



Environment Environnement
Canada Canada

Environmental Protection Operations
Environmental Stewardship Branch
Pacific and Yukon
201 - 401 Burrard Street
Vancouver, BC V6C 3S5

August 17, 2011

CEAR: 10-01-53860
ECPT: 09-0307

Kathy Eichenberger
Project Assessment Manager
Environmental Assessment Office
2nd Fl., 836 Yates Street
Victoria, BC V8W 1L8

Dear Ms. Eichenberger:

Re: Environmental Assessment of the Proposed Vancouver Airport Fuel Delivery Project – Environment Canada Comments on Supplements and July 2011 Issues Tracking Table

Environment Canada has reviewed the following information provided to the working group by the BC Environmental Assessment Office on July 6, 2011:

- Issues Tracking Table (dated July 5, 2011)
- Supplement 3 – Review of Biofilms Relative to Modelled Fuel Spills in the Fraser River Associated With the Proposed VAFF Marine Terminal
- Supplement 4 – Toxicity of the Dissolved Constituents of Jet Fuel in Water.

Please find Environment Canada's comments and recommendations on these documents below.

Further to these, and in response to the department's commitment made at the April 5-6, 2011 working group meetings, Environment Canada is also providing a proposal to enhance the current understanding of the environmental fate and effects of jet fuel, as follows, for review and comment by the working group and proponent.

Environment Canada also notes that due to the complexity of the issues associated with the proposed project, our concerns and recommendations as outlined below cannot be considered exhaustive at this time. As the environmental assessment continues, Environment Canada may provide additional technical review comments and recommendations.

Environment Canada Fate and Effects Proposal

In the Pre-Application and Application phases of the environmental assessment for the Vancouver Airport Fuel Delivery Project (Project), Environment Canada has consistently expressed a number of concerns with the proposed Project (see also our letter of March 23, 2011). In summary, Environment Canada is of the view that:

- The Project would present a new and unacceptable risk to the locally, nationally and internationally important fish and wildlife populations of the Fraser River Estuary, including migratory birds and species at risk;
- There exists a high level of uncertainty, due the lack of credible, peer-reviewed science, regarding the potential effects of acute and chronic spills of Jet-A fuel to migratory birds and their associated habitats, including biofilm; and,
- Based on its mandate for, and operational experience with responding to environmental emergencies, Environment Canada is of the opinion that there is limited ability with currently available technologies to effectively control a potential Jet-A fuel spill in the Fraser River Estuary.

During the April 5-6, 2011 working group meetings in Vancouver, Environment Canada expressed a willingness to work with the proponent to begin addressing some of the most critical science gaps in the understanding of potential environmental fate pathways of Jet-A fuel to biofilm, as well as the effects to biofilm in the event of a spill. Since then, the department has drafted a proposal (as attached) outlining potential studies that could be undertaken, in collaboration with the proponent, at Environment Canada's Pacific and Yukon Laboratory for Environmental Testing (PYLET) in North Vancouver. For additional clarity, the primary objectives of the proposal are two-fold:

1. To determine what fraction, if any, of spilled Jet-A fuel would adhere to particles/sediments in the water column as opposed to dissolving; and,
2. To improve overall understanding of the potential toxicity of spilled Jet-A fuel, particularly as a consequence of exposures that may result from that fuel that adheres to particles/sediments.

In addition to the PYLET proposal, which presents an analytical approach for addressing baseline questions, Environment Canada is actively investigating how to address the outstanding questions regarding the potential effects of jet fuel, including potential impacts to biofilm dynamics and recovery, and on the propensity for contaminated biofilm to transfer toxins to migratory birds.

For additional context, the need for greater understanding and certainty with regards to the potential pathways to and impacts of Jet Fuel A on biofilm relates directly to the mandate of Environment Canada under the *Migratory Birds Convention Act* (1994). Specifically, the Act prohibits the deposition of harmful substances into waters or areas frequented by migratory birds¹.

Environment Canada advises that the results of these credible, science-based studies, which would broadly involve gathering empirically-derived information, further modeling and

¹ 5.1 (1) No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area.

(2) No person or vessel shall deposit a substance or permit a substance to be deposited in any place if the substance, in combination with one or more substances, results in a substance — in waters or an area frequented by migratory birds or in a place from which it may enter such waters or such an area — that is harmful to migratory birds.

monitoring, are needed in support of the Project environmental assessment. As consistently stated, the department recommends a collaborative approach, the results of which would aim to reduce uncertainty, and therefore risk, and by which to provide for informed decision-making. In support of a timely environmental assessment conclusion, it is critical that agreement be reached on these science studies as soon as possible. We welcome the opportunity to meet with the proponent such that a mutually satisfactory path forward can be reached.

Issues Tracking Table and Supplemental Information

As noted, Environment Canada has reviewed the following information provided to the working group by the BC Environmental Assessment Office on July 6, 2011:

- Issues Tracking Table (dated July 5, 2011)
- Supplement 3 – Review of Biofilms Relative to Modelled Fuel Spills in the Fraser River Associated With the Proposed VAFF Marine Terminal
- Supplement 4 – Toxicity of the Dissolved Constituents of Jet Fuel in Water.

Please find Environment Canada's comments and recommendations on these documents below.

Issues Tracking Table

11a No further comment.

11b For clarity, the Project would be precedent-setting in the bulk transport and storage of hydrocarbon-based fuel, for that sole purpose, into the Fraser River Estuary. While it is noted that the proponent proposes a comprehensive spill response plan, as previously stated, both above and in our letter of March 23, 2011, Environment Canada does not have confidence that any such plan would effectively and reliably protect the high ecological values and sensitivities of the estuary from catastrophic or chronic fuel spills.

It is, however, Environment Canada's understanding, following the April 5, 2011 meeting, that the proponent will be providing the working group with a more detailed spill response plan prior to the completion of the environmental assessment, in addition to a more detailed spill response analysis. Upon receipt of both documents Environment Canada will be in a position to comment further on specific aspects of the plan.

11c Refer to the response provided under 11b.

11d Environment Canada seeks clarification as to how introducing Panamax class tankers into the Fraser River Estuary would reduce overall shipping risk?

11e The conservative risk assessment is noted in terms of the likelihood of a spill; however, we do not agree that the overall Project assessment is conservative – or even accurate – in its evaluation of the spill response plan to effectively and reliably protect the ecological values and sensitivities of the Fraser River Estuary. As noted above, upon receipt of the more detailed spill response plan and spill response analysis, Environment Canada will be in a position to comment further.

11f Environment Canada is referring to Table 23.3.2. As stated above, there is uncertainty due to existing science gaps in baseline knowledge on jet fuel fate and effects. Also previously

stated, the department does not share the same confidence as the proponent that the spill response plan would effectively and reliably protect the high ecological values and sensitivities of the estuary. Under ideal conditions spill recovery is challenging, with inevitable loss of product. The dynamic nature of the Fraser River, which the proponent is undoubtedly aware, would further limit the effectiveness of any proposed spill response. We will be in a position to comment further upon receipt of the above-mentioned spill response documents.

11g No further comment.

11h The chronic loss of product remains a concern. The proponent's argument that there would no spills of any kind is contrary to the statistics provided in the Application, and is an overly optimistic position that Environment Canada, based on its experience, does not share.

11i It appears that the proponent has misinterpreted Environment Canada's comment, which is referring to a pipeline spill to a body of water. For additional clarification: the Application indicates (page 16-27) that 'Corrosion' is responsible for 11% of all spills from pipelines, and assigns a probability level of 1-2% for a spill event (which means a spill is likely to occur between 20-100 years as a result of corrosion or related effects). While spills from pipelines clearly do occur within the 20 year timeframe, over the lifetime of the Project, a consequence level of 4 (far less severe than the cited Pine River spill) to a body of water would result in a Low (4) to Moderate (4) rating in the Risk Matrix (Table 16.3.5). On this basis, we do not agree with the proponent's risk assessment generally for pipeline spills to a body of water (as a result of corrosion, third party, or other effects).

11j No further comment.

11k Based on the proponent's response, which remains open-ended, it is our interpretation that the Project could be adapted to accommodate other fuel types, which might arise in response to market-driven demands.

Further to responses offered above, and as a general comment, Environment Canada observes that while the high level of uncertainty regarding the potential impacts of acute and chronic spills of aviation fuel to migratory birds and associated habitats is acknowledged, the proponent continues to contend that the Project would not cause the loss of any product (despite industry statistics) and, if product was released, a spill response plan would reduce the consequences to 'acceptable levels'. Unfortunately, this approach misses Environment Canada's key concern, which, (for emphasis) relates to the consequences of a spill event, despite the relatively low risk levels associated with the occurrence of such events (noting the risk assessment is also being questioned). Information provided in the Application does not address this key concern; to be clear, no amount of professional opinion can replace the existing and significant science gaps on the pathways and effects of Jet-A fuel on the receiving environment. On this basis, Environment Canada recommends that a rigorous, science-based program be developed to address the critical uncertainties and, therefore, risks associated with the Project. The department has taken steps prior to and during this environmental assessment process to assist the proponent in this matter, and, as above, would welcome the opportunity to meet with the proponent to find a mutually satisfactory path forward.

11l No further comment.

11m As noted in Environment Canada's original comment, the proponent refers to secondary containment in relation to both reasonably foreseeable and catastrophic product loss. Particularly for the latter scenario, secondary containment is not guaranteed.

11n No further comment.

11o Acknowledged.

11p-q No further comment.

11r Environment Canada notes that the view of the proponent with regards to routine activities on the lower Fraser River is at odds with the views of both the department and Port Metro Vancouver.

11s-t As previously stated, the department does not share the same confidence as the proponent that the spill response plan would effectively and reliably protect the high ecological values and sensitivities of the estuary. Under ideal conditions spill recovery is challenging, with inevitable loss of product. With reference to booming specifically, we note that the effectiveness of these systems drops significantly in currents of more than 0.5 knots. The dynamic nature of the Fraser River would therefore further limit the effectiveness of any proposed spill response.

Also refer to the second part of our response provided under 11b.

11u Refer to the responses provided under 11e.

11v, w, y and 11 aa Environment Canada recognizes that the fuel receiving and storage facilities at YVR are not part of the Project as outlined for the purposes of the environmental assessment. Nevertheless, the YVR facilities will be inextricably linked, and must therefore have coordinated spill response plans, to those of the proposed Project. Environment Canada therefore requests copies of the existing spill response plans for the facilities at YVR to assist in our review of the forthcoming plan and spill analysis for the Project currently under review.

11x No further comment.

11z-ab As noted above, upon receipt of the more detailed spill response plan and spill response analysis, Environment Canada will be in a position to comment further on the specifics of the plan. Subsequent to this, we would welcome a dialogue with the proponent regarding the plan.

11ac The proponent has misinterpreted Environment Canada's response. The department does not support a habitat compensation plan (HCP) in the context of a fuel spill. Such occurrences are subject to enforcement action as described through the links previously provided. A HCP is recommended in circumstances where Project impacts to habitats, including wetlands and riparian areas, as a result of, for example, the terminal footprint, pipeline footprint, access, etc, cannot be avoided. We recommend the proponent review the information available through the links previously forwarded to better gauge the need for a HCP.

11ad No further comment.

11ae Environment Canada recommends the development of a rigorous, science-based plan to address uncertainty and associated risk.

11af Environment Canada notes the gaps within Moody (1990) (e.g., identification of the source, spill volume and extent), and the proponent's assumptions in this regard. We recommend the proponent contact the author to follow up on the report and its findings, as they relate to the potential impacts of the proposed Project.

11ag Please refer to Environment Canada's general comment following our response above for 11k.

11ah (1) Environment Canada generally agrees with the proponent's view that biofilms are '*found throughout the study area*'. However, even if biofilms are broadly distributed, this does not mean they are available to shorebirds. To suggest so is speculative in the absence of supporting data. Please also refer to our comments below for Supplement 3. (2) Environment Canada questions the accuracy of the statement that, '*fuel would be substantially weathered*', given that, for example, a spill downstream of the proposed terminal would reach Sand Heads Lighthouse in 8 hours (and for upstream areas upstream, including the South Arm marshes, in approximately half that time).

11ai Environment Canada recommends the development of a rigorous, science-based plan to address uncertainty and associated risk.

11aj Environment Canada would like to note that while there may be both direct and indirect impacts to migratory birds and their habitats, and while we acknowledge that these may be difficult to assign, the terms direct and indirect simply describe the pathway of impact, and in no way diminish the potential seriousness or significance of the resulting effect.

11ak The Application states that, '*It is estimated that most fuel entering the marsh would dissipate in a matter of days to weeks but some residual fuel may remain attached to the vegetation canopy, exposed root masses and peat for months*', whereas the response provided in the Tracking Table states that, '*Persistence is likely...*'. These statements are inconsistent, and highlight the scientific uncertainties and associated risks surrounding the impacts of Jet-A fuel on the receiving environment.

Environment Canada notes that the Moody (1990) report states that, '*By September, there were still many areas within the zone of high impact which had no vegetative growth, and only 10% of the sediment area was occupied by vegetation. Fuel was still seeping from the sediments in many locations leaving a distinct film on the incoming tide*'. This indicates that after (a minimum) five months from the time of the spill, there remained clear evidence of product in the affected area. The report also indicates (page 22) that the extent and rate of plant recovery remained uncertain, and questioned whether the pre-spill ecological role of the affected plant communities would return at all. The proponent has failed to acknowledge in its response that a spill involving Jet-A fuel has the potential to persist longer than the Application purports, and that the ecological effects could extend across years, not just days, weeks and months. Environment Canada advises that a more credible approach to addressing these uncertainties is to acknowledge the lack of understanding on these issues, and seek a credible, science-based approach to address uncertainty and associated risk.

11al Environment Canada recommends the development of a rigorous, science-based plan to address uncertainty and associated risk.

11am Following review of the findings of Moody (1990) Environment Canada strongly suggests that Table 19.3.10 should be revisited with respect to Vegetation Damage/Injury and Loss/Mortality. Our evaluation is that the effects of a worst case spill to marsh habitats of the South Arm and Ladner Slough would likely be significant. Additionally, effects to wildlife, including migratory birds, that depend on such habitats, whether to breed, stage and/or forage, also needs to be re-evaluated.

11an (a) It is unclear why the proponent is referring to Chapter 22 Cumulative Environmental Effects in this response. Environment Canada is referring to Chapter 19 Table 19.3.20, and has applied the same significance criteria as shown in that table (magnitude, geographic extent, frequency, duration/recovery time, and VEC resilience); (b) Environment Canada disagrees that potential effects to the Great Blue Heron would not be potentially significant. In this context, we also disagree with the use of the phrase *‘temporary loss of habitat’* unless it can be more clearly defined (refer response under 11ak, for example); (c) Acknowledged; (d) No further comment; (e) (f) (g) Acknowledged.

11ao As previously stated, Environment Canada does not have the same level of confidence as the proponent in a spill response plan to effectively and reliably protect the high ecological values and sensitivities of the Fraser River Estuary. Upon receipt of the more detailed spill response plan and spill response analysis, Environment Canada will be in a position to comment further.

With reference to wildlife hazing, while the merits of issuing a federal hazing permit must always be considered on a case-by-case basis, the *a priori* approach of adopting this as a mitigation measure for the proposed Project is controversial to say the least.

11ap-aq Based on the proponent’s response, Environment Canada advises that where potential impacts to habitats are identified, the development of a HCP is recommended. Please also refer to the response provided under 11ac.

11ar Refer to the first part of the response provided under 11ao.

11 as-11 aw To clarify, the information provided by Environment Canada relates directly to the legislation and policies under which the department is mandated. The information is not a ‘view’ of Environment Canada, as reflected in the proponent’s response.

11ax-ay Please refer to Environment Canada’s general comment following our response above for 11k.

11az It is unclear why the proponent has directed Environment Canada to the response provided for comment 4f. Please clarify.

11aaa No further comment.

19d, 20a, 20e, 20 g It is Environment Canada’s understanding, following the April 5, 2011 meeting, that the proponent will be providing the working group with a more detailed spill response plan prior to the completion of the environmental assessment, in addition to a more detailed spill response analysis. Upon receipt of the documents Environment Canada will be in a position to comment further.

20b Please refer to Environment Canada’s comments on Supplement 4 below.

Supplemental Information

Environment Canada considers Supplements 3 (on biofilm) and 4 (on jet fuel toxicity) provided for review to be particularly important in this environmental assessment process, as the models and information are being used to predict and interpret environmental conditions and qualities in the event of a jet fuel spill in the Fraser River Estuary – one of, if not the most important area for migratory birds in Canada.

We, however, do not support the conclusions drawn in these two Supplements. As acknowledged by the proponent, the significant gaps in the knowledge and understanding of the direct and indirect effects of jet fuel on migratory birds and their habitat, particularly biofilm, pose challenges to the environmental assessment process. However, Environment Canada cannot recommend relying on professional opinion where the science on key issues is so lacking and, very importantly, given the extreme importance of the ecosystem at risk. To reiterate our concerns, and as highlighted in the meeting on April 6, 2011, an absence of information does not, and cannot, automatically translate into the absence of an effect.

Please find Environment Canada's specific comments and recommendations on each Supplement below.

Supplement 3 – Biofilm Memorandum

Environment Canada does not agree with the principal conclusions of Supplement 3 (*italics* below), specifically:

1. Distribution of biofilms may be larger than mapped area - Biofilms are likely widely distributed over the Fraser Delta in the upper tidal flats area where wave exposure is low and where mud is the dominant substrate. To date, biofilms have been documented on about 6% of the mudflats in the Delta, i.e., approximately 2,766 hectares. There are at least 2,500 hectares of similar habitat on Sturgeon Bank and Roberts Bank that is likely to contain biofilms of similar composition. As noted in the worst-case spill modelling, it is highly unlikely that spills originating in the river would contact both Roberts Bank and Sturgeon Bank. So even in the event of a worst-case spill, it is likely that there would be large unaffected biofilm areas.

2. Other areas are available for sandpiper habitat use - While there are large aggregation of sandpipers using the north Roberts Bank area during their migration stops, they utilize other areas as well for feeding, including Boundary Bay and Sidney Spit (Butler et al. 1987). It is also noted that biofilms account for some of the Western Sandpiper diet, but not all (Kuwaie et al. 2008) so there are both alternative feeding areas and alternative food sources, albeit at some energetic cost.

While Environment Canada concurs with the proponent that biofilm undoubtedly occurs in other areas of the Fraser River Estuary, there is no valid evidence that such alternative biofilm source(s) would be suitable for shorebirds and/or, if it were proven so, whether shorebirds could switch to either those areas or to alternative food sources.

The facts are that most of the entire Western Sandpiper species concentrate on Roberts Bank during spring migration to their breeding grounds and that biofilm constitutes an important, if not the most important, food source. To presume the birds would utilize alternative habitats/food

without credible evidence is unwarranted speculation that constitutes an unacceptable population-level risk to at least one migratory species, the Western Sandpiper.

Hitherto, there have been no reports of shorebirds feeding on biofilm in the Fraser River Estuary other than on the upper intertidal of Roberts Bank and on a small fraction of Boundary Bay. Further, published research shows that biofilm constitutes the major dietary source for shorter-billed morphs of Western Sandpipers, especially males, during spring migration on Roberts Bank. These latter birds may be functionally unable to switch to alternative food sources during spring migration.

3. There are no direct results showing effects of Jet A fuel on biofilms - Although there has been no direct research on Jet A fuel effects on biofilm, research studies on biofouling and biofilms have shown them to be remarkably resilient to chemical stress. Biofilms are not a single species culture but rather a complex of bacteria, microalgae and microfauna.

Background literature suggests that fuel sheen would have some effect on a mudflat biofilm, that the effect would likely be patchy and that the biofilm would have the potential to recover quickly (days to weeks) due to ongoing tidal flushing and recruitment of biofilm components from surrounding unaffected areas.

Environment Canada concurs with the proponent that there is no direct evidence on the effects of jet fuel on biofilm, in general, and biofilm communities grazed by shorebirds on Roberts Bank, in particular. However, given these latter facts, Environment Canada cannot support the proponent's assertion that the biofilm is resilient. While the memo refers to the undoubted productivity of biofilms, the proponent should also be aware that the ecological literature shows that being biologically productive does not mean that a system is also robust. Jet fuel could readily introduce toxicity into biofilm communities that, at best, disrupts, or worst, destroys that productivity – with direct impact on a major food resource for shorebirds. Further, should a spill occur during the period of shorebird migration, the robustness or resilience of biofilm over days to weeks would be irrelevant since there would be an acute loss of forage during the physiologically stressful migration period that, for individual birds, can last for shorter periods than the speculated recovery time. Finally, the proponent has not taken into consideration the potential effects of shorebirds grazing biofilm contaminated with jet fuel.

Supplement 4 - Jet Fuel Toxicity in Water

Environment Canada does not agree with the principal conclusion of Supplement 3:

To conclude, in the highly unlikely event that a worst-case spill of jet fuel was to occur in the Fraser River (as presented in Chapter 19 which also conservatively assumes no mitigation can be applied to reduce the volume or reach of a spill), the toxicity of dissolved constituents in the water would not be a concern for aquatic life.

Environment Canada notes that Supplement 4 does not address the potential toxicological consequence(s) to sediment from a spill of jet fuel, or the toxicity of the fraction, if any, that adheres to particles in the water column as opposed to dissolving. The references presented and case studies cited within the Supplement have limited to no relevance to potential toxicological outcomes that could occur in the event of a spill in the Fraser River Estuary specifically. Additionally, the proprietary additives associated with the aviation fuel have not been fully detailed or assessed for their contribution to deleteriousness. Furthermore, while it is understood that laboratory testing cannot replicate *in situ* conditions, science has proven that laboratory based studies, in particular toxicological studies, are accurate predictors of potential

field effects in both liquid and solid phase media. Additionally, CCME guidelines are almost exclusively derived from accredited laboratory based studies, and have proven to be protective of many of Canada's aquatic systems.

Although the proponent notes in this Supplement that there is an almost complete lack of understanding of the nature and the toxicology of jet fuel, the toxicology issues are not subsequently addressed for sediments. Furthermore, the toxicology data that is discussed is for freshwater; Environment Canada questions the relevance of the data to the Project-specific circumstances given the estuarine conditions experienced in the lower Fraser River and the saltwater conditions beyond the mouth of the Fraser. In conclusion, given the sensitive habitat in question, Environment Canada strongly recommends that environmentally relevant toxicological studies and supporting analytical chemistry be conducted under laboratory controlled conditions to determine the potential deleterious consequences associated with the water-soluble fraction and direct sediment contact with jet fuel and associated additives. A preliminary proposal to conduct such studies is appended to this letter for the proponent's consideration.

CONCLUSION

Environment Canada remains concerned that while the high level of uncertainty regarding the potential impacts of acute and chronic spills of jet fuel to migratory birds and associated habitats is acknowledged, the proponent continues to contend that the Project would not result in the loss of any product to the Fraser River Estuary and, if product was released, a spill response plan would reduce the consequences to 'acceptable levels'.

At this time, Environment Canada does not have the same level of confidence as the proponent in a spill response plan to effectively and reliably protect the high ecological values and sensitivities of the Fraser River Estuary. In the absence of an improved understanding of the potential water quality and toxicological consequences in the event of a spill, Environment Canada advises that the ecological risks of the proposal remain too great. Environment Canada emphasizes the need for credible, scientific data based on a comprehensive suite of studies designed to address the uncertainties outlined in this letter, including monitoring and empirical testing. As noted above, and with reference to the attached preliminary study proposal, Environment Canada would welcome a meeting with the proponent to discuss both the proposal, and upon receipt and review, the more detailed spill response plan and analysis.

Environment Canada appreciates the opportunity to provide comments regarding this project. If you have any questions, please do not hesitate to contact me at 604-666-0670.

Yours sincerely,

[ORIGINAL SIGNED BY]

Nadine Parker
Senior Environmental Assessment Officer

Attach. (1)

cc: Juergen Baumann, Port Metro Vancouver

Attachment
Preliminary Jet Fuel Fate and Effects Proposal

Preamble

This preliminary proposal was prepared with assistance from Environment Canada's Pacific and Yukon Laboratory for Environmental Testing (PYLET). Located on Burrard Inlet in North Vancouver, PYLET is a centre for the study of marine, estuarine and freshwater toxicology and chemistry, with specialization in salmonid toxicogenomics, bacterial source tracking, and marine water quality monitoring. The Laboratory works in partnership with other provincial ministries and federal government departments as well as the University of Victoria. Laboratory activities support environmental enforcement and environmental quality monitoring throughout Environment Canada's Pacific and Yukon Region.

The proposal is offered in the context of the ongoing environmental assessment of the proposed Vancouver Airport Fuel Delivery Project, and assumes that studies could be completed in a timeframe that would allow the results to inform environmental assessment decisions. The proposal is offered for discussion purposes at this time and would be subject to further refinement prior to implementation. Delivery of any component of the proposal would be contingent on receipt of financial support from the proponent.

Recognizing that aviation fuel additives may in some circumstances account for the toxicological effects of any fuel spill, and to account for the often-proprietary nature of these additives, the proposal assumes that the proponent would be responsible for supplying a representative sample of jet fuel for the purposes outlined here.

To the extent possible, studies proposed here are designed to address environmental conditions and endpoints expected to be encountered in the site-specific context of the Fraser River Estuary.

Study Objectives

3. To determine what fraction, if any, of spilled Jet-A fuel would adhere to particles/sediments in the water column as opposed to dissolving; and,
4. To improve overall understanding of the potential toxicity of spilled Jet-A fuel, particularly as a consequence of exposures that may result from that fuel that adheres to particles/sediments.

Proposed Study Design

Part 1 – Weathering and Chemistry

Part 1 of the study would involve the introduction of Jet A fuel at various concentrations into freshwater, estuarine (15 ppt) and seawater (27 ppt) samples containing representative concentrations of particles/sediments. Samples would be allowed to 'weather' under various environmentally relevant conditions, for durations (hours-days-weeks-months) to be determined from an evaluation of possible spill scenarios and environmental fate models. At the conclusion of each weathering simulation, particulates/sediments would be filtered or otherwise separated from the liquid fraction, and both fractions would be analyzed using routine analytical chemistry methods to determine the residual chemical constituents.

Part 2 – Toxicological Effects

PYLET-Toxicology Section *Jet Fuel A* Sediment & Water Phase Testing Regime (to be undertaken as a series of steps):

Step A

Objective: To determine the toxicological potential of the water soluble fraction of Roberts Bank sediment spiked with “Jet Fuel A” at various salinities to appropriately acclimated salmonid species.

Method:

- Sediment will be field collected from Roberts Bank.
- Sediment will be spiked with “Jet Fuel A” in ratios (sediment:fuel) to be determined.
- Sediment will be distributed over a “bottom filter” grid to a depth of 2 cm (see Figure 1).
- Testing with salmonids; Coho or Chinook, in freshwater, estuarine (15 ppt) and seawater (27 ppt).
- Aeration will be calibrated to provide sufficient lift of the water to ensure passive movement of water into the sediment and pumped via air stacks back into the overlying water.
- System will be allowed to equilibrate for 24 hours prior to introduction of fish.
- Bioassay will follow established EC RM/9 methods for bioassay.
- Endpoints will be death and behavioral and physiological responses during exposure period.
- Analytical chemistry will be collected at the discretion of project lead.

Step B

Objective: To determine the sublethal effects on the reproduction endpoint of *D. magna*.

Method:

- Using PYLET 21-day *D. magna* method to determine reproductive success.
- Spiked sediment and using SWEP method (water soluble fraction extracted from spiked sediment) to obtain water soluble fraction from sediment.
- Endpoints measured included; LOEC, NOEC, IC25 and IC50 concentration for reproductive success for neonates.

Step C

Objective: To determine the lethality and growth and survival of *Hyalella azteca* (freshwater sediment invertebrate) impacts.

Method:

- Using EC protocols and modified PYLET 14 day cone test assay to determine toxicity, LOEC and NOEC endpoints.
- Growth and Survival endpoints will also be determined.
- Jet fuel spiked in the lab into benign reference sediment.

Step D

Objective: To determine toxicity of Jet Fuel sediment pore water to bacteria (*Microtox*) and larval stages of Echinoids (sea urchin or sand dollar gametes).

Methods:

- Using established EC & PYLET methods to determine toxicity of pore water. Endpoints IC50 and IC25. In both freshwater and saltwater.
- Using above determine IC50 and IC25 to water soluble phase of pore and water soluble fraction.
- Determine larval development after 72 hr of exposure. RM 27

Step E

Objective: To determine the lethality and growth and survival of marine amphipods to spiked sediment impacts.

- Using EC protocols to determine toxicity, LOEC and NOEC endpoints.
- Growth and survival endpoints will also be determined.
- Samples spiked in the lab into benign reference sediment that lab routinely uses.

Part C – Biological Effects

Environment Canada remains concerned about the potential for any toxicological effects of spilled jet fuel to translate to biologically relevant effects on migratory bird habitats and, ultimately, populations. To this end Environment Canada is actively pursuing options to assess potential impacts to biofilm dynamics and recovery, and on the propensity for contaminated biofilm to transfer toxins to migratory birds. Environment Canada commits to making this additional information available, building on the above proposal, as soon as possible.

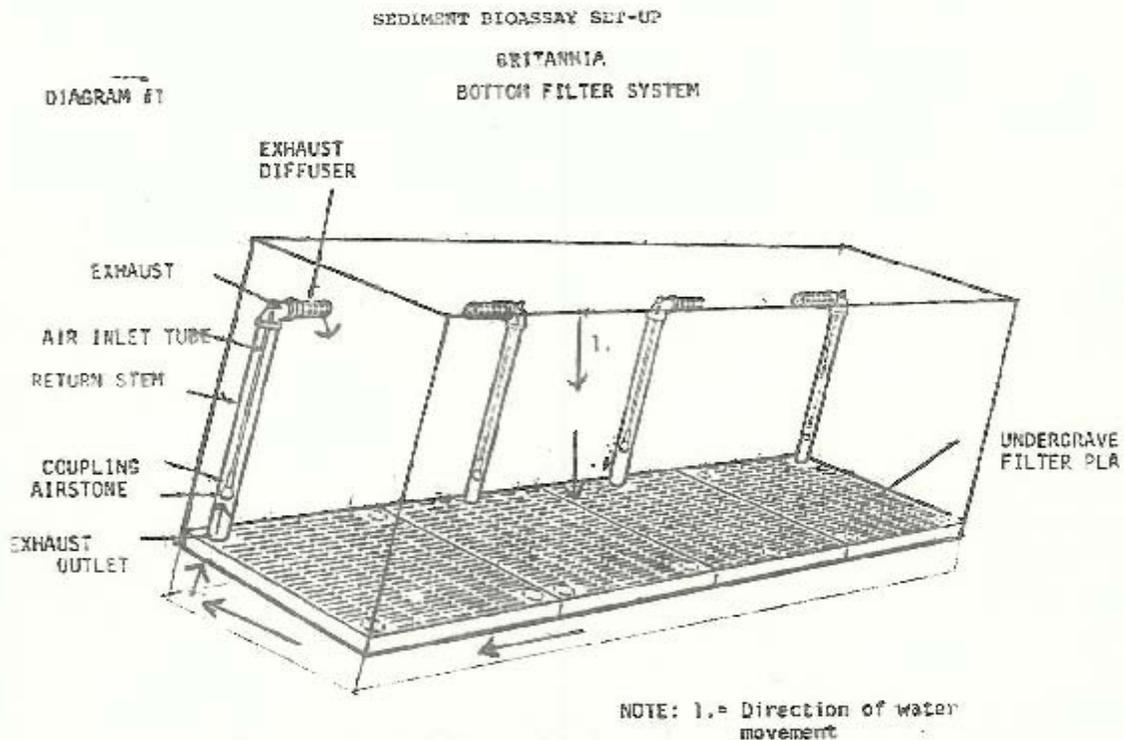


Figure 1. Fish Bioassay Setup. Jet-A Fuel spiked sediment will cover a grid system to a minimum depth of 2 cm, in triplicate. Options include using PYLET well water, estuarine and full strength seawater as dilutant. Appropriately acclimated salmonids will be test species. Endpoints available include conventional toxicity measures.