MEMORANDUM

TO: **ACWA Members with NPDES Wastewater Permits**

FROM: ACWA Water Quality Subcommittee

DATE: 25 January 2011

RE: *Influence of Changing the Oregon Fish Consumption Rate on Major Domestic NPDES Facilities Having Reasonable Potential to Exceed Water Quality Standards*

Summary

An analysis of effluent sampling results from 18 Oregon wastewater treatment plants indicates that the DEQ's proposed toxic water quality standards would not always be achieved by Oregon wastewater treatment plants, in large part due to occasional observed concentrations (including background) of legacy pollutants, such as PCBs and restricted pesticides, and naturally-occurring metals in Oregon's water. According to the SAIC report no feasible, available wastewater treatment technologies can meet the water quality standards proposed by DEQ. The only compliance alternative for Oregon wastewater treatment plants currently being proposed by DEQ would be to pursue a variance under the Clean Water Act. DEQ opines that they have substantial opportunities with timing, duration, and the form for a variance. However, due in part to the lack of experience with variances in Oregon, uncertainty exists related to the process and ultimate success of variances to ensure wastewater treatment plant compliance with applicable standards under Oregon regulations and the Clean Water Act.

Variances by definition are intended to be 'short term and temporary'. There is no expectation that Oregon treatment plants will be able to meet these effluent concentrations necessary to meet the revised toxic water quality standards due to background concentrations of legacy pollutants and metals. This analysis details the impacts on Oregon wastewater treatment plants of the proposed revisions toxic water quality standards. It concludes that as more treatment plants test for pollutants on a routine basis and at lower detection levels, most or all Oregon domestic major treatment plants will exceed the *Reasonable Potential* for exceeding water quality standards and be required to meet the standards at the edge of the mixing zone (likely not technically feasible) or apply for a variance.

Background

The DEQ is in the process of updating its toxic water quality standards.[1] As part of the standards update the DEQ is proposing to increase the fish consumption rate (FCR) used to derive human health criteria. The increased FCR to 175 grams per day will proportionally decrease many water quality criteria potential influencing permit compliance issues for sources. As part of the review, the DEQ has been evaluating compliance strategies. The compliance strategies are currently focused on variance procedures for facilities that find they cannot immediately achieve the water quality standards. There is no practical history with variances in Oregon; no water quality variance has ever been issued in Oregon. However, procedures for developing and approving variances are being developed by DEQ. It is reasonable to presume that a *Reasonable Potential Analysis* will remain an initial step in determining whether a facility may want to consider a variance.

[1] Details are posted on the DEQ web site at *http://www.deq.state.or.us/wq/standards/toxics.htm*

The number of facilities that may have a *Reasonable Potential* to exceed water quality standards that cannot be met with available technology, and will therefore need to seek a variance has not been explicitly determined by DEQ as part of the standards review. However, the DEQ and USEPA contracted in 2008 with SAIC[2] to evaluate the cost of compliance with proposed water quality standards. The SAIC report documents that, with the limited data set used, several facilities would likely have *Reasonable Potential* and need then to evaluate compliance alternatives. The SAIC report notes that for many pollutants, the lowest levels achievable through end-of-pipe treatment are highly uncertain. The report did not identify any end-of-pipe treatment technologies capable of producing the necessary effluent concentrations on a consistent and reliable basis. The SAIC report noted that there may be a need for alternative compliance mechanisms.

ACWA also provided an informal analysis of *Reasonable Potential* using limited data available from 18 (eighteen) facilities in Oregon. The ACWA analysis was consistent with the SAIC report observing the limited data set and that some facilities may have reasonable potential. Not surprisingly, the more facilities that are evaluated and the more data reviewed for selected facility, the more facilities could have *Reasonable Potential*, and the more parameters are identified as compliance issues.

Although not explicit in either the SAIC or ACWA review, the concerns with *Reasonable Potential* are not due solely to the proposed DEQ changes in the water quality standards. For some of the parameters where current analytical technology reporting levels are several orders of magnitude greater than the criteria, any observation could theoretically lead to *Reasonable Potential*. The number of facilities or parameters that may have *Reasonable Potential* could increase as laboratory detection and reporting levels become more precise. The DEQ proposed lower toxic water quality standards focus attention on this issue, making compliance more daunting by driving potential effluent levels lower and reducing effective dilution.

Despite previous efforts, it remains unclear on just how many facilities may end up with *Reasonable Potential* and therefore need to evaluate compliance alternatives. Any such evaluation of historical data will continue to be constrained by sparse data, coarse reporting levels, and incomplete data sets.

In follow-up discussion with DEQ their responses have noted more focus on strategies incorporating more data collection especially for limited data sets or limited observations. The additional data may provide better informed decision making and an opportunity to respond to false positives. The additional data, however, does not necessarily preclude an ultimate finding for reasonable potential.

Additional ACWA Analysis Completed

As part of the follow-up review, two (2) data sets were evaluated. The first was an ad-hoc data set developed by combining priority pollutant scans, monitoring required for pretreatment programs, and any ancillary data a facility may have provided. This data set was provided voluntarily from those ACWA members who chose to participate.

There was no common data set, reporting level, or submitted data. However, the data set provided a representative screening of data currently available. The DEQ has most of this data but it would be a daunting task to search paper files and compile it into a more complete electronic data set. The

[2] *Cost of Compliance with Water Quality Criteria for Toxic Pollutants for Oregon Waters,* June 2008, Science Applications International Corporation (SAIC)

second data set is the initial SB 737 data[3]. Under SB 737, Oregon's largest wastewater treatment plants are testing their wastewater effluent for 117 of the 118 Priority Persistent Pollutants established by Oregon DEQ. These Priority Persistent Pollutants are not water quality standards. The SB 737 data was not collected to evaluate *Reasonable Potential*. However, the SB 737 data provides a unique picture of the distribution of several water quality constituents for a single sampling event covering the major 52 Publically Owned Treatment Works (POTWs) in Oregon. For some of the parameters (e.g. PCBs), lower detection levels were available for the SB 737 monitoring than usually used in water quality sampling efforts.

The attached spreadsheet (Table 1) reviews data provided by 18 facilities. One facility provided two data sets, one of which was a subset of a broader data set. These two submittals were reviewed separately for a general Quality Assurance (QA) review. For all facilities data, the effluent data is compared to the proposed criteria using a fish consumption rate of 175 grams/day as calculated using the US EPA equations. Because the monitoring requirements vary by facility and there is no common data set, the absence of a parameter associated with a facility does not necessarily mean that there is no *Reasonable Potential* - it could simply mean that there was never any monitoring for that parameter at that facility.

The analysis attempted to determine effective dilution needed to ensure there would be no *Reasonable Potential*. Effective dilution (ED_F) differs from volumetric dilution (D_f) by accounting for the background concentration of the pollutant parameter. For example, when the background concentration exceeds the criterion concentration the effective dilution becomes zero (0) regardless of the amount of volumetric dilution, ——, . Two estimates of the effective dilution needed to preclude *Reasonable Potential* are presented.

The first approach employed the method DEQ indicated to ACWA in a meeting focused on this issue that said they would use for *Reasonable Potential*, as outlined in the DEQ Internal Management Directive for Reasonable Potential Analysis for Toxic Pollutants (September, 2005)[4] . An estimated maximum concentration is derived by applying a multiplier to the observed maximum. The multiplier is derived using the USEPA-TSD equation based on a probability factor, confidence intervals, and the coefficient of variation. This estimated maximum is then divided by the criterion concentration to derive the dilution factor (DF=DR +1). The result provides an estimate of the effective dilution needed to ensure that there would be no *Reasonable Potential*. This method is more conservative than that used by SAIC. The SAIC report used the geometric mean for carcinogens and applied the same US EPA multiplier equation .

The second approach estimated the geometric mean and divided that by the water quality criterion to derive a dilution factor. The geometric mean was estimated in several ways, by direct calculation when data was above reporting levels, using censored estimates for non-detects when adequate observed data available, or by assuming all non detects were zero for calculating a geometric mean. The two methods provide boundaries for very simple approaches to *Reasonable Potential* with limited data.

The attached Table 1 (Spreadsheet) presents the calculation of the dilution factor for each facility providing data. The evaluation focused on the organics and pesticides, with a cursory evaluation for

[3] See http://www.deq.state.or.us/wq/SB737/index.htm accessed on 1/22/11
[4] See http://www.deq.state.or.us/wq/pubs/imds/rpatoxics.pdf accessed on 1/22/11

arsenic when provided. Other metals were not evaluated. Results for pollutants not exceeding potential water quality criteria are not presented.

The effective dilution needed to avoid *Reasonable Potential* is identified for each parameter by facility. For the carcinogen pollutants, the dilution factor would be that which occurs at the edge of the assigned mixing zone at the harmonic mean flows. The US EPA Technical Support Document[5] notes that reach averaged dilution should only be used when the human health criteria explicitly allow for it in the standard. The effective dilution is not identified for each facility. The notes provided volumetric dilution for some of the facilities. Volumetric dilution at the harmonic means varies widely for sources. For some of the facilities evaluated, the harmonic mean volumetric dilution was determined to be less than 10. Other facilities had harmonic mean volumetric dilution in the range of 30. For mid sized major POTWs with multiport diffusers discharging to large streams, such as Corvallis and Albany that discharge to the Willamette, harmonic mean volumetric dilution is in the range of 100 to 150. For any background concentration assumed or known to be greater than zero (0), the effective dilution would be less than the volumetric dilution. However, little background data was developed for this analysis.

The results from the review of the ad-hoc data set are consistent with the SAIC report and previous efforts to compile human health toxic data from the wastewater treatment plants. The ACWA analysis found additional parameters would have Reasonable Potential issues than the SAIC report. This is expected due to differences in the period used for review, and the reporting levels. The SAIC identified reasonable potential looking at a limited data set for a several facilities. Not surprisingly, looking at more facilities for longer periods of time generates similar results or more potential *Reasonable Potential* issues.

Categories of Pollutants Likely Exceeding Reasonable Potential

Depending on how DEQ approaches the *Reasonable Potential* (e.g. period of data set used, response to single or limited observations, subsequent monitoring or verification requirements, application of qualified data, reporting levels, etc.) several facilities may be found to have *Reasonable Potential.* The approach could influence if facilities have *Reasonable Potential*, but also the timing of when and how *Reasonable Potential* may be found for a facility. For example, one facility has one value above reporting that is ten years old, which may not be a driving data point.

The results can be discussed by categories including:

- Legacy pesticides and industrial compounds (PCBs, DDT/DDE/DDD and other restricted pesticides)
- Consumer products (Bis -2 ethyl phthalate)
- Industrial chemicals (PAHs)
- Metals including metalloids, other compounds (Arsenic, Mercury)
- Chlorine disinfection by-products

The categories may also facilitate discussion on approaches for reducing ambient concentrations of pollutants exceeding water quality criterion.

[5]Technical Support Document for Water Quality-Based Toxics Control, US EPA, Office of Water EPA/505/2-90-001, March, 1991

Legacy Pollutants

The legacy pollutants are characteristically limited and often single observations. For at least one of the observations, an apparent paired sample was below detection levels. Population characteristics, geometric means, distribution, maximums, from these samples are uncertain at best. The observations are not presented as a percentage of the observations above either the detection level or reporting levels. One facility had qualified data reported (above reporting levels but verification data differed by > 25%). Estimated values above detection but below reporting levels were not identified. Some facilities provided positive values above identified reporting levels but below those quantitation levels identified by DEQ which could influence the ***Reasonable Potential.*** Even with limited sampling - - often only one or two samples - - the frequency of observation above detection indicates that the pollutants may well be present in POTW effluent. For many of the legacy pollutants, the criterion concentrations are so far below reporting levels that any reportable observation could lead to ***Reasonable Potential***, even at current Oregon water quality toxic criteria. Legacy pollutants would be expected to be present in POTW effluent in part due to their conservative structure, widespread presence in the environment, and physical properties, such as partitioning, that effect treatment. There are not likely to be existing industrial or commercial sources.

Consumer Products

The consumer products, primarily 2-Bis-Ethyl Phthalate, show up occasionally (one-third of the facilities analyzed in the SAIC report, for example) in effluent, with some facilities having multiple observations. The 2-Bis-Ethyl Phthalate is a ubiquitous plasticizer present in the environment and in wastewater. The change in water quality criteria results in effective dilution requirements that could lead to ***Reasonable Potential*** based on the limited monitoring. Both the SAIC report and the ACWA data review found 2-Bis-Ethyl Phthalate in effluent at multiple facilities. As noted by SAIC, 2-Bis-Ethyl Phthalate is notorious for monitoring difficulty due to the use of plastics in laboratory sampling and analysis equipment.

Industrial Chemicals

The Industrial Chemical grouping includes Polycyclic Aromatic Hydrocarbons (PAHs). Example PAHs include: acenaphthene, benzopyrene, chrysene, fluorene , pyrene and others.

The PAHs can result from incomplete combustion and have natural and diffuse sources to a waste stream. The PAHs observed that may lead to ***Reasonable Potential*** were limited to a few facilities and observations and may be related to a source which may include current industrial use. For some of the PAHs, the observed values were below the Quantitation Level (QL) provided by DEQ but above the reporting levels provided of the sample.

Chlorination By-Products

Chlorination By-Products are likely the result of disinfection with chlorine. These pollutants are certainly associated with drinking water and are therefore a source to the POTWs. However, the chlorine by-products may also be associated with the use of chlorine as a disinfection agent at the wastewater treatment plant following treatment.

Metals, including Arsenic

For the ACWA ad-hoc data set, arsenic was the only metal evaluated. As noted elsewhere, naturally occurring concentrations of arsenic due to Oregon's volcanic soils may result in very limited effective dilution available for arsenic. Effluent levels appear to frequently exceed criterion concentrations. DEQ has suggested changing the criteria to better reflect natural concentrations. Should the suggested changes provide effective dilution or exceed effluent concentrations, it would provide a broad resolution.

The Senate Bill 737 monitoring results can be used to illustrate the distribution of arsenic in effluent compared to water quality criteria. The observed total arsenic concentrations are well above the current level of proposed criteria making *Reasonable Potential* nearly universal. The DEQ suggested and subsequently withdrew a proposal for a higher criterion concentration[6]. At a higher criterion concentration only about 10 percent of the facilities sampled exceeded criteria. At a higher concentration a better understanding of organic /inorganic ratios, background concentrations and dilution would be needed to estimate *Reasonable Potential*. However, it is likely that even at the higher criterion concentration suggested that several POTWs could have *Reasonable Potential*.

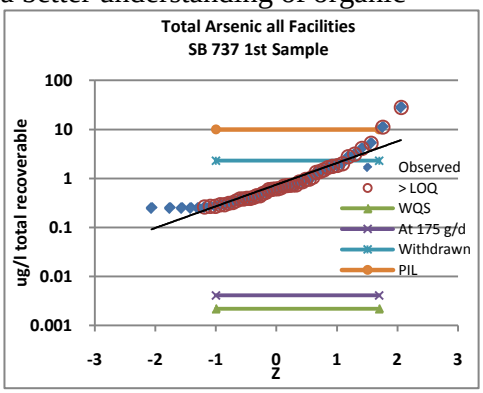


Table 3

Summary of likely *Reasonable Potential* using geometric means From Table 1 At assumed dilutions (Likely > 100)

	RL < 0.05 ug/l		RL > 0.05 ug/l	
	N <7	N>7	N<7	N>7
Likely	2	5	2	0

Analysis Summary

Table 3 shows the number of facilities in the ad-hoc data set evaluated that could have *Reasonable Potential* based on frequency of monitoring and reporting levels used. The facilities characterized as likely or certain using the geometric means were tabulated separately from those with less of an indication the *Reasonable Potential* would be found. A monitoring frequency of 7 was used to sort relative frequent from infrequent monitoring. A reporting level in the range of 0.05 ug/l for the DDT(DDE) was used to characterize levels where pesticides may be found. Arsenic *Reasonable Potential* was not included in Table 3 (above) using the ad-hoc data set and is discussed later in this memo. As a generality and based on a limited ad-hoc data set, the more samples analyzed at lower detection limits will increase the risk of *Reasonable Potential*.

Additional PCB Analysis

The SB 737 total PCB monitoring provided data at a resolution not typically provided by the priority pollutant scans[7]. The SB 737 used a reporting level of 0.1 ng/l as opposed to the DEQ identified quantification level of 0.5 ug/l. The distribution for the single sample event can be compared to the proposed and existing criteria. The facilities with observed PCBs above reporting levels exceed either the current or proposed water quality criteria using 175 grams per day. This data provides and

[6] See http://www.deq.state.or.us/wq/standards/metals.htm accessed on 1/22/11

[7] The 126 pollutants regulated by EPA as 'priority pollutants' are listed at *http://www.epa.gov/ne/npdes/permits/generic/prioritypollutants.pdf, accessed on 1/22/11*

indication that lower reporting levels may find pollutants at facilities where coarser reporting levels did not.

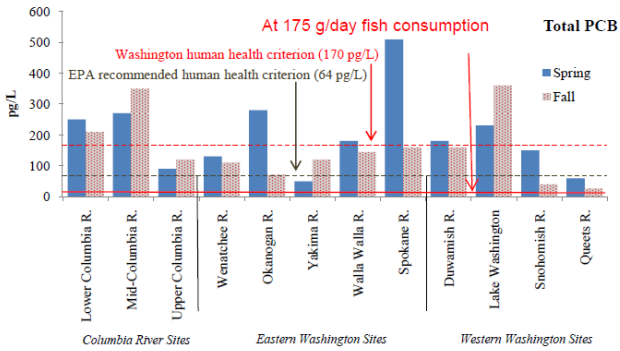
The observed range of PCBs at POTWs is similar or on the low end of what has been reported for PCBs in POTW effluent elswhere. The State of Washington has been monitoirng PCBs in several studies. Average concentrations for POTWs to Washington streams reported by the Washington Deparatment of Ecology (DOE) varied between 0.33 (Pullman) to 1.8 (Spokane) ng/l[8]. For selected municipal facililities discharging in the San Francisco Bay, the observed PCB concentration appears dependent on the level of treatment with an average total PCBs for secondary wastewater treatment plants reported as 3.46 ng/l and advanced secondary treatment plants at 0.208 ng/l[9]. New Jersey reports a range of average total PCB concentrations from 23 POTWs from 6.8 to 23 ng/l[10].

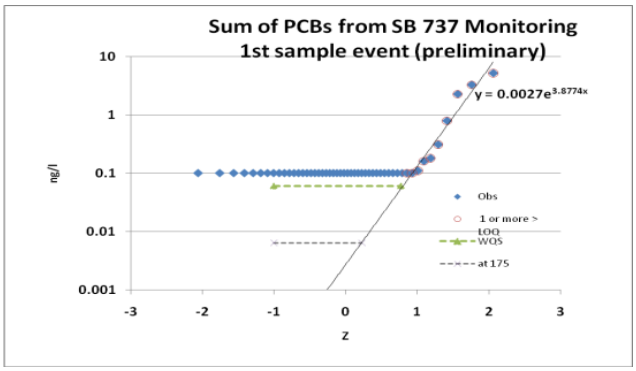
[8] Washington Department of Ecology (DOE), 2002, DOE 2010, DOE 2010

[9] California Regional Water Quality Control Board, San Francisco Bay Region February 13, 2008)

[10] Pecchioli J.A. and G. M. DeGraeve 2008

The State of Washington has conducted a survey of PCBs and other toxic pollutants throughout the state. If results are comparable to Oregon waterbodies, the State of Washington survey indicates there may be limited effective dilution available for PCBs due to existing ambient concentrations. The Washington survey used selected sites. Some of the sites represent areas where fish tissue or previous data indicated the potential for elevated toxics. Other sites, such as Queets River in the Olympic National Park, provide reference conditions for uncontaminated sites. Semi-permeable membrane sampling methods (SPMD) were used to provide a measure of the dissolved concentrations. Like Oregon, the State of Washington does not currently list waterbodies on the 303(d) list using semi permeable membrane technology.





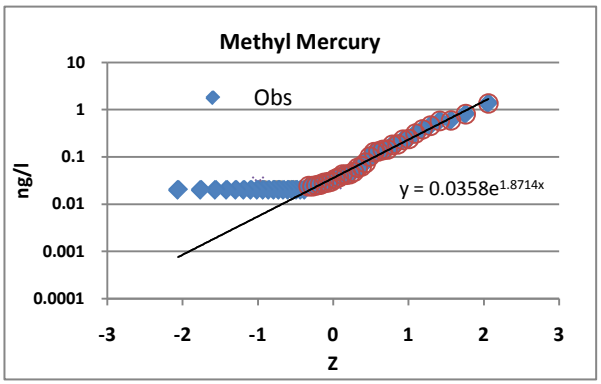
However, the SPMD provides a method for estimating low dissolved concentrations. The State of Washington calculated total concentrations from the measured dissolved concentrations. PCBs were measured at all sites during the 2008 sampling in the spring and fall. All dissolved measures exceeded the total PCB criterion concentration using 175 grams / day fish consumption standard.

The State of Oregon and the USGS have deployed semi permeable membranes in the Willamette River. The membrane results from 2003/2004 varied from below reporting levels of < 2.9 ng/l, through arrange of 0.29 ng/l to 1.6 ng/l. The US Geological Survey (USGS) results in 1997 were 2000 pg/l as reported in table 19, DOE 2005 – see below. The USGS noted that results using the membranes could vary by an order of magnitude. Fish tissue results provide corroborating evidence of the presence of PCBs in the Willamette River. The Mid- Willamette study observed that PCBs are the primary contributor to the calculated cancer risk resulting from consuming fish taken in the mid-Willamette River. Sethajintainin et al. (2001) observed that fish tissue levels in the Portland Harbor exceed the US EPA safety screening level.

As monitoring information increases and more refined reporting levels are used, the *Reasonable Potential* issues for PCBs may increase and be similar for many POTWs in Oregon. Effective dilution may not exist at the proposed water quality criterion, effluent concentrations may exceed criteria, and PCBs may be present in fish tissue. Since the criterion is for total PCBs, the actual PCBs or congeners distribution in effluent, ambient water, and fish tissue may not be the same.

Additional Mercury and Dioxin Analysis

The SAIC report also identified *Reasonable Potential* for both mercury and dioxin (2,3,7,8-TCDD). The SB 737 monitoring did not provide measures of dioxin above the detection level used for any of the 52 treatment plant effluent in the first round of sampling. The SB 737 provided a measure for methyl-mercury. The state has proposed a fish tissue level for mercury, but not an ambient criteria concentration. An ambient concentration can be estimated using the fish tissue criteria, as suggested by SAIC. The dissolved methyl mercury concentration estimated for the Willamette as part of the total mercury TMDL provides a reference for at least several of the major POTWs. The total methyl mercury concentrations suggest that several sources exceed the equivalent dissolved methyl mercury concentration calculated for the Willamette River. Facilities may have *Reasonable Potential* should equivalent concentrations be calculated and additional data be collected. However, the Willamette Mercury TMDL[11] provides an example of how a basinwide TMDL can evaluate contributing sources, describe relative contribution, and develop implementation .



The attached spreadsheet summarizes the ACWA data review and highlights pollutants were *Reasonable Potential* may exist.

[11] See http://www.deq.state.or.us/wq/tmdls/docs/willamettebasin/willamette/appxbmercury.pdf, accessed on 1/22/11