month(s) the waterbody is useable for fish Habitat (without human intervention)

Habitat Classifications

| Habitat Class | Class |
|---|---------|
| Classification based on habitat rating | Class 3 |
| Condition of the waterbody 5 years ago | Class 3 |
| Intuitive classification of the waterbody | Class 3 |
| Predicted classification in 5 years | Class 1 |

*Restore flows/levels (likely not feasible)

Resource Access

| Resource | Distance (km) |
|---------------------|---------------|
| Aircraft on Floats | 0 |
| Aircraft on Wheels | 0 |
| All Season Road | 0 |
| Boat | 0 |
| Electrical Power | 0 |
| FFMC Delivery Point | 0 |
| Seasonal Road | 0 |
| Walking | 0 |

General Uses

| General Use | Harvest Weight |
|----------------------|----------------|
| Commercial Sport | |
| Recreational Angling | |

Needed Improvements

| Year | Improvements | Comments |
|------|---|--|
| 1995 | Discharge data entered in the stream morphology section for April 15, 1987 and May 15, 1987 refer to mean monthly discharges for the river for each respective month from 1981-1993. | |
| 1999 | A weir was constructed near Churchill to improve water levels. | |
| 2000 | The enhancement project has resulted in a redistribution of macrophyte beds. These macrophyte beds are used as fish habitat and consequently, are feeding areas for other animals. | |
| 2002 | Mean muscle mercury concentrations in lake whitefish and northern pike were slightly lower than pre-project. Lake whitefish was below the recommended domestic consumption limit. Northern pike was above, but below the commercial export limit. | First documented occurrence of rainbow smelt in the Churchill River watershed - four specimens were discovered in the stomach of one northern pike. |
| 2003 | The Churchill River Diversion has resulted in lower discharge than previously experienced on the lower Churchill River. | Construction of the weir resulted in upstream flooding, a 2m increase in water level at the upstream face of the weir and a backwater effect extending approximately 10 km upstream. |
| 2004 | The lower Churchill River is being examined to identify any changes in water quality that may have resulted from the operation of the lower Churchill River Water Level Enhancement Weir Project. | In 1976 the Churchill River was impounded at SIL and the majority of stream discharge was diverted by means of the CRD to hydro electric generating stations. Due to lower post-CRD discharge the Project was initiated to improve the altered water regime. |
| 2005 | After creation of the weir, it was expected that the abundance of riverine fish would decrease slightly in the re-watered portion of the river due to the creation of more lacustrine environment. | However, this additional lacustrine environment was expected to increase the overall abundance of fish in the Churchill River reservoir. |
| 2006 | A road was constructed to CR20 pumphouse, providing direct road access to lower reaches of Goose Cr. & facilitated boat access to upstream portions of Goose Cr. inc. Warkworth Lake. (This occurred in 1963 with the relocation of the water supply to CR20.) | Culverts installed at stream crossings in CR30 service road restricted fish access to areas u/s of road when flow/water velocity in culverts were high. During spring/high runoff fish moving u/s gathered below culverts creating rec. fishing opportunities. |
| 2007 | Report #25-03 states that a 300 m wide boulder-garden style fishway was incorporated into the deeper central reach of the overflow section of the weir and a chute designed to facilitate ice movement over the weir was constructed adjacent to the fishway. 2000 The relatively low passage efficiency demonstrated in the Goose Creek fishway suggests that fish may have trouble with the mainstem fishway as well, especially considering its relative size. | |

BIOLOGY

| | |
|---|----------|
| AMERICAN SANDLANCE <i>Ammodytes americanus</i> | Unknown |
| ARCTIC ALLIGATORFISH <i>Aspidophoroides olriki</i> | Unknown |
| ARCTIC CHARR <i>Salvelinus alpinus</i> | Common |
| ARCTIC COD <i>Gadus morhua</i> | Unknown |
| ARCTIC GRAYLING <i>Thymallus arcticus</i> | Uncommon |
| ARCTIC SCULPIN <i>Myoxocephalus</i> | Unknown |
| ARCTIC SHANNY <i>Stichaeus punctatus</i> | Unknown |
| BLACKNOSE DACE <i>Rhinichthys atratulus</i> | Unknown |
| BROOK STICKLEBACK <i>Culaea inconstans</i> | Unknown |
| BROOK TROUT <i>Salvelinus fontinalis</i> | Uncommon |
| BURBOT <i>Lota lota</i> | Uncommon |
| CAPELIN <i>Mallotus villosus</i> | Unknown |
| CISCO <i>Coregonus artedii</i> | Common |
| FOURHORN SCULPIN <i>Myoxocephalus</i> | Unknown |
| GOLDEYE <i>Hiodon alosoides</i> | Common |
| GREENLAND COD <i>Gadus ogac</i> | Unknown |
| LAKE CHUB <i>Couesius plumbeus</i> | Common |
| LAKE STURGEON <i>Acipenser fulvescens</i> | Uncommon |
| LAKE WHITEFISH <i>Coregonus clupeaformis</i> | Abundant |
| LONGNOSE DACE <i>Rhinichthys cataractae</i> | Unknown |
| LONGNOSE SUCKER <i>Catostomus catostomus</i> | Uncommon |
| LUMPFISH <i>Cyclopterus lumpus</i> | Unknown |
| MOTTLED SCULPIN <i>Cottus bairdi</i> | Unknown |
| NINESPINE STICKLEBACK <i>Pungitius pungitius</i> | Common |
| NORTHERN PIKE <i>Esox lucius</i> | Abundant |
| PEARL DACE <i>Semotilus margarita</i> | Abundant |
| RAINBOW SMELT <i>Osmerus maordax</i> | Unknown |
| RIBBED SCULPIN <i>Triglops pingeli</i> | Unknown |

Creel

| Year | Species | Catch/Unit Effort* |
|------|---------------|--------------------|
| 1978 | Northern Pike | 0.35 |

*Catch/Unit Effort = Catch/Hour

| | |
|--|----------|
| ROUND WHITEFISH <i>Prosopium cylindraceum</i> | Uncommon |
| SAUGER <i>Stizostedion canadense</i> | Common |
| SHORTHORN SCULPIN <i>Myoxocephalus scorpius</i> | Unknown |
| SLENDER EELBLENNY <i>Lumpenus fabricii</i> | Unknown |
| SLIMY SCULPIN <i>Cottus cognatus</i> | Common |
| SPOTTAIL SHINER <i>Notropis hudsonius</i> | Unknown |
| TROUT PERCH <i>Percopsis omiscomaycus</i> | Common |
| WALLEYE <i>Stizostedion vitreum</i> | Common |
| WHITE SUCKER <i>Catostomus commersoni</i> | Abundant |

Gene Senior

From: Friesen, Chris (CWS) <Chris.Friesen@gov.mb.ca>
Sent: September-29-15 9:37 AM
To: 'Gene Senior'
Subject: RE: Churchil Marine Observatory

Gene

Thank you for your information request. I completed a search of the Manitoba Conservation Data Centre's rare species database and found no occurrences at this time for your area of interest.

The information provided in this letter is based on existing data known to the Manitoba Conservation Data Centre at the time of the request. These data are dependent on the research and observations of CDC staff and others who have shared their data, and reflect our current state of knowledge. **An absence of data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present;** in many areas, comprehensive surveys have never been completed. Therefore, this information should be regarded neither as a final statement on the occurrence of any species of concern, nor as a substitute for on-site surveys for species as part of environmental assessments.

Because the Manitoba CDC's Biotics database is continually updated and because information requests are evaluated by type of action, any given response is only appropriate for its respective request. Please contact the Manitoba CDC for an update on this natural heritage information if more than six months pass before it is utilized.

Third party requests for products wholly or partially derived from Biotics must be approved by the Manitoba CDC before information is released. Once approved, the primary user will identify the Manitoba CDC as data contributors on any map or publication using Biotics data, as follows as: Data developed by the Manitoba Conservation Data Centre; Wildlife Branch, Manitoba Conservation and Water Stewardship.

This letter is for information purposes only - it does not constitute consent or approval of the proposed project or activity, nor does it negate the need for any permits or approvals required by the Province of Manitoba.

We would be interested in receiving a copy of the results of any field surveys that you may undertake, to update our database with the most current knowledge of the area.

If you have any questions or require further information please contact me directly at (204) 945-7747.

Chris Friesen
Coordinator
Manitoba Conservation Data Centre
204-945-7747
chris.friesen@gov.mb.ca
<http://www.gov.mb.ca/conservation/cdc/>

From: Gene Senior [mailto:GSenior@kgsgroup.com]
Sent: September-16-15 3:43 PM
To: Friesen, Chris (CWS)
Subject: Churchil Marine Observatory

Chris,

Project Description:

KGS Group is conducting an Environment Act Proposal relating to the proposed Churchill Marine Observatory. The project is to be developed by the University of Manitoba on provincial Crown Land just north of the Port of Churchill. An important component of the development will be a saltwater pipeline run from the bottom of the Churchill River estuary to the project site to supply saltwater for the production of sea ice to be used to conduct tests relating to the impacts of oil, liquefied natural gas, and other contaminants.

An overland utilidor (a heated utility box ~50 mm square) will house water intake and discharge pipes, power and fibre optic cables that will be run into the Churchill River estuary. At the shoreline, the piping will trend downward and be shielded through water shallower than 8 m where ice can scour the bottom.

Two alternate routes for the utilidor pipeline are under consideration. The first route (A) follows a gravel surface trail crossing Omnitrax Land westward to the estuary. The second route (B) would go north on federal and provincial crown land and then turn west to the estuary.

Information Requested: We request information regarding the locations of any plant, wildlife and aquatic Species at Risk occurrences at the project site, along the proposed utilidor route and immediate surrounding area. The information will be used to assess potential project impacts on species at risk and their habitat (if any) as well as develop appropriate mitigation measures and follow-up.

Format Requested: Our preference is for the data to be presented in Microsoft Excel Spreadsheet (providing the location of each occurrence) and sent by email.

Location: The lands are located as shown on the attached map just north of the Port and Town of Churchill.

Thanks,

Gene Senior <gsenior@kgsgroup.com>
Environmental Scientist



865 Waverley Street
Winnipeg, Manitoba R3T 5P4
p. 204.896.1209 ext. 357
c. 204.218.3285
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<http://www.kgsgroup.com>



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Gene Senior

From: +WPG574 - HRB Archaeology (TCHSCP) <HRB.archaeology@gov.mb.ca>
Sent: October-22-15 12:29 PM
To: 'Gene Senior'
Subject: RE: Heritage and archaeological resources near Churchill, Manitoba
Attachments: Senior (KGS) October 2015 AAS-15-9785.pdf

Good Afternoon Gene,

The Manitoba Historic Resources Branch has no concerns with the attached proposed development.

Cheers,

Christina Nesbitt

Impact Assessment Archaeologist
Historic Resources Branch
Main Floor - 213 Notre Dame Avenue, Winnipeg, MB R3B 1N3
Phone (204) 945-8145; Fax (204) 948-2384
E-mail: Christina.Nesbitt@gov.mb.ca



Tourism, Culture, Heritage, Sport and Consumer Protection

From: Gene Senior [<mailto:GSenior@ksgsgroup.com>]
Sent: September-15-15 11:52 AM
To: McClean, Heather (TCHSCP)
Cc: Nesbitt, Christina (TCHSCP)
Subject: Heritage and archaeological resources near Churchill, Manitoba

Ms. Heather McClean,

KGS Group is conducting an Environment Act Proposal relating to the proposed Churchill Marine Observatory. The project is to be developed by the University of Manitoba on provincial Crown Land just north of the Port of Churchill. An important component of the development will be a saltwater pipeline run from the bottom of the Churchill River estuary to the project site. The pipeline will supply saltwater for the production of sea ice to be used to conduct tests relating to the impacts of oil, liquefied natural gas, and other contaminants.

An overland utilidor (a heated utility box ~50 mm square) will house water intake and discharge pipes, power and fibre optic cables that will be run into the Churchill River estuary. At the shoreline, the piping will trend downward and be shielded through water shallower than 8 m where ice can scour the bottom.

Two alternate routes for the utilidor pipeline are under consideration. The first route (A), which is the shortest route, follows a gravel surface trail crossing Omnitrax Land westward to the estuary. The second route (B), is longer and would go north on federal and provincial crown land and then turn west to the estuary.

We are looking to identify heritage and archaeological resources which may be impacted by the project. We are requesting a location and description each, if any, resources located on or near these lands. Additionally, we are requesting the data delivered in Excel and ArcView format (or PDF mapsheet).

Regards,

Gene Senior <gsenior@kgsgroup.com>
Environmental Scientist



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DATE: October 22, 2015

TO: Gene Senior
KGS Group
865 Waverley Street
Winnipeg, Manitoba

FROM: Christina Nesbitt
Impact Assessment
Archaeologist
Historic Resources Branch
Main Floor 213 Notre Dame
Avenue
Winnipeg MB
R3B 1N3
Christina.Nesbitt@gov.mb.ca
PHONE NO: (204) 945-8145

SUBJECT: Churchill Marine Observatory
HRB Review and Comments

HRB FILE: AAS-15-9785

Further to your memo requesting a heritage screening for the above proposed Churchill Marine Observatory (Planned Area), the Historic Resources Branch (HRB) has examined the applicable areas proposed for development in conjunction with the Branch's records for areas of potential concern, and can advise you that HRB has no concerns with the project at this time.

However, please be advised that if any heritage resources are encountered in association with the Planned Area during development, the Developer is required to notify HRB and HRB may require that a heritage resource management strategy be implemented to mitigate the effects of development on the heritage resources.

If you have any questions or comments, please feel free to contact the undersigned at the above noted address, phone number, or e-mail.

Christina Nesbitt

Gene Senior

From: Matthews, Rob (CWS) <Rob.Matthews@gov.mb.ca>
Sent: September-24-15 5:46 PM
To: Gene Senior
Subject: RE: Churchill Marine Observatory water rights licence?

Gene,

No, you do not require a water rights licence to take water from this location.

Rob

From: Gene Senior [<mailto:GSenior@ksgroup.com>]
Sent: September-24-15 3:31 PM
To: Matthews, Rob (CWS)
Subject: Churchill Marine Observatory water rights licence?

Hi Rob,
I'm working on the Environmental Assessment for the Churchill Marine Observatory project.

The CMO facility will be run year round, but in the winter months the project will be withdrawing seawater from the Churchill River estuary to produce sea ice for experiments. It is expected that the project would need to withdraw approximately 500,000 litres of fresh water from the Churchill River and up to 20,000,000 litres of saltwater from the Churchill River estuary each year.

Will a water rights license be required for either fresh or salt water withdrawal?

For your information, I am attaching a figure to show the approximate location of the project.
Thanks,

Gene Senior <gseigneur@ksgroup.com>
Environmental Scientist



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APPENDIX E
MSDS SHEETS



Fisher Scientific

Part of Thermo Fisher Scientific

Material Safety Data Sheet

Creation Date 28-Apr-2009

Revision Date 07-Mar-2011

Revision Number 3

1. PRODUCT AND COMPANY IDENTIFICATION

| | |
|---|--|
| Product Name | Acetone |
| Cat No. | A9-4; A9-20; A9-200; A11-1; A11-4; A11-20; A11-200; A11S-4; A16F-1GAL; A16P-1GAL; A16P-4; A16S-4; A16S-20; A18-1; A18-4; A18-20; A18-200; A18-200LC; A18-500; A18CU1300; A18FB-19; A18FB-50; A18FB-115; A18FB-200; A18P-4; A18POP-19; A18POPB-50; A18RB-19; A18RB-50; A18RB-115; A18RB-200; A18RS-28; A18RS-50; A18RS-115; A18RS-200; A18S-4; A18SK-4; A18SS-19; A18SS-28; A18SS-50; A18SS-115; A18SS-200; A19-1; A19-4; A19RS-115; A19RS-200; A40-4; A928-4; A929-1; A929-4; A929RS-19; A929RS-50; A929RS-200; A929SK-4; A929SS-28; A929SS-50; A929SS-115; A929SS-200; A946-4; A946-4LC; A946FB-200; A946RB-19; A946RB-50; A946RB-115; A946RB-200; A949-1; A949-4; A949CU-50; A949N-119; A949N-219; A949POP-19; A949RS-28; A949RS-50; A949RS-115; A949SK-1; A949SK-4; A949SS-19; A949SS-28; A949SS-50; A949SS-115; A949SS-200; BP2403-1; BP2403-4; BP2403-20; BP2404-1; BP2404-4; BP2404SK-1; BP2404SK-4; HC-300-1GAL; 22050131; 22050295 |
| Synonyms | 2-Propanone; Dimethyl ketone; (Certified ACS, HPLC, OPTIMA, Histological, Spectranalyzed, NF/FCC/EP, Pesticide, Electronic, GC Resolv, SAFE-COTE) |
| Recommended Use | Laboratory chemicals |
| Company Fisher Scientific One Reagent Lane Fair Lawn, NJ 07410 Tel: (201) 796-7100 | Emergency Telephone Number CHEMTREC®, Inside the USA: 800-424-9300 CHEMTREC®, Outside the USA: 001-703-527-3887 |

2. HAZARDS IDENTIFICATION

2. HAZARDS IDENTIFICATION

DANGER!

Emergency Overview

Flammable liquid and vapor. Irritating to eyes and skin. May cause irritation of respiratory tract. Vapors may cause drowsiness and dizziness. Repeated exposure may cause skin dryness or cracking.

Appearance Colorless

Physical State Liquid

odor sweet

Target Organs Central nervous system (CNS), Eyes, Respiratory system, Skin, Kidney, Liver, spleen

Potential Health Effects

Acute Effects

Principle Routes of Exposure

| | |
|-------------------|--|
| Eyes | Irritating to eyes. |
| Skin | Irritating to skin. May be harmful in contact with skin. Repeated exposure may cause skin dryness or cracking. |
| Inhalation | Inhalation may cause central nervous system effects. May cause drowsiness and dizziness. May cause irritation of respiratory tract. May be harmful if inhaled. |
| Ingestion | Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea. May be harmful if swallowed. |

Chronic Effects Experiments have shown reproductive toxicity effects on laboratory animals. May cause adverse liver effects. May cause adverse kidney effects.

See Section 11 for additional Toxicological information.

Aggravated Medical Conditions Central nervous system disorders. Preexisting eye disorders. Skin disorders. Kidney disorders. Liver disorders.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Haz/Non-haz

| Component | CAS-No | Weight % |
|-----------|---------|----------|
| Acetone | 67-64-1 | >95 |

4. FIRST AID MEASURES

| | |
|---------------------------|--|
| Eye Contact | Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention. |
| Skin Contact | Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention. |
| Inhalation | Move to fresh air. If breathing is difficult, give oxygen. Get medical attention immediately if symptoms occur. |
| Ingestion | Do not induce vomiting. Obtain medical attention. |
| Notes to Physician | Treat symptomatically. |

5. FIRE-FIGHTING MEASURES

5. FIRE-FIGHTING MEASURES

| | |
|---|--|
| Flash Point | -20°C / -4°F |
| Method | No information available. |
| Autoignition Temperature | 465°C / 869°F |
| Explosion Limits | |
| Upper | 12.8 vol % |
| Lower | 2.5 vol % |
| Suitable Extinguishing Media | CO ₂ , dry chemical, dry sand, alcohol-resistant foam. Cool closed containers exposed to fire with water spray. |
| Unsuitable Extinguishing Media | Water may be ineffective |
| Hazardous Combustion Products | No information available. |
| Sensitivity to mechanical impact | No information available. |
| Sensitivity to static discharge | No information available. |

Specific Hazards Arising from the Chemical

Flammable. Risk of ignition. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA **Health 1** **Flammability 3** **Instability 0** **Physical hazards N/A**

6. ACCIDENTAL RELEASE MEASURES

| | |
|---|--|
| Personal Precautions | Use personal protective equipment. Remove all sources of ignition. Take precautionary measures against static discharges. |
| Environmental Precautions | Should not be released into the environment. |
| Methods for Containment and Clean Up | Remove all sources of ignition. Soak up with inert absorbent material. Take precautionary measures against static discharges. Keep in suitable, closed containers for disposal.. |

7. HANDLING AND STORAGE

| | |
|-----------------|--|
| Handling | Wear personal protective equipment. Keep away from open flames, hot surfaces and sources of ignition. Do not breathe vapors or spray mist. Do not get in eyes, on skin, or on clothing. Use only non-sparking tools. Use explosion-proof equipment. Take precautionary measures against static discharges. |
| Storage | Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Flammables area. |

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Measures

Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure that eyewash stations and safety showers are close to the workstation location.

Exposure Guidelines

| Component | ACGIH TLV | OSHA PEL | NIOSH IDLH |
|-----------|-------------------------------|---|--|
| Acetone | TWA: 500 ppm STEL: 750 ppm | (Vacated) TWA: 750 ppm (Vacated) TWA: 1800 mg/m ³ (Vacated) STEL: 2400 mg/m ³ (Vacated) STEL: 1000 ppm TWA: 1000 ppm TWA: 2400 mg/m ³ | IDLH: 2500 ppm TWA: 250 ppm TWA: 590 mg/m ³ |

| Component | Quebec | Mexico OEL (TWA) | Ontario TWAEV |
|-----------|---|--|-------------------------------|
| Acetone | TWA: 500 ppm TWA: 1190 mg/m ³ STEL: 1000 ppm STEL: 2380 mg/m ³ | TWA: 1000 ppm TWA: 2400 mg/m ³ STEL: 1260 ppm STEL: 3000 mg/m ³ | TWA: 500 ppm STEL: 750 ppm |

NIOSH IDLH: Immediately Dangerous to Life or Health

Personal Protective Equipment

Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

9. PHYSICAL AND CHEMICAL PROPERTIES

| | |
|---------------------------|---------------------------------|
| Physical State | Liquid |
| Appearance | Colorless |
| odor | sweet |
| Odor Threshold | No information available. |
| pH | No information available. |
| Vapor Pressure | 247 mbar @ 20 °C |
| Vapor Density | 2.0 (Air = 1.0) |
| Viscosity | 0.32 mPa.s @ 20 °C |
| Boiling Point/Range | 56°C / 132.8°F |
| Melting Point/Range | -95°C / -139°F |
| Decomposition temperature | > 4°C |
| Flash Point | -20°C / -4°F |
| Evaporation Rate | 5.6 (Butyl Acetate = 1.0) |
| Specific Gravity | 0.790 |
| Solubility | Soluble in water |
| log Pow | No data available |
| Molecular Weight | 58.08 |
| Molecular Formula | C ₃ H ₆ O |

10. STABILITY AND REACTIVITY

10. STABILITY AND REACTIVITY

| | |
|---|---|
| Stability | Stable under normal conditions. |
| Conditions to Avoid | Incompatible products. Heat, flames and sparks. |
| Incompatible Materials | Strong oxidizing agents, Strong reducing agents, Strong bases, Peroxides |
| Hazardous Decomposition Products | Carbon monoxide (CO), Carbon dioxide (CO ₂), Formaldehyde, Methanol |
| Hazardous Polymerization | Hazardous polymerization does not occur. |
| Hazardous Reactions . | None under normal processing.. |

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Component Information

| Component | LD50 Oral | LD50 Dermal | LC50 Inhalation |
|-----------|--------------------|-------------|-----------------|
| Acetone | 5800 mg/kg (Rat) | Not listed | Not listed |

| | |
|---|--|
| Irritation | Irritating to eyes and skin |
| Toxicologically Synergistic Products | Carbon tetrachloride; Chloroform; Trichloroethylene; Bromodichloromethane; Dibromochloromethane; N-nitrosodimethylamine; 1,1,2-Trichloroethane; Styrene; Acetonitrile, 2,5-Hexanedione; Ethanol; 1,2-Dichlorobenzene |
| Chronic Toxicity | |
| Carcinogenicity | There are no known carcinogenic chemicals in this product |
| Sensitization | No information available. |
| Mutagenic Effects | Mutagenic effects have occurred in experimental animals. |
| Reproductive Effects | Experiments have shown reproductive toxicity effects on laboratory animals. |
| Developmental Effects | Developmental effects have occurred in experimental animals. |
| Teratogenicity | Teratogenic effects have occurred in experimental animals.. |
| Other Adverse Effects | The toxicological properties have not been fully investigated.. See actual entry in RTECS for complete information. |
| Endocrine Disruptor Information | No information available |

12. ECOLOGICAL INFORMATION

Ecotoxicity

| Component | Freshwater Algae | Freshwater Fish | Microtox | Water Flea |
|-----------|------------------|--|--------------------------|--|
| Acetone | Not listed | Leuciscus idus: LC50 = 11300 mg/L/48h Salmo gairdneri: LC50 = 6100 mg/L/24h | EC50 = 14500 mg/L/15 min | EC50 = 39 mg/L/48h EC50 = 12700 mg/L/48h EC50 = 12600 mg/L/48h |

Persistence and Degradability Readily biodegradable.

Bioaccumulation/ Accumulation No information available

Mobility

| Component | log Pow |
|-----------|---------|
| Acetone | -0.24 |

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

| Component | RCRA - U Series Wastes | RCRA - P Series Wastes |
|-------------------|------------------------|------------------------|
| Acetone - 67-64-1 | U002 | - |

14. TRANSPORT INFORMATION

DOT

UN-No UN1090
 Proper Shipping Name ACETONE
 Hazard Class 3
 Packing Group II

TDG

UN-No UN1090
 Proper Shipping Name ACETONE
 Hazard Class 3
 Packing Group II

IATA

UN-No UN1090
 Proper Shipping Name ACETONE
 Hazard Class 3
 Packing Group II

14. TRANSPORT INFORMATION

IMDG/IMO

| | |
|----------------------|---------|
| UN-No | UN1090 |
| Proper Shipping Name | ACETONE |
| Hazard Class | 3 |
| Packing Group | II |

15. REGULATORY INFORMATION

International Inventories

| Component | TSCA | DSL | NDSL | EINECS | ELINCS | NLP | PICCS | ENCS | AICS | CHINA | KECL |
|-----------|------|-----|------|-----------|--------|-----|-------|------|------|-------|------|
| Acetone | X | X | - | 200-662-2 | - | | X | X | X | X | X |

Legend:

- X - Listed
- E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
- F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
- N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
- P - Indicates a commenced PMN substance
- R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
- S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
- T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
- XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).
- Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
- Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Not applicable

SARA 311/312 Hazardous Categorization

| | |
|-----------------------------------|-----|
| Acute Health Hazard | Yes |
| Chronic Health Hazard | No |
| Fire Hazard | Yes |
| Sudden Release of Pressure Hazard | No |
| Reactive Hazard | No |

Clean Water Act

Not applicable

Clean Air Act

Not applicable

OSHA
Not applicable

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

| Component | Hazardous Substances RQs | CERCLA EHS RQs |
|-----------|--------------------------|----------------|
| Acetone | 5000 lb | - |

California Proposition 65
This product does not contain any Proposition 65 chemicals.

State Right-to-Know

| Component | Massachusetts | New Jersey | Pennsylvania | Illinois | Rhode Island |
|-----------|---------------|------------|--------------|----------|--------------|
| Acetone | X | X | X | - | X |

U.S. Department of Transportation

Reportable Quantity (RQ): Y
 DOT Marine Pollutant N
 DOT Severe Marine Pollutant N

U.S. Department of Homeland Security

This product contains the following DHS chemicals:

| Component | DHS Chemical Facility Anti-Terrorism Standard |
|-----------|---|
| Acetone | 2000 lb STQ |

Other International Regulations

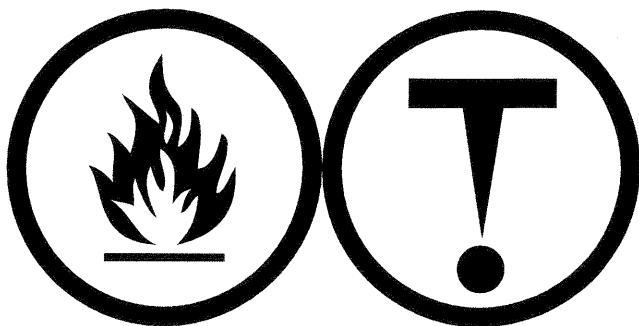
Mexico - Grade Serious risk, Grade 3

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class

B2 Flammable liquid
 D2B Toxic materials



16. OTHER INFORMATION

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 28-Apr-2009

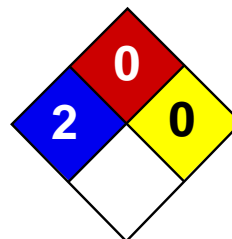
Print Date 07-Mar-2011

Revision Summary "****", and red text indicates revision

Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of MSDS



| | |
|---------------------|---|
| Health | 2 |
| Fire | 0 |
| Reactivity | 0 |
| Personal Protection | E |

Material Safety Data Sheet Alumina MSDS

Section 1: Chemical Product and Company Identification

Product Name: Alumina

Catalog Codes: SLA1906

CAS#: 1344-28-1

RTECS: BD1200000

TSCA: TSCA 8(b) inventory: Aluminum oxide

CI#: Not applicable.

Synonym: Alumina, Activated, 80-200 Mesh

Chemical Name: Aluminium Oxide

Chemical Formula: Al₂O₃

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

| Name | CAS # | % by Weight |
|----------------|-----------|-------------|
| Aluminum oxide | 1344-28-1 | 100 |

Toxicological Data on Ingredients: Aluminum oxide LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. MUTAGENIC EFFECTS: Not available.

TERATOGENIC EFFECTS: Classified None. for human. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Chlorine Trifluoride reacts violently with Aluminum Oxide producing a flame.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:

Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 24°C (75.2°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:

Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 10 (mg/m³) from ACGIH (TLV) [United States] Inhalation Total. TWA: 10 (mg/m³) [Canada] Inhalation Total. TWA: 5 (mg/m³) from OSHA (PEL) [United States] Inhalation Respirable. TWA: 15 from OSHA (PEL) [United States] Inhalation Total. TWA: 10 [United Kingdom (UK)] Inhalation Total. TWA: 4 [United Kingdom (UK)] Inhalation Respirable. Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Solid crystalline powder.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 101.96 g/mole

Color: White.

pH (1% soln/water): Not applicable.

Boiling Point: 2980°C (5396°F)

Melting Point: 2072°C (3761.6°F)

Critical Temperature: Not available.

Specific Gravity: 4 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:

Very slightly soluble in cold water. Insoluble in hot water. Practically insoluble in non-polar organic solvents. Slowly soluble in aqueous alkali solution-forming hydroxides. Very slightly soluble in acid, alkali.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Chlorine Trifluoride reacts violently with Aluminum Oxide producing a flame. Ethylene oxide may polymerize violently when in contact with highly catalytic surfaces such as pure Aluminum Oxide. Reacts with hot chlorinated rubber.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available. LC50: Not available.

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. TERATOGENIC EFFECTS: Classified None. for human.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May cause cancer (tumorigenic) according to animal data. No human data found.

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: May cause skin irritation. Eyes: Nuisance Dust. Dust may cause mechanical eye irritation. Inhalation: Nuisance Dust. Material is irritating to mucous membranes and upper respiratory tract. May cause lung injury. Ingestion: May be harmful if swallowed. Ingestion of large amounts may cause gastrointestinal tract irritation. It is expected to be a low hazard for normal industrial handling.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:

Illinois toxic substances disclosure to employee act: Aluminum oxide Rhode Island RTK hazardous substances: Aluminum oxide Minnesota: Aluminum oxide Massachusetts RTK: Aluminum oxide New Jersey: Aluminum oxide New Jersey spill list: Aluminum oxide California Director's list of Hazardous Substances: Aluminum oxide TSCA 8(b) inventory: Aluminum oxide SARA 313 toxic chemical notification and release reporting: Aluminum oxide

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):

R36/38- Irritating to eyes and skin. S2- Keep out of the reach of children. S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Splash goggles.

Section 16: Other Information

References:

-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.

Other Special Considerations: Not available.

Created: 10/10/2005 12:47 AM

Last Updated: 05/21/2013 12:00 PM

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Fisher Scientific

Part of Thermo Fisher Scientific

Material Safety Data Sheet

Creation Date 29-Sep-2009

Revision Date 07-Aug-2013

Revision Number 1

1. PRODUCT AND COMPANY IDENTIFICATION

| | |
|---|---|
| Product Name | Alumina (Activated/Adsorption/Dry Powder/Acid/Basic/Neutral/Polishing Gamal) |
| Cat No. : | A446-100, A447-500, A505-212, A540-3, A540-500, A591-500, A620-500, A634-3, A941-500, A948-500, A950-500, B365-250, C218-3, P467R, P477, S716842 |
| Synonyms | Aluminum oxide; Alundum; morin dyed |
| Recommended Use | Laboratory chemicals |
| Company Fisher Scientific One Reagent Lane Fair Lawn, NJ 07410 Tel: (201) 796-7100 | Emergency Telephone Number CHEMTREC®, Inside the USA: 800-424-9300 CHEMTREC®, Outside the USA: 001-703-527-3887 |

2. HAZARDS IDENTIFICATION

CAUTION!

Emergency Overview

May cause eye, skin, and respiratory tract irritation . Hygroscopic.

Appearance White

Physical State Solid

Odor odorless

Target Organs No information available.

Potential Health Effects

Acute Effects

Principle Routes of Exposure

| | |
|-------------------|--|
| Eyes | May cause irritation |
| Skin | May cause irritation |
| Inhalation | May cause irritation of respiratory tract |
| Ingestion | Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea |

Chronic Effects None known

See Section 11 for additional Toxicological information.

Aggravated Medical Conditions No information available.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Haz/Non-haz

| Component | CAS-No | Weight % |
|----------------|-----------|----------|
| Aluminum oxide | 1344-28-1 | 100 |

4. FIRST AID MEASURES

| | |
|---------------------------|---|
| Eye Contact | Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention. |
| Skin Contact | Wash off immediately with plenty of water for at least 15 minutes. Get medical attention immediately if symptoms occur. |
| Inhalation | Move to fresh air. If breathing is difficult, give oxygen. Get medical attention immediately if symptoms occur. |
| Ingestion | Do not induce vomiting. Obtain medical attention. |
| Notes to Physician | Treat symptomatically. |

5. FIRE-FIGHTING MEASURES

| | |
|---|---------------------------|
| Flash Point | Not applicable |
| Method - | No information available. |
| Autoignition Temperature | No information available. |
| Explosion Limits | |
| Upper | No data available |
| Lower | No data available |
| Unsuitable Extinguishing Media | No information available. |
| Hazardous Combustion Products | No information available. |
| Sensitivity to mechanical impact | No information available. |
| Sensitivity to static discharge | No information available. |

Specific Hazards Arising from the Chemical

Keep product and empty container away from heat and sources of ignition. Thermal decomposition can lead to release of irritating gases and vapors.

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear

NFPA **Health** 1 **Flammability** 0 **Instability** 1 **Physical hazards** N/A

6. ACCIDENTAL RELEASE MEASURES

| | |
|----------------------------------|---|
| Personal Precautions | Use personal protective equipment. Ensure adequate ventilation. Avoid dust formation. |
| Environmental Precautions | Should not be released into the environment |

Methods for Containment and Clean Up Sweep up and shovel into suitable containers for disposal. Avoid dust formation.

7. HANDLING AND STORAGE

Handling Wear personal protective equipment. Ensure adequate ventilation. Avoid dust formation.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Measures Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Exposure Guidelines This product does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

| Component | ACGIH TLV | OSHA PEL | NIOSH IDLH |
|----------------|--------------------------|--|------------|
| Aluminum oxide | TWA: 1 mg/m ³ | (Vacated) TWA: 10 mg/m ³ (Vacated) TWA: 5 mg/m ³ TWA: 15 mg/m ³ TWA: 5 mg/m ³ | |

| Component | Quebec | Mexico OEL (TWA) | Ontario TWAEV |
|----------------|---------------------------|---------------------------|--------------------------|
| Aluminum oxide | TWA: 10 mg/m ³ | TWA: 10 mg/m ³ | TWA: 1 mg/m ³ |

Personal Protective Equipment

Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure

Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced

9. PHYSICAL AND CHEMICAL PROPERTIES

| | |
|----------------------------------|--------------------------------|
| Physical State | Solid |
| Appearance | White |
| Odor | odorless |
| Odor Threshold | No information available. |
| pH | No information available. |
| Vapor Pressure | negligible |
| Vapor Density | No information available. |
| Viscosity | No information available. |
| Boiling Point/Range | 2980°C / 5396°F |
| Melting Point/Range | 2000°C / 3632°F |
| Decomposition temperature | No information available. |
| Flash Point | Not applicable |
| Evaporation Rate | No information available. |
| Specific Gravity | 4.0 (H ₂ O=1) |
| Solubility | Insoluble in water |
| log Pow | No data available |
| Molecular Weight | 101.96 |
| Molecular Formula | Al ₂ O ₃ |

10. STABILITY AND REACTIVITY

| | |
|---|--|
| Stability | Stable under normal conditions. Hygroscopic. |
| Conditions to Avoid | Incompatible products |
| Incompatible Materials | Strong oxidizing agents |
| Hazardous Decomposition Products | None under normal use conditions |
| Hazardous Polymerization | Hazardous polymerization does not occur |
| Hazardous Reactions | None under normal processing |

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Component Information

| Component | LD50 Oral | LD50 Dermal | LC50 Inhalation |
|----------------|--------------------|-------------|-----------------|
| Aluminum oxide | 5000 mg/kg (Rat) | Not listed | Not listed |

| | |
|---|--|
| Irritation | No information available. |
| Toxicologically Synergistic Products | No information available. |
| <u>Chronic Toxicity</u> | |
| Carcinogenicity | There are no known carcinogenic chemicals in this product |
| Sensitization | No information available. |
| Mutagenic Effects | No information available. |
| Reproductive Effects | No information available. |
| Developmental Effects | No information available. |
| Teratogenicity | No information available. |
| Other Adverse Effects | The toxicological properties have not been fully investigated. |
| Endocrine Disruptor Information | No information available |

12. ECOLOGICAL INFORMATION

Ecotoxicity

Do not empty into drains

| | |
|--------------------------------------|--------------------------|
| Persistence and Degradability | No information available |
|--------------------------------------|--------------------------|

Bioaccumulation/ Accumulation No information available

Mobility No information available

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification

14. TRANSPORT INFORMATION

DOT Not regulated

TDG Not regulated

IATA Not regulated

IMDG/IMO Not regulated

15. REGULATORY INFORMATION

International Inventories

| Component | TSCA | DSL | NDSL | EINECS | ELINCS | NLP | PICCS | ENCS | AICS | CHINA | KECL |
|----------------|------|-----|------|-----------|--------|-----|-------|------|------|-------|------|
| Aluminum oxide | X | X | - | 215-691-6 | - | | X | X | X | X | X |

Legend:

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.

XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).

Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313
 Not applicable

| Component | CAS-No | Weight % | SARA 313 - Threshold Values % |
|----------------|-----------|----------|-------------------------------|
| Aluminum oxide | 1344-28-1 | 100 | 1.0 |

SARA 311/312 Hazardous Categorization

| | |
|-----------------------------------|----|
| Acute Health Hazard | No |
| Chronic Health Hazard | No |
| Fire Hazard | No |
| Sudden Release of Pressure Hazard | No |
| Reactive Hazard | No |

Clean Water Act

Not applicable

Clean Air Act

Not applicable

OSHA Occupational Safety and Health Administration

Not applicable

CERCLA

Not Applicable

California Proposition 65

This product does not contain any Proposition 65 chemicals.

State Right-to-Know

Not applicable

| Component | Massachusetts | New Jersey | Pennsylvania | Illinois | Rhode Island |
|----------------|---------------|------------|--------------|----------|--------------|
| Aluminum oxide | X | X | X | - | X |

U.S. Department of Transportation

| | |
|-----------------------------|---|
| Reportable Quantity (RQ): | N |
| DOT Marine Pollutant | N |
| DOT Severe Marine Pollutant | N |

U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class

Non-controlled

16. OTHER INFORMATION

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 29-Sep-2009

Print Date 07-Aug-2013

Revision Summary "****", and red text indicates revision

Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of MSDS

Safety Data Sheet

Printing date 01/05/2015

Reviewed on 01/05/2015

1 Identification

- **Product identifier**
- **Trade name:** Bio-Beads® S-X1, S-X3, S-X8, S-X12
- **Catalog or product number:** 1522751, 1522750, 1523650, 1522150, 1522151, 1522152, 1523350, 1522753
- **CAS Number:**
9052-95-3
- **Index number:**
585-580-03-X
- **Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.
- **Application of the substance / the mixture** Laboratory chemicals
- **Details of the supplier of the safety data sheet**
- **Manufacturer/Supplier:**
Bio-Rad Laboratories (Canada) Ltd.
1329 Meyerside Drive
Mississauga, Ontario
L5T 1C9
Canada
phone: 1-800-268-0213 Fax: 1-888-913-9779
- **Information department:**
Technical services, customer support
sales_canada@bio-rad.com
- **Emergency telephone number:** 1-800-268-0213

2 Hazard(s) identification

- **Classification of the substance or mixture**
The substance is not classified according to the Globally Harmonized System (GHS).
- **Classification according to Directive 67/548/EEC or Directive 1999/45/EC** not applicable
- **Information concerning particular hazards for human and environment:** not applicable
- **Label elements**
- **GHS label elements** Void
- **Hazard pictograms** Void
- **Signal word** Void
- **Hazard statements** Void
- **Other hazards**
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.

3 Composition/information on ingredients

- **Chemical characterization:** Substances
- **CAS No. Description:**
9052-95-3 Poly(styrene-co-divinylbenzene)
- **Identification number(s):**
- **Index number:** 585-580-03-X
- **Additional information:** For the wording of the listed risk phrases refer to section 16.

Safety Data Sheet

Printing date 01/05/2015

Reviewed on 01/05/2015

Trade name: Bio-Beads® S-X1, S-X3, S-X8, S-X12

(Contd. of page 1)

* **4 First-aid measures**

- **Description of first aid measures**
- **General information** No special measures required.
- **After inhalation** Supply fresh air; consult doctor in case of complaints.
- **After skin contact** Generally the product does not irritate the skin.
- **After eye contact** Rinse opened eye for several minutes under running water.
- **After swallowing** Induce vomiting and call for medical help.
- **Most important symptoms and effects, both acute and delayed** No further relevant information available.
- **Indication of any immediate medical attention and special treatment needed** No further relevant information available.

* **5 Fire-fighting measures**

- **Extinguishing media**
- **Suitable extinguishing agents**
CO2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
- **Special hazards arising from the substance or mixture** No further relevant information available.
- **Advice for firefighters**
- **Protective equipment:** No special measures required.

* **6 Accidental release measures**

- **Personal precautions, protective equipment and emergency procedures** Wear protective clothing.
- **Environmental precautions:** No special measures required.
- **Methods and material for containment and cleaning up:** Pick up mechanically.
- **Reference to other sections**
No dangerous substances are released.
See Section 7 for information on safe handling
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

* **7 Handling and storage**

- **Precautions for safe handling** No special measures required.
- **Information about protection against explosions and fires:** No special measures required.
- **Conditions for safe storage, including any incompatibilities**
- **Storage**
- **Requirements to be met by storerooms and receptacles:** According to product specification
- **Information about storage in one common storage facility:** Not required.
- **Further information about storage conditions:** None.
- **Specific end use(s)** No further relevant information available.

* **8 Exposure controls/personal protection**

- **Additional information about design of technical systems:** No further data; see item 7.
- **Control parameters**
- **Components with limit values that require monitoring at the workplace:** Not required.

(Contd. on page 3)

Safety Data Sheet

Printing date 01/05/2015

Reviewed on 01/05/2015

Trade name: Bio-Beads® S-X1, S-X3, S-X8, S-X12

(Contd. of page 2)

- **Additional information:** The lists that were valid during the creation were used as basis.
- **Exposure controls**
- **Personal protective equipment**
- **General protective and hygienic measures** The usual precautionary measures for handling chemicals should be followed.
- **Protection of hands:** Protective gloves.
- **Material of gloves** Synthetic gloves
- **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
- **Eye protection:** Safety glasses

9 Physical and chemical properties

· **Information on basic physical and chemical properties**

· **General Information**

· **Appearance:**

- **Form:** particulate
- **Color:** White
- **Odor:** Odorless
- **Odour threshold:** Not determined.

· **pH-value:** Not applicable.

· **Change in condition**

- **Melting point/Melting range:** undetermined
- **Boiling point/Boiling range:** undetermined

· **Flash point:** Not applicable

· **Flammability (solid, gaseous)** Product is not flammable.

· **Ignition temperature:**

· **Decomposition temperature:** Not determined.

· **Auto igniting:** Not determined.

· **Danger of explosion:** Product does not present an explosion hazard.

· **Explosion limits:**

- **Lower:** Not determined.
- **Upper:** Not determined.

· **Vapor pressure:** Not applicable.

- **Density at 20 °C:** 1.03 g/cm³
- **Relative density** Not determined.
- **Vapour density** Not applicable.
- **Evaporation rate** Not applicable.

· **Solubility in / Miscibility with**

· **Water:** Fully miscible

· **Partition coefficient (n-octanol/water):** Not determined.

· **Viscosity:**

- **dynamic:** Not applicable.
- **kinematic:** Not applicable.

(Contd. on page 4)

Safety Data Sheet

Printing date 01/05/2015

Reviewed on 01/05/2015

Trade name: Bio-Beads® S-X1, S-X3, S-X8, S-X12

(Contd. of page 3)

| | |
|--------------------------|--|
| Organic solvents: | 0.0 % |
| Solids content: | 100.0 % |
| Other information | No further relevant information available. |

10 Stability and reactivity

- **Reactivity**
- **Chemical stability**
- **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
- **Possibility of hazardous reactions** No dangerous reactions known
- **Conditions to avoid** No further relevant information available.
- **Incompatible materials:** No further relevant information available.
- **Hazardous decomposition products:** No dangerous decomposition products known

11 Toxicological information

- **Information on toxicological effects**
- **Acute toxicity:**
- **Primary irritant effect:**
- **on the skin:** No irritant effect.
- **on the eye:** No irritant effect.
- **Sensitization:** No sensitizing effects known.
- **Additional toxicological information:**
When used and handled according to specifications, the product does not have any harmful effects according to our experience and the information provided to us.
The substance is not subject to classification according to the latest version of the EU lists.

· **Carcinogenic categories**

· **IARC (International Agency for Research on Cancer)**

Substance is not listed.

· **NTP (National Toxicology Program)**

Substance is not listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**

Substance is not listed.

12 Ecological information

- **Toxicity**
- **Aquatic toxicity:** No further relevant information available.
- **Persistence and degradability** No further relevant information available.
- **Bioaccumulative potential** No further relevant information available.
- **Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:** Generally not hazardous for water.
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.

(Contd. on page 5)

Safety Data Sheet

Printing date 01/05/2015

Reviewed on 01/05/2015

Trade name: Bio-Beads® S-X1, S-X3, S-X8, S-X12

(Contd. of page 4)

· **Other adverse effects** No further relevant information available.

13 Disposal considerations

- **Waste treatment methods**
- **Recommendation**
Hand over to hazardous waste disposers.
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.
- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.

14 Transport information

- **UN-Number**
- **DOT, TDG, ADN, IMDG, IATA** Void
- **UN proper shipping name**
- **DOT, TDG, ADN, IMDG, IATA** Void
- **Transport hazard class(es)**
- **DOT, TDG, ADN, IMDG, IATA**
- **Class** Void
- **Packing group**
- **DOT, TDG, IMDG, IATA** Void
- **Environmental hazards:**
- **Marine pollutant:** No
- **Special precautions for user** Not applicable.
- **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code** Not applicable.
- **Transport/Additional information:** Not dangerous according to the above specifications.
- **UN "Model Regulation":** -

15 Regulatory information

- **Safety, health and environmental regulations/legislation specific for the substance or mixture**
- **SARA (Superfund Amendants and Reauthorization Act of 1986 - USA)**

· **Section 302/304 (40CFR355.30 / 40CFR355.40):**

Substance not listed.

· **Section 313 (40CFR372.65):**

Substance is not listed.

· **TSCA (Toxic Substances Control Act):**

Substance is listed.

(Contd. on page 6)

Safety Data Sheet

Printing date 01/05/2015

Reviewed on 01/05/2015

Trade name: Bio-Beads® S-X1, S-X3, S-X8, S-X12

(Contd. of page 5)

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**

Substance is not listed.

· **TLV (Threshold Limit Value established by ACGIH)**

Substance is not listed.

· **MAK (German Maximum Workplace Concentration)**

Substance is not listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**

Substance is not listed.

· **National regulations**

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations

· **Water hazard class:** Generally not hazardous for water.

· **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Department issuing SDS:** Environmental Health and Safety.

· **Contact:**

Life Science Group, Environmental Health and Safety, 2000 Alfred Nobel Drive, Hercules, California, 94547: 1(510) 741-1000

Diagnostic Group, Environmental Health and Safety, 4000 Alfred Nobel Drive, Hercules, California, 94547: 1(510) 724-7000

· **Abbreviations and acronyms:**

IMDG: International Maritime Code for Dangerous Goods

DOT: US Department of Transportation

IATA: International Air Transport Association

ACGIH: American Conference of Governmental Industrial Hygienists

CAS: Chemical Abstracts Service (division of the American Chemical Society)

· * **Data compared to the previous version altered.**

Material Safety Data Sheet

Bondesil-C18 OH

1. Product and company identification

| | |
|------------------------------|--|
| Product name | : Bondesil-C18 OH |
| Material uses | : Analytical chemistry. 100 g plastic bottles |
| Supplier/Manufacturer | : Agilent Technologies, Inc. Logistics Center - Americas 500 Ships Landing Way New Castle, Delaware 19720 800-227-9770 |
| Part No. | : 12213049 |
| Validation date | : 01/16/2013 |
| In case of emergency | : Chemtrec: 1-800-424-9300 |

2. Hazards identification

| | |
|------------------------|--|
| Physical state | : Solid. [Powder.] |
| Odor | : Odorless. |
| OSHA/HCS status | : While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this MSDS contains valuable information critical to the safe handling and proper use of the product. This MSDS should be retained and available for employees and other users of this product. |

Emergency overview

| | |
|--------------------------|---|
| Hazard statements | : NOT EXPECTED TO PRODUCE SIGNIFICANT ADVERSE HEALTH EFFECTS WHEN THE RECOMMENDED INSTRUCTIONS FOR USE ARE FOLLOWED. |
| Precautions | : Keep away from heat, sparks and flame. Prevent dust accumulation. Avoid breathing dust. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. |
| Routes of entry | : Inhalation. |

Potential acute health effects

| | |
|-------------------|--|
| Inhalation | : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs. |
| Ingestion | : No known significant effects or critical hazards. |
| Skin | : No known significant effects or critical hazards. |
| Eyes | : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the eyes. |

Potential chronic health effects

| | |
|------------------------------|--|
| Chronic effects | : Repeated or prolonged inhalation of dust may lead to chronic respiratory irritation. |
| Carcinogenicity | : No known significant effects or critical hazards. |
| Mutagenicity | : No known significant effects or critical hazards. |
| Teratogenicity | : No known significant effects or critical hazards. |
| Developmental effects | : No known significant effects or critical hazards. |
| Fertility effects | : No known significant effects or critical hazards. |

Over-exposure signs/symptoms

| | |
|-------------------|---|
| Inhalation | : Adverse symptoms may include the following: respiratory tract irritation coughing |
| Ingestion | : No specific data. |
| Skin | : No specific data. |

2. Hazards identification

Eyes : Adverse symptoms may include the following:
irritation
redness

Medical conditions aggravated by over-exposure : None known.

See toxicological information (Section 11)

3. Composition/information on ingredients

| Name | CAS number | % |
|--------------------------------|------------|----------|
| Organosilane bonded silica gel | | 60 - 100 |

Note: The hazard information listed is based on unbonded silica gel CAS Number 112926-00-8. To the best of our knowledge, the acute and chronic toxicological properties of bonded silica gels have not been investigated. This product contains synthetic amorphous silica, and should not be confused with crystalline silica such as quartz, cristobalite, or tridymite, or with diatomaceous earth or other naturally occurring forms of amorphous silica that frequently contain crystalline forms of silica.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

4. First aid measures

Eye contact : Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention if symptoms occur.

Skin contact : In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention if symptoms occur.

Inhalation : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

Notes to physician : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

5. Fire-fighting measures

Flammability of the product : Fine dust clouds may form explosive mixtures with air.

Extinguishing media

Suitable : Use dry chemical powder.

Not suitable : Do not use water jet.

Special exposure hazards : No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Hazardous thermal decomposition products : No specific data.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

6. Accidental release measures

- Personal precautions** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing dust. Put on appropriate personal protective equipment (see Section 8).
- Environmental precautions** : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).
- Methods for cleaning up** : Move containers from spill area. Vacuum or sweep up material and place in a designated, labeled waste container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.

7. Handling and storage

- Handling** : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. Avoid breathing dust. Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Prevent dust accumulation. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Electrical equipment and lighting should be protected to appropriate standards to prevent dust coming into contact with hot surfaces, sparks or other ignition sources.
- Storage** : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

8. Exposure controls/personal protection

| Ingredient | Exposure limits |
|--------------------------------|--|
| Organosilane bonded silica gel | <p>ACGIH TLV (United States). Particulate matter not otherwise classified: (PNOC): 10 mg/m³ Form: Inhalable Particulate matter not otherwise classified: (PNOC): 3 mg/m³ Form: Respirable</p> <p>OSHA PEL (United States). Particulate matter not otherwise classified: (PNOC): 5 mg/m³ Form: Respirable fraction Particulate matter not otherwise classified: (PNOC): 15 mg/m³ Form: Total dust</p> |

- Recommended monitoring procedures** : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to appropriate monitoring standards. Reference to national guidance documents for methods for the determination of hazardous substances will also be required.
- Engineering measures** : Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.
- Hygiene measures** : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

8. Exposure controls/personal protection

Personal protection

- Respiratory** : Use a properly fitted, particulate filter respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.
- Hands** : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.
- Eyes** : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields. If operating conditions cause high dust concentrations to be produced, use dust goggles.
- Skin** : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Environmental exposure controls** : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.
- Other protection** : Not available.

9. Physical and chemical properties

- Physical state** : Solid. [Powder.]
- Flash point** : Not available.
- Auto-ignition temperature** : Not available.
- Flammable limits** : Not available.
- Color** : White.
- Odor** : Odorless.
- pH** : Not available.
- Boiling/condensation point** : 2230°C (4046°F)
- Melting/freezing point** : >1700°C (>3092°F)
- Specific gravity** : 2.5 to 3.5
- Vapor pressure** : Not available.
- Vapor density** : Not available.
- Odor threshold** : Not available.
- Evaporation rate** : Not available.
- Solubility** : Insoluble in the following materials: cold water and hot water.

10. Stability and reactivity

- Chemical stability** : The product is stable.
- Conditions to avoid** : Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material. Prevent dust accumulation.
- Materials to avoid** : Reactive or incompatible with the following materials:
oxidizing materials
Other: acids.
Incompatible with: Hydrogen fluoride (HF). hydrofluoric acid
- Hazardous decomposition products** : Under normal conditions of storage and use, hazardous decomposition products should not be produced.
- Possibility of hazardous reactions** : Under normal conditions of storage and use, hazardous reactions will not occur.

10. Stability and reactivity

11. Toxicological information

Acute toxicity

Not available.

Irritation/Corrosion

Conclusion/Summary : Not available.

Sensitizer

Conclusion/Summary : Not available.

Chronic toxicity / Carcinogenicity / Mutagenicity / Teratogenicity / Reproductive toxicity

Not available.

12. Ecological information

Ecotoxicity : Not readily biodegradable. May cause long-term adverse effects in the aquatic environment.

Other adverse effects : No known significant effects or critical hazards.

13. Disposal considerations

Waste disposal : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Disposal should be in accordance with applicable regional, national and local laws and regulations. Local regulations may be more stringent than regional or national requirements.

The information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations.

Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.

14. Transport information

Regulatory information

DOT / IMDG / IATA / : Not regulated.

15. Regulatory information

HCS Classification : Not regulated.

U.S. Federal regulations : **TSCA 8(a) IUR Exempt/Partial exemption:** Not determined

United States inventory (TSCA 8b): This material is listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: No products were found.

SARA 302/304 emergency planning and notification: No products were found.

SARA 302/304/311/312 hazardous chemicals: No products were found.

SARA 311/312 MSDS distribution - chemical inventory - hazard identification: No products were found.

15. Regulatory information

Clean Air Act Section 112(b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

State regulations

Massachusetts : This material is not listed.

New York : This material is not listed.

New Jersey : This material is not listed.

Pennsylvania : This material is not listed.

California Prop. 65

No products were found.

16. Other information

Label requirements : NOT EXPECTED TO PRODUCE SIGNIFICANT ADVERSE HEALTH EFFECTS WHEN THE RECOMMENDED INSTRUCTIONS FOR USE ARE FOLLOWED.

Date of issue : 01/16/2013

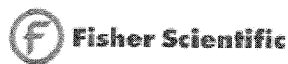
Date of previous issue : No previous validation.

Version : 1

✔ Indicates information that has changed from previously issued version.

Notice to reader

Disclaimer: The information contained in this document is based on Agilent's state of knowledge at the time of preparation. No warranty as to its accurateness, completeness or suitability for a particular purpose is expressed or implied.



Material Safety Data Sheet

Copper, powder or dust

MSDS# 05430

Section 1 - Chemical Product and Company Identification

MSDS Name: Copper, powder or dust
Catalog Numbers: C431-500, C434-500
Synonyms: None.
Company Identification: Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
For information in the US, call: 201-796-7100
Emergency Number US: 201-796-7100
CHEMTREC Phone Number, US: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#: 7440-50-8
Chemical Name: Copper
%: 100
EINECS#: 231-159-6

Hazard Symbols: None listed
Risk Phrases: None listed

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Warning! Flammable solid. Causes respiratory tract irritation. May cause lung damage. May cause liver and kidney damage. Causes eye and skin irritation. Inhalation of fumes may cause metal-fume fever. Can be explosive when exposed to heat or flames. Target Organs: Kidneys, liver, lungs.

Potential Health Effects

Eye: Causes eye irritation.
Skin: Causes skin irritation. May cause skin discoloration.
Ingestion: Causes gastrointestinal irritation with nausea, vomiting and diarrhea. May cause liver and kidney damage. Dust is irritating to the respiratory tract. Inhalation of fumes may cause metal fume fever, which is characterized by flu-like symptoms with metallic taste, fever, chills, cough, weakness, chest pain, muscle pain and increased white blood cell count.
Inhalation:
Chronic: Prolonged or repeated skin contact may cause dermatitis. May cause liver and kidney damage. May cause lung damage.

Section 4 - First Aid Measures

Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists.
Ingestion: Get medical aid. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Individuals with Wilson's disease are more susceptible to chronic copper poisoning.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Dust can be an explosion hazard when exposed to heat or flame. Flammable solid. May burn rapidly with flare burning effect. May re-ignite after fire is extinguished. Finely divided dusts may exhibit pyrophoric tendencies.

Extinguishing Media: Use dry sand, Met-L-X powder, or G-1 graphite powder. Contact professional fire-fighters immediately. Use dry sand, graphite powder, dry sodium chloride-based extinguishers. Dousing metallic fires with water may generate hydrogen gas, an extremely dangerous explosion hazard, particularly if fire is in a confined environment.

Autoignition Temperature: Not applicable.

Flash Point: Not applicable.

Explosion Limits: Lower: Not available

Explosion Limits: Upper: Not available

NFPA Rating: health: 2; flammability: 2; instability: 0;

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up, then place into a suitable container for disposal. Scoop up with a nonsparking tool, then place into a suitable container for disposal. Avoid generating dusty conditions. Remove all sources of ignition.

Section 7 - Handling and Storage

Handling: Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with skin and eyes. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep away from heat, sparks and flame. Avoid ingestion and inhalation. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames.

Storage: Keep away from sources of ignition. Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances. Do not expose to air.

Section 8 - Exposure Controls, Personal Protection

| Chemical Name | ACGIH | NIOSH | OSHA - Final PELs |
|---------------|---|--|--|
| Copper | 0.2 mg/m ³ (fume); 1 mg/m ³ (dust and mist, as Cu) | 1 mg/m ³ TWA (dust and mist) 100 mg/m ³ IDLH (dust, fume and mist) | 0.1 mg/m ³ TWA (fume); 1 mg/m ³ TWA (dust and mist) |

OSHA Vacated PELs: Copper: 0.1 mg/m³ TWA (dust, fume, mists, as Cu)

Engineering Controls:

Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local explosion-proof ventilation to keep airborne levels to acceptable levels.

Exposure Limits

Personal Protective Equipment

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin: Wear appropriate gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to minimize contact with skin.

Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Powder

Color: red to brown

Odor: none reported

pH: Not available

Vapor Pressure: 1 mm Hg @1628C

Vapor Density: Not available

Evaporation Rate: Not applicable.

Viscosity: Not applicable.

Boiling Point: 2595 deg C (4,703.00°F)

Freezing/Melting Point: 1083 deg C (1,981.40°F)

Decomposition Temperature: Not available

Solubility in water: Insoluble in water.

Specific Gravity/Density: 8.92

Molecular Formula: Cu

Molecular Weight: 63.54

Section 10 - Stability and Reactivity

| | |
|--|---|
| Chemical Stability: | Stable at room temperature in closed containers under normal storage and handling conditions. |
| Conditions to Avoid: | Ignition sources, dust generation, moisture, exposure to air, excess heat. |
| Incompatibilities with Other Materials | Strong oxidizing agents. |
| Hazardous Decomposition Products | Copper fumes. |
| Hazardous Polymerization | Has not been reported. |

Section 11 - Toxicological Information

| | |
|------------------|---|
| RTECS#: | CAS# 7440-50-8: GL5325000 GL7440000 GL7590000 |
| LD50/LC50: | RTECS: Not available. |
| Carcinogenicity: | Copper - Not listed as a carcinogen by ACGIH, IARC, NTP, or CA Prop 65. |
| Other: | See actual entry in RTECS for complete information. |

Section 12 - Ecological Information

Not available

Section 13 - Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.

Section 14 - Transport Information

US DOT

Shipping Name: METAL POWDERS, FLAMMABLE, N.O.S.

Hazard Class: 4.1

UN Number: UN3089

Packing Group: II

Canada TDG

Shipping Name: METAL POWDER, FLAMMABLE, N.O.S. (Copper)

Hazard Class: 4.1

UN Number: UN3089

Packing Group: II

USA RQ: CAS# 7440-50-8: 5000 lb final RQ (no reporting of releases of this hazardous substa

Section 15 - Regulatory Information

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:Not available

Risk Phrases:

Safety Phrases:

S 24/25 Avoid contact with skin and eyes.

WGK (Water Danger/Protection)

CAS# 7440-50-8: 0

Canada

CAS# 7440-50-8 is listed on Canada's DSL List

Canadian WHMIS Classifications: D2B, B4

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

CAS# 7440-50-8 is listed on Canada's Ingredient Disclosure List

US Federal

TSCA

CAS# 7440-50-8 is listed on the TSCA
Inventory.

REVIEWED

Section 16 - Other Information

MSDS Creation Date: 12/12/1997

Revision #7 Date 7/20/2009

DATE: JUNE 21/2012

Chutneyford

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall the company be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential, or exemplary damages howsoever arising, even if the company has been advised of the possibility of such damages.

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION
PRODUCT NAME: PETROLEUM CRUDE OIL (SOUR)
SYNONYMS: Crude, Petroleum Hydrocarbon

APPLICATIONS & USE: Refinery feed stock.

PRODUCT DESCRIPTION: A naturally occurring mixture of paraffins, naphthalenes, aromatic hydrocarbons and small amounts of sulphur and nitrogen compounds. The composition and properties will vary significantly according to source of crude. Crude oil with a sulphur content greater than 0.5 weight percent is considered sour.

REGULATORY CLASSIFICATION:
WHMIS: Class B, Division 2, Flammable Liquid

Class D, Division 1, Subdivision A: Very Toxic Material

Class D, Division 2, Subdivision B: Toxic Material

TRANSPORTATION OF DANGEROUS GOODS INFORMATION: (CANADA)
Shipping Name: Petroleum Crude Oil

Primary TDG: 3.1

Secondary TDG: 3.2

P.I.N. 1267

Packing Group: II

EMERGENCY TELEPHONE NUMBERS:
Name of MFG/SUPPLIER:

 Tundra Oil and Gas Ltd.
 295 3rd Avenue,
 Virden, Manitoba ROM 2C0

Telephone: (204) 748-3095

Fax: (204) 748-1007

In Case of Emergency: (204) 748-3095

2. HAZARDOUS INGREDIENTS:

The following components are defined in accordance with subparagraph 13(a). (1) to (iv) or paragraph 14(a) of the Hazardous Product Act.

| <u>Component</u> | <u>%</u> | <u>CAS#</u> |
|---|----------|-------------|
| Hydrocarbons (aromatic and paraffinic hydrocarbons) | 100 | 8002-05-9 |
| Toluene | 100 ppm | 108-88-3 |
| Benzene | 10 ppm | 71-43-2 |
| Xylene | 100 ppm | 1330-20-7 |
| Hydrogen sulphide (H2S) | 10 ppm | 7783-08-4 |

3. TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

| | |
|-------------------------------|--|
| PHYSICAL STATE: | Liquid @ 25°C |
| DENSITY: | 0.8 – 1.0 g/cc |
| VAPOUR DENSITY: | Not Available |
| EVAPORATION RATE: | Variable |
| BOILING POINT / RANGE: | 10°C – 1100°C |
| SOLUBILITY IN WATER: | 0% |
| VAPOUR PRESSURE: | >1 |
| APPEARANCE / ODOR: | Aromatic or sulphide (rotten egg) odor Usually a black or green liquid. |
| ODOR / THRESHOLD: | in Manitoba 1 hr. avg H ₂ S 15 ug/m ³ 24 hr. avg H ₂ S 5 ug/m ³ |

MATERIAL SAFETY DATA SHEET

| | |
|---|--------------------------|
| EVAPORATION RATE: | Variable |
| FREEZING / MELTING PT. | Not available |
| VISCOSITY: | Variable |
| PH: | Not available |
| VOLATILE BY VOL: | 100% |
| CO-EFFICIENT OF WATER/OIL DISTRIBUTION | Not available |
| PERCENT VOLATILE: | 100% |
| MOLECULAR FORMULA: | Not Applicable – mixture |
| MOLECULAR WEIGHT: | Not Applicable - mixture |

4. HEALTH HAZARD INFORMATION:
NATURE OF HAZARD
INHALATION: May cause headache, dizziness, loss of appetite, weakness, loss of coordination, and unconsciousness. Crude oil vapours are irritating to the upper respiratory tract.

EYE CONTACT: Crude oil vapours are moderately irritating to the eyes.

SKIN CONTACT: Prolonged skin contact may result in defatting of the skin resulting in dry cracked skin and dermatitis.

INGESTION: Minimal toxicity. Small amounts of this liquid ingested into the lungs from swallowing or vomiting may cause severe health effects. (eg bronchopneumonia or pulmonary edema).

CHRONIC EFFECTS: Benzene is a known carcinogen and may cause damage to the bone marrow / blood making system and may result in leukemia.

TOXICITY DATA: Product is not listed as a carcinogen by any agent, but individual components have been associated with carcinogenicity, mutagenicity, reproductive and teratogenicity properties in animal experiments.

OCCUPATIONAL EXPOSURE LIMITS:
ACGIH Recommends:

 For oil mists, 5 mg/m³

 For Hydrogen Sulphide, 10 ppm (24 mg/m³)

 For Benzene, the ACGIH recommends a TLV of 10 ppm (30 mg/m³) and describe it as a substance of suspect carcinogenic potential in men.

Manufacturer Recommends:

For total hydrocarbons, 100 ppm recommended.

5. FIRST AID MEASURES
INHALATION: Remove individual to fresh air immediately. If breathing stops, administer artificial resuscitation. Keep victim warm and at rest, seek medical attention.

EYE CONTACT: Flush eyes with large amounts of water for at least 15 minutes and seek medical attention.

SKIN CONTACT: Remove contaminated clothing as soon as possible. Wash exposed skin thoroughly with soap and water. If irritation develops, consult a physician.

INGESTION: DO NOT induce vomiting since it is important that no amount of the material should enter the lungs (aspiration). Get prompt medical attention. Never give anything by mouth to an unconscious person.


5. FIRST AID MEASURES (Cont'd...)

EMERGENCY PRODEDURES: Because hydrogen sulphide inhalation can be fatal, rescuers must wear positive pressure full face piece, self contained or supplied air NIOSH approved respirators before attempting the rescue.

6. PREVENTATIVE AND CORRECTIVE MEASURES

SPECIAL PROTECTION INFORMATION:

Use in a well ventilated area. Adequate ventilation should be provided in the workplace to maintain the hydrocarbon vapours and hydrogen sulphide below the applicable occupational exposure level.

Under normal conditions respiratory protection is not required. Respiratory protection may be required in poorly ventilated areas. Air supplied respirators or positive pressure self contained breathing apparatus is required when atmospheric concentrations of hydrocarbon vapours are likely to exceed 10x the occupational exposure limit or when high concentration of H₂S may be present.

Non-vented chemical goggles should be worn to prevent eye injury. Chemical resistant gloves, apron and/or clothing should be worn if direct contact with liquid is likely to occur. Neoprene or nitrile materials have been shown to provide effective protection against crude oil liquid.

SPILL CONTROL AND DISPOSAL:

Evacuate personnel. Eliminate all ignition sources. Contain spill and absorb with inert absorbent. Large spills should be removed with explosion proof vacuum equipment. Large pools may be covered with foam to prevent vapour evolution.

WASTE DISPOSAL METHOD:

Contaminated material should be placed in disposable containers and disposed in compliance with federal, provincial, and local regulations.

7. FIRE AND EXPLOSION HAZARD

| | |
|-----------------------------|------------------|
| Flash-point (Test Method): | -40 deg C (PMCC) |
| Auto-Ignition | Not Available |
| Flammable Limits (% volume) | Not Available |

GENERAL HAZARDS:

Static discharge: Highly flammable, vapours are heavier than air and may collect in low-lying areas. Vapours may travel considerable distances to ignition sources and cause a flash fire. All storage containers and pumping equipment must be grounded.

FIREFIGHTING:

Fire extinguishing substances: foam, water spray and dry chemical. Water may be ineffective, but water should be used to keep fire-exposed containers cool. If leak or spill has not ignited, use water spray to disperse vapours. Use full protective equipment and self-contained breathing apparatus (SCBA) for fires in enclosed areas.

EXPLOSION / SENSITIVITY DATA:

Stable under normal conditions of temperature and pressure.

MATERIAL SAFETY DATA SHEET

8. REACTIVITY DATA:

This material is stable. Hazardous polymerization will not occur.

INCOMPATIBLE MATERIALS AND CONDITIONS TO AVOID:

Oxidizing material.

HAZARDOUS DECOMPOSITION

May release hydrogen sulphide gas when agitated. See health hazard information. Overheating or incomplete combustion may result in carbon dioxide, carbon monoxide, acrid fumes or decomposition and oxides of sulphur.

Avoid heat, open flame or sources of ignition.

Maintain temperature below the flash-point and keep away from all ignition sources. Head spaces in storage tanks may contain toxic hydrocarbon vapours and hydrogen sulphide gas.

9. NOTES

This product contains benzene. Repeated or prolonged breathing of benzene vapours has been associated with the development of chromosomal damage in experimental animals and various blood disorders in humans ranging from aplastic anemia to leukemia.

This product may also contain polycyclic aromatic hydrocarbons, which have been associated with skin and lung cancers.

ACUTE EFFECTS:

Vary with concentration of hydrogen sulphide release, from mild eye, nose and throat irritation at approximately 100 ppm, to sudden unconsciousness or death at 500 ppm.

INHALATION:

H₂S release may occur in the vapour space of storage tanks. Abnormal behavior or sudden paralysis of breathing and unconsciousness can occur.

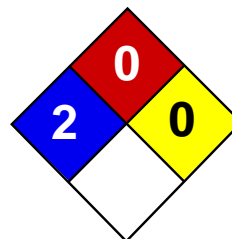
10. PREPARATION INFORMATION

Prepared by: TUNDRA OIL AND GAS LTD.
295 3rd Avenue
Virden, Manitoba ROM 2C0

Telephone: (204) 748-3095

Preparation Date: March 5, 2003
Revision Date: February 23, 2015

CAUTION: To the best of our knowledge, the information contained herein is accurate and is provided in good faith. Although it has been based on data drawn from other sources deemed to be reliable, Tundra Oil and Gas Ltd. cannot guarantee its accuracy and assumes no responsibility for conditions resulting from its use.



| | |
|---------------------|---|
| Health | 2 |
| Fire | 0 |
| Reactivity | 0 |
| Personal Protection | E |

Material Safety Data Sheet

Cupric nitrate trihydrate MSDS

Section 1: Chemical Product and Company Identification

Product Name: Cupric nitrate trihydrate

Catalog Codes: SLC3202, SLC4990

CAS#: 10031-43-3

RTECS: GL7875000

TSCA: TSCA 8(b) inventory: No products were found.

CI#: Not available.

Synonym: Copper (II) Nitrate trihydrate; Nitric acid, copper (2+) salt, trihydrate; Copper nitrate trihydrate; Copper Dinitrate Trihydrate; Copper (II) Nitrate trihydrate (1:2:3)

Chemical Name: Copper (II) nitrate, trihydrate

Chemical Formula: Cu(NO₃)₂·3H₂O

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

| Name | CAS # | % by Weight |
|---------------------------|------------|-------------|
| Cupric nitrate trihydrate | 10031-43-3 | 100 |

Toxicological Data on Ingredients: Cupric nitrate trihydrate: ORAL (LD50): Acute: 940 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:

Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation.

Potential Chronic Health Effects:

Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, liver, cardiovascular system, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.

Skin Contact:

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. Seek medical attention.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: combustible materials

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Ignites paper spontaneously in the presence of moisture.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:

Oxidizing material. Stop leak if without risk. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Oxidizer. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material.. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, combustible materials, organic materials.

Storage:

Deliquescent. Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:

Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 1 CEIL: 2 from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Deliquescent crystals solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 241.6 g/mole

Color: Blue.

pH (1% soln/water): Not available.

Boiling Point: Decomposition temperature: 170°C (338°F)

Melting Point: 114.5°C (238.1°F)

Critical Temperature: Not available.

Specific Gravity: 2.05 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: 8.33 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:

Soluble in cold water. Solubility in Water: 137.8 g/100 cc water @ 0 deg. C.; 1270 g/100 cc @ 100 deg. C. Solubility in alcohol: 100 g/100 cc alcohol @ 12.5 deg. C. Very slightly soluble in liquid ammonia. Practically insoluble in Ethyl acetate.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, moisture

Incompatibility with various substances: Reactive with reducing agents, combustible materials, organic materials, metals.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Incompatible with easily oxidizable materials, paper, wood, organic substances, acetylene, hydrazine, nitromethane, ammonia + potassium amide, acetic anhydride, sodium hypobromide, nitromethanes, potassium ferrocyanide, ether, tin. Reacts vigorously with ether.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 940 mg/kg [Rat].

Chronic Effects on Humans:

May cause damage to the following organs: blood, kidneys, liver, cardiovascular system, central nervous system (CNS).

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: May cause severe irritation with possible burns. May cause dermatitis, and skin discoloration. Eyes: May cause severe irritation and possible eye burns. May cause ulceration of the conjunctiva and cornea. Inhalation: May cause severe irritation of the respiratory tract (nose, throat, lungs) with coughing, wheezing, headache, pain, shortness of breath, inflammation, and possible burns. May cause ulceration and perforation of the nasal septum if inhaled in excessive amounts. Other symptoms may include spasm, inflammation and edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema. Ingestion: May be harmful if swallowed. May cause severe gastrointestinal tract irritation with salivation, headache, cold sweats, nausea, vomiting and abdominal pain, diarrhea, burning of the mouth, esophagus, or stomach, metallic taste, possible burns resulting in gastric bleeding, hemorrhaging of the digestive tract. Other symptoms of over exposure may include cramps in the calves, muscle rigor, prostration, convulsions, paralysis. May affect behavior/central nervous system (convulsions, somnolence, excitation followed by central nervous system depression). May cause liver (jaundice) and kidney damage/failure. This product is a nitrate. The toxicity of nitrates is due to in vivo conversion into nitrites. Nitrites can affect the blood and produce methemoglobinemia which results in deficient oxygenation of the blood, causing difficulty breathing, and cyanosis (a bluish discoloration of the skin). Nitrites may also affect the cardiovascular system (hypotension, cardiac arrhythmias, vasodilation, decreased peripheral vascular resistance, hypotension, bradycardia, shock, cardiovascular collapse) which may result in death. Chronic Potential health effects: Repeated exposure by inhalation may cause shrinking of the inner lining of the nose and may cause ulcers and a hole (perforation) in the bone (septum) dividing the inner nose. Repeated ingestion may cause similar effects to those of acute ingestion. It may cause kidney and liver damage. Repeated exposure by skin contact may cause thickening of the skin, and may cause a greenish color (discoloration) to

the skin and hair. May also cause dermatitis, a skin allergy. Medical Conditions Aggravated by Exposure: Persons with pre-existing skin disorders, impaired liver, kidney or pulmonary function, glucose-6-phosphate dehydrogenase deficiency, or pre-existing Wilson's disease. Individual's with Wilson's disease are unable to metabolize copper. Therefore, copper accumulates in various tissues and may result in liver, kidney, and brain damage.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 5.1: Oxidizing material.

Identification: : Nitrate, inorganic, n.o.s. (Cupric Nitrate) UNNA: 1477 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:

Connecticut hazardous material survey.: Cupric nitrate (CAS no. 3251-23-8) Illinois chemical safety act: Cupric nitrate (CAS no. 3251-23-8) New York release reporting list: Cupric nitrate (CAS no. 3251-23-8) Rhode Island RTK hazardous substances: Cupric nitrate CAS no. 3251-23-8) Pennsylvania RTK: Cupric nitrate or Nitric Acid, Copper (2+) salt (CAS no. 3251-23-8) Massachusetts RTK: Cupric nitrate (CAS no. 3251-23-8) Massachusetts spill list: Cupric nitrate (CAS no. 3251-23-8) New Jersey: Cupric nitrate (CAS no. 3251-23-8) New Jersey spill list: Cupric nitrate CAS no. 3251-23-8) Louisiana spill reporting: Cupric nitrate (CAS no. 3251-23-8) SARA 313 toxic chemical notification and release reporting: Listed as Copper compounds CERCLA: Hazardous substances.: Cupric Nitrate (CAS no. 3251-23-8): 100 lbs. (45.36 kg) TSCA: Cupric Nitrate or Nitric Acid, Copper (II) salt (CAS no. 3251-23-8) is TSCA listed, but Cupric Nitrate trihydrate (CAS no. 10031-43-3) is exempt from TSCA listing (not TSCA listed) since it is a hydrate.

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):

CLASS C: Oxidizing material. CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: COLD LAKE DILBIT / COLD LAKE BLEND / DILBIT COLD LAKE / DILUTED COLD LAKE BITUMEN

Product Description: Petroleum Hydrocarbons

MSDS Number: 11174

Intended Use: Feedstock

COMPANY IDENTIFICATION

Supplier: Imperial Oil - Crude Oil Supply & Marketing
 Downstream
 P.O. Box 2480, Station M
 Calgary, ALBERTA. T2P 3M9 Canada

24 Hour Environmental / Health Emergency 1-866-232-9563

Telephone

Transportation Emergency Phone Number 1-866-232-9563

Supplier General Contact 1-800-567-3776

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

Reportable Hazardous Substance(s) or Complex Substance(s)

| Name | CAS# | Concentration* | Acute Toxicity |
|-----------------------------|------------|----------------|----------------|
| NATURAL GAS CONDENSATE C2-8 | 68919-39-1 | 15 - 40% | None |

Hazardous Constituent(s) Contained in Complex Substance(s)

| Name | CAS# | Concentration* | Acute Toxicity |
|----------|-----------|----------------|----------------|
| BENZENE | 71-43-2 | < 1% | None |
| n-Hexane | 110-54-3 | 0 - 8% | None |
| SULPHUR | 7704-34-9 | 3 - 4% | None |

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

NOTE: Balance of composition is bitumen (oil sands).

SECTION 3 HAZARDS IDENTIFICATION

This material is considered to be hazardous according to regulatory guidelines (see (M)SDS Section 15).

PHYSICAL/CHEMICAL EFFECTS

FLAMMABLE. In use, may form flammable/explosive vapour-air mixture. Material can release vapours that readily form flammable mixtures. Vapour accumulation could flash and/or explode if ignited. Thermal burn hazard - contact with hot material may cause thermal burns. Material can accumulate static charges which may

cause an ignition.

HEALTH EFFECTS

Irritating to skin. May cause cancer. Danger of adverse health effects by prolonged exposure. May impair fertility. Danger of serious irreversible effects by a single exposure. Under conditions of poor personal hygiene and prolonged repeated contact, some polycyclic aromatic compounds (PACs) have been suspected as a cause of skin cancer in humans. Hydrogen sulphide, a highly toxic gas, may be present. Signs and symptoms of overexposure to hydrogen sulphide include respiratory and eye irritation, dizziness, nausea, coughing, a sensation of dryness and pain in the nose, and loss of consciousness. Odour does not provide a reliable indicator of the presence of hazardous levels in the atmosphere. Overexposure to n-hexane may cause effects on the peripheral nerves, resulting in weakness or numbness of lower limbs. High-pressure injection under skin may cause serious damage. Exposure to benzene is associated with cancer (acute myeloid leukaemia and myelodysplastic syndrome), damage to the blood-producing system, and serious blood disorders (see Section 11).

| | | | |
|------------------------|------------|-----------------|---------------|
| NFPA Hazard ID: | Health: 2 | Flammability: 3 | Reactivity: 0 |
| HMIS Hazard ID: | Health: 2* | Flammability: 3 | Reactivity: 0 |

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

INHALATION

Immediately remove from further exposure. Get immediate medical assistance. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. Give supplemental oxygen, if available. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Remove contaminated clothing. Dry wipe exposed skin and cleanse with waterless hand cleaner and follow by washing thoroughly with soap and water. For those providing assistance, avoid further skin contact to yourself or others. Wear impervious gloves. Launder contaminated clothing separately before reuse. Discard contaminated articles that cannot be laundered. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury. For hot product: Immediately immerse in or flush affected area with large amounts of cold water to dissipate heat. Cover with clean cotton sheeting or gauze and get prompt medical attention.

EYE CONTACT

Flush thoroughly with water for at least 15 minutes. Get medical assistance.

INGESTION

Seek immediate medical attention.

NOTE TO PHYSICIAN

This light hydrocarbon material, or a component, may be associated with cardiac sensitisation following very high exposures (well above occupational exposure limits) or with concurrent exposure to high stress levels or heart-stimulating substances like epinephrine. Administration of such substances should be avoided.

PRE-EXISTING MEDICAL CONDITIONS WHICH MAY BE AGGRAVATED BY EXPOSURE

Contains hexane; individuals with pre-existing neurological disease should avoid exposure.

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use dry chemical, carbon dioxide (CO₂), or a dry, non-combustible material such as dry sand or earth to extinguish flames.

Inappropriate Extinguishing Media: DO NOT USE WATER.

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. If a leak or spill has not ignited, use water spray to disperse the vapours and to protect personnel attempting to stop a leak. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Unusual Fire Hazards: Extremely Flammable. Hazardous material. Firefighters should consider protective equipment indicated in Section 8.

Hazardous Combustion Products: Hydrogen sulphide, Smoke, Fume, Sulphur oxides, Incomplete combustion products, Oxides of carbon

FLAMMABILITY PROPERTIES

Flash Point [Method]: <-18°C (0°F) [Closed Cup]

Flammable Limits (Approximate volume % in air): LEL: N/D UEL: N/D

Autoignition Temperature: N/D

SECTION 6 ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

PROTECTIVE MEASURES

Avoid contact with spilled material. Warn or evacuate occupants in surrounding and downwind areas if required, due to toxicity or flammability of the material. See Section 5 for fire fighting information. See the Hazard Identification Section for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for advice on the minimum requirements for personal protective equipment. Additional protective measures may be necessary, depending on the specific circumstances and/or the expert judgment of the emergency responders.

For emergency responders: Respiratory protection: half-face or full-face respirator with filter(s) for organic vapor and, when applicable, H₂S, or Self Contained Breathing Apparatus (SCBA) can be used depending on the size of spill and potential level of exposure. If the exposure cannot be completely characterized or an oxygen deficient atmosphere is possible or anticipated, SCBA is recommended. Chemical goggles and face shield are recommended if contact of eyes with hot product or vapours is possible. Small spills: normal work clothes are usually adequate. Large spills: full body suit of chemical and thermal resistant material is recommended. Work gloves (preferably gauntlet style) that provide adequate chemical resistance. Note: gloves made of polyvinyl acetate (PVA) are not water-resistant and are not suitable for emergency use. If contact with hot product is possible or anticipated, heat-resistant and thermally insulated gloves are

recommended.

SPILL MANAGEMENT

Land Spill: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop leak if you can do so without risk. All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Prevent entry into waterways, sewer, basements or confined areas. A vapour-suppressing foam may be used to reduce vapour. Use clean non-sparking tools to collect absorbed material. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Large Spills: Water spray may reduce vapour, but may not prevent ignition in enclosed spaces.

Water Spill: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop leak if you can do so without risk. Do not confine in area of spill. Advise occupants and shipping in downwind areas of fire and explosion hazard and warn them to stay clear. Warn other shipping. Allow liquid to evaporate from the surface. Remove from the surface by skimming or with suitable absorbents. If permitted by regulatory authorities, the use of suitable dispersants should be considered where permitted in local oil spill contingency plans. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Use booms as a barrier to protect shorelines. Use containment booms when the ambient temperature is below the flash point of the material. Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7

HANDLING AND STORAGE

HANDLING

Avoid all personal contact. Prevent exposure to ignition sources, for example use non-sparking tools and explosion-proof equipment. Hydrogen sulphide (H₂S) may be given off when this material is heated. Do not depend on sense of smell for warning. Avoid vapour from heated materials to prevent exposure to potentially toxic/irritating fumes. Prevent small spills and leakage to avoid slip hazard. Material can accumulate static charges which may cause an electrical spark (ignition source). Use proper bonding and/or ground procedures. However, bonding and grounds may not eliminate the hazard from static accumulation. Consult local applicable standards for guidance. Additional references include American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practice on Static Electricity) or CENELEC CLC/TR 50404 (Electrostatics - Code of practice for the avoidance of hazards due to static electricity).

Static Accumulator: This material is a static accumulator. A liquid is typically considered a nonconductive, static accumulator if its conductivity is below 100 pS/m (100x10⁻¹² Siemens per meter) and is considered a semiconductive, static accumulator if its conductivity is below 10,000 pS/m. Whether a liquid is nonconductive or semiconductive, the precautions are the same. A number of factors, for example liquid temperature, presence of contaminants, anti-static additives and filtration can greatly influence the conductivity of a liquid.

STORAGE

The container choice, for example storage vessel, may effect static accumulation and dissipation. Keep container closed. Handle containers with care. Open slowly in order to control possible pressure release. Store in a cool, well-ventilated area. Outside or detached storage preferred. Storage containers should be earthed and bonded. Fixed storage containers, transfer containers and associated equipment should be grounded and

bonded to prevent accumulation of static charge.

| | |
|------------------|--|
| SECTION 8 | EXPOSURE CONTROLS / PERSONAL PROTECTION |
|------------------|--|

| Substance Name | Form | Limit/Standard | | | Note | Source |
|-------------------|------|----------------|----------------------|--------|------|----------|
| BENZENE | | STEL | 1 ppm | | | Supplier |
| BENZENE | | TWA | 0.5 ppm | | | Supplier |
| BENZENE | | STEL | 2.5 ppm | | Skin | ACGIH |
| BENZENE | | TWA | 0.5 ppm | | Skin | ACGIH |
| n-Hexane | | TWA | 50 ppm | | Skin | ACGIH |
| Hydrogen sulphide | | STEL | 14 mg/m ³ | 10 ppm | | Supplier |
| Hydrogen sulphide | | TWA | 7 mg/m ³ | 5 ppm | | Supplier |
| Hydrogen sulphide | | STEL | 5 ppm | | | ACGIH |
| Hydrogen sulphide | | TWA | 1 ppm | | | ACGIH |

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

Use explosion-proof ventilation equipment to stay below exposure limits.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

Positive-pressure, air-supplied respirator in areas where H₂S vapours may accumulate.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

Chemical resistant gloves are recommended. If product is hot, thermally protective, chemical resistant gloves are recommended. If contact with forearms is likely, wear gauntlet style gloves.

Eye Protection: If contact with material is likely, chemical goggles are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or

manufacturer data. The types of clothing to be considered for this material include:

Chemical/oil resistant clothing is recommended. If product is hot, thermally protective, chemical resistant apron and long sleeves are recommended.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS

Comply with applicable environmental regulations limiting discharge to air, water and soil. Protect the environment by applying appropriate control measures to prevent or limit emissions.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Note: Physical and chemical properties are provided for safety, health and environmental considerations only and may not fully represent product specifications. Contact the Supplier for additional information.

GENERAL INFORMATION

Physical State: Liquid
Colour: Black
Odour: Petroleum/Solvent
Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density: 0.94
Density (at 15.5 °C): 920 kg/m³ (7.68 lbs/gal, 0.92 kg/dm³) - 925 kg/m³ (7.72 lbs/gal, 0.93 kg/dm³)
Flash Point [Method]: <-18°C (0°F) [Closed Cup]
Flammable Limits (Approximate volume % in air): LEL: N/D UEL: N/D
Autoignition Temperature: N/D
Boiling Point / Range: 27°C (81°F) - 565°C (1049°F)
Vapour Density (Air = 1): N/D
Vapour Pressure: [N/D at 20°C] | 12 kPa (90 mm Hg) at 24 °C - 21 kPa (157.5 mm Hg) at 24°C
Evaporation Rate (n-butyl acetate = 1): N/D
pH: N/A
Log Pow (n-Octanol/Water Partition Coefficient): N/D
Solubility in Water: Negligible
Viscosity: 82 cSt (82 mm²/sec) at 40°C - 111 cSt (111 mm²/sec) at 40°C
Oxidizing Properties: See Hazards Identification Section.

OTHER INFORMATION

Freezing Point: N/D
Melting Point: N/D
Pour Point: -43°C (-45°F) - -37°C (-35°F)
Decomposition Temperature: N/D

SECTION 10 STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Avoid heat, sparks, open flames and other ignition sources.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Hydrogen sulphide, Oxides of carbon

HAZARDOUS POLYMERIZATION: Will not occur.

| | |
|-------------------|----------------------------------|
| SECTION 11 | TOXICOLOGICAL INFORMATION |
|-------------------|----------------------------------|

ACUTE TOXICITY

| <u>Route of Exposure</u> | <u>Conclusion / Remarks</u> |
|---|---|
| Inhalation | |
| Toxicity: No end point data for material. | Minimally Toxic. Based on assessment of the components. |
| Irritation: No end point data for material. | Elevated temperatures or mechanical action may form vapours, mist, or fumes which may be irritating to the eyes, nose, throat, or lungs. Based on assessment of the components. |
| Ingestion | |
| Toxicity: No end point data for material. | Slightly Toxic. Based on assessment of the components. |
| Skin | |
| Toxicity: No end point data for material. | Slightly Toxic. Based on assessment of the components. |
| Irritation: No end point data for material. | Irritating to the skin. Based on assessment of the components. |
| Eye | |
| Irritation: No end point data for material. | May cause mild, short-lasting discomfort to eyes. Based on assessment of the components. |

CHRONIC/OTHER EFFECTS

For the product itself:

Very high exposure (confined spaces / abuse) to light hydrocarbons may result in abnormal heart rhythm (arrhythmias). Concurrent high stress levels and/or co-exposure to high levels of hydrocarbons (above occupational exposure limits), and to heart-stimulating substances like epinephrine, nasal decongestants, asthma drugs, or cardiovascular drugs may initiate arrhythmias.

Contains:

BENZENE: Caused cancer (acute myeloid leukemia and myelodysplastic syndrome), damage to the blood-producing system, and serious blood disorders in human studies. Caused genetic effects and effects on the immune system in laboratory animal and some human studies. Caused toxicity to the fetus and cancer in laboratory animal studies. Crude oil: Contains polycyclic aromatic compounds (PACs). Prolonged and / or repeated exposure by skin or inhalation of certain PACs may cause cancer of the skin, lung, and of other sites of the body. In animal studies, some crudes produced skin tumors in mice, while other crudes produced no tumors. Developmental studies of crude oil in lab animals showed reduced fetal weight and increased fetal resorptions at maternally toxic levels. Repeated dermal exposure to crude oils in rats resulted in toxicity to the blood, liver, thymus, and bone marrow.

HYDROGEN SULPHIDE: Chronic health effects due to repeated exposures to low levels of H₂S have not been established. High level (700 ppm) acute exposure can result in sudden death. High concentrations will lead to cardiopulmonary arrest due to nervous system toxicity and pulmonary edema. Lower levels (150 ppm) may overwhelm sense of smell, eliminating warning of exposure. Symptoms of overexposure to H₂S include headache, fatigue, insomnia, irritability, and gastrointestinal problems. Repeated exposures to approximately 25 ppm will irritate mucous membranes and the respiratory system and have been implicated in some eye damage. **N-HEXANE:** Prolonged and/or repeated exposures to n-Hexane can cause progressive and potentially irreversible damage to the peripheral nervous system (e.g. fingers, feet, arms, legs, etc.).

Simultaneous exposure to Methyl Ethyl Ketone (MEK) or Methyl Isobutyl Ketone (MIBK) and n-Hexane can

potentiate the risk of adverse effects from n-Hexane on the peripheral nervous system. n-Hexane has been shown to cause testicular damage at high doses in male rats. The relevance of this effect for humans is unknown.

CMR Status:

| Chemical Name | CAS Number | List Citations |
|---------------|------------|----------------|
| BENZENE | 71-43-2 | 1, 4, 5 |
| n-Hexane | 110-54-3 | 4 |

--REGULATORY LISTS SEARCHED--

1 = IARC 1
2 = IARC 2A

3 = IARC 2B
4 = ACGIH ALL

5 = ACGIH A1
6 = ACGIH A2

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Expected to be toxic to aquatic organisms. May cause long-term adverse effects in the aquatic environment.

MOBILITY

More volatile component -- Highly volatile, will partition rapidly to air. Not expected to partition to sediment and wastewater solids.

High molecular wt. component -- Low water solubility, expected to sink and migrate into the sediment. Expected to partition to sediment and wastewater solids.

Low molecular wt. component -- Moderate potential to migrate through soil.

High molecular wt. component -- Low potential to migrate through soil.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Low molecular wt. component -- Expected to be inherently biodegradable

High molecular wt. component -- Expected to be persistent.

Atmospheric Oxidation:

More volatile component -- Expected to degrade rapidly in air

BIOACCUMULATION POTENTIAL

Majority of components -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

OTHER ECOLOGICAL INFORMATION

VOC (EPA Method 24): 2.353 lbs/gal

SECTION 13 DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

REGULATORY DISPOSAL INFORMATION

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

| | |
|-------------------|------------------------------|
| SECTION 14 | TRANSPORT INFORMATION |
|-------------------|------------------------------|

LAND (TDG)

Proper Shipping Name: PETROLEUM CRUDE OIL
Hazard Class & Division: 3
UN Number: 1267
Packing Group: I

LAND (DOT)

Proper Shipping Name: PETROLEUM CRUDE OIL
Hazard Class & Division: 3
ID Number: 1267
Packing Group: I
Product RQ: 833.33 LBS - BENZENE
ERG Number: 128
Label(s): 3
Transport Document Name: UN1267, PETROLEUM CRUDE OIL, 3, PG I

SEA (IMDG)

Proper Shipping Name: PETROLEUM CRUDE OIL
Hazard Class & Division: 3
EMS Number: F-E, S-E
UN Number: 1267
Packing Group: I
Label(s): 3
Transport Document Name: UN1267, PETROLEUM CRUDE OIL, 3, PG I, (-18°C c.c.)

AIR (IATA)

Proper Shipping Name: PETROLEUM CRUDE OIL
Hazard Class & Division: 3
UN Number: 1267
Packing Group: I
Label(s) / Mark(s): 3
Transport Document Name: UN1267, PETROLEUM CRUDE OIL, 3, PG I

| | |
|-------------------|-------------------------------|
| SECTION 15 | REGULATORY INFORMATION |
|-------------------|-------------------------------|

WHMIS Classification: Class B, Division 2: Flammable Liquids Class D, Division 2, Subdivision A: Very Toxic Material Class D, Division 2, Subdivision B: Toxic Material

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

CEPA: All components of this material are either on the Canadian Domestic Substances List (DSL), exempt, or have been notified under CEPA.

Complies with the following national/regional chemical inventory requirements AICS, DSL, KECI, TSCA

The Following Ingredients are Cited on the Lists Below:

| Chemical Name | CAS Number | List Citations |
|---------------|------------|----------------|
| BENZENE | 71-43-2 | 6 |
| n-Hexane | 110-54-3 | 6 |

--REGULATORY LISTS SEARCHED--

- | | | |
|--------------|-------------|--------------|
| 1 = TSCA 4 | 3 = TSCA 5e | 5 = TSCA 12b |
| 2 = TSCA 5a2 | 4 = TSCA 6 | 6 = NPRI |

| SECTION 16 | OTHER INFORMATION |
|------------|-------------------|
|------------|-------------------|

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

- Revision Changes:
- Section 09: Boiling Point C(F) information was modified.
 - Section 09: Pour Point C(F) information was modified.
 - Section 16: Not determined, Not applicable information was modified.
 - Section 09: Density kg/m3(lbs/gal) information was modified.
 - Section 09: Vapour Pressure information was modified.
 - Section 01: Company Mailing Address information was modified.
 - Section 09 Viscosity information was modified.
 - Section 14: Proper Shipping Name information was modified.
 - Section 14: UN Number information was modified.
 - Section 14: EMS Number information was modified.
 - Section 14: Transport Document Name information was modified.
 - Section 14: Proper Shipping Name information was modified.
 - Section 14: Proper Shipping Name information was modified.
 - Section 14: UN Number information was modified.
 - Section 14: Proper Shipping Name information was modified.
 - Section 14: UN Number information was modified.
 - Section 14: Transport Document Name information was modified.

Composition: Component table information was modified.
Section 14: Hazard Class & Division - Header information was added.
Section 14: Hazard Class information was added.
Section 14: UN Number - Header information was added.
Section 14: UN Number information was added.
Section 14: Packing Group - Header information was added.
Section 14: Packing Group information was added.
Section 14: Label(s) - Header information was added.
Section 14: Label(s) information was added.
Section 14: Transport Document Name - Header information was added.
Section 14: Transport Document Name information was added.
Section 09 Viscosity information was deleted.
Section 14: Special Provisions - Header information was deleted.
Section 14: Special Provisions information was deleted.

PRECAUTIONARY LABEL TEXT:

WHMIS Classification: Class B, Division 2: Flammable Liquids Class D, Division 2, Subdivision A: Very Toxic Material
Class D, Division 2, Subdivision B: Toxic Material

HEALTH HAZARDS

Irritating to skin. May cause cancer. Danger of adverse health effects by prolonged exposure. May impair fertility.
Danger of serious irreversible effects by a single exposure.

PHYSICAL HAZARDS

FLAMMABLE. In use, may form flammable/explosive vapour-air mixture. Thermal burn hazard - contact with hot material may cause thermal burns. Material can accumulate static charges which may cause an ignition.

PRECAUTIONS

Avoid all personal contact. Prevent exposure to ignition sources, for example use non-sparking tools and explosion-proof equipment. Use proper bonding and/or earthing procedures. However, bonding and earthing may not eliminate the hazard from static accumulation.

FIRST AID

Eye: Flush thoroughly with water for at least 15 minutes. Get medical assistance.

Oral: Seek immediate medical attention.

Skin: Remove contaminated clothing. Dry wipe exposed skin and cleanse with waterless hand cleaner and follow by washing thoroughly with soap and water. For those providing assistance, avoid further skin contact to yourself or others. Wear impervious gloves. Launder contaminated clothing separately before reuse. Discard contaminated articles that cannot be laundered. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury. For hot product: Immediately immerse in or flush affected area with large amounts of cold water to dissipate heat. Cover with clean cotton sheeting or gauze and get prompt medical attention.

FIRE FIGHTING MEDIA

Use dry chemical, carbon dioxide (CO₂), or a dry, non-combustible material such as dry sand or earth to extinguish flames. DO NOT USE WATER.

SPILL/LEAK

Land Spill: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop leak if you

can do so without risk. Prevent entry into waterways, sewer, basements or confined areas. A vapour-suppressing foam may be used to reduce vapour. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.

Water Spill: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop leak if you can do so without risk. Do not confine in area of spill. Advise occupants and shipping in downwind areas of fire and explosion hazard and warn them to stay clear. Warn other shipping. Allow liquid to evaporate from the surface. Remove from the surface by skimming or with suitable absorbents. Report spills as required to appropriate authorities. If permitted by regulatory authorities, the use of suitable dispersants should be considered where permitted in local oil spill contingency plans. Seek the advice of a specialist before using dispersants.

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DGN: 5009162 (1005279)

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Prepared by: Imperial Oil Limited, IH and Product Safety

1. PRODUCT AND COMPANY IDENTIFICATION

| | | | |
|--|--|--------------|--|
| Product name | : Ethanol | | |
| Product Number | : 676829 | | |
| Brand | : Sigma-Aldrich | | |
| Product Use | : For laboratory research purposes. | | |
| Supplier | : Sigma-Aldrich Canada Co. 2149 Winston Park Drive OAKVILLE ON L6H 6J8 CANADA | Manufacturer | : Sigma-Aldrich Corporation 3050 Spruce St. St. Louis, Missouri 63103 USA |
| Telephone | : +1 9058299500 | | |
| Fax | : +1 9058299292 | | |
| Emergency Phone # (For both supplier and manufacturer) | : 1-800-424-9300 | | |
| Preparation Information | : Sigma-Aldrich Corporation Product Safety - Americas Region 1-800-521-8956 | | |

2. HAZARDS IDENTIFICATION

Emergency Overview

Target Organs

Nerves., Liver, Heart, Eyes, Kidney, Central nervous system, Cardiovascular system., Gastrointestinal tract

WHMIS Classification

| | | |
|-----|--|---|
| B2 | Flammable liquid | Flammable liquid |
| D1B | Toxic Material Causing Immediate and Serious Toxic Effects | Toxic by ingestion |
| D2B | Toxic Material Causing Other Toxic Effects | Toxic by skin absorption Moderate eye irritant |

GHS Classification

Flammable liquids (Category 2)
Acute toxicity, Oral (Category 4)
Skin irritation (Category 2)
Eye irritation (Category 2A)
Specific target organ toxicity - single exposure (Category 1)
Specific target organ toxicity - single exposure (Category 3)

GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

| | |
|------|-------------------------------------|
| H225 | Highly flammable liquid and vapour. |
| H302 | Harmful if swallowed. |
| H315 | Causes skin irritation. |
| H319 | Causes serious eye irritation. |
| H335 | May cause respiratory irritation. |

H370 Causes damage to organs.
Precautionary statement(s)
P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P260 Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P307 + P311 IF exposed: Call a POISON CENTER or doctor/ physician.

HMIS Classification

Health hazard: 2
Chronic Health Hazard: *
Flammability: 3
Physical hazards: 0

Potential Health Effects

Inhalation Toxic if inhaled. Causes respiratory tract irritation.
Skin Toxic if absorbed through skin. Causes skin irritation.
Eyes Causes eye irritation.
Ingestion Toxic if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms : Ethyl alcohol
Reagent alcohol

Formula : C₂H₆O

| CAS-No. | EC-No. | Index-No. | Concentration |
|-------------------|-----------|--------------|---------------|
| Ethanol | | | |
| 64-17-5 | 200-578-6 | 603-002-00-5 | 90 % |
| Methanol | | | |
| 67-56-1 | 200-659-6 | 603-001-00-X | 5 % |
| 2-Propanol | | | |
| 67-63-0 | 200-661-7 | 603-117-00-0 | 5 % |

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability

Flammable in the presence of a source of ignition when the temperature is above the flash point. Keep away from heat/sparks/open flame/hot surface. No smoking.

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special protective equipment for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

Explosion data - sensitivity to mechanical impact

no data available

Explosion data - sensitivity to static discharge

no data available

Further information

Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES**Personal precautions**

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

7. HANDLING AND STORAGE**Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Moisture sensitive. Handle and store under inert gas.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION**Components with workplace control parameters**

| Components | CAS-No. | Value | Control parameters | Basis |
|------------|---------------------|-----------|--------------------------------------|---|
| Ethanol | 64-17-5 | TWA | 1,000 ppm 1,880 mg/m ³ | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | | TWA | 1,000 ppm 1,880 mg/m ³ | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | | TWAE V | 1,000 ppm 1,880 mg/m ³ | Québec. Regulation respecting occupational health and safety, Schedule 1, Part 1: Permissible exposure values for airborne contaminants |
| | | STEL | 1,000 ppm | Canada. British Columbia OEL |
| Methanol | 67-56-1 | STEV | 250 ppm 328 mg/m ³ | Québec. Regulation respecting occupational health and safety, Schedule 1, Part 1: Permissible exposure values for airborne contaminants |
| Remarks | Skin (percutaneous) | | | |
| | | TWA | 200 ppm | Canada. British Columbia OEL |

| | | | | |
|------------|---------|-----------|--|---|
| | | | Contributes significantly to the overall exposure by the skin route. | |
| | | STEL | 250 ppm | Canada. British Columbia OEL |
| | | | Contributes significantly to the overall exposure by the skin route. | |
| | | TWA | 200 ppm 262 mg/m3 | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | | | Substance may be readily absorbed through intact skin | |
| | | STEL | 250 ppm 328 mg/m3 | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | | | Substance may be readily absorbed through intact skin | |
| | | TWAE V | 200 ppm 262 mg/m3 | Québec. Regulation respecting occupational health and safety, Schedule 1, Part 1: Permissible exposure values for airborne contaminants |
| | | | Skin (percutaneous) | |
| | | TWA | 200 ppm 262 mg/m3 | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | | | Substance may be readily absorbed through intact skin | |
| | | STEL | 250 ppm 328 mg/m3 | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | | | Substance may be readily absorbed through intact skin | |
| 2-Propanol | 67-63-0 | TWAE V | 400 ppm 983 mg/m3 | Québec. Regulation respecting occupational health and safety, Schedule 1, Part 1: Permissible exposure values for airborne contaminants |
| | | TWA | 200 ppm | Canada. British Columbia OEL |
| | | STEL | 400 ppm | Canada. British Columbia OEL |
| | | STEL | 400 ppm 984 mg/m3 | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | | TWA | 200 ppm 492 mg/m3 | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | | STEL | 500 ppm 1,230 mg/m3 | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | | TWA | 400 ppm 983 mg/m3 | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | | STEV | 500 ppm 1,230 mg/m3 | Québec. Regulation respecting occupational health and safety, Schedule 1, Part 1: Permissible exposure values for airborne contaminants |

Personal protective equipment

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: butyl-rubber

Minimum layer thickness: 0.3 mm

Break through time: 480 min
Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.2 mm
Break through time: 30 min
Material tested: Dermatrill® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Eye protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Specific engineering controls

Use mechanical exhaust or laboratory fumehood to avoid exposure.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

| | |
|--------|-------------------|
| Form | liquid |
| Colour | no data available |

Safety data

| | |
|--|--|
| pH | no data available |
| Melting point/freezing point | Melting point/range: -130 °C (-202 °F) |
| Boiling point | 78 °C (172 °F) at 1,013 hPa (760 mmHg) |
| Flash point | 9 °C (48 °F) - closed cup |
| Ignition temperature | no data available |
| Auto-ignition temperature | 362 °C (684 °F) |
| Lower explosion limit | 3.3 %(V) |
| Upper explosion limit | 24.5 %(V) |
| Vapour pressure | 59.5 hPa (44.6 mmHg) at 20 °C (68 °F) |
| Density | 0.785 g/cm ³ |
| Water solubility | no data available |
| Partition coefficient: n-octanol/water | no data available |
| Relative vapour density | no data available |
| Odour | no data available |

Odour Threshold no data available

Evaporation rate no data available

10. STABILITY AND REACTIVITY

Chemical stability

Stable under recommended storage conditions.

Possibility of hazardous reactions

Vapours may form explosive mixture with air.

Conditions to avoid

Heat, flames and sparks. Extremes of temperature and direct sunlight.

Materials to avoid

Aluminium, Acids, Oxidizing agents, Alkali metals, Halogenated compounds, Ammonia, Acid chlorides, Acid anhydrides, Reducing agents, Peroxides

Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides
Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50

Inhalation LC50

Dermal LD50

Other information on acute toxicity

no data available

Skin corrosion/irritation

no data available

Serious eye damage/eye irritation

Eyes: no data available

Respiratory or skin sensitisation

no data available

Germ cell mutagenicity

no data available

Carcinogenicity

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (2-Propanol)

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)

no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)

no data available

Aspiration hazard

no data available

Potential health effects

| | |
|-------------------|---|
| Inhalation | Toxic if inhaled. Causes respiratory tract irritation. |
| Ingestion | Toxic if swallowed. |
| Skin | Toxic if absorbed through skin. Causes skin irritation. |
| Eyes | Causes eye irritation. |

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated., Central nervous system depression, Gastrointestinal disturbance, Nausea, Dizziness, Headache, narcosis, May cause convulsions.

Synergistic effects

no data available

Additional Information

RTECS: Not available

12. ECOLOGICAL INFORMATION**Toxicity**

no data available

Persistence and degradability

no data available

Bioaccumulative potential

no data available

Mobility in soil

no data available

PBT and vPvB assessment

no data available

Other adverse effects

no data available

13. DISPOSAL CONSIDERATIONS**Product**

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION**DOT (US)**

UN number: 1170 Class: 3 Packing group: II

Proper shipping name: Ethanol solutions

Marine pollutant: No

Poison Inhalation Hazard: No

IMDG

UN number: 1170 Class: 3 Packing group: II EMS-No: F-E, S-D

Proper shipping name: ETHANOL SOLUTION

Marine pollutant: No

IATA

UN number: 1170 Class: 3 Packing group: II

Proper shipping name: Ethanol solution

15. REGULATORY INFORMATION**WHMIS Classification**

| | | |
|-----|--|---|
| B2 | Flammable liquid | Flammable liquid |
| D1B | Toxic Material Causing Immediate and Serious Toxic Effects | Toxic by ingestion |
| D2B | Toxic Material Causing Other Toxic Effects | Toxic by skin absorption Moderate eye irritant |

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

16. OTHER INFORMATION**Further information**

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Fisher Scientific

Part of Thermo Fisher Scientific

Material Safety Data Sheet

Creation Date 08-Feb-2010

Revision Date 05-Jun-2012

Revision Number 2

1. PRODUCT AND COMPANY IDENTIFICATION

| | |
|------------------------|--|
| Product Name | Formaldehyde solution 37% |
| Cat No. | F75F-1GAL; F75P-1GAL; F75P-4; F75P-20; F77-20; F77-200; F77P-4; F77P-20; F79-1; F79-4; F79-4LC; F79-20; F79-200; F79-500; F79P-4; F79P-20 |
| Synonyms | Formalin; Methanal; Methylene oxide; Oxymethane; Formic aldehyde; Methyl aldehyde (Preserved/Stabilized/USP/Molecular Biology/Certified ACS) |
| Recommended Use | Laboratory chemicals |
| Company | Emergency Telephone Number |
| Fisher Scientific | CHEMTREC®, Inside the USA: 800-424-9300 |
| One Reagent Lane | CHEMTREC®, Outside the USA: 001-703-527-3887 |
| Fair Lawn, NJ 07410 | |
| Tel: (201) 796-7100 | |

2. HAZARDS IDENTIFICATION

DANGER!

Emergency Overview

Flammable liquid and vapor. Cancer hazard. Poison, may be fatal or cause blindness if swallowed. Cannot be made non-poisonous. Toxic by inhalation, in contact with skin and if swallowed. Causes burns by all exposure routes. Vapor harmful. May cause an allergic skin reaction. May cause central nervous system effects. **WARNING!** This product contains a chemical known in the State of California to cause birth defects or other reproductive harm.

Appearance Colorless

Physical State Liquid

odor pungent

Target Organs

Gastrointestinal tract (GI), Central nervous system (CNS), Eyes, Respiratory system, Skin, Optic nerve, Heart, Liver, Kidney, spleen, Blood

Potential Health Effects

Acute Effects

Principle Routes of Exposure

Eyes

Causes burns.

Skin

Causes burns. Toxic in contact with skin. May produce an allergic reaction.

Inhalation

Causes burns. Toxic by inhalation. Inhalation may cause central nervous system effects.

Ingestion May be fatal or cause blindness if swallowed. Causes burns. May cause central nervous system effects. May cause adverse liver effects. May cause adverse kidney effects.

Chronic Effects May cause cancer. Tumorigenic effects have been reported in experimental animals.. Experiments have shown reproductive toxicity effects on laboratory animals. May cause adverse liver effects. May cause adverse kidney effects. Repeated contact may cause allergic reactions in very susceptible persons. Component substance is listed on California Proposition 65 as a developmental hazard.

See Section 11 for additional Toxicological information.

Aggravated Medical Conditions Central nervous system disorders. Gastrointestinal tract. Preexisting eye disorders. Skin disorders.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Haz/Non-haz

| Component | CAS-No | Weight % |
|----------------|-----------|----------|
| Water | 7732-18-5 | 45 - 48 |
| Formaldehyde | 50-00-0 | 37 - 40 |
| Methyl alcohol | 67-56-1 | 15 |

4. FIRST AID MEASURES

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Immediate medical attention is required.

Ingestion Do not induce vomiting. Call a physician or Poison Control Center immediately.

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flash Point 50°C / 122°F

Method No information available.

Autoignition Temperature No information available.

Explosion Limits

Upper No data available

Lower No data available

Suitable Extinguishing Media Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Unsuitable Extinguishing Media No information available.

Hazardous Combustion Products No information available.

Sensitivity to mechanical impact
Sensitivity to static discharge

No information available.
 No information available.

Specific Hazards Arising from the Chemical

Flammable. Risk of ignition. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Containers may explode when heated.

Protective Equipment and Precautions for Firefighters

Thermal decomposition can lead to release of irritating gases and vapors.

NFPA **Health 3** **Flammability 2** **Instability 0** **Physical hazards N/A**

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions Use personal protective equipment. Remove all sources of ignition. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Take precautionary measures against static discharges. Do not get in eyes, on skin, or on clothing.

Environmental Precautions Should not be released into the environment.

Methods for Containment and Clean Up Remove all sources of ignition. Soak up with inert absorbent material. Take precautionary measures against static discharges. Keep in suitable, closed containers for disposal..

7. HANDLING AND STORAGE

Handling Use only under a chemical fume hood. Remove all sources of ignition. Keep away from open flames, hot surfaces and sources of ignition. Take precautionary measures against static discharges. Do not breathe vapors or spray mist. Do not get in eyes, on skin, or on clothing.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Flammables area.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Measures

Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure that eyewash stations and safety showers are close to the workstation location.

Exposure Guidelines

| Component | ACGIH TLV | OSHA PEL | NIOSH IDLH |
|----------------|---------------------------------------|--|--|
| Formaldehyde | Ceiling: 0.3 ppm | (Vacated) TWA: 3 ppm (Vacated) STEL: 10 ppm (Vacated) Ceiling: 5 ppm TWA: 0.75 ppm STEL: 2 ppm | IDLH: 20 ppm TWA: 0.016 ppm Ceiling: 0.1 ppm |
| Methyl alcohol | TWA: 200 ppm STEL: 250 ppm Skin | (Vacated) TWA: 200 ppm (Vacated) TWA: 260 mg/m ³ (Vacated) STEL: 250 ppm (Vacated) STEL: 325 mg/m ³ Skin TWA: 200 ppm TWA: 260 mg/m ³ | IDLH: 6000 ppm TWA: 200 ppm TWA: 260 mg/m ³ STEL: 250 ppm STEL: 325 mg/m ³ |

| Component | Quebec | Mexico OEL (TWA) | Ontario TWA/EV |
|----------------|--|--|---------------------------------------|
| Formaldehyde | Ceiling: 2 ppm Ceiling: 3 mg/m ³ | Peak: 2 ppm Peak: 3 mg/m ³ | STEL: 1.0 ppm CEV: 1.5 ppm |
| Methyl alcohol | TWA: 200 ppm TWA: 262 mg/m ³ STEL: 250 ppm STEL: 328 mg/m ³ Skin | TWA: 200 ppm TWA: 260 mg/m ³ STEL: 250 ppm STEL: 310 mg/m ³ | TWA: 200 ppm STEL: 250 ppm Skin |

NIOSH IDLH: Immediately Dangerous to Life or Health

Personal Protective Equipment

Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure

Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State

Liquid

Appearance

Colorless

odor

pungent

Odor Threshold

No information available.

pH

No information available.

Vapor Pressure

No information available.

Vapor Density

> 1.0

Viscosity

No information available.

Boiling Point/Range

101°C / 213.8°F

Melting Point/Range

0°C / 32°F

Decomposition temperature

No information available.

Flash Point

50°C / 122°F

Evaporation Rate

No information available.

Specific Gravity

No information available.

9. PHYSICAL AND CHEMICAL PROPERTIES

Solubility Soluble in water
log Pow No data available

10. STABILITY AND REACTIVITY

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products. Heat, flames and sparks.

Incompatible Materials Strong oxidizing agents, Strong bases, nitriles, Acids, Isocyanates, Acid anhydrides, Metals, Acid chlorides

Hazardous Decomposition Products Carbon monoxide (CO), Carbon dioxide (CO₂), Hydrogen, Formaldehyde

Hazardous Polymerization Hazardous polymerization does not occur

Hazardous Reactions . None under normal processing.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Product Information No acute toxicity information is available for this product

Component Information

| Component | LD50 Oral | LD50 Dermal | LC50 Inhalation (Dust) |
|----------------|--------------------|------------------------|--|
| Formaldehyde | 500 mg/kg (Rat) | Not listed | 0.578 mg/L (Rat) 4 h |
| Methyl alcohol | 5628 mg/kg (Rat) | 15800 mg/kg (Rabbit) | 64000 ppm (Rat) 4 h 83.2 mg/L (Rat) 4 h |

Irritation Causes burns by all exposure routes

Toxicologically Synergistic Products No information available.

Chronic Toxicity

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

| Component | ACGIH | IARC | NTP | OSHA | Mexico |
|--------------|-------|---------|------------------------|------|--------|
| Formaldehyde | A2 | Group 1 | Reasonably Anticipated | X | A2 |

ACGIH: (American Conference of Governmental Industrial Hygienists)

A1 - Known Human Carcinogen

A2 - Suspected Human Carcinogen

A3 - Animal Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)

IARC: (International Agency for Research on Cancer)
 IARC: (International Agency for Research on Cancer)
 Group 1 - Carcinogenic to Humans
 Group 2A - Probably Carcinogenic to Humans
 Group 2B - Possibly Carcinogenic to Humans
NTP: (National Toxicity Program)
 NTP: (National Toxicity Program)
 Known - Known Carcinogen
 Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen

Sensitization May cause sensitization by skin contact

Mutagenic Effects Mutagenic effects have occurred in humans.

Reproductive Effects Experiments have shown reproductive toxicity effects on laboratory animals.

Developmental Effects Developmental effects have occurred in experimental animals. Component substance is listed on California Proposition 65 as a developmental hazard.

Teratogenicity Teratogenic effects have occurred in experimental animals..

Other Adverse Effects Tumorigenic effects have been reported in experimental animals.. See actual entry in RTECS for complete information.

Endocrine Disruptor Information No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity
 . Do not empty into drains.

| Component | Freshwater Algae | Freshwater Fish | Microtox | Water Flea |
|----------------|------------------|--|---|---|
| Formaldehyde | Not listed | Leuciscus idus: LC50 = 15 mg/L 96h | Not listed | EC50 = 20 mg/L 96h EC50 = 2 mg/L 48h |
| Methyl alcohol | Not listed | Pimephales promelas: LC50 > 10000 mg/L 96h | EC50 = 39000 mg/L 25 min EC50 = 40000 mg/L 15 min EC50 = 43000 mg/L 5 min | EC50 > 10000 mg/L 24h |

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available

Mobility .

| Component | log Pow |
|----------------|---------|
| Formaldehyde | -0.35 |
| Methyl alcohol | -0.74 |

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification

| Component | RCRA - U Series Wastes | RCRA - P Series Wastes |
|--------------------------|------------------------|------------------------|
| Formaldehyde - 50-00-0 | U122 | - |
| Methyl alcohol - 67-56-1 | U154 | - |

14. TRANSPORT INFORMATION

DOT

UN-No UN1198
Proper Shipping Name FORMALDEHYDE, SOLUTIONS, FLAMMABLE
Hazard Class 3
Subsidiary Hazard Class 8
Packing Group III

TDG

UN-No UN1198
Proper Shipping Name FORMALDEHYDE, SOLUTIONS, FLAMMABLE
Hazard Class 3
Subsidiary Hazard Class 8
Packing Group III

IATA

UN-No UN1198
Proper Shipping Name FORMALDEHYDE, SOLUTIONS, FLAMMABLE
Hazard Class 3
Subsidiary Hazard Class 8
Packing Group III

IMDG/IMO

UN-No UN1198
Proper Shipping Name FORMALDEHYDE, SOLUTIONS, FLAMMABLE
Hazard Class 3
Subsidiary Hazard Class 8
Packing Group III

15. REGULATORY INFORMATION

International Inventories

| Component | TSCA | DSL | NDSL | EINECS | ELINCS | NLP | PICCS | ENCS | AICS | CHINA | KECL |
|----------------|------|-----|------|-----------|--------|-----|-------|------|------|-------|------|
| Water | X | X | - | 231-791-2 | - | | X | - | X | X | X |
| Formaldehyde | X | X | - | 200-001-8 | - | | X | X | X | X | X |
| Methyl alcohol | X | X | - | 200-659-6 | - | | X | X | X | X | X |

Legend:

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
 N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
 P - Indicates a commenced PMN substance
 R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
 S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
 T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
 XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).
 Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
 Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

| Component | CAS-No | Weight % | SARA 313 - Threshold Values % |
|----------------|---------|----------|-------------------------------|
| Formaldehyde | 50-00-0 | 37 - 40 | 0.1 |
| Methyl alcohol | 67-56-1 | 15 | 1.0 |

SARA 311/312 Hazardous Categorization

Acute Health Hazard Yes
 Chronic Health Hazard Yes
 Fire Hazard Yes
 Sudden Release of Pressure Hazard No
 Reactive Hazard No

Clean Water Act

| Component | CWA - Hazardous Substances | CWA - Reportable Quantities | CWA - Toxic Pollutants | CWA - Priority Pollutants |
|--------------|----------------------------|-----------------------------|------------------------|---------------------------|
| Formaldehyde | X | 100 lb | - | - |

Clean Air Act

| Component | HAPS Data | Class 1 Ozone Depletors | Class 2 Ozone Depletors |
|----------------|-----------|-------------------------|-------------------------|
| Formaldehyde | X | | - |
| Methyl alcohol | X | | - |

OSHA

| Component | Specifically Regulated Chemicals | Highly Hazardous Chemicals |
|--------------|--|----------------------------|
| Formaldehyde | 2 ppm STEL 0.5 ppm Action Level 0.75 ppm TWA | TQ: 1000 lb |

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

| Component | Hazardous Substances RQs | CERCLA EHS RQs |
|--------------|--------------------------|----------------|
| Formaldehyde | 100 lb | 100 lb |

| Component | Hazardous Substances RQs | CERCLA EHS RQs |
|----------------|--------------------------|----------------|
| Methyl alcohol | 5000 lb | - |

California Proposition 65

This product contains the following Proposition 65 chemicals:

| Component | CAS-No | California Prop. 65 | Prop 65 NSRL |
|----------------|---------|---------------------|--------------|
| Formaldehyde | 50-00-0 | Carcinogen | 40 µg/day |
| Methyl alcohol | 67-56-1 | Methanol | - |

State Right-to-Know

| Component | Massachusetts | New Jersey | Pennsylvania | Illinois | Rhode Island |
|----------------|---------------|------------|--------------|----------|--------------|
| Formaldehyde | X | X | X | X | X |
| Methyl alcohol | X | X | X | X | X |

U.S. Department of Transportation

Reportable Quantity (RQ): Y
 DOT Marine Pollutant N
 DOT Severe Marine Pollutant N

U.S. Department of Homeland Security

This product contains the following DHS chemicals:

| Component | DHS Chemical Facility Anti-Terrorism Standard |
|--------------|---|
| Formaldehyde | 11250 lb STQ (solution) |

Other International Regulations

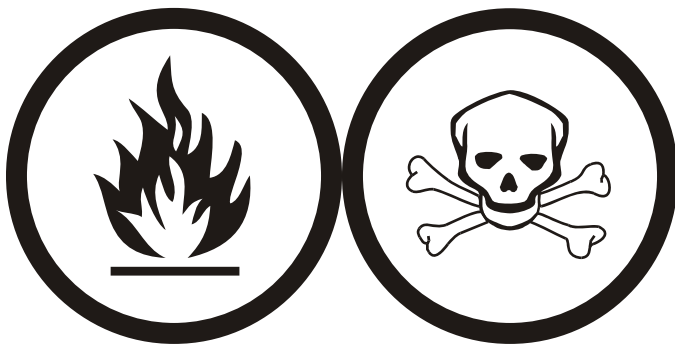
Mexico - Grade Moderate risk, Grade 2

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class

- B3 Combustible liquid
- D1A Very toxic materials
- D2A Very toxic materials
- D2B Toxic materials
- E Corrosive material





16. OTHER INFORMATION

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 08-Feb-2010

Print Date 05-Jun-2012

Revision Summary "****", and red text indicates revision

Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of MSDS



MATERIAL SAFETY DATA SHEET

Date Prepared: April 21, 2006
Supersedes: February 7, 2006
MSDS Number: 5842

1. PRODUCT INFORMATION

Product Identifier: HFO 7015
HEAVY FUEL OIL #6 (HIGH FLASH)
HEAVY FUEL OIL 6020 (HIGH FLASH)
HEAVY FUEL OIL 7120
HEAVY FUEL OIL 7020
HEAVY FUEL OIL 7025
HEAVY FUEL OIL 7130
HFO 7025
HFO 7130
HFO 7020
HFO 7015
BUNKER FUEL OIL
NO. 6 FUEL OIL
FUEL OIL NO. 6
HEAVY FUEL OIL BASE
HEAVY FUEL OIL 6300
HFO 6020
HEAVY FUEL OIL BASE LOW SULPHUR
INTERMEDIATE FUEL OIL BASE
HEAVY FUEL OIL 6030
HFO 6030

Application and Use:
Multi-purpose fuel

Product Description:

A complex mixture of aliphatic, olefinic, naphthenic and aromatic hydrocarbons.

REGULATORY CLASSIFICATION

WHMIS:
Class B, Division 3: Combustible Liquids.
Class D, Division 2, Subdivision A: Very Toxic Material.
Class D, Division 2, Subdivision B: Toxic Material

CEPA: CANADIAN ENVIRONMENTAL PROTECTION ACT

All components of this product are either on the Domestic Substances List (DSL), exempt, or have been notified under CEPA.

TDG INFORMATION (RAIL/ROAD):

Not regulated in Canada if the loading temperature does not exceed the flash point and the flash point is above 60.5C or the classification is one of the following depending on the criteria below:

1) Shipping Name:

ELEVATED TEMPERATURE LIQUID, FLAMMABLE, N.O.S. with flash point above 60.5 deg C and with loading temperature at or above its flashpoint

Class: 3

Packing Group: III

PIN Number: UN3256

Marine Pollutant: N

2) Shipping Name:

ELEVATED TEMPERATURE LIQUID, FLAMMABLE, N.O.S. at or above 100 deg C and below its flash point

Class: 9

PIN Number: UN3257

Packing Group: III

Marine Pollutant: N

Please be aware that other regulations may apply.

TELEPHONE NUMBERS

MANUFACTURER/SUPPLIER:

Emergency 24 hr. (519) 339-2145

Technical Info. (800) 268-3183

IMPERIAL OIL
Products Division
240 4th Avenue S.W.
Calgary, Alberta
T2P 3M9

2. REGULATED COMPONENTS

The following components are defined in accordance with sub-paragraph 13(a) (i) to (iv) or paragraph 14(a) of the Hazardous Products Act:

| NAME | % | CAS # |
|-------------------------------|-----------|------------|
| Residual Fuel Oil | 0-100 V/V | 68476-33-5 |
| Cat Cracked Clarified Oil | 0-100 V/V | 64741-62-4 |
| Heavy Atmospheric Gas Oil | 0-40 V/V | 68915-96-8 |
| Light Atmospheric Gas Oil | 0-40 V/V | 64741-44-2 |
| Light Cat. Cracked Distillate | 0-40 V/V | 64741-59-9 |

3. TYPICAL PHYSICAL & CHEMICAL PROPERTIES

Physical State: Liquid
Specific gravity: 0.970 to 1.150 at 15.0 deg C
Viscosity: 50.00 cSt at 50 deg C
to 635.00 cSt at 50 deg C
Vapour Density: not available
Boiling Point: not available
Evaporation rate: <1 (1= n-butylacetate)
Solubility in water: negligible
Freezing/Pour Point: 21 deg C LESS THAN
Odour Threshold: not available
Vapour Pressure: 0.1 kPa at 20 deg C
Appearance/odour: Black viscous liquid, petroleum hydrocarbon odour.

4. HEALTH HAZARD INFORMATION

NATURE OF HAZARD

INHALATION:

Low toxicity.
Elevated temperatures or mechanical action may form vapours, mists or fumes which may affect various internal body systems.
It is possible for the toxic gas hydrogen sulphide to build up in tanks or other confined spaces that contain this product. Although the gas smells like rotten eggs at low concentrations, it may cause irritation, respiratory collapse, coma and death without necessarily any warning odour being sensed.
Avoid breathing vapours or mists.

EYE CONTACT:

Hot splashes may cause eye burns and permanent eye damage.

SKIN CONTACT:

Irritating.
Frequent or prolonged contact may irritate the skin and cause a skin rash (dermatitis).
Certain components present in this material may be absorbed through the skin in toxic quantities.
Exposure to hot material may cause thermal burns.

INGESTION:

Low toxicity.
Irritating to mouth, throat and stomach and may cause digestive tract disorder and/or damage.

CHRONIC:

Contains polycyclic aromatic compounds (PAC's). Prolonged and/or repeated skin contact with certain PAC's has been shown to cause skin cancer. Prolonged and/or repeated exposures by inhalation of certain PAC's may also cause cancer of the lung and of other parts of the body. This material or one of its components has shown evidence of causing mutations in laboratory animals. Prolonged and/or repeated exposures may cause liver disorder and/or damage .

ACUTE TOXICITY DATA:

Based on animal testing data from similar materials and products, the acute toxicity of this product is expected to be:

Oral : LD50 > 5000 mg/kg (Rat)
Dermal : LD50 > 2000 mg/kg (Rabbit)
Inhalation : LC50 > 2500 mg/m3 (Rat)

OCCUPATIONAL EXPOSURE LIMIT:

Manufacturer Recommends:

For total oil mist and particulate, 0.1 mg/m3 benzene soluble fraction recommended.

ACGIH recommends:

For Hydrogen Sulphide, 10 ppm (14 mg/m3).

Local regulated limits may vary.

5. FIRST AID MEASURES**INHALATION:**

In emergency situations use proper respiratory protection to immediately remove the affected victim from exposure. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.

EYE CONTACT:

Flush eyes with large amounts of water until irritation subsides. If irritation persists, get medical attention.

SKIN CONTACT:

Immediately flush with large amounts of water. Use soap if available. Remove contaminated clothing, including shoes, after flushing has begun. If irritation persists, seek medical attention. For hot material, immediately immerse in or flush affected area with large amounts of cold water to dissipate heat. Cover with clean cotton sheeting or gauze and get prompt medical attention.

INGESTION:

If swallowed, DO NOT induce vomiting. Keep at rest. Get prompt medical attention.

6. PREVENTIVE AND CORRECTIVE MEASURES

PERSONAL PROTECTION:

The selection of personal protective equipment varies, depending upon conditions of use.

Gloves and safety glasses should be worn.

Where concentrations in air may exceed the occupational exposure limits given in Section 4 and where engineering, work practices or other means of exposure reduction are not adequate, approved respirators may be necessary to prevent overexposure by inhalation.

ENGINEERING CONTROLS:

The use of local exhaust ventilation is recommended to control emissions near the source. Laboratory samples should be handled in a fumehood. Provide mechanical ventilation of confined spaces.

HANDLING, STORAGE AND SHIPPING:

Keep containers closed. Handle and open containers with care.

Store in a cool, well ventilated place away from incompatible materials.

In keeping with good personal hygiene practices, wash hands thoroughly after handling the material.

Do not handle or store near an open flame, sources of heat, or sources of ignition.

Material will accumulate static charges which may cause a spark. Static charge build-up could become an ignition source. Use proper relaxation and grounding procedures.

Empty containers may contain product residue. Do not pressurize cut, heat, or weld empty containers. Do not reuse empty containers without commercial cleaning or reconditioning.

LAND SPILL:

Eliminate source of ignition. Keep public away. Prevent additional discharge of material, if possible to do so without hazard.

Prevent spills from entering sewers, watercourses or low areas. Contain spilled liquid with sand or earth. Do not use combustible materials such as sawdust.

Recover by pumping (use an explosion proof motor or hand pump), or by using a suitable absorbent.

If liquid is too viscous for pumping, scrape up.

Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately. Take all additional action necessary to prevent and remedy the adverse effects of the spill.

WATER SPILL:

Remove from surface by skimming or with suitable absorbents. If allowed by local authorities and environmental agencies, sinking and/or suitable dispersants may be used in unconfined waters.

Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately. Take all additional action necessary to prevent and remedy the adverse effects of the spill.

7. FIRE AND EXPLOSION HAZARD

Flashpoint and method: Varies, Minimum 66deg C PMCC D93

Autoignition: NA Flammable Limits: LEL: NA UEL: NA

GENERAL HAZARDS:

Combustible Liquid; may form combustible mixtures at or above the flash point.

Decomposes; flammable/toxic gases will form at elevated temperatures (thermal decomposition).

Toxic gases will form upon combustion.

Static Discharge; material may accumulate static charges which may cause a fire.

FIRE FIGHTING:

Use water spray to cool fire exposed surfaces and to protect personnel. Shut off fuel to fire.

Use foam, dry chemical or water spray to extinguish fire.

Respiratory and eye protection required for fire fighting personnel.

A self-contained breathing apparatus (SCBA) should be used for all indoor fires and any significant outdoor fires. For small outdoor fires, which may easily be extinguished with a portable fire extinguisher, use of an SCBA may not be required.

HAZARDOUS COMBUSTION PRODUCTS:

Fumes, smoke, carbon monoxide, hydrogen sulfide, sulfur oxides, aldehydes and other decomposition products, in the case of incomplete combustion.

8. REACTIVITY DATA**STABILITY:**

This product is stable. Hazardous polymerization will not occur.

INCOMPATIBLE MATERIALS AND CONDITIONS TO AVOID:

Avoid contact with strong oxidants such as liquid chlorine, concentrated oxygen, sodium hypochlorite, calcium hypochlorite, etc., as this presents a serious explosion hazard.

HAZARDOUS DECOMPOSITION:

Fumes, smoke, carbon monoxide, hydrogen sulfide, sulfur oxides, aldehydes and other decomposition products, in the case of incomplete combustion.

9. NOTES

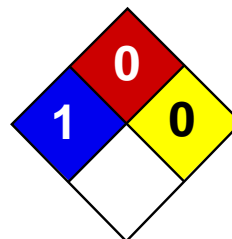
All components of this product are listed on the U.S. TSCA inventory.

Revised Section 1

10. PREPARATION

Date Prepared: April 21, 2006
Prepared by: Lubricants & Specialties
IMPERIAL OIL
Products Division
240 4th Avenue S.W.
Calgary, Alberta
T2P 3M9
(800) 268-3183

CAUTION: " The information contained herein relates only to this product or material and may not be valid when used in combination with any other product or material or in any process. If the product is not to be used for a purpose or under conditions which are normal or reasonably foreseeable, this information cannot be relied upon as complete or applicable. For greater certainty, uses other than those described in Section 1 must be reviewed with the supplier. The information contained herein is based on the information available at the indicated date of preparation. This MSDS is for the use of Imperial Oil customers and their employees and agents only. Any further distribution of this MSDS by Imperial Oil customers is prohibited without the written consent of Imperial Oil."



| | |
|---------------------|---|
| Health | 1 |
| Fire | 0 |
| Reactivity | 0 |
| Personal Protection | E |

Material Safety Data Sheet Glass wool MSDS

Section 1: Chemical Product and Company Identification

Product Name: Glass wool

Catalog Codes: SLG1363

CAS#: 7631-86-9

RTECS: VV7328000

TSCA: TSCA 8(b) inventory: Glass wool

CI#: Not applicable.

Synonym: Sand; Silica gel

Chemical Name: Silicon dioxide

Chemical Formula: SiO₂

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

| Name | CAS # | % by Weight |
|------------|-----------|-------------|
| Glass wool | 7631-86-9 | 100 |

Toxicological Data on Ingredients: Glass wool: ORAL (LD50): Acute: 3160 mg/kg [Rat.].

Section 3: Hazards Identification

Potential Acute Health Effects:

Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant).

Potential Chronic Health Effects:

Hazardous in case of ingestion. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of inhalation. **CARCINOGENIC EFFECTS:** Classified A3 (Proven for animal.) by ACGIH. **MUTAGENIC EFFECTS:** Not available. **TERATOGENIC EFFECTS:** Not available. **DEVELOPMENTAL TOXICITY:** Not available. The substance is toxic to lungs, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: No known effect on eye contact, rinse with water for a few minutes.

Skin Contact:

After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:

Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Keep container tightly closed.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:

Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up Do not ingest. Do not breathe dust. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label.

Storage:

Carcinogenic, teratogenic or mutagenic materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 10 (mg/m³) Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Solid powder.)

Odor: Odorless.

Taste: Tasteless.

Molecular Weight: 60.08 g/mole

Color: White.

pH (1% soln/water): Not applicable.

Boiling Point: 2230°C (4046°F)

Melting Point: 1710°C (3110°F)

Critical Temperature: Not available.

Specific Gravity: 2.2 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water, methanol, diethyl ether, n-octanol.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity: Incompatible with hydrogen fluoride.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 3160 mg/kg [Rat.].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans:

Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Material is irritating to mucous membranes and upper respiratory tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:

California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Glass wool California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a

warning under the statute: Glass wool Pennsylvania RTK: Glass wool Massachusetts RTK: Glass wool TSCA 8(b) inventory: Glass wool

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):

R40- Possible risks of irreversible effects.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Industrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II.

Other Special Considerations: Not available.

Created: 10/09/2005 05:37 PM

Last Updated: 05/21/2013 12:00 PM

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1. PRODUCT AND COMPANY IDENTIFICATION

| | | | |
|--|---|--|---|
| Product name | : | Hexane | |
| Product Number | : | 650552 | |
| Brand | : | Sigma-Aldrich | |
| Product Use | : | For laboratory research purposes. | |
| Supplier | : | Sigma-Aldrich Canada Co. 2149 Winston Park Drive OAKVILLE ON L6H 6J8 CANADA | Manufacturer : Sigma-Aldrich Corporation 3050 Spruce St. St. Louis, Missouri 63103 USA |
| Telephone | : | +1 9058299500 | |
| Fax | : | +1 9058299292 | |
| Emergency Phone # (For both supplier and manufacturer) | : | 1-800-424-9300 | |
| Preparation Information | : | Sigma-Aldrich Corporation Product Safety - Americas Region 1-800-521-8956 | |

2. HAZARDS IDENTIFICATION

Emergency Overview

Target Organs

Peripheral nervous system., Kidney, Testes. Peripheral nervous system., Kidney, Testes.

WHMIS Classification

| | | |
|-----|---|------------------------|
| B2 | Flammable liquid | Flammable liquid |
| D2A | Very Toxic Material Causing Other Toxic Effects | Reproductive hazard |
| D2B | Toxic Material Causing Other Toxic Effects | Moderate skin irritant |

GHS Classification

Flammable liquids (Category 2)
Skin irritation (Category 2)
Eye irritation (Category 2B)
Reproductive toxicity (Category 2)
Specific target organ toxicity - single exposure (Category 3), Central nervous system
Specific target organ toxicity - repeated exposure, Oral (Category 2), Nervous system
Aspiration hazard (Category 1)
Acute aquatic toxicity (Category 2)
Chronic aquatic toxicity (Category 2)

GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

| | |
|-------------|---|
| H225 | Highly flammable liquid and vapour. |
| H304 | May be fatal if swallowed and enters airways. |
| H315 + H320 | Causes skin and eye irritation. |
| H336 | May cause drowsiness or dizziness. |

| | |
|----------------------------|--|
| H361f | Suspected of damaging fertility. |
| H373 | May cause damage to organs (Nervous system) through prolonged or repeated exposure if swallowed. |
| H411 | Toxic to aquatic life with long lasting effects. |
| Precautionary statement(s) | |
| P210 | Keep away from heat/sparks/open flames/hot surfaces. - No smoking. |
| P261 | Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray. |
| P273 | Avoid release to the environment. |
| P281 | Use personal protective equipment as required. |
| P301 + P310 | IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician. |
| P305 + P351 + P338 | IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. |
| P331 | Do NOT induce vomiting. |

HMIS Classification

| | |
|-------------------------------|---|
| Health hazard: | 2 |
| Chronic Health Hazard: | * |
| Flammability: | 3 |
| Physical hazards: | 0 |

Potential Health Effects

| | |
|-------------------|---|
| Inhalation | May be harmful if inhaled. Causes respiratory tract irritation. Vapours may cause drowsiness and dizziness. |
| Skin | May be harmful if absorbed through skin. Causes skin irritation. |
| Eyes | Causes eye irritation. |
| Ingestion | May be harmful if swallowed. Aspiration hazard if swallowed - can enter lungs and cause damage. |

3. COMPOSITION/INFORMATION ON INGREDIENTS

| | |
|------------------|----------------------------------|
| Synonyms | : <i>n</i> -Hexane |
| Formula | : C ₆ H ₁₄ |
| Molecular Weight | : 86.18 g/mol |

| CAS-No. | EC-No. | Index-No. | Concentration |
|-----------------|-----------|--------------|---------------|
| n-Hexane | | | |
| 110-54-3 | 203-777-6 | 601-037-00-0 | - |

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability

Flammable in the presence of a source of ignition when the temperature is above the flash point. Keep away from heat/sparks/open flame/hot surface. No smoking.

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special protective equipment for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

Explosion data - sensitivity to mechanical impact

no data available

Explosion data - sensitivity to static discharge

no data available

Further information

Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES**Personal precautions**

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

7. HANDLING AND STORAGE**Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION**Components with workplace control parameters**

| Components | CAS-No. | Value | Control parameters | Basis |
|------------|--|-----------|---------------------------------|---|
| n-Hexane | 110-54-3 | TWA | 50 ppm 176 mg/m ³ | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| Remarks | Substance may be readily absorbed through intact skin | | | |
| | | TWA | 20 ppm | Canada. British Columbia OEL |
| | Contributes significantly to the overall exposure by the skin route. | | | |
| | | TWAE V | 50 ppm 176 mg/m ³ | Québec. Regulation respecting occupational health and safety, Schedule 1, Part 1: Permissible exposure values for airborne contaminants |
| | Skin (percutaneous) | | | |

Personal protective equipment

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 480 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 30 min

Material tested: Dermatril® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Eye protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Specific engineering controls

Use mechanical exhaust or laboratory fumehood to avoid exposure.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form liquid

Colour colourless

Safety data

pH 7.0

Melting point/freezing point Melting point/range: -95 °C (-139 °F)

Boiling point 69 °C (156 °F)

Flash point -26.0 °C (-14.8 °F) - closed cup

Ignition temperature 234 °C (453 °F)

Auto-ignition temperature 234.0 °C (453.2 °F)

| | |
|---|--|
| Lower explosion limit | 1.2 %(V) |
| Upper explosion limit | 7.7 %(V) |
| Vapour pressure | 341.3 hPa (256.0 mmHg) at 37.7 °C (99.9 °F) 176.0 hPa (132.0 mmHg) at 20.0 °C (68.0 °F) |
| Density | 0.659 g/mL at 25 °C (77 °F) |
| Water solubility | insoluble |
| Partition coefficient: n-octanol/water | log Pow: 3.90 - 4.11 |
| Relative vapour density | no data available |
| Odour | no data available |
| Odour Threshold | no data available |
| Evaporation rate | 15.8 |

10. STABILITY AND REACTIVITY

Chemical stability

Stable under recommended storage conditions.

Possibility of hazardous reactions

Vapours may form explosive mixture with air.

Conditions to avoid

Heat, flames and sparks. Extremes of temperature and direct sunlight.

Materials to avoid

Oxidizing agents

Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides
Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50

LD50 Oral - rat - 25,000 mg/kg

Inhalation LC50

LC50 Inhalation - rat - 4 h - 48000 ppm

Dermal LD50

no data available

Other information on acute toxicity

no data available

Skin corrosion/irritation

no data available

Serious eye damage/eye irritation

Eyes - rabbit - Mild eye irritation

Respiratory or skin sensitisation

no data available

Germ cell mutagenicity

no data available

Carcinogenicity

Carcinogenicity - rat - Inhalation

Tumorigenic: Carcinogenic by RTECS criteria. Tumorigenic Effects: Testicular tumors.

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

Reproductive toxicity

Overexposure may cause reproductive disorder(s) based on tests with laboratory animals. Suspected human reproductive toxicant Suspected of damaging fertility.

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)

May cause drowsiness or dizziness.

Specific target organ toxicity - repeated exposure (Globally Harmonized System)

Ingestion - May cause damage to organs through prolonged or repeated exposure. - Nervous system

Aspiration hazard

May be fatal if swallowed and enters airways.

Potential health effects

| | |
|-------------------|---|
| Inhalation | May be harmful if inhaled. Causes respiratory tract irritation. Vapours may cause drowsiness and dizziness. |
| Ingestion | May be harmful if swallowed. Aspiration hazard if swallowed - can enter lungs and cause damage. |
| Skin | May be harmful if absorbed through skin. Causes skin irritation. |
| Eyes | Causes eye irritation. |

Signs and Symptoms of Exposure

Prolonged or repeated contact with skin may cause: defatting, Dermatitis, Contact with eyes can cause: Redness, Blurred vision, Provokes tears., Effects due to ingestion may include: Gastrointestinal discomfort, Central nervous system depression, Lung irritation, chest pain, pulmonary edema, giddiness, slowed reaction time, slurred speech, Headache, Dizziness, Drowsiness, Unconsciousness

Synergistic effects

no data available

Additional Information

RTECS: MN9275000

12. ECOLOGICAL INFORMATION

Toxicity

| | |
|---|--|
| Toxicity to fish | LC50 - Pimephales promelas (fathead minnow) - 2.5 mg/l - 96.0 h |
| Toxicity to daphnia and other aquatic invertebrates | EC50 - Daphnia magna (Water flea) - 3,878.00 mg/l - 48 h |
| Toxicity to algae | EC50 - Chlorella vulgaris (Fresh water algae) - 12,840.00 mg/l - 3 h EC50 - SKELETOMA - 0.30 mg/l - 8 h |

Persistence and degradability

no data available

Bioaccumulative potential

no data available

Mobility in soil

no data available

PBT and vPvB assessment

no data available

Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Toxic to aquatic life with long lasting effects.

13. DISPOSAL CONSIDERATIONS

Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1208 Class: 3 Packing group: II
Proper shipping name: Hexanes
Reportable Quantity (RQ): 5000 lbs
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG

UN number: 1208 Class: 3 Packing group: II EMS-No: F-E, S-D
Proper shipping name: HEXANES
Marine pollutant: No

IATA

UN number: 1208 Class: 3 Packing group: II
Proper shipping name: Hexanes

15. REGULATORY INFORMATION

WHMIS Classification

| | | |
|-----|---|------------------------|
| B2 | Flammable liquid | Flammable liquid |
| D2A | Very Toxic Material Causing Other Toxic Effects | Reproductive hazard |
| D2B | Toxic Material Causing Other Toxic Effects | Moderate skin irritant |

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

16. OTHER INFORMATION

Further information

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Fisher Scientific

Part of Thermo Fisher Scientific

SAFETY DATA SHEET

Creation Date 26-Oct-2009

Revision Date 02-Apr-2014

Revision Number 1

1. Identification

Product Name

Hexane

Cat No. :

BP2615-100; H291-4; H291-20; H291-200; H291-500; H291FB-19; H291FB-50; H291FB-200; H291RB-19; H291RB-50; H291RB-115; H291RB-200; H291RS-19; H291RS-28; H291RS-50; H291RS-115; H291RS-200; H291S-4; H291SS-28; H291SS-50; H291SS-115; H291SS-200; H300-4; H302-1; H302-4; H302-4LC; H302N-119; H302N-119LC; H302N-219; H302POP-19; H302POP-50; H302RS-19; H302RS-28; H302RS-50; H302RS-115; H302RS-200; H302SK-1; H302SK-4; H302SS-19; H302SS-28; H302SS-50; H302SS-115; H302SS-200; H303-1; H303-4; H303-4LC; H303RS-19; H303RS-28; H303RS-50; H303RS-115; H303RS-200; H303SK-4; H303SS-19; H303SS-28; H303SS-50; H303SS-115; H303SS-200; H307-4; H334-1; H334-4; N3-20; N3-200; N3S-4; O3386-20; H291FB-115

Synonyms

n-Hexane with < 5% various methyl pentanes; Lignoine; Naptha Solvent (Anhydrous/Certified ACS/Pesticide/HPLC/OPTIMA/GC Resolv/Spectranalyzed/Technical/Laboratory)

Recommended Use

Laboratory chemicals.

Uses advised against

No Information available

Details of the supplier of the safety data sheet

Company

Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number

CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

| | |
|---|------------|
| Flammable liquids | Category 2 |
| Skin Corrosion/Irritation | Category 2 |
| Serious Eye Damage/Eye Irritation | Category 2 |
| Reproductive Toxicity | Category 2 |
| Specific target organ toxicity (single exposure) | Category 3 |
| Target Organs - Respiratory system, Central nervous system (CNS). | |

| | |
|--|------------|
| Specific target organ toxicity - (repeated exposure) | Category 1 |
| Target Organs - Liver, Heart, Blood. | |
| Aspiration Toxicity | Category 1 |

Label Elements**Signal Word**

Danger

Hazard Statements

Highly flammable liquid and vapor
May be fatal if swallowed and enters airways
Causes skin irritation
Causes serious eye irritation
May cause respiratory irritation
May cause drowsiness or dizziness
Suspected of damaging fertility
Causes damage to organs through prolonged or repeated exposure

**Precautionary Statements****Prevention**

Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Wear eye/face protection
Do not breathe dust/fume/gas/mist/vapors/spray
Do not eat, drink or smoke when using this product
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Keep cool

Response

IF exposed or concerned: Get medical attention/advice

Inhalation

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

Skin

If skin irritation occurs: Get medical advice/attention

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower

Wash contaminated clothing before reuse

Eyes

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing

If eye irritation persists: Get medical advice/attention

Ingestion

IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician

Do NOT induce vomiting

Fire

In case of fire: Use CO2, dry chemical, or foam for extinction

Storage

Store locked up
Store in a well-ventilated place. Keep container tightly closed

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

Toxic to aquatic life with long lasting effects

3. Composition / information on ingredients

| Component | CAS-No | Weight % |
|-----------|----------|----------|
| Hexane | 110-54-3 | >95 |

4. First-aid measures

| | |
|--|--|
| Eye Contact | Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention. |
| Skin Contact | Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention. |
| Inhalation | Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Obtain medical attention. Aspiration into lungs can produce severe lung damage. |
| Ingestion | Do not induce vomiting. Call a physician or Poison Control Center immediately. If vomiting occurs, lean victim forward to reduce the risk of aspiration. |
| Most important symptoms/effects | Breathing difficulties. . Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting |
| Notes to Physician | Treat symptomatically |

5. Fire-fighting measures

| | |
|---|--|
| Suitable Extinguishing Media | CO ₂ , dry chemical, dry sand, alcohol-resistant foam. Cool closed containers exposed to fire with water spray. |
| Unsuitable Extinguishing Media | Water may be ineffective, This material is lighter than water and insoluble in water. The fire could easily be spread by the use of water in an area where the water cannot be contained |
| Flash Point | -22 °C / -7.6 °F |
| Method - | No information available |
| Autoignition Temperature | 223 °C / 433.4 °F |
| Explosion Limits | |
| Upper | 7.5 vol % |
| Lower | 1.1 vol % |
| Sensitivity to Mechanical Impact | No information available |
| Sensitivity to Static Discharge | No information available |

Specific Hazards Arising from the Chemical

Flammable. Risk of ignition. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Containers may explode when heated.

Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO₂)

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full

protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health
2

Flammability
3

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions

Use personal protective equipment. Ensure adequate ventilation. Evacuate personnel to safe areas. Remove all sources of ignition. Take precautionary measures against static discharges.

Environmental Precautions

Do not flush into surface water or sanitary sewer system. Avoid release to the environment. Collect spillage.

Methods for Containment and Clean Up

Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment. Take precautionary measures against static discharges.

7. Handling and storage

Handling

Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Do not breathe vapors or spray mist. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. Use explosion-proof equipment. Take precautionary measures against static discharges. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded.

Storage

Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Flammables area.

8. Exposure controls / personal protection

Exposure Guidelines

| Component | ACGIH TLV | OSHA PEL | NIOSH IDLH |
|-----------|---------------------|--|---|
| Hexane | TWA: 50 ppm Skin | (Vacated) TWA: 50 ppm (Vacated) TWA: 180 mg/m ³ TWA: 500 ppm TWA: 1800 mg/m ³ | IDLH: 1100 ppm TWA: 50 ppm TWA: 180 mg/m ³ |

| Component | Quebec | Mexico OEL (TWA) | Ontario TWAEV |
|-----------|---|---|---------------------|
| Hexane | TWA: 50 ppm TWA: 176 mg/m ³ Skin | TWA: 50 ppm TWA: 176 mg/m ³ | TWA: 50 ppm Skin |

Legend

ACGIH - American Conference of Governmental Industrial Hygienists

OSHA - Occupational Safety and Health Administration

NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures

Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location. Use explosion-proof electrical/ventilating/lighting/equipment.

Personal Protective Equipment**Eye/face Protection**

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard

EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

| | |
|---|-----------------------------|
| Physical State | Liquid |
| Appearance | Colorless |
| Odor | Petroleum distillates |
| Odor Threshold | No information available |
| pH | No information available |
| Melting Point/Range | -95 °C / -139 °F |
| Boiling Point/Range | 69 °C / 156.2 °F @ 760 mmHg |
| Flash Point | -22 °C / -7.6 °F |
| Evaporation Rate | No information available |
| Flammability (solid,gas) | Not applicable |
| Flammability or explosive limits | |
| Upper | 7.5 vol % |
| Lower | 1.1 vol % |
| Vapor Pressure | 160 mbar @ 20 °C |
| Vapor Density | 2.97 |
| Relative Density | 0.659 |
| Solubility | Insoluble in water |
| Partition coefficient; n-octanol/water | No data available |
| Autoignition Temperature | 223 °C / 433.4 °F |
| Decomposition Temperature | No information available |
| Viscosity | 0.31 mPa s at 20 °C |
| Molecular Formula | C6 H14 |
| Molecular Weight | 86.18 |

10. Stability and reactivity

| | |
|---|--|
| Reactive Hazard | None known, based on information available |
| Stability | Stable under normal conditions. |
| Conditions to Avoid | Incompatible products. Heat, flames and sparks. Exposure to light. Keep away from open flames, hot surfaces and sources of ignition. |
| Incompatible Materials | Strong oxidizing agents, Halogens |
| Hazardous Decomposition Products | Carbon monoxide (CO), Carbon dioxide (CO ₂) |
| Hazardous Polymerization | Hazardous polymerization does not occur. |
| Hazardous Reactions | None under normal processing. |

11. Toxicological information

Acute Toxicity**Product Information****Component Information**

| Component | LD50 Oral | LD50 Dermal | LC50 Inhalation |
|-----------|-----------------|-----------------------|-----------------------|
| Hexane | 25 g/kg (Rat) | 3000 mg/kg (Rabbit) | 48000 ppm (Rat) 4 h |

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Irritating to eyes and skin

| Sensitization | No information available | | | | | | | | | | | | | | |
|---|--|------------|------------|------------|------------|------------|------|--------|--------|----------|------------|------------|------------|------------|------------|
| Carcinogenicity | The table below indicates whether each agency has listed any ingredient as a carcinogen. | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th>Component</th> <th>CAS-No</th> <th>IARC</th> <th>NTP</th> <th>ACGIH</th> <th>OSHA</th> <th>Mexico</th> </tr> </thead> <tbody> <tr> <td>Hexane</td> <td>110-54-3</td> <td>Not listed</td> <td>Not listed</td> <td>Not listed</td> <td>Not listed</td> <td>Not listed</td> </tr> </tbody> </table> | Component | CAS-No | IARC | NTP | ACGIH | OSHA | Mexico | Hexane | 110-54-3 | Not listed | Not listed | Not listed | Not listed | Not listed |
| Component | CAS-No | IARC | NTP | ACGIH | OSHA | Mexico | | | | | | | | | |
| Hexane | 110-54-3 | Not listed | Not listed | Not listed | Not listed | Not listed | | | | | | | | | |
| Mutagenic Effects | Mutagenic effects have occurred in experimental animals. | | | | | | | | | | | | | | |
| Reproductive Effects | Experiments have shown reproductive toxicity effects on laboratory animals. | | | | | | | | | | | | | | |
| Developmental Effects | Developmental effects have occurred in experimental animals. | | | | | | | | | | | | | | |
| Teratogenicity | Teratogenic effects have occurred in experimental animals. | | | | | | | | | | | | | | |
| STOT - single exposure | Respiratory system Central nervous system (CNS) | | | | | | | | | | | | | | |
| STOT - repeated exposure | Liver Heart Blood | | | | | | | | | | | | | | |
| Aspiration hazard | No information available | | | | | | | | | | | | | | |
| Symptoms / effects, both acute and delayed | Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting | | | | | | | | | | | | | | |
| Endocrine Disruptor Information | No information available | | | | | | | | | | | | | | |
| Other Adverse Effects | Tumorigenic effects have been reported in experimental animals. See actual entry in RTECS for complete information. | | | | | | | | | | | | | | |

12. Ecological information

Ecotoxicity

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

| Component | Freshwater Algae | Freshwater Fish | Microtox | Water Flea |
|-----------|------------------|---------------------------|------------|---------------------|
| Hexane | Not listed | 2.1 - 2.98 mg/L LC50 96 h | Not listed | EC50: 3.87 mg/L/48h |

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility.

| Component | log Pow |
|-----------|---------|
| Hexane | 4.11 |

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

| | |
|-----------------------------|---------|
| UN-No | UN1208 |
| Proper Shipping Name | Hexanes |
| Hazard Class | 3 |
| Packing Group | II |

TDG

| | |
|-----------------------------|---------|
| UN-No | UN1208 |
| Proper Shipping Name | HEXANES |
| Hazard Class | 3 |
| Packing Group | II |

IATA

UN-No UN1208
 Proper Shipping Name Hexanes
 Hazard Class 3
 Packing Group II

IMDG/IMO

UN-No UN1208
 Proper Shipping Name Hexanes
 Hazard Class 3
 Packing Group II

15. Regulatory information**International Inventories**

| Component | TSCA | DSL | NDSL | EINECS | ELINCS | NLP | PICCS | ENCS | AICS | IECSC | KECL |
|-----------|------|-----|------|-----------|--------|-----|-------|------|------|-------|------|
| Hexane | X | X | - | 203-777-6 | - | | X | X | X | X | X |

Legend:

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.

XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).

Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

| Component | CAS-No | Weight % | SARA 313 - Threshold Values % |
|-----------|----------|----------|-------------------------------|
| Hexane | 110-54-3 | >95 | 1.0 |

SARA 311/312 Hazardous Categorization

Acute Health Hazard Yes
 Chronic Health Hazard Yes
 Fire Hazard Yes
 Sudden Release of Pressure Hazard No
 Reactive Hazard No

Clean Water Act Not applicable

Clean Air Act

| Component | HAPS Data | Class 1 Ozone Depletors | Class 2 Ozone Depletors |
|-----------|-----------|-------------------------|-------------------------|
| Hexane | X | | - |

OSHA Occupational Safety and Health Administration
 Not applicable

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

| Component | Hazardous Substances RQs | CERCLA EHS RQs |
|-----------|--------------------------|----------------|
| Hexane | 5000 lb | - |

California Proposition 65 This product does not contain any Proposition 65 chemicals

State Right-to-Know

| Component | Massachusetts | New Jersey | Pennsylvania | Illinois | Rhode Island |
|-----------|---------------|------------|--------------|----------|--------------|
| Hexane | X | X | X | X | X |

U.S. Department of Transportation

Reportable Quantity (RQ): Y
 DOT Marine Pollutant N
 DOT Severe Marine Pollutant N

U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade Serious risk, Grade 3

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class B2 Flammable liquid
 D2A Very toxic materials



16. Other information

Prepared By Regulatory Affairs
 Thermo Fisher Scientific
 Email: EMSDS.RA@thermofisher.com

Creation Date 26-Oct-2009
Revision Date 02-Apr-2014
Print Date 02-Apr-2014
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of SDS

MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: (see Section 16 for Synonyms) **HEAVY RESIDUAL FUEL (HIGH FLASH)**
Product Description: Petroleum Hydrocarbons
MSDS Number: 5842
Product Code: 10202010
Intended Use: FUEL OIL

COMPANY IDENTIFICATION

Supplier: Imperial Oil Downstream
 240 4th Avenue
 Calgary, ALBERTA. T2P 3M9 Canada
24 Hour Environmental / Health Emergency Telephone: 1-866-232-9563
Transportation Emergency Phone Number: 1-866-232-9563
Product Technical Information: 1-800-268-3183
Supplier General Contact: 1-800-567-3776

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

Reportable Hazardous Substance(s) or Complex Substance(s)

| Name | CAS# | Concentration* | Acute Toxicity |
|------------------------------------|------------|----------------|---|
| CATALYTIC CRACKED CLARIFIED OIL | 64741-62-4 | 0 - 100% | None |
| HEAVY ATMOSPHERIC GAS OIL | 68915-96-8 | 0 - 50% | None |
| LIGHT ATMOSPHERIC GAS OIL | 64741-44-2 | 0 - 40% | None |
| LIGHT CATALYTIC CRACKED DISTILLATE | 64741-59-9 | 0 - 40% | Inhalation Lethality: LC50 4.65 mg/l (Rat) |
| RESIDUAL FUEL OIL | 68476-33-5 | 0 - 70% | None |

Hazardous Constituent(s) Contained in Complex Substance(s)

| Name | CAS# | Concentration* | Acute Toxicity |
|-----------------------------------|-----------|----------------|---|
| HYDROGEN SULPHIDE | 7783-06-4 | < 0.1% | Inhalation Lethality: LC50 444 ppm (Rat) |
| POLYNUCLEAR AROMATIC HYDROCARBONS | | > 0.1% | None |

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

SECTION 3 HAZARDS IDENTIFICATION

This material is considered to be hazardous according to regulatory guidelines (see (M)SDS Section 15).

PHYSICAL/CHEMICAL EFFECTS

Combustible. Material can release vapours that readily form flammable mixtures. Vapour accumulation could flash and/or explode if ignited. Contact with hot material can cause thermal burns which may result in permanent damage or blindness. Material can accumulate static charges which may cause an ignition.

HEALTH EFFECTS

Irritating to skin. May cause cancer. Under conditions of poor personal hygiene and prolonged repeated contact, some polycyclic aromatic compounds (PACs) have been suspected as a cause of skin cancer in humans. Hydrogen sulphide, a highly toxic gas, is expected to be present. Signs and symptoms of overexposure to hydrogen sulphide include respiratory and eye irritation, dizziness, nausea, coughing, a sensation of dryness and pain in the nose, and loss of consciousness. Odour does not provide a reliable indicator of the presence of hazardous levels in the atmosphere. May be irritating to the eyes, nose, throat, and lungs. High-pressure injection under skin may cause serious damage.

| | | | |
|------------------------|------------|-----------------|---------------|
| NFPA Hazard ID: | Health: 2 | Flammability: 2 | Reactivity: 0 |
| HMIS Hazard ID: | Health: 2* | Flammability: 2 | Reactivity: 0 |

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

INHALATION

Immediately remove from further exposure. Get immediate medical assistance. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. Give supplemental oxygen, if available. If breathing has stopped, assist ventilation with a mechanical device.

SKIN CONTACT

Remove contaminated clothing. Dry wipe exposed skin and cleanse with waterless hand cleaner and follow by washing thoroughly with soap and water. For those providing assistance, avoid further skin contact to yourself or others. Wear impervious gloves. Launder contaminated clothing separately before reuse. Discard contaminated articles that cannot be laundered. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury. For hot product: Immediately immerse in or flush affected area with large amounts of cold water to dissipate heat. Cover with clean cotton sheeting or gauze and get prompt medical attention.

EYE CONTACT

Flush thoroughly with water for at least 15 minutes. Get medical assistance.

INGESTION

Seek immediate medical attention.

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Unusual Fire Hazards: Combustible. Hazardous material. Firefighters should consider protective equipment indicated in Section 8. The product may form flammable mixtures and can burn only when heated above the flash point.

Hazardous Combustion Products: Hydrogen sulphide, Incomplete combustion products, Smoke, Fume, Oxides of carbon, Sulphur oxides, Aldehydes

FLAMMABILITY PROPERTIES

Flash Point [Method]: $\geq 61^{\circ}\text{C}$ (142°F) [ASTM D-93]

Flammable Limits (Approximate volume % in air): LEL: N/D UEL: N/D

Autoignition Temperature: N/D

SECTION 6

ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

PROTECTIVE MEASURES

Avoid contact with spilled material. Warn or evacuate occupants in surrounding and downwind areas if required, due to toxicity or flammability of the material. See Section 5 for fire fighting information. See the Hazard Identification Section for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for advice on the minimum requirements for personal protective equipment. Additional protective measures may be necessary, depending on the specific circumstances and/or the expert judgment of the emergency responders.

SPILL MANAGEMENT

Land Spill: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop leak if you can do so without risk. All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Prevent entry into waterways, sewer, basements or confined areas. A vapour-suppressing foam may be used to reduce vapour. Use clean non-sparking tools to collect absorbed material. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Large Spills: Water spray may reduce vapour, but may not prevent ignition in enclosed spaces.

Water Spill: Stop leak if you can do so without risk. Warn other shipping. Material will sink. Remove material, as much as possible, using mechanical equipment.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Remove debris in path of spill prior to oiling and remove contaminated debris from shoreline and water surface.

Dispose of according to local regulations. Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7 HANDLING AND STORAGE

HANDLING

Avoid all personal contact. Harmful amounts of H₂S may be present. The toxic and olfactory (sense of smell) fatigue properties of hydrogen sulfide require that air monitoring alarms and respiratory protection be used where the concentration might be expected to reach a harmful level, such as in an enclosed space, heated transport vessel, or in a spill or leak situation.

Prevent small spills and leakage to avoid slip hazard. Material can accumulate static charges which may cause an electrical spark (ignition source). When the material is handled in bulk, an electrical spark could ignite any flammable vapors from liquids or residues that may be present (e.g., during switch-loading operations). Use proper bonding and/or earthing procedures. However, bonding and earthing may not eliminate the hazard from static accumulation. Consult local applicable standards for guidance. Additional references include American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practice on Static Electricity) or CENELEC CLC/TR 50404 (Electrostatics - Code of practice for the avoidance of hazards due to static electricity).

Static Accumulator: This material is a static accumulator.

STORAGE

The container choice, for example storage vessel, may effect static accumulation and dissipation. Keep container closed. Handle containers with care. Open slowly in order to control possible pressure release. Store in a cool, well-ventilated area. Storage containers should be earthed and bonded. Fixed storage containers, transfer containers and associated equipment should be grounded and bonded to prevent accumulation of static charge.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

| Substance Name | Form | Limit/Standard | | | Note | Source |
|--|-----------------|----------------|-----------------------|--------|------|----------|
| | | | | | | |
| CATALYTIC CRACKED CLARIFIED OIL [benzene solubles] | Total oil mist | TWA | 0.1 mg/m ³ | | Skin | Supplier |
| HEAVY RESIDUAL FUEL [benzene solubles] | Aerosol. | TWA | 0.1 mg/m ³ | | Skin | Supplier |
| HYDROGEN SULPHIDE | | STEL | 14 mg/m ³ | 10 ppm | | Supplier |
| HYDROGEN SULPHIDE | | TWA | 7 mg/m ³ | 5 ppm | | Supplier |
| HYDROGEN SULPHIDE | | STEL | 5 ppm | | | ACGIH |
| HYDROGEN SULPHIDE | | TWA | 1 ppm | | | ACGIH |
| LIGHT ATMOSPHERIC GAS OIL | Stable Aerosol. | TWA | 5 mg/m ³ | | | Supplier |
| LIGHT ATMOSPHERIC GAS OIL | Vapour. | TWA | 200 mg/m ³ | | | Supplier |

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

Use explosion-proof ventilation equipment to stay below exposure limits.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

Positive-pressure, air-supplied respirator in areas where H₂S vapours may accumulate.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

Thermally protective, chemical resistant gloves are recommended. If contact with forearms is likely, wear gauntlet-style gloves.

Eye Protection: If contact with material may occur, safety glasses and face shield are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

Chemical/oil resistant clothing is recommended. If product is hot, thermally protective, chemical resistant apron and long sleeves are recommended.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS

Comply with applicable environmental regulations limiting discharge to air, water and soil. Protect the environment by applying appropriate control measures to prevent or limit emissions.

| | |
|------------------|---|
| SECTION 9 | PHYSICAL AND CHEMICAL PROPERTIES |
|------------------|---|

Note: Physical and chemical properties are provided for safety, health and environmental considerations only and may not fully represent product specifications. Contact the Supplier for additional information.

GENERAL INFORMATION

Physical State: Liquid

Form: Viscous
Colour: Black
Odour: Petroleum/Solvent
Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 °C): 0.97 - 1.15
Flash Point [Method]: >=61°C (142°F) [ASTM D-93]
Flammable Limits (Approximate volume % in air): LEL: N/D UEL: N/D
Autoignition Temperature: N/D
Boiling Point / Range: N/D
Vapour Density (Air = 1): N/D
Vapour Pressure: 0.1 kPa (0.75 mm Hg) at 20°C
Evaporation Rate (n-butyl acetate = 1): < 1
pH: N/A
Log Pow (n-Octanol/Water Partition Coefficient): N/D
Solubility in Water: Negligible
Viscosity: [N/D at 40°C] | 50 cSt (50 mm2/sec) at 50°C - 635 cSt (635 mm2/sec) at 50°C
Oxidizing Properties: See Hazards Identification Section.

OTHER INFORMATION

Freezing Point: N/D
Melting Point: N/A
Pour Point: < 21°C (70°F)
Decomposition Temperature: N/D

SECTION 10 STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.
CONDITIONS TO AVOID: Open flames and high energy ignition sources.
MATERIALS TO AVOID: Halogens, Alkalies, Strong oxidizers, Strong Acids
HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.
HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

ACUTE TOXICITY

| <u>Route of Exposure</u> | <u>Conclusion / Remarks</u> |
|---|--|
| Inhalation | |
| Toxicity: No end point data for material. | Minimally Toxic. Based on assessment of the components. |
| Irritation: No end point data for material. | Elevated temperatures or mechanical action may form vapours, mist, or fumes which may be irritating to the eyes, nose, throat, or lungs. |
| Ingestion | |
| Toxicity: No end point data for material. | Minimally Toxic. Based on assessment of the components. |
| Skin | |
| Toxicity: No end point data for material. | Minimally Toxic. Based on assessment of the components. |

| | |
|---|--|
| Irritation: No end point data for material. | Irritating to the skin. Based on assessment of the components. |
| Eye | |
| Irritation: No end point data for material. | May cause mild, short-lasting discomfort to eyes. Based on assessment of the components. |

CHRONIC/OTHER EFFECTS

For the product itself:

Contains:

HYDROGEN SULPHIDE: Chronic health effects due to repeated exposures to low levels of H₂S have not been established. High level (700 ppm) acute exposure can result in sudden death. High concentrations will lead to cardiopulmonary arrest due to nervous system toxicity and pulmonary edema. Lower levels (150 ppm) may overwhelm sense of smell, eliminating warning of exposure. Symptoms of overexposure to H₂S include headache, fatigue, insomnia, irritability, and gastrointestinal problems. Repeated exposures to approximately 25 ppm will irritate mucous membranes and the respiratory system and have been implicated in some eye damage. **MIDDLE DISTILLATES WITH CRACKED STOCKS:** Carcinogenic in animal tests. Caused mutations in-vitro. Repeated dermal exposures to high concentrations in test animals resulted in reduced litter size and litter weight, and increased fetal resorptions at maternally toxic doses. Dermal exposure to high concentrations resulted in severe skin irritation with weight loss and some mortality. Inhalation exposure to high concentrations resulted in respiratory tract irritation, lung changes/infiltration/accumulation, and reduction in lung function. **RESIDUAL FUEL OIL:** Carcinogenic in animal tests. Caused mutations in-vitro. Dermal exposure to high concentrations resulted in maternal toxicity, decreased fetal weight and fetal survival, and some external fetal malformations. Dermal studies in animals: increased mortality, skin irritation, liver, kidney, thymus, bone marrow, blood and lymphoid tissue toxic effects. Possible allergen and photoallergen.

CMR Status:

| Chemical Name | CAS Number | List Citations |
|---------------------------------|------------|----------------|
| CATALYTIC CRACKED CLARIFIED OIL | 64741-62-4 | 3 |
| HYDROGEN SULPHIDE | 7783-06-4 | 4 |
| RESIDUAL FUEL OIL | 68476-33-5 | 3 |

--REGULATORY LISTS SEARCHED--

1 = IARC 1
 2 = IARC 2A

3 = IARC 2B
 4 = ACGIH ALL

5 = ACGIH A1
 6 = ACGIH A2

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Expected to be very toxic to aquatic organisms. May cause long-term adverse effects in the aquatic environment.

MOBILITY

More volatile component -- Highly volatile, will partition rapidly to air. Not expected to partition to sediment

and wastewater solids.

High molecular wt. component -- Low water solubility, expected to sink and migrate into the sediment.
Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Majority of components -- Expected to be inherently biodegradable

Atmospheric Oxidation:

More volatile component -- Expected to degrade rapidly in air

BIOACCUMULATION POTENTIAL

Base oil component -- Potential to bioaccumulate is low.

SECTION 13

DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

REGULATORY DISPOSAL INFORMATION

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. **DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.**

SECTION 14

TRANSPORT INFORMATION

LAND (TDG)

Proper Shipping Name: ELEVATED TEMPERATURE LIQUID, FLAMMABLE, N.O.S.

Hazard Class & Division: 3

UN Number: 3256

Packing Group: III

LAND (DOT)

Proper Shipping Name: ELEVATED TEMPERATURE LIQUID, FLAMMABLE, N.O.S.

Hazard Class & Division: 3

ID Number: 3256

Packing Group: III

ERG Number: 128

Label(s): 3

Transport Document Name: UN3256, ELEVATED TEMPERATURE LIQUID, FLAMMABLE, N.O.S., 3, PG

III

SEA (IMDG)

Proper Shipping Name: ELEVATED TEMPERATURE LIQUID, FLAMMABLE, N.O.S.
Hazard Class & Division: 3
EMS Number: F-E, S-D
UN Number: 3256
Packing Group: III
Label(s): 3
Transport Document Name: UN3256, ELEVATED TEMPERATURE LIQUID, FLAMMABLE, N.O.S., 3, PG III

AIR (IATA)

Proper Shipping Name: ELEVATED TEMPERATURE LIQUID, FLAMMABLE, N.O.S.
Hazard Class & Division: 3
UN Number: 3256
Packing Group: III
Label(s) / Mark(s): 3
Transportation Limitations: FORBIDDEN FOR AIR TRANSPORT
Transport Document Name: FORBIDDEN

[Footnote: If the product is offered for transport below the flashpoint, the product classification is Not Regulated.]

| | |
|-------------------|-------------------------------|
| SECTION 15 | REGULATORY INFORMATION |
|-------------------|-------------------------------|

WHMIS Classification: Class B, Division 3: Combustible Liquids Class D, Division 2, Subdivision A: Very Toxic Material Class D, Division 2, Subdivision B: Toxic Material

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

CEPA: All components of this material are either on the Canadian Domestic Substances List (DSL), exempt, or have been notified under CEPA.

Listed or exempt from listing/notification on the following chemical inventories: AICS, DSL, IECSC, KECI, TSCA

The Following Ingredients are Cited on the Lists Below: None.

--REGULATORY LISTS SEARCHED--

| | | |
|--------------|-------------|--------------|
| 1 = TSCA 4 | 3 = TSCA 5e | 5 = TSCA 12b |
| 2 = TSCA 5a2 | 4 = TSCA 6 | 6 = NPRI |

| | |
|-------------------|--------------------------|
| SECTION 16 | OTHER INFORMATION |
|-------------------|--------------------------|

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

Revision Changes:

- Section 04: First Aid Ingestion information was modified.
- Section 01: Company Mailing Address information was modified.
- Section 16: Not determined, Not applicable information was modified.
- Section 07: Handling and Storage-Handling information was modified.
- Hazard Identification: Physical/Chemical Hazard information was modified.
- Section 11: Dermal Lethality Test Data information was modified.
- Section 11: Dermal Lethality Test Comment information was modified.
- Section 11: Oral Lethality Test Data information was modified.
- Section 11: Inhalation Lethality Test Data information was modified.
- Section 11: Dermal Irritation Test Data information was modified.
- Section 11: Eye Irritation Test Data information was modified.
- Section 11: Oral Lethality Test Comment information was modified.
- Section 11: Eye Irritation Test Comment information was modified.
- Section 05: Hazardous Combustion Products information was modified.
- Section 14: Transport Document Name information was modified.
- Section 11: Inhalation Lethality Test Comment information was modified.
- Section 15: National Chemical Inventory Listing - Header information was modified.
- Section 11: Additional Health Information information was modified.
- Section 16: Synonyms information was modified.
- Section 16: MSN,MAT ID information was modified.
- Composition: Component table information was modified.
- Section 08: Exposure Limits Table information was modified.
- Section 16: Physical Hazards additional information was modified.
- Section 16: Precautions information was modified.
- Section 11: Tox List Cited Table information was modified.
- Section 11: Other Health Effects Header information was modified.
- Section 11: Other Health Effects information was added.
- Composition: Component table information was added.
- Composition: Acute Toxicity information was added.
- Section 12: Ecological Information - Acute Aquatic Toxicity information was added.
- Section 12: Ecological Information - Acute Aquatic Toxicity information was added.
- Section 09: Decomposition Temperature information was added.
- Section 09: Decomposition Temp - Header information was added.
- Composition: Constituents Table - Header information was added.
- Composition: CAS Number information was added.
- Composition: Concentration - Header information was added.
- Composition: Primary Ingredient Name information was added.
- Section 04: First Aid Notes information was deleted.
- Section 04: First Aid Notes - Header information was deleted.
- Section 16: First Aid Oral information was deleted.
- Section 16: First Aid Oral - Header information was deleted.
- Section 12: Ecological Information - Acute Aquatic Toxicity information was deleted.
- Section 12: Ecological Information - Acute Aquatic Toxicity information was deleted.

SYNONYMS: BUNKER FUEL OIL, HEAVY FUEL OIL 6030, HFO 6015, HEAVY FUEL OIL 7020, HEAVY FUEL OIL 7025, HEAVY FUEL OIL 7120 CFB, HEAVY FUEL OIL 7130 CFB, INTERMEDIATE FUEL OIL BASE, NO. 6 FUEL OIL, HEAVY FUEL OIL 6025, HEAVY FUEL OIL 6020, HEAVY FUEL OIL 6022, HEAVY FUEL OIL BASE, HEAVY FUEL OIL #6 (HIGH FLASH), HEAVY FUEL OIL BASE LOW SULPHUR, HFO 6020, HFO 6030, HFO 6300, HFO 7020, HFO

7015, HFO 7025, HFO 7120 CFB, HFO 7130 CFB, HFO 6025, FUEL OIL NO.6, HEAVY FUEL OIL 6300, HEAVY FUEL OIL 7015, HEAVY FUEL OIL 6020 (HIGH FLASH), HFO 6022, HEAVY FUEL OIL 6015, HEAVY FUEL OIL 6035, HFO 6035

PRECAUTIONARY LABEL TEXT:

WHMIS Classification: Class B, Division 3: Combustible Liquids Class D, Division 2, Subdivision A: Very Toxic Material Class D, Division 2, Subdivision B: Toxic Material

HEALTH HAZARDS

Irritating to skin. May cause cancer. If swallowed, may be aspirated and cause lung damage.

PHYSICAL HAZARDS

In use, may form flammable/explosive vapour-air mixture. Combustible. Contact with hot material can cause thermal burns which may result in permanent damage or blindness. Material can accumulate static charges which may cause an ignition.

PRECAUTIONS

Avoid all personal contact. Use proper bonding and/or earthing procedures. However, bonding and earthing may not eliminate the hazard from static accumulation. The toxic and olfactory (sense of smell) fatigue properties of hydrogen sulfide require that air monitoring alarms and respiratory protection be used where the concentration might be expected to reach a harmful level, such as in an enclosed space, heated transport vessel, or in a spill or leak situation.

FIRST AID

Inhalation: Immediately remove from further exposure. Get immediate medical assistance. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. Give supplemental oxygen, if available. If breathing has stopped, assist ventilation with a mechanical device.

Eye: Flush thoroughly with water for at least 15 minutes. Get medical assistance.

Skin: Remove contaminated clothing. Dry wipe exposed skin and cleanse with waterless hand cleaner and follow by washing thoroughly with soap and water. For those providing assistance, avoid further skin contact to yourself or others. Wear impervious gloves. Launder contaminated clothing separately before reuse. Discard contaminated articles that cannot be laundered. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury. For hot product: Immediately immerse in or flush affected area with large amounts of cold water to dissipate heat. Cover with clean cotton sheeting or gauze and get prompt medical attention.

FIRE FIGHTING MEDIA

Use water fog, foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

SPILL/LEAK

Land Spill: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop leak if you can do so without risk. Prevent entry into waterways, sewer, basements or confined areas. A vapour-suppressing foam may be used to reduce vapour. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.

Water Spill: Stop leak if you can do so without risk. Report spills as required to appropriate authorities. Material will sink. Remove material, as much as possible, using mechanical equipment.

Use

Not intended or suitable for use in or around a household or dwelling.

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DGN: 5005923 (1015216)

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Prepared by: Imperial Oil Limited, IH and Product Safety

Material Safety Data Sheet

Version 5.2
Revision Date 02/05/2013
Print Date 01/13/2014

1. PRODUCT AND COMPANY IDENTIFICATION

| | | | |
|--|---|--|---|
| Product name | : | Hydrochloric acid | |
| Product Number | : | H1758 | |
| Brand | : | Sigma | |
| Product Use | : | For laboratory research purposes. | |
| Supplier | : | Sigma-Aldrich Canada Co. 2149 Winston Park Drive OAKVILLE ON L6H 6J8 CANADA | Manufacturer : Sigma-Aldrich Corporation 3050 Spruce St. St. Louis, Missouri 63103 USA |
| Telephone | : | +1 9058299500 | |
| Fax | : | +1 9058299292 | |
| Emergency Phone # (For both supplier and manufacturer) | : | 1-800-424-9300 | |
| Preparation Information | : | Sigma-Aldrich Corporation Product Safety - Americas Region 1-800-521-8956 | |

2. HAZARDS IDENTIFICATION

Emergency Overview

WHMIS Classification

E Corrosive Material Corrosive

GHS Classification

Skin corrosion (Category 1B)
Serious eye damage (Category 1)
Specific target organ toxicity - single exposure (Category 3)

GHS Label elements, including precautionary statements

Pictogram



Signal word Danger

Hazard statement(s)

H314 Causes severe skin burns and eye damage.
H335 May cause respiratory irritation.

Precautionary statement(s)

P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310 Immediately call a POISON CENTER or doctor/ physician.

HMIS Classification

Health hazard: 3
Flammability: 0
Physical hazards: 0

Potential Health Effects

| | |
|-------------------|---|
| Inhalation | May be harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract. |
| Skin | May be harmful if absorbed through skin. Causes skin burns. |
| Eyes | Causes eye burns. |
| Ingestion | May be harmful if swallowed. |

3. COMPOSITION/INFORMATION ON INGREDIENTS

Formula : HCl

| CAS-No. | EC-No. | Index-No. | Concentration |
|--------------------------|-----------|--------------|---------------|
| Hydrochloric acid | | | |
| 7647-01-0 | 231-595-7 | 017-002-01-X | 37 % |
| Water | | | |
| 7732-18-5 | 231-791-2 | - | 63 % |

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Continue rinsing eyes during transport to hospital.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability

Not flammable or combustible.

Suitable extinguishing media

Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Special protective equipment for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products

Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas

Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas

Explosion data - sensitivity to mechanical impact

no data available

Explosion data - sensitivity to static discharge

no data available

Further information

The product itself does not burn.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

Environmental precautions

Do not let product enter drains.

Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

7. HANDLING AND STORAGE

Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

| Components | CAS-No. | Value | Control parameters | Basis |
|-------------------|--|-------|--------------------------------|---|
| Hydrochloric acid | 7647-01-0 | (c) | 2 ppm 3 mg/m ³ | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| Remarks | Occupational exposure limit is based on irritation effects and its adjustment to compensate for unusual work schedules is not required | | | |
| | | C | 2 ppm | Canada. British Columbia OEL |
| | | CEV | 2 ppm | Canada. Ontario OELs |
| | | C | 5 ppm 7.5 mg/m ³ | Québec. Regulation respecting occupational health and safety, Schedule 1, Part 1: Permissible exposure values for airborne contaminants |
| | A substance which may not be recirculated in accordance with section 108 | | | |

Personal protective equipment

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 480 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 120 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Eye protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Specific engineering controls

Use mechanical exhaust or laboratory fumehood to avoid exposure.

9. PHYSICAL AND CHEMICAL PROPERTIES**Appearance**

| | |
|--------|--------------|
| Form | liquid |
| Colour | light yellow |

Safety data

| | |
|--|--|
| pH | no data available |
| Melting point/freezing point | -30 °C (-22 °F) |
| Boiling point | > 100 °C (> 212 °F) - lit. |
| Flash point | not applicable |
| Ignition temperature | no data available |
| Auto-ignition temperature | no data available |
| Lower explosion limit | no data available |
| Upper explosion limit | no data available |
| Vapour pressure | 227 hPa (170 mmHg) at 21.1 °C (70.0 °F) 547 hPa (410 mmHg) at 37.7 °C (99.9 °F) |
| Density | 1.2 g/cm ³ at 25 °C (77 °F) |
| Water solubility | soluble |
| Partition coefficient: n-octanol/water | no data available |
| Viscosity, dynamic | 2.3 mPa.s at 15 °C (59 °F) |
| Relative vapour density | no data available |
| Odour | pungent |
| Odour Threshold | no data available |
| Evaporation rate | no data available |

10. STABILITY AND REACTIVITY**Chemical stability**

Stable under recommended storage conditions.

Possibility of hazardous reactions

no data available

Conditions to avoid

no data available

Materials to avoid

Bases, Amines, Alkali metals, Metals, permanganates, e.g. potassium permanganate, Fluorine, metal acetylides, hexalithium disilicide

Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas

Other decomposition products - no data available

Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas

11. TOXICOLOGICAL INFORMATION**Acute toxicity****Oral LD50**

no data available (Hydrochloric acid)

Inhalation LC50

no data available (Hydrochloric acid)

Dermal LD50

no data available (Hydrochloric acid)

Other information on acute toxicity

no data available (Hydrochloric acid)

Skin corrosion/irritation

Skin - rabbit - Causes burns. (Hydrochloric acid)

Serious eye damage/eye irritation

Eyes - rabbit - Corrosive to eyes (Hydrochloric acid)

Respiratory or skin sensitisation

no data available (Hydrochloric acid)

Germ cell mutagenicity

(Hydrochloric acid)

no data available (Hydrochloric acid)

(Hydrochloric acid)

Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification. (Hydrochloric acid)

(Hydrochloric acid)

(Hydrochloric acid)

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Hydrochloric acid)

Reproductive toxicity

(Hydrochloric acid)

no data available (Hydrochloric acid)

(Hydrochloric acid)

Teratogenicity

(Hydrochloric acid)

(Hydrochloric acid)

no data available (Hydrochloric acid)

Specific target organ toxicity - single exposure (Globally Harmonized System)

The substance or mixture is classified as specific target organ toxicant, single exposure, category 3 with respiratory tract irritation. (Hydrochloric acid)

Specific target organ toxicity - repeated exposure (Globally Harmonized System)

no data available

Aspiration hazard

no data available (Hydrochloric acid)

Potential health effects

| | |
|-------------------|---|
| Inhalation | May be harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract. |
| Ingestion | May be harmful if swallowed. |
| Skin | May be harmful if absorbed through skin. Causes skin burns. |
| Eyes | Causes eye burns. |

Signs and Symptoms of Exposure

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. (Hydrochloric acid)

Synergistic effects

no data available

Additional Information

RTECS: MW4025000

12. ECOLOGICAL INFORMATION

Toxicity

Toxicity to fish LC50 - *Gambusia affinis* (Mosquito fish) - 282 mg/l - 96 h (Hydrochloric acid)

Persistence and degradability

no data available

Bioaccumulative potential

no data available

Mobility in soil

no data available (Hydrochloric acid)

PBT and vPvB assessment

no data available

Other adverse effects

no data available

13. DISPOSAL CONSIDERATIONS

Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1789 Class: 8 Packing group: II
Proper shipping name: Hydrochloric acid
Reportable Quantity (RQ): 13514 lbs
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG

UN number: 1789 Class: 8 Packing group: II EMS-No: F-A, S-B
Proper shipping name: HYDROCHLORIC ACID

Marine pollutant: No

IATA

UN number: 1789 Class: 8

Packing group: II

Proper shipping name: Hydrochloric acid

15. REGULATORY INFORMATION

WHMIS Classification

E

Corrosive Material

Corrosive

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

16. OTHER INFORMATION

Text of H-code(s) and R-phrase(s) mentioned in Section 3

Further information

Copyright 2013 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only. The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

SAFETY DATA SHEET

Version 5.0
Revision Date 06/27/2014
Print Date 09/17/2015

1. PRODUCT AND COMPANY IDENTIFICATION

| | | | |
|--|---|--|---|
| Product name | : | Isooctane (purity, impurities) | |
| Product Number | : | IRMM442 | |
| Brand | : | Sigma-Aldrich | |
| Product Use | : | For laboratory research purposes. | |
| Supplier | : | Sigma-Aldrich Canada Co. 2149 Winston Park Drive OAKVILLE ON L6H 6J8 CANADA | Manufacturer : Sigma-Aldrich Corporation 3050 Spruce St. St. Louis, Missouri 63103 USA |
| Telephone | : | +1 9058299500 | |
| Fax | : | +1 9058299292 | |
| Emergency Phone # (For both supplier and manufacturer) | : | 1-800-424-9300 | |
| Preparation Information | : | Sigma-Aldrich Corporation Product Safety - Americas Region 1-800-521-8956 | |

2. HAZARDS IDENTIFICATION

Emergency Overview

Target Organs

Liver, Kidney

WHMIS Classification

| | | |
|-----|--|--|
| B2 | Flammable liquid | Flammable liquid |
| D2B | Toxic Material Causing Other Toxic Effects | Specific target organ toxicity - single exposure Moderate skin irritant |

GHS Classification

Flammable liquids (Category 2)
Acute toxicity, Inhalation (Category 5)
Acute toxicity, Dermal (Category 5)
Skin irritation (Category 2)
Specific target organ toxicity - single exposure (Category 3), Central nervous system
Aspiration hazard (Category 1)
Acute aquatic toxicity (Category 1)

GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

| | |
|-------------|--|
| H225 | Highly flammable liquid and vapour. |
| H304 | May be fatal if swallowed and enters airways. |
| H313 + H333 | May be harmful in contact with skin or if inhaled. |
| H315 | Causes skin irritation. |
| H336 | May cause drowsiness or dizziness. |
| H400 | Very toxic to aquatic life. |

Precautionary statement(s)

P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P273 Avoid release to the environment.
P301 + P310 IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
P331 Do NOT induce vomiting.

HMIS Classification

Health hazard: 2
Chronic Health Hazard: *
Flammability: 3
Physical hazards: 0

Potential Health Effects

Inhalation May be harmful if inhaled. Causes respiratory tract irritation. Vapours may cause drowsiness and dizziness.
Skin May be harmful if absorbed through skin. Causes skin irritation.
Eyes Causes eye irritation.
Ingestion May be harmful if swallowed. Aspiration hazard if swallowed - can enter lungs and cause damage.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Molecular Weight : 114.23 g/mol

| CAS-No. | EC-No. | Index-No. | Concentration |
|-------------------------------|-----------|--------------|---------------|
| 2,2,4-Trimethylpentane | | | |
| 540-84-1 | 208-759-1 | 601-009-00-8 | <=100% |

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability

Flammable in the presence of a source of ignition when the temperature is above the flash point. Keep away from heat/sparks/open flame/hot surface. No smoking.

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special protective equipment for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

Explosion data - sensitivity to mechanical impact

no data available

Explosion data - sensitivity to static discharge

no data available

Further information

Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

7. HANDLING AND STORAGE

Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

| Components | CAS-No. | Value | Control parameters | Basis |
|------------------------|----------|-------|------------------------------------|---|
| 2,2,4-Trimethylpentane | 540-84-1 | TWA | 300 ppm 1,401 mg/m ³ | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | | TWA | 300 ppm | Canada. British Columbia OEL |

Personal protective equipment

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 482 min

Material tested: Dermatrill® P (KCL 743 / Aldrich Z677388, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 90 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

Eye protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Specific engineering controls

Use mechanical exhaust or laboratory fumehood to avoid exposure.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

| | |
|--------|-------------------|
| Form | liquid |
| Colour | no data available |

Safety data

| | |
|--|--|
| pH | no data available |
| Melting point/freezing point | -107 °C (-161 °F) |
| Boiling point | 98 - 99 °C (208 - 210 °F) at 1,013 hPa (760 mmHg) |
| Flash point | -12 °C (10 °F) - closed cup |
| Ignition temperature | 396 °C (745 °F) |
| Auto-ignition temperature | no data available |
| Lower explosion limit | 1 %(V) |
| Upper explosion limit | 6 %(V) |
| Vapour pressure | 55 hPa (41 mmHg) at 21 °C (70 °F) 117 hPa (88 mmHg) at 37.80 °C (100.04 °F) |
| Density | 0.690 g/cm ³ |
| Water solubility | insoluble |
| Partition coefficient: n-octanol/water | log Pow: 4.6 |
| Relative vapour density | 3.94 - (Air = 1.0) |
| Odour | no data available |
| Odour Threshold | no data available |
| Evaporation rate | no data available |

10. STABILITY AND REACTIVITY

Chemical stability

Stable under recommended storage conditions.

Possibility of hazardous reactions

Vapours may form explosive mixture with air.

Conditions to avoid

Heat, flames and sparks. Extremes of temperature and direct sunlight.

Materials to avoid

Strong oxidizing agents

Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION**Acute toxicity****Oral LD50**

LD50 Oral - rat - > 5,000 mg/kg

Inhalation LC50

LC50 Inhalation - rat - 4 h - > 33.52 mg/l

Dermal LD50

LD50 Dermal - rabbit - > 2,000 mg/kg

Other information on acute toxicity

no data available

Skin corrosion/irritation

no data available

Skin - rabbit - Irritating to skin. - OECD Test Guideline 404

Serious eye damage/eye irritation

Eyes - rabbit - No eye irritation - OECD Test Guideline 405

Respiratory or skin sensitisation

no data available

Germ cell mutagenicity

Genotoxicity in vivo - rat - Oral

Unscheduled DNA synthesis

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)

May cause drowsiness or dizziness.

Specific target organ toxicity - repeated exposure (Globally Harmonized System)

no data available

Aspiration hazard

The substance or mixture is known to cause human aspiration toxicity hazards or has to be regarded as if it causes a human aspiration toxicity hazard.

Potential health effects

| | |
|-------------------|---|
| Inhalation | May be harmful if inhaled. Causes respiratory tract irritation. Vapours may cause drowsiness and dizziness. |
| Ingestion | May be harmful if swallowed. Aspiration hazard if swallowed - can enter lungs and cause damage. |
| Skin | May be harmful if absorbed through skin. Causes skin irritation. |
| Eyes | Causes eye irritation. |

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Synergistic effects

no data available

Additional Information

RTECS: Not available

12. ECOLOGICAL INFORMATION

Toxicity

no data available

Persistence and degradability

Biodegradability Result: - Biodegradable

Bioaccumulative potential

Mobility in soil

no data available

PBT and vPvB assessment

no data available

Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Very toxic to aquatic life.

13. DISPOSAL CONSIDERATIONS

Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1262 Class: 3 Packing group: II
Proper shipping name: Octanes
Reportable Quantity (RQ): 1000 lbs
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG

UN number: 1262 Class: 3 Packing group: II EMS-No: F-E, S-E
Proper shipping name: OCTANES

Marine pollutant: No

IATA

UN number: 1262 Class: 3

Packing group: II

Proper shipping name: Octanes

15. REGULATORY INFORMATION

WHMIS Classification

| | | |
|-----|--|--|
| B2 | Flammable liquid | Flammable liquid |
| D2B | Toxic Material Causing Other Toxic Effects | Specific target organ toxicity - single exposure Moderate skin irritant |

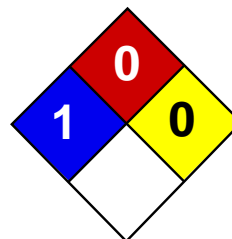
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

16. OTHER INFORMATION

Text of H-code(s) and R-phrase(s) mentioned in Section 3

Further information

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| | |
|---------------------|---|
| Health | 1 |
| Fire | 0 |
| Reactivity | 0 |
| Personal Protection | E |

Material Safety Data Sheet

Magnesium sulfate anhydrous MSDS

Section 1: Chemical Product and Company Identification

Product Name: Magnesium sulfate anhydrous

Catalog Codes: SLM2992, SLM2227

CAS#: 7487-88-9

RTECS: OM4500000

TSCA: TSCA 8(b) inventory: Magnesium sulfate anhydrous

CI#: Not available.

Synonym:

Chemical Formula: MgSO₄

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

| Name | CAS # | % by Weight |
|-----------------------------|-----------|-------------|
| Magnesium sulfate anhydrous | 7487-88-9 | 100 |

Toxicological Data on Ingredients: Not applicable.

Section 3: Hazards Identification

Potential Acute Health Effects:

Hazardous in case of ingestion. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of inhalation.

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact: Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used.

Skin Contact:

After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used.

Cover the irritated skin with an emollient. If irritation persists, seek medical attention.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:

Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:

Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions: No specific safety phrase has been found applicable for this product.

Storage:

No specific storage is required. Use shelves or cabinets sturdy enough to bear the weight of the chemicals. Be sure that it is not necessary to strain to reach materials, and that shelves are not overloaded.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 120.38 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: Not available.

Melting Point: Not available.

Critical Temperature: Not available.

Specific Gravity: Not available.

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Ingestion.

Toxicity to Animals:

LD50: Not available. LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans:

Hazardous in case of ingestion. Slightly hazardous in case of skin contact (irritant), of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Human: passes through the placenta, excreted in maternal milk.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations: TSCA 8(b) inventory: Magnesium sulfate anhydrous

Other Regulations: Not available..

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):

This product is not classified according to the EU regulations.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:22 PM

Last Updated: 05/21/2013 12:00 PM

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1. PRODUCT AND COMPANY IDENTIFICATION

| | | | |
|--|---|--|---|
| Product name | : | Methanol | |
| Product Number | : | 34860 | |
| Brand | : | Sigma-Aldrich | |
| Product Use | : | For laboratory research purposes. | |
| Supplier | : | Sigma-Aldrich Canada Co. 2149 Winston Park Drive OAKVILLE ON L6H 6J8 CANADA | Manufacturer : Sigma-Aldrich Corporation 3050 Spruce St. St. Louis, Missouri 63103 USA |
| Telephone | : | +1 9058299500 | |
| Fax | : | +1 9058299292 | |
| Emergency Phone # (For both supplier and manufacturer) | : | 1-800-424-9300 | |
| Preparation Information | : | Sigma-Aldrich Corporation Product Safety - Americas Region 1-800-521-8956 | |

2. HAZARDS IDENTIFICATION

Emergency Overview

Target Organs

Eyes, Kidney, Liver, Heart, Central nervous system Eyes, Kidney, Liver, Heart, Central nervous system

WHMIS Classification

| | | |
|-----|--|--|
| B2 | Flammable liquid | Flammable liquid |
| D1B | Toxic Material Causing Immediate and Serious Toxic Effects | Toxic by ingestion |
| | | Toxic by skin absorption |
| | | Specific target organ toxicity - single exposure |

GHS Classification

Flammable liquids (Category 2)
Acute toxicity, Oral (Category 3)
Acute toxicity, Inhalation (Category 3)
Acute toxicity, Dermal (Category 3)
Specific target organ toxicity - single exposure (Category 1)

GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

| | |
|--------------------|--|
| H225 | Highly flammable liquid and vapour. |
| H301 + H311 + H331 | Toxic if swallowed, in contact with skin or if inhaled |
| H370 | Causes damage to organs. |

Precautionary statement(s)

| | |
|------|--|
| P210 | Keep away from heat/sparks/open flames/hot surfaces. - No smoking. |
| P260 | Do not breathe dust/ fume/ gas/ mist/ vapours/ spray. |

P280 Wear protective gloves/ protective clothing.
P301 + P310 IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
P307 + P311 IF exposed: Call a POISON CENTER or doctor/ physician.

HMIS Classification

Health hazard: 2
Chronic Health Hazard: *
Flammability: 3
Physical hazards: 0

Potential Health Effects

Inhalation Toxic if inhaled. May cause respiratory tract irritation.
Skin Toxic if absorbed through skin. May cause skin irritation.
Eyes May cause eye irritation.
Ingestion Toxic if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms : Methyl alcohol
Formula : CH₄O
Molecular Weight : 32.04 g/mol

| CAS-No. | EC-No. | Index-No. | Concentration |
|-----------------|-----------|--------------|---------------|
| Methanol | | | |
| 67-56-1 | 200-659-6 | 603-001-00-X | <=100% |

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability

Flammable in the presence of a source of ignition when the temperature is above the flash point. Keep away from heat/sparks/open flame/hot surface. No smoking.

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special protective equipment for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

Explosion data - sensitivity to mechanical impact

no data available

Explosion data - sensitivity to static discharge

no data available

Further information

Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES**Personal precautions**

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

7. HANDLING AND STORAGE**Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION**Components with workplace control parameters**

| Components | CAS-No. | Value | Control parameters | Basis |
|------------|--|-------|----------------------|---|
| Methanol | 67-56-1 | STEV | 250 ppm 328 mg/m3 | Québec. Regulation respecting occupational health and safety, Schedule 1, Part 1: Permissible exposure values for airborne contaminants |
| Remarks | Skin (percutaneous) | | | |
| | | TWA | 200 ppm | Canada. British Columbia OEL |
| | Contributes significantly to the overall exposure by the skin route. | | | |
| | | STEL | 250 ppm | Canada. British Columbia OEL |
| | Contributes significantly to the overall exposure by the skin route. | | | |
| | | TWA | 200 ppm 262 mg/m3 | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | Substance may be readily absorbed through intact skin | | | |
| | | STEL | 250 ppm 328 mg/m3 | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | Substance may be readily absorbed through intact skin | | | |
| | | TWAEV | 200 ppm 262 mg/m3 | Québec. Regulation respecting occupational health and safety, Schedule 1, Part 1: Permissible exposure values for airborne contaminants |
| | Skin (percutaneous) | | | |

| | | | | |
|---|--|------|----------------------------------|---|
| | | TWA | 200 ppm 262 mg/m ³ | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| Substance may be readily absorbed through intact skin | | | | |
| | | STEL | 250 ppm 328 mg/m ³ | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| Substance may be readily absorbed through intact skin | | | | |
| | | TWA | 200 ppm | USA. ACGIH Threshold Limit Values (TLV) |
| | | STEL | 250 ppm | USA. ACGIH Threshold Limit Values (TLV) |

Personal protective equipment

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: butyl-rubber

Minimum layer thickness: 0.3 mm

Break through time: 480 min

Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 31 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Eye protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Specific engineering controls

Use mechanical exhaust or laboratory fumehood to avoid exposure.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form

liquid

Colour colourless

Safety data

pH no data available

Melting point/freezing point Melting point/range: -98 °C (-144 °F)

Boiling point 64.7 °C (148.5 °F)

Flash point 9.7 °C (49.5 °F) - closed cup

Ignition temperature 455 °C (851 °F)

Auto-ignition temperature 455.0 °C (851.0 °F) at 1,013 hPa (760 mmHg)

Lower explosion limit 6 %(V)

Upper explosion limit 36 %(V)

Vapour pressure 130.3 hPa (97.7 mmHg) at 20.0 °C (68.0 °F)
546.6 hPa (410.0 mmHg) at 50.0 °C (122.0 °F)
169.27 hPa (126.96 mmHg) at 25.0 °C (77.0 °F)

Density 0.791 g/mL at 25 °C (77 °F)

Water solubility completely miscible

Partition coefficient: n-octanol/water log Pow: -0.77

Relative vapour density 1.11

Odour pungent

Odour Threshold no data available

Evaporation rate no data available

10. STABILITY AND REACTIVITY

Chemical stability

Stable under recommended storage conditions.

Possibility of hazardous reactions

Vapours may form explosive mixture with air.

Conditions to avoid

Heat, flames and sparks. Extremes of temperature and direct sunlight.

Materials to avoid

Acid chlorides, Acid anhydrides, Oxidizing agents, Alkali metals, Reducing agents, Acids

Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides
Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50

LDLO Oral - Human - 143 mg/kg

Remarks: Lungs, Thorax, or Respiration:Dyspnea. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhoea.

LD50 Oral - rat - 1,187 - 2,769 mg/kg

Inhalation LC50

LC50 Inhalation - rat - 4 h - 128.2 mg/l

LC50 Inhalation - rat - 6 h - 87.6 mg/l

Dermal LD50

LD50 Dermal - rabbit - 17,100 mg/kg

Other information on acute toxicity

no data available

Skin corrosion/irritation

Skin - rabbit - No skin irritation

Serious eye damage/eye irritation

Eyes - rabbit - No eye irritation

Respiratory or skin sensitisation

Maximisation Test - guinea pig - OECD Test Guideline 406 - Does not cause skin sensitisation.

Germ cell mutagenicity

Genotoxicity in vitro - Ames test - *S. typhimurium* - with and without metabolic activation - negative

Genotoxicity in vitro - in vitro assay - fibroblast - negative

Mutation in mammalian somatic cells.

Genotoxicity in vivo - mouse - male and female - Intraperitoneal - negative

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

Reproductive toxicity

Fertility classification not possible from current data.

Teratogenicity

Damage to fetus not classifiable

Specific target organ toxicity - single exposure (Globally Harmonized System)

Causes damage to organs.

Specific target organ toxicity - repeated exposure (Globally Harmonized System)

The substance or mixture is not classified as specific target organ toxicant, repeated exposure.

Aspiration hazard

No aspiration toxicity classification

Potential health effects

| | |
|-------------------|--|
| Inhalation | Toxic if inhaled. May cause respiratory tract irritation. |
| Ingestion | Toxic if swallowed. |
| Skin | Toxic if absorbed through skin. May cause skin irritation. |
| Eyes | May cause eye irritation. |

Signs and Symptoms of Exposure

Methyl alcohol may be fatal or cause blindness if swallowed.

Effects due to ingestion may include:, Headache, Dizziness, Drowsiness, metabolic acidosis, Coma, Seizures.

Symptoms may be delayed., Damage of the:, Liver, Kidney

Synergistic effects

no data available

Additional Information

RTECS: PC1400000

12. ECOLOGICAL INFORMATION

Toxicity

| | |
|---|---|
| Toxicity to fish | mortality LC50 - Lepomis macrochirus (Bluegill) - 15,400.0 mg/l - 96 h NOEC - Oryzias latipes - 7,900 mg/l - 200 h |
| Toxicity to daphnia and other aquatic invertebrates | EC50 - Daphnia magna (Water flea) - > 10,000.00 mg/l - 48 h |
| Toxicity to algae | Growth inhibition EC50 - Scenedesmus capricornutum (fresh water algae) - 22,000.0 mg/l - 96 h |

Persistence and degradability

| | |
|------------------|---|
| Biodegradability | aerobic Result: 72 % - rapidly biodegradable |
|------------------|---|

Bioaccumulative potential

| | |
|-----------------|--|
| Bioaccumulation | Cyprinus carpio (Carp) - 72 d at 20 °C Bioconcentration factor (BCF): 1.0 |
|-----------------|--|

Mobility in soil

Will not adsorb on soil.

PBT and vPvB assessment

| | |
|---------------------------|--|
| Results of PBT assessment | This substance is not considered to be persistent, bioaccumulating nor toxic (PBT)., This substance is not considered to be very persistent nor very bioaccumulating (vPvB). |
|---------------------------|--|

Other adverse effects

| | |
|-----------------------------------|-----------------------------------|
| Biochemical Oxygen Demand (BOD) | 600 - 1,120 mg/g |
| Chemical Oxygen Demand (COD) | 1,420 mg/g |
| Additional ecological information | Avoid release to the environment. |

13. DISPOSAL CONSIDERATIONS

Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1230 Class: 3 Packing group: II
Proper shipping name: Methanol
Reportable Quantity (RQ): 5000 lbs
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG

UN number: 1230 Class: 3 (6.1) Packing group: II EMS-No: F-E, S-D
Proper shipping name: METHANOL
Marine pollutant: No

IATA

UN number: 1230 Class: 3 (6.1)

Packing group: II

Proper shipping name: Methanol

15. REGULATORY INFORMATION**WHMIS Classification**

| | | |
|-----|--|--|
| B2 | Flammable liquid | Flammable liquid |
| D1B | Toxic Material Causing Immediate and Serious Toxic Effects | Toxic by ingestion |
| | | Toxic by skin absorption |
| | | Specific target organ toxicity - single exposure |

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

16. OTHER INFORMATION**Further information**

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Fisher Scientific

Part of Thermo Fisher Scientific

Material Safety Data Sheet

Creation Date 27-Jan-2010

Revision Date 05-Jun-2012

Revision Number 3

1. PRODUCT AND COMPANY IDENTIFICATION

| | |
|------------------------|---|
| Product Name | Methylene chloride |
| Cat No. | BP1186-4; BP1186POP-200; BP1186SS-28; BP1186SS-50; BP1186SS-200; D35-1; D35-4; D37-1; D37-4; D37-20; D37-200; D37-200LC; D37FB-19; D37FB-50; D37FB-115; D37FB-200; D37POP-19; D37POPB-50; D37POPB-200; D37RB-19; D37RB-50; D37RB-115; D37RB-200; D37RS-19; D37RS-28; D37RS-50; D37RS-115; D37RS-200; D37SK-4; D37SK-4LC; D37SS-28; D37SS-50; D37SS-115; D37SS-200; D37SS-1350; D138-1; D138-4; D138SK-4; D142-4; D142RS-19; D142RS-28; D142RS-50; D142RS-115; D142RS-200; D142SS-28; D142SS-50; D142SS-115; D142SS-200; D143-1; D143-4; D143-4LC; D143N2-19; D143POP-28; D143RS-19; D143RS-28; D143RS-50; D143RS-115; D143RS-200; D143SK-4; D143SS-19; D143SS-28; D143SS-50; D143SS-115; D143SS-200; D149RS-19; D149RS-50; D149RS-200; D150-1; D150-4; D150-4LC; D150SK-1; D150SK-4; D151-1; D151-4; D151-4LC; D151RS-19; D151RS-28; D151RS-50; D151RS-115; D151RS-200; D151SK-4; D151SS-19; D151SS-28; D151SS-50; D151SS-115; D151SS-200; D154-4; D154-4LC; D158-4 |
| Synonyms | Dichloromethane; DCM (Stabilized/Not Stabilized/Pentene Preserved/Cyclohexene Preserved/Spectranalyzed/Certified ACS/HPLC/Pesticide/OPTIMA/GC Resolv) |
| Recommended Use | Laboratory chemicals |
| Company | Emergency Telephone Number |
| Fisher Scientific | CHEMTREC®, Inside the USA: 800-424-9300 |
| One Reagent Lane | CHEMTREC®, Outside the USA: 001-703-527-3887 |
| Fair Lawn, NJ 07410 | |
| Tel: (201) 796-7100 | |

2. HAZARDS IDENTIFICATION

2. HAZARDS IDENTIFICATION

WARNING!

Emergency Overview

Possible cancer hazard. May cause cancer based on animal data. Irritating to eyes and skin. May be harmful if inhaled. May cause irritation of respiratory tract. Inhalation may cause central nervous system effects. **WARNING!** This product contains a chemical known in the State of California to cause birth defects or other reproductive harm.

Appearance Colorless

Physical State Liquid

odor sweet

Target Organs

Skin, Eyes, Central nervous system (CNS), Blood, Liver, Kidney

Potential Health Effects

Acute Effects

Principle Routes of Exposure

Eyes

Irritating to eyes.

Skin

Irritating to skin. May be harmful in contact with skin.

Inhalation

May be harmful if inhaled. Inhalation may cause central nervous system effects. May cause irritation of respiratory tract.

Ingestion

May be harmful if swallowed. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.

Chronic Effects

Possible cancer hazard based on tests with laboratory animals. Tumorigenic effects have been reported in experimental animals.. Experiments have shown reproductive toxicity effects on laboratory animals. May cause adverse liver effects. May cause adverse kidney effects. Component substance is listed on California Proposition 65 as a developmental hazard.

See Section 11 for additional Toxicological information.

Aggravated Medical Conditions

Central nervous system disorders. Preexisting eye disorders. Skin disorders.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Haz/Non-haz

| Component | CAS-No | Weight % |
|--------------------|----------|----------|
| Methylene chloride | 75-09-2 | >95.5 |
| Methyl alcohol | 67-56-1 | 0 - 0.4 |
| 2-Methyl-2-butene | 513-35-9 | 0 - 0.01 |
| Cyclohexene | 110-83-8 | 0 - 0.01 |

4. FIRST AID MEASURES

Eye Contact

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention.

Skin Contact

Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.

Inhalation

Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Get medical attention immediately if symptoms occur. Move to fresh air. If breathing is difficult, give oxygen.

Ingestion

Do not induce vomiting. Call a physician or Poison Control Center immediately.

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

| | |
|---|--|
| Flash Point | No information available. |
| Method | No information available. |
| Autoignition Temperature | 556°C / 1032.8°F |
| Explosion Limits | |
| Upper | 23 vol % |
| Lower | 13 vol % |
| Suitable Extinguishing Media | Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. |
| Unsuitable Extinguishing Media | No information available. |
| Hazardous Combustion Products | No information available. |
| Sensitivity to mechanical impact | No information available. |
| Sensitivity to static discharge | No information available. |

Specific Hazards Arising from the Chemical

Thermal decomposition can lead to release of irritating gases and vapors. Keep product and empty container away from heat and sources of ignition.

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA **Health** 2 **Flammability** 1 **Instability** 0 **Physical hazards** N/A

6. ACCIDENTAL RELEASE MEASURES

| | |
|---|---|
| Personal Precautions | Use personal protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing. |
| Environmental Precautions | Should not be released into the environment. |
| Methods for Containment and Clean Up | Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.. |

7. HANDLING AND STORAGE

| | |
|-----------------|---|
| Handling | Use only under a chemical fume hood. Wear personal protective equipment. Ensure adequate ventilation. Do not get in eyes, on skin, or on clothing. Do not breathe vapors or spray mist. |
| Storage | Keep container tightly closed in a dry and well-ventilated place. Keep away from heat and sources of ignition. Keep away from direct sunlight. Keep at temperatures below 40°C. |

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Measures

Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Exposure Guidelines

| Component | ACGIH TLV | OSHA PEL | NIOSH IDLH |
|--------------------|---------------------------------------|--|--|
| Methylene chloride | TWA: 50 ppm | (Vacated) TWA: 500 ppm (Vacated) STEL: 2000 ppm (Vacated) Ceiling: 1000 ppm TWA: 25 ppm STEL: 125 ppm | IDLH: 2300 ppm |
| Methyl alcohol | TWA: 200 ppm STEL: 250 ppm Skin | (Vacated) TWA: 200 ppm (Vacated) TWA: 260 mg/m ³ (Vacated) STEL: 250 ppm (Vacated) STEL: 325 mg/m ³ Skin TWA: 200 ppm TWA: 260 mg/m ³ | IDLH: 6000 ppm TWA: 200 ppm TWA: 260 mg/m ³ STEL: 250 ppm STEL: 325 mg/m ³ |
| Cyclohexene | TWA: 300 ppm | (Vacated) TWA: 300 ppm (Vacated) TWA: 1015 mg/m ³ TWA: 300 ppm TWA: 1015 mg/m ³ | IDLH: 2000 ppm TWA: 300 ppm TWA: 1015 mg/m ³ |

| Component | Quebec | Mexico OEL (TWA) | Ontario TWAEV |
|--------------------|--|---|---------------------------------------|
| Methylene chloride | TWA: 50 ppm TWA: 174 mg/m ³ | TWA: 100 ppm TWA: 330 mg/m ³ STEL: 500 ppm STEL: 1740 mg/m ³ | TWA: 50 ppm |
| Methyl alcohol | TWA: 200 ppm TWA: 262 mg/m ³ STEL: 250 ppm STEL: 328 mg/m ³ Skin | TWA: 200 ppm TWA: 260 mg/m ³ STEL: 250 ppm STEL: 310 mg/m ³ | TWA: 200 ppm STEL: 250 ppm Skin |
| Cyclohexene | TWA: 300 ppm TWA: 1010 mg/m ³ | TWA: 300 ppm TWA: 1015 mg/m ³ | TWA: 300 ppm |

NIOSH IDLH: Immediately Dangerous to Life or Health

Personal Protective Equipment**Eye/face Protection**

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure

Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State
Appearance
odor
Odor Threshold
pH
Vapor Pressure
Vapor Density
Viscosity

Liquid
Colorless
sweet
No information available.
No information available.
20 mmHg @ °C
2.93 (Air = 1.0)
No information available.

9. PHYSICAL AND CHEMICAL PROPERTIES

| | |
|----------------------------------|----------------------------------|
| Boiling Point/Range | 40°C / 104°F |
| Melting Point/Range | -97°C / -142.6°F |
| Decomposition temperature | No information available. |
| Flash Point | No information available. |
| Evaporation Rate | No information available. |
| Specific Gravity | 1.33 |
| Solubility | No information available. |
| log Pow | No data available |
| Molecular Weight | 84.93 |
| Molecular Formula | C H ₂ Cl ₂ |

10. STABILITY AND REACTIVITY

| | |
|---|--|
| Stability | Stable under normal conditions. |
| Conditions to Avoid | Incompatible products. Excess heat. |
| Incompatible Materials | Strong oxidizing agents, Strong acids, Amines |
| Hazardous Decomposition Products | Carbon monoxide (CO), Carbon dioxide (CO ₂), Hydrogen chloride gas, Phosgene |
| Hazardous Polymerization | Hazardous polymerization does not occur. |
| Hazardous Reactions . | None under normal processing.. |

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Component Information

| Component | LD50 Oral | LD50 Dermal | LC50 Inhalation (Dust) |
|--------------------|--------------------|------------------------|--|
| Methylene chloride | 2000 mg/kg (Rat) | Not listed | 76000 mg/m ³ (Rat) 4 h |
| Methyl alcohol | 5628 mg/kg (Rat) | 15800 mg/kg (Rabbit) | 64000 ppm (Rat) 4 h 83.2 mg/L (Rat) 4 h |
| 2-Methyl-2-butene | 700 mg/kg (Rat) | 2000 mg/kg (Rat) | 61000 ppm (Rat) 4 h |
| Cyclohexene | 2400 µL/kg (Rat) | >200 mg/kg (Rat) | >21.6 mg/L/4h (rat) |

Irritation Irritating to eyes and skin

Toxicologically Synergistic Products No information available.

Chronic Toxicity

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

| Component | ACGIH | IARC | NTP | OSHA | Mexico |
|--------------------|-------|----------|------------------------|------|--------|
| Methylene chloride | A3 | Group 2B | Reasonably Anticipated | X | A3 |

ACGIH: (American Conference of Governmental Industrial Hygienists)

A1 - Known Human Carcinogen

A2 - Suspected Human Carcinogen

A3 - Animal Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)

IARC: (International Agency for Research on Cancer)

IARC: (International Agency for Research on Cancer)

Group 1 - Carcinogenic to Humans

Group 2A - Probably Carcinogenic to Humans

Group 2B - Possibly Carcinogenic to Humans

NTP: (National Toxicity Program)

NTP: (National Toxicity Program)

Known - Known Carcinogen

Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen

| | |
|--|--|
| Sensitization | No information available. |
| Mutagenic Effects | Mutagenic effects have occurred in microorganisms. |
| Reproductive Effects | Experiments have shown reproductive toxicity effects on laboratory animals. |
| Developmental Effects | Developmental effects have occurred in experimental animals. Component substance is listed on California Proposition 65 as a developmental hazard. |
| Teratogenicity | No information available. |
| Other Adverse Effects | Tumorigenic effects have been reported in experimental animals.. See actual entry in RTECS for complete information. |
| Endocrine Disruptor Information | No information available |

12. ECOLOGICAL INFORMATION

Ecotoxicity

. Do not empty into drains.

| Component | Freshwater Algae | Freshwater Fish | Microtox | Water Flea |
|--------------------|--------------------|---|---|-----------------------------|
| Methylene chloride | EC50:>660 mg/L/96h | Pimephales promelas: LC50:193 mg/L/96h | EC50: 1 mg/L/24 h EC50: 2.88 mg/L/15 min | EC50: 140 mg/L/48h |
| Methyl alcohol | Not listed | Pimephales promelas: LC50 > 10000 mg/L 96h | EC50 = 39000 mg/L 25 min EC50 = 40000 mg/L 15 min EC50 = 43000 mg/L 5 min | EC50 > 10000 mg/L 24h |
| 2-Methyl-2-butene | Not listed | Not listed | Not listed | 3 mg/L EC50 = 48 h |
| Cyclohexene | Not listed | Poecillia reticulata: 7.1 mg/L/96h | Not listed | Daphnia: EC50: 5.3 mg/L/48h |

Persistence and Degradability No information available**Bioaccumulation/ Accumulation** No information available**Mobility**

| Component | log Pow |
|--------------------|---------|
| Methylene chloride | 1.25 |
| Methyl alcohol | -0.74 |
| Cyclohexene | 3.27 |

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

| Component | RCRA - U Series Wastes | RCRA - P Series Wastes |
|------------------------------|------------------------|------------------------|
| Methylene chloride - 75-09-2 | U080 | - |
| Methyl alcohol - 67-56-1 | U154 | - |

14. TRANSPORT INFORMATION

DOT

UN-No UN1593
Proper Shipping Name DICHLOROMETHANE
Hazard Class 6.1
Packing Group III

TDG

UN-No UN1593
Proper Shipping Name DICHLOROMETHANE
Hazard Class 6.1
Packing Group III

IATA

UN-No UN1593
Proper Shipping Name Dichloromethane
Hazard Class 6.1
Packing Group III

IMDG/IMO

UN-No UN1593
Proper Shipping Name Dichloromethane
Hazard Class 6.1
Packing Group III

15. REGULATORY INFORMATION

International Inventories

| Component | TSCA | DSL | NDSL | EINECS | ELINCS | NLP | PICCS | ENCS | AICS | CHINA | KECL |
|--------------------|------|-----|------|-----------|--------|-----|-------|------|------|-------|------|
| Methylene chloride | T | X | - | 200-838-9 | - | | X | X | X | X | X |
| Methyl alcohol | X | X | - | 200-659-6 | - | | X | X | X | X | X |

| 15. REGULATORY INFORMATION | | | | | | | | | | | |
|----------------------------|---|---|---|-----------|---|--|---|---|---|---|---|
| 2-Methyl-2-butene | X | X | - | 208-156-3 | - | | X | X | X | X | X |
| Cyclohexene | X | X | - | 203-807-8 | - | | X | X | X | X | X |

Legend:

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.

XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).

Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b)

| Component | TSCA 12(b) |
|--------------------|------------|
| Methylene chloride | Section 4 |

SARA 313

| Component | CAS-No | Weight % | SARA 313 - Threshold Values % |
|--------------------|---------|----------|-------------------------------|
| Methylene chloride | 75-09-2 | >95.5 | 0.1 |
| Methyl alcohol | 67-56-1 | 0 - 0.4 | 1.0 |

SARA 311/312 Hazardous Categorization

| | |
|-----------------------------------|-----|
| Acute Health Hazard | Yes |
| Chronic Health Hazard | Yes |
| Fire Hazard | No |
| Sudden Release of Pressure Hazard | No |
| Reactive Hazard | No |

Clean Water Act

| Component | CWA - Hazardous Substances | CWA - Reportable Quantities | CWA - Toxic Pollutants | CWA - Priority Pollutants |
|--------------------|----------------------------|-----------------------------|------------------------|---------------------------|
| Methylene chloride | - | - | X | X |

Clean Air Act

| Component | HAPS Data | Class 1 Ozone Depletors | Class 2 Ozone Depletors |
|--------------------|-----------|-------------------------|-------------------------|
| Methylene chloride | X | | - |
| Methyl alcohol | X | | - |

OSHA

| Component | Specifically Regulated Chemicals | Highly Hazardous Chemicals |
|--------------------|---|----------------------------|
| Methylene chloride | 125 ppm STEL 12.5 ppm Action Level 25 ppm TWA | - |

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

| Component | Hazardous Substances RQs | CERCLA EHS RQs |
|--------------------|--------------------------|----------------|
| Methylene chloride | 1000 lb | - |
| Methyl alcohol | 5000 lb | - |

California Proposition 65

This product contains the following Proposition 65 chemicals:

| Component | CAS-No | California Prop. 65 | Prop 65 NSRL |
|--------------------|---------|---------------------|-------------------------|
| Methylene chloride | 75-09-2 | Carcinogen | 200 µg/day 50 µg/day |
| Methyl alcohol | 67-56-1 | Methanol | - |

State Right-to-Know

| Component | Massachusetts | New Jersey | Pennsylvania | Illinois | Rhode Island |
|--------------------|---------------|------------|--------------|----------|--------------|
| Methylene chloride | X | X | X | X | X |
| Methyl alcohol | X | X | X | X | X |
| 2-Methyl-2-butene | X | X | X | - | - |
| Cyclohexene | X | X | X | - | X |

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

Other International Regulations

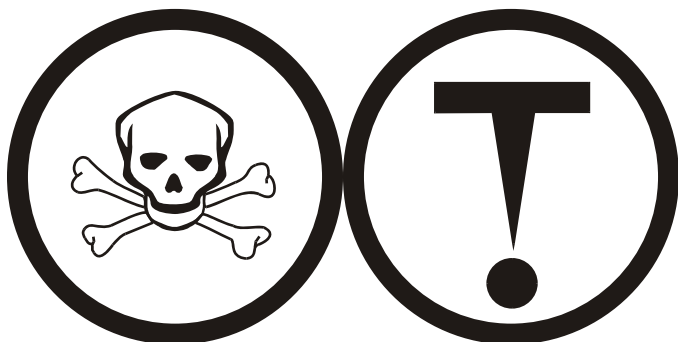
Mexico - Grade No information available

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class

D1B Toxic materials
D2A Very toxic materials
D2B Toxic materials



16. OTHER INFORMATION

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 27-Jan-2010

Print Date 05-Jun-2012

Revision Summary (M)SDS sections updated 2

Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of MSDS

1. PRODUCT AND COMPANY IDENTIFICATION

| | | | |
|--|--|--------------|--|
| Product name | : Nitric acid | | |
| Product Number | : 258121 | | |
| Brand | : Sigma-Aldrich | | |
| Product Use | : For laboratory research purposes. | | |
| Supplier | : Sigma-Aldrich Canada Co. 2149 Winston Park Drive OAKVILLE ON L6H 6J8 CANADA | Manufacturer | : Sigma-Aldrich Corporation 3050 Spruce St. St. Louis, Missouri 63103 USA |
| Telephone | : +1 9058299500 | | |
| Fax | : +1 9058299292 | | |
| Emergency Phone # (For both supplier and manufacturer) | : 1-800-424-9300 | | |
| Preparation Information | : Sigma-Aldrich Corporation Product Safety - Americas Region 1-800-521-8956 | | |

2. HAZARDS IDENTIFICATION

Emergency Overview

Target Organs

Lungs, Teeth, Cardiovascular system. Lungs, Teeth., Cardiovascular system.

WHMIS Classification

| | | |
|---|--------------------|--|
| E | Corrosive Material | Corrosive to metals Corrosive Oxidizer |
| C | Oxidizing Material | Oxidizer |
| E | Corrosive Material | Corrosive to metals Corrosive |

GHS Classification

Oxidizing liquids (Category 3)
Skin corrosion (Category 1A)
Serious eye damage (Category 1)

GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H272

May intensify fire; oxidiser.

H314

Causes severe skin burns and eye damage.

Precautionary statement(s)

P220

Keep/Store away from clothing/ combustible materials.

P280

Wear protective gloves/ protective clothing/ eye protection/ face protection.

P305 + P351 + P338

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P310

Immediately call a POISON CENTER or doctor/ physician.

HMIS Classification

Health hazard: 3

Chronic Health Hazard: *

Flammability: 0

Physical hazards: 3

Potential Health Effects

Inhalation

May be harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.

Skin

May be harmful if absorbed through skin. Causes skin burns.

Eyes

Causes eye burns. Causes severe eye burns.

Ingestion

May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Formula : HNO₃

| CAS-No. | EC-No. | Index-No. | Concentration |
|--------------------|-----------|--------------|------------------|
| Nitric acid | | | |
| 7697-37-2 | 231-714-2 | 007-004-00-1 | >= 90 - <= 100 % |
| Water | | | |
| 7732-18-5 | 231-791-2 | - | <= 10 % |

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Continue rinsing eyes during transport to hospital. Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability

Not flammable or combustible.

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special protective equipment for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products

Hazardous decomposition products formed under fire conditions. - nitrogen oxides (NO_x)

Explosion data - sensitivity to mechanical impact

no data available

Explosion data - sensitivity to static discharge

no data available

Further information

Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

Environmental precautions

Do not let product enter drains.

Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

7. HANDLING AND STORAGE

Precautions for safe handling

Avoid inhalation of vapour or mist.

Keep away from sources of ignition - No smoking. Keep away from heat and sources of ignition.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

| Components | CAS-No. | Value | Control parameters | Basis |
|-------------|-----------|-----------|--------------------------------|---|
| Nitric acid | 7697-37-2 | TWAE V | 2 ppm 5.2 mg/m ³ | Canada. Quebec OELs |
| | | STEV | 4 ppm 10 mg/m ³ | Canada. Quebec OELs |
| | | TWA | 2 ppm | Canada. British Columbia OEL |
| | | STEL | 4 ppm | Canada. British Columbia OEL |
| | | STEL | 4 ppm 10 mg/m ³ | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | | TWA | 2 ppm 5.2 mg/m ³ | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |

Personal protective equipment

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Eye protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Specific engineering controls

Use mechanical exhaust or laboratory fumehood to avoid exposure.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

| | |
|--------|------------|
| Form | liquid |
| Colour | colourless |

Safety data

| | |
|--|---|
| pH | < 1 at 20 °C (68 °F) |
| Melting point/freezing point | no data available |
| Boiling point | 100 °C (212 °F) at 1,013 hPa (760 mmHg) |
| Flash point | no data available |
| Ignition temperature | no data available |
| Autoignition temperature | no data available |
| Lower explosion limit | no data available |
| Upper explosion limit | no data available |
| Vapour pressure | 11 hPa (8 mmHg) at 20 °C (68 °F) |
| Density | 1.48 g/cm ³ |
| Water solubility | completely soluble |
| Partition coefficient: n-octanol/water | no data available |
| Relative vapour density | no data available |
| Odour | no data available |
| Odour Threshold | no data available |
| Evaporation rate | no data available |

10. STABILITY AND REACTIVITY

Chemical stability

Stable under recommended storage conditions. Stable under recommended storage conditions.

Possibility of hazardous reactions

no data available

Conditions to avoid

May discolor on exposure to air and light.

Materials to avoid

Alkali metals, Organic materials, Acetic anhydride, Acetonitrile, Alcohols, Acrylonitrile

Hazardous decomposition products

Other decomposition products - no data available

Hazardous decomposition products formed under fire conditions. - nitrogen oxides (NO_x)

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50

no data available

Inhalation LC50

no data available

Dermal LD50

no data available

Other information on acute toxicity

no data available

Skin corrosion/irritation

no data available

Serious eye damage/eye irritation

Eyes: no data available

Respiratory or skin sensitization

Germ cell mutagenicity

no data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)

no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)

no data available

Aspiration hazard

no data available

Potential health effects

| | |
|-------------------|---|
| Inhalation | May be harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract. |
| Ingestion | May be harmful if swallowed. |
| Skin | May be harmful if absorbed through skin. Causes skin burns. |
| Eyes | Causes eye burns. Causes severe eye burns. |

Signs and Symptoms of Exposure

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., Inhalation may provoke the following symptoms:, spasm, inflammation and edema of the bronchi, spasm, inflammation and edema of the larynx, pneumonitis, Symptoms and signs of poisoning are:, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, Pulmonary edema. Effects may be delayed., Large doses may cause: conversion of hemoglobin to methemoglobin, producing cyanosis; marked fall in blood pressure, leading to collapse, coma, and possibly death.

Synergistic effects

no data available

Additional Information

RTECS: Not available

12. ECOLOGICAL INFORMATION

Toxicity

no data available

Persistence and degradability

no data available

Bioaccumulative potential

no data available

Mobility in soil

no data available

PBT and vPvB assessment

no data available

Other adverse effects

13. DISPOSAL CONSIDERATIONS

Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 2031 Class: 8 (5.1) Packing group: I
Proper shipping name: Nitric acid
Reportable Quantity (RQ): 1000 lbs
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG

UN number: 2031 Class: 8 (5.1) Packing group: I EMS-No: F-A, S-Q
Proper shipping name: NITRIC ACID
Marine pollutant: No

IATA

UN number: 2031 Class: 8 (5.1) Packing group: I
Proper shipping name: Nitric acid
IATA Passenger: Not permitted for transport

15. REGULATORY INFORMATION

WHMIS Classification

| | | |
|---|--------------------|--|
| E | Corrosive Material | Corrosive to metals Corrosive Oxidizer |
| C | Oxidizing Material | Oxidizer |
| E | Corrosive Material | Corrosive to metals Corrosive |

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

16. OTHER INFORMATION**Further information**

Copyright 2012 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only. The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

1. PRODUCT AND COMPANY IDENTIFICATION

| | | | |
|--|---|--|---|
| Product name | : | Nitrogen | |
| Product Number | : | 00474 | |
| Brand | : | Fluka | |
| Product Use | : | For laboratory research purposes. | |
| Supplier | : | Sigma-Aldrich Canada Co. 2149 Winston Park Drive OAKVILLE ON L6H 6J8 CANADA | Manufacturer : Sigma-Aldrich Corporation 3050 Spruce St. St. Louis, Missouri 63103 USA |
| Telephone | : | +1 9058299500 | |
| Fax | : | +1 9058299292 | |
| Emergency Phone # (For both supplier and manufacturer) | : | 1-800-424-9300 | |
| Preparation Information | : | Sigma-Aldrich Corporation Product Safety - Americas Region 1-800-521-8956 | |

2. HAZARDS IDENTIFICATION

Emergency Overview

WHMIS Classification

A Compressed Gas Compressed Gas

GHS Classification

Gases under pressure (Compressed gas)

GHS Label elements, including precautionary statements

Pictogram



Signal word Warning

Hazard statement(s)

H280 Contains gas under pressure; may explode if heated.

Precautionary statement(s)

P410 + P403 Protect from sunlight. Store in a well-ventilated place.

HMIS Classification

Health hazard: 0

Flammability: 0

Physical hazards: 0

Potential Health Effects

| | |
|------------|---|
| Inhalation | May be harmful if inhaled. May cause respiratory tract irritation. |
| Skin | May be harmful if absorbed through skin. May cause skin irritation. |
| Eyes | May cause eye irritation. |
| Ingestion | May be harmful if swallowed. |

3. COMPOSITION/INFORMATION ON INGREDIENTS

Formula : N₂
Molecular Weight : 28.01 g/mol

| CAS-No. | EC-No. | Index-No. | Concentration |
|-----------------|-----------|-----------|---------------|
| Nitrogen | | | |
| 7727-37-9 | 231-783-9 | - | - |

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability

Not flammable or combustible.

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special protective equipment for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products

Hazardous decomposition products formed under fire conditions. - nitrogen oxides (NO_x)

Explosion data - sensitivity to mechanical impact

no data available

Explosion data - sensitivity to static discharge

no data available

Further information

Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

Environmental precautions

Do not let product enter drains.

Methods and materials for containment and cleaning up

Clean up promptly by sweeping or vacuum.

7. HANDLING AND STORAGE

Precautions for safe handling

Normal measures for preventive fire protection.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place.

Contents under pressure.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

| Components | CAS-No. | Value | Control parameters | Basis |
|------------|---|-------|--------------------|------------------------------|
| Remarks | These agents are examples of simple asphyxiants which have not been assigned any definite exposure values. These agents cause asphyxiation by diluting the atmospheric oxygen level below that required to maintain normal respiratory function. If any of the listed gases and vapours is present in the air, the minimal oxygen content should not be less than 18 per cent by volume at any time. A number of the simple asphyxiants can form explosive mixtures in air; therefore, the explosive hazard should be considered when limiting the airborne concentration of these asphyxiants. | | | |
| | Substance is a simple asphyxiant that may create an atmosphere deficient in oxygen. Available oxygen in the range of 19.5 percent to 23 percent by volume must be present. | | | |
| | Simple asphyxiant | | | |
| | Substance is a simple asphyxiant that may create an atmosphere deficient in oxygen. Available oxygen in the range of 19.5 percent to 23 percent by volume must be present | | | |
| | Simple asphyxiant | | | |
| | Simple asphyxiant | | | |
| Nitrogen | 7727-37-9 | | 0.0 | Canada. British Columbia OEL |
| | Simple asphyxiant | | | |

Personal protective equipment

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Immersion protection

Material: butyl-rubber

Minimum layer thickness: 0.3 mm

Break through time: > 480 min

Material tested: Butoject® (Aldrich Z677647, Size M)

Splash protection

Material: Chloroprene

Minimum layer thickness: 0.6 mm

Break through time: > 30 min

Material tested: Camapren® (Aldrich Z677493, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 873000, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an Industrial Hygienist familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Eye protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

impervious clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Specific engineering controls

Use mechanical exhaust or laboratory fumehood to avoid exposure.

9. PHYSICAL AND CHEMICAL PROPERTIES**Appearance**

| | |
|--------|----------------|
| Form | Compressed gas |
| Colour | colourless |

Safety data

| | |
|--|---|
| pH | no data available |
| Melting point/freezing point | Melting point/range: -210 °C (-346 °F) - lit. |
| Boiling point | -196 °C (-321 °F) - lit. |
| Flash point | not applicable |
| Ignition temperature | no data available |
| Autoignition temperature | no data available |
| Lower explosion limit | no data available |
| Upper explosion limit | no data available |
| Vapour pressure | no data available |
| Density | 0.97 g/cm ³ |
| Water solubility | no data available |
| Partition coefficient: n-octanol/water | no data available |
| Relative vapour density | no data available |
| Odour | odourless |
| Odour Threshold | no data available |
| Evaporation rate | no data available |

10. STABILITY AND REACTIVITY**Chemical stability**

Stable under recommended storage conditions.

Possibility of hazardous reactions

no data available

Conditions to avoid

no data available

Materials to avoid

Strong oxidizing agents

Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - nitrogen oxides (NOx)

Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50

no data available

Inhalation LC50

no data available

Dermal LD50

no data available

Other information on acute toxicity

no data available

Skin corrosion/irritation

no data available

Serious eye damage/eye irritation

no data available

Respiratory or skin sensitization

no data available

Germ cell mutagenicity

no data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)

no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)

no data available

Aspiration hazard

no data available

Potential health effects

Inhalation

May be harmful if inhaled. May cause respiratory tract irritation.

Ingestion

May be harmful if swallowed.

Skin

May be harmful if absorbed through skin. May cause skin irritation.

Eyes

May cause eye irritation.

Signs and Symptoms of Exposure

May be harmful., Nausea, Headache, Vomiting

Synergistic effects

no data available

Additional Information
RTECS: QW9700000

12. ECOLOGICAL INFORMATION

Toxicity

no data available

Persistence and degradability

no data available

Bioaccumulative potential

no data available

Mobility in soil

no data available

PBT and vPvB assessment

no data available

Other adverse effects

no data available

13. DISPOSAL CONSIDERATIONS

Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1066 Class: 2.2
Proper shipping name: Nitrogen, compressed
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG

UN number: 1066 Class: 2.2
Proper shipping name: NITROGEN, COMPRESSED
Marine pollutant: No

EMS-No: F-C, S-V

IATA

UN number: 1066 Class: 2.2
Proper shipping name: Nitrogen, compressed

15. REGULATORY INFORMATION

WHMIS Classification

A Compressed Gas Compressed Gas

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

16. OTHER INFORMATION

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

1. PRODUCT AND COMPANY IDENTIFICATION

| | | | |
|--|---|--|---|
| Product name | : | Oxygen | |
| Product Number | : | 295604 | |
| Brand | : | Aldrich | |
| Product Use | : | For laboratory research purposes. | |
| Supplier | : | Sigma-Aldrich Canada Co. 2149 Winston Park Drive OAKVILLE ON L6H 6J8 CANADA | Manufacturer : Sigma-Aldrich Corporation 3050 Spruce St. St. Louis, Missouri 63103 USA |
| Telephone | : | +1 9058299500 | |
| Fax | : | +1 9058299292 | |
| Emergency Phone # (For both supplier and manufacturer) | : | 1-800-424-9300 | |
| Preparation Information | : | Sigma-Aldrich Corporation Product Safety - Americas Region 1-800-521-8956 | |

2. HAZARDS IDENTIFICATION

Emergency Overview

WHMIS Classification

A Compressed Gas Compressed Gas

GHS Classification

Oxidising gases (Category 1)
Gases under pressure (Compressed gas)

GHS Label elements, including precautionary statements

Pictogram



Signal word Danger

Hazard statement(s)

H270 May cause or intensify fire; oxidiser.
H280 Contains gas under pressure; may explode if heated.

Precautionary statement(s)

P220 Keep/Store away from clothing/ combustible materials.
P410 + P403 Protect from sunlight. Store in a well-ventilated place.

HMIS Classification

Health hazard: 0
Flammability: 0
Physical hazards: 0

Potential Health Effects

Inhalation May be harmful if inhaled. May cause respiratory tract irritation.
Skin May be harmful if absorbed through skin. May cause skin irritation.
Eyes May cause eye irritation.
Ingestion May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Formula : O₂
Molecular Weight : 32.00 g/mol

| CAS-No. | EC-No. | Index-No. | Concentration |
|---------------|-----------|--------------|---------------|
| Oxygen | | | |
| 7782-44-7 | 231-956-9 | 008-001-00-8 | - |

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability

Not flammable or combustible.

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special protective equipment for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products

no data available **Explosion data - sensitivity to mechanical impact**
no data available

Explosion data - sensitivity to static discharge

no data available

Further information

Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

7. HANDLING AND STORAGE

Precautions for safe handling

Keep away from sources of ignition - No smoking.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place.

Contents under pressure.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Contains no substances with occupational exposure limit values.

Personal protective equipment

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: butyl-rubber

Minimum layer thickness: 0.3 mm

Break through time: 480 min

Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)

Splash protection

Material: Chloroprene

Minimum layer thickness: 0.6 mm

Break through time: 30 min

Material tested: Camapren® (KCL 722 / Aldrich Z677493, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an Industrial Hygienist familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Eye protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Specific engineering controls

Use mechanical exhaust or laboratory fumehood to avoid exposure.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form Compressed gas

Colour colourless

Safety data

pH no data available

Melting point/freezing point Melting point/range: -218 °C (-360 °F) - lit.

Boiling point -183 °C (-297 °F) - lit.

| | |
|--|--|
| Flash point | no data available |
| Ignition temperature | no data available |
| Auto-ignition temperature | no data available |
| Lower explosion limit | no data available |
| Upper explosion limit | no data available |
| Vapour pressure | no data available |
| Density | no data available |
| Water solubility | no data available |
| Partition coefficient: n-octanol/water | no data available |
| Relative vapor density | 1.1 - (Air = 1.0) 1.1 - (Air = 1.0) |
| Odour | odourless |
| Odour Threshold | no data available |
| Evaporation rate | no data available |

10. STABILITY AND REACTIVITY

Chemical stability

Stable under recommended storage conditions.

Possibility of hazardous reactions

no data available

Conditions to avoid

no data available

Materials to avoid

Phosphorus, Organic materials, Powdered metals

Hazardous decomposition products

no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50

no data available

Inhalation LC50

no data available

Dermal LD50

no data available

Other information on acute toxicity

no data available

Skin corrosion/irritation

no data available

Serious eye damage/eye irritation

no data available

Respiratory or skin sensitization

no data available

Germ cell mutagenicity

no data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)

no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)

no data available

Aspiration hazard

no data available

Potential health effects

| | |
|-------------------|---|
| Inhalation | May be harmful if inhaled. May cause respiratory tract irritation. |
| Ingestion | May be harmful if swallowed. |
| Skin | May be harmful if absorbed through skin. May cause skin irritation. |
| Eyes | May cause eye irritation. |

Signs and Symptoms of Exposure

Nausea, Dizziness, Unconsciousness, May be harmful.

Synergistic effects

no data available

Additional Information

RTECS: RS2060000

12. ECOLOGICAL INFORMATION**Toxicity**

no data available

Persistence and degradability

no data available

Bioaccumulative potential

no data available

Mobility in soil

no data available

PBT and vPvB assessment

no data available

Other adverse effects

no data available

13. DISPOSAL CONSIDERATIONS

Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION**DOT (US)**

UN number: 1072 Class: 2.2 (5.1)
Proper shipping name: Oxygen, compressed
Marine Pollutant: No
Poison Inhalation Hazard: No

IMDG

UN number: 1072 Class: 2.2 (5.1)
Proper shipping name: OXYGEN, COMPRESSED
Marine Pollutant: No

EMS-No: F-C, S-W

IATA

UN number: 1072 Class: 2.2 (5.1)
Proper shipping name: Oxygen, compressed

15. REGULATORY INFORMATION**WHMIS Classification**

A Compressed Gas Compressed Gas

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

16. OTHER INFORMATION**Further information**

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1. PRODUCT AND COMPANY IDENTIFICATION

Product name : Phosphoric acid, ≥85 wt. %

Product Number : 452289

Brand : Aldrich

Product Use : For laboratory research purposes.

Supplier : Sigma-Aldrich Canada Co.
2149 Winston Park Drive
OAKVILLE ON L6H 6J8
CANADA

Manufacturer : Sigma-Aldrich Corporation
3050 Spruce St.
St. Louis, Missouri 63103
USA

Telephone : +1 9058299500

Fax : +1 9058299292

Emergency Phone # (For both supplier and manufacturer) : 1-800-424-9300

Preparation Information : Sigma-Aldrich Corporation
Product Safety - Americas Region
1-800-521-8956

2. HAZARDS IDENTIFICATION

Emergency Overview

Target Organs

Liver, Blood, Bone marrow

WHMIS Classification

| | | |
|-----|---|----------------------------|
| D1A | Very Toxic Material Causing Immediate and Serious Toxic Effects | Highly toxic by inhalation |
| D2B | Toxic Material Causing Other Toxic Effects | Moderate eye irritant |
| E | Corrosive Material | Corrosive |

GHS Classification

Acute toxicity, Oral (Category 4)
Acute toxicity, Inhalation (Category 2)
Acute toxicity, Dermal (Category 5)
Skin corrosion (Category 1B)
Serious eye damage (Category 1)

GHS Label elements, including precautionary statements

Pictogram



Signal word : Danger

Hazard statement(s)

| | |
|------|--|
| H302 | Harmful if swallowed. |
| H313 | May be harmful in contact with skin. |
| H314 | Causes severe skin burns and eye damage. |
| H330 | Fatal if inhaled. |

Precautionary statement(s)

| | |
|------|---|
| P260 | Do not breathe dust/ fume/ gas/ mist/ vapours/ spray. |
| P280 | Wear protective gloves/ protective clothing/ eye protection/ face protection. |

P284 Wear respiratory protection.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310 Immediately call a POISON CENTER or doctor/ physician.

HMIS Classification

Health hazard: 3
Chronic Health Hazard: *
Flammability: 0
Physical hazards: 0

Potential Health Effects

Inhalation May be fatal if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.
Skin Harmful if absorbed through skin. Causes skin burns.
Eyes Causes eye burns.
Ingestion Harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms : Orthophosphoric acid

Formula : H₃O₄P

| CAS-No. | EC-No. | Index-No. | Concentration |
|------------------------|-----------|--------------|---------------|
| Phosphoric acid | | | |
| 7664-38-2 | 231-633-2 | 015-011-00-6 | >= 85 % |
| Water | | | |
| 7732-18-5 | 231-791-2 | - | < 15 % |

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Continue rinsing eyes during transport to hospital.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability

Not flammable or combustible.

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special protective equipment for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products

Hazardous decomposition products formed under fire conditions. - Thermal decomposition may produce toxic fumes of phosphorus oxides and/or phosphine

Hazardous decomposition products formed under fire conditions. - Oxides of phosphorus

Explosion data - sensitivity to mechanical impact

no data available

Explosion data - sensitivity to static discharge

no data available

6. ACCIDENTAL RELEASE MEASURES**Personal precautions**

Wear respiratory protection. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

7. HANDLING AND STORAGE**Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION**Components with workplace control parameters**

| Components | CAS-No. | Value | Control parameters | Basis |
|-----------------|--|-----------|---------------------|---|
| Phosphoric acid | 7664-38-2 | TWA | 1 mg/m ³ | Canada. British Columbia OEL |
| | | STEL | 3 mg/m ³ | Canada. British Columbia OEL |
| | | TWA | 1 mg/m ³ | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| Remarks | Occupational exposure limit is based on irritation effects and its adjustment to compensate for unusual work schedules is not required | | | |
| | | STEL | 3 mg/m ³ | Canada. Alberta, Occupational Health and Safety Code (table 2: OEL) |
| | Occupational exposure limit is based on irritation effects and its adjustment to compensate for unusual work schedules is not required | | | |
| | | TWAE V | 1 mg/m ³ | Canada. Quebec OELs |
| | | STEV | 3 mg/m ³ | Canada. Quebec OELs |

Personal protective equipment

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Immersion protection

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (Aldrich Z677272, Size M)

Splash protection

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 873000, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an Industrial Hygienist familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Eye protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Specific engineering controls

Use mechanical exhaust or laboratory fumehood to avoid exposure.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

| | |
|--------|-------------------|
| Form | liquid, clear |
| Colour | no data available |

Safety data

| | |
|------------------------------|--|
| pH | no data available |
| Melting point/freezing point | Melting point/range: 40 °C (104 °F) - lit. |
| Boiling point | 158 °C (316 °F) - lit. |
| Flash point | no data available |
| Ignition temperature | no data available |
| Autoignition temperature | no data available |

| | |
|---|--|
| Lower explosion limit | no data available |
| Upper explosion limit | no data available |
| Vapour pressure | no data available |
| Density | 1.685 g/cm ³ at 25 °C (77 °F) |
| Water solubility | no data available |
| Partition coefficient: n-octanol/water | no data available |
| Relative vapour density | no data available |
| Odour | no data available |
| Odour Threshold | no data available |
| Evaporation rate | no data available |

10. STABILITY AND REACTIVITY

Chemical stability

Stable under recommended storage conditions.

Possibility of hazardous reactions

no data available

Conditions to avoid

no data available

Materials to avoid

Strong bases, Powdered metals

Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Thermal decomposition may produce toxic fumes of phosphorus oxides and/or phosphine

Hazardous decomposition products formed under fire conditions. - Oxides of phosphorus

Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50

no data available

Inhalation LC50

no data available

Dermal LD50

no data available

Other information on acute toxicity

no data available

Skin corrosion/irritation

no data available

Serious eye damage/eye irritation

Eyes: no data available

Respiratory or skin sensitization

no data available

Germ cell mutagenicity

no data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)

no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)

no data available

Aspiration hazard

no data available

Potential health effects

| | |
|-------------------|---|
| Inhalation | May be fatal if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract. |
| Ingestion | Harmful if swallowed. |
| Skin | Harmful if absorbed through skin. Causes skin burns. |
| Eyes | Causes eye burns. |

Signs and Symptoms of Exposure

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin.

Synergistic effects

no data available

Additional Information

RTECS: Not available

12. ECOLOGICAL INFORMATION

Toxicity

no data available

Persistence and degradability

no data available

Bioaccumulative potential

no data available

Mobility in soil

no data available

PBT and vPvB assessment

no data available

Other adverse effects

no data available

13. DISPOSAL CONSIDERATIONS

Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION**DOT (US)**

UN number: 1805 Class: 8 Packing group: III

Proper shipping name: Phosphoric acid solution

Reportable Quantity (RQ): 5000 lbs

Marine pollutant: No

Poison Inhalation Hazard: No

IMDG

UN number: 1805 Class: 8 Packing group: III EMS-No: F-A, S-B

Proper shipping name: PHOSPHORIC ACID SOLUTION

Marine pollutant: No

IATA

UN number: 1805 Class: 8 Packing group: III

Proper shipping name: Phosphoric acid, solution

15. REGULATORY INFORMATION**WHMIS Classification**

| | | |
|-----|---|----------------------------|
| D1A | Very Toxic Material Causing Immediate and Serious Toxic Effects | Highly toxic by inhalation |
| D2B | Toxic Material Causing Other Toxic Effects | Moderate eye irritant |
| E | Corrosive Material | Corrosive |

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

16. OTHER INFORMATION**Text of H-code(s) and R-phrase(s) mentioned in Section 3****Further information**

Copyright 2012 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only. The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.



Material Safety Data Sheet

Material Name: PolyFox™ 151N Fluorosurfactant

ID: OM-00186 151N

*** Section 1 - Chemical Product and Company Identification ***

Material Name PolyFox™ 151N Fluorosurfactant

Chemical Description: Fluorinated polyether

Product Use: Surfactant for aqueous coating formulations. Flow, level and wetting additive for aqueous coating formulations.

Manufacturer Information

OMNOVA Solutions Inc.
Performance Chemicals
165 South Cleveland Avenue
Mogadore OH 44260-1505

Phone: 803 377 2231, Information Only Monday-Friday,
8:00 a.m. - 5:00 p.m. EST.

24 Hour Emergency # 1 800 424 9300** (CHEMTREC)
Outside of the U.S.A.call CHEMTREC in Arlington, Virginia,
(USA) @ 703 527 8346 **Collect

General Comments

NOTE: CHEMTREC telephone number is to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure, or accident involving chemicals. All non-emergency questions should be directed to customer service @ 803 377 2231.

Recipients of this Material Safety Data Sheet should study it carefully to become aware of and understand the health or physical hazards associated with this product. It may be appropriate or necessary to consult experts or reference books about safe handling, ventilation, toxicology, environmental regulations and fire prevention in order to sufficiently understand the Material Safety Data Sheet. Employers should inform workers and any others who are potentially or actually exposed to health or physical hazards associated with this product.

*** Section 2 - Composition / Information on Ingredients ***

| CAS # | Component | Approx. Percent |
|-------------|--|-----------------|
| Proprietary | Hydroxy-terminated fluorinated polyether | 50 |
| 112-34-5 | Diethylene glycol monobutyl ether | 10 |
| 7732-18-5 | Water | 40 |

Component Information/Information on Non-Hazardous Components

This material is classified as hazardous under OSHA regulations. This MSDS contains valuable information critical to the safe handling and proper use of the products. This MSDS should be retained and available for employees and other users of this product.

*** Section 3 - Hazards Identification ***

Emergency Overview

Product is a non-flammable liquid. It is supplied in the form of a clear to yellow liquid with a mild odor. This product may be irritating to the eyes, skin and respiratory tract. Firefighters should wear full protective clothing and self contained breathing apparatus.

Potential Health Effects: Eyes

This product may be irritating to the eyes. Thermal processing mists or vapors also produce irritation.

Potential Health Effects: Skin

Prolonged or repeated contact may cause irritation with redness and swelling.

Potential Health Effects: Ingestion

This product may produce irritation to the gastrointestinal tract if it is swallowed.

Material Safety Data Sheet**Material Name: PolyFox™ 151N Fluorosurfactant****ID: OM-0186 151N****Potential Health Effects: Inhalation**

This product may be irritating to the respiratory system. Inhalation of processing fumes or vapors may be irritating to the respiratory system.

HMIS Ratings: Health: 1 Fire: 1 Reactivity: 0, Pers. Prot.: X (Should be determined by your Supervisor)

(Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard)

***** Section 4 - First Aid Measures *******First Aid: Eyes**

In case of contact with eyes, rinse immediately with plenty of water for 15 minutes and seek medical advice.

First Aid: Skin

For skin contact, promptly wash with soap and water. Remove contaminated clothing, shoes, watchband, etc. If irritation persists, get medical attention.

First Aid: Ingestion

If the material is swallowed, get immediate medical attention or advice. Do not induce vomiting unless instructed to do so by medical personnel. Have victim rinse mouth thoroughly with water. Drink 8 to 10 oz. of water. Never give anything by mouth to a victim who is unconscious or is having convulsions.

First Aid: Inhalation

If symptoms are experienced, remove source of contamination or move victim to fresh air. Get medical attention or advice.

First Aid: Notes to Physician

None identified.

***** Section 5 - Fire Fighting Measures *******Flash Point:** 169°C**Upper Flammable Limit (UFL):** N/A**Auto Ignition:** Not available**Rate of Burning:** Not available**General Fire Hazards**

Not considered to be a fire hazard.

Hazardous Combustion Products

Decomposition of this product may yield oxides of carbon, hydrofluoric acid and peroxides.

Extinguishing Media

Dry chemical, foam, carbon dioxide.

Fire Fighting Equipment/Instructions

Firefighters should wear full protective clothing including self contained breathing apparatus. Firefighters should avoid inhaling any combustion products.

NFPA Ratings: Health: 1 Fire: 1 Reactivity: 1

(Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe)

Method Used: Pensky-Martin Closed Cup**Lower Flammable Limit (LFL):** N/A**Flammability Classification:** Class IIIB***** Section 6 - Accidental Release Measures *******Containment Procedures**

Contain the discharged material. Do not allow the spilled product to enter public drainage system or open water courses. Dike the spilled material, where this is possible.

Clean-Up Procedures

Absorb spilled material with an inert absorbent. Scrape up the absorbed spilled material. Ventilate the contaminated area. Shovel the material into waste container.

Evacuation Procedures

Isolate area. Keep unnecessary personnel away.

Special Procedures

Wear appropriate protective equipment and clothing during clean-up.

Material Safety Data Sheet**Material Name: PolyFox™ 151N Fluorosurfactant****ID: OM-0186 151N******* Section 7 - Handling and Storage *******Handling Procedures**

Avoid getting this material into contact with your skin and eyes. Avoid breathing vapors or mists of this product. Use this product with adequate ventilation. Wash thoroughly after handling.

Storage Procedures

Store at room temperature. Store out of direct sunlight. Store away from areas of potential food or pharmaceutical contact. Keep container closed and in a well ventilated place.

***** Section 8 - Exposure Controls / Personal Protection *******Exposure Guidelines****A: General Material Information**

Follow all applicable exposure limits. Work practices should be instituted to minimize exposures and compliance with OSHA Standards and Regulations 29 CFR 1910.1000 and 1910.1200.

B: Component Exposure Limits

ACGIH, OSHA, and NIOSH have not developed exposure limits for any of this product's components present at greater than 0.1%.

Engineering Controls

Use appropriate local exhaust ventilation to keep exposures below the regulated limits.

PERSONAL PROTECTIVE EQUIPMENT**Personal Protective Equipment: Eyes/Face**

Wear chemical goggles; face shield (if splashing is possible).

Personal Protective Equipment: Skin

Use impervious gloves (neoprene or nitrile). The use of protective coveralls and long sleeved clothing is recommended for prolonged or repeated contact.

Personal Protective Equipment: Respiratory

If ventilation is not sufficient to effectively remove vapors or mists use a negative pressure respirator with organic vapor cartridge.

Personal Protective Equipment: General

Use good industrial hygiene practices in handling this material.

***** Section 9 - Physical & Chemical Properties *****

| | | | |
|--------------------------|----------------|--------------------------|----------------|
| Appearance: | Colorless | Odor: | None |
| Physical State: | Liquid | pH: | Neutral |
| Vapor Pressure: | < 1mm @20° C | Vapor Density: | Not determined |
| Boiling Point: | Not determined | Melting Point: | Not available |
| Solubility (H2O): | Not determined | Specific Gravity: | Not determined |
| Evaporation Rate: | Not determined | | |

***** Section 10 - Chemical Stability & Reactivity Information *******Chemical Stability**

Stable under normal conditions.

Chemical Stability: Conditions to Avoid

Avoid prolonged storage in air. Avoid strong oxidizers. Will react with isocyanates, epoxies and acid chlorides. Avoid Temperatures above 200° C.

Hazardous Decomposition

Decomposition of this product may yield oxides of carbon.

Hazardous Polymerization

Hazardous polymerization will not occur.

Material Safety Data Sheet**Material Name: PolyFox™ 151N Fluorosurfactant****ID: OM-0186 151N******* Section 11 - Toxicological Information *******Acute Toxicity****A: General Material Information**

No data is available for this product.

B: Component Analysis – LD50/LC50**Diethylene glycol monobutyl ether (112-34-5)**

Oral LD50 Rat: 5660 mg/kg

Oral LD50 Mouse: 2400 mg/kg

Dermal LD50 Rabbit: 4120 mL/kg

Hydroxy-terminated fluorinated polyether

Oral LD50 Rat: > 2,000 mg/kg

Carcinogenicity**A: General Material Information**

No carcinogenicity data available for this product.

B: Component Carcinogenicity

None of this product's components present at greater than 0.1% are listed by ACGIH, IARC, OSHA, NIOSH, or NTP.

Epidemiology

No data available for this product.

Neurotoxicity

No data available for product.

Mutagenicity**Hydroxy-terminated fluorinated polyether**

This product is not mutagenic.

Teratogenicity

No data available for this product.

Other Toxicological Information

None available.

***** Section 12 - Ecological Information *******Ecotoxicity****A: General Material Information**

No data available for this product.

B: Component Analysis - Ecotoxicity - Aquatic Toxicity

No data available for this product.

Environmental Fate

No data available for this product.

***** Section 13 - Disposal Considerations *******US EPA Waste Number & Descriptions**

You must test your waste using methods described in 40 CFR Part 261 to determine if it meets these or other applicable definitions of hazardous wastes.

Disposal Instructions

Dispose of waste material according to Local, State, Federal, and Provincial Environmental Regulations.

Material Safety Data Sheet**Material Name: PolyFox™ 151N Fluorosurfactant****ID: OM-0186 151N******* Section 14 - Transportation Information *******US DOT Information****Shipping Name:** Not regulated for transportation**Hazard Class:** None**UN/NA #:** None**Packing Group:** None**Required Label(s):** None**Additional Info.:** None**International Transportation Regulations**

No information available.

***** Section 15 - Regulatory Information *******US Federal Regulations****A: General Product Information**

TOXIC SUBSTANCES CONTROL ACT (TSCA): This product contains an ingredient that is exempt from listing under the TSCA Polymer Exemption (40 CFR 723.250). The remaining ingredients are listed on TSCA.

US EPA TSCA Section 12(b): This product may contain a trace amount of a substance for which Export Notification is required.

Substance: Tetrahydrofuran (CAS # 109-99-9), Section 4**B: Component Analysis**

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Diethylene glycol monobutyl ether (112-34-5)

SARA 313: form R reporting required for 1.0% de minimis concentration

State Regulations**A: General Material Information**

Other state regulations may apply. Check individual state requirements.

B: Component Analysis – State

The following components appear on one or more of the following state hazardous substances lists:

| Component | CAS # | CA | FL | MA | MN | NJ | PA |
|-----------------------------------|----------|----|----|----|----|-----|-----|
| Diethylene glycol monobutyl ether | 112-34-5 | No | No | No | No | Yes | Yes |

Other Regulation**A: General Material Information**

**This product contains ingredients that are not included in the Canadian Domestic Substances List (DSL) or Canadian Non-domestic Substances List (NDSL). Use of this product beyond the threshold for New Substance Notification (3,000 kg/year/importer based on the one unlisted component), is restricted to only research and development as permitted by the Canadian Environmental Protection Act (CEPA) and other appropriate jurisdictional regulations.

*** EUROPEAN INVENTORY OF EXISTING COMMERCIAL CHEMICAL SUBSTANCES (EINECS) AND EUROPEAN LIST OF NOTIFIED CHEMICAL SUBSTANCES (ELINCS): This product is currently being managed in the European Community under Article 13 paragraph 2 of Substances Directive (67/548/EEC) as a substance intended solely for purposes of scientific research and development carried out under controlled conditions. This product is to be used only for research and development as permitted by EC and other appropriate jurisdictional regulations. For use by original recipient only.

Material Safety Data Sheet**Material Name: PolyFox™ 151N Fluorosurfactant****ID: OM-0186 151N****B: Component Analysis – Inventory**

| Component | CAS # | TSCA | DSL | EINECS/ELINCS |
|--|---------------|------|------|---------------|
| Hydroxy-terminated fluorinated polyether | Not available | No* | No** | No*** |
| Diethylene glycol monobutyl ether | 112-34-5 | Yes | Yes | Yes |

* See TSCA information above.

** See Canada DSL information above.

*** See European information above.

C: Component Analysis - WHMIS IDL

No components are listed on the WHMIS IDL.

***** Section 16 - Other Information *******Other Information**

Reasonable care has been taken in the preparation of this information, but the manufacturer makes no warranty of merchantability or any other warranty, expressed or implied, with respect to this information. The manufacturer makes no representations and assumes no liability for any direct, incidental or consequential damages resulting from its use.

Key/Legend

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act; ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; NFPA = National Fire Protection Association; HMIS = Hazardous Material Identification System; CERCLA = Comprehensive Environmental Response, Compensation and Liability Act; SARA = Superfund Amendments and Reauthorization Act; ASRIT = Activated Sludge Respiration Inhibition Test; BOD = Biochemical Oxygen Demand; COD = Chemical Oxygen Demand TLV = Threshold Limit Value; TWA = Time-Weighted Average; STEL = Short-Term Exposure Limit; HAP = Hazardous Air Pollutant; DSL = Canadian Domestic Substance List

For emergencies, call CHEMTREC at 1-800-424-9300

EU Risk and Safety Phrases

R36 Irritating to eyes

S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical attention.

This MSDS has been revised to include Tetrahydrofuran as a TSCA 12b notice substance, to update physical chemistry and toxicological data, to correctly indicate the TSCA and other jurisdictional status of this product and to correct a number of typographical errors in the previous version.

End of MSDS OM-0186 151N

SAFETY DATA SHEET

PSA - Primary Secondary Amine - Bulk Sorbent

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Product name : PSA - Primary Secondary Amine - Bulk Sorbent
EC number : Not available.
CAS number : Not available.
Part No. : 5982-5753
Chemical formula : $\text{Si}(\text{CH}_2\text{NH}_2)_x$

1.2 Relevant identified uses of the substance or mixture and uses advised against

| Identified uses |
|--------------------------------|
| Analytical chemistry. 100 g |

1.3 Details of the supplier of the safety data sheet

Agilent Technologies Manufacturing GmbH & Co. KG
Hewlett-Packard-Str. 8
76337 Waldbronn
Germany
0800 603 1000

e-mail address of person responsible for this SDS : pdl-msds_author@agilent.com

1.4 Emergency telephone number

Emergency telephone number (with hours of operation) : CHEMTREC®: +(44)-870-8200418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mono-constituent substance

Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Not classified.

Classification according to Directive 67/548/EEC [DSD]

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Signal word : No signal word.
Hazard statements : No known significant effects or critical hazards.
Precautionary statements
Prevention : Not applicable.
Response : Not applicable.
Storage : Not applicable.
Disposal : Not applicable.
Supplemental label elements : Not applicable.

Date of issue/Date of revision : 28/08/2013

SECTION 2: Hazards identification**Special packaging requirements**

Tactile warning of danger : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII : Not applicable.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII : Not applicable.

Other hazards which do not result in classification : Handling and/or processing of this material may generate a dust which can cause mechanical irritation of the eyes, skin, nose and throat.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mono-constituent substance

| Product/ingredient name | Identifiers | % | Classification | | Type |
|-------------------------|-------------|-----|-----------------|-------------------------------------|------|
| | | | 67/548/EEC | Regulation (EC) No. 1272/2008 [CLP] | |
| PSA | - | 100 | Not classified. | Not classified. | [A] |

Note: The hazard information listed is based on unbonded silica gel CAS Number 112926-00-8. To the best of our knowledge, the acute and chronic toxicological properties of bonded silica gels have not been investigated. This product contains synthetic amorphous silica, and should not be confused with crystalline silica such as quartz, cristobalite, or tridymite, or with diatomaceous earth or other naturally occurring forms of amorphous silica that frequently contain crystalline forms of silica.

There are no additional ingredients present which, within the current knowledge of the supplier, are classified and contribute to the classification of the substance and hence require reporting in this section.

Type

[A] Constituent

[B] Impurity

[C] Stabilising additive

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures**4.1 Description of first aid measures**

- Eye contact** : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Get medical attention if irritation occurs.
- Inhalation** : Remove victim to fresh air and keep at rest in a position comfortable for breathing. Get medical attention if symptoms occur. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.
- Skin contact** : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.
- Ingestion** : Wash out mouth with water. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Do not induce vomiting unless directed to do so by medical personnel. Get medical attention if symptoms occur.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Date of issue/Date of revision : 28/08/2013

SECTION 4: First aid measures

Potential acute health effects

- Eye contact** : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the eyes.
- Inhalation** : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs. Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.
- Skin contact** : No known significant effects or critical hazards.
- Ingestion** : No known significant effects or critical hazards.

Over-exposure signs/symptoms

- Eye contact** : Adverse symptoms may include the following:
irritation
redness
- Inhalation** : Adverse symptoms may include the following:
respiratory tract irritation
coughing
- Skin contact** : No specific data.
- Ingestion** : No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

- Notes to physician** : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.
- Specific treatments** : No specific treatment.

SECTION 5: Firefighting measures

5.1 Extinguishing media

- Suitable extinguishing media** : Use an extinguishing agent suitable for the surrounding fire.
- Unsuitable extinguishing media** : None known.

5.2 Special hazards arising from the substance or mixture

- Hazards from the substance or mixture** : No specific fire or explosion hazard.
- Hazardous combustion products** : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
nitrogen oxides
metal oxide/oxides

5.3 Advice for firefighters

- Special precautions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.
- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode. Clothing for fire-fighters (including helmets, protective boots and gloves) conforming to European standard EN 469 will provide a basic level of protection for chemical incidents.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

- For non-emergency personnel** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilt material. Avoid breathing dust. Put on appropriate personal protective equipment.

SECTION 6: Accidental release measures

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Methods for cleaning up : Move containers from spill area. Vacuum or sweep up material and place in a designated, labelled waste container. Dispose of via a licensed waste disposal contractor.

6.4 Reference to other sections : See Section 1 for emergency contact information.
See Section 8 for information on appropriate personal protective equipment.
See Section 13 for additional waste treatment information.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Avoid breathing dust.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

7.2 Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

7.3 Specific end use(s)

Recommendations : Industrial applications, Professional applications.

Industrial sector specific solutions : Not applicable.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational exposure limits

| Product/ingredient name | Exposure limit values |
|-------------------------|---|
| PSA | ACGIH TLV (United States). Particulate Matter Not Otherwise Classified: (PNOC): 10 mg/m ³ Form: Inhalable Particulate Matter Not Otherwise Classified: (PNOC): 3 mg/m ³ Form: Respirable |

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to monitoring standards, such as the following: European Standard EN 689 (Workplace atmospheres - Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy) European Standard EN 14042 (Workplace atmospheres - Guide for the application and use of procedures for the assessment of exposure to chemical and biological agents) European Standard EN 482 (Workplace atmospheres - General requirements for the performance of procedures for the

SECTION 8: Exposure controls/personal protection

measurement of chemical agents) Reference to national guidance documents for methods for the determination of hazardous substances will also be required.

Derived effect levels

No DNELs available.

Predicted effect concentrations

No PNECs available.

8.2 Exposure controls

Appropriate engineering controls : Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapour or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields. If operating conditions cause high dust concentrations to be produced, use dust goggles.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, particulate filter respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance

| | |
|--|-----------------------|
| Physical state | : Solid. [Powder.] |
| Colour | : White. / Off-white. |
| Odour | : Faint odour. |
| Odour threshold | : Not available. |
| pH | : Not available. |
| Melting point/freezing point | : Not available. |
| Initial boiling point and boiling range | : Not available. |
| Flash point | : Not available. |
| Evaporation rate | : Not available. |

SECTION 9: Physical and chemical properties

| | |
|---|---|
| Flammability (solid, gas) | : Not available. |
| Upper/lower flammability or explosive limits | : Not available. |
| Vapour pressure | : Not available. |
| Vapour density | : Not available. |
| Relative density | : Not available. |
| Solubility(ies) | : Insoluble in the following materials: cold water and hot water. |
| Partition coefficient: n-octanol/water | : Not available. |
| Auto-ignition temperature | : Not available. |
| Decomposition temperature | : Not available. |
| Viscosity | : Not available. |
| Explosive properties | : Not available. |

9.2 Other information

No additional information.

SECTION 10: Stability and reactivity

| | |
|--|--|
| 10.1 Reactivity | : No specific test data related to reactivity available for this product or its ingredients. |
| 10.2 Chemical stability | : The product is stable. |
| 10.3 Possibility of hazardous reactions | : Under normal conditions of storage and use, hazardous reactions will not occur. |
| 10.4 Conditions to avoid | : No specific data. Avoid creating dusty conditions and prevent wind dispersal. |
| 10.5 Incompatible materials | : Reactive or incompatible with the following materials: oxidizing materials and acids. Incompatible with: HF |
| 10.6 Hazardous decomposition products | : Under normal conditions of storage and use, hazardous decomposition products should not be produced. |

SECTION 11: Toxicological information**11.1 Information on toxicological effects**Acute toxicity

Not available.

Irritation/Corrosion

Conclusion/Summary : Not available.

Sensitiser

Conclusion/Summary : Not available.

Chronic toxicity / Carcinogenicity / Mutagenicity / Teratogenicity / Reproductive toxicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

SECTION 11: Toxicological information

Information on the likely routes of exposure : Routes of entry anticipated: Oral, Inhalation.
Routes of entry not anticipated: Dermal.

Potential acute health effects

Inhalation : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs. Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.

Ingestion : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Eye contact : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the eyes.

Symptoms related to the physical, chemical and toxicological characteristics

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing

Ingestion : No specific data.

Skin contact : No specific data.

Eye contact : Adverse symptoms may include the following:
irritation
redness

Delayed and immediate effects and also chronic effects from short and long term exposure**Short term exposure**

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

General : Repeated or prolonged inhalation of dust may lead to chronic respiratory irritation.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Other information : Not available.

SECTION 12: Ecological information**12.1 Toxicity**

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Based on chemical experience, will degrade over very long period of time.

12.3 Bioaccumulative potential

Not available.

12.4 Mobility in soil

Soil/water partition coefficient (K_{oc}) : Not available.

Mobility : Not available.

Date of issue/Date of revision : 28/08/2013

SECTION 12: Ecological information

12.5 Results of PBT and vPvB assessment

- PBT** : Not applicable.
P: Not available. B: Not available. T: Not available.
- vPvB** : Not applicable.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

- Methods of disposal** : The generation of waste should be avoided or minimised wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction.
- Hazardous waste** : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

Packaging

- Methods of disposal** : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.
- Special precautions** : This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

Regulatory information

ADR/RID / IMDG / IATA : Not regulated.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

- Europe inventory** : Not determined.
- Black List Chemicals** : Not listed
- Priority List Chemicals** : Not listed

SECTION 15: Regulatory information

Integrated pollution prevention and control list (IPPC) - Air : Not listed

Integrated pollution prevention and control list (IPPC) - Water : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments might still be required.

SECTION 16: Other information

✔ Indicates information that has changed from previously issued version.

Abbreviations and acronyms : ATE = Acute Toxicity Estimate
 CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
 DNEL = Derived No Effect Level
 EUH statement = CLP-specific Hazard statement
 PNEC = Predicted No Effect Concentration
 RRN = REACH Registration Number

Procedure used to derive the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

| Classification | Justification |
|-----------------|---------------|
| Not classified. | |

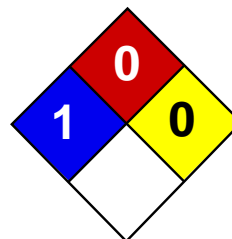
Date of issue/ Date of revision : 28/08/2013

Date of previous issue : No previous validation.

Version : 1

Notice to reader

Disclaimer: The information contained in this document is based on Agilent's state of knowledge at the time of preparation. No warranty as to its accurateness, completeness or suitability for a particular purpose is expressed or implied.



| | |
|---------------------|---|
| Health | 1 |
| Fire | 0 |
| Reactivity | 0 |
| Personal Protection | E |

Material Safety Data Sheet

Silica gel, grade 60, 230-400 mesh MSDS

Section 1: Chemical Product and Company Identification

Product Name: Silica gel, grade 60, 230-400 mesh

Catalog Codes: SLS2758

CAS#: 63231-67-4 or 112926-00-8 or 1343-98-2

RTECS: VV7340000 or VV7315000 or VV8853000

TSCA: TSCA 8(b) inventory: Silica gel (silica)

CI#: Not available.

Synonym: Silica - Amorphous, Gel; Amorphous Silicon Dioxide; Silica Gel; Silicic Acid; Silica Gel, grade 60, 230-400 mesh. Synthetic amorphous silica, not to be confused with crystalline silica such as quartz, cristobalite, or tridymite or with diatomaceous earth or other naturally occurring forms of amorphous silica that frequently contain crystalline forms.

Chemical Name: Synthetic Amorphous Silica

Chemical Formula: SiO₂.xH₂O

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

| Name | CAS # | % by Weight |
|---------------------------------|----------------|-------------|
| Silica gel, grade 40, 6-12 mesh | 63231-67-4 or | 100 |
| | 112926-00-8 or | |
| | 1343-98-2 | |

Toxicological Data on Ingredients: Not applicable.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Substance can explode when wet and heated with magnesium.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:

Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Do not ingest. Do not breathe dust. If ingested, seek medical advice immediately and show the container or the label.

Storage:

Hygroscopic. Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 6 (mg/m³) [Canada] TWA: 10 (mg/m³) from ACGIH (TLV) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance:

Solid. (Granular solid. Beads solid. Powdered solid.)

Odor: Odorless.

Taste: Tasteless.

Molecular Weight: 60.09 + xH₂O g/mole

Color: White.

pH (1% soln/water): Not applicable.

Boiling Point: Not available.

Melting Point: Not available.

Critical Temperature: Not available.

Specific Gravity: 2.1 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:

Insoluble in cold water. Soluble in hot KOH and MaOH solutions. Insoluble in ethanol. Insoluble in acids except hydrofluoric acid

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, moisture, excess dust generation.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Hygroscopic. Incompatible with hydrogen fluoride, xenon hexafluoride, oxygen difluoride, and chlorine trifluoride.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:

Acute oral toxicity (LD50): >31600 mg/kg [Rat. This is data from a 48 hr. oral test for DOT hazard classification conducted with finely-ground silica gel.]. Acute dermal toxicity (LD50): >2000 mg/kg [Rabbit. This is data from a 48 hr. dermal test for DOT hazard classification conducted with finely-ground silica gel.].

Chronic Effects on Humans: CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: May cause irritation with dryness of the skin in cases of severe exposure Eyes: No adverse effects expected, but dust may cause mechanical irritation. Silica gel is a synthetic amorphous silica, not to be confused with crystalline silica such as quartz, cristobalite, or tridymite or with diatomaceous earth or other naturally occurring forms of amorphous silica that frequently contain crystalline forms. Epidemiological studies indicate a low potential for health effects. Inhalation: May cause dryness and irritation to mucous membranes and respiratory tract in case of severe exposure. Ingestion: May be harmful if swallowed in large amounts. However, no adverse effects are expected for normal industrial handling.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:

Minnesota: Silica Massachusetts RTK: Silica TSCA 8(b) inventory: Silica

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):

This product is not classified according to the EU regulations. Not applicable.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 06:25 PM

Last Updated: 05/21/2013 12:00 PM

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1. PRODUCT AND COMPANY IDENTIFICATION

| | | | |
|--|---|--|---|
| Product name | : | Sodium sulfate | |
| Product Number | : | 238597 | |
| Brand | : | Sigma-Aldrich | |
| Product Use | : | For laboratory research purposes. | |
| Supplier | : | Sigma-Aldrich Canada Co. 2149 Winston Park Drive OAKVILLE ON L6H 6J8 CANADA | Manufacturer : Sigma-Aldrich Corporation 3050 Spruce St. St. Louis, Missouri 63103 USA |
| Telephone | : | +1 9058299500 | |
| Fax | : | +1 9058299292 | |
| Emergency Phone # (For both supplier and manufacturer) | : | 1-800-424-9300 | |
| Preparation Information | : | Sigma-Aldrich Corporation Product Safety - Americas Region 1-800-521-8956 | |

2. HAZARDS IDENTIFICATION

Emergency Overview

WHMIS Classification

Not WHMIS controlled.

GHS Classification

Acute aquatic toxicity (Category 3)

GHS Label elements, including precautionary statements

| | |
|----------------------------|--------------------------|
| Pictogram | none |
| Signal word | none |
| Hazard statement(s) | |
| H402 | Harmful to aquatic life. |
| Precautionary statement(s) | none |

HMIS Classification

| | |
|-------------------|---|
| Health hazard: | 0 |
| Flammability: | 0 |
| Physical hazards: | 0 |

Potential Health Effects

| | |
|-------------------|---|
| Inhalation | May be harmful if inhaled. May cause respiratory tract irritation. |
| Skin | May be harmful if absorbed through skin. May cause skin irritation. |
| Eyes | May cause eye irritation. |
| Ingestion | May be harmful if swallowed. |

3. COMPOSITION/INFORMATION ON INGREDIENTS

| | | |
|------------------|---|----------------------------------|
| Formula | : | Na ₂ O ₄ S |
| Molecular Weight | : | 142.04 g/mol |

| CAS-No. | EC-No. | Index-No. | Concentration |
|-----------------------|-----------|-----------|---------------|
| Sodium sulfate | | | |
| 7757-82-6 | 231-820-9 | - | <=100% |

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability

Not flammable or combustible.

Suitable extinguishing media

Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Special protective equipment for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products

Hazardous decomposition products formed under fire conditions. - Sulphur oxides, Sodium oxides

Explosion data - sensitivity to mechanical impact

no data available

Explosion data - sensitivity to static discharge

no data available

Further information

The product itself does not burn.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

7. HANDLING AND STORAGE

Precautions for safe handling

Provide appropriate exhaust ventilation at places where dust is formed.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place. Keep in a dry place. strongly hygroscopic Handle and store under inert gas.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Personal protective equipment

Respiratory protection

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Eye protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Specific engineering controls

Use mechanical exhaust or laboratory fumehood to avoid exposure.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form powder

Colour white

Safety data

pH 5.2 - 8 at 50 g/l at 20 °C (68 °F)

Melting point/freezing point Melting point/range: 884 °C (1,623 °F)

Boiling point no data available

Flash point not applicable

Ignition temperature no data available

Auto-ignition temperature no data available

| | |
|---|----------------------------|
| Lower explosion limit | no data available |
| Upper explosion limit | no data available |
| Vapour pressure | no data available |
| Density | 2.68 g/mL at 25 °C (77 °F) |
| Water solubility | soluble |
| Partition coefficient: n-octanol/water | no data available |
| Relative vapour density | no data available |
| Odour | no data available |
| Odour Threshold | no data available |
| Evaporation rate | no data available |

10. STABILITY AND REACTIVITY

Chemical stability

Stable under recommended storage conditions.

Possibility of hazardous reactions

no data available

Conditions to avoid

no data available

Materials to avoid

Strong acids, Aluminum, Magnesium

Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Sulphur oxides, Sodium oxides

Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50

LD50 Oral - mouse - 5,989 mg/kg

Inhalation LC50

no data available

Dermal LD50

no data available

Other information on acute toxicity

no data available

Skin corrosion/irritation

no data available

Serious eye damage/eye irritation

no data available

Respiratory or skin sensitisation

no data available

Germ cell mutagenicity

no data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)

no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)

no data available

Aspiration hazard

no data available

Potential health effects

| | |
|-------------------|---|
| Inhalation | May be harmful if inhaled. May cause respiratory tract irritation. |
| Ingestion | May be harmful if swallowed. |
| Skin | May be harmful if absorbed through skin. May cause skin irritation. |
| Eyes | May cause eye irritation. |

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Synergistic effects

no data available

Additional Information

RTECS: WE1650000

12. ECOLOGICAL INFORMATION

Toxicity

| | |
|---|--|
| Toxicity to fish | LC50 - other fish - 56 mg/l - 96 h |
| Toxicity to daphnia and other aquatic invertebrates | Immobilization EC50 - Daphnia - 3,150.21 mg/l - 48 h |

Persistence and degradability

no data available

Bioaccumulative potential

no data available

Mobility in soil

no data available

PBT and vPvB assessment

no data available

Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Harmful to aquatic life.

13. DISPOSAL CONSIDERATIONS

Product

Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION**DOT (US)**

Not dangerous goods

IMDG

Not dangerous goods

IATA

Not dangerous goods

15. REGULATORY INFORMATION**WHMIS Classification**

Not WHMIS controlled.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

16. OTHER INFORMATION**Further information**

Copyright 2013 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only. The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.



Material Safety Data Sheet

Creation Date 11-Jun-2009

Revision Date 16-Sep-2013

Revision Number 3

1. PRODUCT AND COMPANY IDENTIFICATION

| | |
|---|---|
| Product Name | Toluene |
| Cat No. : | S80229HPLC; T288-1; T288RS-19; T290-1; T290-1LC; T290-4; T290RS-19; T290RS-28; T290RS-200; T290N2-19; T290SK-1; T290SK-4; T290SS-28; T290SS-50; T290SS-115; T290SS-200; T291-4; T291-4LC; T291RS-200; T291SK-4; T291SS-19; T313-4; T313SK-4; T323-4; T323-20; T324-1; T324-4; T324-20; T324-200; T324-500; T324CU-1300; T324FB-19; T324FB-50; T324FB-115; T324FB-200; T324POP-200; T324POPB-200; T324RB-19; T324RB-115; T324RB-200; T324RS-19; T324RS-28; T324RS-50; T324RS-115; T324RS-200; T324S-4; T324SK-4; T324SS-28; T324SS-50; T324SS-115; T324SS-200; T326F-1GAL; T326P-4; T326S-20; T326S-20LC; T330-4 |
| Synonyms | Methylbenzene; Toluol; Phenyl methane (Certified ACS, HPLC, OPTIMA, Laboratory, Histological, Spectranalyzed, Scintanalyzed) |
| Recommended Use | Laboratory chemicals |
| Company Fisher Scientific One Reagent Lane Fair Lawn, NJ 07410 Tel: (201) 796-7100 | Emergency Telephone Number CHEMTREC®, Inside the USA: 800-424-9300 CHEMTREC®, Outside the USA: 001-703-527-3887 |

2. HAZARDS IDENTIFICATION

DANGER!

Emergency Overview

Flammable liquid and vapor. Causes eye, skin, and respiratory tract irritation. Vapors may cause drowsiness and dizziness. Aspiration hazard if swallowed - can enter lungs and cause damage. Danger of serious damage to health by prolonged exposure. Possible risk of harm to the unborn child. May cause adverse kidney effects. May cause adverse liver effects.

Appearance Colorless

Physical State Liquid

Odor aromatic

Target Organs

Eyes, Skin, Respiratory system, Liver, Kidney, Central nervous system (CNS), Blood, spleen

Potential Health Effects

Acute Effects

Principle Routes of Exposure

| | |
|------------------------|--|
| Eyes | Irritating to eyes. |
| Skin | Irritating to skin. Can be absorbed through skin. May be harmful in contact with skin. |
| Inhalation | Irritating to respiratory system. May be harmful if inhaled. May cause drowsiness and dizziness. |
| Ingestion | Aspiration hazard if swallowed - can enter lungs and cause damage. May be harmful if swallowed. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea. Harmful if swallowed. Potential for aspiration if swallowed. |
| Chronic Effects | Component substance is listed on California Proposition 65 as a developmental hazard. Experiments have shown reproductive toxicity effects on laboratory animals. May cause adverse liver effects. May cause adverse kidney effects. Danger of serious damage to health by prolonged exposure. |

See Section 11 for additional Toxicological information.

Aggravated Medical Conditions Central nervous system disorders. Preexisting eye disorders. Kidney disorders. Liver disorders. Skin disorders.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Haz/Non-haz

| Component | CAS-No | Weight % |
|-----------|----------|----------|
| Toluene | 108-88-3 | >95 |

4. FIRST AID MEASURES

| | |
|---------------------------|--|
| Eye Contact | Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required. |
| Skin Contact | Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required. |
| Inhalation | Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Immediate medical attention is required. Aspiration into lungs can produce severe lung damage.. |
| Ingestion | Clean mouth with water and drink afterwards plenty of water. Do not induce vomiting. Call a physician or Poison Control Center immediately. If vomiting occurs, lean victim forward to reduce the risk of aspiration.. |
| Notes to Physician | Treat symptomatically. |

5. FIRE-FIGHTING MEASURES

| | |
|-------------------------------------|---|
| Flash Point | 4°C / 39.2°F |
| Method - | No information available. |
| Autoignition Temperature | 535°C / 995°F |
| Explosion Limits | |
| Upper | 7.1 vol % |
| Lower | 1.1 vol % |
| Suitable Extinguishing Media | Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray. |

| | |
|---|---------------------------|
| Unsuitable Extinguishing Media | No information available. |
| Hazardous Combustion Products | No information available. |
| Sensitivity to mechanical impact | No information available. |
| Sensitivity to static discharge | No information available. |

Specific Hazards Arising from the Chemical

Flammable. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

| | | | | |
|-------------|-----------------|-----------------------|----------------------|-----------------------------|
| NFPA | Health 2 | Flammability 3 | Instability 0 | Physical hazards N/A |
|-------------|-----------------|-----------------------|----------------------|-----------------------------|

6. ACCIDENTAL RELEASE MEASURES

| | |
|---|---|
| Personal Precautions | Use personal protective equipment. Ensure adequate ventilation. Keep people away from and upwind of spill/leak. Avoid contact with skin, eyes and inhalation of vapors.. Remove all sources of ignition. Take precautionary measures against static discharges. |
| Environmental Precautions | Should not be released into the environment. Do not flush into surface water or sanitary sewer system. Local authorities should be advised if significant spillages cannot be contained. |
| Methods for Containment and Clean Up | Provide adequate ventilation. Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment. |

7. HANDLING AND STORAGE

| | |
|-----------------|---|
| Handling | Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. Use explosion-proof equipment. Take precautionary measures against static discharges. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. |
| Storage | Keep containers tightly closed in a dry, cool and well-ventilated place. Flammables area. Keep away from heat and sources of ignition. |

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Measures

Ensure that eyewash stations and safety showers are close to the workstation location. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure adequate ventilation, especially in confined areas.

Exposure Guidelines

| Component | ACGIH TLV | OSHA PEL | NIOSH IDLH |
|-----------|-------------|--|---|
| Toluene | TWA: 20 ppm | (Vacated) TWA: 100 ppm (Vacated) TWA: 375 mg/m ³ Ceiling: 300 ppm (Vacated) STEL: 150 ppm (Vacated) STEL: 560 mg/m ³ TWA: 200 ppm | IDLH: 500 ppm TWA: 100 ppm TWA: 375 mg/m ³ STEL: 150 ppm STEL: 560 mg/m ³ |

| Component | Quebec | Mexico OEL (TWA) | Ontario TWA EV |
|-----------|---|---|----------------|
| Toluene | TWA: 50 ppm TWA: 188 mg/m ³ Skin | TWA: 50 ppm TWA: 188 mg/m ³ | TWA: 20 ppm |

NIOSH IDLH: Immediately Dangerous to Life or Health

Personal Protective Equipment

Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced

9. PHYSICAL AND CHEMICAL PROPERTIES

| | |
|---------------------------|----------------------------|
| Physical State | Liquid |
| Appearance | Colorless |
| Odor | aromatic |
| Odor Threshold | 1.74 ppm |
| pH | Not applicable |
| Vapor Pressure | 29 mbar @ 20 °C |
| Vapor Density | 3.1 (Air = 1.0) |
| Viscosity | 0.6 mPa.s @ 20 °C |
| Boiling Point/Range | 111°C / 231.8°F @ 760 mmHg |
| Melting Point/Range | -95°C / -139°F |
| Decomposition temperature | No information available. |
| Flash Point | 4°C / 39.2°F |
| Evaporation Rate | 2.4 (Butyl acetate = 1.0) |
| Specific Gravity | 0.866 |
| Solubility | Insoluble in water |
| log Pow | No data available |
| Molecular Weight | 92.14 |
| Molecular Formula | C7 H8 |

10. STABILITY AND REACTIVITY

Stability

Stable under normal conditions.

Conditions to Avoid

Incompatible products. Excess heat. Keep away from open flames, hot surfaces and sources of ignition.

| | |
|---|---|
| Incompatible Materials | Strong oxidizing agents, Strong acids |
| Hazardous Decomposition Products | Carbon monoxide (CO), Carbon dioxide (CO ₂) |
| Hazardous Polymerization | Hazardous polymerization does not occur. |
| Hazardous Reactions | None under normal processing. |

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Product Information

Component Information

| Component | LD50 Oral | LD50 Dermal | LC50 Inhalation |
|-----------|----------------------|--|-----------------------|
| Toluene | > 5000 mg/kg (Rat) | 12124 mg/kg (Rat) 8390 mg/kg (Rabbit) | 26700 ppm (Rat) 1 h |

Irritation Irritating to eyes, respiratory system and skin

Toxicologically Synergistic Products No information available.

Chronic Toxicity

Carcinogenicity There are no known carcinogenic chemicals in this product

Sensitization No information available.

Mutagenic Effects Not mutagenic in AMES Test

Reproductive Effects Experiments have shown reproductive toxicity effects on laboratory animals.

Developmental Effects Developmental effects have occurred in experimental animals.

Teratogenicity Possible risk of harm to the unborn child.

Other Adverse Effects The toxicological properties have not been fully investigated.

Endocrine Disruptor Information No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity

Do not empty into drains

| Component | Freshwater Algae | Freshwater Fish | Microtox | Water Flea |
|-----------|---|--|-------------------------|---|
| Toluene | 433 mg/L EC50 > 96 h 12.5 mg/L EC50 = 72 h | 50-70 mg/L LC50 96 h 5-7 mg/L LC50 96 h 15-19 mg/L LC50 96 h 28 mg/L LC50 96 h 12 mg/L LC50 96 h | EC50 = 19.7 mg/L 30 min | 11.5 mg/L EC50 = 48 h 5.46 - 9.83 mg/L EC50 48 h |

Persistence and Degradability Readily biodegradable.

Bioaccumulation/ Accumulation No information available

Mobility . Will likely be mobile in the environment due to its water solubility.

| Component | log Pow |
|-----------|---------|
| Toluene | 2.65 |

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

| Component | RCRA - U Series Wastes | RCRA - P Series Wastes |
|--------------------|------------------------|------------------------|
| Toluene - 108-88-3 | U220 | - |

14. TRANSPORT INFORMATION

DOT

UN-No UN1294
 Proper Shipping Name TOLUENE
 Hazard Class 3
 Packing Group II

TDG

UN-No UN1294
 Proper Shipping Name TOLUENE
 Hazard Class 3
 Packing Group II

IATA

UN-No UN1294
 Proper Shipping Name TOLUENE
 Hazard Class 3
 Packing Group II

IMDG/IMO

UN-No UN1294
 Proper Shipping Name TOLUENE
 Hazard Class 3
 Packing Group II

15. REGULATORY INFORMATION

International Inventories

| Component | TSCA | DSL | NDSL | EINECS | ELINCS | NLP | PICCS | ENCS | AICS | CHINA | KECL |
|-----------|------|-----|------|-----------|--------|-----|-------|------|------|-------|------|
| Toluene | X | X | - | 203-625-9 | - | | X | X | X | X | X |

Legend:

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.

XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).

Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

| Component | CAS-No | Weight % | SARA 313 - Threshold Values % |
|-----------|----------|----------|-------------------------------|
| Toluene | 108-88-3 | >95 | 1.0 |

SARA 311/312 Hazardous Categorization

| | |
|-----------------------------------|-----|
| Acute Health Hazard | Yes |
| Chronic Health Hazard | Yes |
| Fire Hazard | Yes |
| Sudden Release of Pressure Hazard | No |
| Reactive Hazard | No |

Clean Water Act

| Component | CWA - Hazardous Substances | CWA - Reportable Quantities | CWA - Toxic Pollutants | CWA - Priority Pollutants |
|-----------|----------------------------|-----------------------------|------------------------|---------------------------|
| Toluene | X | 1000 lb | X | X |

Clean Air Act

| Component | HAPS Data | Class 1 Ozone Depletors | Class 2 Ozone Depletors |
|-----------|-----------|-------------------------|-------------------------|
| Toluene | X | | - |

OSHA Occupational Safety and Health Administration

Not applicable

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

| Component | Hazardous Substances RQs | CERCLA EHS RQs |
|-----------|--------------------------|----------------|
| Toluene | 1000 lb | - |

California Proposition 65

This product contains the following Proposition 65 chemicals:

| Component | CAS-No | California Prop. 65 | Prop 65 NSRL |
|-----------|----------|--------------------------------------|--------------|
| Toluene | 108-88-3 | Developmental Female Reproductive | - |

State Right-to-Know

| Component | Massachusetts | New Jersey | Pennsylvania | Illinois | Rhode Island |
|-----------|---------------|------------|--------------|----------|--------------|
| Toluene | X | X | X | X | X |

U.S. Department of Transportation

Reportable Quantity (RQ): Y
 DOT Marine Pollutant N
 DOT Severe Marine Pollutant N

U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

Other International Regulations

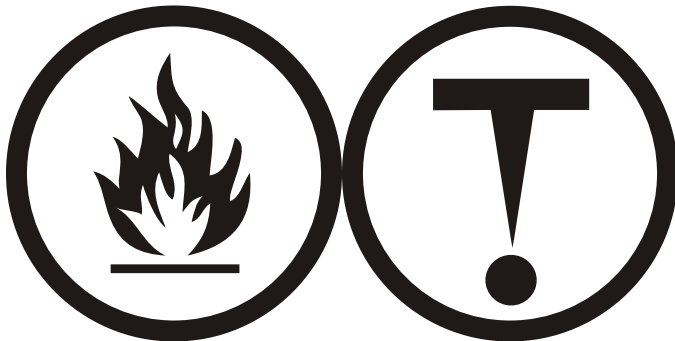
Mexico - Grade Serious risk, Grade 3

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class

B2 Flammable liquid
 D2A Very toxic materials
 D2B Toxic materials



16. OTHER INFORMATION

Prepared By Regulatory Affairs
 Thermo Fisher Scientific
 Email: EMSDS.RA@thermofisher.com

Creation Date 11-Jun-2009

Print Date 16-Sep-2013

Revision Summary

Update to Format, (M)SDS sections updated, 4, 8, 11, 12, 13, 15, 16.

Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of MSDS

APPENDIX F
CONSULTATION

Summary of the provincial review of the Churchill Marine Observatory

June 25, 2015

Conference call and request for comments on the Churchill Marine Observatory:

Conservation and Water Stewardship,

Duncan, James (CWS) – Wildlife and Fisheries Branch,
Ramrattan, Alisa (CWS) – Forestry and Peat land management Branch;
Braun, Tracey (CWS) – Environment Approval Branch;
Matthews, Rob (CWS) – Water Use Licensing Section
Morin, Michael (CWS) – Water Power Licensing
Missyabit, Ron (CWS) – Indigenous Relations Branch
Gilbertson, Mike (CWS) – Parks and Natural Areas
Stevenson, Lori (CWS) – Lands Branch
Roberts, Pierce (CWS) – Northeast Regional Director
David.Barber@umanitoba.ca (proponent)

Request: Branch Director's/Managers please participate by conference call or have a delegate participate on your behalf we require comments regarding a site for the construction of the Churchill Marine Observatory by end of day July 2nd, 2015.

I will also be asking Dr. Barber – Project Lead – University of Manitoba if he could give us a short verbal overview of the project, although may not be able due to the short notice.

The province is working with the University of Manitoba to identify a suitable site for the Churchill Marine Observatory. An ideal site, comprising approximately three acres of Manitoba Crown lands, has been site inspected and selected and steps are being taken to support the issuance of an interim general permit to facilitate the planning and design phase of the project. A long term lease would then follow, which will permit the university to move ahead with construction of the facility. Construction is anticipated to begin in 2016. The site is shown on the attached map. The area contains predominately a very large flat rock outcrop void of most vegetation.

The Churchill Marine Observatory will transform the ability to directly observe variability and change in the arctic eco-system. It will look to address issues pertaining to sea ice and marine transportation throughout the Arctic.

Please provide any comments/concerns/support by July 2, 2015 regarding the use of the site identified to construct a building, that will be enclosed within a fenced area, to house the necessary equipment. The site is located on Manitoba Crown land accessible by means of an existing developed road.

Hello all, attached are the additional maps and photos from today's call. The photo was taken by me on June 10, 2015 standing in the approximate location for the Oil in Sea Ice Mesocosm (OSIM) building and garage site looking west. The building in the foreground is Parks Canada's building and in the distance west across the Churchill River you can see Fort Prince of Wales.

Please advise by end of day July 2, 2015 of any existing known use/user of the site identified so we may include it in our assessment. In addition, general questions or comments regarding the site should be provided by the due date and will be responded to as quickly as possible.

Thank you for your assistance in this priority item.

Lori Stevenson
Director of Lands
Conservation and Water Stewardship

Notes: During the conference call the water intake / discharge pipeline and sensing equipment to be placed on the bed of the Churchill River was discussed and it was determined Environment Approval Branch would review the project in additional detail with the University and determine if an Environment Act License is required.

Summary of results of the provincial review of the CMO site:

Conservation and Water Stewardship – no concerns from any Branches, subject to review of EAL requirements regarding the water intake/discharge. No concerns with the site.

Manitoba Infrastructure and Transportation, Highway Planning and Design, June 29, 2015 – no concerns

Manitoba Infrastructure and Transportation, Northern Airports and Marine, June 25, 2015 - no concerns

Town of Churchill – June 25, 2015 – full support of the application

Aboriginal and Northern Affairs – July 2, 2015 – no concerns

Manitoba Mineral Resources – July 3, 2015 – no concerns

Letters of Notification sent August 7, 2015, requested comments by August 30th, 2015 (No comments or requests for additional information were received in response to the letters):

York Factory First Nation

Sayisi Dene First Nation

Kivalliq Inuit Assoc.

Churchill Metis Local Inc.

No circulation was sent to Tourism, Culture, Heritage, Sport, and Consumer Protection

Lori Stevenson noted that there was no evidence of burial sites or artifacts of a cultural or historical nature observed during the site visit. Also in her discussions with local residents the site is not utilized for any ceremonial or berry picking/gathering purposes.

Parks Canada, the adjacent land owners have been involved in the site identification and attended the site visit and did not express any concerns.



Conservation and Water Stewardship

Finance and Crown Lands Division/Lands Branch
Box 20000, 123 Main Street West
Neepawa, MB R0J 1H0
T 204-476-0053 F 204-476-7539
email: Lori.Stevenson@gov.mb.ca

August 7, 2015

Dear Sir or Madam:

Churchill Marine Observatory – Town of Churchill in Part NE 5-113-20 EPM

Conservation and Water Stewardship is providing notice to your community that the University of Manitoba is seeking a long term lease for a three acre (approximate) parcel of Crown land located within the limits of the Town of Churchill for the establishment of the Churchill Marine Observatory.

An overview of the Churchill Marine Observatory along with a site map of the proposed facility is included for your review. Prior to the issuance of a lease, an interim general permit or letter of authorization and a work permit will be issued because leases require surveys which take time to finalize. It is expected that the authorization to allow for site design and testing will be issued by August 10, 2015. No construction may occur under this initial allocation although the drilling of test holes and base sampling is likely to occur.

Manitoba's preliminary review of the project and location has determined that the proposed Crown decision would not adversely affect the exercise of aboriginal or treaty rights. To ensure our assessment is correct this notice is being provided to area First Nations, Inuit and Aboriginal communities that may exercise rights in the general area of the proposed disposition. The purpose of this notice is to inquire as to whether your community would like to offer in writing any concerns about the proposed disposition or any suggested conditions that may be considered prior to the issuance of a Crown land lease.

If you would like further information on the proposed Churchill Marine Observatory, the University of Manitoba has indicated that they would be willing to provide more information to those that request it or may have missed the presentation that occurred in the Town of Churchill in July, 2015.

Should you wish to respond to this notice or would like further information on the Churchill Marine Observatory, please do so in writing by August 30, 2015, to the Director of Lands, Conservation and Water Stewardship at P.O. Box 20000, 123 Main Street West, Neepawa MB R0J 1H0 by mail or by fax to 1-204-476-7539. If no response is received by that time we will continue with the approval of the request as described.

Yours truly,

“original signed by”

Lori L. Stevenson
Director of Lands

Churchill Marine Observatory Overview:

The Churchill Marine Observatory (CMO) will be a globally unique, highly innovative, multidisciplinary research facility located in Churchill, Manitoba, adjacent to Canada's only Arctic deep-water port. The CMO will directly address technological, scientific and economic issues pertaining to Arctic marine transportation and oil and gas exploration and development throughout the Arctic.

The CMO will include three research elements: an Oil in Sea Ice Mesocosm (OSIM); an Environmental Observing (EO) system and a logistics base. The OSIM will consist of a building containing two 9 x 9 x 3 metre saltwater sub-pools designed to simultaneously accommodate contaminated and control experiments on various scenarios of oil spills in sea ice as well as a storage garage. The logistics base will underpin all CMO research. The saltwater sub-pools, building and storage garage will be located on the three acre site that is the subject of this notification. The area will be lighted and fenced for safety. Access to the site will be by means of an existing public road.

The OSIM system includes a heated utility box (~50mm square) that will house water intake and discharge pipes and fibre optic cable to be located in the Churchill estuary. The EO system will use underwater cable, moorings and observational equipment situated along the main shipping channel across Hudson Bay and Strait. The EO system will provide a state-of-the-art monitoring system and will be used to scale process studies conducted in OSIM to Hudson Bay and the larger Arctic environment. The corridor for the water pipes and fibre optic cable is expected to cross above ground to the point at which it is directed to the river bottom. Discussions are occurring to situate the utility corridor on private land owned by OmniTRAX or an alternate route across federal Crown land. The water pipes and fibre optic cable will lay on the river bottom and will have no effect on shipping vessels or other water craft or fish. Similar installations in other areas of the world exist without interference to shipping or negative effects on the marine environment.

The ownership of the bed of the river at this location is understood to be federal at this time however the reversion of the bed of the river to the province has been contemplated for some time. If ownership is or becomes provincial at the time installation is necessary an easement or similar form of tenure would be issued by the province.

The university will be filing an Environment Act proposal with Conservation and Water Stewardship. It is currently unknown if a federal environment assessment will be required related to the data collection equipment situated in the Bay and the impact, if any, on fish and fish habitat.

CMO will position Canada as a global leader of research into the detection, impacts and mitigation of oil spills in sea ice. Knowledge gained through CMO will strengthen Canada's technological capacity to protect the Arctic environment. Partnerships with indigenous organizations will ensure knowledge exchange; the private sector will provide market-driven uptake of technology and various levels of government will transfer knowledge into policy and regulation. The Churchill Marine Observatory will transform the ability to directly observe variability and change in the arctic eco-system. It will look to address issues pertaining to sea ice and marine transportation throughout the Arctic.

The Site:

The University of Manitoba and the province have identified a three acre site for the construction of the **Churchill Marine Observatory**. The site is located within the limits of the Town of Churchill, immediately east of Parks Canada land (Cape Merry Battery) and north of private land owned by OmniTRAX. The location has been inspected and reviewed by the province. No concerns or previous use of the land has been identified. The site is located on a predominately large flat rock outcrop void of most vegetation.

Based on the site inspection and provincial review of the site the province is planning to accommodate the immediate need of the University of Manitoba and issue an interim permit to facilitate the planning and design phase of the project. No construction will be allowed during this phase. In the upcoming months following the development of a lease agreement and survey of the land a long-term lease would be issued.

| Disposition Type and Number | Applicant (name provided if not an individual): | Specified Use |
|---|---|---|
| (Interim permits) Long term lease number to be assigned | University of Manitoba | Churchill Marine Observatory |
| Description of the Land: Part NE 5-113-20 EPM; Excepting All Mines, Minerals and other matters set out in <i>The Crown Lands Act</i> . Approximately ± 3.00 acres (to be confirmed by survey) | | Map Reference Outlined in red |

Subject to the following additional conditions:

- a. the Applicant acknowledges that Manitoba has reserved out of the disposition of the land all mines and minerals together with the right to enter, locate, prospect, mine for, and remove minerals from the land;
- b. the Applicant will obtain a survey to describe the land for lease purposes, with all associated expenses being the sole responsibility of the Applicant;





**Proposed Site for Marine Observatory
- Including Ownership**

