Potential Water Impurities

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Impurity Name	General Information
1,2,3,4-tetrachlorobenzene	Mol. wt. 215.90 1,2,3,4-tetrachlorobenzene is a white crystalline solid which is partially soluble in water (approximately 4 mg/L at 25 degrees Celsius) and soluble in ether. It is reported to have low toxicity. It is used in dielectric fluids and in organic synthesis reactions.
1,2,3,5-tetrachlorobenzene	Mol. wt. 215.90 1,2,3,5-tetrachlorobenzene is a white flake material which is partially soluble in water (approximately 4 mg/L at 25 degrees Celsius) and soluble in ether and benzene. There is no toxicological information reported specifically for this compound. [See information on 1,2,3,4-tetrachlorobenzene or 1,2,4,5-tetrachlorobenzene.]
1,2,3-trichlorobenzene	Mol. wt. 181.46 1,2,3-trichlorobenzene is a white crystalline solid which is partially soluble in water (approximately 24 mg/L at 25 degrees Celsius) and is soluble in such solvents as carbon disulfide, ether and benzene. There is little toxicological information on this substance, but it is reported to be moderately toxic by ingestion and inhalation. It is a minor skin and mucous membrane irritant. In combination with the other two isomers of trichlorobenzene, it has been used in the control of termites.
1,2,4,5-tetrachlorobenzene	Mol. wt. 215.90 1,2,4,5-tetrachlorobenzene is a white flake material which is insoluble in water (approximately 0.6 mg/L at 25 degrees Celsius) and soluble in ether and benzene. It is reported to have low toxicity. It is used in the manufacture of herbicides and defoliants, insecticides and electric insulation.

Impurity Name	General Information
1,2,4-trichlorobenzene	Mol. wt. 181.46 1,2,4-trichlorobenzene is colorless liquid which is partially soluble in water (approximately 35 mg/L at 25 degrees Celsius) and is soluble in most organic solvents (eg. benzene, ether and carbon disulfide). There is little toxicological information on this compound, but it is reported to be toxic by ingestion and inhalation. It is used as a solvent, in the manufacturing of dyes, as a dielectric fluid and as an insecticide.
1,2-dichloroethane (ethylene dichloride)	Mol. wt. 98.96 1,2-dichloroethane is a pleasant smelling liquid which is moderately soluble in water and soluble in alcohol and ether. 1,2-dichloroethane is an experimental carcinogen and exhibits mutagenic effects. The US EPA has classified it as a probable human carcinogen (Group B2) It is slightly toxic by ingestion and at high vapor concentrations can irritate the eyes, nose and throat. Chronic exposure can lead to depression of the central nervous system and damage to the liver, kidneys and adrenals. It is used in the manufacture of vinyl chloride and tetraethyl lead. It is also used as a lead scavenger in gasoline, as an insecticide fumigant, in tobacco flavoring, as a metal degreaser and in ore flotation.
1,3,5-trichlorobenzene	Mol. wt. 181.46 1,3,5-trichlorobenzene is a crystalline solid which is partially soluble in water (approximately 15 mg/L at 25 degrees Celsius) and soluble in such organic solvents as benzene, ether and carbon disulfide. There is no reported toxicological information reported specifically for 1,3,5-trichlorobenzene. [See either 1,2,3-trichlorobenzene or 1,2,4-trichloro-benzene.]
1,3-dichlorobenzene (m-dichlorobenzene)	Mol. wt. 147.00 1,3-dichlorobenzene is a colorless liquid. It is slightly soluble in water (approximately 130 mg/L at 25 degress Celsius) and soluble in alcohol and ether. While there is little toxicological information on this form of dichloro-benzene, it is important to note that it has been used as an insecticide and fumigant.

Impurity Name	General Information
1,4-dichlorobenzene (p-dichlorobenzene)	Mol. wt. 147.00 1,4,-dichlorobenzene is a white crystalline solid with a pungent odor. It is slightly soluble in water (approximately 72 mg/L at 25 degrees Celsius) and is soluble in alcohol and ether. It is poisonous by ingestion and possibly other routes. It is toxic by inhalation and is an eye irritant. It is reported to be an experimental carcinogen and demonstrated mutagenic effects. It will react violently with oxidizing agents. 1,4-dichlorobenzene is used as a moth repellent, as an insecticide, and in the manufactureing of 2,5-dichloroaniline.
2,4,5-T (2,4,5-trichlorophenoxyacetic acid)	Mol. wt. 255.49 2,4,5-T is a crystalline solid which is partially soluble in water (approximately 238 ppm at 30 degrees Celsius) and soluble in alcohol. It was usually supplied in the form of amines or esters and often in combination with 2,4-D. 2,4,5-T was used as a herbicide in the control of broad-leaf weeds and in the control of woody plants. The mode of toxicity in plants is to act as a growth hormone in plants. 2,4,5-T toxicity in animals is poorly understood, but it does not have any hormonal effect in animals. It is moderately toxic by ingestion (<500 mg/kg LD50 rat). Examination of laboratory animals over exposured to the point of death has shown that 2,4,5-T damages the stomach, liver and kidneys. TCDD is a common comtaminant of both 2,4,5-T and 2,4-D. TCDD may be responsible for the chloracne observed in workers exposed to 2,4,5-T.
2,4,5-TP (silvex)	2,4,5-TP is a colorless powder. It is slightly soluble in water and soluble in organic solvents such as acetone, methanol and diethyl ether. It is a hormone-type herbicide which is absorbed by leaves and stems. It is used to control brush, aquatic weeds and broad-leaved weeds. 2,4,5-TP is moderately toxic by ingestion. Thermal decompostion releases chlorine.
2,4-D (BEE) (2,3-dichlorophenoxyacetic acid)	2,4-D is a colorless powder exhibiting limited solubility in water, but soluble in aqueous alkali, alcohols and diethyl ether. It is reported on the IARC List as a Group 2B compound. 2,4-D, its salts and esters are systemic herbicides used in the control of weeds in cereals and other crops. It is a suspected human carcinogen. Poisonous by ingestion, intravenous and intraperitoneal injection, it is moderately toxic by skin contact. It is also a skin and severe eye irritant. Systemic effects on the human body include somnolence (sleepness), convulsions, coma, nausea and vomiting. The liver and kidneys can also be damaged. Thermal decompostion can release chlorine.

Impurity Name	General Information
2,4-DB (2,4 dichlorophenoxybutyric acid)	Mol. wt. 249.1. Pure 2,4-DB forms colorless crystals. Only slightly soluble in water, it is soluble in acetone, benzene, ethanol and diethyl ether. 2,4-DB is a translocatable herbicide used in the control of broad-leaved weeds. It is more selective than 2,4-D due to its activity being dependant on the beta-oxidation to 2,4-D within the plant. It has been used on lucerne, undersown cereals and grasslands.
2,4-dichlorophenol (DCP)	[SEE INFORMATION ON: dichlorophenol]
Abietic Acid	Mol. wt. 302.44 The Ontario Provincial Water Quality Objective for abietic acid is set as a total resin acid objective. Receiving Water pH / Total Resin Acids (ug/L) 5 / 1 5.5 / 3 6 / 4 6.5 / 9 7 / 25 7.5 / 45 8 / 52 8.5 / 60 9 / 62 A readily available organic acid which is synthesized by heating rosin either alone or with acids. The resulting abietic acid is a yellow, glassy or crystalline substance with a melting point of 85 degrees Celsius. It is insoluble in water, but soluble in ether, acetone, carbon disulfide and dilute sodium hydroxide solutions. Abietic acid is used in the manufacture of such esters as methyl, vinyl and glyceryl esters for use in lacquers and varnishes. It is also used in the manufacturing of soap, plastics and paper.
Alachlor	In pure form, a cream-colored solid. Having limited solubility in water it is soluble in a number of organic solvents (eg. acetone). Alachlor is an acetanilide and as such is related to butachlor and propachlor. Alachlor is a preemergence herbicide used in the control of broad-leaved and grass weeds in such crops as corn, oilseed rape and cotton. It is slowly decomposed by soil microbial action over a 42 to 70 day period. It is slightly toxic to mammals through normal routes of exposure and can be slightly irritating to the skin. It is toxic to fish. There is little information on its reproductive effects or its carcinogenic potential.

Impurity Name	General Information
Aldicarb	Aldicarb forms colorless crystals. It is soluble in water as well as in most organic solvents. It is a member of the carbamate family of pesticides. It was registered for use as a pesticide in the US in 1970. It is listed on the US EPA Extremely Hazardous Substances List. Aldicarb is a systemic pesticide used in the control of mites, nematodes and insects. It is a deadly poison by ingestion (extremely toxic), skin contact and possibly other routes. Its chemical structure was specifically designed to resemble the structure of acetylcholine. Aldicarb is readily metabolized in animals and readily breaks down in the environment. Thermal decomposition releases oxides of nitrogen and sulfur.
Aldrin	Pure aldrin is a colorless crystalline solid. While insoluble in water it is highly soluble in several organic solvents. Storage of this chemical slowly leads to hydrogen chloride formation. It is a member of the chlorinated cyclodiene family of pesticides and is easily epoxidized to diedrin. Aldrin was first made available for use as a pesticide in 1949. Aldrin is on the US EPA Extremely Hazardous Substances List. Aldrin is an insecticide which is poisonous to a number of soil inhabiting insects, either by contact or ingestion. It is used against termites and ants and is readily epoxidised to dieldrin in living organisms. It is poisonous to humans by skin contact, ingestion, intravenous, intraperitoneal injections and other routes. Humans ingesting this chemical experience nausea or vomiting, excitement and tremors. There is evidence linking it to carcinogenic, teratogenic and reproductive effects. Thermal decompostion can lead to the formation of hydrogen chloride fumes.

Impurity Name	General Information
Alkalinity	Alkalinity is a measure of capacity; capacity to accept protons. On the other hand, pH is a measure of intensity. For example, a 0.001 M sodium hydroxide solution has a pH of 11, but will only neutralize 0.001 moles of acid; a 0.100 M sodium bicarbonate solution has a pH of 8.34, but will neutralize 0.100 moles of acid. In this example alkalinity of the sodium bicarbonate solution is 100 times greater than that of the sodium hydroxide solution. Alkalinity is often referred to as a "fertility factor". Algae has the ability to use bicarbonate or carbon dioxide, water and sun light to produce biomass. If atmospheric carbon dioxide cannot keep up with the rapid consumption of inorganic carbon the result is frequently a water with a pH of 10 or greater. The hydroxyl, carbonate and bicarbonate groups are the usual chemical groups responsible for the alkalinity of natural waters. Alkalinity is expressed in several ways. Alkalinity can be expressed as phenolphthalein alkalinity (P-alkalinity), corresponding to titration with acid to the pH at which bicarbonate is predominate (pH of 8.34). Alkalinity can also be expressed as methyl orange alkalinity (M-alkalinity), corresponding to titration with acid to an endpoint where both bicarbonate and carbonate species have been completed converted to carbon dioxide. Engineers frequently express alkalinity in terms of mg/L carbon dioxide. Chemists measure alkalinity in terms of equivalents/L.

Impurity Name	General Information
Aluminum	Al; Atomic no. 13; Atomic wt. 26.98; Valence +3. Group IIIA (metal) The Ontario Provincial Water Quality Objective (Guideline) is as follows. Aluminum, Inorganic Monomeric - 0.015 mg/L, at pH 4.5-5.5 measured in day-free samples Aluminum, Acid Soluble Inorganic - <10% increase above average background at pH>5.5-6.5 in clay free samples Aluminum Total - 0.075 mg/L at pH 6.5-9.0 measured in clay free samples Aluminum is the third most abundant element in the earth's crust (oxygen is the most abundant crustal element and silicon is the second most abundant) and it is the most abundant metal on earth. The principal ore of aluminum is bauxite and it is a major constituent of clay in the form of various silicates. Aluminum is toxic by ingestion when massive doses are administered however, the human body appears to be quite capable of handling average normal intakes of aluminum (approx. 6 mg/day). While the degree of absorption of ingested aluminum and its compounds is small. Those aluminum salts which are absorbed in the gastrointestinal tract are converted to phosphate salts and excreted in the feces. Interference with phosphate metabolism may result in rickets. Exposure to aluminum fume may produce weakness, fatigue and respiratory distress (Shaver's disease). Fibrosis has also be associated with exposure to aluminum dust. There is presently much discussion as to whether aluminum in linked to Alzheimer's disease. Aluminum has many uses including water purification (addition of aluminum sulfate as a coagulant), alloy manufacturing, paints, explosives and as an electrical conductor.
Ammonia	Mol. wt. 17.03 Ammonia is a gas at normal temperatures. Ammonia in water forms a certain amount of ammonium hydroxide. [Ammonia and ammonium hydroxide are both toxic and injure cells due to their caustic action.] Water quality is often measured by the oxidative state of the nitrogen present in the water itself. [Ammonia is made-up of one atom of nitrogen and three atoms of hydrogen.] Under anaerobic conditions (polluted water, eg. high BOD present) nitrate may be oxidized to form gaseous nitrogen or ammonia. Under aerobic conditions ammonia may be oxidized to nitrite and nitrate. Protein bond nitrogen can be decomposed to ammonia by microorganisms while ammonia plus organic carbon can be used by microorganisms to build cells. Aquatic plants and algae can use nitrate and to some extent ammonia as a nutrient. In summary, the presence of ammonia (and other nitrogenous compounds) usually indicates the presences of pollution. Ammonia signals recent pollution while nitrate indicates past pollution.

Impurity Name	General Information
Arsenic	As; Atomic no. 33; Atomic wt. 74.92; Valence +3,+5. Group VA Arsenic is listed by IARC as a Group 1 substance. Minerals containing arsenic include arsenolite and arsenopyrite. Dissociation of arsenic from its natural minerals accounts for some of the element's presence in water (arsenic is found in most soil types). However, arsenic pollution is usually associated with metals mining and alloy production of copper and lead. It is interesting to note that shellfish naturally contain relatively high concentrations of arsenic. As(V) is found in aerobic waters in the form of arsenate. As(III) is found in anaerobic waters. The toxicity of arsenic varies greatly depending on its form. Metallic arsenic is relatively low in toxicity while arsine (a colorless gas with a disagreeable garlic odor) is highly poisonous (0.5 ppm can be toxic). Arsenic and certain of its compounds are reported as confirmed human carcinogens. It readily bioaccumulates in the body and concentrates in the hair, skin and nails. Acute arsenic poisoning is characterized by nausea, vomiting and diarrhea, possibly leading to death. Chronic poisoning can lead to many bodily changes including skin color changes and damage to the liver and kidneys. Arsenic has many industrial uses including the making of glass, herbicides, insecticides and wood preservatives (eg. complexed with copper and chromium).
Atrazine (and D-ethyl Atrazine)	A colorless powder, it exhibits partial solubility in water and good solubility in chloroform and ethyl acetate. It is a member of the triazine family of pesticides. Atrazine is a herbicide used to control weeds in such crops as corn, grasses and sugarcane. It is sightly toxic by ingestion and only mildly toxic by inhalation and skin contact. Thermal decompostion releases chlorine and oxides of nitrogen.
Azinphos-methyl	Technical azinphos-methyl is a yellow-brown solid. It readily decomposes at elevated temperature and is soluble in most organic solvents. It was first registered as an insecticide in the US in 1956. It is applied to fruit and field crops, vegetable, tobacco, ornamentals and forest trees. Azinphos-methyl is a highly toxic organophosphorus insecticide. There is little to no information on its mutagenic, teratogenic or carcinogenic properties. It exhibits low soil mobility and low leaching potential in a variety of soil types. It is also metabolized by aerobic microorganisms.

Impurity Name	General Information
Barium	Ba; Atomic no. 56; Atommic wt. 137.34; Valence +2. Alkaline Earth Barium is found in both igneous and sedimentary rock. In igneous rock it is more abundant than strontium. Barite (barium sulfate) and witherite (barium carbonate) are the most common barium ores. Insoluble forms of barium are not toxic by ingestion because they are only minimally absorbed. Soluble forms of barium are very toxic relative to calcium and strontium. Ingestion of barium can cause muscular paralysis, ventricular fibrillation and extra systoles. Barium has proven digitalis-like toxicity, muscle stimulation and central nervous system effects. It is suggested that barium maybe needed for proper health. Plants accumulate barium from the soil (eg. Brazil nuts have barium in concentrations of 3000 to 4000 ppm). Barium is used in various alloys, paints, soap, paper, rubber and in the manufacture of ceramics and glass. Due to barium sulfate's insolubility it is used as a radiopaque aid in x-ray diagnosis.
Bendiocarb	In pure form it is a white solid. It is a member of the carbamate family of pesticides. Bendiocarb is a contact insecticide and stomach poison. As a carbamate it acts as a cholinesterase inhibitor, but is only moderately toxic to animals.

Impurity Name	General Information
Benzene	Benzene is a typical petroleum hydrocarbon and as such has been widely found in surface and groundwaters. Benzene is listed by IARC as a Group 1 substance. Benzene is a confirmed human carcinogen causing myeloid leukemia, Hodgkin's disease and lymphomas. It is poisonous by inhalation, skin contact, intravenous and intraperitoneal injection. It is moderately toxic by ingestion and is a severe eye and moderate skin irritant. Exposure by inhalation and ingestion can lead to euphoria (narcotic action), somnolence, changes in sleep, changes in motor activity, nausea or vomiting, dermatitis, fever and changes in blood composition. Some of these symptoms can be noticed at exposures of 100 ppm via inhalation. Benzene is so widespread because of its physical properties (solubility of 1.8 g/L at 25 degrees Celsius and vapor pressure allowing air concentrations of up to 75000 ppm) and because it has been manufactured in such large quantities. The presence of benzene is commonly used as a sign of human activity. For example, groundwater near petroleum underground petroleum storage tanks is frequently tested for benzene in order to check for tank leaks. Very often it is a good indicator, but the presence of benzene or one of its derivatives (toluene, ethylbenzene or xylene) can be found naturally in shale oil and certain soil systems. Benzene is used as a starting material for other chemical compounds. Nearly 90 percent of all benzene recovered or manufactured is used to produce ethylbenzene (for the production of polystyrenic plastics and rubbers); cyclohexane (for the fabrication of nylon products); nitrobenzene (for aniline); and cumene (for phenol). As previously mentioned, benzene and many of its derivatives are found in most petroleum products (eg. gasoline and diesel fuel).
Benzo(a)pyrene	Mol. wt. 252.32 Benzo(a)prene is one the thoroughly studied polynuclear aromatic hydrocarbons (PAH).In pure form it is a yellow crystalline solid which is insoluble in water (10 ng/L). However its solublity along with the solubility of other PAHs can be increased due to the presence of detergents and other surfactants. Benzo(a)pyrene is a known carcinogen in laboratory animals. It is poisonous by subcutaneous route and mutagenic data has been reported. Benzo(a)pyrene in formed during the pyrolysis of hydrocarbons and is a natural constituent of coal, coal tar, petroleum, shale, kerosene, cigarette smoke.

Impurity Name	General Information
Beryllium	Be; Atomic no. 4; Atomic wt. 9.01; Valence +2. Alkaline Earth Concentrations of beryllium should not exceed 11 ug/L in an unfiltered sample of hardness less than 75 mg/L of calcium carbonate and should not exceed 1100 ug/L in an unfiltered sample of hardness greater than 75 mg/L calcium carbonate. Beryllium is found in silicates associated with igneous rock formations (beryl is the chief ore of beryllium). Beryllium oxide and beryllium hydroxide are very insoluble at a pH of 7 and as a result beryllium is found in natural waters in very low concentrations. It is on the IARC List as a Group 2A substance. Beryllium is not well absorbed by any route, but it is a suspected carcinogen via inhalation (shown to cause osteogenic sarcoma and bronchogenic carcinoma in laboratory animals). Beryllium has many industrial uses including the hardening of copper, the manufacture of alloys, ceramics and electronic components. Its used in florescent lights was discontinued due to its adverse effects on the respiratory system and skin.
BOD	Biochemical Oxygen Demand. Biochemical Oxygen Demand is a standardized test used to determine the oxygen required by bacteria to oxidize organic matter to water and carbon dioxide. This test usually requires a minimum of 5 days to complete. It is not unusual for natural waters to have a 1 to 2 mg/L BOD. This is derived from decaying vegetation. A high concentration of BOD can quickly deplete water of its dissolved oxygen; oxygen which is needed for fish and aerobic microorganisms to survive. Once this oxygen depletion occurs the anaerobic microorganisms will take over and produce such pollutants as hydrogen sulfide (giving polluted waters a rotten egg smell), ammonia and methane. In a naturally balanced water system the rate of oxygen depletion is offset by the oxygen produced by reaeration and photosynthesis.

Impurity Name	General Information
Boron	B; Atomic no. 5; Atomic wt. 10.81; Valence +3. Group IIIA (metaloid) Boron occurs in as many as 80 different minerals, the most common of which is tourmaline. In general, boron is found in natural waters due to the weathering of surrounding geological formations. Boric acid is the most common form of boron in both fresh and salt waters. It is moderately soluble and does not dissociate readily. Boron has been shown to essential to plants, but has not been shown to be essential to animals. Boron found in food (average daily intake is approximately 15 mg, mostly from fruits and vegetables) in the form of sodium borate or boric acid, is readily absorbed and ultimately excreted in the urine. Toxic effects of boron vary depending on the specific boron compound in question. For example, poisoning by over exposure to boranes and boric acid have been reported. Pentaborane is very hazardous, while diborane is a lung and kidney irritant. Over exposure to boron can lead to accumulations of this element in the brain, central nervous system depression and gastrointestinal irritation. Today the vast majority of boron is used in the production of glass and enamels (borosilicates). It is also used in soaps, welding, the nuclear industry and due to its mild antiseptic properties, medicines.
Bromoxynil	Bromoxynil is a cyanide compound. It is used as a herbicide. It is moderately toxic to animals.
Cadmium	Cd; Atomic no. 48; Atomic wt. 112.41; Valence +2. Group IIB (metal) Cadmium is found in natural geological formations combined with sulfur or often as an impurity in zinc, copper and lead ores. It is also found in petroleum products such as crude oil and gasoline. In natural (unpolluted) waters cadmium is usually not detectable at concentrations of 1 ug/L. Like mercury, cadmium has the ability to form compounds with ammonia and cyanide. Unlike lead, cadmium readily exists in aqueous media for long periods of time, easily building in concentration. Unlike lead, copper and zinc, it readily bioaccumulates in plants. Cadmium is listed by IARC as a Group 2A substance. Cadmium is a very toxic substance. It bioaccumulates in organisms and has a half-life of 20 years or more in the human body. Concentration factors (bioaccumulation ratios) can vary anywhere from 1000 in fish muscle to 3000 in marine plants. Cadmium accumulates in such body organs as the kidney, liver, pancreas and thyroid. In addition, cadmium toxicity is increased in the presence of other metals (synergy). For example, both zinc and copper significantly increase the toxicity of cadmium. Cadmium has and is used in numerous industrial processes and consumer products not the least of which are nickel-cadmium batteries, insecticides and pigments.

Impurity Name	General Information
Calcium	Ca; Atomic no. 20; Atomic wt. 40.08; Valence +2. Alkaline Earth Calcium is the fifth most abundant element in the earth's crust. Some of the more common geological formations containing the element include gypsum, limestone and marble. In natural waters it is usually the most abundant cation. As calcium carbonate and calcium bicarbonate it is the main constituent of "hard water". Water hardness is usually expressed in terms of parts per million (ppm) of calcium carbonate. Some typical ranges are: 0 - 75 ppm - - Soft Water 75 - 150 ppm - - Moderately Hard Water 150 - 300 ppm - - Hard Water > 300 ppm - - Very Hard Water Calcium bicarbonate is relatively soluble and can be easily removed by heating the water (called "temporary hardness") resulting in calcium carbonate, water and carbon dioxide being produced. Since calcium carbonate is relatively insoluble, it precipitates out as a solid. Lime (calcium oxide), slaked lime (calcium hydroxide) and calcium carbonate are used in many commercial and industrial processes not to mention their use in various flue gas and waste water treatment technologies. Calcium performs many necessary functions within the human body including helping to form healthy teeth and bones and proper blood coagulation. Health and Welfare Canada suggest a recommended dietary intake for adults of approximately 800 mg/day.
Carbaryl	A colorless crystalline solid, partially soluble in water and highly soluble in dimethylformamide. It is listed on the IARC List (Group 3). It was the first of the carbamate insecticides to be introduced (intial registration in US, 1958) and is still the most heavily used carbamate on the market today. Carbaryl is an insecticide which is poisonous by all the usual routes of exposure, although only slowly absorbed through the skin. As a reversible cholinesterase inhibitor, symptoms of poisoning are blurred vision, headache, stomache ache and vomiting. It is extremely toxic to aquatic invertebrates and honey bees. It is moderately toxic to fish. There is no evidence to indicate that it is an oncogen. It exhibits low mutagenic and teratogenic effects. Carbaryl is metabolized by bacteria and fungi. The half-life under areobic conditions is reported to be approximately 7 days.

Impurity Name	General Information
Carbofuran	Technical carbofuran is a white crystalline solid which is slightly soluble in water (700 ppm) and is soluble in a number of organic solvents (eg. acetone). It was first registered in the US as an insecticide in 1969. It is appied to fruit and field crops, vegetables, tobacco, ornamental and forest trees. Carbofuran is a member of the carbamate family of compounds. It is systemic poison which acts as a cholinesterase inhibitor. While it is highly toxic (8-14 mg/kg LD50 rat), it is rapidly metabolized in animals.
Carbon tetrachloride	Mol. wt. 153.81 Carbon tetrachloride is a heavy colorless liquid at room temperature. It is partially soluble in water (805 mg/L at 20 degrees Celsius). This volatile organic compound has an atmospheric half-life of 30-50 years and information on its biodegradability is limited. Carbon tetrachloride is listed by IARC as a Group 2B compound. It is an experimental carcinogen and has been classified by the US EPA as a probable human carcinogen (Group B2). It is poisonous by ingestion and in moderately toxic by inhalation. Moderate exposure to its vapors can cause gastrointestinal upset, headache, confusion and possible serious kidney and liver damage. A high level of exposure results in depression of the central nervous system leading to unconsiousnes and possible repiratory failure. It is also a severe eye irritant and a moderate skin irritant. It is a narcotic. There are no known natural sources of carbon tetrachloride. It is found in the wastewater of iron and steel manufacturing plants, foundries, petroleum refineries and paint manufacturers. Its uses include chemical synthesis of fluorocarbons, degreaser, fire extinguisher and grain fumigant.
Cesium-137	Cs-137; Atomic no. 55; Valence +1; Alkali metal Cesium in its natural form has one form, nonradioactive cesium-133. Cesium is found in nature in aluminosilicates (pollucite and lepidolite) and in the borate, zhodizite. Cesium-137 is a man-made radionuclide which is produced during a fission-based explosions (0.16 MCi/megaton) and in thermal reactors (1.2 MCi/MW/yr). It emits both beta and gamma radiation and has a half-life of 30.17 years. Cesium-137 is strongly bound to the soil and therefore is not readily absorbed by plants. Since it is chemically similar to potassium it can compete with potassium for use in the human body. Regardless as to how it is administered, it is quickly distributed throughout the body by the blood stream; in essence resulting in the whole body being irradiated. Death in this instance is usually due to the destruction of the bone marrow. The biological half-life of Cs-137 in the human body is between 50 and 150 days.

Impurity Name	General Information
Chlordane	A viscous amber liquid. It is soluble in water and completely miscible with such solvents as acetone, cyclohexane and ethanol. Chlordane is on the IARC List (Group 3) and the US EPA Extremely Hazardous Substances List. Chlordane is a member of the family of chlorinated cyclodienes and was first registered for use in the US in 1948. It is a persistent, non-systemic poison which acts by contact or ingestion. Its uses are varied and include ant, grasshopper and earthworm control. Chlordane is potentially poisonous by all routes of exposure. While its exact mode of action is not known, it is a central nervous system stimulant. It also has experimental teratogenic and reproductive effects. As with most chlorine based insecticides, chlordane is persistent and accumulates in the adipose tissue. There are documented fatalities associated with this chemical. Thermal decomposition can lead to the formation of hydrogen chloride and to the release of nitrogen oxides.
Chloride	Cl(I) Chloride, the anion of chlorine, is relatively nontoxic and is found in most natural waters in concentrations less than sulfate and bicarbonate. Chloride is also the reduction product of using chlorine as a disinfectant in water and wastewater treatment. In concentrations greater than 400 mg/L water takes on a salty taste. Concentrations greater than 250 mg/L can have negative physiological effects on humans. Chloride is essential for human life and along with sodium and potassium is integral to the body maintaining a proper water balance. Humans excrete between 110-250 mg of chloride in a 24 hour period; because of this, high concentrations of chloride are associated with polluted waters.
Chlorine	Cl; Atomic no. 17; Atomic wt. 35.45; Valence -1. Halogen Chlorine is a gas at normal temperatures. Chlorine is highly toxic. [It was used as a poisonous gas in World War I.] Due to its toxicity it is used as a disinfectant in municipal drinking water treatment/distribution systems. [Some European cities use ozone as their water disinfectant instead of chlorine.] SEE chloride FOR MORE INFORMATION ON CHLORINE.

Impurity Name	General Information
Chlorpyrifos (Dursban)	Colorless crystals. It is partially soluble in water and highly soluble in typical organic solvents. Its initial registration in the US for use as insecticide was in 1965. Chlorpyrifos is a non-systemic organophosphate insecticide which acts by contact, ingestion and vapor. It is used in the control of a variety of insects including flies and mosquitoes. It is potentially poisonous by all routes of exposure. It is highly toxic to fish, birds and other wildlife. Thermal decompostion leads to hydrogen chloride formation and the release of oxides of phosphorus, nitrogen and sulfur.
Chromium	Cr; Atomic no. 24; Atomic wt. 52.00; Valence +1 to +6. Grp. VIB metal Chromium is found in many geological formations and is found in natural water in low concentrations. Coal contains measurable amounts of chromium. It is on the IARC List as a Group 1 substance. The toxicity of chromium varies greatly according to its oxidation state. Chromium (III) has little to no toxicity. In fact it is an essential trace element and is required for glucose and lipid metabolism in mammals. Chromium (VI) has been demonstrated to cause cancer (bronchogenic carcinoma). Chromium bioaccumulates with concentration factors varying according to the biological organism of interest (eg. 70 in fish, 1600 in benthic algae). Chromium is used in the production of steel (eg. stainless steel), refractory brick, tanning agents, pigments and wood preservatives (eg. in combination with copper and arsenic).
COD (Chemical Oxygen Demand)	COD is measured using potassium dichromate as an oxidizing agent. Unfortunately some organics (eg. benzene and toluene) are resistant to this form of oxidization; while some inorganics, such as ferrous ion, sulfides and manganese, are oxidized. COD values are always higher than BOD values. For example, cellulose is easily oxidized chemically, but slow to decompose biologically.
Color	Natural waters have color due to: negatively charged colloidal particles (imparting a pale green-blue tint); dissolved organic matter (imparting a yellow-brown color); and suspended solids. Color by itself is not necessarily an indication of pollution, nor is it necessarily objectionable from the standpoint of health. A regulatory limit or objective is usually based on esthetics.

Impurity Name	General Information
Copper	Cu; Atomic no. 29; Atomic wt. 63.55; Valence +1,+2. Group IB metal There are several geological formations which are copper containing including cuprite and various sulphide ores (eg. copper pyrite and indigo copper). Natural waters typically contain very small quantities of copper. Total copper in water may occur as Cu(II), insoluble particules and soluble complexes. Copper in ionic form (Cu(II)) is toxic; as are Pb, Zn and Cd in ionic form. It can kill many types of algae at concentrations as little as 0.5 ppm. Cu(II) can kill fish at only a few parts per million. It is important to note that calcium and magnesium (hard water) reduces the toxicity of Cu(II) in water by acting as an antagonist and drinking water standards are usually based on the disagreeable taste imparted by copper rather than on the toxicity of the copper in the water. In humans, acute copper poisoning causes abdominal pain, vomiting and convulsions. Chronic poisoning can result in damage to the liver and kidneys. Copper has many commerial and industrial uses including water pipes, wiring, brass works, algaecides and wood preservatives (eg. complexed with arsenic and cadmium). Copper (II) is a required nutrient for plant and animal life. It is an essential nutrient for the human body. It is associated with the proper function of a number of enzymes (eg. cytochrome a and ferroxidase). Health and Welfare Canada recommends a daily dietary intake of 1.55 mg for adults.
Cyanazine	Cyanazine is a colorless crystalline solid. It is partially soluble in water and soluble in most organic solvents. As a herbicide it is used to control broad-leaved weeds in such crops as potatoes, cotton and sugarcane. It is poisonous by ingestion and is moderately toxic by skin contact. Thermal decomposition releases chlorine, cyanide and oxides of nitrogen.
Cyanide	Mol. wt. 26.02; Cyanide is generally not found in natural waters, however it is a chemical found in certain plants. For example, hydrogen cyanide is found naturally in combination with glucose in glucose amygdalin which is present in bitter almonds, laurel leaves and some other species of plant. It is both biologically and chemically degradable. While readily absorbed through the skin, gastrointestinal tract and lungs, in small doses it can be detoxified in the liver to form thiocyanate. Acute doses affect cell respiration by combining with cytochrome and preventing oxygen transport.

Impurity Name	General Information
Dalapon	Dalapon is a colorless liquid, while the actual herbicide dalapon-sodium (the salt of dalapon) ia a hygroscopic powder. It is soluble in water, partially soluble in acetone and only slightly soluble in benzene and diethyl ether. It is a selective herbicide which is easily absorbed by the plant's leaves and roots. It has a variety of uses including the control of grasses. It is reported to be readily decomposable by soil microorganisms. Dalapon is moderately toxic by ingestion. It is corrosive and a skin irritant. Thermal decomposition can lead to the release of chlorine.
DDT (includes metabolities) Dichlorodiphenyltrichloroethane	Whilst a Provincial Water Quality Objective (PWQO) has been set, DDT has been set out as a substance with a "zero tolerance limit". No new discharges of this substance are allowed and all existing discharges should be reduced to the lowest possible level. In the presence of other pesticides the total amount of pesticide shall not exceed the sum of their Maximum Acceptable Concentrations or 0.1 mg/L, whichever is the lesser. Technical grade DDT is a waxy solid. It insoluble in water (1.2 ppb), moderately soluble in hydroxylic or polor organic solvents and soluble in most aromatic and chlorinated solvents. It is soluble in fat (100,000 ppm). It is listed by IARC as a Group 2B substance. DDT is an organochlorine insecticide which was first discovered in 1939. DDT has exhibited experimental carcinogenic, neoplastigenic and tumorigenic effects. While DDT by itself is moderately toxic it is not readily toxic unless mixed with a solvent. Ingestion can lead to convulsions, headache, analgesia, cardiac arrythmias, nausea, vomiting and sweating. DDT and its metabolities (eg. DDE) bioaccumulate in adipose tissue. This has been studied in animals and humans and is one of the main concerns associated with DDT. While its use has been banned in many parts of the world for some years now (banned in the early 1970s in the US), it continues to be found in the food chain. Thermal decompostion leads to the release of chlorine.

Impurity Name	General Information
Dehydroabietic acid	Mol. wt. 300.4 While an Ontario Provincial Water Quality Objective for total resin acids in water [see Resin Acids, total], an Ontario Provincial Water Quality Objective has been specifically set for dehydroabietic acid. Receiving Water pH / Dehydroabietic Acid (ug/L) 5 / 1 5.5 / 1.9 6 / 2.5 6.5 / 4.2 7 / 8 7.5 / 11.8 8 / 12.9 8.5 / 14 9 / 14.3 [For more information on dehydroabietic acid see Resin Acids, total].
Diazinon	Pure diazinon is in the form of a clear colorless liquid. It is partially soluble in water and very soluble in the usual organic solvents (eg. acetone and benzene). Initially registered in the US as an insecticide in 1952. A non-systemic organophosphate insecticide, it has been used on such crops as rice, potatoes, sugarcane and grapes. Moderately poisonous by ingestion, skin contact, subcutaneous, intravenous and intraperitoneal injection, it is also mildly toxic by inhalation. Exposed humans show signs of sweating, changes in motor activity and muscle weakness. Diazinon is also a skin and eye irritant.
Dibutylphthalate	Mol. wt. 278.38. Dibutylphthalate is moderately toxic to mammals and extremely toxic to fish. Teratogenic and reproductive effects have been reported. Ingestion by humans can cause hallucinations, distorted perception, nausea or vomiting, and kidney, ureter or bladder changes. It is incompatible with chlorine (reacts violently with chlorine gas). When exposed to an open flame it burns readily to emit acrid smoke and fumes. Phthalate esters are used in plastic production and as carriers for pesticides, oils and insect repellants.

Impurity Name	General Information
Dicamaba (Banvel)	Technical grade dicamba is a pale buff crystalline solid. Pure dicamba is a colorless solid. It is soluble in water and acetone and highly soluble in dioxane and ethanol. It is a herbicide which is readily absorbed by the plant's roots and leaves. It is used to control broad-leaved weeds in such crops as asparagus, cereals, grain and corn. Dicamaba has a half-life in soil of less than 14 days. Dicamba is moderately toxic by ingestion and potentially other routes. It is extremely corrosive to the eyes and moderately irritating to the skin. It has been found to be a skin sensitizer in laboratory trials with guinea-pigs.
Dichloromethane (methylene chloride)	Mol. wt 84.94 Dichloromethane is a colorless liquid which is moderately soluble in water and soluble in ether and alcohol. It is poisonous by ingestion (LD50 rat 1.6 ml/kg) and intravenous routes. It is moderately toxic by inhalation and at high levels of exposure exhibits narcotic effects and damage to the liver. Dichloromethane is an eye and skin irritant. It has not been shown to be either a carcinogen or teratogen. Dichloromethane is used as a solvent (including laboratory work) and in the manufacture of paint removers, insecticides, cleaners and fire extinguishers.

Impurity Name	General Information
Dichlorophenols	Mol. wt. 163.00 The six possible dichlorophenols are all solids at room temperature. Chlorophenols have a half-life in aquatic systems of approximately 5 days. This is due to the fact that chlorophenols are photolyzed and biodegraded. There is limited toxicological information on the dichlorophenols. The most well studied dichlorophenols, 2,4-dichlorophenol and 2,6-dichlorophenol, are both moderately toxic by ingestion, intraperitoneal and subcutaneous routes. As with most chlorophenols, except possibly the monochlorophenols, the toxic mode of action of the dichlorophenols is to block ATP production. Ultimately the exposed organism dies from a lack of cellular energy. The chronic toxic effects of chlorophenols appears to be secondary to the chronic effects of the typical contaminants associated with commonly marketed chlorophenols. In fact the presence of chlorophenols may be indicative of the presence of such contaminants as polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs). Nonetheless, 2,4-dichlorophenol has been reported as an experimental carcinogen. 2,4-dichlorophenol is an important intermediate in the production of the herbicide 2,4-D. |1,2-dichlorobenzene (o-dichlorobenzene). Mol. wt. 147.00 1,2-dichorobenzene is a colorless liquid with a pleasant odor. Technical grade form of 1,2-dichlorobenzene can contain various percentages of 1,3- and 1,4-dichlorobenzene. 1,2-dichlorobenzene is slightly soluble in water (approximately 140 mg/L at 25 degrees Celsius) and miscible with most organic solvents. It is poisonous by ingestion and intravenous injection. It is toxic by inhalation and is an eye, skin and mucous membrane irritant. 1,2-dichloro-benzene is an experimental carcinogen. It will react violently with oxidizing agents. Its many uses included: solvent; manufacturing of dyes; fumigant and insecticide; heat transfer; and metal polishes.
Diclofop-methyl	Mol. wt. 341.2 Diclofop-methyl is a colorless crystalline solid which is partially soluble in water (approximately 3 mg/L at 22 degress Celsius) and soluble in acetone, and diethyl ether. Diclofos-methyl is a herbicide used to control annual grasses and volunteer maize. Diclofop-methyl degrades in plants and soil to diclofop, which decomposes further. Diclofop-methyl is slightly toxic by ingestion (LD50 rat >500 mg/kg), but is toxic to rainbow trout in concentrations less than 1 ppm.

Impurity Name	General Information
Dieldrin (objective includes Aldrin)	Impure dieldrin is in the form of light tan flakes. It is soluble in water. It is listed on IARC (Group 3). Dieldrin is a non-systemic and persistent insecticide which acts on contact or by ingestion. While not recommended for edible food crops (due to residue problems) it is highly effective against termites and as such is used in the manufacture of telecommunication cables and plywood. It is potentially poisonous by all routes and by ingestion it is more poisonous than DDT. It is an experimental teratogen and is questionably a carcinogen. Dieldrin is the product of expoxidation of aldrin in living organisms and readily bioaccumulates at chronic exposure levels. Thermal decompostion can lead to the formation of hydrogen chloride.
Diethylhexylphthalate (bis(2-ethylhexyl) phthalate) DEHP	Mol wt. 390.54. It is on the IARC List as a Group 2B substance. This relatively high molecular weight phthalate is less toxic than the lower molecular weight phthalates. For example, in studying the toxicity of dibutylphthalate in rats it dibuthylphthalate was found to be an order-of-magnitude more toxic than DEHP. However DEHP does exhibit the toxicological characteristics associated with most phthalates. These typical characteristics include cytotoxicity and teratogenicity. Diethylhexylphthalate is a mild skin and eye irritant. DEHP's cummulative toxic effects are well documented and is known to be rapidly biotransformed to mono-ethyl-hexyl phthalate, an extremely toxic agent. One of the main uses of DEHP is as a plasticizer. When used as a plasticizer in PVC tubing in hemodialyzers it was linked to outbreaks of hepatitis. Phthalate esters are used in plastic production and as a carrier for pesticides, oils and insect repellants. When used as a plasticizer in PVC tubing in hemodialyzers it was linked to outbreaks of hepatitis.
Dimethoate	A colorless crystalline solid. It is moderately toxic (350 mg/kg LD 50 rat) organophosphate insecticide.

Impurity Name	General Information
Dioxins and Furans	Polychlorinated dibenzo-para-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). The dioxins and furans are byproducts of combustion (eg. fires involving PCBs) and the synthesis of certain types of chemicals [see pentachlorophenol]. The US EPA has classified 2,3,7,8-TCDD as a probable human carcinogen (Group 2B). Laboratory test animals upon exposure to this dioxin have exhibited hepatocellular carcinomas, thyroid carcinomas and adrenal cortical adenomas. There are 75 PCDDs of which 2,3,7,8-tetrachlorodibenzo-para-dioxin (2,3,7,8-TCDD) is the most toxic. TCDD is a colorless crystalline solid at room temperature and is sparingly soluble in water or organic solvents. TCDD is extremely toxic with an LD50 for female guinea pig of 0.0006 mg/kg. In addition, it has caused severe cases of chloracne and is reported to have mutagenic effects at very low doses (ppb to ppt range). Dioxins are not mobile in soils. Of the possible 135 PCDFs, 2,3,4,7,8-pentachlorodibenzofuran (2,3,4,7,8-PeCDF) and 2,3,7,8-tetrachlorodibenzofuran are two of the most toxic PCDFs. All the PCDFs are crystalline solids at room temperature and are sparingly soluble in water and organic solvents. The LD50 of 2,3,7,8-TCDF for most animal species is in the order of parts per billion.
Diquat	This technical product contains greater than 95 percent solid diquat dibromide. While soluble in water, it is only slightly soluble in such solvents as alcohols and insoluble in non-polar organic solvents. Diquat exhibits some systemic properties as a herbicide. It is used as a crop desicant and in the control of aquatic weeds. Poisonous by all typical routes of exposure, it is also an eye and skin irritant. The healing of cuts and wounds are retarded and inhalation can cause nose bleeds.
Dissolved Gases	In order to protect aquatic organisms, the total dissolved gas concentration in water should not exceed 110 percent of the saturated value for gases at the existing atmospheric and hydrostatic pressures.

Impurity Name	General Information
Dissolved Organic Carbon (DOC)	Dissolved organic carbon occurs in natural waters from the prsence of decaying plant and animal matter. The plant matter is responsible for the presence of humate and fulvate anions. Polluted waters often contain dissolved organic carbon from any number of possible man made sources. One example of this is the contamination of groundwater from petroleum leaking underground storage tanks. The dissolved organic carbon from this type of pollution can present a major health hazard for people whose drinking wells may be tainted by the presence of petroleum hydrocarbons in their water. Dissolved organics, depending on their nature, can be difficult to get rid of. Certain hydrocarbons are more easily destroyed than others. For example, acetic acid is a fundamental biological building block for nearly every living organism and is therefore readily destroyed in the environment. On the other hand, organic molecules such as DDT can remain in the environment for years.
Dissolved Solids, total	Total dissolved solids in the form of salts (eg. salts of chloride and sulfate) are found in many if not all natural waters. Typically groundwater due to its more intimate contact with soils has a higher concentration of dissolved solids than does surface water. The limit for dissolved solids is set in order to meet taste requirements. In fact waters containing dissolved solids concentrations as high as 1000 ppm are suitable for growing all types of plants given that there is good soil drainage. Some plants will grow when watered with dissolved solids concentrations as high as 3100 ppm. Concentrations of dissolved solids in the range of 5000 to 10000 ppm do not permanently affect most types of fish enless these concentrations are maintained for longer than 24 hours. It is important to note that the solubility of oxygen decreases as the concentration of salt increases. Dissolved solids are the result of a number of man's activities including the salting of roads in the winter time and soil erosion due to present day farming practices.
Diuron	Pure diuron is a colorless crystalline solid. It is partially soluble in water and acetone and sparingly soluble in hydrocarbons. Registered as a herbicide in the US in 1966. It is a member of the substitued urea family of chemicals. As a herbicide it inhibits photosynthesis and is used as a general weed control on non-crop areas. As a phytotoxin it is persistent for approximately one growing season. It is mildly toxic by ingestion, intraperitoneal injection and potentially other routes. It has significant toxicological effects on certain species of fish. Thermal decomposition can lead to oxides of chlorine and nitrogen being formed.

Impurity Name	General Information
DO (Dissolved Oxygen)	At no time should dissolved oxygen concentrations be less than the values specified below: T (Celsius) / Cold Water Biota mg/L / Warm Water Biota mg/L 0 / 8 / 7 5 / 7 / 6 10 / 6 / 5 15 / 6 / 5 20 / 5 / 4 25 / 5 / 4 In situations where additional physical and/or chemical stresses are present these minimum levels may prove inadequate and more stringent objectives may be necessary. Dissolved oxygen is a very important water quality indicator when determining the water's ability to support aquatic life. Preferentially the concentration of dissolved oxygen should reach saturation. However, because of the presence of naturally derived organic matter and human pollution, the concentration of oxygen in waters is generally less than the saturation value. There are a number of different types of oxygen demand and there are several measures of oxygen demand. [See BOD, COD, TOD and TOC.] Typically the two sources of dissolved oxygen are the atmosphere (aeration is often used in waste water treatment) and photosynthesis. As a result, most groundwaters have little to no dissolved oxygen.
Endosulfan (Endosulphan)	Technical grade endosulfan comes in the form of a brown crystalline solid. It is insoluble in water and soluble in dichloromethane, ethyl acetate and toluene. An organochlorine insecticide which acts on contact and by ingestion, it is effective against a number of insects and certain mites. It has been used on such crops as potatoes, coffee, fruit and vegetables. Endosulfan is poisonous by ingestion, inhalation, skin contact, intraperitoneal and subcutaneous injection. There is some question as to its carcinogenic effects. It is a central nervous system stimulant, but notably it does not accumulate in adipose tissue. It is highly toxic to fish. Thermal decomposition can lead to a large formation of hydrogen chloride.
Endrin	White crystals. On the IARC list (Group 3) and the US EPA Extremely Hazardous Substances List. Poisonous by skin contact, ingestion, intravenous and other routes. A central nervous system stimulant it is highly toxic to birds, fish and man. As little as 1 mg/kg ingested by man has caused symptoms. It does not bioaccumulate in human tissue.

Impurity Name	General Information
Escherichia coli (E. coli)	Escherichia is not the only genus of bacteria (family: Enterobactriaceae) found in the intestinal tract and feces of warm-blooded animals, but it is the one most often used to determine the quality of drinking water. Bacilli (rod shaped bacteria including E. coli) are found in the colon shortly after birth and probably serve a number of functions not the least of which is to produce needed vitamins. It should be noted that while there is one species of Escherichia, there are hundreds of antigenic types and some of these types can cause disease. For example, E. coli is now known to cause three major types of acute diarrhea and is one organism possibly responsible for travelers experiencing diarrhea.
Ethylbenzene	Mol. wt. 106.18 Ethylbenzene is a colorless liquid which is slightly soluble in water (1.5 mg/L) and soluble in alcohol and ether. Ethylbenzene is moderately toxic by ingestion and inhalation. It is a severe eye, skin and mucous membrane irritant. Over exposure via inhalation can cause dizziness, unconsciousness and finally, respiratory failure. While it has been reported to be an experimental teratogen it has not been shown to cause cancer. Chronic exposure to ethylbenzene has led to liver, kidney and central nervous disorders. It is used in the production of styrene and is also used as an organic solvent. It is found in petroleum products such as gasoline.
Fecal Coliform	Fecal coliform are those bacteria which meet the general classification of coliform bacteria [see Total Coliform], but are associated with the feces of warm-blooded animals. Unlike the coliform that are native to water and soil and flurish at 20 degrees Celsius, fecal coliforms grow best at 37 degrees Celsius. Fecal coliform and distinguished in the laboratory from total coliform by growing the culture at 43 to 44.5 degrees Celsius.
Fenthion (Baytex)	Fenthion in pure form is a colorless liquid. It is slightly soluble in water, but is highly soluble in dichloromethane and propanol. It is an insecticide which works on contact and by ingestion. It has been used to control fruit flies, leaf hoppers and cereal bugs. Upon oxidation within plants it forms two highly potent insecticides, sulphoxide (mesulfenfos) and sulphone. Fenthion is poisonous by the usual routes and it is moderately toxic by inhalation. Toxic effects by ingestion include increased heart rate, diarrhea, hypermotility, nausea or vomiting. It is a questionable carcinogen with both tumorigenic and mutagenic data having been reported. Thermal decomposition produces oxides of phosphorus and sulfur.

Impurity Name	General Information
Fluoride	F; Atomic no. 9; Atomic wt. 19.00; Valence -1. Group VIIA halogen Fluorine is found as fluoride in such geological formations as fluorite and fluoroapatite. Fluoride is commonly found in natural surface waters due to the solubility of the minerals in the surrounding rock formations. Many municipalities add fluoride to their public water supplies for the purpose of preventing tooth decay. The typical concentration of fluoride for this purpose is approximately 1 mg/L. The toxic effects associated with over exposure to fluoride are generally chronic in nature and are usually relegated to mottling of teeth enamel (dental fluorosis) and skeletal fluorosis. Epidemiological studies of waters containing approximately 1 mg/L of fluoride have failed to uncover any adverse effects. Skeletal fluorosis has only been observed when water contains more than 3 mg/L of fluoride.
Glyphosate (Roundup)	Glyphosate was first registered for use in the US in 1974. It is used in the control of grasses, broadleaf weeds and woody brush and trees. Glyphosate is slightly toxic to birds, aquatic invertebrates and freshwater fish (4320 mg/kg LD50 rat). It has a low acute toxicity and is not teratogenic to rats or rabbits. It has not been shown to have mutagenic effects. It is strongly absorbed to soil and as a result is expected to have a low potential to contaminate groundwater.
Guthion (trade mark) azinphos-methyl (common name)	In its pure state Guthion is a colorless crystalline solid. It is partially soluble in water and highly soluble in dichloromethane and toluene. It is listed on the US EPA Extremely Hazardous Substances List. Guthion is a non-systemic insecticide which is highly effective against biting and sucking insects. It has been used on such crops as citrus, corn, fruits and vegetables. The toxicological information on this chemical is limited, but it is very toxic by all routes of exposure. It is an experimental carcinogen, teratogen and has reproductive effects. It is highly toxic to certain species of fish. Thermal decompostion can lead to the release of oxides of phosphorus, sulfur and nitrogen.

Impurity Name	General Information
Hardness.	Hardness in the Province of Ontario is set as an operational guideline (OG) rather than a true aesthetic objective. The hardness of water is caused by the presence of the alkali earth elements, the most common of which are calcium and magnesium. Water hardness is usually expressed in terms of parts per million (ppm) of calcium carbonate. Some typical ranges are: 0 - 75 ppm - - Soft Water 75 - 150 ppm - - Moderately Hard Water 150 - 300 ppm - - Hard Water >300 ppm - - Very Hard Water Calcium bicarbonate is one of the more soluble forms of calcium and most water softening processes center around its removal. It can be removed by such methods as: heating the water; addition of soda ash (sodium carbonate); addition of excess lime (done at a pH of 10.5); and the addition of sodium metaphosphate (calgon process). It should be noted that harder waters result in a reduction in the toxicity of certain heavy metals which may be present in the water.
Heptachlor (including heptachlor epoxides)	Heptachlor in pure form is a crystalline solid. While insoluble in water, it is soluble in cyclohexanone. It is readily epoxidized. This chlorinated cyclodiene was first registered for use as an insecticide in the US in 1952. It is on the IARC List (Group 3). A persistent, non-systemic contact and stomach insecticide, it is non-phytotoxic at insecticidal concentrations. While the EPA has canceled most of its allowable uses, it can still be used to control termites by subsurface ground insertion in outdoor environments. Heptachlor is a suspected carcinogen and human mutagenic data has been reported. It is poisonous by ingestion, skin contact, intraperitoneal and intravenous injection. Acute and chronic doses cause liver damage. acute poisoning leads to tremors, convulsions, kidney damage, respiratory collapse and death. Thermal decompostion release large quantities of chlorine.
Heterotrophic Plate Count	This test is performed by counting the number of colonies produced from placing a known quantity of water on a culture plate which contains the needed nutrients for heterotrophic bacteria to grow. [Heterotrophic bacteria are unable to use carbon dioxide as their sole source of carbon and thus require one or more organic compounds.] Plate count standards are not truly representative of the quality of the water being tested (a few pathogenic bacteria is more dangerous than water containing many saprophytic bacteria), nonetheless a good quality water would have a low heterotrophic plate count. [Saprophytic bacteria live on dead organic matter.

Impurity Name	General Information
Hexachlorobenzene (perchlorobenzene)	Mol. wt. 284.79 Hexachlorobenzene forms white needles which are insoluble in water (approximately 0.3 mg/L at 25 degrees Celsius) and soluble in ether and benzene. This compound is anticipated to cause cancer. It is moderately toxic by ingestion and prolonged over exposure via ingestion can lead to cutaneous porphyria (the skin becomes blistered, fragile, photosensitive and subject to excessive hair growth; along with damage to the eyes, weight loss and skeletal muscle atrophy). Hexachlorobenzene is used in organic synthesis, as a seed fungicide and as a wood preservative.
Hydrogen Sulfide	Molecular wt. 34.08 Hydrogen sulfide is a poisonous, flammable (206 degrees Celsius ignition temperature) gas which exhibits a rotten egg smell in low concentrations. It occurs naturally in gas wells, sulfur springs, coal pits and naturally decaying matter containing sulfur. Microorganisms, under certain conditions (eg. anaerobic conditions), may use the sulfate anion as an electron acceptor (known as "reduction") which results in the formation of hydrogen sulfide. The presence of hydrogen sulfide is usually used as an indicator of water quality; a high concentration indicating heavy organic pollution.
Iodine-131	I-131; Atomic no. 53; Atomic wt. 130.90; Valence -1,+1 to +7. Group VIIA. Iodine can exit in water as iodine, hypoiodous acid, iodate and iodide. Iodine-131 is a beta and gamma emitter with a half-life of 8.040 days. 2 to 4 grams of ingested iodine can be fatal. Lesser amounts cause abdominal pain, nausea, vomiting and diarrhea. This substance can be severely irritating to eyes, skin and mucous membranes. Iodine is an essential element for human life. It is an important constituent of the thyroid produced hormones thyroxine and triiodothyronine. A lack of iodine can cause a number of aliments including goiter. [The thyroid consumes approximately 70 to 100 ug of iodine per day for hormone synthesis.] Iodine is used in germicides and antiseptics. It is used as a catalyst in alkylation and condensation of aromatic amines, sulfations and sulfonations. I-131 is used therapeutically to destroy cells of a hyperactive thyroid gland.

Impurity Name	General Information
Iron	Fe; Atomic no. 26; Atomic wt. 55.85; Valence +1 to +6. Group VIII metal Iron is the fourth most abundant element in the earth's crust. Some of the more common iron containing rocks include hematite, magnetite and pyrite. Almost all ground and surface waters contain measurable amounts of dissolved or suspended iron. Water draining from coal, copper and gold mining operations often contain high concentrations of iron along with acidic pHs. This occurs due to the ability of certain bacteria (eg. Thiobacillus ferroxidans) to oxidize pyrite (ferrous sulfide) and in so doing form strong mineral acids. The amount of ionic iron in water is a function of pH, the amount of organic matter present and the presence or absence of iron using bacteria. Water which contains free carbon dioxide dissolves iron readily. In fact both high iron and manganese concentrations are associated with anaerobic conditions. Under these conditions iron and manganese can be reduced resulting in Fe(II) and Mn(II). [Groundwater contains a high iron and manganese content due to these waters being typically oxygen deficient]. Upon exposure to the atmosphere the soluble ferrous ion is oxidized to the insoluble ferric ion (Fe(III)). The water may become turbid due to the precipitation of the ferric oxides. Aerobic bacteria such as Crenothrix and Leptothrix metabolize iron. Usually their metabolic activies result in the oxidation of Fe(II) to ferric hydroxide. Iron is non-toxic at high levels, but can impart poor taste, color and staining ability to domestic water. The uses of iron are many and include: steel production; water treatment (iron has the ability to bind up phosphorus); and permanent magnets. Iron is an important mineral for proper cell and body function. In addition to its important role in hemoglobin it is associated with a number of enzymes, including ferredoxin (needed for photosynthesis) and cytochromes (needed for electron transport). Health and Welfare Canada recommends an intake for adults between the ages of 25 and 49 as: 8 mg/day for males; and 14 mg/day for premenopausal females.
Iron Sulfide	Iron pyrite is a typical source of sulfide in natural waters. It ia also formed from the decomposition of sulfur containing organic matter under anaerobic conditions. The resultant hydrogen sulfide is characteristic of heavily polluted waters.and chromium).

Impurity Name	General Information
Lead	Pb; Atomic no. 82; Atomic wt. 207.2; Valence +2,+4. Group IVA metal Lead is listed by IARC as a Group 2B substance. The Provincial Water Quality Objective for lead in water varies with the alkalinity of the water: Max. Lead Conc. ug/L — Alkalinity mg/L as Calcium Carbonate 5 — <=20 10 — >20 & <=40 20 — >40 & <=80 25 — >80 Lead occurs in natural geological forms around the world and is usually found as a sulfide, oxide or carbonate ore. Since lead and its compounds are relatively insoluble, Pb(II) readily precipitates and becomes bound in soil matrices. It is on the IARC List as a Group 2B substance. Lead can be absorbed in the gastrointestinal tract. Ca(II) and Mg(II), which have some chemical similarities to Pb(II), act as antagonists thereby reducing lead toxicity in "hard water". Acute lead poisoning can result in anorexia, vomiting and convulsions. Chronic lead poisoning causes anemia by inhibiting the synthesis of heme (a complex of Fe(II) and a substituted porphyrin found in hemoglobin and cytochromes). Lead bioaccumulates in bone and it can damage the kidneys causing sclerosis of vessels and glomerular atrophy. It is also well known for its damaging affects on the central nervous system. Lead ingestion by children retards central nervous system development. Other symptoms associated with central nervous system damage include restlessness, dullness, loss of memory and irritability. Lead palsey was a usual occupational hazard. The uses of lead are well known by most people and include: lead acid batteries; lead solder; various lead alloys; lead chloride in asbestos brake linings; and lead hydroxide as a component in sealed nickel-cadmium batteries.

Impurity Name	General Information
Lindane (Gamma-lindane, HCH or BHC)	The physical properties of lindane vary according to the isomer of lindane being studied. Slightly soluble in water, it is partially soluble in such solvents as acetone, benzene, diethyl ether and ethanol. This chlorinated hydrocarbon was first registered for use in the US in 1950. Gamma-lindane is an insecticide which works on contact and by ingestion. Trace amounts of the other isomers can lead to the ruin of crops for human consumption. There are reported carcinogenic, neoplastigenic, tumorigenic and reproductive effects associated with this chemical. It is more poisonous than DDT or dieldrin. It is moderately toxic by skin contact. Lindane is an organochlorine compound which is persistent and accumulates in mammalian tissues. Its effects on the body varies with the isomer being discussed. Gamma and alpha isomers stimulate the central nervous system resulting in convulsions. The beta and delta isomers are central nervous system depressants. Workers exposed to high concentrations of lindane in the air experience headache, nausea, eye, nose and throat irritation. Allergic reactions have also been reported in sensitized individuals. Thermal decompostion leads to phosgene and hydrogen chloride formation.
Magnesium	Mg; Atomic no. 12; Atomic wt. 24.31; Valence 2. Alkaline earth Magnesium is the eighth most abundant element in the earth's crust. It is found in such minerals as domolite, magnesite and olivine. It is found in nearly all natural waters, usually in a ratio of between 3:1 to 5:1 with calcium (calcium:magnesium). When water contains magnesium in a concentration greater than calcium this may be an indication of a foreign source of magnesium. Along with calcium, magnesium is a major contributor to water hardness as magnesium carbonate. Mg(II) is essential for plant and animal life. Mg(II) is needed for the proper functioning of a number of enzymes which regulate the various nucleoside phosphates (energy storing molecules of cells). Magnesium has a number of industrial uses including light alloy production and as a replacement for zinc in dry cell batteries. Magnesium poisoning is usually only seen in two cases. Magnesium metal embedded in the skin can cause necrosis, gangrene and subcutaneous emphysema. Magnesium oxide fumes associated with welding can cause typical metal fume fever symptoms. Magnesium deficiency can occur in humans due to such conditions as alcoholism, congenital heart failure, malabsorption, aldosteronism, etc. The most notable result of magnesium deficiency is weakness, nausea, tremor, stupor, coma and cardiac arrhythmia. Health and Welfare Canada suggests a daily dietary intake of magnesium for adult males age 25 to 49 to be 250 mg and 200 mg/day for females in the same age bracket.

Impurity Name	General Information
Malathion	95 percent pure malathion is a clear amber color. It is soluble in water. Malathion is on the IARC List (Group 3). It is a non-systemic insecticide with relatively low mammalian toxicity. Typically it is non-phytotoxic, but can damage certain crops under greenhouse conditions. It has been used to control human head and body lice. As an organophosphate it functions by inhibiting cholinesterase allowing significant quantities of the neurotransmitter acetylcholine to accumulate. Effects on humans include coma, blood pressure drop and difficulty in breathing. Thermal decomposition leads to oxides of phosphorus and sulfur being released.
Manganese	Mn; Atomic no. 25; Atomic wt. 54.94; Valence +1 to +7. Group VIIB metal Manganese occurs in such minerals as manganosite and braunite. It is commonly found in low levels in natural waters. Similar to iron, manganese has two common oxidation states in water. Mn(II) is soluble in water and its presence in high concentrations is associated with anaerobic conditions. Mn(IV) compounds are insoluble and as a result water containing Mn(IV) compounds may become turbid. Due to the absence of dissolved oxygen groundwaters usually contain increased concentrations of manganese and iron. Steel production, alloy production and dry cell batteries are some common uses of manganese. Manganese is non-toxic at levels most commonly encountered in water supplies, but it can impart an unpleasant taste, color and staining ability. Ingestion of large quanties of manganese and its salts can cause serious damage to the central nervous system. Manganese is an essential micronutrient for both plants and animals. One important function is its needed presence for the proper functioning of the enzyme arginase. [Arginase is integral to the process of converting ammonia to urea in mammals.] Health and Welfare Canada recommends a daily dietary manganese intake for adults of 2.5 mg.

Impurity Name	General Information
Mercury	Hg; Atomic no. 80; Atomic wt. 200.6; Valence +1,+2. Group IIB (metal) Whilst an Ontario Provincial Water Quality Objective (PWQO) has been set, mercury has been set out as a substance with a "zero tolerance limit". No new discharges of this substance are allowed and all existing releases should be reduced to the lowest possible level. Almost everyone is familiar with the toxic nature of mercury. Mercury is found in many geological formations and like cadmium readily forms compounds of sulfur. Also like cadmium, mercury is often found as an impurity in zinc, copper and lead ores. Petroleum and coal also generally contain measurable quantities of mercury. Due to its high vapor pressure (0.002 mm at 25 Celsius) and the ease of adsorption onto surfaces, mercury is naturally found in soils, air and water. In natural (unpolluted) waters mercury is generally found in concentrations of less than 1 ug/L. Ground water may show higher concentrations due to the lengthy and intimate contact between water and soil. Inorganic mercury is readily absorbed through the lungs and ultimately makes its way to the kidney, erythrocytes (red blood cells) and the brain. Organic mercurial compounds (eg. methylmercury) are at least 10 times more toxic than inorganic forms. The bioaccumulative nature of alkyl mercury compounds is well documented and concentration factors of over 1000 are not uncommon. Mercury is used in industry and is found in many consumer products such as batteries, switches, thermometers and street lamps.
Methane	Molecular wt. 16.05 A colorless, odourless, tasteless gas occurring in nature as "natural gas" and associated with decaying organic material in swamps and marshes, as well as being produced during the natural digestive process of many farm animals. In highly polluted waters microbes use carbon dioxide as an electron acceptor (known as "reduction") to form methane (eg. "marsh gas"). While it is nontoxic, its presence in water usually indicates the presence of large quantities of organic pollution.
Methoxychlor	Forms colorless crystals in pure form. It is insoluble in water, but very soluble in solvents such as chloroform. It is listed on IARC (Group 3). Methoxychlor is an insecticide which is moderately toxic by skin contact, ingestion and intraperitoneal injection. Skin contact in humans causes a systemic effect known as somnolence (sleepiness). It shows little tendency to accumulate in adipose tissue and has therefore been used to control barn flies in the dairy industry. Thermal decomposition can lead to the release of chlorine.

Impurity Name	General Information
Metolachlor	Metolachlor is a colorless liquid, in pure form. It is slightly soluble in water and highly soluble in organic solvents such as benzene, dichloromethane, hexane and methanol. Metolachlor is a germination inhibitor used mainly on grasses. It is slightly toxic to mammals and is practically non-toxic to birds and honeybees. It is a slight eye and skin irritant.
Metribuzin	A colorless crystalline solid, it is partially soluble in water (1200 ppm at 20 degrees Celsius) and highly soluble in acetone and chloroform. It is a member of the triazine family of chemicals and was first registered for use in the US in 1973. Metribuzin is a herbicide used to control broadleaf weeds and grasses in such crops as soybeans potatoes, barley, winter wheat, asparagus, sugarcane, tomatoes, lentils and peas. It is slightly to moderately toxic to most animals (2200 mg/kg LD50 rat). While it is unknown as to its oncogenic effects, it has been not shown any teratogenic or mutagenic effects to date. Metribuzin has been found in both surface and ground water. Thermal decompostion releases oxides of nitrogen and sulfur.
Mirex (dechlorane)	Whilst an Ontario Provincial Water Quality Objective (PWQO) has been set, Mirex has been set out as a substance with a "zero tolerance limit". No new discharges of this substance are allowed and all existing releases should be reduced to the lowest possible level. Mirex is a white, odorless crystal. Insoluble in water, but soluble in dioxane and benzene. It is on both the IARC List (Group 2B) and the NTP List. It is a persistent insecticide capable of bioaccumulation. Mirex is moderately toxic by ingestion and moderately toxic by inhalation and skin contact.Its use was cancelled in the US in 1977. Thermal decomposition will release large quanties of chlorine.

Impurity Name	General Information
Monochlorobenzene (chlorobenzene)	Mol. wt. 112.56 Monochlorobenzene is a clear colorless flammable liquid. It is partially soluble in water (approximately 520 mg/L at 25 degrees Celsius) and is soluble in various organic solvents. Monochlorobenzene is moderately toxic by ingestion and is a strong narcotic with slight irritant properties. Symptoms of acute exposure may include somnolence, unconsciousness, twitching of the extremities, cyanosis and arrhythmia. Chronic exposure may cause liver and kidney damage. It will react violent with oxidizers and ther is a moderate explosion hazard associated with this chemical. Monochlorobenzene is used to manufacture phenol, chloronitrobenzene aniline and is used as a pesticide and as a heat transfer fluid.
Monochlorophenols	Mol. wt. 128.56 At room temperature meta- and paramonochlorophenol are both solids while orthomonochlorophenol is a liquid. All three monochlorophenols are slightly soluble in water and soluble in alcohol and ether. Chlorophenols have a half-life in aquatic systems of approximately 5 days. This is due to the fact that chlorophenols are readily photolyzed and biodegraded. Monochlorophenols are slightly toxic by ingestion (approximately 670 mg/kg). Its toxic mode of action is probably more similar to that of phenol than to that of the chlorophenols. [Phenol denatures and precipitates cellular proteins and therefore destroys cells directly.] Over exposure to monochlorophenol may cause tremors, convulsions, dyspnea and coma. Parachlorophenol is used as an antiseptic.

Impurity Name	General Information
Nickel	Ni; Atomic no. 28; Atomic wt.58.69; Valence +1,+2,+3,+4; Group VIII. The main nickel containing geological formations include chalcopyrite, pyrrhotite, pentlandite and garnierite. While nickel is normally found in water in very low concentrations, it does occur in vegetables, legumes and grains in relatively high concentrations (1-5 mg/kg). It is on the IARC List as a Group 1 compound. Nickel is a well known cause of dermatitis (nickel itch) and eczema. It has been shown to cause pulmonary asthma and conjunctivitis, but with the exception of nickel carbonyl, the systemic toxicity of nickel or its compounds has yet to be proven epidemiologically. Nickel carbonyl is the most toxic form of nickel (inhalation of 30 ppm for 20 minutes may be lethal in man). In addition to nickel carbonyl's use in the industrial setting, it has been reported that cigarette smoke contains significant amounts of the compound. Nickel is used in plating, batteries, stainless stell, lighting rod tips, spark plugs and catalysts.
Nitrate	In the province of Ontario, where both nitrate and nitrite are present the total nitrate plus nitrite-nitrogen should not exceed 10 mg/L. Nitrogen is the most abundant gas in the atmosphere. Nitrate is one of the most common ions in natural waters. Typical values of nitrate nitrogen in surface waters lie between 1 to 2 mg/L, but this can vary significantly from source to source. Sources of nitrogen include decaying organic matter and nitrogen fertilizers. If anaerobic conditions exist excess nitrate, if present, can be reduced to gaseous nitrogen or to ammonia. Under aerobic conditions ammonia can be oxidized to nitrite and ultimately to nitrate. Nitrate nitrogen and to a lesser extent ammonia, can be utilized by aquatic plants and algae to support their growth (some algae and soil microorganisms can fix atmospheric nitrogen). Nitrate in drinking water is noted for having two possible health effects. First, at high intake levels it may induce methemoglobinemia (especially in infants due to more alkaline conditions in their upper gastrointestinal tract) by it being reduced to nitrite in the saliva and in the gastrointestinal tract. The nitrite then oxidizes the hemoglobin to methemoglobin which is incapable of carrying oxygen. Anoxia and death can occur. Second, carcinogenic nitrosamines can be formed when nitrate or nitrite are ingested along with nitrosatable compounds. In surface waters the presence of compounds containing nitrogen is usually an indication of pollution. Nitrogen in the form of organic nitrogen and ammonia indicates recent pollution. The presence of nitrates on the other hand are indicative of past pollution which has had a chance to stabilize.

Impurity Name	General Information
Nitrilotriacetic Acid (NTA)	Mol. wt. 191.16 Nitrilotriacetic acid (NTA) is a confirmed carcinogen. It is poisonous by intraperitoneal injection and is moderately toxic by ingestion. Thermal decomposition leads to the formation of nitrogen oxides. It is used as a sequestering (complexing) agent.
Nitrite	In the province of Ontario, where both nitrate and nitrite are present the total nitrate plus nitrite-nitrogen should not exceed 10 mg/L. Nitrogen is the most abundant gas in the atmosphere. The presence of nitrogenous compounds in surface waters usually indicates pollution. Sources of nitrogen include decaying organic matter and nitrogen fertilizers. If anaerobic conditions exist excess nitrate, if present, can be reduced to gaseous nitogen or to ammonia. Under aerobic conditions ammonia can be oxidized to nitrite and ultimately to nitrate. Nitrate nitrogen and to a lesser extent ammonia, can be utilized by aquatic plants and algae to support their growth (some algae and soil microorganisms can fix atmospheric nitrogen). Nitrite does not usually occur in natural waters at significant levels. The presence of nitrite in natural waters may indicate either wastewater contamination and/or a lack of oxidizing conditions. Nitrogen in the form of organic nitrogen and ammonia indicates recent pollution. The presence of high levels of nitrates on the other hand can be indicative of past pollution which has had a chance to stabilize. Due to the problems associated with methemoglobin, waters containing nitrite-nitrogen at a concentration greater than 1 mg/L should not be used for infant feeding.
N-nitrosodimethylamine (dimethylnitrosamine) (NDMA)	Mol. wt. 74.10 N-nitrosodimethylamine (NDMA) is soluble in water, alcohol and ether. It is on the IARC List as a Group 2A chemical and is also on the EPA Extremely Hazardous Ssubstances List. It is a confirmed carcinogen and is noted for crossing the placental barrier (transplacental carcinogen). The mechanism of its carcinogenicity is the alkylation of DNA. It is poisonous by all routes. Ingestion of NDMA can cause ulceration of the small intestine, nausea or vomiting and fever. It has also caused jaundice and fatal liver disease in humans. NDMA exhibits experimental teratogenic and reproductive effects. Thermal decomposition of NDMA releases toxic nirogen oxide fumes. NDMA was once used extensively as an industrial solvent and has been isolated as a chemical intermediate in a number chemical reactions.

Impurity Name	General Information
Odor	Odor is imparted to water by organic compounds, inorganic compounds and dissolved gases. These substances may be natural or anthropogenic in origin. Potable water should be free of any offensive odor. This is no small task as the sense of smell in many cases is more sensitive then the most sensitive laboratory instruments. For example, hydrogen sulfide can be smelt at a concentration of 0.001 mg/L.
Oil and Grease (TOG, total oil and grease)	Oil and grease should not be present in concentrations that: - can be detected as a visible film, sheen or discoloration on the surface; - can be detected by odor; - can cause tainting of edible aquatic organisms; - can form deposits on shorelines and bottom sediments that are detectable by sight or odor; or - are deleterious to resident aquatic organisms. Mineral oils and shale oils are listed by IARC as Group I substances. Oil and greases are found in natural waters due to human activities and to a much lesser extent, natural seepage from geological formations. Most of these petroleum products ultimately end up in the oceans. Petroleum products that enter the hydrosphere are dispersed and degradated. Biological degradation usually involves only very specific compounds. Oil and grease are usually mixtures of many different types of hydrocarbons. It has been suggested that straight chain alkanes of 10 to 18 carbons in length are the most susceptible to biological oxidation, while waxes and greases are less likely to be degradated. It is important to note that most groundwaters do not contain any aerobic bacteria, therefore microorganism mediated degradation occurs very slowly or not at all. The less hydrotreated the petroleum hydrocarbon the more likely it will exhibit carcinogenic properties. Petroleum hydrocarbon toxicity is generally inversely proportional to the product's viscosity. Very viscose hydrocarbons exhibit limited toxicity, while lighter hydrocarbons with little viscosity can be potentially fatal if swallowed in the necessary quantity (10 ml given orally has been reported to be potentially fatal). Crude oil can be toxic to fish at concentrations of 0.3 mg/L. Inhalation of petroleum products can cause depression of the central nervous system resulting in dizziness and incoordination. Again, extremely high levels of exposure may produce death in experimental animals. Petroleum hydrocarbons are used in everything from gasoline, to plastics, to fabric manufacture.

Impurity Name	General Information
Organic Nitrogen.	Organic nitrogen is one of the four primary forms of nitrogen found in surface water and groundwater (the others being: ammonia, nitrites and nitrates). Organic nitrogen is usually measured at the same time as ammonia and the combination of the two is called total Kjeldahl nitrogen. Organic nitrogen can be decomposed by heterotrophic microorganisms to the ammonium ion. Under aerobic conditions obligate autotrophic organisms can, through the nitrification process, convert the ammonium ion to nitrite and ultimately to nitrate. The presence of nitrogenous compounds in surface waters and ground waters usually indicates pollution. Possible sources of organic nitrogen include sewage and decaying plant matter.
Paraquat	Technical grade paraquat dichloride is a yellow odorless hygroscopic powder. It is very soluble in water, slightly soluble in alcohols and insoluble in hydrocarbons. This desiccant bipyridinium was first registered for use as a herbicide and defoliant in the US in 1964. It is used to control weeds in corn, soybean, fruit and nut crops. Paraquat is extremely toxic to mammals via oral, dermal amd inhalation routes of exposure. It is not oncogenic to mice, but exhibits oncogenic effects in rats. Paraquat is moderately toxic to birds, slightly toxic to fish and moderately toxic to aquatic invertebrates. It ia relatively nontoxic to honeybees. It is reasonably immobile in soils containing a high organic content. It is not readily desorbed from the soil and it is not likely to contaminate groundwater in agricultural lands.
Parathion	Pale yellow liquid. Partially soluble in water, but very soluble in most organic solvents. Parathion is on the IARC List (Group 3) and on the US EPA Extremely Hazardous Substances List. An insecticide, it is a deadly poison. As with most organophosphate poisons, it is a cholinesterase inhibitor; thus allowing significant quantities of the neurotransmitter acetylcholine to accumulate. Cholinesterase given in the proper quantity is the suggested antidote. Thermal decomposition of parathion gives off oxides of nitrogen, sulfur and phosphorus.

Impurity Name	General Information
Parathion-methyl	It forms colorless crystals in pure form. Parathion-methyl is more soluble in water than its close relative Parathion (55 - 60 mg/L versus 24 mg/L at 25 degrees Celsius). If this pesticide is present with any other MAC (maximum acceptable concentration) listed pesticide the "total pesticides" must not exceed the sum of their MAC's or 0.1 mg/L, whichever is the lesser. It was intially registered for use in the US in 1954. Parathion-methyl is on the IARC List (Group 3) and on the US EPA Extremely Hazardous Substances List. Like parathion, parathion-methyl is an organophosphate insecticide which is highly poisonous. As a cholinesterase inhibitor it allows large quantities of the neurotransmitter acetylcholine to accumulate. Cholinesterase given in the proper quantity is the suggested antidote. Thermal decomposition releases oxides of nitrogen, sulfur and phosphorus.
PBB (Polybrominated biphenyl)	Whilst an Ontario Provincial Water Quality Objective (PWQO) has been set, PBBs have been set out as substances with a "zero tolerance limit". No new discharges of these substances are allowed and all existing releases should be reduced to the lowest possible level. PBBs are listed by IARC as a Group 2B substance. Polybrominated biphenyls are analogs of polychlorinated biphenyls and are assumed to have many of the same properties of PCBs, including the ability to bioaccumulate in adipose tissue. PBBs are suspected carcinogens with experimental carcinogenic and neoplastigenic data. They also exhibit teratogenic and reproductive effects. Polybrominated biphenyls have been used as flame retardants. Thermal decomposition of PBBs leads to the release of bromine and the possible production of hydrogen bromide.

Impurity Name	General Information
PCB (polychlorinated biphenyl)	Whilst an Ontario Provincial Water Quality Objective (PWQO) has been set, PCBs have been set out as substances with a "zero tolerance limit". No new discharge of these substances are allowed and all existing releases should be reduced to the lowest possible level. Polychlorinated biphenyls are on the IARC List as a Group 2A substance. PCBs are two phenyl (benzene rings, each minus a hydrogen atom) groups covalently bonded together and one or more chlorine atoms substituted for hydrogen(s) on the ring(s). There are up to 210 different PCB isomers, with chlorine making up 12 to 68 percent of the molecule by weight. PCBs have been found in many water systems around the world. The transport of this man-made chemical is not well understood, but it has become ubiquitous in the environment. PCBs bioaccumulate in the same manner as DDT and as little as 0.02 ppm is toxic to Daphnia (a type of water flea). PCBs exhibit both carcinogenic and tumorigenic effects. They also effect the skin and are damaging to the liver. Severe liver damage may lead to a coma and death. PCBs are similar to DDT in their chemical properties and in fact are more environmentally persistent than DDT. The greater the chlorine substitution on the phenyl rings the more resistant the PCB is to bacterial degradation. PCBs have been used since the 1920's. Due to their low flammability and their high dielectric constant they were used in such apparatus as electric transformers and capacitors. They have also been used in the manufacture of tires, plastics, pesticides, paints, ink and wrapping paper. This group of chemicals presents a special fire hazard. Heating PCBs to sufficient temperatures (even without a fire) can produce the more toxic polychlorinated dibenzofurans (PCDFs) and polychlorinated dibenzo-p-dioxins (PCDDs). In addition, exposing PCBs to fire results in the formation of large quantities of hydrogen chloride. As a consequence, PCB fires represent a significant health hazard.
Pentachlorobenzene	Mol. wt. 250.34 Pentachlorobenzene is a solid with is insoluble in water (approximately 0.8 mg/L at 25 degrees Celsius) and slightly soluble in ether and benzene.

Impurity Name	General Information
Pentachlorophenol (PCP)	Mol. wt. 266.35 At room temperature pentachlorophenol (PCP) is a solid in the form of needle-like crystals. It is slightly soluble in water (approx. 8 ppm at 25 degrees Celsius), but is soluble in alcohol, ether and benzene. Chlorophenols have a half-life in aquatic systems of approximately 5 days. This is due to the fact that chlorophenols are readily photolyzed and biodegraded. PCP does have the potential for bioaccumulation with a concentration factor of approximately 1000. Of all the chlorophenols PCP is the most acutely toxic. At the lethal dose level (100-200 mg/kg) it also exhibits reproductive effects. The toxic mode of action of all chlorophenols, with the possible exception of the monochlorophenols, is to block ATP production. Ultimately the exposed organism dies from a lack of cellular energy. Ingestion may cause decreased respiration, blood pressure and urinary output; along with fever, gastrointestinal irritability, convulsions and death. The chronic toxic effects of chlorophenols appears to be secondary to the chronic effects of the typical contaminants usually associated with commonly marketed chlorophenols. In fact, the presence of chlorophenols may be indicative of the presence of such contaminants as polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs). The use of PCP is as a wood preservative. It has also been used as a herbicide.
pH	By definition pH is a measure of the concentration of hydronium ion in a given solution. Mathematically, pH is the negative logarithm of the concentration of the hydronium ion: pH = -log[H+]. It is a measure of intensity, not a measure of capacity (see alkalinity for a discussion). Most natural waters are buffered by a carbon dioxide - bicarbonate system. Any acidity in these systems is usually due to the presence of carbonic acid which is formed by the presence of carbon dioxide in the water. The pH of water can have a significant effect on the solubility of many chemicals in the water. In general, more alkaline pHs decrease the solubility of many metals, making them less toxic. On the other hand, low and high pH values can solubilize metals from sludges and bottom sediments. Fish are very sensitive to small changes in pH and sudden small changes can easily kill fish.

Impurity Name	General Information
Phenols	Phenols refers to a class of chemical compounds which can be broadly characterized as aromatic alcohols (at least one benzene ring attached to at least one hydroxyl group). Many of the more well known phenols have nitro and halogen atoms (eg. pentachlorophenol - a wood preservative). Phenols can be isolated as an intermediate product of microbial organic compound degradation. Commercially they are available as an extract of coal tar. The chemical known as "phenol" (consisting of one hydroxyl group attached to a single benzene ring) is toxic. Fatal doses may be absorbed through the skin. Acute exposure effects the central nervous system, while chronic exposures are known to damage the spleen, kidneys and pancreas. Due to the toxicity of phenols in general they are used as antiseptics and disinfectants. Phenols are also used in the production of "phenolic resins".
Phorate	Technical grade phorate is a colorless to light-yellow liquid. It is soluble in water (50 mg/L) and miscible with carbon tetrachloride, xylenes, alcohols, ethers and esters. It is used to control leaf-feeding insects, mites and soil insects in such crops as beans, corn, peanuts, potatoes, barley and wheat. Phorate is a systemic organophosphate insecticide which is highly toxic to mammals (3.7 mg/kg LD50 rat), birds, fish and aquatic invertebrates. Phorate has been shown to exhibit carcinogenic, teratogenic and mutagenic effects. It is reported to be mobile in loamy sand, sandy loam, silt loam and loam soils. Its ability to contaminate groundwater has not been fully characterized.
Phthalates (other)	There are a number of "other" phthalate esters, including diethylphthalate and dimethylphthalate. Phthalates are found in parts per billion in many surface waters. To a greater or lesser extent they are all toxic to fish and are moderately toxic to mammals.
Picloram	Picloram is a white powder exhibiting a chlorine like odor. It is soluble in water (43 mg/100 mL, at 25 degrees Celsius), very soluble in a variety of alcohols and slightly soluble in kerosene. This member of the picolinic acid family was first registered as a herbicide in the US in 1964. It is used in the control of broadleaf weeds and woody plants. While picloram is classified as moderately toxic by ingestion and dermal exposures, it is considered highly toxic by inhalation. The major risk to humans appears to be from exposure to hexachlorobenzene (HCB) which is a common contaminant of picloram. [HCB is a probable human carcinogen.] Picloram is persistent and mobile in the environment. However, it does not bioaccumulate in fish. It has a high potential to reach groundwater and has a lenghty half-life (100-300 days) under aerobic soil conditions.

Impurity Name	General Information
Potassium	K; Atomic no. 19; Atomic wt. 39.10; Valence +1. Alkali Metal While found in most natural waters the content of potassium is usually less than calcium, magnesium, and sodium. Potassium is less common than sodium in igneous rock, but slightly more common than sodium in sedimentary rock. This fact can assist in determining the source of water. The ratio of sodium to potassium generally ranges between 2:1 to 3:1. When potassium is present in a concentration greater than that of sodium this may be a indication of a foreign source of potassium. Potassium as a cation is essential for the human body. It is constantly excreted in the urine and must be replenished by eating a normal diet.
Prometryn	A colorless powder, prometryn is partially soluble in water and highly soluble in acetone and dichloromethane. This substituted triazine was first registered for use in the US in 1964. It is a herbicide used in the control of weeds found in beans, carrots, peas, potatoes and sunflowers. At the high end of its application rate it persists in soil for 30 to 90 days. It is moderately toxic to humans, but toxic to fish in the ppm range. It is also an eye irritant. Thermal decomposition can release oxides of nitrogen and sulfur.
Pyrethrum (Pyrethrins)	A pale yellow liquid. Barely soluble in water, they decompose in light. A contact insecticide, pyrethrins are moderately toxic to humans and are highly toxic to fish. They are detoxified in the gastrointestinal tract, but at the same time can produce gastrointestinal, respiratory and central nervous system effects. Long-term exposure can cause liver damage.
Radium-226	Ra; Atomic no. 88; Atomic wt. 226.03; Valence +2. Alkaline earth metal As a naturally radioactive product of the disintegration of uranium-238 Radium-226 is always found in minerls containing uranium (eg. pitchblende). It is a alpha and gamma emitter, with a half-life of 1600 years. Its daughter, radon-222, is linked to lung cancer. Radium-226 is highly radioactive with an activity of 1 Ci per gram (compared to uranium-238 with an activity of 0.36E-6 Ci per gram. Ra-226 is a metabolic analog of calcium. The biological half-life for the whole body is 900 days, while the biological half-life for bone is 10-12 years. Exposure to Ra-226 can lead to bone sarcomas, but it is most well known to induce head carcinomas. It has been used in the radiography of metals and as a source of radon. At one time it was used to manufacture luminescent paints, some of which were used on the hands of wrist watches.

Resin Acids, total

The Ontario Provincial Water Quality Objective for total resin acids is as follows:

Receiving Water pH	Total Resin Acids (ug/L)
5	1
5.5	3
6	4
6.5	9
7	25
7.5	45
8	52
8.5	60
9	62

Resin acids are the chief component of rosin.

Rosin is a translucent, amber-colored solid which is insoluble in water, but soluble in alcohol, benzene, ether, glacial acetic acid, oils and dilute solutions of alkali hydroxides.

The main resin acids found in rosin include abietic and pimaric type acids. Each of the resin acids is a long chain hydrocarbon (usually C20 or longer) and a solid at room temperature. Each resin acid has a phenanthrene nucleus.

Rosin and its individual acid resins are used in the manufacture of varnishes, soaps, printing inks, plastics, soldering compounds and sealants.

Selenium

Se; Atomic no. 34; Atomic wt. 78.96; Valence -2,+4,+6. Group 6A

Selenium is found in a variety of geological formations including sulfur deposits, coal deposits (at least 10 times the crustal average of 0.05 ppm) and organic-rich soils (as much as 1200 ppm). It is recovered from copper refinery slimes for commercial uses. Most surface and groundwaters contain levels of selenium in the parts per billion range.

Selenium in small amounts is a required nutrient for the normal growth of some animals. It is part of the glutathione peroxidase enzyme and plays a role in the cyctochrome electron transport system. The average selenium content in human blood is 0.2 ppm.

Selenium and its compounds are poisonous by inhalation and intravenous routes.
Acute toxicity in laboratory animals has been linked to such effects as renal, liver and heart damage. While these effects have not been demonstrated in humans, dermatitis, hair loss, abnormal nail formation and psychological disturbances (eg. depression) have been attributed to chronic over exposure of selenium by humans. In addition, chronic over exposure (5-40 ppm) can cause "garlic breath" (dimethyl selenide), pallor, nervousness, and digestive disturbances. Selenium is reported to react in vivo with other elements such as mercury, cadmium, silver and thallium, thus protecting against heavy metal toxicity.

Selenium has many commercial and industrial applications and can be found in electronics (rectifiers and xerographic copying machines), pigments and medicines. It is also used to remove mercury from stack gases by forming mercury selenide.

Impurity Name	General Information
Silver	Ag; Atomic no. 47; Atomic wt. 107.87; Valence +1,+2. Group IB. Silver is found in many geological formations including argentite. It is often obtained as a by-product in the refining of copper, lead, and other metals. Trace amounts of silver are found in natural waters. Its solubility ranges from 0.1 to 10 mg/L depending on the pH and the chloride concentration of the water being studied. Due to silver's strong bactericidal action (0.001-500 ug/L to sterilize water) it has been considered for use as a water disinfectant. Silver does not generally occur in animal tissue. Exposure to silver on the skin can cause argyria, usually producing localized gray-blue patches on the skin or in some cases, widespread pigmentation covering most uncovered parts of the body. The eyes may be affected to the extent that vision is impaired. Inhaled silver can be absorbed and ingested silver can be absorbed and retained by the gastrointestinal tract. Large amounts of silver nitrate can cause severe gastrointestinal irritation due to its caustic action. Silver is used in many electrical applications as well as being used in photography, indelible inks, antiseptics and medicines.
Simazine (and D-ethyl Simazine)	A colorless powder exhibiting partial solubility in water. It is highly soluble in such solvents as diethyl ether. Simazine is a herbicide with a variety of uses, including the control of broad-leaved and grass weeds in deep-rooted crops such as coffee, tea, turf, vineyards, cocoa and corn. In the US it has also been used to control algae. It has limited toxicity to mammals, birds and honeybees. It is however, a skin and eye irritant. Thermal decomposition can lead to chlorine and nitrogen oxide release.
Strontium-90	Sr-90; Atomic no. 38; Atomic wt. 89.62; Valence +2. Alkaline Earth. Strontium and calcium have similar chemical and geological properties. Strontium carbonate, strontianite and strontium sulfate are typical geological formations containing strontium. Strontium has two natural isotopes strontium-90 (half-life 29 years; beta emitter) and strontium-89 (half-life 50.52 days; beta emitter). Sr-90 is produced by the detonation of a nuclear device (a product of fission) at a rate of 0.1 MCi/Megaton. During the atmospheric testing period between 1945-1963 193 megatons were tested. Under normal circumstances calcium is preferentially absorbed by the body and strontium is excreted. Excess strontium is stored in the teeth and bones with a biological half-life of 18,000 days (in bone). While strontium is virtually nontoxic, strontium-90 presents the typical problems associated with radioactive material.

Impurity Name	General Information
Sulfate	Sulfate is commonly found in natural waters. It is found in such geological formations as gypsum, anhydrite, epsomite and mirabilite. Another source is pyrite (iron sulfide) which provides sulfide in solution that can be oxidized catalytically by microorganisms to produce sulfate. Ultimately the sulfate concentration of natural waters is dependent on the solubility of the geological source. For example, gypsum can produce waters containing sulfate in concentrations of 1000 mg/L. Sulfur in anaerobic conditions can act as an electron acceptor, typically producing hydrogen sulfide. In aerobic conditions sulfate is formed and acts as an electron acceptor. While sulfate in water does not usually present a health hazard, in high concentrations it acts as a laxative. Sulfur is an essential element. One of the functions that sulfate performs in the human body is the elimination of xenobiotic species (conjugation by sulfate eliminates alcohols, phenols and arylamines).
Taste	Taste is imparted to water by organic compounds, inorganic compounds (including salts) and dissolved gases. These substances may be natural or anthropogenic in origin. Potable water should be free of any offensive taste. This is no small task as the sense of taste is can be very discerning. For example, chlorophenols can be tasted at a concentration of 0.001 mg/L.
TDS (Total Dissolved Solids)	All natural waters contain a certain amount of dissolved solids in the form of minerals. In the case of groundwater, the older or the deeper the groundwater the more likely it is to contain higher concentrations of minerals in solution. Dissolved organic matter should also be expected in natural waters. Dissolved and suspended solids can be separated by filtration of the sample. The residue after evaporation represents the total dissolved solids. Another measure that can be correlated to the concentration of TDS is specific conductance (typically 640 mg/L is approximately equal to 1000 millimhos/L). Most potable water has a specific conductance of between 50 and 1500 micromhos/cm. Sea water shows a specific conductance of 50000 micromhos/cm. Distilled water exhibits a specific conductance of between 0.5 to 5 micromhos/cm. Groundwater may range between 30 and 5000 micromhos/cm.

Impurity Name	General Information
Temephos	Pure temephos is a colorless crystalline solid; technical grade temephos is a brown viscous liquid. While only slightly soluble in water, hexane, and methylcyclohexane, it is soluble in acetonitrile, carbon tetrachloride, diethyl ether and toluene. It is reported to be stable in both fresh and salt water a temperatures of 25 degrees Celsius. Temephos is used to control the larvae of biting midges, blackflies, mosquitoes, moths and sand flies. It is also useful in controlling fleas on dogs, cats and lice on humans. Temephos has also been used to control cutworms, thrips on citrus and Lygus bugs. Temephos is slightly toxic, with humans showing no toxic effects at doses of 256 mg per day for five days. The LC50 for rainbow trout is reported to be approximately 32 mg/L.
Temperature	For a full description of the Ontario Provincial Water Quality Objective for temperature see the Water Management "Blue Book". Temperature can greatly affect the concentration of dissolved gases such as oxygen. In fact temperature significantly affects physical, biological and chemical processes. Potable water temperatures above 15 degrees Celsius are objectionable to most people. Groundwater temperature at a given depth is generally constant. Shallow groundwater (<50 feet depth) temperatures vary from one season to the next, but waters from depths of greater than 50 feet remain quite constant at a given depth. At depths of greater than 100 feet the temperature of the groundwater increases steadily at a rate of approximately 0.6 degrees Celsius per 112 feet of depth increase.
Terbufos	Mol. wt. 288.4 Technical grade terbufos is a pale yellow to colorless liquid which is partially solubility in water (10-15 mg/L) and soluble in acetone, alcohol, and a number of other organic solvents. It decomposes in acidic or alkaline conditions (pH<2 or pH>9). It is used to control anthropods and nematodes in the soil. Terbufos is extremely toxic (LD50 rat 1.6 mg/kg). Its toxic mode of action is to inhibit cholinesterase.

Impurity Name	General Information
Tetrachlorophenols	Mol. wt. 231.89 The three possible terachlorophenols are all solids at room temperature. Chlorophenols have a half-life in aquatic systems of approximately 5 days. This is due to the fact that chlorophenols are photolyzed and biodegraded. There is limited toxicological information on the tetrachlorophenols. The most studied tetrachlorophenol, 2,4,5,6-tetrachlorophenol, is poisonous by ingestion, skin contact, intraperitoneal and subcutaneous routes. It is reported to be an experimental carcinogen. The acute toxic mode of action of chlorophenols, with the possible exception of the monochlorophenols, is to block ATP production. Ultimately the exposed organism dies from a lack of cellular energy. Tetrachlorophenol is found in significant concentrations (approximately 10%) in technical grade pentachlorophenol.
Tifluralin	Technical grade trifluralin is an organic crystalline solid. It is slightly soluble in water (<1 mg/L at 27 degrees Celsius) and it is soluble in acetone and xylene. It is reported to be susceptable to decomposition by U.V. radiation. Trifluralin is a herbicide used in the control of broad-leaved weeds in such crops as beans, brassicas, cotton, orchards, soyabeans, sunflowers, tomatoes and vineyards. It is relatively nontoxic to most mammals (>10000 mg/kg oral LD50 rat). It is not irritating to the skin.
Tin	Sn; Atomic no. 50; Atomic wt. 118.69; Valence +2,+4. Group IVA. Tin is found in such geological formations as cassiterite, stannite and tealite. Methylated tin can be produced biologically in the environment. The inhalation of tin in the form of dust or fume can lead to pneumoconiosis. Tin or inorganic tin compounds which are ingested are relatively nonpoisonous, requiring large quantities (eg. 500 mg/kg for 14 months) to produce toxicity. Tin is used to manufacture a number of different organometallic compounds. They tend to be significantly more toxic than inorganic tin compounds. The type of toxic effect is dependent on the tin compound. Triethyltin can produce depression and cerebral edema. Tributyltin has been reported to cause acute burns or subacute dermal irritation. Triphenyltin is a potent immunosuppressant. Tin has many industrial and commercial uses including fungicides, bactericides, insecticides, catalysts, wood, leather, paper and textile preservatives.

Impurity Name	General Information
TOC (Total Organic Carbon)	The TOC test is a measure of the amount of organic material present in the water and theoretically it can be related to the oxygen demand. One test method used to measure TOC oxidizes a small water sample at 950 degrees Celsius and the resultant carbon dioxide produced is then measured. The inorganic carbon present in the water is removed prior to combustion or measured and subtracted from the final results.
TOD (Total Oxygen Demand)	TOD is determined by measuring the oxygen loss during the oxidation of a small sample exposed to 900 degrees Celsius in the presence of a platinum catalyst. The test can be completed in minutes and avoids some of the shortcomings of the COD test. The test also provides a measure of the nitrogen demand.
Toluene (methylbenzene)	Mol. wt. 92.15 Toluene is a volatile colorless liquid which is moderately soluble in water (535 mg/L) and is soluble in alcohol, acetone, ether and glacial acetic acid. Toluene is moderately toxic by ingestion and inhalation, with most of the effect data coming from exposure by inhalation. In the ppm concentrations toluene is a narcotic and the cause of such symptoms as fatigue, weakness and confusion. While damage to the kidneys, liver and lungs have been reported, toluene unlike benzene has not been shown to permanent damage the blood or cause cancer. Skin absorption does occur, but is not a significant route of exposure in most cases. Toluene has bben used in recent years as a substitute for benzene. It is also found in gasoline and is used as a solvent in paints, varnishes and resins.
Total Coliform	When checking how sanitary a water supply is one of the tests which is often used is to test for the presence of coliform. Coliform bacteria are a type of bacilli (rod shaped bacteria) that are gram-negative, nonsporeforming, aerobic, facultatively anaeorbic which ferment lactose to produce acid and gas within 48 hours and at a temperature of 35 degrees Celsius. Since this test makes no attempt at determining the origin, genera or species of the bacteria found it is a test which is used to determine if more testing is required. Some coliform are not only found in the intestinal tract of warm-blooded animals, but are also found in soil, water and other media (eg. Klebsiella pneumoniae found in grain). In addition, it is important to note that not all coliforms are pathogenic. In fact there are a number of organisms which are capable of surviving environments in which all coliform have been killed (eg. viruses). The test can provide false positive results when the coliform are naturally a part of the aquatic flora; or when the bacteria Aeromonas is present in the water. High populations of HPC (heterotrophic plate count) bacteria can suppress coliform activity hence, giving a false negative result.

Impurity Name	General Information
Total Phosphorus	P; Atomic no. 15; Atomic wt. 30.97; Valence +3,+4;. Group VA The Ontario Provincial Water Quality Objective is 10 ug/L for lakes and 30 ug/L for rivers and streams. Phosphorus is found naturally in a number of phosphate forms, both organic and inorganic (hence, "total phosphorus"). Natural waters usually do not contain more than 0.1 to 0.3 mg/L. Higher concentrations are associated with waste water disposal and phosphate mining. Anthropogenic sources of phosphates include commercial fertilizer, phosphate containing detergents and the decomposition of organic matter containing phosphorus. Phosphorus is an essential nutrient for plant and animal life. An over abundance of phosphate in the water stimulates the growth of aquatic plant life; in essence speeding up the natural aging process associated with lakes (eutrophication). While perhaps in the order of one-half of all the phosphorus discharged to our lakes comes from agricultural runoff, it was much easier to limit the amount of phosphorus discharged from cities. As a result Canada passed a law in the early 1970's limiting the amount of phosphate in detergents to 2.2%, expressed as phosphorus. In addition many municipal sewage treatment plants (STPs) can now remove phosphates by the addition of some simple chemicals (eg. lime and ferric chloride). Typical phosphorus (inorganic) values in human urine vary with diet. Health and Welfare Canada suggests a recommended dietry intake of 4 mg/kg body weight for adults or 280 mg/day for a 70 kg adult.
Total Suspended Solids (TSS)	The concentration of suspended solids in water can be caused by natural and/or man-made processes. TSS measures the concentration of both the organic and the inorganic suspended material. The inorganic fraction may include sand, clay, silt and insoluble metal compounds. The organic fraction may include plankton, grease, oil, fibers and other insoluble organic matter. Suspended solids are important in that they can act as a substrate for pathogens and toxic contaminants to cling to, clog fish gills, reduce benthic (bottom dwelling organisms) activity and inhibit photosynthesis.
Toxaphene	A yellow wax like material, toxaphene is a complex mixture of unspecified chlorinated camphene derivatives. It is partially soluble in water and readily soluble in organic solvents and petroleum oils. It decomposes upon exposure to sunlight, heat or certain metals to give hydrogen chloride. Toxaphene is on the IARC List as a Group 2B. It is a non-systemic contact insecticide which acts on contact or by ingestion. It has limited phytoxicity and is used on corn, fruit and vegetables. Toxaphene is toxic by all routes of exposure. In humans systemic effects include somnolence, convulsions, coma and allergic skin dermatitis. This chemical is also known to accumulate in adipose tissue. It is a confirmed carcinogen, as well as exhibiting experimental teratogenic and reproductive effects. Fatalities associated with the chemical have been recorded. Thermal decomposition can lead to the formation of vast quantities of hydrogen chloride.

Impurity Name	General Information
Triallate	Pure triallate is an amber oil with a melting point of 29-30 degrees Celsius. It is partially soluble in water (4 mg/L at 25 degrees Celsius) and soluble in organic solvents. It is a pre-plant or post-plant soil-incorporated herbicide used in the control of wild oats in such crops as barley, lentils, peas and wheat. Its activity and loss from the soil is mainly due to degradation by microorganisms and/or loss by volatilization. It is slightly toxic to mammals (1471 mg/kg LD50 rat).
Trichloroethylene (trichloroethene) (TCE)	Mol wt. 131.40 Trichloroethylene is partial soluble in water and soluble in ether, alcohol and chloroform. The US EPA have classified TCE as a probable human carcinogen (Group B2). TCE is highly toxic by ingestion (LD50 rat 4.92 ml/kg). Moderate exposure to trichloroethylene vapors causes headache and drowsiness along with eye and skin irritation. Acute exposure causes central nervous system depression and ventricular fibrillation resulting in cardiac failure. There are reports of damage to the liver and other organs from chronic exposure. TCE is used in many comercial and industrial applications as a solvent and is most notably in dry cleaning.
Trichlorophenols	Mol. wt. 197.45 All six possible trichlorophenols are solids at room temperature. Each is relatively insoluble in water and soluble to very soluble in alcohol and ether. Chlorophenols have a half-life in aquatic systems of approximately 5 days. This is due to the fact that chlorophenols are readily photolyzed and biodegraded. There is limited toxicological information on the trichlorophenols. The two most studied trichlorophenols, 2,4,5-trichlorophenol and 2,4,6-trichloro-phenol, are both moderately toxic by ingestion and subcutaneous routes. Both are reported to exhibit experimental carcinogenic effects and yet in some experiments the purity of the tested trichlorophenol has not been reported. There is some suggestion that the typical contaminants (ie. dioxins) associated with all technical grade chlorophenols may be the cause of some of the chronic effects presently attributed to chlorophenols. The acute toxic mode of action of chlorophenols, with the possible exception of the monochlorophenols, is to block ATP production. Ultimately the organism dies from a lack of cellular energy. 2,4,5-trichlorophenol is used in the production of such herbicides as 2,4,5-T and 2,4,5-TP. Dioxin is a common contaminant of 2,4,5-trichlorophenol.

Impurity Name	General Information
Trifluralin	Technical grade trifluralin is an organic crystalline solid. It is slightly soluble in water (<1mg/L at 27 degrees Celsius) and it is soluble in acetone and xylene. It is reported to be susceptab;e tp decomposition by U.V. radiation. Trifluralin is a herbicide used in the control of broad-leaved weeds in such crops as beans, brassicas, cotton, orchards, soyabeans, sunflowers, tomatoes and vineyards. It is relatively nontoxic to most mammals (>10000 mg/kg oral LD50 rat). It is not irritating to the skin.
Trihalomethanes	The term "trihalomethanes" includes chloroform, bromodichloromethane, chlorodibromomethane and bromoform. Their concentrations are determined by the gas sparge and purge equivalent method. Halogenated hydrocarbons are considered to be potentially carcinogenic. They are usually formed by the substitution of a hydrogen atom with a chlorine or bromine atom. They are commonly formed during water treatment (ie. chlorination). It is important to note that not only are trihalomethanes ingested, but they are also absorbed by the skin and inhaled while showering or bathing.
Tritium	T; Atomic no. 1; Atomic wt. 3.02. Tritium is a naturally occurring radioactive isotope (half-life of 12.26 years, beta-emitter). Natural water would contain almost immeasurable quantities of tritium, but tritium in the air is higher than background due to the use of tritium in fusion based thermonuclear weapons. Since river water and continental rain have a greater opportunity to equlibrate with atmospheric tritium they contain higher concentrations of tritium than oceanic or old ground waters.
Turbidity	Inland waters can be naturally turbid, especially in the summer and fall, due to the presence of plankton and/or substantial amounts of suspended solids. Turbidity, while related to the amount of suspended solids in the water, is a measure of the interference of the passage of light through the water. Suspended solids are measured by filtration and evaporation. Turbid waters can clog fish gills and also reduce the amount of sunlight available for oxygen production by plankton. In fact, high turbidity can quickly lead to water systems becoming anaerobic. The erosion of farmland, mining practices and urban runoff are some of the major contributors to the increased turbidity of inland waters.

Impurity Name	General Information
Uranium	U; Atomic no. 92; Atomic wt. 238.03; Valence +3,4,5,6. Actinide Uranium is a naturally occurring radioactive element which in its natural state is a combination of three isotopes, U-238 (99.276%), U-235 (0.718%) and U-234 (0.0056%). Pitchblende is the principal ore from which uranium is extracted. U-238 is an alpha and gamma emitter with a half-life of 4.468E9 years. U-235 and U-234 have half-lives of 7.04E8 and 2.45E5 respectively. The uranyl ion is readily absorbed by the wall of gastrointestinal tract. While as much as sixty percent of the absorbed uranium is excreted in the urine, the remaining uranium accumulates in the sketetal system in the same way that radium does. Uranium has not been proven to cause cancer, but it is assumed to cause cancer. Soluble compounds of uranium are known to cause acute renal damage and with high exposure, renal failure and death. Dusts containing uranium persist in the lung for extended periods of time and at a minimum cause pulmonary irritation. U-238 is not fissionable by thermal neutrons (<1MeV) and therefore without further processing is unsuitable for use in reactors or weapons. U-235 is used in atom and hydrogen bombs. U-235 and U-234 are used as nuclear fuel in power reactors.
Xylenes	Mol. wt. 106.18 There are three possible isomers of xylene: ortho, meta and para. They are slightly soluble in water. Xylene is moderately toxic by all routes of exposure. It is severely irritating to the eyes at low ppm concentrations and can cause pulmonary edema. Like most organic solvents, it is irritating to the skin. It exhibits effects on the central nervous system and can damage the liver. It has not been shown to be carcinogenic. Xylenes are used as organic solvents, precursors for other organics, in the manufacturing of varnishes, resins and paints. It is also found in such petroleum products as gasoline.

Impurity Name	General Information
Zinc	Zn; Atomic no. 30; Atomic wt. 65.38; Valence +2. Group 2B metal Zinc is found in many common geological formations including sulfide ores. Zinc and cadmium are found together in nature and their physical separation is difficult. Zn(II) is toxic; as are Pb, Cu and Cd ions. Zn(II) is lethal to aquatic plants in concentrations between 0.3 to 500 ppm. Zinc, like Cu(II) and Pb(II), is less toxic in hard water than in soft because toxicity is antagonized by Ca(II) and Mg(II). On the other hand, the presence of Cu and Cd acts synergistically to increase the toxicity of zinc. Anything that reduces DO (dissolved oxygen), for example, increased organic pollution or increased temperature, also increases the toxicity of zinc. A drinking water limit or objective for zinc is usually based on the disagreeable taste and water appearance rather then the toxicity of Zn(II). Zinc(II) is essential for all plant and animal life. It is an essential nutrient for the human body. It is associated with the proper function of a number of enzymes including RNA and DNA polymerases, carbonic anhydrase and carboxypeptidase. In humans acute toxicity is rarely seen unless associated with metal fume fever. Zinc has many commercial and industrial applications including metal coatings (galvanized metal), dry cell batteries, paints and ointments. Health and Welfare Canada recommends a daily dietary intake of 8 to 9 mg for Adults.