7.5. AGRICULTURE

ESG International Inc. (ESG) was contracted by Bennett to conduct an Agricultural Impact Assessment related to the development of the proposed facility. Issues identified in the Approved Terms of Reference are presented here with regards to potential effects to the agricultural environment. The entire report entitled, "Agricultural Impact Assessment" can be found in separate Appendix 10.

The assessment was conducted and prepared in compliance with the Approved Terms of Reference for the Environmental Assessment. The current section describes:

- Potential contaminant pathways and bio-magnification within food production processes and natural chains,
- Potential impact to the agricultural resource base and farmer livelihoods by actual or perceived contamination of food by emissions,
- Disruption of traditional transportation routes for farm machinery and produce resulting from increased truck traffic volumes or events such as road closures due to spills,
- Potential crop chemical uptake and livestock dosage
- Effect of air emissions and contaminant distribution/long term accumulations and persistence,
- Potential direct surface and groundwater contamination, and
- Potential effects on local agricultural employment and employment income.

Each of the above points is addressed in the sections below. If you would like to review supporting data and information on the existing agricultural environment, please refer to the "Agricultural Impact Assessment" that can be found as separate Appendix 10. A discussion of the existing agricultural environment can be found in Section 4.6.

7.5.1. Potential contaminant pathways and bio-magnification within food production processes and natural chains

7.5.1.1. Bioaccumulation Study

The methodology used in estimating the bioconcentration potential of the proposed Bennett thermal treatment facility is based upon the United States Environmental Protection Agency's (EPA) Hazardous Waste Identification Rule 1999. The HWIR99 represents a state-of-the-art, screening-level risk-based assessment of potential human and ecological health risks resulting from long-term (chronic) exposure to hazardous chemicals released from land-based waste management units (WMUs).

A central feature of the HWIR99 technical approach is a comprehensive, site-based risk assessment model. This model simulates the release, fate and transport, exposure and risk associated with disposed chemicals. The module and its associated sub-modules can accommodate a wide array of input data requirements in categories such as facility location, water body and water quality, ecological receptor types and locations, and human health benchmarks.

Sub-modules within the 3MRA Modeling System (Multimedia, Multi-pathway, Multi-receptor Risk Assessment) system can predict a chemical's release from aerated tanks, landfills, land

application units, surface impoundments, and waste piles; movement through the air, groundwater, soil, watersheds, rivers, lakes, and wetlands; a chemical's concentration at drinking water wells, residential soils, and farms; bioaccumulation in plants and animals (both on land and in water bodies); and exposures and risks to humans and animals through ingestion of contaminated materials such as food and soil, inhalation of air (human only), and direct contact with contaminated media (ecological only).

7.5.1.2. Contaminant Pathways

It is important to emphasize that although the study presented here does assess the risk for bioaccumulation through comparison to human health benchmarks, the work presented here is a screening level assessment meant to convey relative risk to the agricultural economy of a region. Cantox performed a comprehensive terrestrial and human health assessment, and the Cantox study should serve as the definitive risk assessment for human and terrestrial life in the area.

The Farm Food Chain (FFC) Module

The bioaccumulation model used in this study is based largely on the Farm Food Chain (FFC) sub-module of the USEPA's 3MRA Modeling System. The FFC Module can calculate the concentration of a chemical in homegrown produce (fruits and vegetables), and farm crops for cattle (forage, grain, and silage), beef and milk. The model framework is based on recent and ongoing research conducted by the US Environmental Protection Agency Office of Research and Development (ORD).

The module is designed to predict the accumulation of a contaminant in the edible parts of plants from uptake of contaminants in soil and through transpiration and direct deposition of the contaminant in air. Concentrations are predicted for three main categories of food crops eaten by humans: exposed fruits and vegetables (i.e., those without protective coverings, such as lettuce), protected vegetables (e.g., those with protective covering, such as corn), and root vegetables (e.g., potatoes). In addition, the module estimates the contaminant concentration from the biotransfer of contaminants in feed (i.e., forage, grain, and silage), soil, and drinking water to beef and dairy cattle through ingestion.

Aboveground Plant Concentration

Plant vegetation is separated into three main categories: "exposed" fruits and vegetables, "Protected" fruits and vegetables and root vegetables. The terms "exposed" and "protected" refer to whether or not the edible portion of the produce is exposed to the atmosphere. Examples include tomatoes (exposed vegetables), corn (protected vegetable), and potatoes (root vegetables). Final calculations give a contaminant concentration for each type of plant.

Vegetation consumed by animals includes grain, forage, and silage. Grain is considered to be "protected" vegetation and forage, "exposed" vegetation. Silage refers to any plants harvested for animal consumption, whether protected or exposed. Thus, silage is calculated as exposed vegetation but is given a practical parameter, to account for being partly protected and partly exposed.

Waste management units release contaminants into the air that then redeposit to the ground, or move through the air, and redeposit on plants by wet or dry deposition. The contaminant in the soil can then be taken up through a plant's roots. The three mechanisms by which contaminants

can bioaccumulate in vegetation are: deposition of particle-bound contaminants to exposed plant tissues, deposition of vapour-phase contaminant to exposed plant tissues, and root uptake.

Accumulations can occur by root uptake of contaminants through water for protected vegetables and fruit grown aboveground or by absorption into the outer parts of the root vegetables. Equations used to calculate total exposed aboveground plant concentration and contaminant concentration in the plant due to direct deposition are included in Appendix B of Appendix 10. It is important to note that since few non-grain vegetables and very little fruit are grown in the study area, the bioaccumulation study focused on the potential biotransfer of contaminants to farm animals.

Soil Concentrations

Calculation of bioconcentration in plant material also requires data on soil chemical concentrations. The equations in Appendix A of Appendix 10, were used to calculate chemical soil concentrations resulting from deposition of particle and vapour phase contaminants onto soils. These equations calculate an average soil concentration over the scenario exposure duration (20 years) as a result of wet and dry deposition of particles and vapours to soil. In this way, potential long-term effects related to the routine operation of the facility were accounted for through the soil pathway.

Animal Tissue Concentrations

The animal products that were evaluated come from beef and dairy cattle with contaminant concentrations resulting from plant and water ingestion. For the Kirkland Lake agricultural area, it was assumed that animals do not have direct access to surface water sources. Although some agricultural producers, may in fact, use surface water streams or ponds as a watering source for livestock, streams would experience continuous flushing, thereby not accumulating deposited contaminants. Open surface water ponds, if not connected to stream networks providing flushing, are likely fed from groundwater sources, or are artificially replenished by farm operators. Therefore, potential contaminant concentrations in water fed to livestock were derived from dissolved concentrations in groundwater, since the groundwater pathway appears to have a greater potential for accumulation of contaminants.

The animals are assumed to ingest soil, with which they come in contact during grazing or other activities on untilled soils. The soil concentration used is that of the top layer of soil. Equations used to calculate the concentration of contaminants in beef and milk are included in Appendix B of Appendix 10.

Discussion of how fugitive emissions and contaminant spill modeling were incorporated into the agricultural evaluation, please refer to Section 7.6.3.

Bioaccumulation modelling was performed at distances where significant and intensive pockets of agricultural activity are located, namely at Englehart (36km), Earlton (50km), and New Liskeard (75km). Chemical concentrations and deposition rates modeled by the air quality impact study were predicted at distances south-southeast (SSE) of the proposed facility.

Using results of the air quality impact assessment (Appendix 3), predicted potential increases in bioaccumulated contaminant concentrations in beef and milk produced by the Bennett facility alone, as well as estimated total bioaccumulated contaminant concentrations in beef and milk from all other potential sources, were calculated at various distances from the proposed thermal

treatment facility. These were then multiplied by typical meat and dairy product consumption rates for the average Canadian adult as defined by Health Canada. This resulted in the characterization of a high risk profile, as represented by the potential increase in contaminant ingestion rate for a 70 kg adult whose meat and dairy product diet originates entirely from the Study area.

7.5.1.3. Bioaccumulation Modeling Study Results

Results of the bioaccumulation modeling study for the parameters of concern (POCs) are shown in Appendix B of Appendix 10 (Tables 4.3a-4.8b and Figure 4.1). Bioaccumulation estimates generally show very low increase in POC concentrations in beef and milk products as a result of the activity of the proposed Bennett thermal treatment facility.

As expected, all increases in POC concentrations and POC dietary intakes decrease as one moves further away from the proposed facility. A detailed discussion on the results for each parameter grouping is provided in the following sections and focuses on predicted results at a distance of 36km (Englehart). This distance was chosen because it represents the northern limit of the more intense agricultural activity in greatest proximity to the proposed facility. The predicted results for the 50km and 75km distances are shown in Appendix B of Appendix 10. It is important to recall that all bioaccumulation modeling results include estimates releases from fugitive emissions.

Dioxins, Furans and PCBs

Increases in background concentration of dioxins and furans and PCBs in beef and milk products are predicted to be well below 0.1% of estimated background concentrations in the Kirkland Lake area. For example, at a distance of 36km from the proposed facility, the approximate location of the village of Englehart, the increase in dioxin (TEQ) concentration is projected to be 0.0111% in beef and 0.0147% for milk. PCB concentrations are projected to increase by 0.0048% and 0.008% over background levels in beef and milk products, respectively.

Chlorophenols

For chlorophenols, no estimates of existing background concentrations in beef and milk products could be found in the literature. However, at a distance of 36km from the proposed facility, the increase in chlorophenol concentrations in beef and milk are projected to represent approximately 0.00000002% of the oral reference dose (ORD). Long-term exposure to this increase in chlorophenol levels in beef and milk products would increase an individual's risk of developing cancer by approximately 1 in 55 trillion. Therefore, projected increases in chlorophenol levels in food and associated risks are extremely low.

Metals

At a distance of 36km from the proposed facility, increases in background concentrations of metals in beef and milk products are generally predicted to range form 0.00005 to 0.0012% of estimated background concentrations in Canada. For example, the increase in cadmium concentration over background levels is projected to be approximately 0.00005% in beef and 0.0001% in milk at Englehart.

Benzo(a)pyrene

For benzo(a)pyrene, the predicted concentration in crease in beef at Englehart represents approximately 0.025% of estimated existing background concentration in beef products. This increase represents about 0.21% of the Mean Dietary Intake. Long term exposure to this increase in benzo(a)pyrene levels in beef and milk products would increase an individual's risk of developing cancer by approximately 1 in 15.6 million.

Total benzo(a)pyrene predicted concentrations in beef and milk at Englehart represent approximately 0.077% of estimated existing background concentrations in beef products. This level represents about 0.65% of the Mean Dietary Intake. Long term exposure to this increase in benzo(a)pyrene levels in beef and milk products would translate to an individual's risk of developing cancer of approximately 1 in 4.95 million.

Pesticides

At a distance of 36km from the proposed facility, projected cumulative increases in concentrations of DDT, DDD, and DDE in beef and milk products are generally estimated to represent 0.0011-0.0547% of quoted benchmark levels. Emissions from the proposed treatment facility are predicted to induce a 0.013% increase in the hypothetical mean dietary intake (MDI) of dieldrin for an individual consuming milk and beef products exclusively from the exposure area. This increase in the MDI corresponds to only 0.00008% of the ORD or MRL. For heptachlor, operation of the facility would result in a 0.0005% increase in the MDI, representing only 0.000000095% of the ORD.

VOCs

At the Village of Englehart, projected cumulative increases in concentrations of VOCs in beef and milk products are generally estimated to represent as little as 0000000078-0.000000165% of quoted benchmark levels. The exception to this range is benzene, for which emissions from the proposed treatment facility are predicted to induce a 0.000024% increase in the hypothetical mean dietary intake (MDI) of an individual consuming milk and beef products from the exposure area exclusively.

7.5.1.4. Discussion

Bioaccumulation modeling results demonstrate that VOC compounds and chlorophenol have the lowest potential to bioaccumulate within the farm food chain due to their relatively high loss rates (VOCs) and relatively low deposition rate and concentration (chlorophenol). Risks for cancer incidence are in the 1 in 20 billion to 1 in 55 trillion range. Therefore, it is likely that other VOC parameters not modeled in this bioaccumulation study would also represent a very low risk for biotransfer.

The pesticides group represents the second lowest level of risk (1 in 133 million to 1 in 525 million). One pesticide, heptachlor, had a very low cancer risk of 1 in 469 billion. However, DDD and dieldrin represent the greatest predicted risk for pesticide biotransfer in this study. This is due to the very low benchmark values for these pesticides, and their relatively elevated potential for air to plant biotransfer. Nevertheless, the computed total risk for cancer incidence from the treatment of these compounds is still low at 1 in 133 to 160 million, 36km from the proposed treatment facility.

The metals represent a somewhat higher, though variable risk with biotransfer generally achieved only through direct deposition on plant material or uptake from the soil. The total risk for developing cancer through metals approaches or is above the 1 in 1 billion range for beryllium and lead, but is greatest for chromium (1 in 2.62 million) and arsenic (1 in 9.27 million) at a distance of 36km from the proposed facility due to the presence of other sources for these parameters. It is important to note that when considering emissions from the Bennett facility only, the cancer risk for these latter 2 parameters drops to around 1 in 500 million.

Dioxins, furans, PCBs and benzo(a)pyrene generally represent the highest levels of risk. Although dioxin, furan, and benzo(a)pyrene benchmark values are extremely low, the correspondingly extremely low predicted deposition rates and ambient concentrations for these parameters still result in acceptable biotransfer risk potential for these parameters. The potential the incidence of cancer for a hypothetical individual consuming his/her meat and dairy diet entirely form the exposure area is in the range of 1 in 1.4 to 5 million for benzo(a)pyrene and dioxins and furans, 36km from the proposed site.

7.5.2. Potential impact to the agricultural resource base and farmer livelihoods by actual or perceived contamination of food by emissions

7.5.2.1. Impact on Agriculture in Case of Contamination

It is important to recall that all bioaccumulation modeling results include estimated releases from fugitive emissions. Spill impact potential is estimated to be very low due to the nature of the contaminated product transported and the limited number of pathways (groundwater only) available for exposure to occur.

Results of the bioaccumulation study for the proposed thermal treatment facility at Kirkland Lake demonstrate that increases in parameter concentrations within meat and dairy products will be minimal.

7.5.2.2. Potential Impacts of the Facility on Agriculture: St. Ambroise Case Study

This section will investigate past practices and effects on agricultural products as a result of the introduction of a facility similar to the proposed Kirkland Lake facility, specifically the area within the zone of influence of Bennett's Récupère Sol Inc. (RSI) Thermal Treatment Facility in St. Ambroise, Quebec. According to the Terms of Reference for this study: "The proposed facility in Kirkland Lake will be a scaled up version of the RSI facility" (June 19, 2000:1). The RSI facility previously served as a bio-treatment facility, and was retrofitted into its current capacity between May and September 1996. Test runs for the RSI facility began in October 1996 and it has been in continuous operation ever since.

Analysis of the impacts of the RSI facility on agriculture in St. Ambroise is based on three components:

- A brief description of agriculture in St. Ambroise;

- A review of Statistics Canada's Census of Agriculture and Whole Farm Data Base (WFDB) data for the St. Ambroise Census Subdivision in comparison with other areas in Quebec; and,
- Telephone interviews with local Federation of Agriculture (l'Union des Producteurs Agricoles, or UPA) Directors, primary producers from the St. Ambroise area, and purchasers/distributors of agricultural products from the St. Ambroise area.

Agriculture in St. Ambroise

The rural municipality of St. Ambroise is located to the east of Lac St. Jean, approximately 20 kilometres northwest of the Town of Chicoutimi. It is a Census Subdivision as defined by Statistics Canada, located in Le Fjord du Saguenay Census Subdivision. In turn, Le Fjord du Saguenay is one of eight Census Divisions that make up the Saguenay, Lac-St. Jean-Cote Nord Agricultural Region. In total, there are twelve agricultural regions across Quebec (Figure 5-1, Appendix A of Appendix 10).

Beef farms and Field Crop farms (primarily potatoes) make up the greatest proportion of farm types in St. Ambroise, with each comprising about 36.1% of the total number of farms. Dairy farms also play an important role in local agriculture, comprising about 18.4% of St. Ambroise farms. Miscellaneous Specialty farms are also present, accounting for 18.4% of all farm types, and including blueberry farms, apiculture, silviculture and horticulture-based operations.

Impacts of the RSI facility on Agricultural Production

This review uses agricultural data from Statistics Canada's Census of Agriculture for census years up to and including 1996, and from the Whole Farm Data Base (WFDB) for the years 1995 to 1999, inclusive.

Trends in agriculture in St. Ambroise

The number of farms in St. Ambroise has been in decline since at least 1986, but these declines were consistent with concurrent trends in Le Fjord du Saguenay Census Division, Saguenay Lac-St.-Jean Cote-Nord Agricultural Region, and the province of Quebec.

The data show that the number of farms in the four regions fluctuates from year to year, although long-term trends indicate a real decline in the number of farms. Previous studies conducted in Ontario have shown that the number of farms in that province has been declining over time, largely as a result of smaller farms becoming less competitive and being amalgamated into much larger farming operations (Cummings et al, various 1998-2001). This also appears to be the trend in Quebec, where the number of farms in the province decreased by 25.2% between 1981 and 1996. As a result, the decline in farms in St. Ambroise is not likely attributable to the construction and/or operation of the RSI facility, as the number of farms in the area has been in decline since before the plant was built.

The amount of available farmland in St. Ambroise has also been in decline since at least 1986. Declines in St. Ambroise between 1991 and 1996 were consistent with trends in Le Fjord du Saguenay Census Division (-14.9%), and the Saguenay Lac-St. Jean Cote-Nord Census Division (-8.2%), but were contrary to the province of Quebec (+0.8%). Although the area of available farmland across the province of Quebec increased by 0.8% between 1991 and 1996, long-term trends indicate that the amount of farmland in the province is in real decline, having decreased by 8.5% between 1981 and 1996.

As trends in St. Ambroise generally follow those of the province, it can be assumed that the area of farmland and cropland in St. Ambroise is also likely also in decline. As the decline of available farmland and cropland is part of a provincial trend that has been occurring in St. Ambroise since before the RSI facility was constructed, as is illustrated by the Census of Agriculture data, it is unlikely that the facility has contributed to the decrease in available farmland and cropland.

Beef and Dairy cattle are the primary livestock types in St. Ambroise. Although the number of cattle in St. Ambroise increased between 1991 and 1996, the number of head is still lower than that recorded in 1986. The data show that the number of cattle in Quebec is also slowly declining, with the number of head being reduced by 5.6% between 1986 and 1996.

However, as long-term provincial trends indicate cattle inventories are slowly decreasing, and that trends in St. Ambroise generally follow those of the province, it can be safely assumed that cattle inventories in St. Ambroise are also decreasing. As the decrease in cattle inventories is part of a provincial trend that has been occurring in St. Ambroise since before the RSI facility was constructed, it is unlikely that the facility has contributed to changes in cattle inventories.

Farm Gate Sales and Farm Revenue

Farm gate sales in St. Ambroise have fluctuated since 1985. Long-term trends indicate that farm gate sales in Quebec are increasing, having grown by 144.7% between 1980 and 1995. Data from 1998 and 1999 show that farm revenue in St. Ambroise increased since the 1995 farm gate sales reported in the 1996 Census of Agriculture ($12.0 million in 1999 compared with $7.0 million in 1995). As such, it appears that farm gate revenue in St. Ambroise is increasing, a trend that is consistent with the long-term provincial trend.

The data show that farm gate sales and revenue fluctuate from year-to-year, but are steadily increasing in the long term. The fact that farm gate sales and revenue are increasing in spite of fewer farms and shrinking farmland is not an uncommon occurrence. Previous studies conducted in Ontario show that farm gate sales have continued to increase despite declines in the total number of farms and available farmland (Cummings et al, various 1998-2001). In general, farms have become more productive as greater investment in farm capital has replaced labour-intensive agricultural practices. As increases in farm gate sales and revenue is a long-term trend that has been occurring in St. Ambroise since before the RSI facility was constructed, it is unlikely that the facility has contributed to any changes in farm gate sales and revenue in the local area.

Impacts of the RSI Facility on the Consumption of Agricultural Goods

This component incorporates first-hand qualitative information on the perceptions of producers and purchasers towards agricultural products originating from areas that have such facilities. Primary producers from each of the main farm types in the St. Ambroise area, along with major purchasers of agricultural products from the area and Directors of the local Federation of Agriculture (Union des Producteurs Agricoles du Saguenay Lac St-Jean pour la region de Shipshaw-Valin) were identified. Telephone interviews were conducted to determine their attitudes towards products originating from areas with perceived environmental implications as a result of these facilities.

The participants were asked four questions relating to trends in agriculture in St. Ambroise over the past ten years and the effects, if any, of the Récupère Sol Inc. facility on agriculture in the St.

Ambroise area. The following sections summarize the responses provided for each of the questions.

Question 1: Briefly discuss major trends in agriculture in the St. Ambroise region over the past ten years.

Respondents stated that people in St. Ambroise still make their living from agriculture, and that the sector continues to expand with the growing population. Potato production in particular has increased significantly, and blueberry production also continues to increase. They said that although the number of farms has decreased, the sizes of the remaining farms are now significantly larger. Production of meat and dairy products has remained generally the same, although dairy production has experienced a decrease in the past ten years. This decrease, however, was not related to the Récupère Sol Inc. facility.

Question 2: What have been the effects, if any, of the Récupère Sol Inc. (RSI) Thermal Treatment Facility on agriculture in the St. Ambroise region?

The respondents stated that the greatest effect was the division of townspeople into those who supported the Récupère Sol Inc. facility and those who opposed it. Supporters of the facility claimed that it provided jobs to local people. This had some effect on the sales of agricultural products within the community, particularly potatoes and horticultural goods, as some farms lost clients due to differences of opinion with regards to the facility. Meat and dairy production was not as great a concern. The farmers stated however, that these effects were not directly related to the plant itself. On the whole, these effects were short-lived, and had their greatest impact in the first few months that the facility began operation. Since that time the concerns have largely faded away, and there have not been any noticeable impacts on the production or sales of agricultural products within the area.

Respondents felt that from the onset of the project, facility management has not been sufficiently transparent in its processes and follow-up. An example was given of soil samples being taken around the facility, but that the results were not made available to the agricultural community until two years later. Respondents claimed not to have received any documentation or information that would enable them to determine if there was a problem, and that the people initially chosen to be part of the follow-up committee were not directly involved with the issue. As a result, they said that they would not be able to know if there was a problem with the contamination of agricultural land until it was too late.

Question 3: Has the construction or operation of the facility impacted upon farmers' ability to operate their farm-businesses?

Respondents stated that the Récupère Sol Inc. facility was developed on property where a different industry had previously been located. This location is surrounded by forest, and as such there were no physical boundaries that prevented agricultural practices. The only spatial limitations that were presented as a result of the facility were the placement of advertising billboards on some agricultural properties. Farmers in the area are concerned about the possibility of soil contamination, and they have heard that levels of heavy metals in the soil have increased. They stated that they have no information to confirm these concerns, as they don't have access to the soil test results. Although they are not aware of any further physical impacts as a result of the plant, one respondent reported that the smell of ammonia is occasionally noticeable, and comes from the direction of the plant.

Question 4: Has the construction or operation of the facility limited the ability to sell agricultural produce from the St. Ambrose region?

Respondents reported that, when the Récupère Sol Inc. facility started operations, there was a period of three to four months where St. Ambroise agricultural producers had difficulties selling their products, particularly potatoes, in Montreal. They cited rumours that St. Ambroise potatoes were contaminated as a result of the Récupère Sol Inc. facility. These concerns did not last for long however, and no longer influence the sales of potatoes from the area. Meat products were not a concern, as cattle from St. Ambroise were brought to slaughterhouses and were mixed with animals from other areas. As a result, purchasers could not trace meat products back to St. Ambroise. Producers in the area report that the government is presently introducing this concept to develop a law in the next few months so that consumers are able to know the origin of meat in their local supermarkets.

Other Comments and Suggestions

Respondents stated there were no consultations with the public while the project was proposed. One respondent claimed that they first heard about the facility on the radio, after it had been established, and had no opportunity to take part in the planning process. Compounding the problem, they said, was that the agricultural community did not receive results from the Récupère Sol Inc. facility until two years after soil sampling had taken place. Furthermore, there were no baseline data to compare the samples as no sampling took place before the plant was installed. Once it was provided, the data were not always clearly explained to the public.

Respondents suggested that Bennett Environmental Inc. provide a greater level of transparency when developing the Kirkland Lake facility. They suggested that public consultations or public meetings should take place before the project begins. This will help to garner support from local people for the facility. They also suggested that soil samples should always be taken at the same place, to ensure that the changes can actually be noticed, and there should also be a follow-up to inform people of the results.

Summary of Impacts Upon Agriculture in St. Ambroise

Through the review of the agricultural statistics, it appears that the construction and operation of the RSI Thermal Treatment Facility in St. Ambroise has had little to no effect on local agricultural productivity. Trends in the number of farms, availability of cropland, livestock inventories and farm gate sales and revenues are consistent with those experienced in the larger geographic regions within the province, yet outside of the facility's zone of influence. Trends in St. Ambroise agriculture that were identified through the statistical review were confirmed through the interviews with the agriculture community, most notably the increase in farm gate sales and revenue as a result of increased potato production. The interviews also confirmed decreasing levels of dairy production, resulting in smaller inventories of dairy cattle in St. Ambroise. Farmers stated in the interviews that this decline was not a result of the Récupère Sol Inc. facility.

Although there were no substantive economic impacts on local agriculture as a result of the Récupère Sol Inc. facility, there were social impacts in that the community became divided in their support for the facility. This did result in the loss of some local sales of agricultural products within the community. Agriculturalists claimed that the primary reason for initial opposition to the facility (and the resulting division of opinion in the town) was that they were not provided with information regarding soil samples from the Récupère Sol Inc. facility. However, it does not

appear that the division has had any noticeable impacts on the production of agricultural goods, particularly potatoes, beef and dairy products that are the mainstays of St. Ambroise agriculture. St. Ambroise farmers claim that some difficulties in selling their products outside of the area were encountered during the first few months of the facility's operation, but that these were largely due to misinformed perceptions and rumours, and no longer affect the sale of their products.

It is therefore felt that operation of the proposed treatment facility will have a virtually undetectable impact on the quality of meat and dairy products produced in the Kirkland Lake/New Liskeard area.

7.5.3. Disruption of traditional transportation routes for farm machinery and produce resulting from increased truck traffic volumes or events such as road closures due to spills

As part of the bioaccumulation modeling exercise, and as a requirement of the Terms of Reference, fugitive emissions from transport vehicles traveling through the Kirkland Lake agricultural area were to be considered. Envirometrex modeled fugitive emissions from the thermal treatment facility for metal contaminants only since these were deemed to have the greatest potential for fugitive emission release. Therefore, all biotransfer calculations include fugitive emissions from the treatment facility.

With respect to potential fugitive emissions of contaminants from transport vehicles, an analysis of material transport methods determined that fugitive emissions of contaminants from transported material are unlikely to occur. Materials with relatively low concentrations, especially VOCs that can be safely handled in bulk will be transported double-bagged in polyethylene. The plastic will be folded over the soil at the front and back of the transport truck, so as to act like an envelope. In addition, a tarp will be pulled over top of the load and will be cinched and secured to the side, where seals will be placed to ensure nothing escapes or is added to the load en route to the facility. Materials with higher concentrations will be packaged: packaged materials will be accepted in any container that is gas tight so that particulates and volatiles cannot escape. For these reasons, an analysis of potential fugitive emissions from transported material was deemed unnecessary.

7.5.3.1. Contaminant spill modelling

The Terms of Reference require the impact assessment of a potential contaminant spill occurring via the transportation route (Highway 11) when contaminated material is transported through the Study Area. Contaminated soils and solids will be processed at the thermal treatment facility. Therefore, it is likely that the spill area resulting from transport vehicle accidents will be readily contained, as opposed to contaminated liquid spills, which may spread much more rapidly.

Assuming that no crops are grown on the spill site prior to the implementation of mitigation measures, and that farm animals are not allowed near the spill site, or near local surface waters, then the only potential pathway for contaminant bioaccumulation would be groundwater used for animal watering. Therefore, the potential for bioaccumulation from contaminant spills was evaluated by calculating the mass of spilled contaminant leaching into shallow groundwater. This mass was then divided by the volume of infiltrated water to arrive at a contaminant concentration in the drinking water source in mg/L.

The spilled material was assumed to remain on-site for a period of 1 year prior to removal. The leached mass calculated therefore represents the mass of contaminant that may leach to the groundwater over a period of 1 year. The volume of infiltrated rainfall was also assumed to occur over an average year. Since no additional dilution from the existing groundwater was assumed, this method therefore represents a conservative assessment of potential spill contaminant leaching. Contaminant concentrations in spilled material were obtained from examples of typical concentrations found in soil transported to BEI's Récupère Sol facility in Québec. Typically recorded concentrations for each contaminant were used, along with a truck capacity for contaminated material of 38 tonnes. For PCBs, an additional scenario was run using the maximum soil concentration for this parameter that will be accepted at the facility (5000ppm).

Table 7-31 Contaminant Concentrations Used in Transport Spill Modelling

Contaminant	Concentration (ppm)
Chlorophenol	0.0072
PCB	419 or 5000
As	4.46
Cd	0.675
Cr	25.6
Hg	0.1
Pb	50.5
PCDD/PCDF	154.4 (ppt)

Tables 4.9a and 4.9b of Appendix B in Appendix 10 summarize the predicted increases in and total parameter concentrations in beef and milk products, including a hypothetical spill event for which contaminated soil remains on the spill site for a period of 1 year. Resultant changes in predicted increases in parameter concentrations at the 36km SSE distance are minimal, with the greatest change occurring for PCBs, where a spill of 38 tonnes of soil contaminated with a PCB concentration of 419ppm would increase a hypothetical individual's total daily intake from 2.47E-9 mg/kg body weight per day to 1.08E-7 mg/kg body weight per day. A transport truck spill containing the maximum allowable PCB concentration of 5000ppm would only increase a hypothetical individual's daily intake of PCBs to approximately 1.16E-7 mg/kg body weight per day. This value still represents less than 0.5% of all benchmark values. Spill impact potential is therefore estimated to be very low due to the nature of the contaminated product transported and the limited number of pathways (groundwater only) available for exposure to occur.

7.5.4. Potential crop chemical uptake and livestock dosage

As described in Section 7.6.1.2 for existing agricultural environment, the Farm Food Chain module was designed to predict the accumulation of a contaminant in the edible parts of plants from uptake of contaminants in soil and through transpiration and direct deposition of the contaminant in air. Concentrations can be predicted for the three main categories of food crops eaten by humans: exposed fruits and vegetables (i.e., those without protective coverings, such as lettuce), protected vegetables (i.e., those with protective covering such as corn), and root vegetables (i.e., potatoes). In addition the module can estimate the contaminant concentration from the biotransfer of contaminants in feed (i.e., forage, grain and silage), soil, drinking water to beef and dairy cattle through ingestion. Final calculations give a contaminant concentration for each type of plant.

Waste management units (WMUs) release contaminants into the air that then redeposit to the ground, or move through the air, and redeposit on plants by wet or dry deposition. The

contaminant in the soil can then be taken up through a plant's roots. The three mechanisms by which contaminants can bioaccumulate in vegetation are: deposition of particle-bound contaminants to exposed plant tissues, deposition of vapour-phase contaminant to exposed plant tissues, and root uptake.

Accumulation can occur by root uptake of contaminants through water for protected vegetables and fruit grown aboveground or by absorption into the outer parts of the root vegetables. Equations used to calculate total exposed aboveground plant concentration and contaminant concentration in the plant due to direct deposition are included in Sub-Appendix B of Appendix 10 for the EA.

To calculate the maximum risk for beef and dairy cattle, crop uptake is an important consideration in the food chain. The majority of crops grown in the 'Little Clay Belt' region of the Timiskaming District are for the consumption of farm animals, a much smaller percentage being consumed by humans. In addition, this small percentage of crops grown for direct human consumption is often of the protected type (i.e., grain or root vegetables protected from direct deposition), or when an exposed fruit or vegetable, will be subject to rinsing prior to consumption, therefore minimizing the presence of particulate residues. In contrast, farm animals directly consume forage and silage, without similar potential for removal of particulates. The concentrations in the plants were used to determine the 'livestock dosage' value that is required for calculating potential concentrations of chemicals in beef and dairy items that are consumed by humans. This was considered the major pathway for potential bioaccumulation, and, therefore, agricultural impact.

It is important to note that beef and dairy concentrations have been calculated so a 'human dosage' can be determined. Ultimately, it is the resultant human dosage that is to be considered, since human health benchmarks have been developed for the parameters assessed in the bioaccumulation study. Much less research has focused on the development of benchmark dosage levels for livestock. In fact, during the execution of this study, no equivalent benchmark levels for livestock were uncovered in the literature. In addition, when considering that human health benchmarks are often based on chronic exposure to chemical parameters over a lifetime, selection of these benchmarks is, therefore, sufficiently conservative for the agricultural impact study. In contrast, beef or dairy cattle, which are raised for consumption, have a much shorter lifespan. In this context, the importance of applying human health benchmarks to the agricultural impact study becomes clear: such an approach provides for the most conservative evaluation of potential agricultural impacts.

Table 7-32 shows Total Parameter Concentrations in Silage and Forage 36 km SSE of Propose Bennett Facility, including the spill event discussed in section 7.6.3.

Table 7-32 Total Parameter Concentrations in Silage and Forage, and Total Livestock Dosages 36 km SSE of Proposed Bennett Facility, Including Spill Event

Parameter	PDW		Livestock Dosage	
	Silage	Forage	Beef	Dairy
	(mg/kg DW)		(mg/kg BW)*	
Dioxins & Furans	0.000000000231	0.000000000408	0.00000000000548	0.00000000000785
PCB (419ppm)	0.00000203	0.00000411	0.0000000487	0.0000000721
PCB (5000 ppm)	0.00000203	0.00000411	0.000000180	0.000000203
Chlorophenol	0.00000119	0.0000117	0.0000000931	0.000000151
Arsenic	0.000203	0.000298	0.00000331	0.00000511
Beryllium	0.0000400	0.0000612	0.000000677	0.00000104
Cadmium	0.0000480	0.000104	0.000000630	0.00000102
Chromium	0.00282	0.00402	0.0000376	0.0000583
Lead	0.000466	0.00123	0.00000773	0.0000121
Mercury	0.0000811	0.000109	0.000000774	0.00000127
Benzo(a)pyrene	0.0000132	0.0000228	0.000000243	0.000000376
DDT	0.00000151	0.00000303	0.0000000264	0.0000000436
DDD	0.0000302	0.0000603	0.000000519	0.000000863
DDE	0.00000974	0.0000195	0.000000168	0.000000279
Dieldrin	0.00000129	0.00000258	0.0000000223	0.0000000369
Heptachlor	0.0000000112	0.0000000259	0.000000000220	0.000000000364
Benzene	0.0103	0.0146	0.000132	0.000221
Bis (2-Chloroethyl) ether	0.000000532	0.000000722	0.000000888	0.000000892
Chloroform	0.0000118	0.0000166	0.000000150	0.000000251
Trichloroethylene	0.0000390	0.0000544	0.000000491	0.000000822
Vinyl Chloride	0.000000739	0.00000106	0.00000000950	0.0000000159
* A total Body Weight (BW) of 500 kg was assumed for both beef and dairy livestock				

7.5.5. *Effect of air emissions and contaminant distribution/long term accumulations and persistence*

Chemical parameters selected for modeling were largely based on those modeled by the Air Quality Impact Assessment. These included Chlorinated Polycyclic Aromatics (Dioxins & Furans (PCDD and PCDF in Toxic Equivalent Units – modeled jointly), PCBs; Chlorinated Monocyclic Aromatics (Chlorophenols); Metals (Arsenic, Beryllium, Cadmium, Chromium, Lead, Mercury); Polynuclear Aromatic Hydrocarbons (PAHs) (Benzo(a)pyrene); Pesticides (DDT, DDD, DDE, Dieldrin, Heptachlor); and Volatile Organic Chemicals (VOCs) (Benzene, Bis(2-chloroethyl)ether, Chloroform, Trichloroethylene, Vinyl Chloride).

All these parameters were modeled for the Bennett facility to project the potential relative increase in bioaccumulated contaminant concentration stemming from the introduction of such a facility in the Kirkland Lake area. A subset of these parameters was modeled to assess potential bioaccumulation from all sources. The chemical specific variables selected for use in the bioaccumulation calculations are presented in Appendix B of Appendix B to the EA (Tables B1 to B20).

Chemical concentrations and deposition rates modeled by the Air Quality study were predicted at distances south-southeast (SSE) of the proposed facility. It was assumed that these concentrations and rates would be similar at equivalent distances in slightly different cardinal directions. The Air Quality study modeled air quality and deposition rates at distances of 10, 20, 30, 40 and 50 km SSE of the proposed facility. Values at 36km were interpolated from the 30 and 40km data. Values at the 60 and 75 km were extrapolated from the 50km distance data by multiplying the 50km value by a decrease proportional to that produced from 40 to 50km. Since chemical parameter concentrations and deposition rates do not change significantly at these distances, this assumption was considered acceptable.

Bioaccumulation estimates generally show very low increases in parameters of concern concentrations in beef and milk products as a result of the activity of the proposed Bennett thermal treatment facility (Figure 7-18). As expected, all increases in parameter of concern (POC) concentrations and POC dietary intakes decrease as one moves further away from the proposed facility.

A detailed discussion of the results for each parameter grouping is provided in Section 7.6.1.3.

Figure 7-18 Bioaccumulation Isopleths

-external link-

7.5.6. Potential direct surface and groundwater contamination

The Canadian Council of Ministers of the Environment (CCME) provides a summary of Existing Canadian Environmental Quality Guidelines. Specifically, the guidelines present water quality criteria for agricultural livestock for a variety of chemical parameters. For the most part, the Ontario Provincial Water Quality Objectives (PWQOs) are more restrictive than the CCME water guidelines for agricultural livestock. The "Surface and Groundwater Impact Assessment: Potential Impacts and Mitigation Measures" (Appendix 6) details how the proposed Bennett facility does not lead to any exceedances of the PWQO or Ontario Drinking Water Standards (ODWS) for chemical parameters in water bodies.

It has also been established in Section 7.6.5 that increases in concentrations parameters of concern (POC) and POC dietary intakes, as would be introduced by the presence of the proposed facility, decrease as one moves further away from the proposed facility. Therefore, because there is no impact to surface or groundwater in the vicinity of the proposed facility, surface or groundwater quality at a minimum of 36km from the proposed facility will not be impacted by the proposed Bennett facility.

The animal products that were evaluated come from beef and dairy cattle with contaminant concentrations resulting from soil, plant and water ingestion. For the Kirkland Lake agricultural area, it was assumed that animals do not have access to surface water sources. Although some agricultural producers may, in fact, use surface water streams or ponds as a watering source for livestock, streams would experience continuous flushing, thereby not accumulating deposited contaminants. Open surface water ponds, if not connected to stream networks providing flushing, are likely fed from groundwater sources, or are artificially replenished by farm operators. Therefore, potential contaminant concentrations in water fed to livestock were derived from dissolved concentrations in groundwater (as calculated by the Farm Food Chain Module), since the groundwater pathway appears to have a greater potential for accumulation of contaminants.

In the absence of available values from the literature, biotransfer factors for beef cattle and dairy cows were calculated. Very little research has been conducted on the biotransfer of contaminants from water. However, in the absence of such data, the plant biotransfer factors were used.

For the purpose of arriving at a conservative estimate of animal contaminant concentrations, it was assumed that all feed and water consumed by animals originates from the area influenced by the proposed thermal treatment facility.

7.5.7. Potential effects on local agricultural employment and employment income

As demonstrated through the St. Ambroise case study (discussed in Section 7.6.2, the Récupère Sol Inc. soil treatment facility had little to no economic impact upon agriculture in the region. Although the proposed Kirkland Lake facility is larger in scale, it is anticipated that the impacts upon agriculture in the study area should be consistent with those in St. Ambroise. Farmers in the study area will not be inhibited in their abilities to operate their farms by the construction and operation of the proposed Kirkland Lake facility, nor should there by any long-term impacts on their abilities to sell their produce.

Concerns raised by the agricultural community in the study area indicate they are concerned for impacts on agriculture from the proposed facility, but that these concerns are largely limited to the area within 30km of Kirkland Lake. Farmers in the area are placing the onus on Bennett to provide them with accurate information.

Therefore, it is reasonable to expect that there will be little to no negative effect on local agricultural employment and employment income, as long as Bennett and the farming community keep the lines of communication open. Bennett commits to keeping open communications with the Temiskaming Federation of Agriculture so as to try and address any concerns that arise.

7.5.8. Conclusion

The bioaccumulation of contaminants of the routine operation of the proposed treatment facility will have virtually no impact on the quality of meat and dairy products produced in the Kirkland Lake/New Liskeard area. The consumption of agricultural goods from the study area will not impose any appreciable increases in health risk.

A similar case study of the St. Ambroise farming community, in which Bennett's Récupère Sol Inc. thermal treatment facility is located, indicated that there was little to no effect on the local agricultural economy or the productivity of the farms in the area. It is expected that the proposed treatment facility in Kirkland Lake, Temiskaming Region will also have little to no effect on the agriculture sector.

As demonstrated above the Agricultural Impact Assessment was completed pursuant to the approved Terms of Reference describing: the potential contaminant pathways and bio-magnification within food production processes and natural chains; the potential impact to the agricultural resource base and farmer livelihoods by actual or perceived contamination of food by emissions; the disruption of traditional transportation routes for farm machinery and produce resulting from increased truck traffic volumes or events such as road closures due to spills; the potential crop chemical uptake and livestock dosage; effect of air emissions and contaminant distribution/long term accumulations and persistence; the potential direct surface and ground water contamination; and potential effects on local agricultural employment and employment income. For the further detail on agricultural impacts please see Appendix 10, Agricultural Impact Assessment.