Appendix A

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RESPONSIVENESS SUMMARY

Rayonier Mill Off-Property Soil Dioxin Study

June 30—July 30, 2008 Public Comment Period

Draft Soil Sampling Plan

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Table of Contents

Appendices

Soil Dioxin Study Information

Location: Port Angeles, Clallam County
Project Manager: Connie Groven
Public Involvement Coordinator: Hannah Aoyagi

The Washington State Department of Ecology (Ecology) is planning a study of dioxin and furan pollution in soils near and downwind of the Rayonier Mill cleanup site. Past soil sampling has shown that dioxin levels in this area may exceed state cleanup levels. This study will look at:

- Where dioxin pollution is most likely to be found.
- The nature and extent of dioxin soil pollution near the Rayonier site.
- Evaluating the chemical patterns of dioxins to determine where they came from.
- Whether any dioxin pollution can be attributed to the Rayonier site.

Background

Port Angeles is located in Clallam County, on the Strait of Juan de Fuca, in the northern part of the Olympic Peninsula (see page 4 for a map). The Port Angeles Rayonier Mill Off-Property Soil Dioxin Study will generally focus on an area of over 4 square miles surrounding the Rayonier site, to a maximum distance of about 3 miles in the dominant downwind direction (east/southeast). Previous sampling has shown that some soils in Port Angeles have dioxins above the state cleanup level of 11.1 parts per trillion (ppt). **Dioxins** and **furans** are toxic chemicals that can cause cancer and may cause reproductive and developmental effects. They are stored in fatty tissues and accumulate as they move up the marine food chain. They come from natural and manmade sources, such as:

- Forest fires.
- Burning seawater-soaked wood.
- Garbage burning.
- Industrial incinerators.
- Chlorine bleaching.
- Other industrial processes.

Possible dioxin sources in Port Angeles include local industries such as Rayonier, medical waste incineration, natural fires, wood-burning stoves, burn barrels, and garbage incineration.

Soil Sampling Activities

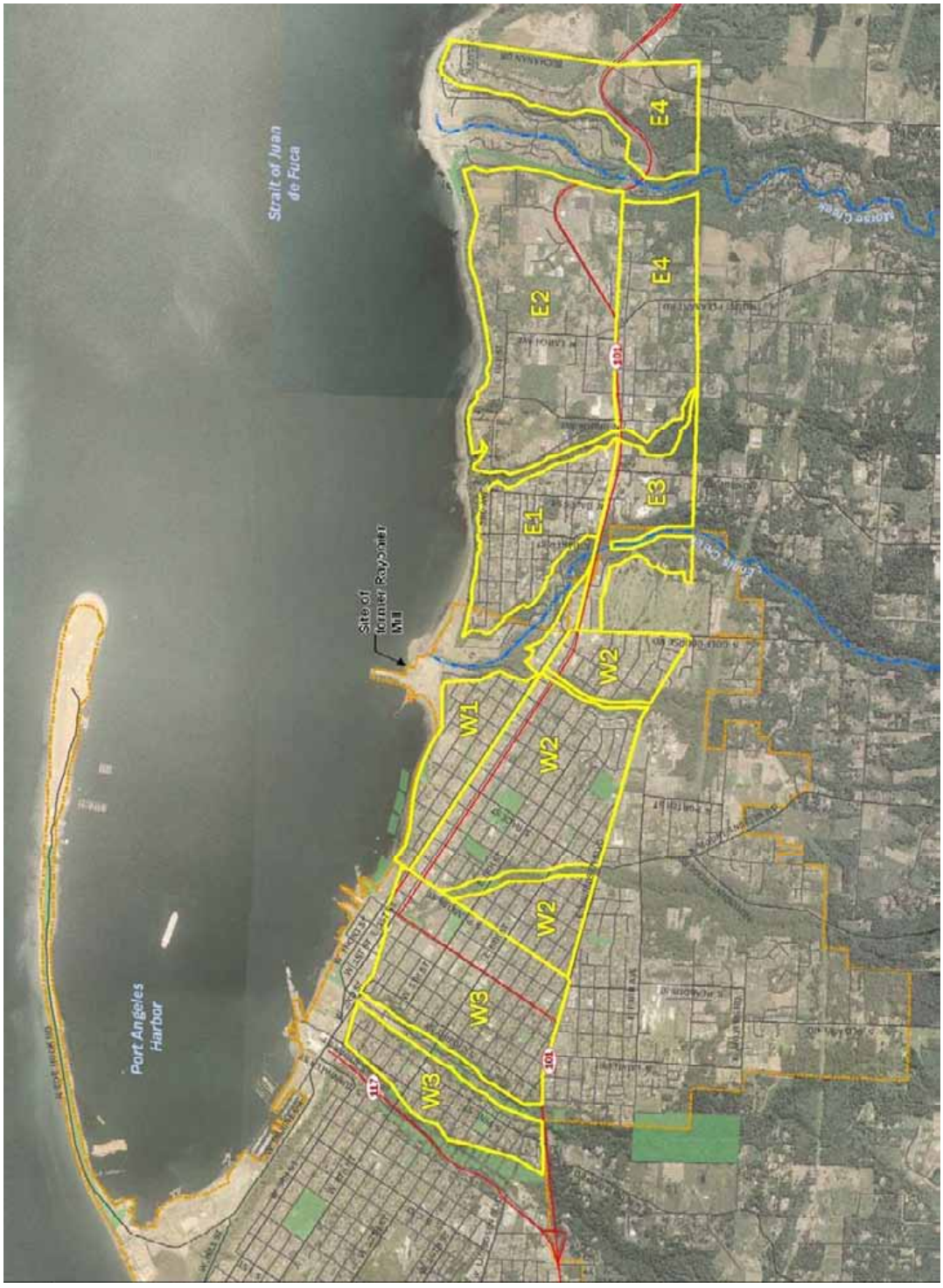
Ecology has been working with a contractor to plan the soil dioxin sampling process. Local property owners may be contacted for permission to access their property for sampling. Samples will take several months to analyze in a laboratory. Data evaluations will include analysis of the chemical patterns of dioxins to determine possible sources of contamination. The final report will be ready in the spring of 2009.

Next Steps

Next steps depend on the soil sampling results and analysis of chemical patterns. The dioxin levels will determine Ecology's response and the patterns may determine liability. Dioxin levels below state cleanup standards (under 11.1 parts per million) will not require action or further studies. Slightly higher levels may be addressed by public education about protective measures such as hand-washing and keeping soil out of the home. Ecology will need to work with the Washington State Department of Health, the local health department, and the Port Angeles community to address higher levels. Further studies may be needed in these two cases. If Ecology identifies Rayonier or another source as contributing to soil dioxins, they will be held liable for further studies and cleanup.

Public Comment Period

Ecology has considered all public comments in finalizing the Soil Sampling Plan for this study. This Responsiveness Summary lists all public comments and Ecology responses. Further questions can be directed to Site Manager Connie Groven, (360) 407-6254, cgro461@ecy.wa.gov.



Rayonier Mill Off-Property Soil Dioxin Study map, from the Soil Sampling Plan
(study zones outlined in yellow)

Comments Received and Ecology Responses

The following comments were received during the June 30 – July 30, 2008 public comment period for the Rayonier Mill Off-Property Soil Dioxin Study. These comments will be added to the site file and made publicly available.

Ecology Response to General Comments

Several issues were raised by more than one commenter. This section of the Responsiveness Summary addresses these common concerns.

General Response 1: Sampling Depth

Several comments were submitted stating that the proposed sampling depth of 0-4 inches (10 cm) was too deep, and recommending a shallower depth for sample collection.

The depth profile for dioxins/furans in the soil column is associated with individual locations. Some variation in those depth profiles across locations is to be expected as a result of the history of soil-disturbing activities (both anthropogenic and non-anthropogenic) at various locations, as well as the physical and chemical characteristics of the soils. Soil profiles for dioxins/furans may also reflect the cumulative amount of deposition that has occurred, which is a function of location, land cover, and other variables.

In this study, considering design objectives and available resources, a decision was made to sample only a single depth interval, thereby providing information on a larger number of sampling locations. The choice of a uniform depth interval for sampling is made without site-specific information on the distribution of depth profiles over the study area. For an air deposition pathway, surface soils are most relevant; the remaining issue is the detailed definition of a uniform depth for sampling surface soils.

Selection of a sampling depth interval involves a balancing of two factors: detection/source identification and quantification of dioxin/furan concentrations in soils. If dioxins/furans occur mostly or only in the upper few inches of the soil column, including soils below those near-surface depths in a sample will dilute the sample and produce lower reported dioxin/furan concentrations. Modest degrees of sample dilution will not affect detection of dioxins/furans. If depth profiles are somewhat inverted (i.e., higher concentrations occurring at deeper depths in the soil column), not sampling deep enough may also produce lower reported concentrations. If near-surface soils include little or no dioxins/furans (e.g., clean fill soils placed on top of those former surface soils where deposition occurred), more than sample dilution may result – detectability may be excluded. Absent detectability, a sample will not contribute toward source identification. Given these considerations, a sampling depth of 0-4 inches was proposed that favored detection (especially recognizing that most samples would be collected at developed rather than forested/undeveloped properties) while accepting a possible small degree of dilution in reported dioxin/furan concentrations.

Without detailed depth profiling at all sampled locations, the information from sampling a single uniform depth interval will always be somewhat generalized. No standard surface soil depth interval has been used across studies, either for source identification or exposure/risk assessment. A number of studies have used uniform 0-4 inch (10 cm) sampling of surface soils to investigate dioxin/furan impacts around known emissions sources. Those studies (see, for example, Floret et al. 2007; Oh et al. 2006; Pirard et al. 2005) have produced data sets that demonstrated gradients with distance from the investigated source, higher dioxin/furan concentrations in comparison to unaffected locations (upwind or reference locations), and chemical patterns that supported source identification. The levels of soil dioxin/furan impacts in these studies were comparable to concentrations previously documented or expected at Port Angeles (Floret et al. 2007: 0.25 to 28.0 pg TEQ/g; Oh et al. 2006: 1.25 to 74.98 pg TEQ/g; Pirard et al. 2005: 3.3 to 59.0 pg TEQ/g). A sampling depth of 0-4 inches has thus proven to be effective in some studies.

Inverted profiles for soil contamination have been observed in other studies where multiple depth intervals were sampled. A number of locations around both the former Tacoma and Everett smelters in Washington (all affected by air emissions and deposition) showed inverted profiles, more frequently at developed than undeveloped properties. Such inverted profiles have been interpreted as more typically a result of physical disturbance of the soil profile than leaching/downward mobility of deposited contaminants, although the latter may occur with certain soil properties. The literature provides examples of inverted soil profiles for dioxins/furans. Bakoglu et al. (2005) report higher TEQ values at 30 cm (12 inches) versus 5 cm (2 inches) at 3 of 4 locations in a highly developed study area. Brzuzy and Hites (1995) report maximum dioxin/furan concentrations well below 30 cm (at about 40 cm and 50 cm) in two soil cores collected in a state park in Indiana, with increases from the surface to those maximum depths. Demond et al. (2008) provide summary statistics for 0-1 inch versus 1-6 inch depth intervals for samples at developed properties (residences) near an air emissions source for dioxins/furans in Michigan. The mean, median, and upper percentiles are nearly identical for the distributions across locations at those two depth intervals. This could occur if the 0-1 inch and 1-6 inch concentrations were nearly the same at every location, but it is more likely to reflect a balance between cases where one or the other depth interval was higher. (Note: the data in this study were collected under a condition of strict confidentiality including the concentrations found. The lead author of the study has been contacted to see if ratios of 0-1 to 1-6 inch values could be made available by sampling location, which would indicate the variability in depth profiles).

Given these results, as well as observations of the type and frequency of soil-disturbing activities, an assumption that all dioxins/furans deposited to soils over time (decades) from an air emissions source will always be found in the topmost 1 to 2 inches appears unwarranted.

Site-specific depth profiling of dioxins/furans in soils, or an area-based study to evaluate the distribution of such depth profiles, may become a component of later studies at Port Angeles, if required. The comparative results for 0-4 inch versus a shallower sampling depth cannot be known until such studies are performed. **Considering the multiple comments requesting a shallower sampling interval, the general literature on the fate of dioxins/furans in soils, the design principle to try to bias sampling toward**

least-disturbed soils, and the uncertainty regarding an optimal sampling interval, the proposed sampling depth of 0-4 inches is modified to 0-3 inches. If the true occurrence of inverted profiles is not too frequent, this may modestly increase reported dioxin/furan concentrations at many locations while reducing detectability or reducing reported concentrations at the remaining locations. A sampling depth interval of 0-3 inches should still meet the study objectives.

General Response 2: Study Area Boundaries

Comments were submitted recommending both expansion and significant reduction in the study area boundaries. Expansion to the south was requested to cover additional areas where odor complaints were reported. Expansion to the west was requested to further characterize impacts from other potential dioxin/furan emission sources. Restriction of the study area to locations of higher deposition as shown by air modeling of Rayonier Mill emissions was also proposed on the basis that the air modeling results delineate the limited potential extent of impacts on soil dioxin/furan levels. See also General Response 4: Deposition Models and Soil Concentrations.

After considering these submitted comments, no changes to the proposed study area boundaries have been made.

A brief discussion of scale issues may be helpful in understanding the proposed spatial scale of the study. Loftis et al. (1991) provide a detailed discussion of scale issues in the context of water quality modeling; those discussions extend naturally to other types of sampling programs, such as the current soil study in Port Angeles. Loftis et al. call attention to the importance of explicit consideration of scale issues in developing sampling designs and the relationship of scale issues to study objectives. A failure to give adequate consideration to scale issues can lead to inappropriate data analysis conclusions. Loftis et al. give an example of evaluating time trends for water quality time series data, and how trend detection is scale-dependent. Short periods of record may appear to reflect a trend in concentrations when over a longer record it is apparent there are no long-term trends. Assuming the short-term trend is real, and simply limited in duration (e.g., a seasonal effect), it is critical to note that more intensive sampling during only that short-term period would do nothing to correct a misinterpretation that there is a long-term trend in water quality. Only sampling over the longer time period would provide relevant data for a different time scale of interest.

The inverse situation, in which short-term records show no trend but long-term monitoring makes a significant trend evident, follows exactly the same reasoning.

For the Port Angeles soil study, the variability and/or trend (gradient) in soil dioxin/furan concentrations are likely to be scale-dependent in a manner analogous to the temporal trends of water quality data as discussed by Loftis et al. (1991). So are the variability and/or trend in chemical patterns among dioxin/furan congeners and homologue classes. Soil sampling that is restricted to a small local area near the Rayonier Mill is likely to reflect a limited range of dioxin/furan concentrations and patterns, compared to sampling over a larger area. More intensive sampling only within that local area cannot provide information relevant to the range of results or trends over a larger spatial scale.

Thus, an understanding of spatial gradients and of chemical patterns likely to be required for successful analysis of the impacts of Rayonier emissions compared to other potential sources will benefit from increasing the spatial scale of the study area. Sampling over larger areas is intended to increase information on gradients and chemical patterns, and by providing information at a larger scale and with greater contrasts lessen the potential for misinterpretations from more restricted data sets. Note that this does not suggest that Rayonier impacts are assumed to be detectable and/or significant at all proposed sampling locations over the study area.

Once a sufficiently large study area has been delineated to meet the objectives of this study to assess the existence of off-site impacts from Rayonier emissions, it is not necessary or advantageous to extend sampling to the farthest limits of spatial gradients in soil dioxin/furan concentrations or to fully characterize impacts from other possible sources (see also the general response on study objectives). Dilution of the spatial coverage of sampling is a limiting concern. The discrimination among sources of dioxins/furans depends in part on the scale of the study being adequate to identify distinguishable chemical patterns among soil impacts from sources, but does not require full spatial evaluation of the impacts of each source. The proposed study area will provide soil samples from the vicinity of or downwind of many other potential sources of dioxins/furans.

A review of published studies of soil impacts around other air emission sources of dioxins/furans indicates that the maximum distance at which such impacts have been identified is in the range of 3 to 5 km (i.e., up to about 3 miles). The proposed study area is consistent in scale with these findings, extending approximately three miles from the Rayonier site in the dominant downwind direction. At this scale for soil sampling it will also be possible to sample a number of forested areas east of the Mill; such forested locations are likely to retain the highest level of air-deposited dioxins/furans. Sampling only at developed properties closer to the Mill would have the potential to underestimate the highest levels of soil concentrations, which would be of interest for any future property development activities.

Community concerns for the spatial scale of Rayonier off-site impacts were reflected in the attempt to document the locations of odor complaints. That interest is reinforced by Comment 3.11, submitted by the Olympic Environmental Council, requesting an extension of the study area to include additional odor complaint locations to the south. The relationship between odor complaints and dioxin/furan emissions has been questioned. It is true that multiple facility-related sources, and other non-Rayonier sources, could have produced odors leading to citizen complaints; however, in its technical study of odors in the community TRC noted that a substantial proportion of verified complaints were found to be associated with hog fuel boiler emissions, and the hog fuel boiler is recognized as a primary source of dioxin/furan emissions from Rayonier. The proposed study area includes most of the mapped verified odor complaints, and samples will be collected throughout the study area to provide spatial coverage. Thus, new information on soil levels will be made available covering most odor complaint locations and thereby respond to community interests. The study area has not been extended to cover all past odor complaint locations to avoid dilution effects, and because delineating final boundaries for impacts is not an objective of this study.

Ecology's development of the concept of area wide sites reflects the spatial scale of contamination and not the number of sources contributing. Both the Tacoma Smelter and Everett Smelter sites are designated as area wide sites based on the scale of impacts from a single air emissions source, for example. The scale of the proposed study area for this Port Angeles study does not indicate that a community-wide investigation of soil dioxin/furan concentrations resulting from all sources is required. The study area boundaries reflect an interest in evaluating the impacts within the community from one source – Rayonier – in an area where other sources are also likely to occur. (See the general response on study objectives). Previous area wide investigations for Ecology have developed a logical sequencing of studies, with early studies focused on identifying if significant contamination exists and where subsequent, more detailed studies (e.g., property-by-property sampling) should be focused. The current study design has adopted a study area boundary reflecting a similar overall approach.

General Response 3: Study Objectives

Several comments were received requesting further clarity of the study objectives. Others questioned why the study objectives were selected instead of other possible objectives, such as determining risk, delineating the full extent of contamination, and evaluating background levels.

The former Rayonier Mill property has been designated as a site for cleanup actions under Washington's Model Toxics Control Act (MTCA). An open question is whether that site should be extended to include off-property areas within greater Port Angeles that have been impacted by Mill emissions. This initial question may be followed by additional questions, such as defining the full extent of all impacted areas, evaluating exposures and risks at individual properties, determining effective approaches for cleanup to reduce potential exposures and risks, and evaluating background contaminant levels in comparison to risk-based concentrations (which could affect cleanup levels).

The current study addresses the first question of whether off-property soil dioxin/furan contamination exists, associated with Rayonier operations, at a magnitude that should require further evaluations as part of the overall cleanup process. The focus of this study is therefore on analyzing soil dioxin/furan concentrations and assessing the sources contributing to those measured concentrations. In the course of collecting information for these purposes, the study will also provide some preliminary information relevant to other questions, without fully addressing them. For example, the measured concentrations can be compared to MTCA default risk-based concentrations to provide a preliminary indication of potential significance for human health. The spatial scale of the study (study area boundaries) will allow for an examination of gradients, whose lowest concentrations may suggest levels in less-affected areas and how they compare to risk-based values. The sampling results across the defined study area should provide a preliminary indication of the extent of soil dioxin/furan contamination exceeding selected threshold levels. In all of these instances, while some relevant information will be made available, this study will not provide definitive answers. The reason a single study does not completely address all of the questions of interest at the same time is that different study designs are required for different purposes. The initial investigation addresses the

first-level question of whether the Rayonier site should be extended to off-site properties. If the answer is no, off-property studies are then at an end. Otherwise, the partial information this study will provide related to further questions is used to focus additional studies so they can be performed in a cost-effective manner.

Soil contamination has repeatedly been shown to exhibit substantial variability over local spatial scales (e.g., properties within a neighborhood); this is especially the case for developed residential properties where the individual property histories affect soil levels. Given this fact, property-by-property sampling has typically been required to support evaluations of potential risks and decisions on cleanup actions; uncritical interpolation from sampled to unsampled properties is prone to substantial error. Sampling of all properties would not be a cost-effective approach in an initial study before the extent of contamination had been approximately defined.

Moreover, the evaluation of potential exposures from soil contamination typically requires much more than a single sample per property. The variations in soil concentrations across a property (influenced by the property-specific history) and behaviors affecting the locations, frequencies, and intensities of soil contact typically dictate the collection of multiple samples. Sampling at multiple depths may also be performed to support exposure assessments and the design of cleanup actions. Such detailed sampling is also not effective in an initial study.

The issues involved in determining background concentrations of a contaminant in soils have often been given too little attention. The background dioxin/furan level in soils is not a number, nor is it a simple distribution of values. Absent any significant point source for dioxins/furans, the diffuse types of sources produce an urban-suburban-rural-remote gradient in soil levels. Background concentrations within these stations along the gradient also differ depending on the land use/land cover of a property. The dioxin/furan concentrations in relatively undisturbed forest sites, open fields, and developed residential properties are not the same. More than a few samples are required to appropriately categorize background soil values, considering both the type of background relevant for a site and the variability in concentrations for that type. Assigning a small number of samples from the current study to defining background would not be effective.

The design for this study also incorporates a preference for sampling the least disturbed soils that can be identified. There are two reasons for this approach to collecting soil data that are “biased high” for dioxin/furan concentrations, rather than using simple random sampling. First, a “biased high” data set will be strongest with respect to minimizing artifacts and variability and thereby better support evaluations of spatial gradients and chemical patterns. Source identification evaluations will therefore be enhanced. The second reason has to do with an essential asymmetry between biased and unbiased (uncontrolled) sampling. If sampling is directed toward “high bias” locations, the interpretation of results will be clear no matter what the results. Significant impacts determined to be associated with Rayonier would justify further studies. If soil dioxin/furan levels are low and/or Rayonier emissions are not associated with measured soil levels, further off-property investigations would not be required. In other words, not finding any significant impacts when the “worst” locations have been sampled provides a definitive negative answer to the initial question of interest. If the potentially highest impact locations are not sampled, some uncertainty would remain with respect to

whether higher levels of impact were missed; negative findings would be less definitive. (In an extreme example, sampling highly disturbed soils where dioxin/furan concentrations have been diluted, or recently imported clean soils, would provide very little information on what levels would be found at undisturbed soils on adjacent properties). Sampling at "high bias" locations serves the purposes of this study – deciding on the need for further investigations and "getting one's hands around the problem" – but all interpretation and communication of results must recognize the "high bias" inherent in the study design.

General Response 4: Deposition Models and Soil Concentrations

Comments were submitted proposing that the air dispersion and deposition modeling performed for the Rayonier facility provides the best evidence for impacts to nearby soils, and that sampling should be limited to locations of relatively high deposition as shown by that modeling. (See also the general response addressing study area boundaries).

Air dispersion or dispersion and deposition models are frequently used to evaluate impacts from sources of air emissions. On the other hand, soil sampling and analysis has been established as an effective approach for assessing the cumulative deposition of contaminants from air emissions; soil acts as a conservative matrix (sink) for the collection of atmospheric deposition (Brzuzy and Hites 1995), absent disturbance. Human exposures and risks from soil contamination are directly evaluated from soil measurements; air modeling provides an indirect approach for such evaluations. A basic consideration in interpreting and applying air modeling results is how accurately they correspond to measured soil concentrations, correctly interpreted. Map stability is a key concept in this regard. A stable map is one that does not change as new data are collected. Maps based on air modeling can be evaluated for stability with regard both to the qualitative pattern of impact magnitudes and to the absolute (quantified) concentrations in soils. It should be noted that deposition estimates are not the same as soil concentrations; additional soil mixing assumptions or models are required to derive soil concentration estimates.

Modeling results can be informative and useful even if they are not highly predictive – for example, as guides to further investigations (see Goovaerts et al. 2008a, 2008b). The question is what degree of confidence should be placed in the specific modeling results.

Air models can incorporate many components to simulate processes known or assumed to influence the dispersion and deposition of emitted contaminants. The many parameters used in air models can incorporate varying levels of uncertainty (e.g., whether a single stack test is representative of long-term emission rates, or for the particle size distributions of individual dioxin/furan congeners both as emitted and as they evolve during plume transport). Changing parameter values to perform sensitivity analyses is one way to begin to evaluate these uncertainties (see Lohman and Seigneur 2001; Lorber et al. 2000). In addition to parameter uncertainty, models may not include all of the processes affecting the behavior of emitted contaminants, thereby introducing additional model uncertainty (see Floret et al. 2006; Lorber et al. 2001).

Lohman and Seigneur (2001) used a modified ISCLT dispersion and deposition model to evaluate the fate of emitted dioxins/furans from multiple source types. Their sensitivity analyses pointed to several model components that had substantial effects on model results. For example, local deposition was shown to be very sensitive to the treatment of dispersion for sources with short stack heights. (The Rayonier hog fuel boiler stack height is relatively short in relation to ground elevations on top of the shoreline bluff in Port Angeles). Particle size distributions were another set of parameters showing higher sensitivity. The authors conclude that "An atmospheric dispersion model such as the EPA-recommended ISC model should be used only for screening assessments and more advanced dispersion models should be used for refined assessments" (p. 169).

Several studies of air modeling for dioxin/furan emissions, and the comparison of model predictions versus soil measurements, are available. Studies of this type provide useful information on the performance of dispersion/deposition models.

Lorber et al. (2000) combine the results of the ISCST3 model with a soil mixing/dissipation model for impacts from a large MSWI in Ohio. After subtracting estimated background concentrations (since the model estimates only impacts from the modeled source), they compare modeling estimates to soil dioxin/furan data from 31 locations off-site, between 0.5 and 8 km from the facility. (Three additional onsite soil results were not considered because of likely impacts from ash disposal rather than plume deposition). Based on two available stack tests providing emissions estimates, which differed by a factor of 4, two sets of model runs produced estimated soil concentrations that also differed by a factor of 4. Dioxin/furan soil TEQ levels at the closest distance (0.5 km) were under- or overestimated by a factor of about 2, depending on which stack test data were used. The degree of overestimation increased as distance from the facility increased, which the authors note must be related to the air modeling and not the soil mixing component. Considering all of the results, the authors state that modeling results were generally within a factor of 10 of measured soil values. At the level of homologues, there were both under- and overestimates. The mapping of modeled versus measured results showed global similarities and local differences.

Xu et al. (2008) similarly compared the results of ISCST3 modeling and measured soil dioxin/furan concentrations for a MSWI in China. Their results were the opposite of those by Lorber et al. (2000). The predicted values were less than observed values, and the degree of underestimation increased at greater distances. Most of the predicted values within 1 km were noted as being within a factor of ten.

Floret et al. (2006) had previously performed a health risk study for populations near a MSWI in France, estimating exposures based on spatial patterns of predicted ground-level dioxin/furan concentrations from an air dispersion model (APC3). The pattern from air modeling was compared to the measured dioxin/furan results from 75 soil samples between 0.1 and 12 km from the facility. Since the air modeling was performed for future, reduced emission rates and not higher historic emission rates, comparisons were based on relative and not absolute values. In that portion of the study area with simple topography, the predicted air concentrations reproduced the strong gradients measured in soil samples. In more complex topography, the model did not match the pattern of soil results; overprediction was most pronounced at small distances from the facility.

Goovaerts et al. (2008a, 2008b) developed a sophisticated geostatistical model for soil dioxin/furan levels near an incinerator site in Michigan. Their approach used air modeling (ISCST3) to incorporate spatial trend into the final model. Soil sampling results from 53 locations provided additional information and were compared to the air modeling predictions for deposition; regression modeling was performed to develop residuals for the sampling locations. Based on these results, stochastic/probabilistic modeling was used to predict soil dioxin/furan concentrations at the nodes of a very dense grid. Uncertainties were addressed by repeated runs, each producing a grid map of predicted soil concentrations. Maps at any desired scale can be produced from these simulated results by averaging the results at grid nodes included in defined blocks. Uncertainties can be assessed by examining the variability in grid node or block values over the set of repeated simulations. The authors note that dispersion models often fail to capture the complexity observed in field measurements and by not evaluating uncertainties appropriately can provide a false sense of confidence in model accuracy (Goovaerts et al. 2008a). The comparison of modeled deposition and soil measurements showed that the model accounted for 44 percent of the variance in soil TEQ values.

The accuracy and precision of the model developed in this manner were evaluated by collecting an additional 51 soil samples and comparing those measured values to the distributions of repeated simulation results (n=100) at the closest model grid node (Goovaerts et al. 2008b). The model was then updated using all 104 soil results. The correlation between average modeled grid node values and measured soil values was modest at 0.44. The distributions of modeled soil concentrations at the 51 closest grid nodes were broad; interquartile ranges as graphed in the paper typically appeared to reflect factors of 5 to 10. (Local uncertainties therefore remain relatively high after dispersion/deposition model results are incorporated). The measured soil results occurred mostly in the upper tail of these distributions; 42 of 51 results were above the median. The modeled values thus tended to underestimate field-measured values. This underestimation was most pronounced at distances close to the facility. The authors note that with respect to a regulatory criterion value for Michigan, the model results produced far more false negatives than false positives. The additional information provided by 51 new soil sampling results produced changes in the model, including the relation of measured values to modeled wet and dry deposition and some of the spatial patterns and predicted concentrations for soil values near the facility.

In summary, studies comparing model predictions and field measurements do not show consistent results, but cumulatively indicate some of the limitations in the accuracy of model predictions. Underestimates of measured soil values by an order of magnitude have been shown by some studies. In terms of map stability, they suggest that collecting additional soils data is likely to produce some degree of change to the mapping based on modeling alone. This was specifically demonstrated by the most sophisticated approach to modeling in the Goovaert et al. study (2008a, 2008b).

The air deposition modeling results for the Rayonier Mill were useful for developing the current sampling design; they were a primary consideration for the decisions made regarding the distribution of sampling locations across the study area. The sampling density in those areas closest to the Rayonier property and emissions sources, where the model showed deposition to be greatest, is an order-of-magnitude greater than in the outlying parts of the study area. Other studies have similarly used variable sampling

densities (see for example Floret et al. 2006). Sampling beyond the modeled primary deposition areas will provide a check on the spatial pattern and quantification of soil dioxins/furans (modeling uncertainty), as well as providing data for evaluating the spatial and chemical patterns of soil dioxins/furans at a suitable scale to support source identification analyses (see also the general response on study area boundaries). Comparisons of the soils data produced in this study and the previous air deposition modeling results will be illuminating. Those modeling results are not determined to be a suitable basis for restricting soil sampling to a small area close to the Rayonier property boundary.

General Response 5: Next Steps

Several comment requested further explanation about how the results of this study will be used and of the steps that will be taken following this study. The comments also addressed the issue of funding for future studies and cleanup.

Analysis of the soil samples will take several months. When the results are ready, Ecology will send participants a letter with their results and information on how to interpret those results. Ecology will then release a summary of the results and general statistics to the public. Ecology will be using these results to look at the pattern and magnitude of soil dioxin to see if there are areas where soil dioxin levels are elevated and may pose a threat to human health or the environment.

Soil dioxin concentrations can vary widely, even within a small area. Therefore, the single sample collected on a property will not be enough to understand the contamination on a property. The sample will also not be enough to understand the possible health risk. This study is not designed to determine if individual properties need cleanup. The study is designed to determine if there are any areas of concern that Ecology should focus on for further studies.

What Action Will Ecology Take?
Ecology understands the public's request for firm answers about the next steps for this study, and will provide more information as it becomes available. At this time, there are several likely next steps, depending on the sampling results. Ecology's level of response will be proportional with the magnitude of the results:

1. Below state cleanup levels - Levels may be low enough that no further action is needed and no further studies are necessary.
2. Slightly higher levels would be addressed with education and outreach about protective actions such as proper hand washing, removing shoes before entering the house, and housecleaning. Further study may be needed.
3. Higher levels - Ecology will work with study participants, citizens, Clallam County Environmental Health, and the Washington Department of Health (WDOH) to develop the appropriate next steps for higher levels. Further study will be needed.

Who Is Responsible?
Ecology will also try to determine the relative contributions of the former Rayonier Mill or other sources, to any soil dioxin concentrations. If a source or sources are identified,

Ecology will require the source(s) to do further studies and remediation if necessary. If no sources are identified as liable for dioxin contamination, Ecology cannot guarantee that state funding will be available for further studies or cleanup. However, Ecology will work through every possible avenue to ensure that public health is protected.

Return to Table of Contents

Letter #1 Barbara Trejo, Washington State Department of Health

(see Appendix A)

Comment 1.1
DOH typically recommends a zero to three-inch bgs sample for evaluating health risks associated with exposure to contaminants in surface soil. However, these soil samples are not being used to assess health risk but rather are being used to determine whether air emissions associated with operation of the former Mill affected soils in the Port Angeles community. Given that many of the soils in Port Angeles are disturbed, a zero to four-inch bgs sample interval seems reasonable.

Ecology Response
Please see General Response 1: Sampling Depth for a discussion of the change in sampling depth from 4 inches to 3 inches.

Return to Table of Contents

Letter #2 City of Port Angeles

(see Appendix A)

Comment 2.1

General comment 1: The title and introductory sections of the document indicate that contamination from the Rayonier Mill is the focus of this study: however, statements within the document regarding other potential sources and the broad areal extent of sampling away from the Rayonier site indicate more general interest in characterizing dioxins/furans in soil in the City of Port Angeles. The intent of this study should be more clearly and consistently stated throughout the document.

Ecology Response

See General Response 3: Study Objectives and General Response 2: Study Area Boundaries.

Comment 2.2

General comment 2: The intended use of the results of the soil sampling investigation is unstated and is particularly unclear, given that many of the expected uses of sampling investigations associated with contaminated soil are stated to be outside the scope of the study. Without a clear description of how the data will be used, it is difficult *to evaluate whether the data collected according to the sampling plan will be usable and* for what purpose. Transparency in the intended use of the results and potential consequences is also important for providing property owners with fully informed consent for access agreements.

Ecology Response

See General Response 3: Study Objectives.

Comment 2.3

General comment 3: The sampling plan notes several issues that are outside the scope of the study including definition of background dioxin/furan levels, characterization of contamination at sampled properties to support exposure and risk assessments or cleanup actions, or interpolation of results from sampled to not-sampled properties. However, samples from properties may then simply be compared to Ecology's new more stringent default risk-based values for dioxins/furans in soil. No information on background levels will be available for evaluation. Moreover, banks could then redline whole neighborhoods based on sampled properties that exceed the stringent risk-based values.

Ecology Response

See General Response 3: Study Objectives. If no values exceeding Ecology's default risk-based cleanup level are found (unlikely), no further off-property investigations will be required. If exceedances of that risk-based cleanup level for soil dioxins/furans are found, indicating some potential for exposures above acceptable risk levels under MTCA, further investigations may be considered. Additional factors affecting that decision will be spatial trends (gradients) and chemical patterns (source identification).

Comment 2.4
General comment 4: A study that focuses on characterizing the magnitude of dioxins/furans in soil over a wide areal extent will provide a biased view of potential exposure and risk in the community regardless of the disclaimer that this is not the intent of the data.

Ecology Response
The presentation and communication of results from this study will be done with specific reference to the objectives and design of the study. Ecology recognizes concerns over unwarranted and overly broad interpretations of study results and will pay due attention to clear communications. See also General Response 2: Study Area Boundaries and General Response 3: Study Objectives.

Comment 2.5
General comment 5: Given the stated resource limitations, a study more focused on the area within the likely area of deposition from the Rayonier Mill would be more likely to characterize the magnitude of impact from the Mill as well as provide a statistically valid sample size for distinguishing among sources within the vicinity of the Mill.

Ecology Response
See General Response 2: Study Area Boundaries and General Response 4: Deposition Models and Soil Concentrations.

Introduction and Study Objectives
Comment 2.6
The report title and introductory section imply that dioxins/furans from the Rayonier Mil are the primary motivation for this investigation. The stated goal of the study likewise appears to be focused on the Rayonier Mill as the primary source: "The goal of the Rayonier Mill Off-Property Soil Dioxin Study is to increase understanding of dioxin/furan soil contamination in areas surrounding the former Rayonier Mill, including the magnitude and likely sources of contamination of surface soils." The two study objective listed are to determine 1) the magnitude of dioxin/furan contamination in offsite soils that result from airborne emissions from the Rayonier Mill, and 2) the relative contribution of the Rayonier Mill emissions compared to other potential sources.

The goal stated in the Conceptual Site Model document is inconsistent with the goal in the sampling plan (p. 4, last paragraph): "This study seeks to evaluate dioxin/furan concentrations near the former Rayonier Mill, recognizing there may be impacts from other nearby sources". No mention is made of characterizing the magnitude or upper range of soil concentrations from the Mill.

Ecology Response
See General Response 3: Study Objectives. Ecology disagrees that the statements of goals in the two documents are inconsistent. The Conceptual Site Model document also states: "The Department of Ecology is interested in dioxins/furans in eastern Port Angeles due to the potential for soil contamination resulting from decades of pulp and paper operations at the Rayonier Mill facility" (section 1.3). Both reports state a primary interest in off-property impacts to community soils from Rayonier Mill emissions, with

recognition of the fact that in the urbanized Port Angeles environs there are other potential sources for dioxins/furans that need to be considered in order to appropriately evaluate the impacts from Mill emissions.

Comment 2.7
Given the initial focus and study objectives on areas near the Rayonier Mill site that have been impacted by air emissions, the large study area designated for sampling seems overly broad to accomplish these stated goals. The sampling plan acknowledges that potential variability in soil contaminant concentrations among nearby sampling locations can be quite large, especially in more developed land use areas, which is typical of the study area. Given the focus and stated objectives, sample variability, and stated resource constraints limiting sample and study phases (page 7, fifth paragraph), the study should focus on a smaller area near and downwind of the Rayonier Mill to sample more intensively. Such a study would better achieve the study objective of characterizing the magnitude of dioxins/furans in soil resulting from air emission for the Mill and would allow a more statistically valid comparison of sample concentrations in evaluating relative sources within the area primarily impacted by Mill emissions.

Ecology Response
See General Response 2: Study Area Boundaries and General Response 4: Deposition Models and Soil Concentrations.

Comment 2.8
On page 7, fifth paragraph, the sampling plan notes: "[i]t is notable that the scope for the study will produce one of the most detailed and extensive assessments of soil dioxin/furan contamination in an urban area completed to date within Washington state." The sampling plan does not justify why such an achievement would be of benefit to the people of the City of Port Angeles or Washington State. On the contrary, this statement and the large sampling area including properties far from the Rayonier Mill seem to imply that the community is being singled out for characterization of the upper range of dioxin/furan contamination. No rationale is provided for studying the urban sources in this community over other communities in the state with a long history of settlement, residential wood burning, use of burn barrels, and other common urban sources such as boilers, crematoriums, hospitals, etc. Because the study seeks to characterize the upper-range of soil dioxin/furan concentrations and similar data will not be available from other comparable communities, Port Angeles will appear to be a very contaminated area, if not the most contaminated in the state.

Ecology Response
See General Response 2: Study Area Boundaries and General Response 3: Study Objectives. The main benefit of this detailed study is that it will provide a strong basis for appropriately evaluating the community impacts from Rayonier Mill emissions, which occurred in a complex urban environment within which other sources for dioxins/furans can be assumed to exist. The location of the former Rayonier Mill in the midst of an urban environment dictates the scale of this study. In the course of this investigation, more will be learned about urban soil dioxin/furan levels, but Port Angeles has not been singled out for any purpose other than assessing impacts from Rayonier operations.

Ecology reiterates that it is sensitive to concerns about misuse or mischaracterization of the study results.

Comment 2.9
On page 9, first full paragraph under Source Identification, the sampling plan states: "[i]t will be important for Ecology to support its determination of potentially liable persons under MTCA (WAC 173-340-500), if any, based on credible evidence of the comparative contributions of different sources to the measured dioxins/furans in surface soil" No further explanation is provided. Ecology's intent of the sampling is thus unclear. This statement could be interpreted as directed at the Rayonier Mill, although the word "persons" almost implies that homeowners and other smaller parties may be targeted in a search for liable parties, which is consistent with the broad area extent of the sampling away from the Mill. Eighty-five percent of samples are to be collected from residential properties (85 of 100 samples are on residential properties, according to information provided at the Ecology Technical Workshop on July 19, 2009). Sampling limitations resulting from resource constraints would also limit Ecology's ability to collect statistically valid "credible evidence" of contributions.

Ecology Response
See General Response 2: Study Area Boundaries and General Response 3: Study Objectives.

Potentially liable person is terminology used in MTCA. It is not meant to imply that Ecology may target homeowners and other smaller parties in determining potentially liable parties.

Under MTCA, a potentially liable person can be a current or past owner or operator at a property. A person can be held liable regardless of fault – that is, whether they caused the contamination or not. Hence, a residential property owner can be held liable for contamination on their property. HOWEVER, Ecology has enforcement discretion. Ecology outlines its enforcement discretion in Policy 540A (April 8, 1992) related to residential property owners. In general, Ecology will not pursue enforcement actions toward residential property owners unless:

- The residential homeowners' activities lead to a release or threatened release of hazardous substances which results in the need for remedial actions at the site;
- The property owner fails to comply with any MTCA obligations (e.g., reporting the release of a hazardous substance);
- The property owner fails to provide access to the site or information, or fails to cooperation with Ecology's investigation or cleanup at the site;
- The property owner develops or improves the property in a manner inconsistent with residential use, or the development of the property lease to a release or threatened release of hazardous substances; or
- The property owner fails to comply with any institutional controls established at the site.

The design of this study will provide information on the magnitude of dioxin/furan contamination across the Port Angeles area. The single sample collected from an individual property will not be used by Ecology to characterize contamination on a

property, but will be used to look at patterns and identify areas where further studies will be needed. This study does not target homeowners, and source identification is aimed at large sources of dioxins.

Our objective is to establish if the profile representative of Rayonier exists and can be distinguished from other sources. It is possible that other source profiles will be determined. The "unmixing" methods of several multivariate chemometric techniques do not require source information. It is possible that a previously unconsidered source could be "found" by this study. This study has been designed to include a sufficient number of samples to provide credible evidence and to adequately support source identification, if possible, based on the number of possible sources identified in the area.

The estimate of 85 of 100 samples being collected from residential properties was an estimate based on the relative percentage of types of properties available for sampling in the study area. It was not a number targeted in the study.

Comment 2.10
Page 9, beginning with the third full paragraph, notes that chemical profiles or chemical "fingerprinting" of congeners will be evaluated and that multivariate statistical techniques will be used to provide source allocation estimates. As noted by the sampling plan, however, weathering will complicate this evaluation by tending to make the fingerprint of dioxin/furan congeners from different sources more similar. Combined with a low sample frequency over the large area and small numbers for different sources (e.g., only two samples by the highway), it will likely be difficult statistically to distinguish sources.

Ecology Response
If contributions of dioxins/furans from multiple sources with different congener/homologue profiles all have evolved to an identical pattern in soils over time (unlikely), multivariate "unmixing" methods will not be able to distinguish them. If despite an evolution in congener/homologue profiles there are still residual differences in dioxin/furan patterns from different sources, multivariate methods can be applied to try to identify and interpret those differences. The changes in congener/homologue patterns are expected to be a function of time and distance. Therefore, especially for continuing sources, it is unlikely that uniformity in evolved patterns will be found.

No evaluation approach is known, or demonstrated in the literature, to guarantee effective source differentiation and allocation in situations where multiple sources contribute, environmental samples reflect mixtures from those sources, and patterns may change over space and time. Multiple lines of evidence (e.g., spatial and chemometric evaluations) will be applied in this study. The evaluation methods chosen have been used in other similar studies and are recognized as appropriate for this type of problem. The sampling strategy for this study attempts to minimize artifacts and provide a strengthened data set that increases the likelihood of successful source discrimination, but success cannot be guaranteed.

Data sets to which multivariate methods will be applied should include sufficient samples to reflect the natural variability in measured values. One rule-of-thumb is that the minimum number of samples should be approximately 3 times the number of principal components necessary to describe that variation. Frequently, this puts numbers

between 10 and 20. Because the number of identifiable sources in Port Angeles is likely to be smaller than 10, the proposed data set with approximately 100 samples should be sufficient.

Comment 2.11
On page 10, several issues are stated to be outside the scope of the study. However, these stated issues are those that sampling investigations for contaminated soil are typically intended to address, including delineation of contamination from emission from the Mill site, characterization of contamination of properties to support exposure and risk assessment or cleanup actions, definition of background levels, and interpolation of results from sampled to not-sampled properties. Consequently, the purpose and benefit of this sampling investigation is unclear. Whether stated by the sampling plan or not, the results could be used for red-lining properties and neighborhoods for denying mortgages or transactions, or for site listing of additional liable parties.

Ecology Response
See General Response 3: Study Objectives. Clear communication of the study results will be very important. All interpretations of study results will need to explicitly recognize features of the study design, the objectives of the study, and limitations on (unwarranted) extensions of the results (e.g., from forest properties to residential properties, or from sampled to unsampled properties. The results from this study will be considered as part of the Remedial Investigation of the former Rayonier Mill Site to determine if Rayonier should include additional areas of Port Angeles, beyond the Rayonier property boundaries, in future Remedial Investigation studies and cleanup actions.

Comment 2.12
The conceptual site model (p.4, last line) also notes that statistical and geospatial evaluations of the data will be used as lines of evidence to identify sources and contribution allocations. These evaluations, likely involving contouring of soil concentrations of dioxins/furans over sampled and not-sampled properties, are inconsistent with the statement in the sampling plan results will not be interpolated from sampled to not-sampled properties.

Ecology Response
Contour mapping of the soil dioxin/furan results is not anticipated. Spatial mapping will be based on “dot maps” and distance/direction scatterplots reflecting only the sample results, recognizing the stated caution that interpolation from sampled to unsampled properties should be avoided.

Comment 2.13
Undisturbed areas are stated to be the ideal soil sampling locations for the study (p.11) and “samples will not be collected from locations considered ideal for risk assessment, areas where people are most likely to contact soil.” These statements are misleading because they imply that samples will not be collected from residential yards or that the study results will not be from soil that residents might contact; however, most of the samples will be collected from residential yards. The sampling procedures later note that samples will be collected in yards under the existing turf; however, soil sample results under turf are often assumed to represent potential exposure in a yard. Ecology

would not consider contamination covered by a few inches of turf to be acceptable for a residential cleanup.

Ecology Response
See General Response 3: Study Objectives. A distinction should be recognized between the identification of most preferred sampling locations and the availability of such locations. Comparatively undisturbed forest soils are preferred for sampling, and will be used to the extent they are available. Data interpretations will take account of the differences in land cover/land use between forest and residential sampling locations and will not uncritically combine the data from different types of sampling locations.

Soils beneath a simple grass cover would indeed pose a potential for exposure to homeowners. Sampling in this study, however, would purposely omit sampling in high-use and high-contact areas such as gardens, ornamental planting strips, and play areas with bare soils. Even for lawn areas, a single small-area composite would not be representative of potential exposure concentrations. The essential point of the text is that this study design and one to determine soil exposures for risk evaluations would be quite different.

Definition of Study Area
Comment 2.14
The TRC odor study (p. 16) results appear to be used to justify the large area selected for the sampling. Nevertheless, odorous compounds from the Mill are gases that may be expected to behave differently in the environment than particulates; other sources of odors exist in the area as well (e.g., tidal areas). Airborne transport of gases from the Mill likely differs from that of dioxin/furan compounds bound to particulates (the conceptual site model notes that most dioxins/furan adsorb to particles because of their low vapor pressure, p. 15). Sources and emission characteristics may also differ for odorous gases from the Mill versus the dioxin/furan compounds adsorbed to particulates. These characteristics would affect the dispersion of gases versus likely areas of highest deposition of particulates from the Mill and should be considered in the sampling plan. The odor study data thus should not be considered representative of location of upper ranges of dioxin/furan deposition from the Mill.

Ecology Response
See General Response 2: Study Area Boundaries. Ecology notes, as stated in the SSP, that TRC found the hog fuel boiler – recognized as a primary source of Rayonier dioxin/furan emissions – to be associated with a substantial proportion of the registered community odor complaints. The spatial mapping of odor complaints was only one of several types of information considered in defining the study area. The defined study area will provide information addressing long-standing community concerns about perceived impacts from Rayonier operations.

Comment 2.15
Page 18, second paragraph, acknowledges that the proposed study area is quite large compared to the limited areas of higher deposition according to air modeling, and that impacts associated with the Mill may be limited to a small portion of the study area. The rest of the paragraph attempts to justify the large area of the study as “an opportunity for

compiling 'confirming negative evidence' without pre-judging the spatial scale of impacts." This rationale seems inconsistent with the study focus and the resource constraints noted earlier. Because the intent of the study is not to delineate the extent of contamination from the Mill, sampling a more limited distance from the expected area of high impact from the Mill should be sufficient to confirm this expectation and accomplish the goal of characterizing the upper range of soil concentrations from the Mill.

Ecology Response
See General Response 2: Study Area Boundaries, General Response 3: Study Objectives, and General Response 4: Deposition Models and Soil Concentrations. Beyond simply identifying the peak level of impacts to community soils from Rayonier emissions, this study will provide preliminary information on additional questions that can be used to focus further investigations, if required.

Selection of Sampling Locations
Comment 2.16
Although undisturbed areas (such as mature forested area) are repeatedly stated to be preferred sampling location (e.g., p. 11, p. 19, p.21) to provide the best estimates of upper range soil concentration, relatively few of the actual planned samples are from forested areas. Repeated mention of preferred sampling areas as undisturbed areas such as mature forests is misleading, given that 85 percent of sampling locations are on residential properties.

Ecology Response
A distinction should be recognized between the identification of most preferred sampling locations and the availability of such locations. Comparatively undisturbed forest soils are preferred for sampling, and will be used to the extent they are available. Data interpretations will take account of the differences in landcover/land use between forest and residential sampling locations and will not uncritically combine the data from different types of sampling locations.

Comment 2.17
Page 23, third full paragraph, notes that "sample allocations for more distant zones are anticipated to be sufficient to reveal other potential sources for soil dioxins/furans and for initial evaluation of spatial gradients in concentrations at the scale of the study area." Justification is needed for this statement. Statistical confidence would require information on variability in sample concentrations throughout the large study area.

Such information does not appear to be available given the data reviewed by the sampling plan.

Ecology Response
The study area, including three upslope transects, includes locations outside of the developed urban core of greater Port Angeles (especially to the east and south). Considering the literature on urban-to-rural gradients in soil dioxin/furan concentrations, sampling at the proposed spatial scale is expected to reflect similar gradients. Published studies also indicate the spatial scale at which even major dioxin/furan air emissions sources have shown measurable impacts on local soils to be relatively small (no more

than 3 to 5 kilometers). Sampling locations in this study include locations in non-preferred downwind directions with respect to the Rayonier Mill stacks, in proximity to other potential air emissions sources. With regard to evaluating Rayonier impacts, the distribution of sampling locations is judged reasonably likely to provide information clarifying spatial variability (gradients, trends) and chemical patterns in soil dioxins/furans. The objectives of this study do not require complete characterization of all sources. (See also General response 2: Study Area Boundary and General response 3: Study Objectives).

Sample Analysis
Comment 2.18
Page 31, last paragraph, states that samples submitted to the laboratory are to be archived for at least one year in case tracer chemicals of emissions from the Mill are later identified. Archiving samples for this length of time will be in violation of holding time requirements and could result in chemical alteration of the samples.

Ecology Response
Ecology recognizes that official holding times may be exceeded during the one year archival period; however, there may be usefulness to doing further analysis of archived samples even if official hold times have been exceeded as long as there is a basis for accepting the results. Information, even if not legally admissible under strict interpretations of hold times, could suggest what analytes would be more effective (e.g., for source evaluations) for new sampling.

Implementation of Soil sampling plan
Comment 2.19
Full disclosure should be provided to prospective property owners regarding the purpose of the study, how the data will be used, whether their identity and their results will be disclosed to other parties, and potential implications for their property.

Ecology Response
The Property Access Agreement, Cover Letter, and Frequently Asked Question List mailed to participants stated the purpose of the study, public disclosure requirements, and the need to report contamination on Real Estate Disclosure forms.

Data Reporting
Comment 2.20
The sampling plan does not mention whether the results will be provided to property owners or residents. If information is provided to owners or residents, Ecology should consider that people will have questions about what their sample results mean and may potentially be concerned about health risks, particularly if default MTCA risk-based screening levels are used as a comparison, as noted in the Conceptual Site Model report.

Ecology Response
Property owners were asked on the access form if they would like to receive a copy of the results from the sample collected on their property. Residents were informed of

when to expect their results in the Frequently Asked Question List supplied with all access request letters. Ecology recognizes that clear, careful communication will be needed to avoid misinterpretation of the results. Ecology, working with Clallam County Environmental Health, and the WDOH, will provide information to all participants on how to interpret the results. Participants will be reminded of the study objectives and that the single sample collected on a property is not enough to characterize any contamination on their property or to evaluate health risks.

Comment 2.21
Table 1-2 presents a summary of dioxin/furan data collected in Port Angeles. The names of residential property owners are listed in this table, which seems inappropriate for a public document. This listing of owner names implies that the report of results from the planned sampling investigation will also list the residential data by owner name. If this is true, property owners should be notified that their names and data will not be held confidential before asking for their consent to sample.

Ecology Response
Property owners were informed on the access letters that the data collected from their property are subject to requests for public disclosure under the Public Record Act or the Freedom of Information Act. However, Ecology will not publish any names or addresses in any report generated by the Washington State Department of Ecology or its representatives.

Return to Table of Contents

Letter #3 Olympic Environmental Council

(see Appendix A)

Comment 3.1
We recommend that the study area be expanded to the south, if possible, to better determine trends in dioxin soil concentrations south of the former Mill. Expanding either sampling zone E3 or E4 could make collecting these additional data possible while increasing the potential gradient of measured dioxin depositions. If this expansion is not possible, then Ecology should attempt to obtain a number of samples on the southern borders of sampling zones E2 and E4. These samples could be used in conjunction with samples from the areas described in Figure 5-3 to provide better resolution for these southern areas and provide better estimations of dioxin exposures experienced by those that reported odors from the plant.

Ecology Response
See General Response 2: Study Area Boundaries.

Comment 3.2
The term “chemometric evaluation", referring to the analysis of detected chemical profiles to determine the source, is an appropriate method to use in this case. Since Rayonier used specific industrial methods at the Mill, the types and proportions of chemicals released (like PCB/dioxin congeners) should be specific to the source. It is a useful approach that can identify the contamination from Rayonier. The methods for using this analysis should be presented in this document in some form. The proper scientific approach is to define the methods before data collection.

Ecology Response
Chemometrics is the science of characterizing measurements made on a chemical system or process via application of mathematical and/or statistical methods.

For this study, data evaluation will take place in two stages. First, data will be analyzed with at least two exploratory tools, principal components analysis (PCA) and hierarchical cluster analysis (HCA). Second, samples will be subjected to analysis by a mixture analysis method called multivariate curve resolution-alternating least squares (MCR-ALS) (see Murphy and Morrison 2007 for more details). The latter method seeks to describe the underlying chemical shapes (for example, congener profiles) in a data matrix - that is, the sources of variation - together with the proportion in which each source contributes to the total value measured in each sample. The result of the analysis is therefore a list of contributing source patterns and their estimated contributions to each collected sample. Other methods may also be applied to support the conclusions obtained from these methods.

The common use of dioxin/furan lab analyses only for 17 2,3,7,8-substituted congeners and 10 homologues is based primarily on concerns for toxicity and exposure/risk assessments. Several investigators have recently questioned the adequacy of those limited dioxin/furan analyses for source identification (Masunaga et al. 2003; Xu et al. 2008). Expanded congener-level analyses, and evaluations of isomer patterns within homologue classes, have been proposed as a more effective approach for source

identification. In the event additional congener-level information is deemed useful for the Port Angeles study, archived soil samples may be reanalyzed. Data evaluation methods could then be expanded to include additional source profile comparisons, isomer patterns within homologue classes, and similar approaches (see Masunaga et al. 2003; Xu et al. 2008).]

Comment 3.3
Section 3 seems not highly relevant to the document. As an overview, it doesn't provide a substantial amount of context to the sampling plan. The information and overview within this section would be better suited to either of the two preceding chapters. For the most part, the chapter simply refers the reader to other chapters, too far into the document to provide a readily accessible and useful summary. Therefore, we recommend that this chapter a) be deleted from the document, b) the summary of study objectives be in Section 1 and c) the rest of the information presented in this chapter be included in Section 2.

Ecology Response
Thank you for your comment. Some readers may find an overview helpful and Ecology has decided Section 3 will remain in the document.

Comment 3.4
Section 1.3, page 4, bullet points: The report notes but we would like to further emphasize that the data from the 2006 Uplands RI were collected by Rayonier and may not be applicable to investigations of this nature. We appreciate Ecology is seeking independent data.

Ecology Response
Comment noted.

Comment 3.5
Section 9.1, page 37, last paragraph: "After completion of the technical memorandum and submittal to Ecology for review, an appropriate strategy for chemometric evaluation of the data will be assessed and discussed with Ecology." This sampling plan should provide all the information about the spatial extent, the types of compounds sampled for, and sampling methods to develop an approach for chemometric evaluations. There is no reason that the design of this evaluation cannot begin as soon as the soil sampling plan is approved. Waiting until data have been collected could introduce a number of biases into chemometric evaluations.

Ecology Response
Comment noted. See the response to Comment 3.2, above.

Comment 3.6
Figure 4-3, page 77: The color gradients used in this figure do not provide enough contrast and are difficult to distinguish. The figure would be easier to read if the colors went from green for lower concentrations to red for higher ones.

Ecology Response
Comment noted. Ecology is not planning to edit this figure at this time.

Return to Table of Contents

Letter #4 Paul Perlwitz, Nippon Paper USA

(From an e-mail dated July 2, 2008)

Comment 4.1

I noticed that the locations of Fiberboard and the K-Ply Mills were mislocated on Figure 4-4 of the Dioxin SAP. I've marked up the PDF with the correct locations. Please revise the figure.

Ecology Response

Comment noted. The locations will be corrected on Figure 4-4.

Return to Table of Contents

Letter #5 People for Puget Sound

(see Appendix A)

Comment 5.1
We have no specific comments about the document other than supporting the comments provided by Environmental Stewardship Concepts on Behalf of the Olympic Environmental Council.

Ecology Response
Comment noted.

Return to Table of Contents

Letter #6 Rayonier

(see Appendix A)

Comment 6.1

General Comment 1: As Ecology states in the plan, this is a very large data collection effort. The Plan anticipates collection of 100 samples across a three mile area in Port Angeles, yet excludes from the study's objectives the delineation of contamination, data collection for risk assessment, and background determination. Rayonier questioned the exclusion of these objectives in earlier briefings with Ecology and was told that the agency expects that the areas being sampled in the proposed study will need to be sampled again by others in the future, to then characterize contamination, determine background, and develop data for risk assessments. Besides being expensive and a waste of public resources, Rayonier is very concerned that redundant sampling will result in further delays in reaching cleanup decisions about the former Mill site.

Ecology Response

See General Response 3: Study Objectives and General Response 5: Next Steps.

Comment 6.2

General Comment 2: Rayonier is very concerned that the contractor does not plan to characterize any of these other recognized sources as part of this study. Not only are these sources likely contributors to any contamination that might be found in the proposed study area, but many are upwind of the former Mill; plumes from other sources may have contributed to contamination on the Mill site. It is not clear how Ecology will achieve its stated objective of determining relative contribution to dioxin/furan concentrations without fully characterizing all likely contributors.

Ecology Response

See General Response 2: Study Area Boundaries and General Response 3: Study Objectives. See also the response to Comment 8.4.

The objective of this study is not to identify or fully characterize all potential sources in the region, but rather to establish that the chemical profile associated with Rayonier emissions can be distinguished from the profiles of non-Rayonier sources. In the process of doing this source apportionment, it is possible, even likely, that other source profiles will be described. It is not known in advance whether those additional source profiles will be ascribed to specific physical sources. The spatial scale of this study and the determination of study area boundaries did specifically consider at what scale impacts from other potential dioxin/furan sources might occur so that collected samples would include a range of chemical profiles. The primary objective of evaluating Rayonier impacts on community soils will be met to the extent that Rayonier and non-Rayonier contributions can be distinguished, which does not require that non-Rayonier sources or their impacts be fully characterized.

Sources that are no longer operating and that have little or no historical information would be hard to characterize beyond general information from the literature (e.g., generic source signatures). Information on other sources could be compiled at any time if deemed of value for data interpretations; such information could be considered after

soil sampling and analysis. More to the point, however, the “unmixing” methods of several multivariate chemometric techniques do not require source signatures in advance. The identification and contributions of multiple sources are determined from the variability and patterns found in the results of soil samples.

Comment 6.3
General Comment 3: We believe that Ecology's contractor has selected non-standard methods for conducting the study and analyzing the samples, and indicates that they plan to use an experimental approach for pattern analysis. EPA has already tested and validated models and methods precisely designed for conducting these types of soil studies. Given the objective basis and effective history of the EPA models, Rayonier questions whether Ecology has selected the best study design to conduct a defensible and unbiased study of contamination in the soils at Port Angeles.

Ecology Response
Multivariate data evaluation methods have been broadly applied to environmental data sets, including the characterization of dioxin/furan measurements in soils, sediments, and other media. Such applications include cases with relatively low levels of contamination. These multivariate methods have demonstrated effectiveness in interpreting data patterns and source attribution. For selected examples, see Xu et al. 2008; Ogura et al. 2001; Sakurai et al. 1998; Masunaga et al. 2003; Oh et al. 2006; Shen et al. 2008; and Park et al. 2004.

See Comment 6.9 for additional information on the method used for analysis of samples. See also General Response 4: Deposition Models and Soil Concentrations.

Comment 6.4
Overview of the Study Design – The Study Design is Based on an Area-Wide Contamination Approach which is Neither Efficient, nor Necessary for Determining the Impacts from a Single Facility. Based on the comments received at the public meeting, Ecology has received questions regarding the magnitude of the study design. We believe this is because of an inconsistency between the approach and the document's objectives.

This section starts out with the statement "As with other area-wide sampling programs developed in Washington State" indicating the study design is based on approaches that Ecology has taken with area-wide contamination issues at other sites. Three references are listed noting the approach follows an Area-Wide Contamination sampling program, and two of these three references include authorship by the primary author of this report (Glass).

Limited information is given in the remaining document to discuss the area-wide concept as presented by the Washington Department of Ecology'. In particular, Ecology' notes that: "area-wide soil contamination is low-to-moderate level of soil contamination that is dispersed over large geographic areas, ranging in size from several hundred acres to many square miles," and that "Area-wide soil contamination was caused by a number of historical activities ..."

These definitions of area-wide contamination are in conflict with the study objectives (and title)" which focus on characterizing soil contamination from a single facility'. If Ecology is approaching this study as an investigation of area-wide contamination, then most of our comments can simply be addressed by changing the title and the objectives of the study to not be facility-specific, but rather to be the first step in characterizing area-wide Dioxin and Furan (D/F) soil contamination in Port Angeles, Washington from several sources. Otherwise, we believe the sampling program and rationale are inappropriate and inefficient for determining sources of D/F soil contamination around Port Angeles from Rayonier.

Ecology Response
See General Response 2: Study Area Boundaries and General Response 3: Study Objectives. With respect to this sampling design, the relevance of Ecology's concept of area wide sites is the logical sequencing of studies to develop the information needed to address them. This approach has been used to study locales affected by one primary source (e.g., the Everett Smelter Site). Ecology reiterates that the primary objective of this study is the evaluation of impacts on community soils from cumulative Rayonier Mill emissions, which requires recognition and consideration of other potential sources, but not their full characterization. The spatial scale of the study area is determined by the need to evaluate Rayonier impacts, and not to produce a complete characterization of dioxin/furan concentrations from all sources over all of greater Port Angeles.

Comment 6.5
Overview of the Study Design – No Reference is Provided to Indicate the Authors have Reviewed or Conducted Studies Using the Proposed Methods to Achieve the Objectives noted with D/Fs at Concentrations Currently Observed in the Port Angeles Study Area.
Given the magnitude of the proposed sampling design, indirect economic impacts are likely to occur to both the City of Port Angeles and the property owners in the study area. Because conducting one of the "largest studies' of this type implicitly communicates this area has a significant problem. Knowing this economic impact will occur, we believe the department has a responsibility to use methods which have precedence and scientific acceptance. However, despite past requests, the department has not provided any references to justify or demonstrate that source attribution techniques proposed can differentiate sources of D/Fs at the concentrations found in Port Angeles.

We do not believe that such techniques have been scientifically proven at the levels found in Port Angeles. Sites involving D/F contamination with multiple stakeholders (and thus need techniques to determine source contribution) have historically been managed by EPA, and EPA has historically applied a cleanup level for D/Fs of 1,000 ppt TEQ in residential soils". Thus, source attribution techniques as described in this plan have historically been applied to soil concentrations above 1,000 ppt TEQ. Thus, they have not been routinely applied to soil levels such as those found in Port Angeles.

In addition, we direct Ecology's attention to one of the only references to D/F source attribution techniques in soils (Plumb 2004) which states:

> "... samples, with a calculated total dioxin-furan congener concentration ranging from 231 <ppt> nanograms per kilogram (ng/kg) to 1,302,460 <ppt> ng/kg, were specifically selected to demonstrate the capability of this fingerprinting technique..."

A methods validity for determining sources of D/Fs in soils where concentrations have increased to 1,302,460 ppt does not extend to its validity for evaluating soils with <1 to 29 ppt.

Ecology Response
See the response to Comment 6.3. Ecology calls attention to the fact that under their respective cleanup program rules, EPA and Ecology do not have equal values for acceptable risks (ranges). Acceptable risk values have a determinative effect on cleanup standards.

The differences between "fingerprinting" data evaluation approaches, which are based on a pattern match to identified source profiles, and multivariate source apportionment data evaluation approaches, which are not based on using pre-identified source profiles to "unmix" measured values, must be recognized (see sections 2.2 and 8.0 of the SSP). The source apportionment approach proposed for this study has been used in many other environmental studies. In particular, the MCR-ALS method is a great improvement over older methods such as FALCON (Plumb 2004, cited in the comment) which are based on a simpler conceptual model and do not elicit comparable information from a data set. The text "An Introduction to Environmental Forensics" (Murphy and Morrison 2007) provides detailed discussion of MCR-ALS and similar multivariate methods and their applications.

Given that previous soil sampling in Port Angeles includes a relatively small number of samples, provided for sampling at locations that may have had significant soil disturbance, and did not sample locations (forest soils) where increased deposition and retention of dioxins/furans is likely, the true upper bound for soil levels is problematic. The previous maximum of 29 ppt TEQ cited by Rayonier should not be accepted as a true upper bound, and can be re-evaluated after the results from this study are available. Ecology also notes that the comparison in the last sentence of this comment mixes bulk dioxin/furan and TEQ concentrations.

Comment 6.6
Depth of Sampling. This document proposes to sample soil from 0-4". The rationale for this is based on professional judgment. EPA and ATSDR generally recommend the soil interval of 0-2" be sampled for the purposes of characterizing exposure in risk assessment, but many sites have used 0-3" for such evaluations. EPA's previous sampling in proximity to the former Rayonier Mill was based on 0-3" sampling. Unless there is compelling evidence that extending the samples another inch would provide some benefit to the analyses, we recommend maintaining a 0-3" sampling depth so the data are comparable to past studies, and, if further analyses are warranted in the future for risk assessment or remediation, these samples do not need to be redone.

Ecology Response
See General Response 1: Sampling Depth. The sampling depth interval has been modified to 0-3 inches.

Comment 6.7

Scope of the Sampling is Unjustified – Why Port Angeles? Based on the air model *(Remedial Investigation for the Uplands Environment of the Former Rayonier Mill Site: Port Angeles, Washington,* the highest areas of deposition off-property are spatially located in an area approximately 100 by 1,000 feet downwind from the Mill (see Figure 4-3). The air model remains a validated, EPA developed and endorsed, and academically reviewed approach to determine the spatial extent of contamination from a stack emission such as the former Rayonier Mill. Furthermore, the air model at this location is not nearly as meteorologically or topographically complex as most sites where it has been successfully applied for this purpose. Pattern analyses as proposed will provide a separate line of evidence regarding the former Rayonier Mill's impact, but given the limited availability of any data for defining the pattern in the source, such an approach is not superior to the air model and any conclusions would not necessarily take precedent over the air model or prior pattern analyses.

Ecology's perception that the original data did not correlate well with the air model is noted; however, as stated by Ecology this is most likely due to the samples being located in disturbed soils. It does not indicate that the model is inaccurate. In fact, nothing provided by Ecology in the report indicates the model is inaccurate or justifies ignoring it for the purposes of planning additional sampling activities. Thus, while additional sampling in undisturbed areas of the deposition field may provide better data on the magnitude and influence of the former Rayonier Mill, this could be done with fewer than 10 samples due to the small area of influence. Ecology's design which takes over 100 samples across more than three miles is unjustified within the document, and the number of samples within the work plan provided for review is noted as determined due to `budget constraints', not scientific design.

The decision to focus, as Ecology characterizes "one of the largest studies of its kind," on the off-property area of the former Rayonier Mill in Port Angeles, Washington appears inappropriate based on the information provided in the report. Consider the following:

1. Port Angeles, Washington soil sample D/F concentrations range from non-detect to 29 ppt TEQ"' (Table 1-2).
2. Bellingham, Washington soil sample D/F concentrations range above concentrations found in Port Angeles, but those samples sampled away from the Oeser site range from 0.1 to 18.8 ppt TEQ (Table 1-3).
3. City Parks sampled throughout the State of Washington ranged from 0.13 to 19 ppt TEQ (Table 1-3).

Although the upper range of the City of Port Angeles samples is marginally higher than other areas near the former Rayonier Mill, the difference between a maximum concentration of 29 ppt, and 18.8 ppt or 19 ppt can be the result of analytical chemistry precision at these low levels, the number of samples, or the soil types (presence of smaller particles or organic carbon) and thus, does not support such a large study effort to be focused on this site.

Ecology Response
See General Response 2: Study Area Boundaries and General Response 4: Deposition Models and Soil Concentrations.

Given that previous soil sampling in Port Angeles includes a relatively small number of samples, provided for sampling at locations that may have had significant soil disturbance, and did not sample locations (forest soils) where increased deposition and retention of dioxins/furans is likely, the true upper bound for soil levels is problematic. The previous maximum of 29 ppt TEQ should not be accepted as a true upper bound, and can be re-evaluated after the results from this study are available.

Comment 6.8
Collection of Site-Specific Data May Not Provide for a Better Understanding of the Source or Magnitude of the D/Fs in the Off-Property Areas. In the absence of detailed explanations which do not exist in the report being reviewed, most people fundamentally accept statements that "real data" are always better than a "model". However, such a conclusion relies heavily on the quality of the "real data" that can be collected. We believe the air model will continue to be the strongest line of evidence for determining relative deposition rates and impacts from sources at the former Rayonier Mill and thus this sampling program is too large and unwarranted. Consider the following:

1. The air model has had a long history of use dating back to 1979"[ii];
2. Over the years, it has undergone numerous updates by EPA, has been released for review by the National Academy of Sciences, Public, EPA Science Advisory Board, and has undergone numerous peer reviews"".
3. The ability of this model to estimate particulate deposition, wet flux, and dry flux has been validated by EPA and numerous researchers'.
4. The air model being proposed has been validated by showing a statistically significant correlation with near-field data predominantly located in the riparian area maintained by Rayonier on their property".

In contrast, data collected and analyzed from soil sampling near the facility will have the following limitations:

5. The history of the soils, and therefore the source of the soil, or the chemicals in the soil will be impossible to definitively determine based on visual observations and current property owner interviews considering the timeframe that the former Rayonier Mill may have influenced the soils. Consider the following timeframes:

    A. The Mill ceased operations in 1997. For the past 11 years, stack emissions from the Mill have not been a source of D/Fs to the surface soils.

    B. In 1981, the Mill installed updated emission controls which included a scrubber that drastically reduced the amount of particulate (which is what the D/Fs would have been associated with) being released. The change in off-property deposition is shown in the Figure 1 of these

comments. The plan provided shows the particulate deposition rates and patterns which predominantly occurred more than 20 years ago. Substantially less emission occurred after 1981 as shown in Figure 1 (attached).

C. Other sources (fireplaces, wood burning and oil burning stoves, backyard trash burning, fertilizers and other soil amendments, and other industrial emissions in the Port Angeles area) that have been contributing to the report's referenced 'urban plume' D/F concentrations have been ongoing while the Rayonier emissions have ceased to exist, or been dramatically reduced in the past 10 —27 years.

6. Not knowing the history of the soils will cause uncertainty in the soils data analyses because much of it relies on the assumption that those soils were present when the emissions occurred. Furthermore, some of the proposed statistical analyses assume the soils samples collected are replicates, and thus uniformly exposed for those years.

7. Undisturbed soils probably do not exist, or do not exist at sufficient frequency to allow for near-field development of a source pattern. The use of the term "undisturbed soils" can be misleading. Within the plan, undisturbed soils are targeted and implicitly defined to represent soils which have not been influenced by activities such as gardening, lawn maintenance, or other urban development and landscaping practices. However, as the near-field, off-property soils occur in housing developments, even non-landscaped soils have been influenced by the development of the housing division and the surrounding urban environment (and thus subject to soil compaction, grading, and disturbances of the natural soil layers'"), and they are likely subject to greater degrees of wind erosion. As wind erosion occurs continuously from the surface layers of soils which have no vegetation or are sparsely vegetated, any analyses linking sources of D/Fs in soils will have uncertainty regarding the actual soil layer's exposure to the prior emission.

8. During the EPA led Expanded Site Inspection (ESI) in 1998, the collection of off-site soils was attempted. The 1998 study noted that [emph. added] "specific sampling locations for the project were determined in the field by the START based on available background information; discussions with Rayonier, State, and Tribal representatives; field sampling conditions; and demolition activities." Without access to the SAP which was not provided by Ecology for public review, it seems like the current study is proposing to collect residential samples using background information and field observations that will be no different than the information used previously and thus is likely to give the same result.

Ecology Response

See General Response 4: Deposition Models and Soil Concentrations.

Soils are a conservative matrix and act as a sink for cumulative deposition of dioxins/furans, absent soil disturbance. They will reflect cumulative emissions over time, not just the reduced level of deposition in the latter years of Rayonier operations. Studies at other sites with air emissions of dioxins/furans have demonstrated the utility of

soil sampling for interpreting impacts, with no lesser potential for the types of limitations mentioned in this comment. This study design recognizes factors that could affect the representativeness of soil data for the study objectives and applies criteria to reduce the potential for artifacts.

Comment 6.9

Table 6-1. D/F Reporting Limits. The Report is Proposing a Non-Standard Analytical Method, but Does Not Identify This, Nor Does it Provide the Appropriate Detail to Allow all Reviewers to Understand and Comment on This Method. The amount of a chemical that is in a given sample is *estimated* based on a series of assumptions and *mathematical calculations* characterizing how the sample concentrations perform with respect to the instrument sensor and is quantified based on a relationship to known standards on a specific piece of equipment in a specific media. Inherent with any *mathematical calculation,* is the ability to *theoretically* calculate very small numbers, but the validity of these numbers is unknown if unmeasured against proven standards. Calibration standards are chemical concentrations in clean media (such as distilled water) which are purchased by laboratories from certified sources. A series of standards at various concentrations are performed prior to analyzing a batch of samples, and these standards are then used to calibrate the instrument. For example, EPA Method 1613b identifies five concentrations to calibrate the instrument for 2378-TCDD: 1 ppt, 10 ppt, 100 ppt, 1,000 ppt, and 10,000 ppt. The PQL/RL under Method 1613b for 2378-TCDD is set at 1 ppt as this is the lowest concentration which can be proven and compared to a known certified reference, and is thus highly reproducible, defensible, and widely accepted by the scientific and legal communities.

To define the MDL, chemists have prepared statistical arguments regarding the amount of error that may occur as detections are extrapolated below the lowest calibration standards. As a professional practice, chemists, site managers and EPA guidance suggest an acceptable error for the purposes of hazardous waste site risk assessments occurs when peaks can be seen on the chromatogram above noise levels at detectable levels up to 10 times lower than the PQL/RL. Thus, common practice is to report levels up to 10 times below the PQL/RLs as an MDL, but to flag these as "estimated" values as the accuracy and precision do not meet the standards set forth for reproducibility.

The technical and legal issue of the appropriate "detection limit" has been defined by professional practices used by site managers nationwide as well as CERCLA and MTCA which use the terms Practical Quantitation Limit (PQL as defined under MTCA) and Reporting Limit (RL as defined by EPA) which are synonymous, and the Method Detection Limit (MDL) used under both regulations. The standard of practice for defining the PQL/RL is to set it at the limit of the lowest calibration standard used to calibrate the instrument.

Table 6-1 reports that the intent of this investigation is to use a 20 gram sample following EPA Method 1613B to derive a detection limit of 0.025 ppt. This is approximately 100 times lower than the lowest calibration standard defined in Method 1613B. The report does not indicate if a lower internal standard than defined in the method will be prepared, if the standard will be prepared in the laboratory or be purchased from a

certified source, and other key aspects of the method to justify a valid detection limit of 0.025 ppt. By simply stating "EPA Method 1613B" the document gives the impression that this is a standard analytical method. It is not a standard method and should be reported as a "Modified Method 1613B" and all modifications identified to allow for full review by the public. Any methods that are proprietary to the laboratory should also be fully disclosed to allow scientific review and reproducibility or an alternative lab should not be pursued.

Additional Methodology Concerns: When evaluating chemical concentrations, the laboratory must maintain the instrument within the calibration range or the data will be qualified as estimated. When analyzing a D/F mixture in soil or sediment, the 2378-TCDD and 2378-TCDF congeners can commonly occur at levels near 0.1 ppt while OCDD and OCDF can occur at levels of 100 ppt or greater. In a single analysis on a GC/MS as defined in Method 1613B, it is impossible for the instrument to satisfy the calibration requirements for such an extreme range of values in a single extract. The report does not propose how this problem will be resolved. If the extract will be split and analyzed twice, this can maintain the instrument calibration, but creates additional QA/QC requirements which should also be provided for review, and the analyses of two extracts at such low levels will further introduce error thereby reducing the precision and accuracy of the estimates.

Ecology Response
Regarding Table 6.1 of the SSP: Dioxin/Furan Reporting Limits:

For this project, AXYS was requested to provide lower detection limits than those listed under the EPA Method 1613B. This will be accomplished by increasing the sample size from 10 g to 20 g and by using a 5-times lower internal calibration standard, which results in a 6-point linearity series rather than the 5-point series described in the comment above.

For 2,3,7,8-TCDD, this results in a PQL of 0.1 pg/g, according to the following equation:

$$\frac{0.1 pg/uL \text{ solution} \times 20 uL \text{ final volume}}{20 \text{g sample size}}.$$

AXYS intends to provide a nominal detection limit of 0.025 pg/g, which will be four-times lower than the above demonstrated PQL of 0.1 pg/g but is within the common practice guideline of reporting down to ten-times below the PQL. Data detected below the PQL can be flagged as estimated (J) following routine conventions. All data reported are required to meet all the QA/QC specifications defined in EPA Method 1613B (a performance based method).

The MDLs listed in the attached Tables 1 and 2 provide additional demonstration of AXYS' ability to report to a nominal detection limit of 0.025 pg/g. The values provided in these tables are based on a sample size of 10 g and yield an MDL of 0.031 pg/g for 2,3,7,8-TCDD. Use of a 20 g sample for this project will result in approximately two-times lower MDLs than the proposed nominal detection limit. Using the results provided in the attached tables, the MDL for 2,3,7,8-TCDD becomes 0.0075 pg/g

based on a 20 g sample. The MDL nominal detection limit of 0.025 pg/g to be achieved for this project is well above what can be achieved using a 20 g sample.

The accommodations of increasing the sample size in conjunction with a five-times lower calibration point have been used by AXYS for many years on many projects. For example, the modified MDLs (2,3,7,8-TCDD = 0.01 pg/g) were the required methodology used to report the dioxin/furan concentrations for the U.S. EPA National Study of Chemical Residues in Lake Fish Tissue for year 2000 to 2004 (http://www.epa.gov/waterscience/fish/study/tissue.htm).

Should samples be encountered that have high levels of OCDD/OCDF, the above noted 6-point linearity can accommodate samples that contain up to 2,000 pg/g. If levels higher than this are encountered in samples they will be dealt with by dilution or repeat analysis from a smaller sample size, as appropriate, depending on the levels and in consultation with the client.

Refer to Tables 1 and 2 below.

AXYS Analytical Services Ltd

METHOD DETECTION LIMIT FOR DIOXINS AND FURANS IN SEDIMENT SAMPLES

November 2005

TABLE 1

AXYS Method:	MLA-017
Analysis Type:	Chlorinated Dioxins and Furans FMS Clean up
Instrument Type:	High Resolution GC/MS - Micromass Ultima
Matrix Spiked:	Sediment
AXYS Work Group:	WG17149
GC Column Type:	DB-5
MDL Protocol:	Federal Register 40 CFR Part 136, Appendix B

MDL 1 DATA FILE:	DX52_487A S:8	SAMPLE ID: WG17149-103,,SPM	ANALYSIS DATE: 09-Nov-05
MDL 2 DATA FILE:	DX52_488A S:5	SAMPLE ID: WG17149-104,,SPM	ANALYSIS DATE: 10-Nov-05
MDL 3 DATA FILE:	DX52_488A S:6	SAMPLE ID: WG17149-105,,SPM	ANALYSIS DATE: 10-Nov-05
MDL 4 DATA FILE:	DX52_488A S:7	SAMPLE ID: WG17149-106,,SPM	ANALYSIS DATE: 10-Nov-05
MDL 5 DATA FILE:	DX52_488A S:8	SAMPLE ID: WG17149-107,,SPM	ANALYSIS DATE: 10-Nov-05
MDL 6 DATA FILE:	DX52_488A S:9	SAMPLE ID: WG17149-108,,SPM	ANALYSIS DATE: 10-Nov-05
MDL 7 DATA FILE:	DX52_488A S:10	SAMPLE ID: WG17149-109,,SPM	ANALYSIS DATE: 10-Nov-05
MDL 8 DATA FILE:	DX52_488A S:11	SAMPLE ID: WG17149-110,,SPM	ANALYSIS DATE: 10-Nov-05

ALL CONCENTRATIONS REPORTED ON THIS FORM ARE CONCENTRATIONS IN SAMPLES
Based on 10g Sample Size

Native Analyte	Spiking Level (pg/g)	No. of Observations	Mean (pg/g)	Standard Deviation	Student's t-Value	Method Detection Limit (pg/g)
2,3,7,8-TCDF	0.2	8	0.24	0.005	2.998	0.015
1,2,3,7,8-PeCDF	1	8	1.08	0.032	2.998	0.095
2,3,4,7,8-PeCDF	1	8	1.11	0.032	2.998	0.096
1,2,3,4,7,8-HxCDF	1	8	1.04	0.030	2.998	0.091
1,2,3,6,7,8-HxCDF	1	8	1.08	0.040	2.998	0.12
1,2,3,7,8,9-HxCDF	1	8	1.07	0.031	2.998	0.093
2,3,4,6,7,8-HxCDF	1	8	1.11	0.040	2.998	0.12
1,2,3,4,6,7,8-HpCDF	1	8	1.14	0.033	2.998	0.099
1,2,3,4,7,8,9-HpCDF	1	8	1.04	0.029	2.998	0.088
OCDF	2	8	2.03	0.095	2.998	0.28
2,3,7,8-TCDD	0.2	8	0.26	0.010	2.998	0.031
1,2,3,7,8-PeCDD	1	8	1.08	0.044	2.998	0.13
1,2,3,4,7,8-HxCDD	1	8	1.10	0.063	2.998	0.19
1,2,3,6,7,8-HxCDD	1	8	1.15	0.060	2.998	0.18
1,2,3,7,8,9-HxCDD	1	8	1.14	0.056	2.998	0.17
1,2,3,4,6,7,8-HpCDD	1	8	1.14	0.056	2.998	0.17
OCDD	2	8	2.48	0.276	2.998	0.83

AXYS Analytical Services Ltd

USEPA METHOD 1613B
METHOD DETECTION LIMIT FOR DIOXINS AND FURANS IN SEDIMENT SAMPLES
November 2005

TABLE 2

AXYS Method:	MLA-017 Rev 10
Analysis Type:	Chlorinated Dioxins and Furans FMS Clean up
Instrument Type:	High Resolution GC/MS - Micromass Ultima
Matrix Spiked:	Sediment
AXYS Work Group:	WG17149
GC Column Type:	DB-5
MDL Protocol:	Federal Register 40 CFR Part 136, Appendix B

MDL 1 DATA FILE: DX52_487A S:8	SAMPLE ID: WG17149-103,,SPM	ANALYSIS DATE: 09-Nov-05
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MDL 3 DATA FILE: DX52_488A S:6	SAMPLE ID: WG17149-105,,SPM	ANALYSIS DATE: 10-Nov-05
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MDL 5 DATA FILE: DX52_488A S:8	SAMPLE ID: WG17149-107,,SPM	ANALYSIS DATE: 10-Nov-05
MDL 6 DATA FILE: DX52_488A S:9	SAMPLE ID: WG17149-108,,SPM	ANALYSIS DATE: 10-Nov-05
MDL 7 DATA FILE: DX52_488A S:10	SAMPLE ID: WG17149-109,,SPM	ANALYSIS DATE: 10-Nov-05
MDL 8 DATA FILE: DX52_488A S:11	SAMPLE ID: WG17149-110,,SPM	ANALYSIS DATE: 10-Nov-05

ALL CONCENTRATIONS REPORTED ON THIS FORM ARE CONCENTRATIONS IN SAMPLES
Based on 10g Sample Size

Analyte	MDL 1	MDL 2	MDL 3	MDL 4	MDL 5	MDL 6	MDL 7	MDL 8	Mean	Standard Deviation
2,3,7,8-TCDF	0.23	0.24	0.24	0.23	0.24	0.25	0.24	0.23	0.24	0.005
1,2,3,7,8-PeCDF	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.032
2,3,4,7,8-PeCDF	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.032
1,2,3,4,7,8-HxCDF	1.1	1.0	1.1	1.0	1.0	1.0	1.1	1.0	1.0	0.030
1,2,3,6,7,8-HxCDF	1.1	1.1	1.2	1.0	1.1	1.0	1.1	1.1	1.1	0.040
2,3,4,6,7,8-HxCDF	1.1	1.1	1.1	1.1	1.0	1.0	1.1	1.1	1.1	0.031
1,2,3,7,8,9-HxCDF	1.2	1.1	1.2	1.1	1.1	1.1	1.1	1.1	1.1	0.040
1,2,3,4,6,7,8-HpCDF	1.1	1.2	1.2	1.1	1.1	1.1	1.2	1.2	1.1	0.033
1,2,3,4,7,8,9-HpCDF	1.0	1.0	1.0	1.0	1.1	1.1	1.0	1.1	1.0	0.029
OCDF	2.1	2.1	2.2	1.9	2.0	1.9	2.1	2.0	2.0	0.095
2,3,7,8-TCDD	0.25	0.24	0.27	0.26	0.26	0.27	0.26	0.25	0.26	0.010
1,2,3,7,8-PeCDD	1.0	1.1	1.1	1.1	1.0	1.1	1.1	1.2	1.1	0.044
1,2,3,4,7,8-HxCDD	1.0	1.1	1.1	1.0	1.1	1.1	1.2	1.1	1.1	0.063
1,2,3,6,7,8-HxCDD	1.1	1.2	1.2	1.1	1.2	1.1	1.2	1.2	1.2	0.060
1,2,3,7,8,9-HxCDD	1.1	1.2	1.2	1.1	1.2	1.1	1.2	1.1	1.1	0.056
1,2,3,4,6,7,8-HpCDD	1.2	1.1	1.2	1.1	1.2	1.1	1.1	1.1	1.1	0.056
OCDD	2.8	2.8	2.6	2.1	2.5	2.2	2.6	2.2	2.5	0.28
Labelled Surrogates - % Recovery										
13C-2,3,7,8-TCDF	77	77	67	85	77	89	71	90	78	8.3
13C-1,2,3,7,8-PeCDF	85	83	73	88	86	96	70	87	83	8.4
13C-2,3,4,7,8-PeCDF	87	81	71	86	83	93	83	105	83	9.9
13C-1,2,3,4,7,8-HxCDF	86	95	82	97	101	112	81	106	94	11
13C-1,2,3,6,7,8-HxCDF	85	93	81	97	98	110	78	97	92	11
13C-2,3,4,6,7,8-HxCDF	85	89	76	92	92	104	73	90	87	9.5
13C-1,2,3,7,8,9-HxCDF	86	86	73	85	89	98	80	99	85	8.7
13C-1,2,3,4,6,7,8-HpCDF	92	93	80	104	97	108	72	85	92	12
13C-1,2,3,4,7,8,9-HpCDF	93	92	71	80	85	95	0	0	80	9.0
13C-2,3,7,8-TCDD	78	75	66	80	77	86	69	87	77	7.4
13C-1,2,3,7,8-PeCDD	88	81	71	87	88	94	72	90	84	8.6
13C-1,2,3,4,7,8-HxCDD	84	82	71	87	84	93	70	87	82	8.0
13C-1,2,3,6,7,8-HxCDD	82	80	71	84	87	98	75	90	83	8.5
13C-1,2,3,4,6,7,8-HpCDD	90	109	75	86	88	98	55	64	83	17.9
13C-OCDD	77	80	55	80	66	92	-	-	68	13.9
37Cl-2,3,7,8-TCDD	81	77	68	83	81	88	65	84	78	8.2

Comment 6.10
The Modification of the EPA 1613B Method is not Necessary for the Study Objectives. While lower detection limits may provide additional information, that information will ultimately be of little use for accomplishing the study's objectives because:

1. The data will be inaccurate and lack reproducibility (precision). Split samples will be analyzed at more than one laboratory and intra-laboratory variation will be enumerated and it is very likely that splits will show a difference between the laboratory results at these trace levels are greater than any difference which may be found using post hoc, exploratory statistical pattern analyses.

2. The report proposes to determine the magnitude of concentrations, but to a large extent, the ranges of concentrations are likely to be below the PQL. Given that values below the PQL are by definition "estimated," and that the PQL represents a threshold for cleanup, the quantification of the magnitude of D/Fs off-site below the PQL does not meet any purpose under MTCA and the expenditure of such funds is unwarranted . Furthermore, MTCA defines the PQL as that concentration which can be reliably measured during routine laboratory conditions.

Ecology Response
It is not clear what split samples are being referenced and how the analysis of split samples renders the investigative data inaccurate and lacking in reproducibility. Field replicate samples and internal laboratory QA/QC standards provide quantitative estimates of both the field and analytical precision and reproducibility, including precision and reproducibility of concentrations below the unmodified method PQL. Please refer to the attached Tables 1 and 2 which provides an example of the reproducibility of MDLs generated by AXYS. All data reported are required to meet all the QA/QC specifications defined in EPA Method 1613B (a performance based method). Alternatively, Ecology could obtain analytical results reported to the unmodified method PQL and, making assumptions regarding the distribution of data below the PQL, use statistical methods to estimate values below the PQL. However, Ecology has determined that it is preferable to obtain measured, sample-specific detection limits using methods accepted and used by the EPA to support source identification objectives (see response to comment 6.9 above regarding validity of method).

Ecology cannot assume that the range of dioxin/furan concentrations in off-property soils is likely to be below the PQL based on the results of the few off-property soil samples collected in 1997. Based on Rayonier's air model, dioxin/furan fate and transport, and duration of operation, it is possible that many samples in the higher deposition areas will have dioxin/furan concentrations at least as large as the PQL, and likely greater, such that values reported below the PQL will not be an issue. In samples where dioxin/furan concentrations are at or below the PQL, the lowest quantifiable value obtained will be advantageous for the source identification process. The decision to obtain sample-specific detection limit values was based on the source identification objective of the study. A calculation of TEQs from the PQL will produce a TEQ well below the MTCA risk-based value; therefore, the PQL will not become a cleanup value.

Comment 6.11

Figure 7-1. Process for Obtaining Property Access. The process indicates that the pre-sampling interview is only going to be used if more than one property in a grid grants access for sampling. We believe this is inappropriate. Regardless of the number of properties that can be accessed within a grid, the screening process is meant to identify those properties which have soils that could represent the magnitude and source pattern from past emissions. Properties which have had localized activities (e.g., urban landscaping) that would influence the D/F concentrations in the soils would provide no value to the study's objectives, and incurring costs associated with sampling and analyses of such areas would be unwarranted regardless of the availability of other samples.

Ecology Response

Ecology will interview all volunteers to assure that all properties meet the criteria for this study. Section 7.1 states “all property owners who submit a signed access agreement will be contacted via telephone or in person to complete a pre-sampling interview.”

Comment 6.12

Section 8.0 Data Evaluation. This section indicates that a weight of evidence approach will be used to evaluate source contributions using various methods which include FALCON, univariate and multivariate statistics, and mixture analysis methods. Because these are described as different "methods", it can be confused with the concept of an analytical or censusing method that produces data. The methods discussed in this section are simply ways in which data can be mathematically rearranged and calculated. The underlying data remains constant regardless of the method.

Our concerns with the approach are:

1. T his approach relies on post hoc methods. That is, the scientists are applying them after the data have become available. If the researcher is tasked with trying to find a pattern to fit a presumed source such as a Mill, by "identifying <and eliminating> anomalous data" as stated in the report, and 'exploring' the data by mathematically creating various calculations to represent patterns, the large number of patterns that can be created will result in the researcher's ability to show a pattern to that source. However, this does not necessarily indicate that such a pattern exists, or that the pattern is in fact statistically valid as suggested in this section. Thus, the analyses will not lead to any definitive conclusions about a source.

2. The individual acknowledged as performing the data analyses is not an author to the work plan. Since most of the methods briefly discussed rely on the relative concentrations of the congeners/homologs among samples, the sample density, detection limits, and chemical pattern will influence the chemometric analyses. We recommend that the report be revised under the partial authorship of the chemometric expert and that he establish *a priori* statistical hypotheses tests based on proven peer-reviewed literature derived patterns to demonstrate sources. This does not preclude post hoc analyses, but

provides for the report to have an opportunity to achieve its second goal in a more scientifically rigorous manner and avoid the perception of bias that can be associated with post hoc analyses.

3. Two historical sources are acknowledged in the report: The Olympic Memorial Hospital Medical Waste Incinerator and the former Rayonier Mill stacks (predominantly from the hog fuel boiler). These are approximately 2,500 feet apart based on the scale shown in Figure 1-1. Given the proximity of these sources to each other, and the report's acknowledgement that limited data confirming the congener patterns of either source are available, the study will be inconclusive regarding the attribution or assignment of a source to the various data. Since the hospital is positioned on the bluff, that stack may have been as high, or higher than the Rayonier stack. Thus, it is entirely possible that the primary and highest area of deposition was adjacent to and even overlapped the former Rayonier Mill property which is downwind. Given that medical waste incinerators have been identified by EPA as the biggest sources of release of D/Fs to the air (Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds National Academy Sciences (NAS) Review Draft EPA 2003), dismissing this source's influence because of a lack of data is inappropriate, and the report does not seem to acknowledge that no amount of mathematical/statistical calculations will ever provide data regarding the presence, height, longevity, D/F load and D/F pattern of that incinerator. Thus, the effort proposed here can not accomplish the second objective of the study.

4. As noted, the analytical method proposed is not the standard, but rather a modified method which is attempting to analyze the data at a lower concentration. This method modification may result in a mathematical change to the patterns of the congeners and homologs detected in the soil samples and thus, may invalidate the use of published reference patterns since the reference patterns were analyzed using different methods.

Ecology Response

Ecology agrees that all data evaluation approaches will proceed from one data set produced by laboratory analyses of collected samples.

See also the response to Comment 3.2, above.

None of the multivariate methods to be applied to samples in this study assumes anything about uniformity among samples or any other distributional characteristics. They are often referred to as soft methods because of the lack of assumptions about prior knowledge.

The data evaluation approaches to be used for this study do not a priori dismiss any potential sources of dioxins/furans. It is likely that two neighboring sources of dissimilar nature (congener profile, stack height, plume rise, and so on) that have operated at different times and rates would have different effects in terms of deposition to soils. Thus, even though they might be located proximally, their signatures in the environment are likely discernible. In contrast to “fingerprinting” (FALCON) data evaluation

approaches, the lack of a site-specific source signature for a possible source does not affect the application of the multivariate source apportionment methods.

Dr. Scott Ramos was consulted on multiple occasions during development of the study design. The detailed sampling approach was reviewed by him and determined to provide suitable information for chemometric analyses and source evaluations. The assumption that the statistical data evaluation methods were proposed without his participation is incorrect.

Return to Table of Contents

Letter #7 Darlene Schanfald, Olympic Environmental Committee

(From two e-mails dated June 27, 2008 and July 8, 2008)

Comment 7.1
Byproduct vs direct chlorination. I didn't see where the document said Rayonier used chlorine to brighten their pulp, which would be another reason for dioxin being an issue.

Ecology Response
Text will be added to Section 1.2 noting the use of chlorine to bleach pulp although it is not clear if the bleaching and steam-drying would produce dioxins/furans.

Comment 7.2
Three, not two, landfills were sampled. The 3rd was Daishowa's off Monroe Rd. Rayonier dumped there when it was owned by Lawson (sp?) when it was just a quarried hole in the ground.

Ecology Response
This third landfill will be mentioned in the text, noting that samples were collected. No data will be presented.

Comment 7.3
P. 4 A house fire? or burning in outdoor pits?

Ecology Response
Review of the original document that reported these elevated dioxin/furan results indicates that no explanation was provided for the elevated concentrations observed in two samples. The statement regarding a house fire will be removed from the text.

Comment 7.4
What does the last sentence mean, "single mobilization" vs "phased sample"?

Ecology Response
Samples will be collected during one field event rather than during several, phase field events over a period of time.

Comment 7.5
Last sentence in 2.2., explain a little more. "I.E. ..."

Ecology Response
The text will be revised as follows: "The statistical data analyses are expected to identify a set of source patterns contributing to soil contamination over the entire study area and the estimated contribution of each source pattern to each sampling location". See the response for comment 3.2 for more information.

Comment 7.6

So what is the next step if d/fs are found at significant levels on a property? What is the process for more in depth analysis/property and getting the d/fs removed? State this in the document so the public understands there is a next step and all this is not being done out of curiosity

Ecology Response
See General Responses #5 Outcomes and Next Steps and #3: Study Objectives.

Comment 7.7
Bullet 4; use number of samples in place of sample allocation is that is what you mean. It is less jargonized.

Ecology Response
Comment noted. Language in the text will be changed for clarity.

Comment 7.8
What will be done to insure undisturbed areas targeted for sampling do not become disturbed before sampling?

Ecology Response
We cannot ensure that property will not be disturbed prior to sampling. Available information will be used to characterize locations at the time of sampling with respect to the possibility of soil disturbance that could affect dioxin/furan measurements.

Comment 7.9
Do you really mean no houses built after "1977?" Did you mean to write "1997"?

Ecology Response
We are targeting homes built prior to 1977 in order to capture properties with at least 20 years of post-development deposition from Rayonier Mill emissions. Operations at the Rayonier Mill ceased in 1997. Measurements at properties where significant soil disturbance may have occurred more recently would likely not reflect cumulative deposition of Mill emissions very well, and would not be representative of potential community impacts. A review of building records indicates most Port Angeles residences were built before 1977, so most properties will not be excluded because of their date of construction.

Comment 7.10
4" is too deep for dioxin sampling. Sites cited in this document went down 2". In 1997, OEC wanted 1-2". Regardless of the reasoning of this depth on P. 35. 4" is too deep and risks diluting the upper soils d/f levels.

Ecology Response
See General Response 1: Sampling Depth.

Comment 7.11
Section 6.4 Tracer Chemicals: metals in soil, sediments or g-water not sufficiently elevated! Yes, there were areas with sufficient elevations. Have staff review earlier findings.

Ecology Response
Elevated metals in onsite soil, sediment, and groundwater were not emitted from the hog fuel boiler along with D/F. No other persistent chemicals, including metals, have been identified yet that were emitted to ambient air at levels justifying analysis and evaluation as indicators of impacts from Rayonier.

Comment 7.12
This lack of explanation is glaring. No reason is cited why D/Fs are being sampled and analyzed. These have significant health consequences and this fact and the consequences should be included in the report.

Ecology Response
The toxicity of and rationale for analyzing for D/F is provided in Sections 1.1 and 1.2 of the Soil Sampling Plan.

Comment 7.13
The Landfill dioxin data for the Mt Pleasant Landfill area was not used by EPA. It was poorly done. EPA hired a different company and redid all the testing in this area, including the Rayonier wetland and Morse Creek and home sites in 4 Seasons park below the dump site, on the north side of Hwy 101 and west of Cedar Park, still in your sampling area (altho' it isn't included). Higher levels of dioxin were found in the 2nd sampling. Please have E&E access and use the EPA data. I think it was released around June 1998.

Ecology Response
Comment noted. Changes will be made to Figure 1-2 and Table 1-2 to show additional soil sample locations and results.

Comment 7.14
Forested is used a lot. I would think that undisturbed vegetated areas are good sites; sites with a lot of brush.

Ecology Response
If vegetated areas are present and have not been disturbed, those areas will be considered for sampling in the absence of forested areas. Mature forested areas are generally preferred because they represent vegetated areas with a longer history since disturbance. The amount of surface area in a mature forest canopy almost certainly results in greater deposition to soils there than in non-forested vegetated areas (low brush, for example).

Return to Table of Contents

Letter #8 Washington State Department of Natural Resources

(see Appendix A)

Comment 8.1
General comment 1: The Study is well conceived and developed. The results of the sampling methodology and data analyses should be able to clarify significantly the nature and extent of dioxin/furans attributable to emissions from the former Rayonier Port Angeles Mill.

Ecology Response
Comment noted.

Comment 8.2
General comment 2: It is unlikely that the data from this study will be able to meet the second objective. The sampling is not sufficiently adequate in western parts of the city of Port Angeles to answer that question unequivocally. The sampling is clustered in the former primary wind plume of the Rayonier Mill and does not extend far enough west to include all other possible existing or former paper or wood processing dioxin/furan sources.

Ecology Response
See General Response 2: Study Area Boundaries and General Response 3: Study Objectives.

Comment 8.3
General comment 3: The data will be analyzed with complex multivariate data analyses that may not lead to conclusive determinations showing clear relationships between past and present potential sources and present dioxin levels. Because dioxins are present in the upper 6 inches or so of soil layers and urban soils are subject to high levels of disturbance, a very high level of variation may exist within the data. In addition the nature of the complex pattern of sampling may confound clear analyses of the data. Stratifying the sampling by time with an initial survey and then focusing on areas of concern should be considered. Increasing the number of samples would resolve the question, but is undoubtedly cost prohibitive.

Ecology Response
Stratifying the sampling design in time, and collecting samples in phases, could help to focus on areas of concern. Ecology, however, determined that schedule requirements would not allow for a sequential, phased approach for this study. The sampling design is stratified spatially by sampling zone, with variation of more than an order of magnitude in the density of sampling locations over the study area. This stratification in sampling density was based on several types of available information. Ecology notes that if developed properties present soil dioxin/furan data that are highly variable on a local scale, smaller initial (Phase I) studies would also be confronted with the task of evaluating data with such characteristic variability.

Comment 8.4
DNR would like to see as one of the outcomes of the study clear identification of past and present dioxin sources.

Ecology Response
See General Response 3: Study Objectives. This study seeks an evaluation of the impacts on community soils of cumulative Rayonier Mill emissions, in a setting in which it is necessary to recognize that other sources may be contributing to measured dioxin/furan concentrations. The statistical data evaluations will attempt to identify a number of contributing sources at the scale of the study area, where sources are distinguished by chemical patterns. Those identified source patterns may or may not be successfully associated with specific sources. For the purposes of this study, distinguishing between contributions from Rayonier versus other sources is the primary objective, rather than complete characterization of all other sources and their impacts.

Comment 8.5
A stakeholders group should be formed that would be able to interact effectively with the community and concerned agencies as the sampling, data analyses, interpretation of data, and explorations of alternatives take place. A stakeholders group could be an effective vehicle to coordinate and disseminate information to the community.

Ecology Response
Ecology is committed to open communication and stakeholder involvement. The agency is currently working with many different stakeholders, including local residents and study participants, other public agencies, local and county governments, the Lower Elwha Klallam Tribe, environmental organizations, businesses, educators, and the general public.

There are several ways Ecology works with stakeholders:

1. The general public is invited to comment on key documents for the study and attend public events. Broad outreach efforts include fact sheet mailers, e-mails, and news releases to announce public comment periods and public meetings. Please contact Hannah Aoyagi at 360.407.6790 to join the mailing list.

   Ecology responds to all written public comments in a Responsiveness Summary and uses feedback from public meetings to better communicate with the public. The Responsiveness Summary and all public comment period documents are available on Ecology's Web site: http://www.ecy.wa.gov/programs/tcp/sites/rayonierOffProp/rayonierOffPr_hp.htm.

2. In the past, Ecology has worked with a Regulatory Technical Advisory Group (RTAG) on the cleanup process for the Rayonier Mill property. This group consisted of federal and state agencies, the City of Port Angeles, Clallam County Environmental Health Division, and the technical advisor for the Olympic Environmental Council (OEC). Although this group no longer has a formal role in the Rayonier Mill cleanup, Ecology has kept members updated and involved in this study and with other projects related to the cleanup.

3. Non-profit organizations may apply for Public Participation Grants to help educate their communities about toxic cleanups. Currently, the OEC has a grant with Ecology for education and outreach, as well technical assistance from a consultant. Those interested in applying for a grant can contact Blake Nelson (360.407.6044) or Jason Alberich (360.407.6061) in the Solid Waste and Financial Assistance Program.

At this time, Ecology does not plan to develop a new stakeholder group or committee. However, the agency would like to work with any individuals and organizations interested in learning more about the study and providing public comments.

Comment 8.6
Ecology is to be commended for the well presented technical and public workshops held on July 9 in Port Angeles.

Ecology Response
Thank you. Comment acknowledged.

Comment 8.7
Ecology is to be commended for undertaking a unique detailed study. Hopefully, the study will lead to a clear identification of the nature and extent of the dioxin/furan contamination in upland areas of Port Angeles.

Ecology Response
Thank you. Comment acknowledged.

Return to Table of Contents