Guidance for Odour Impact Assessments and Odour Management for Proposed Oil Sands Projects on Fort McKay's Traditional Territories (Draft- 2021)

Guidance Document Overview and Summary

Oil sands development related odours have been, and continue to be, a major issue for, and of concern to, the Community of Fort McKay. The assessment of the potential odour impacts of proposed oil sands projects on Fort McKay's Traditional Territories both singly, and in combination with other approved and planned projects, is therefore an important component of project EIAs and/or applications.

The Fort McKay Sustainability Department (FMSD), in its review of project applications, has identified what it considers are significant deficiencies with certain elements of the odour impact assessments (OIAs) that are part of a proposed project's EIA and/or application. This Guidance Document has been prepared to provide oil sands developers with guidance on the FMSD's expectations regarding OIAs for proposed projects on Fort McKay's Traditional Territories.

The following is a summary of the specific recommendations/requests in the Guidance Document. The technical basis and rationale for recommendations/requests are outlined in the body of the Guidance Document.

Odorants Assessed in OIAs:

In their assessment of potential project and cumulative development impacts on odours, the proponents of proposed oil sands projects on Fort McKay's Traditional Territories include, but not necessarily be limited to, the odorants listed in Table 1.

Odour Thresholds used in OIAs:

1. ***Proponents of proposed oil sands projects on Fort McKay's Traditional Territories use whenever possible odour thresholds for odorants from Nagata (2003) or another source meeting the Level 1 odour threshold methodology criteria as outlined by the Texas Commission on Environmental Quality.***
2. ***When conducting OIAs, project proponents use the odour thresholds listed in Table 2 for the noted substances unless a more defensible value is available for the "extrapolated" odour thresholds or unless a Level 1 methodology odour threshold is available for those thresholds in the Table that are based on AESRD, AIHA or TCEQ.***

Odorant Mixtures

The proponents of proposed oil sands projects on Fort McKay's Traditional Territories assume that the odour potential of mixtures of odorants is the sum of the odour units i.e. concentration of odorant divided by its odour threshold, of all the individual odorants in the mixture.

Averaging Times for OIAs

1. ***Proponents of proposed oil sands projects on Fort McKay's Traditional Territories use an averaging time of 3 minutes for estimating odour potential i.e. the frequency and duration of odour periods above 1 odour unit.***
2. ***When conducting OIAs, project proponents use a multiplier of 2.6 to convert hourly odour predictions to 3 minute predictions or provide justification for the use of an alternate multiplier.***
3. ***Any deviation from the above averaging period approach be discussed with the FMSD before the OSI is conducted.***

Odour Monitoring and Management

1. ***Develop a source and fugitive odorant-related emissions monitoring and ambient air monitoring program the purpose of which is to verify OIA assumptions and predictions regarding odorant emissions and to guide ongoing management of odorant emission sources;***
2. ***Develop an odour-related community engagement plan that, at a minimum, would involve:***
    a. ***developing an odour notification system/plan that would facilitate both community members notifying the company of any odour issues and allow the company to notify the community of planned or unplanned events that may result in offsite odours; and***
    b. ***engagement of community members in periodic site visits one purpose which would be to get community member feedback on any odours they note or have noted related to the project.***

The FMSD expects proponents of projects on their Traditional Territories to follow the recommendations and requests in the Guidance Document unless they have discussed alternate approaches with the FMSD. The intent is to update the Guidance Document as additional information becomes available and as OIAs evolve.

Introduction

Odours are a major problem in, and concern to, the Community of Fort McKay. Since the 1980s the community has experienced, and continues to experience, detectable levels of odour on a frequent basis. Odour events are not only a nuisance but significantly affect quality of life in the Community. Odours also result in concerns by Community members regarding the possible health effects associated with both the substance(s) responsible for the odours and the other possible non-odorous air contaminants that might also be present during odour events.

The concerns regarding odours have been heightened by periodic extreme odour events in the Community that have resulted in health complaints and issues. These include:

- Syncrude's flue gas desulphurization start-up problems in the spring of 2006;
- Syncrude's diverter stack use event in early 2009; and
- CNRL's Horizon project sulphur recovery unit bypass on August 2, 2012.

All these events resulted in severe odours in the community. The spring 2006 event resulted in some students going to the hospital for treatment[1] and the August 2, 2012 event resulted in several 5-minute average total reduced sulphur (TRS) readings above 100ppb and concerns by some community members that the community should be evacuated.

Odours are also prevalent in many areas of Fort McKay's traditional lands, generally near development sites. This adversely affects Community members' use and enjoyment of the land and further erodes quality of life. Odour occurrences also raise concerns amongst Community members regarding the impact that these odours might have on wildlife in terms of their availability and quality as a food source.

The Community's concerns regarding odours are discussed in detail in the FMSA (2010)[2] which outlines Fort McKay's expectations regarding regional odours which are:

- there should be no detectable odours in the Community under normal industrial operating conditions,
- odour episodes under industrial upset conditions are of short duration and do not create a severe nuisance problem and never represent a health risk, and
- odours on Fort McKay traditional lands outside development areas are very infrequent.

[1] Nikiforuk, A. (2009). Tar Sands: Dirty Oil and the Future of a Continent. Publisher David Suzuki Foundation, ISBN 1553654072, 9781553654070

[2] FMSA. (2010). Fort McKay Specific Assessment-Supplemental Information for the Shell Canada Limited Jackpine Mine Expansion and Pierre River Mine Project Application).Fort McKay Industry Relations Corporation (IRC) March, 2010.

Fort McKay expects that existing oil sands developments, and proposed new or expanded oil sands projects, will be planned, designed and operated to prevent and/or minimize odorant emissions in order to meet these expectations.

The need for improved regional odour management has also been identified by the 2010 Royal Society on Oil Sands[3] which indicated that:

> "*Resolution of the odour problems being caused by oil sands developments is clearly necessary.*"

The report also indicated that:

> "*Although odour has often been considered a nuisance rather than a health effect, chronic odours become a burden on community well-being which ultimately leads to stress with the possibility of associated health effects.*"

In 2016 the Alberta Energy Regulator and Alberta Health released a report entitled: "*Recurrent Human Health Complaints Technical Information Synthesis: Fort McKay Area*"[4] which assessed air related odour and human health issues and had seventeen recommendations to address the identified issues. A Fort McKay Air Quality and Odour Advisory Committee (FMAQOAC) was formed to oversee the implementation of the recommendations which commenced in 2017 and is currently (May 2021) ongoing (see: Improving Air Quality and Odours in Fort McKay | Alberta Energy Regulator (aer.ca). One of the seventeen recommendations (#11) was:

- "*Air dispersion modelling conducted in EPEA approval applications and environmental impact assessments should consider odours generated during project activities. Additional guidance or review of the Air Quality Model Guideline to improve consistency across operators and applications for air dispersion modelling for odours is needed.*"

This Guidance document is consistent with, and supports, this recommendation.

The standardized terms of reference for in-situ and mining oil sands projects (AESRD, 2013)[5] require that project EIAs "…*identify components of the Project that will affect air*

[3] Royal Society of Canada Expert Panel. 2010. Environmental and Health Impacts of Canada's Oil Sands Industry-Report. December 2010 < http://www.rsc.ca/documents/expert/RSC%20report%20complete%20secured%209Mb.pdf>

[4] Alberta Energy Regulator and Alberta Health. (2016). Recurrent Human Health Complaints Technical Information Synthesis: Fort McKay Area. Calgary: Alberta Energy Regulator. Retrieved November 6, 2016, from http://aer.ca/documents/reports/FortMcKay_FINAL.pdf

[5] AESRD. (2013) Environmental Assessment Program: Standardized Terms of Reference.

quality, and describe the potential for reduced air quality (including odours and visibility) resulting from the Project and discuss any implications of the expected air quality for environmental protection and public health."

Many recent oil sands project EIAs have include comprehensive odour impact assessments (OIAs). Fort McKay views this as a positive step towards ensuring that odour issues and management are considered as a regional cumulative effects issue and that proposed new projects assess potential cumulative odour impacts and incorporate best practices for odour control and management.

Purpose of the Guidance Document

The purpose of this document is to provide guidance to companies/consultants regarding the FMSD's expectations with respect to the approaches/methodologies used for certain elements of an OIA. The intent is to try and minimize the potential for concerns and issues regarding OIA methodology and to allow the FMSD's review of OIAs to focus on the acceptability of any predicted odour impacts and the adequacy of proposed odour mitigation measures.

The nature of bitumen extraction operations is such that odours are an inherent part of such facilities and the issue is the frequency, intensity, duration, offensiveness and location (FIDOL) of offsite odours from such facilities. The FMSD recognizes and acknowledges that assessing the potential odour impact of possible multiple odorant emission sources, each consisting of multiple potential odorants, is challenging. This challenge is complicated by the very limited odorant characterization and quantification data for many potential odour emission sources and the transient nature of some of the odorant emission sources.

In its reviews of proposed oil sands projects, and in the Fort McKay Specific Assessment,[6] the FMSD has made, and continues to make, several recommendations to provincial regulators that it considers are necessary to provide the information necessary to support better OIAs and odour management. These recommendations include:

- the development and implementation, in conjunction with industry and other stakeholders, of a detailed and ongoing regional odorant emission source characterization and quantification monitoring program for oil sands related processes and activities that have the potential to result in odorant releases;

Alberta Environment and Sustainable Resource Development Updated January 2013. http://environment.gov.ab.ca/info/library/8126.pdf

[6] FMSA. (2010). Fort McKay Specific Assessment-Supplemental Information for the Shell Canada Limited Jackpine Mine Expansion and Pierre River Mine Project Application).Fort McKay Industry Relations Corporation (IRC) March, 2010.

- the requirement that oil sands operations develop comprehensive plant site fugitive emissions detection, monitoring and characterization programs and associated leak detection and repair/reduction programs;
- the collecting, reviewing and collating of all hydrocarbon and reduced sulphur compound monitoring data that has been generated to date related to mine faces, tailings ponds, fugitive bitumen processing and upgrading emissions and stack emissions;
- the designing and undertaking of an odour study, in consultation with Fort McKay, at key areas within Fort McKay's Traditional Lands, and within the Community of Fort McKay;
- the establishment of a regional odour panel that would be used to help characterize odour events and help relate odour events, associated air quality measurements and possible odorant emission sources;
- the use of the information from the above actions to improve odour modeling and predictions and odour management; and
- the establishment and use of both analytical and human sensory odour-based monitoring at oil sands facilities to manage possible odour emissions and issues.

The FMSD through:

- direct dealings with government regulators and oil sands companies,
- its participation on multi-stakeholder groups like WBEA,
- the FMAQOAC work, and
- community-based monitoring initiatives,

is attempting to have these information deficiency issues addressed.

In its review of recent OIAs the Fort McKay Sustainability Department (FMSD) has also identified a number odour assessment approach and methodology issues that it considers deficiencies. These include:

- different lists of potential odorants being assessed;
- use of different odour thresholds for specific compounds;
- different averaging times for assessing odour impacts;
- different approaches for converting 1-hour modeling predicted values to a shorter averaging periods; and
- different approaches for considering/assessing mixtures of odorants;

This guidance document is focused on these issues. It provides an outline of the approach and methodology that the FMSD would like project proponents to consider/use for each of these issues when undertaking OIAs.

Odorants Assessed

The number of identified odorants used to assess project and cumulative odour impacts varies considerably from EIA to EIA. The FMSD would like to see a standard list of odorants that must be part of OIAs with the discretion for the applicant to add other odorants based on new emission information and/or expected odorant emissions from the proposed project. For cumulative effects assessments it is important that a standard list of regionally relevant odorants be used particularly considering the additive effects of odorants (see "assessing mixtures" for the discussion on this).

The "standard" list of odorants that the FMSD requests be assessed in all OIAs is presented in Table 1. This list is based on:

1. Odorant assessment lists from previous oil sands and, in particular, the odorant assessment list from the STP McKay Thermal Project – Phase 2 (November, 2011)[7];
2. The odorants that have been detected by Fort McKay in at least 3 odour event samples and at a level above 0.1 of a "screening level" odour threshold (see Spink and Dennis, 2010 for a description of this sampling program and the odour thresholds used[8]);
3. Odorants that Fort McKay is aware are associated with some company operations based on personal communication and emission and air quality data provided to the FMSD; and
4. Odorants identified by WBEA's Pneumatic Focusing Gas Chromatograph and associated cartridge sampler ambient air monitoring program[9].

Treating some odorants as a group may be appropriate e.g. thiophenes, if the odour thresholds for the individual odorants in the group are similar.

Table 1: Specific Odorants that the FMSD would like assessed in OIAs for Proposed Oil Sands Projects Located on its Traditional Territories

[7]Southern Pacific Resources Corporation – STP McKay Thermal Project – Phase 2: Energy Resources Conservation Board (ERCB) and Alberta Environment and Water (AEW) Approvals Application (November, 2011)

[8] Spink, D. and Dennis, J. (2010). *Odour Event Air Quality Monitoring in the Community of Fort McKay: A Report on the Fort McKay IRC Odour Event Canister Sampling Program: Background and May 11 and June 1, 2010 – Odour Sampling Results.* Fort McKay Industrial relations Corporation. November, 2010

[9] O'Brien, R.J. (2012). Speciated VOC & SulfurMeasurements at WBEA Station AMSW-01 Summer-Winter, 2011 Quarterly Report for PFGC at Station 1. WBEA http://www.wbea.org/members/reports/human-monitoring-reports

Compound Name	CAS	Mol Formula	Compound Name	CAS	Mol Formula
Benzaldehyde	100-52-7	C7H6O	Dimethyl disulphide	624-92-0	C2H6S2
Nitrogen Dioxide	10102-44-0	NO2	2,3-dimethyl Thiophene	632-16-6	C6H8S
2 ethyl hexanol	104-76-7	C8H18O	2,4-dimethyl Thiophene	638-00-6	C6H8S
Benzene, 1-ethyl-4-methyl-	622-96-8	C9H12	2,5-dimethyl Thiophene	638-02-8	C6H8S
Acrolein	107-02-8	C3H4O	Hexanal	66-25-1	C6H12O
Thiophene	110-02-1	C4H4S	Sulfur dioxide	7446-09-5	O2S
Pentyl mercaptan	110-66-7	C5H12S	Methyl mercaptan	74-93-1	CH4S
Heptanal	111-71-7	C7H14O	Acetaldehyde	75-07-0	C2H4O
Hexanal, 2-ethyl-	123-05-7	C8H16O	Carbon disulphide	75-15-0	CS2
Nonanal	124-19-6	C9H18O	Dimethyl sulphide	75-18-3	C2H6S
Methyl ethyl disulphide	20333-39-5	C3H8S2	Hydrogen sulphide	7783-06-4	H2S
Carbonyl sulphide	463-58-1	COS	Isoprene	78-79-5	C5H8
Isobutyl mercaptan	513-44-0	C4H10S	Methyl ethyl ketone	78-93-3	C4H8O
2-methyl Thiophene	554-14-3	C5H6S	2-ethyl Thiophene	872-55-9	C6H8S
Allyl sulphide	592-88-1	C6H10S	Naphthalene	91-20-3	C10H8
o-Ethyltoluene	611-14-3	C9H12	Dimethyl sulphide	926-09-0	C2H6S
3-methyl Thiophene	616-44-4	C5H6S			

Recommendation/Request: ***In their assessment of potential project and cumulative development impacts on odours, the proponents of proposed oil sands projects on Fort McKay's Traditional Territories include, but not necessarily be limited to, the odorants listed in Table 1.***

Odour Thresholds

In the absence of actual sensory based emission odour characterization data i.e. odour units or dilution to threshold odour values, odour threshold values for the substances of interest or concern must be used to estimate when and where emissions may result in odours being detected.

There are many physical and physiological factors affecting the sensory detection of, and response to, odours. These factors result in a wide range of measured and reported odour thresholds for the same substance with odour thresholds for the same compound varying by as much as 5 orders of magnitude (e.g. odour thresholds for methyl mercaptan (AIHA, 1989[10])). The challenge is therefore to select odour detection limits that will provide a reasonable and realistic indication of whether a compound in air, at a certain concentration, is likely, singly or in combination with other odorants, to result in an odour.

The approach used by the FMSD to develop the odour thresholds used in its odour-event canister sampling program was to review many odour threshold studies and odour threshold reviews/compilations. Based on this review the FMSD selected odour thresholds that were based on a standardized methodology and therefore reproducible.

[10] AIHA. (1989). Odor Thresholds for Chemicals with Established Occupational Health Standards. Fairfax, Virginia: American Industrial Hygiene Association. AEAR89-108, 1989.

The issue of odour threshold reliability and reproducibility has been addressed by the Texas Commission on Environmental Quality (TCEQ, 2010)[11]. The TCEQ identifies the triangle odour bag odour threshold determination methodology used by Nagata (2003)[12] as reliable and reproducible method for determining odour thresholds and where the TCEQ has a "final" odour effect screening level (ESL) it is often based on Nagata (2003)[11]. The FMSD therefore uses odour thresholds for odorants from Nagata (2003)[11] if available and would like OIAs conducted for proposed projects on its Traditional territories to use a similar approach to selecting odour thresholds for OIAs.

Table 2 lists the odour thresholds for the specific odorants that the FMSD would like assessed in OIAs for any proposed oil sands projects located on its Traditional Territories. The references for these proposed odour thresholds are provided at the bottom of the Table. Some of the odour thresholds in Table 2 are based on odour thresholds for other compounds. Where an odour threshold for a compound is not available the FMSD uses an odour threshold (OT) for a similar compound e.g. use OT for diethyl-disulphide for methyl, ethyl-disulphide and for methyl, propyl-disulphide and use OT for thiophene for all thiophenes. If a project proponent finds an odour threshold for one of these OT "extrapolated" compounds that is based on a TCEQ Level 1 methodology then it should be used in the assessment.

In summary, the FMSD would note that, when determining potential odour impacts, scientifically defensible odour thresholds should be used. Regulatory air quality standards or objectives such as the Alberta Ambient air Quality Objectives (AAAQOs)[13] are regulatory instruments not impact determination criteria. Alberta Environment and Sustainable Resource Development[14] has indicated that AAAQOs do not represent "safe" or no impact levels and this generally applies to most jurisdictional standards and objectives. The acceptability of impacts can be considered relative to AAAQOs and other regulatory standards, but cannot, and should not, be used as no impact levels.

In conclusion, it is the FMSD's position that for odour impact determinations to be meaningful, level 1 (see TCEQ (2010)[15]) odour threshold like those from Nagata (2003)[16], need to be used in OIAs.

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[11] TCEQ. (2010). *Interim Guidelines for Setting Odor-Based Effects Screening Levels.* Texas Commission on Environmental Quality. May 28, 2010. http://www.tceq.state.tx.us/assets/public/implementation/tox/esl/guidelines/odor.pdf

[12] Nagata, Y. "Measurement of odor threshold by triangle odor bag method." *Odor Measurement Review, Japan Ministry of the Environment.* 2003. *www.env.go.jp/en/air/odor/olfactory_mm/04ref_2.pdf*.

[13] AESRD. (2013). Alberta Ambient Air Quality Objectives and Guidelines Summary. Alberta Environmenta and Sustainable Resource Development.Issued February 2013. http://environment.alberta.ca/01009.html

[14] Clean Air Strategic Alliance (CASA). (2009*). Priority Setting Workshop Proceedings*. Workshop Hosted by The Clean Air Strategic Alliance For Alberta Environment. March 2009. http://www.casahome.org/Projects/CompletedProjects/PrioritySettingWorkshop.aspx (last visited April 16, 2011)

[15] TCEQ. (2010). *Interim Guidelines for Setting Odor-Based Effects Screening Levels.* Texas Commission on Environmental Quality. May 28, 2010. http://www.tceq.state.tx.us/assets/public/implementation/tox/esl/guidelines/odor.pdf

[16] Nagata, Y. "Measurement of odor threshold by triangle odor bag method." *Odor Measurement Review, Japan Ministry of the Environment.* 2003. *www.env.go.jp/en/air/odor/olfactory_mm/04ref_2.pdf*

Table 2: The Specific Odorants and their Odour Thresholds that the FMSD would like Assessed and Used in OIAs for Proposed Oil Sands Projects Located on its Traditional Territories

Compound Name	CAS	Mol Formula	Conc Units	Odour Threshold (OT)	Basis for OT[1,2,3,4&5]
Benzaldehyde	100-52-7	C7H6O	ppbv	5	Nagata (2003)
Nitrogen Dioxide	10102-44-0	NO2	ppbv	120	Nagata (2003)
2 ethyl hexanol	104-76-7	C8H18O	ppbv	140	TCEQ (2010)
Acrolein	107-02-8	C3H4O	ppbv	3.6	Nagata (2003)
Thiophene	110-02-1	C4H4S	ppbv	0.56	Nagata (2003)
Pentyl mercaptan	110-66-7	C5H12S	ppbv	0.0078	Nagata (2003)
Heptanal	111-71-7	C7H14O	ppbv	50	TCEQ (2012)
Hexanal, 2-ethyl-	123-05-7	C8H16O	ppbv	0.28	Based on n-hexylaldehyde Nagata (2003)
Nonanal	124-19-6	C9H18O	ppbv	0.34	Nagata (2003)
Methyl ethyl disulphide	20333-39-5	C3H8S2	ppbv	2	based on diethyl disulphide (Nagata, 2003)
Carbonyl sulphide	463-58-1	COS	ppbv	55	Nagata (2003)
Isobutyl mercaptan	513-44-0	C4H10S	ppbv	0.0068	Nagata (2003)
2-methyl Thiophene	554-14-3	C5H6S	ppbv	0.56	Based on Thiophene (Nagata, 2003)
Allyl sulphide	592-88-1	C6H10S	ppbv	0.22	Nagata (2003)
o-Ethyltoluene	611-14-3	C9H12	ppbv	0.08	Based on m-xylene (Nagat, 2003)
3-methyl Thiophene	616-44-4	C5H6S	ppbv	0.56	Based on Thiophene (Nagata, 2003)
Benzene, 1-ethyl-4-methyl-	622-96-8	C9H12	ppbv	0.39	Based on p-diethlybenzene (Nagata, 2003)
Dimethyl disulphide	624-92-0	C2H6S2	ppbv	0.2	Nagata (2003)
2,3-dimethyl Thiophene	632-16-6	C6H8S	ppbv	0.56	Based on Thiophene (Nagata, 2003)
2,4-dimethyl Thiophene	638-00-6	C6H8S	ppbv	0.56	Based on Thiophene (Nagata, 2003)
2,5-dimethyl Thiophene	638-02-8	C6H8S	ppbv	0.56	Based on Thiophene (Nagata, 2003)
Hexanal	66-25-1	C6H12O	ppbv	20	TCEQ (2010)
Sulfur dioxide	7446-09-5	O2S	ppbv	870	Nagata (2003)
Methyl mercaptan	74-93-1	CH4S	ppbv	0.07	Nagata (2003)
Acetaldehyde	75-07-0	C2H4O	ppbv	1.5	Nagata (2003)
Carbon disulphide	75-15-0	CS2	ppbv	10	AESRD (2013)
Dimethyl sulphide	75-18-3	C2H6S	ppbv	1	Nagata (2003)
Hydrogen sulphide	7783-06-4	H2S	ppbv	0.41	Nagata (2003)
Isoprene (1,3-Butadiene, 2-methyl-)	78-79-5	C5H8	ppbv	5	TCEQ (2012)
Methyl ethyl ketone	78-93-3	C4H8O	ppbv	8.5	TCEQ (2012)
2-ethyl Thiophene	872-55-9	C6H8S	ppbv	0.56	Based on Thiophene (Nagata, 2003)
Naphthalene	91-20-3	C10H8	ppbv	38	AIHA (1989)
Dimethyl sulphide	926-09-0	C2H6S	ppbv	3	Nagata (2003)

[1] Nagata, Y. "Measurement of odor threshold by triangle odor bag method." Odor Measurement Review, Japan Ministry of the Environment. 2003. www.env.go.jp/en/air/odor/olfactory_mm/04ref_2.pdf.

[2] TCEQ. (2010). Uses of Effects Screening Levels (ESLs) and Air Monitoring Comparison Values (AMCVs). Texas Commission on Environmental Quality. May, 2010. http://www.tceq.state.tx.us/assets/public/implementation/tox/monitoring/amcv/document.doc

[3] TCEQ. (2012). March 2012 Effects Screening Levels. http://www.tceq.texas.gov/toxicology/esl/list_main.html/ and Air Monitoring Comparison Values. http://www.tceq.texas.gov/toxicology/AirToxics.html

[4] AESRD. (2013). Alberta Ambient Air Quality Objectives and Guidelines Summary. Alberta Environmenta and Sustainable Resource Development.Issued February 2013. http://environment.alberta.ca/01009.html

[5] AIHA. (1989). Odor Thresholds for Chemicals with Established Occupational Health Standards. Fairfax, Virginia: American Industrial Hygiene Association. AEAR89-108, 1989.

Recommendation/Request:

1. ***Proponents of proposed oil sands projects on Fort McKay's Traditional Territories use, whenever possible, odour thresholds for odorants from Nagata***

(2003)[15]or another source meeting the Level 1 odour threshold methodology criteria as outlined by the Texas Commission on Environmental Quality[14].

2. ***When conducting OIAs, project proponents use the odour thresholds listed in Table 2 for the noted substances unless a more defensible value is available for the "extrapolated" odour thresholds or unless a Level 1 methodology odour threshold is available for those thresholds in the Table that are based on AESRD, AIHA or TCEQ.***

Odorant Mixtures

Oil sands developments have several emission sources which can contain a broad spectrum of volatile organic compounds (VOCs) and reduced sulphur compounds (RSCs). On an individual compound basis many of these VOCs and RSCs are odourous. The question or issue is how mixtures of odorants behave and how mixtures should be assessed in OIAs?

Most EIAs treat odorants singly which is not the way odorants behave when in mixtures. At lower concentrations, i.e. near or below their odour threshold levels, the literature would indicate that the effects of individual odorants are additive[17,1819,20,21,22&23] (see reference 21 for a summary on this issue).

Regarding odours associated with complex mixtures and odour units, Schiffman et al. (2001)[24], in a study on odours from swine operations, noted that:

> "*The compounds identified were diverse, and included many acids, alcohols, aldehydes, amides, amines, aromatics, esters, ethers, fixed gases, halogenated hydrocarbons, hydrocarbons, ketones, nitriles, other nitrogen-containing compounds, phenols, sulfur-containing compounds, steroids, and other compounds. The vast majority of these compounds were present at concentrations below published odor and irritation*

[17] Rosen, A.A., Peter, J.B. and Middletone, F.M. (1962). Odor Thresholds of Mixed Organic Chemicals Water Pollution Control Federation, Vol. 34, No. 1 pp. 7-14

[18] Guadagni, D.G., Miers, J.C. and Venstrom. (1969). Concentration Effect on Odor Addition or Synergism in Mixtures of Methyl Sulfide and Tomato Juice. Journal of Food Science. Volume 34, Issue 6 pages 630–632, November 1969

[19] Cometto-Muniz, J.E., Cain, W.S. and Abraham, M.H. (2004). Detection of single and mixed VOCs by smell and sensory irritation. *Indoor Air 2004:14 (Suppl 8): 108-117*

[20] Kim, K-H and Park, S-Y. (2008). A comparative analysis of malodor samples between direct (olfactometry) and indirect (instrumental) methods. Atmospheric Environment: 42 (2008) 5061-5070

[21] Laska, M. and Hudson, R. 1991. A comparison of the detection thresholds of odour mixtures and their components. Chem. Senses (1991) 16 (6): 651-662.

[22]Miyazawa, T., Gallagher, M., Preti, G. and Wise, P. M.2008. The Impact of Subthreshold Carboxylic Acids on the Odor Intensity of Suprathreshold Flavor Compounds.
Chem. Percept. 1:163–167

[23] Berglund, B. and Olsson, M. J. 1993.Odor-Intensity Interaction in Binary Mixtures.
Journal or Experimental Psychology: Human Perception and Performance. Vol. 19. No. 2. 302-314

[24] Schiffman, S.S., Bennett, J.L. and Raymer, J.H. (2001). Quantification of odors and odorants from swine operations in North Carolina. *Agriculture and Forest Meteorology 108 (2001) 213-240.*

thresholds. Yet human assessments indicated that odors (and irritant sensations) in the immediate vicinity of the swine houses (and even at distances beyond 1000ft) were strong. Comparison of the findings from chemical and human assessment points to the importance of the cumulative effects of hundreds of compounds in producing odor and irritation downwind of swine operations."

This study found very high odour unit levels e.g. >200, based on an odour panel, despite concentrations of most compounds being below reported odour threshold levels and generally in the low ppb or ppt concentration range. This study used odour thresholds that were generally quite high relative to those determined by Nagata (2003) which likely resulted in an underestimation of the potential odour contribution of individual compounds. However, even using lower odour thresholds for the compounds identified, the only plausible explanation for the high odours measures is that the effect of the odorants was additive. The variety of aliphatic and aromatic hydrocarbons, ketones, aldehydes and reduced sulphur compounds associated with oil sands operations creates a similar "odorant mixture" type situation in the Fort McMurray area.

Fort McKay's odour event canister sampling canister sampling has similarly conducted detailed chemical characterization of air quality during odour events with generally all or most potential odorants measured at below odour threshold levels yet very strong odours are nevertheless present. Using an additive approach for identified odorants results in odour level estimates that are consistent with, and explain, the observed sensory-based odour levels.

One EIA OIA [25] reviewed by the FMSD calculated odour units (OUs) for odorant emission sources based on odour thresholds and a straight additive effects assumption. The emission and dispersion of OUs were then modeled with predicted ground-level OUs used to assess the potential for odour issues. This approach represents an alternative to modeling individual odorants in emission sources and then converting the predicted individual ground-level odorant concentrations into odour potential based on odour thresholds and an additive odorant effect of individual odorants.

The FMSD supports the use of either of these approaches provided the odour thresholds used are as per the above "odour threshold" guidance and provided mixtures of odorants are assumed to be additive.

In summary the FMSD requests that an OIA consider the cumulative effect of all odorants in a mixture and that an additive approach based on odour thresholds be used as per the approach outlined by Kim and Park (2008)[26].

[25] MEG (2012). Application for Approval of the Surmont Project. MEG Energy Corp. (MEG) September 2012.
[26] Kim, K-H and Park, S-Y. (2008). A comparative analysis of malodor samples between direct (olfactometry) and indirect (instrumental) methods. Atmospheric Environment: 42 (2008) 5061-5070

Recommendation/Request: ***The proponents of proposed oil sands projects on Fort McKay's Traditional Territories assume that the odour potential of mixtures of odorants is the sum of the odour units i.e. the sum of the individual concentration of each odorant divided by its odour threshold.***

Averaging Period

For most air contaminants the minimum assessment or averaging period is 1-hour and air quality modeling generally provides air quality predictions for a minimum period of 1-hour. Since odours can be detected in a few breaths i.e. over the space of less than a minute, it is necessary to use averaging periods much shorter than an hour in order to assess the potential for detectable odours and related odour impacts. The issue is what is an appropriate averaging period and what approach should be used to covert 1-hour predictions to this appropriate averaging period?

Angle and Spink (2012)[27] in a review of an oil sands project application noted that:

> *"Odours are detectable in a single breath (about 4 seconds) or two breaths. Concentrations downwind of a pollution source will fluctuate over a wide range as a result of turbulence as shown in Figure 2. Short period concentrations can be much larger than the nominal 1-h averaging periods used to report monitoring data and make modelling predictions. The difference between the sampling time for human noses and the sampling time for ambient air monitors or model predictions has been represented as the Peak-to-Mean ratio. Many formulas have been proposed to estimate the Peak-to-Mean ratios, which can often include dependence of such variables as source height, source type, atmospheric stability, and receptor location relative to the source.* It has been noted that: "*Thirty-second concentrations are often 4-10 times the corresponding 1-h average and many odor analysts multiply the 1-h model estimates by 10 to 20*.[28]*"*

[27] Angle, R. and Spink, D. (2012). Air Review of Application for Approval of the Peace River Oil Sands Carmon Creek Project Submitted by Shell Canada Limited to the Energy Resources Conservation Board and Alberta Environment, November 2009. For D. S. Environmental. March 2012.

[28]Turner, D.B. and Schulze, R.H. (2007). Practical Guide to Atmospheric Dispersion Modeling. Air and Waste Management Association

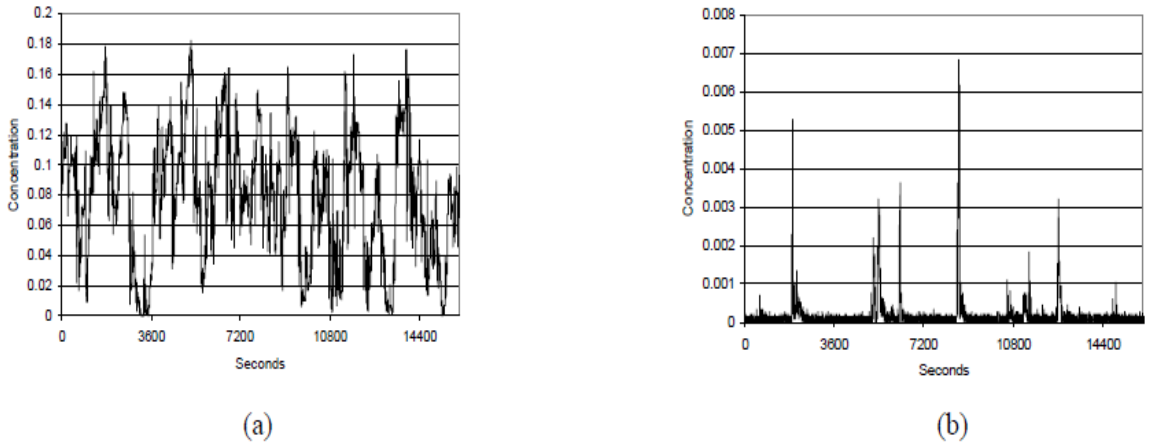

Figure 1. Concentration time-series from wind tunnel simulations of an (a) area and (b) elevated point source, for 1000m downwind of the source in neutral stability[29]

In some EIAs[30,31,32&33] a short term averaging time of 3 minutes has been used and the 9th highest hourly concentration has been converted to a 3 minute average based on an "*averaging period-conversion factors*" equation of the form recommended by the Ontario Ministry of Environment[34]. The equation has the form:

$C_x = C_{60}$ x (60 minutes/x minutes)^a

Where:

"C_x" is the shorter-term averaging time e.g. the three-minute peak concentration;
"C_{60}" is the predicted one-hour concentration; and
"*a*" is an atmospheric stability dependent exponent.

In the above noted EIAs the exponent "*a*" used has varied from 0.2 to 0.32 giving a range of multipliers for converting 1-hour values to 3 minute values of 1.82 to 2.6.

It is the FMSD's position that a standard approach for converting 1-hour odour predictions to a specified, and shorter, averaging time should be used.

[29] Best, P.R., Lunney, K.E. and Killip, C. A. (2001). Statistical elements of predicting the impact of a variety of odour sources. 2001. Water Science and Technology, Australia, 44: 9 pp 157-164
[30] Dover Commercial Project. (2010). EPEA and Water Act Applications. December 2010
[31] Southern Pacific Resources Corp. (2011). STP McKay Thermal Project - Phase 2 Application for Approval November 2011
[32] Teck and Silver Birch Energy. (2011). Application for Approval of the Frontier Oil Dands Mine Project (Frontier Project). November 24, 2011.
[33] MEG (2012). Application for Approval of the Surmont Project. MEG Energy Corp. (MEG) September 2012.
[34]Ontario Ministry of Environment. 2009. Air Dispersion Modelling Guideline for Ontario http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079138.pdf

Recommendation/Request:

1. ***Proponents of proposed oil sands projects on Fort McKay's Traditional Territories use an averaging time of 3-minutes for estimating odour potential i.e. the frequency and duration of odour periods above 1 odour unit.***
2. ***When conducting OIAs, project proponents use a multiplier of 2.6 to convert hourly odour predictions to 3-minute predictions.***
3. ***Any deviation from the above averaging period approach be discussed with the FMSD before the OSI is conducted.***

Odour Monitoring and Management

The FMSD expects that in OIAs odour monitoring and management options will be identified. The sensory nature of odour issues makes it important that there be a strong human component to the monitoring and reporting on odours and in determining whether odours are an issue with the project alone or cumulatively with other projects. There is also considerable uncertainty regarding the odorant makeup and character of most emission sources in the region with fugitive emissions and plant upsets often cited as a major potential source of odours.

More and better odour related monitoring and direct involvement of Fort McKay community members in assessing project and cumulative issues are therefore issues the FMSD would like addressed in project OIAs.

Recommendation/Request that Proponents of proposed oil sands projects on Fort McKay's Traditional Territories as part of an OIA:

1. ***develop a source and fugitive odorant-related emissions monitoring and ambient air monitoring the purpose of which is to verify OIA assumptions and predictions regarding odorant emissions and to guide ongoing management of odorant emission sources;***
2. ***develop an odour-related community engagement plan, that at a minimum, would involve developing an odour notification system/plan that:***
    a. ***would facilitate both community members notifying the company of any odour issues and allow the company to notify the community of planned or unplanned events that may result in offsite odours; and***
    b. ***would engage community members in periodic site visits one purpose which would be to get community member feedback on any odours they note or have noted related to the project.***

Summary

Odour issues have been, and continue to be, a major issue for the Community of Fort McKay and its residents. Odours are therefore considered one the most important potential air-

related impacts associated with existing and proposed regional industrial oil sands development. OIAs are one tool for identifying potential project and cumulative development related odour issues and for developing mitigation strategies to address identified potential odour issues. The FMSD has developed this Guidance Document to assist project proponents in conducting OIAs by outlining its expectations with respect to certain elements of OIAs.

The FMSD recognizes that OIAs are in their infancy in terms of oil sands developments and have been, and are, evolving. As part of this evolution the FMSD expects advances in the knowledge and understanding related to regional odour issues and recognizes that this will impact the relevance and appropriateness of some of the recommendations/requests in this Guidance Document. Nevertheless, the FMSD expects proponents of projects on their Traditional Territories to follow the recommendations and requests in the Guidance Document unless they have discussed alternate approaches with the FMSD.

Comments on, and suggested revisions to, the Guidance Document are welcome and should be provided to:

Ryan Abel
Senior Manager - Environmental & Regulatory Affairs
Fort McKay First Nation
<contact information removed>