Prince William Sound
Regional Citizens Advisory Council

Review of EPA Draft Permit, Fact Sheet, and Other Documents for Proposed Reissuance of Valdez Marine Terminal NPDES Wastewater Discharge Permit (AK-002324-8)

Seven-tray air stripper units at the reconfigured VMT BWTF (photo: J.A. Kalmar)

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Selected Abbreviations, Acronyms, and Units Used in Report

ADEC – Alaska Department of Environmental Conservation
AHC – aliphatic hydrocarbons (also sometimes referred to as saturated hydrocarbons – SHC)
AMT – Alyeska Marine Terminal (aka VMT in permit)
AMT-S – Alyeska Marine Terminal Sediment Sampling Site (LTEMP)
AWQS – Alaska Water Quality Standard
AZB – acute zone boundary
bbl – barrel (42 gallons)
BMP – Best Management Practices
BOD – biological oxygen demand
BOD_5 – amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter
BTEX – benzene, toluene, ethylbenzene, and xylene(s)
BTT -- Biological Treatment Tank
BWTF – Ballast Water Treatment Facility
CIRCAC – Cook Inlet Regional Citizens' Advisory Council
CTD – conductivity, temperature, density (classical water column parameters)
DAF – dissolved air floatation
DMR – discharge monitoring report
EMP –Environmental Monitoring Program
ERL – Effects Results- Low
ERM – Effects Results- Moderate
EVOS – *Exxon Valdez* oil spill
FC – fecal coliform bacteria
FID GC – flame ionization detector gas chromatography
GC/MS – gas chromatography/mass spectrometry
GOC – Gold Creek Sampling Site (LTEMP)
GPD – gallons per day
gpm – gallons per minute
HPAH – higher-molecular-weight PAH (4-6 ringed compounds) summed in Table 2-4 (p 41) of Blanchard et al. (2011) for data analysis
IC_{25} – inhibitory concentration, 25%
IWSS – Industrial Wastewater Sewage System
kg/m^3 – kilogram per cubic meter (part per thousand)
KLI – Kinnetic Laboratories, Inc.
LPAH—lower-molecular-weight PAH (2 and 3 ringed naphthalene through phenanthrene) summed in Table 2-4 (p 41) of Blanchard et al. (2011) for data analysis
LTEMP – Long Term Environmental Monitoring Program
MDL – method detection limit
mg/L – milligrams per liter (parts per million)
MGD – million gallons per day
MZB – mixing zone boundary
ng/g – nanograms/gram (parts per billion)
ng/L – nanograms/liter (parts per trillion)
NIST – National Institute of Standards and Technology
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration

NOEC – no observable effect concentration
NPDES – National Pollutant Discharge Elimination System
NRDA – natural resource damage assessment
PAH – polycyclic aromatic hydrocarbons (sometimes referred to as polynuclear aromatic hydrocarbons)
pH –alkalinity/acidity index (-logarithm of hydrogen ion concentration, ranging 0 to 14)
POTW – Publically Owned Treatment Works
PRP – potential responsible party
PWS – Prince William Sound
PWSRCAC – Prince William Sound Regional Citizens' Advisory Council
QA – quality assurance
QAP – Quality Assurance Plan
RCAC – Regional Citizen's Advisory Council
RTO -- Regenerative Thermal Oxidizer
S/T – steranes/triterpane oil biomarkers
SBR – sequencing batch reactor
SERVS – Ship Escort Response Vessel System
SHC – saturated hydrocarbon(s)
sigma-t – density of water (kg/m^3) -1000, i.e., 1025.4 kg/m^3 becomes 25.4 sigma-t
SIM – selected ion monitoring
SOPs – standard operating procedures
SRM – Standard Reference Material (usually developed by NIST)
TA – TestAmerica Corporation
TAH – total aromatic hydrocarbons (defined in the Permit as only BTEX)
TAqH – total aqueous hydrocarbons (defined in the Permit as TAH plus EPA Priority Pollutant PAH)
TARO – Total Aromatics (summed by Blanchard et al. (2011) to include only the 18 EPA Priority Pollutant PAH that were historically analyzed in the EMP between 1989 and 2010)
TDI – contract analytical lab in College Station, TX performing Method 8270D
TOC – total organic carbon
TPAH – total PAH
TROG – total recoverable oil and grease
TSHC – total saturated hydrocarbons
TSS – total suspended solids
TU_a – acute toxicity unit
TUc – chronic toxicity unit
µg/L – microgram per Liter (part per billion)
USCG – United States Coast Guard
VOCs – volatile organic compounds
VMT – Valdez Marine Terminal (aka AMT by LTEMP)
WET – Whole Effluent Toxicity

Review of EPA Draft Permit, Fact Sheet and Other Documents for Proposed Reissuance of Valdez Marine Terminal NPDES Wastewater Discharge Permit (AK-002324-8)

Executive Summary

The overall objective of the Ballast Water Treatment Facility (BWTF) is to recover oil from ballast water and to treat runoff from rainfall and snowmelt, crude storage draws, and miscellaneous site process waters introduced through the Industrial Wastewater Sewage System (IWSS) prior to discharge. Since the last NPDES issuance, the BWTF has undergone a significant reduction in volumes processed which has necessitated a system redesign. In short, the system has been redesigned with surplus capacity (10MGD for the current 2MGD flow).

The proposed NPDES permit is essentially a renewal of permissions, with modest modifications to previously permitted operations, to continue discharging treated ballast water. But with onsite waste products becoming equal or more dominant in proportion to the (now cleaner) ballast water, we don't know what to expect or to be monitoring for. Oily ballast water will comprise only 25-55% of the future influx and the onsite IWSS influents are likely to be much more variable in composition than the consistently-oiled ballast water. We suggest a special study to characterize the effluent stream from the redesigned system under various flow and seasonal conditions to more fully understand the BWTF constituents and treatment efficacy.

Another concern is the changing salinity of the incoming wastewater; it has historically been a saline system with tankers emptying up to 20 MGD of oceanic water into the process. With reduced ballast input and record rain and snowfalls within the last few years, how do the quickly changing saltwater/freshwater conditions affect the bacteria living in the BTT?

While we find it highly commendable for Alyeska to propose reducing the mixing zone to 50 m, we still have little confidence in the modeling that determines its theoretical boundaries. The model of plume behavior is again computed using conditions measured only once, on one day in October, 1971 (Table 2) and makes no attempt to incorporate the water column's dramatic seasonal mixing and stratifying. Circumstantially, EMP and LTEMP results are still showing some evidence of oil in sediments nearby the diffuser, thus demonstrating oil is reaching the sediments. Does the plume contact the bottom under unanticipated conditions? We recommend collecting seasonal water structure data (CTD) at the diffuser location to create a more realistic model and thus better assurance of mixing compliance.

Mentioned in the last NPDES review, we again strongly advise analyzing effluent and environmental samples for the full suite of alkylated PAH. This is the standard regulatory, research, and industry practice for unambiguously tracking petroleum products in the environment. To continue the current practice, reporting just a subset (<4-10%) of the PAH suite, seriously compromises the ability to understand BWTF efficacy, output composition, and the effluent's transport-and-fate in the environment. The knowledge is available, the method is available, and the need is unquestionable.

The requirement for Benthic Biological Monitoring has been removed from the Alyeska Environmental Monitoring Program in spite of the fact that at the shallow stations, abundance, biomass, and the number of taxa were overall lower at stations near the diffuser compared to reference stations. Dropping infauna monitoring was justified by the absence of direct correlation with measured hydrocarbon components in the sediments; mostly non-quantified environmental factors were postulated. We suggest that better correlations could have been made with sediment hydrocarbon chemistry had a more representative suite of alkylated PAH been examined. Further, at TDI, the contract laboratory, alkylated PAH data are being acquired using the analytic methods but are not being reported. It would serve the credibility of the EMP's benthic monitoring component to acquire the historic alkylated PAH data and reevaluate their conclusions. Note that this is the second time this facility has been exempted from biological monitoring requirements. In 1996, monitoring mussels was dropped from the permit, ironically because the chemistry data generated by an inadequate method was producing inconclusive results.

Whole effluent toxicity test (WET) has been a reassuring albeit infrequent component to the effluent monitoring. We support the inclusion of the WET Monitoring with the new species and the increase to quarterly frequency particularly considering the changing nature of the effluent composition.

Based on DMRs, the treatment processes are capable of achieving the applicable Total Aromatic Hydrocarbons (TAH; effectively BTEX as defined by the Permit) and Total Aqueous Hydrocarbons (TAqH) water quality criteria at the edge of the mixing zone. However, we again question the permit terms denying the need for TAqH limits and the need for additional monitoring during special events. We suggest increased monitoring and reporting for both TAH and TAqH during all significantly different treatment system operational conditions during the month (e.g., tray air strippers on and off, BTT operational and non-operational, wastewater flow rates exceeding the 3,850 gpm maximum capacity of the tray air strippers) including sampling following any one weather event during the month when the percentage of fresh water (rainfall and snowmelt) exceeds a significant percentage (e.g., 25%) of the daily flow volume.

Background and Conceptual Issues

The Ballast Water Treatment Facility (BWTF) system at the Valdez Marine Terminal (VMT) processes both ballast water from tankers and influents from onsite via the industrial waste sewage system (IWSS) prior to discharging them into Port Valdez. The overall objective of the BWTF is to recover oil from ballast water and to treat runoff from rainfall and snowmelt, crude storage draws, and miscellaneous site process waters introduced through the IWSS prior to discharge. The BWTF treatment process equipment includes two ballast water storage and gravity separation tanks (90s tanks), two covered dissolved air flotation (DAF) cells, four shallow-tray air strippers (three may be operated in parallel with a fourth on standby), a single remaining biological treatment tank (BTT), and packed-tower air strippers. Vapors (including BTEX and other volatile organic compounds (VOCs)) are trapped and removed from the 90s tanks, the DAF cells, and the shallow-tray air strippers. The 90s tank's vapors are burned to generate electricity or incinerated in the VMT's original incinerators, while the vapors from the DAF cells and the shallow-tray air strippers are destroyed in a Regenerative Thermal Oxidizer (RTO) that requires additional propane for operation. Oily water waste recovered during treatment is routed to the 80s recovered crude oil tanks for gravity separation after which the water goes back into the 90s tanks and the oil is loaded onto tankers. Processed effluent from the BTT (and optional packed-tower air strippers) is discharged into Port Valdez from Outfall 001 located 356 m offshore at 62-82 m through a 63 m-long multiport diffuser.

Since previous periods of NPDES permitted operation, the BWTF has undergone a significant reduction in volumes processed. Operations, curtailed by reduced North Slope production and segregated-ballast tankers, are currently discharging approximately 2 MGD (million gallons per day), well below the proposed permit limits of 10.1 MGD (based upon the maximum throughput of the two DAF cells, 7000 gpm each). Additionally, an optional processing step has been added to the system comprising three shallow 7-tray air strippers to remove soluble and volatile hydrocarbons during periods of high BTEX. The maximum throughput for the three air strippers operating in parallel is 3,850 gpm total, roughly one half of the maximum permitted daily flow rate. In short, the system has been redesigned with surplus capacity to more effectively remove soluble hydrocarbons, recover waterborne oil, biologically degrade what remains and dilute the discharge plume by mixing in the ambient waters of Port Valdez.

Sanitary wastes from the VMT are processed on-site through a fill and draw activated sludge sequencing batch reactor (SBR) that can treat 10,000 gallons per day (gpd) before discharging through Outfall 002 in 12 m of water. Historically, Alyeska has generally achieved sanitary waste discharge compliance within previous limits, and technology based limits are justified for BOD5, TSS, and total residual chlorine discharged through Outfall 002. Fecal Coliform (FC) and *Enterococci* limits are new with the permit re-issuance; everything else is retained from the previous permit. A fecal coliform and *Enterococci* effluent study is required for Outfall 002 within 18 months of permit issue. New treatment designs are due to ADEC within 24 months, and a new disinfection treatment process must be installed and operational within 36 months. Detailed reports on progress with fecal coliform and *Enterococci* effluent treatment improvements are due to EPA and ADEC semiannually. Currently, Fecal Coliform is measured at the property boundary (shoreline near the diffuser) rather than at the edge of the mixing zone for Outfall 002; it is unclear where *Enterococci* monitoring will be conducted, but presumably it will be from the same location. We believe that these elements of the Permit are adequate.

Concerns raised during our review of EPA's draft NPDES permit, fact sheet, and associated permit application documents (released for public comment on February 8, 2012) are presented in the following sections.

BWTF Influent Composition

Alyeska is to be commended for generally operating within the permitted limits for Total Aromatic Hydrocarbons (TAH) defined as benzene, toluene, ethyl benzene, and xylenes (BTEX) during the past permit period, and this is particularly true since the BWTF reconfiguration in mid-February 2011 (Figure 1). An obvious concern, however, is that the VMT is entering a new phase of operation with a modified system and with lesser volumes which will result in changing the proportions of influents in a

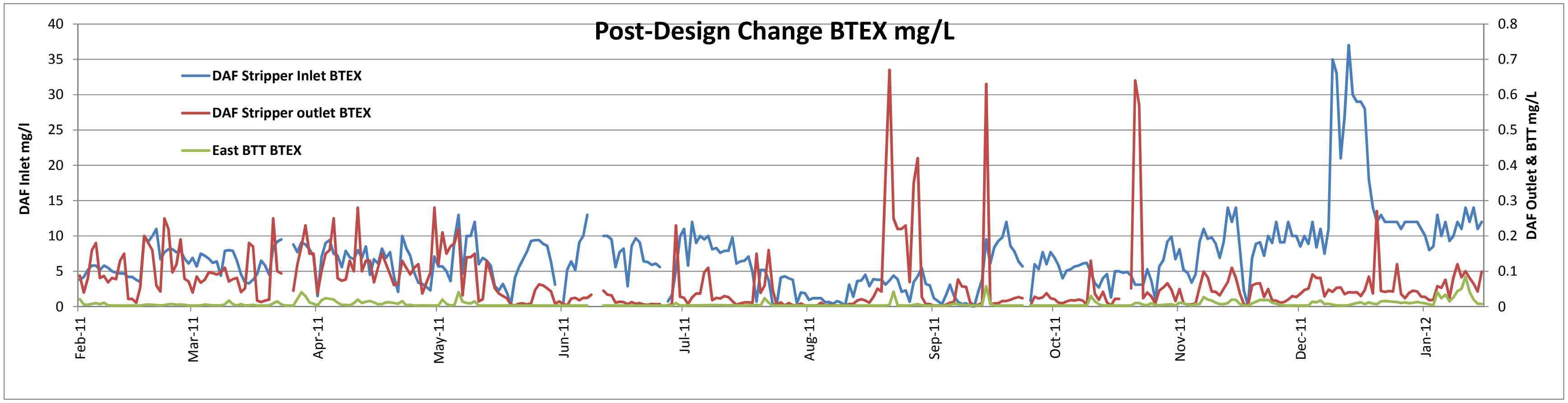

Figure 1. Measured BTEX concentrations in the DAF air-stripper inlet, DAF air-stripper outlet, and BTT effluent since the BWTF reconfiguration in February 2011. Note the different concentration scales for the DAF air-stripper inlet (left axis) and the DAF air-stripper outlet and BTT diffuser (right axis).

system primarily designed to process bulk volumes of oily water. There are various estimates in the Factsheet, Best Management Practice (BMP) Plan, and other documents stating that the once dominant oily ballast water will comprise only 25-55% of the future influx. Areas served by the IWSS which may contribute contaminates from spills or leaks include, but are not limited to: the tank farms, power generation/vapor recovery area, fuel storage and loading areas, emergency response building (which includes the laboratory and otter cleaning station), the sludge tank area, transformer dike areas, berths, fire pump buildings, west metering facilities, maintenance/warehouse area, SERVS and SERVS vessels including tank vessel escort tugs, discharge bilge waters, and oil spill waters.

Fortunately, the VMT's BMP Plan comprehensively lists the major and minor sources and estimates average flow for each albeit some are seasonal or special-event related (Table 1). Although dated 2011, the table suggests an average total flow of 130,000 bbl/day (~5.5 MGD) ignoring extraordinary contingency sources (e.g., oil-spill event wildlife wash water). Tanker ballast alone is estimated at 4.2 MGD. Although the values in this table are similar to the average monthly flow limit in the Permit Fact Sheet, they don't seem to reflect the reality and thus the true mixture of influent constituents. We suggest this table needs to be amended, perhaps to show current and expected future operations as well as the conceptual higher capacity total discharge value. The Mixing Zone Application makes future estimates with production further decreasing and ballast water effluent comprising only 41.3%.

As a general comment, this compilation (Table 1) is symptomatic of the entire permit. The permit is essentially a renewal of permissions, with modest modifications to previously permitted operations, to continue discharging treated ballast water. Yet oily ballast water is no longer the primary component of the waste stream. In fact, we don't really know what constituents to expect exiting the BTT diffuser into Port Valdez. In previous years, we knew that a consistent Alaska North Slope crude oil signature albeit of varying concentration and states of weathering should be expected. Indeed, as volumes decreased, both the PWSRCAC Long Term Environmental Monitoring Program (LTEMP) and the VMT Environmental Monitoring Program (EMP) were seeing decreased signatures that were becoming more pyrogenic than petrogenic in nature. But with onsite waste products becoming equal or more dominant in proportion to the (now cleaner) ballast water, we don't know what to expect or to be monitoring for. Under the old, higher-flow conditions, ambient air and water temperatures made a huge difference in the degradation rates, overall PAH load, and effluent composition, and this is likely to be even more of a factor under the anticipated future lower-flow conditions. See the discussion below for seasonal alternations to the polycyclic aromatic hydrocarbon (PAH) composition historically measured in the BTT effluent. In addition to temperature effects, the lower flows may result in low biomass, potentially starving the BTT bacteria under certain conditions.

We would suggest a special study to characterize the effluent stream from the redesigned system under various flow and seasonal conditions to more fully understand the BWTF constituents and treatment efficacy. At a minimum, we would like to see a broad spectrum analysis of hydrocarbons and other constituents using full-scan GC/MS in addition to selected ion monitoring (SIM) GC/MS to include alkylated PAH, aliphatics, and sterane/triterpane biomarkers (all available using EPA methods 8260 and

Table 1. BWTF Influent Sources, Valdez Marine Terminal, adapted from Alyeska Marine Terminal Ballast Water Treatment Best Management Practices Plan, MP-69-1, Edition 2, Rev 11, effective date 3/22/11.

est flow (bbl/day)		est flow (bbl/day)	
0.4	Chemicals for water treatment maintenance/processing/analysis	2,000	Crude oil
2	Concentrate fire foam	0.333	Crude oil residues
3,000	Fire Water[1]	786	Crude oil and diesel tank
50	Dilute fire foam[2]	370	Tank cleaning solution water draws
<0.01	Waste glycol	8000	Hydrotest water[3]
2	Dilute glycol	2,500	Oil spill cleanup water
240	Potable, raw, salt water	100,000	Tanker ballast
11,000	Rain and snow melt	5,000	Oil recovery system water
1,500	Scrubber water	26.6	Service vessel bilges and draws
2,000	Boiler blowdown	33	Sludge processing filtrate slops
14	Filter backwash	2	Hydrogen peroxide
300	Washdown water	5	Dilute polymer
3	Dry firefighting chemical	8	Nutrient
121	Knockout water[4]	2	Corrosion inhibitors
<1.00	Degreasers	<0.10	Chemicals used for laboratory tests
1	Diesel fuel	2,000	Wildlife wash water
<0.03	Gasoline	1,400	Groundwater
0.03	Lubricating oils	0.13	Hydrochloric Acid
<0.03	Hydraulic fluids	40	Gray water
**	Transformer fluid[5]	**Total** ~140,000 bbl/day (5.88 MGD)	

[1] More fire water is generated in winter than in summer.

[2] Approximately 70 bbl of dilute fire foam is generated during fire training exercises.

[3] Hydrotest water includes water used to lift floating roofs and up to 500,000 bbls per event may be generated.

[4] More knockout is generated in spring than in winter.

[5]Waste not routinely generated. Enters BWTF on emergency basis only.

modified 8270D—see further discussion below). Considering the industrial origins of the waste, we also support precautionary, periodic scans of the outfall effluent for heavy metals and persistent organic pollutants (halogenated compounds and other constituents from cleaning agents, solvents, bilge washes, surface runoff, etc.).

Alyeska may have already accomplished studies such as these and needs only to make the data available. If results show benign levels of contaminants, then the BWTF could confidently continue operating within its Management Practices. If a problem contaminant appears, then it may require further monitoring or an operational solution to identify and minimize the risk.

Salinity Effects on BTT Efficiency

Another concern is the changing salinity of the incoming wastewater. From our own studies (Payne et al., 2005 b,c), the BWTF is quite effective at degrading BTEX, saturated hydrocarbons (SHC), and selected lower-molecular-weight PAH, but it has historically been a saline system with tankers emptying up to 20 MGD of oceanic water into the process. With reduced ballast input and record rain and snowfalls at times within the last few years, are precipitation patterns changing and how do the quickly changing saltwater/freshwater conditions affect the bacteria living in the BTT? If there are bacterial die-off events in the BTT with the changing conditions, how does a microbial decline affect efficiency of degrading hydrocarbons, and how long does it take to recover the populations? The DMRs do not report salinity. Does Alyeska have data showing the system's effectiveness during lower salinity conditions? Is operational mitigation required or feasible?

Mixing Zone Modeling and Assumptions

The modeling for the mixing zone is also a concern. While we find it highly commendable for Alyeska to unilaterally propose reducing the mixing zone to a miniscule 50 m (relative to the previous zone), we still have little confidence in the modeling that determines its theoretical boundaries. The primary concern lies in basing the entire model on plume behavior computed using conditions measured only once, on one day in October, 1971 (Table 2). We know from other studies (e.g., Muench and Nebert, 1973) that the structure of the water column in Port Valdez changes dramatically through the season from highly stratified to fully mixed (Figure 2). It seems disingenuous to give credence to a model suggesting that a

Table 2. Characteristics of the ambient water structure as measured on 11 October 1971. From Revised Submittal Alyeska Pipeline Service Company Mixing Zone Application, Section 401 Certification, Valdez Marine Terminal, NPDES Permit AK-002324-8 Renewal; dated June 30 2011.

Depth (m)	Ambient Current (m/s)	Current Direction (degrees)	Ambient Density (psu)	Ambient Density (Sigma t)
0	0.02	0	12.1	9.25
10	0.02	0	28.44	21.95
20	0.02	0	29.27	22.59
30	0.02	0	29.56	22.82
50	0.02	0	30.14	23.27
75	0.02	0	30.81	23.79

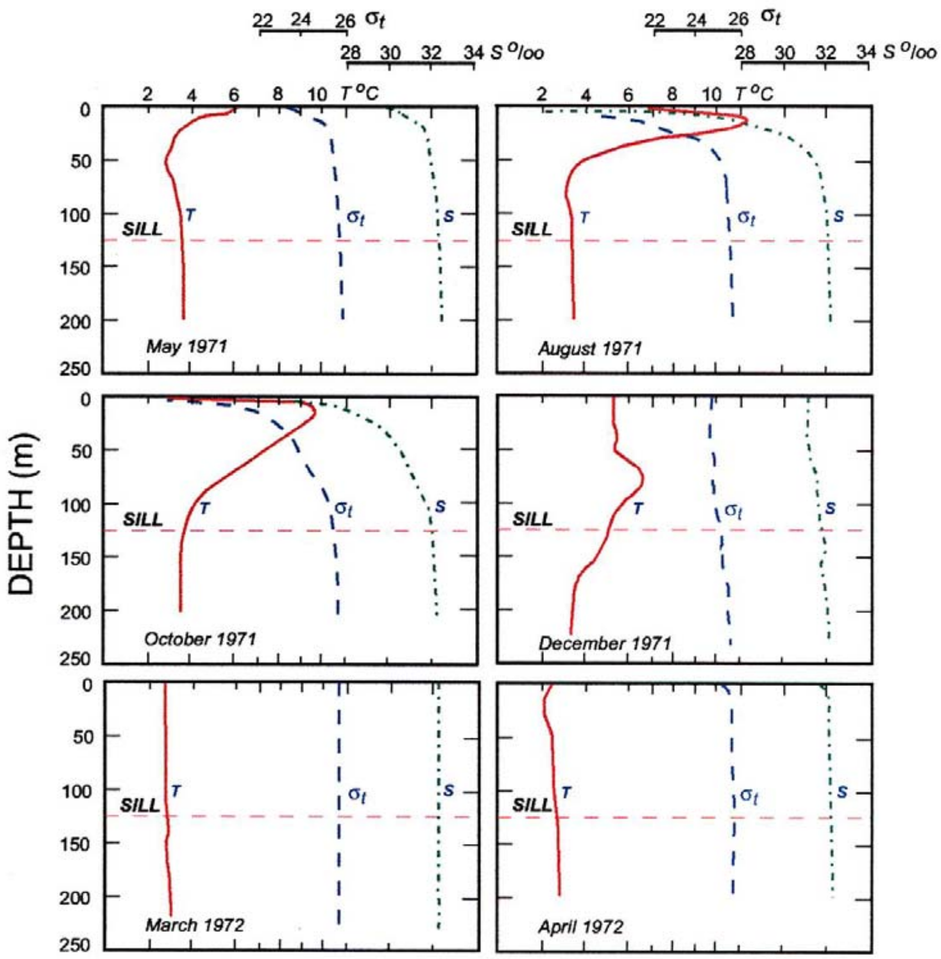

Figure 2. Seasonal salinity, temperature and density (sigma-t) of the water structure in Port Valdez. From Muench and Nebert (1973).

plume would be entrapped at a theoretical depth under non-stratified conditions, and from LTEMP data (Payne et al., 2001), there is evidence that oil-phase PAH from the BWTF diffuser can reach the surface to form a microlayer under non-stratified winter conditions. There are more comprehensive data available to characterize the dynamic nature of water column.

Another modeling concern lies in the effluent stream density relative to the assumed field conditions, again based on one observed data point. In reviewing the measured-once-monthly, historic sigma-t values (loosely expressing density in kg/m^3) reported in the DMRs for 2006-2012, there were two instances (Dec 2006 and April 2007) where sigma-t broached 25, a value that exceeds the plume model's assumption for "critical ambient conditions" of bottom water density, 23.79. We postulate the UM-3 plume model calculates that turbulent mixing from the nozzle ejection velocity and bottom currents will effectively disperse a slightly-negative-density plume, and yet slack tides occur four times a day whereby counter to permit requirements, such a plume may contact the bottom. From Muench and Nebert's (1973) work, the bottom waters at 200 m in the Port are seasonally consistent with density values in the 25 range, while at 70m (closer to the diffuser depth) they appear to vary by roughly ±1 sigma-t unit. These values compared to the DMR data (measured once monthly with only two values above 25), suggest negatively buoyant effluents are unlikely be a chronic problem. However, the 1973 field data are from a deepwater station, presumably in mid-fjord rather than at the outfall at 70m on the rim of the basin where circulation and mixing will create a different water structure. As a one-time study, it would seem almost trivial for Alyeska to acquire a set of CTD data on a semi-monthly basis from the constantly transiting SERVs small vessel fleet.

Circumstantially, in the 2011 EMP report, Blanchard et al. report a light sheen in bottom sediments from station 143 (near the outfall) and occasional oil smears or smudges in lab equipment while sorting samples from other nearby stations. These may have been a result of sample grabs encountering historically entrapped oil; other coring methods would have to be used to ascertain the oil's depth and time of deposition. But the fact remains that sediment contaminants (oil) are reported higher in the vicinity of the outfall (Blanchard et al., 2011) and are corroborated at the LTEMP station (Payne et al., 2001, 2003, 2005a, 2006, 2008a,b, and 2010) in the same area. So, to some unknown extent, transport to the sediments occurs. The point is that although plume behavior has been modeled (Table 3), it is based upon unrealistic seasonal extrapolations and thus is poorly understood except for a single snapshot of stratified conditions. The mixing zone application states that "the worst-case situation occurs when the effluent density is the same as the ambient (receiving water) density and when the effluent flow rate is reduced." From this perspective, it would seem reasonable to expect a more accurate, seasonally-varying plume model to assure that chronic contact with the sediments is not occurring. If such assurance were not the case, seasonal minimum flow requirements may be necessary.

Table 3. Summary of outfall dilution modeling, adapted from Alyeska mixing zone application, 30 June 11.

Summary of Dilution Modeling for Alyeska BWTF Outfall Acute Mixing Zone					
Model Run No.	Density at Discharge Depth (sigma-t)[a]		Effluent Flow Rate (gpm)	Predicted Flux-Average Dilution Factor at AZB[b]	Plume Travel Time to MZB (Sec)[c]
	Effluent	Receiving Water			
1	23.79	23.79	5,000	38	342
2	23.79	23.79	10,000	45	167
3	23.79	23.79	15,000	49	<70
4	24.74	23.79	5,000	55	<70
5	25.76	23.79	5,000	67	48

[a] From the density profile (attachment), the discharge depth density (75m) is 23.79.

[b] The proposed acute zone boundary (AZB) is 50 feet in any direction from a discharge port.

[c] Plume travel times are times to edge of the proposed mixing zone boundary (MZB).

Linked to the inadequacy of the single-state model is its confirmation. The plume is not monitored or measured; the only proof for mixing zone compliance is absence of a visual surface sheen and sediment oiling (which is not the case). Lacking significant evidence of either event, discharging continues assuming the model is functionally adequate. But we again suggest that influent conditions are changing and the effluent may one-day exceed its dispersal characteristics implied in the model.

Analytical Methods Issues

In the early 1980s, scientists involved in oil spill research recognized that alkyl-substituted PAH homologues predominated over the parent PAH components in all petroleum products and crude oils, including Alaska North Slope crude oil (Payne et al. 1984; Payne and McNabb, Jr. 1984). As a result, most investigators have long since used analytical methods based upon selected ion monitoring (SIM) gas chromatography/mass spectrometry (GC/MS) that allow quantification of these important constituents (Table 4). While we were heartened to see the analytical methods specified in the 2004 reissued NPDES Permit improve from 1980s-era flame ionization detector gas chromatography to EPA Method 625 SIM GC/MS procedures, there are still several issues with the presently utilized procedures that we'd like to address.

The EPA Method 625 does provide better quantification of individual PAH with less interference, but the current protocols used by Alyeska for measuring the PAH fraction to determine total Aqueous Hydrocarbons (TAqH) stop short of identifying all the alkylated PAH necessary to adequately characterize the BWTF effluent. Likewise, the sediment chemistry measurements completed as part of the VMT EMP (Blanchard et al., 2011) suffer from the same problem. Sauer and Boehm (1991) contrasted a number of procedures with EPA promulgated analytical methods (including Methods 625 and 8270 for GC/MS analyses of semivolatile priority pollutant organics) and concluded that the data generated by the EPA methods lacked the chemical specificity to assess environmental damage from oil spills and chronic inputs of petroleum hydrocarbons to the marine environment.

Short et al. (1996) documented the more sensitive methods used by NOAA/NMFS for analysis of hydrocarbons in crude oil, tissues, sediments, and seawater collected for National Resource Damage Assessment efforts following the *Exxon Valdez* oil spill, and those methods (or slight modifications thereof) have been used by both Trustee (including NOAA)and Potential Responsible Party (PRP) scientists for documenting petroleum hydrocarbon impacts from chronic discharges and major oil spill events ever since. The PWSRCAC has utilized these methods exclusively in the Long Term Environmental Monitoring Program (LTEMP) throughout Prince William Sound and within Port Valdez since 1993 (for a review and synthesis through 1997 see Payne et al. 1998, and Payne et al., 2003, 2005a, 2006, 2008a,b, 2010, and Driskell et al., 2005 for updates ever since). Similar methods are also utilized by the Cook Inlet RCAC (CIRCAC) for all of their Environmental Monitoring Programs, by NOAA's National Status and Trends – Mussel Watch Program, and by the US Coast Guard for forensic investigations. The modified EPA 8270D method is the industry standard for evaluating oiled materials. In 2010, The National Institute of Standards (NIST) coordinated an interlaboratory evaluation the EPA 8270D method at commercial, academic and agency labs in support of the Gulf Oil Spill. Participating labs analyzed standard samples of tissue, sediment and what is now a NIST oil SRM using the EPA 8270D method.

Table 4. Polycyclic aromatic hydrocarbon (PAH) and saturated hydrocarbon (SHC) analytes recommended for TAqH measurements for BWTF effluent monitoring and the VMT Environmental Monitoring Program. The parent Priority Pollutant PAH measured with EPA Methods 625 and 8270 are shown with an asterisk (*) and are highlighted in yellow. The abbreviations shown are used to denote the individual PAH in Figures 3 through 5.

Analytes	Abbreviation	Analytes	Abbreviation
PAH			
Naphthalene *	N	Benzo(e)pyrene *	BEP
C1-Naphthalene	N1	Benzo(a)pyrene *	BAP
C2-Naphthalene	N2	Perylene	PER
C3-Naphthalene	N3	Indeno(1,2,3-cd)pyrene *	IP
C4-Naphthalene	N4	Dibenzo(a,h)anthracene *	DA
Biphenyl *	BI	Benzo(g,h,i)perylene *	BP
Acenaphthylene *	AC	Total PAH	TPAH
Acenaphthene	AE		
Fluorene *	F	**SHC**	
C1-Fluorenes	F1	n-Decane	C10
C2-Fluorenes	F2	n-Undecane	C11
C3-Fluorenes	F3	n-Dodecane	C12
Dibenzothiophene *	D	n-Tridecane	C13
C1-Dibenzothiophene	D1	n-Tetradecane	C14
C2-Dibenzothiophene	D2	n-Pentadecane	C15
C3-Dibenzothiophene	D3	n-Hexadecane	C16
C4-Dibenzothiophene	D4	n-Heptadecane	C17
Anthracene *	A	Pristane	Pristane
Phenanthrene *	P	n-Octadecane	C18
C1-Phenanthrene/Anthracene	P/A1	Phytane	Phytane
C2-Phenanthrene/Anthracene	P/A2	n-Nonadecane	C19
C3-Phenanthrene/Anthracene	P/A3	n-Eicosane	C20
C4-Phenanthrene/Anthracene	P/A4	n-Heneicosane	C21
Fluoranthene *	FL	n-Docosane	C22
Pyrene *	PYR	n-Tricosane	C23
C1-Fluoranthene/Pyrene	F/P1	n-Tetracosane	C24
C2-Fluoranthene/Pyrene	F/P2	n-Pentacosane	C25
C3-Fluoranthene/Pyrene	F/P3	n-Hexacosane	C26
C4-Fluoranthene/Pyrene	F/P4	n-Heptacosane	C27
Benzo(a)Anthracene *	BA	n-Octacosane	C28
Chrysene *	C	n-Nonacosane	C29
C1-Chrysenes	C1	n-Triacontane	C30
C2-Chrysenes	C2	n-Hentriacontane	C31
C3-Chrysenes	C3	n-Dotriacontane	C32
C4-Chrysenes	C4	n-Tritriacontane	C33
Benzo(b)fluoranthene *	BB	n-Tetratriacontane	C34
Benzo(k)fluoranthene *	BK	Total SHC	TSHC

Of even greater relevance to the VMT NPDES review, these same analytical methods were utilized in a detailed study of BWTF efficacy in both summer and winter conditions (Payne et al., 2005b,c) where the fate of all the parent and alkylated PAH could be traced throughout the complete BWTF treatment train (Figures 3 and 4). In contrast, the methods used for all Alyeska programs only report data on parent priority-pollutant PAH components (Table 4 and Figure 5).

The seasonal data (Figures 3 and 4) clearly demonstrate the loss of lower-molecular-weight PAH (parent and alkylated-naphthalenes along with parent fluorene, anthracene, phenanthrene, and dibenzothiophene) as a result of both evaporation and microbial degradation processes during the warmer months. At lower temperatures, these processes are retarded; much higher concentrations of alkylated-naphthalenes and all the other higher-molecular-weight PAH are still present in the effluent. Significant temperature-controlled retardation of microbial degradation of saturated hydrocarbons (n-alkanes vs. branched pristane and phytane) is also observed in the figures.

A closer examination of just the effluent data (Figure 5) reveals that in addition to the bacterial preference for parent PAH, only reporting those components significantly under-represents the total PAH (TPAH) loading to the environment. The parent EPA Priority Pollutant PAH only represent 4 and 10 percent of the true PAH contribution to Total Aqueous Hydrocarbon (TAqH) concentration for summer and winter effluent, respectively. And yet, as measured by the NPDES program, that is all that is reported. By only focusing on the EPA priority pollutant PAH components, the majority of the PAH burden in the effluent is being ignored.

Using the full suite of alkylated PAH, Salazar et al. (2002) demonstrated that these PAH are bioavailable for accumulation in caged mussels placed at depth near the mixing zone, as did Payne et al. (2001, 2003, 2005a) to positively identify chronic oil transport from the BWTF diffuser to a reference site near Gold Creek (GOC), 6 km across the port. Utilizing the alkylated-PAH constituents measured in intertidal mussels, it was possible to distinguish between a seasonally-controlled dissolved-phase (summer months) vs. oil-droplet/particulate-phase (winter months) transport pathway within Port Valdez. During unstratified winter conditions, oil can reach the water surface to potentially form a non-visible microlayer. More recently, Carls et al., (2006) have demonstrated that these same alkylated PAH constituents are accumulating in copepods in the eastern zones of Port Valdez compared to western zones and the waters of Prince William Sound. Furthermore, a review on the aquatic toxicity of parent and alkyl-substituted PAH completed by French-McCay (2001, 2002) has shown that the toxicities of individual PAH constituents are additive, and that less soluble, alkylated components are actually more toxic than the parent compounds. In another study, inclusion of alkylated PAH homologues in addition to the parent compounds has also shown increased human cancer risk in deterministic and probabilistic risk assessments (Bruce et al., 2007).

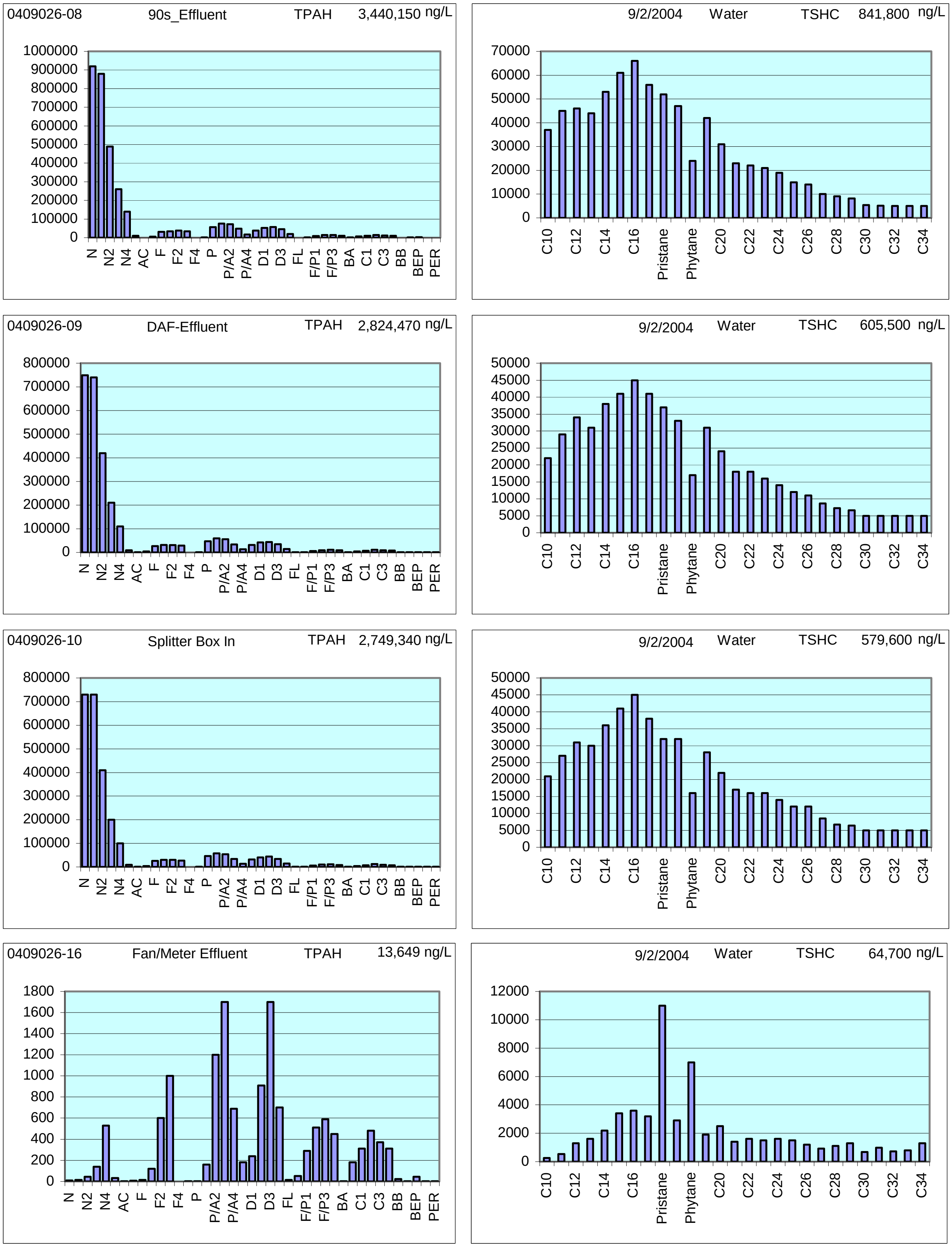

Figure 3. PAH and SHC histogram plots showing true TAqH (with alkylated PAH) and aliphatic components in warm season (September 2004) effluent from the 90s tanks, the DAF cells, the Splitter Box, and the BWTF diffuser (concentrations in ng/L). PAH abbreviations are identified in Table 4. Data from Payne et al., 2005b,c.

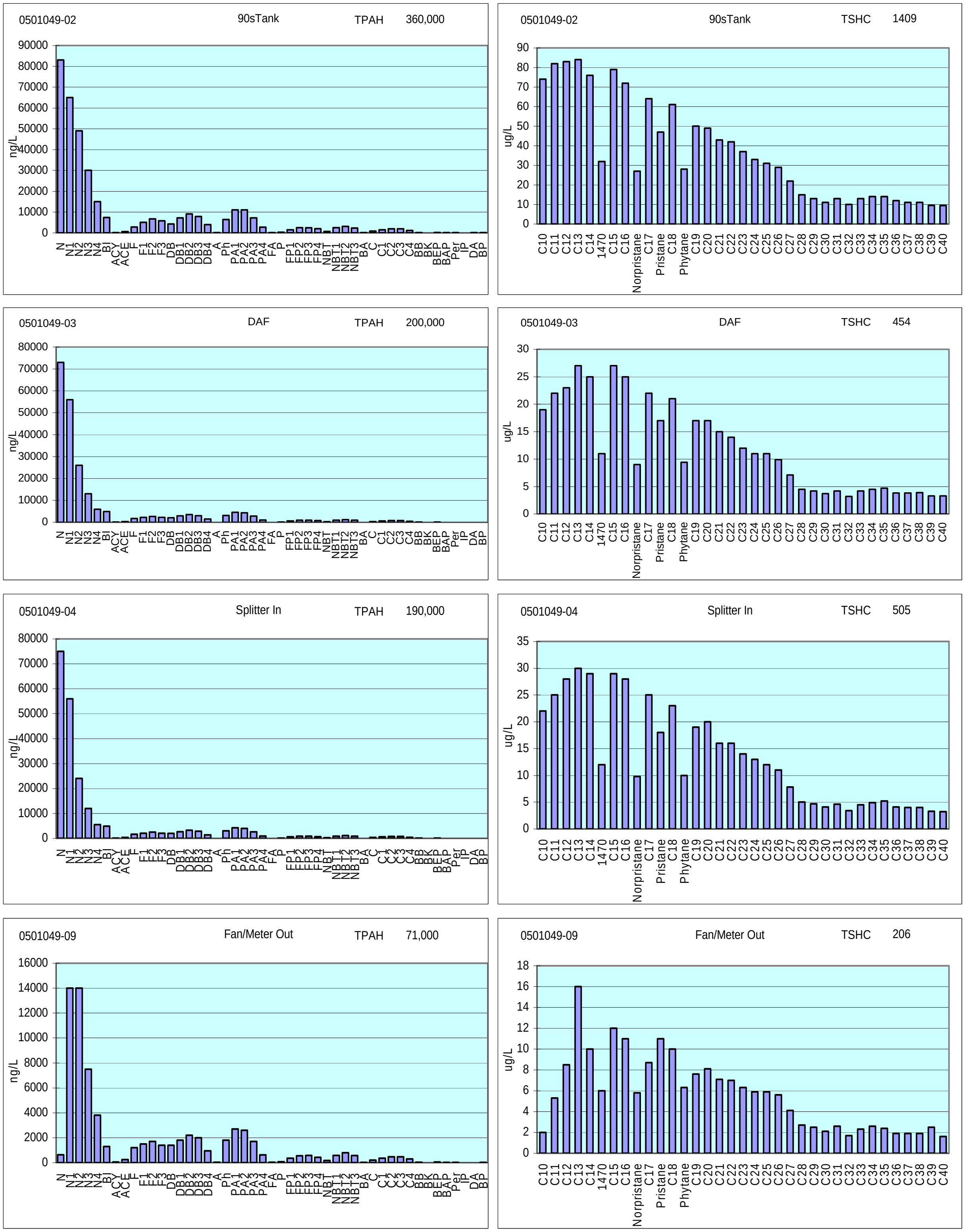

Figure 4. PAH and SHC histogram plots showing true TAqH (with alkylated PAH) and aliphatic components in cold season (January 2005) effluent from the 90s tanks, the DAF cells, the Splitter Box, and the BWTF diffuser (PAH concentrations in ng/L, SHC in µg/L). Data from Payne et al., 2005b,c.

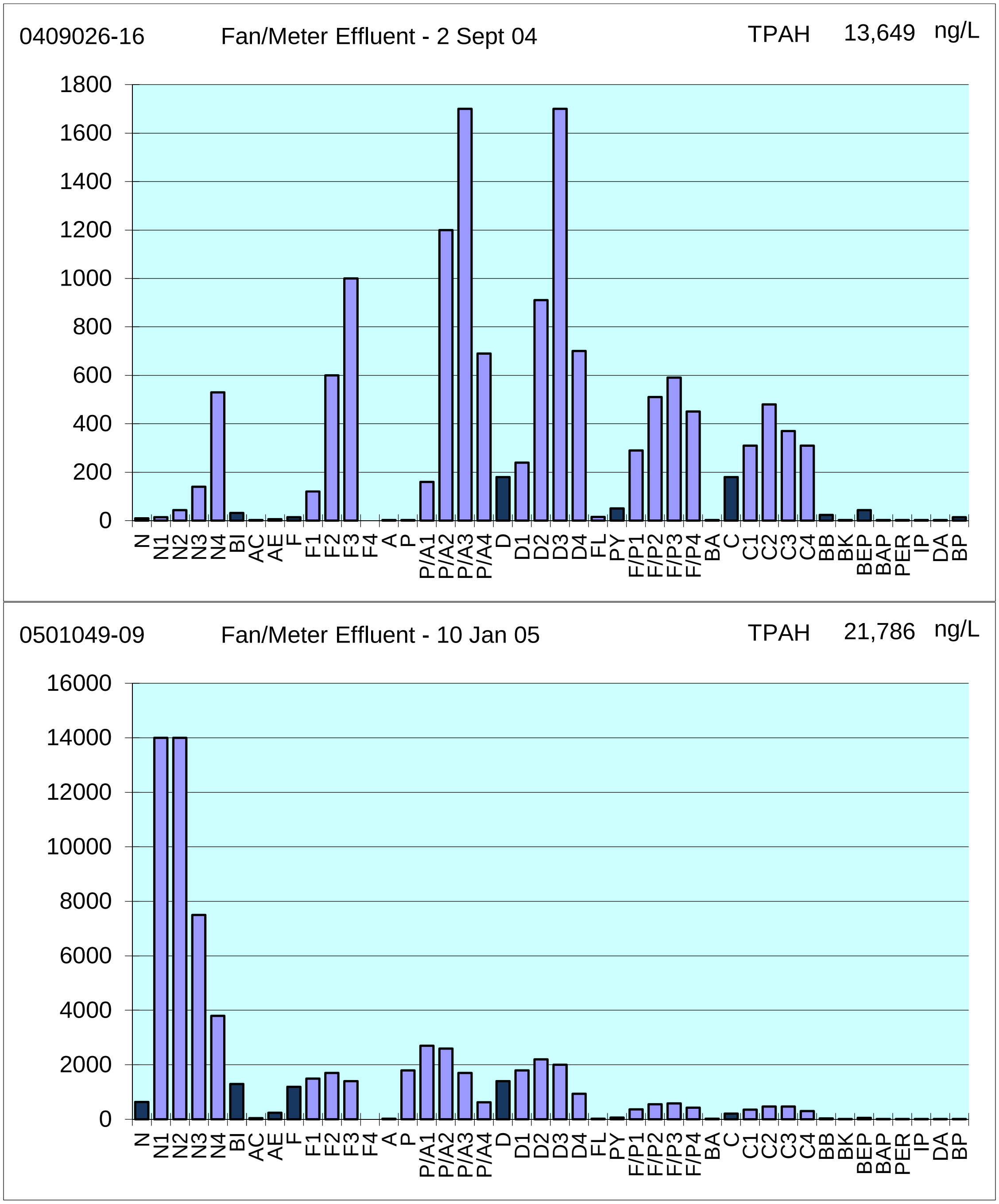

Figure 5. Expanded view of parent- and alkylated-PAH components from BWTF diffuser effluent (sampled from the Fan Meter Building) in September 2004 (top) and January 2005 (bottom) with the EPA Priority Pollutant parent PAH highlighted as darker bars for comparison to the alkylated PAH. The summed PAH concentrations from just the EPA Priority Pollutant PAH (590 and 7,130 ng/L) contribute only 4 and 10 percent of the total PAH (TPAH) actually present in the warm- and cold-season effluent samples, respectively. Data from Payne et al., 2005b,c.

With regard to sediment samples near the VMT diffuser, LTEMP samples recently showed low and declining levels of TPAH concentrations (Figure 6) in agreement with the trend identified in the EMP (Blanchard et al., 2011). However, with the additional alkylated PAH data in the LTEMP data set, it is possible to differentiate the weathered oil signal from the ballast water treatment system (plus combustion products) from the even lower pyrogenic PAH levels at the Gold Creek control site across the Port (Figure 7). If only the parent EPA Priority Pollutant PAH were monitored, it would likely be impossible to differentiate the sources; e.g., Blanchard et al., utilized non-PAH hopane ratios to conclude that low-level sediment contamination by Alaska North Slope crude (presumably derived from the BWTF diffuser) had occurred throughout the port. Elsewhere they suggest a number of other PAH sources in the sediments of Port Valdez, including: oil spills, the small boat harbor, the hatchery, the seafood processors, storm water runoff from the City of Valdez, tanker discharges, commercial/ recreational boats, and the Valdez POTW. These sources cannot be differentiated with the current, limited suite of PAH measured by EPA Method 625. As the PAH components in the BWTF effluent are anticipated to continue declining, it will be even more important to utilize the more sensitive and informative analytical methods presenting the full suite of alkylated PAH to document the changes in sediment PAH composition and concentrations over time.

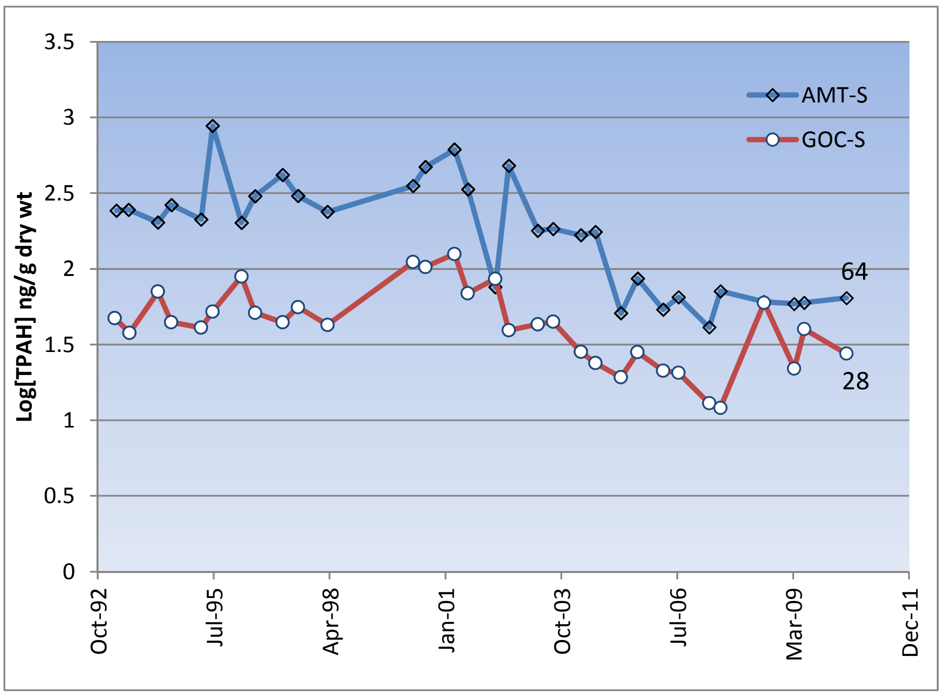

Figure 6. Time series of log TPAH in sediments at Alyeska Marine Terminal (AMT) and Gold Creek (GOC) reference station from the PWSRCAC Long Term Environmental Monitoring Program (LTEMP).

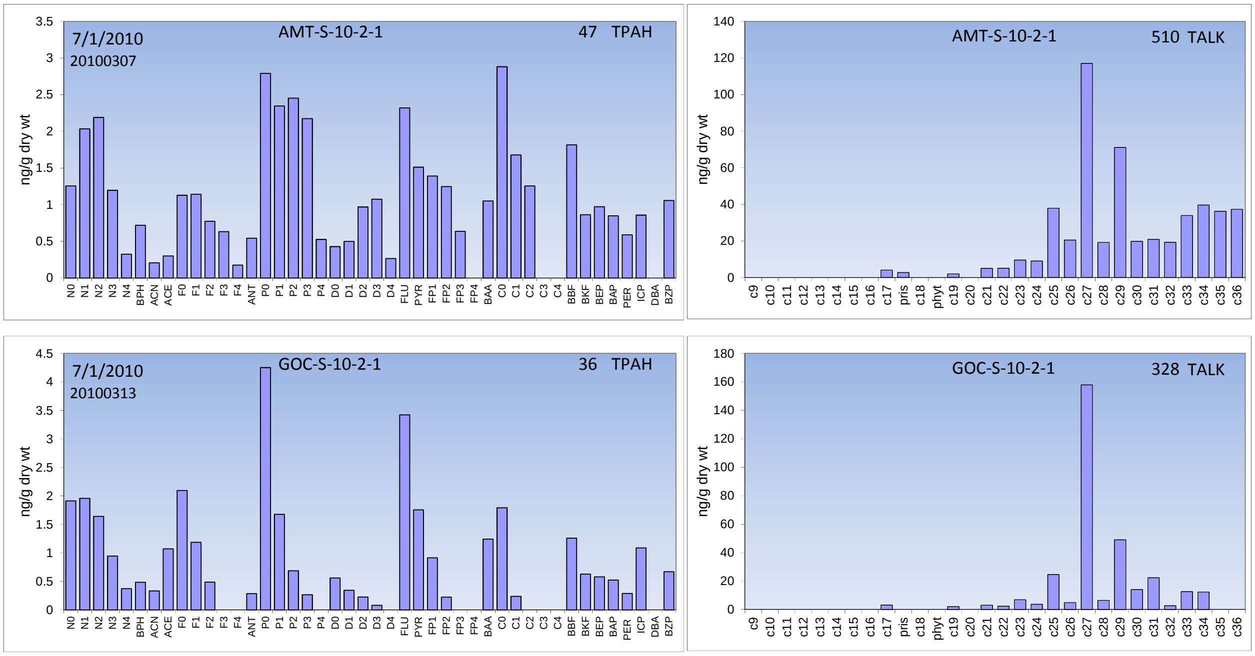

Figure 7. Example PAH and SHC signatures in 2010 sediments at the Alyeska Marine Terminal (AMT) and the Gold Creek (GOC) reference station measured during the PWSRCAC LTEMP program. The AMT PAH profile shows a predominant petrogenic pattern with lesser contributions from combustion products, while the SHC signal shows heavily biodegraded oil plus biogenic, terrestrial plant waxes. The GOC PAH pattern is dominated by combustion products with little evidence of input from the terminal, while the SHC pattern is almost exclusively biogenic.

Analytical procedures that are appropriate for these alkylated PAH measurements have been widely published for over 20 years (Sauer and Boehm 1991, 1995; KLI 1995, Boehm et al. 1997; Short and Harris 1996; Stout et al. 2001, 2002) and they are promulgated in the Federal Register (Federal Register 2003). They can be performed by a number of commercial analytical laboratories, including TDI Brooks who are currently completing the EPA Method 625 analyses on the sediment samples from the VMT Environmental Monitoring Program (Blanchard et al., 2011) and TestAmerica who (according to the BMP-associated Analytical QAP) are contracted to provide analytical services as part of the BTT effluent monitoring program[1]. As such, there are several administrative vehicles in place that could be utilized to facilitate getting these analyses underway with a minimum of contractual difficulties. Both laboratories have been audited against very rigorous QA standards for performing similar analyses for forensics determinations of trace level (ng/g) oil contamination in sediment and water samples collected during the Deepwater Horizon NRDA.

[1] TestAmerica (TA) Denver is currently providing Effluent Monitoring analyses for dissolved phosphate, ammonia-nitrogen, and TROG, and the QAP states they can also run PAH, total recoverable zinc, and halogenated semivolatile and volatile Priority Pollutants. They do not run alkylated-PAH, but the TestAmerica laboratory in Burlington, VT does run EPA Modified 8270D for 44 alkylated PAH plus Biomarkers. Contact Bryce Stearns at (802) 660-1990) or by e-mail Bryce.Stearns@testamericainc.com for details on their SOPs or pricing data.

In EPA's response to PWSRCAC's comments on the 2004 NPDES renewal regarding the alkylated PAH (EPA 2004), they stated that Alyeska's position was… *that the collection, analytical testing and reporting of alkylated homologs derived from the GC/MS SIM method was not technically justified, nor do comparative standards exist that are scientifically appropriate. Alyeska urged EPA and the Alaska Department of Environmental Conservation (ADEC) to reconsider the requirement and exclude effluent testing for alkylated homologs in the final permit as their relevance had not been verified.* The technical relevance for these analyses is clearly stated above. To reiterate:

> 1) The current EPA Method 625 misses 90-95% of the PAH that are present in the effluent (i.e., the data are simply not representative);
>
> 2) The method has been widely used and universally accepted for major oil-spill environmental forensics programs (e.g., EVOS and Deepwater Horizon) for over 20 years;
>
> 3) It is successfully utilized in at least two other Alaska Marine Monitoring Programs run by USCG-certified Regional Citizens Advisory Councils (PWSRCAC and CIRCAC), for reporting NOAA Mussel Watch data, and for all U.S. Coast Guard oil forensic investigations;
>
> 4) The concentrations of PAH in the effluent are expected to decrease in the future and tracing the environmental impacts and/or improvements associated with the changing BWTF treatment train can only be completed with the more sensitive method, and
>
> 5) With other potential sources of contaminants (including pyrogenics and other industrial wastes) potentially contributing more to the wastestream, hydrocarbon fingerprinting will become all the more important to differentiate sources as the BWTF influent becomes more heterogeneous.

In the 2004 EPA response to public comments, *it was also argued by Alyeska that the current GC/MS analysis method for target PAHs is a scientifically valid and technically defensible method. Individual PAH compounds are commercially available so accurate analytical standards can be prepared. Precision and accuracy statements can be made for each compound for the analytical method. Alyeska contends that the same is not true for the alkylated homologs.* It is true that individual PAH compounds are not present for <u>every</u> alkylated compound, but most labs utilizing this method do not consider them necessary. By consensual practice (and at NIST), alkylated PAH are quantified against accurate standards prepared with the pure component parent compound or (in the case of naphthalene, phenanthrene, and one or two other PAH) C1- and C2-methy-substituted standards. The response factors are not all that different, and once the analytical method is established at a given laboratory, the results for the alkylated homologues are relative anyway. This makes sample-to-sample comparisons less arduous than Alyeska contended.

This is an EPA method, published in the Federal Register, and analyses of hundreds of check samples and NIST-certified reference materials over the last 10-15 years have allowed the development of statistically valid precision and accuracy data for the very laboratories that we are recommending in this document.

Finally, *Alyeska was concerned about how the data would be interpreted, and its relevance to the monitoring goals of the permit. Current state standards and other regulatory thresholds such as criteria for sediment quality indices are based on concentrations of parent PAH compounds.* We believe this is a specious argument, as Blanchard et al. (2011) had to deal with this issue when upgrading from FID GC data for 18 PAH to 24 components as currently measured by EPA 625 methods. They simply reported data as TARO (for the total of the 18 PAH that were historically analyzed between 1989 and 2010) and calculated ERL or ERM values using a sum of 7 lower-molecular-weight PAH (LPAH) plus 6 higher-molecular-weight PAH (HPAH). These PAH and other sums used for data analysis are defined in Table 2-4 "Sediment quality values used for comparison with results of this study" (on p 41 of Blanchard et al., 2011), and they just ignored the rest of the analytes when trying to compare a particular subset of data to previously established Sediment Quality Guidelines. That same approach can be used with the expanded list of alkylated PAH when comparisons are desired against older, antiquated, and more limited guidelines, but to argue that the more representative alkylated-PAH data (for crude oil and petroleum products) be ignored because it will make the "new" totals go up is disingenuous.

Use of the full suite of alkylated PAH is the industry standard in oil spill and chronic oil pollution Natural Resource Damage Assessment (NRDA) efforts, and to do less than that going forward (especially under a new largely untested BWTF design with highly variable input to the system) would seem to ignore an obvious risk and negate any potential for effective monitoring. In looking at Figure 5, the question is what set of PAH is more representative of oil contamination – the seven highlighted parent PAH that are present in miniscule quantities in the weathered oil matrix or the full suite of alkylated PAH in the figure? EPA is authorized to modify a permit "when pollutants that are not limited in the permit exceed the level that can be achieved by technology- based treatment… and with the receipt of new information relevant to the determination of permit conditions." We strongly believe that inclusion of the alkylated PAH in the Permit is warranted, and that data from such analyses will support monitoring and assist future decisions regarding permit requirements.

Biological Monitoring

The requirement for Benthic Biological Monitoring has been removed from the Alyeska Environmental Monitoring Program in spite of the fact that at the shallow stations, abundance, biomass, and the number of taxa were overall lower for stations near the diffuser compared to the reference stations. No statistical differences were observed among deeper stations for biomass. The justification for dropping the biological monitoring was because there didn't appear to be a direct correlation with measured hydrocarbon components in the sediments. Specifically, hydrocarbon influence near Outfall 001 is claimed to be minimal (p 30, Blanchard et al., 2001) compared to other factors, including: sediment characteristics, variable phytoplankton flux, grazing zooplankton, and climatic variability. Rather than invoking these mostly non-quantified factors, we suggest that better correlations could have been made with hydrocarbon chemistry in the sediments had a more representative suite of alkylated PAH been examined as part of the EMP. The alkylated PAH data are being generated by the analytic methods at the TDI Laboratory but are not being reported. It would serve the credibility of the EMP's benthic monitoring component to acquire the historic data from TDI and have Dr. Blanchard reevaluate their conclusions. Or even more to the point, we have recommended (and had rejected) in a previous review that the EMP acquire some form of primary productivity data as part of the program to more fully understand the infauna population dynamics.

Unfortunately, this is the second time this facility has been exempted from biological monitoring requirements. Previously, an EMP mussel monitoring component was removed (1996), ironically, because the chemistry results obtained using inadequate FID GC methods were inconclusive (despite better methods available at the time). The oil signature that was and is so readily apparent using the full alkylated PAH suite was not discernible in the limited EMP results.

Whole Effluent Toxicity (WET) Testing

All but 8 of 46 chronic toxicity tests between 2004 and 2009 showed no effect concentrations varying from 50 to 100% effluent. Only 1 of 7 tests showed acute toxicity, and it would be mitigated by a dilution factor of 3.7. (Fact Sheet). EPA calculations suggest no exceedances are likely, but given the reduced size of the mixing zone, WET monitoring must be continued for Outfall 001 every 3 months. Echinoderm fertilization (most sensitive, in lieu of the bivalve test) and topsmelt larvae will be used for the new tests. Given a chronic dilution factor or 9.6, the end-of-pipe chronic toxicity trigger is 9.6 TU_c, which will be < 10.4% effluent.

Acute testing was annual under the previous permit, but now it will be quarterly (with the same species). The acute toxicity dilution factor is 3.7. That translates to an acute receiving water concentration of 90% effluent and end of pipe trigger of 1.1 TU_a,(although the text on p 31 of the Fact Sheet makes it sound like EPA has applied the nationally recommended criteria of 0.3 TU_a to establish acute toxicity triggers and limits). This was somewhat confusing and should be clarified.

Alyeska has a good record for the Sanitary Wastes Outfall 002, so no WET monitoring will be required for Outfall 002.

We support the inclusion of the WET Monitoring with the new species and the quarterly frequency.

Wastewater Treatment Processes and Representative Sampling

As noted above in this document and in the Fact Sheet, the BWTF treatment process equipment includes two ballast water storage and gravity separation tanks (90s tanks), two covered dissolved air flotation (DAF) cells, four shallow-tray air strippers (three may be operated in parallel with a fourth on standby), a single biological treatment tank (BTT), and packed-tower air strippers.

It is our assessment, based on past DMR reporting data, that these treatment processes are capable of achieving the applicable TAH and TAqH water quality criteria at the edge of the mixing zone. However, the actual operational use of the treatment equipment processes (specifically the air strippers and the BTT) is not established. As stated in the Fact Sheet (bolding and the equivalent flow in MGD added):

> Four new 7-tray air stripper units were installed to remove soluble hydrocarbons in the wastewater stream from the DAF units on an as-needed basis. These **shallow tray air strippers are a modular component and can be operated independently or in conjunction with biological treatment**. Each air stripper unit has a normal design operating envelope of 500 – 1,100 gallons per minute (gpm), and the system of three

> stripper s operating in parallel has a maximum design upper limit of 3,850 gpm [5.54 MGD]. A fourth stripper is available as a spare for maintenance outages. The stripper offgas will be collected and routed to a Recuperative [sic] Thermal Oxidizer (RTO) for destruction of hydrocarbons.

This description indicates that the shallow tray air strippers do not need to be used for treatment and possibly even that the BTT does not need to be optimized for biological treatment (e.g., no nutrient addition or BTT aeration blower operation) if the shallow tray air strippers are operational. Section II of the draft NPDES permit has the requirement that Alyeska continue to update and maintain a Best Management Practices Plan. However, nowhere in the draft permit are there specific requirements for operating the individual treatment processes or for sampling during a change in unit processes (with the exception of TSS sampling being required on the day of and day after post-BTT packed tower stripper activation). This operational flexibility raises a potential concern in the ability to selectively choose (i.e., "cherry pick") the one day per week that TAH is monitored and the one day per month that TAqH is monitored.

Typically, in an application for an NPDES Permit there is a requirement for submittal of an engineering report with plans and procedures developed for treatment system processes and their operations. The best management practices plan for the BWTF (Alyeska, 2011) does not provide specific guidelines for when to place the tray strippers into operation, how many of the air strippers to bring online, and whether to treat all or only a portion of the total flow rate. There are only vague statements in the plan that "If operations determines the BTT's will not be able to adequately treat the water, the waste water can be routed to 7 Tray Air Strippers for dissolved hydrocabon [sic] removal." and "The 7 tray air strippers receive water from the operating DAFs and can be configured to receive the entire flow or a fraction of the flow. Their purpose is to supplement the biological treatment tanks in the removal of volatile compounds during periods when biological treatment is not optimal." It is expected that the BTT treatment effectiveness will be reduced during low temperatures, low dissolved oxygen concentration, and without adequate nutrient (i.e., nitrogen and phosphorous) addition. The plan does discuss the NPDES permit requirement for continuous recording of dissolved oxygen level and temperature in the BTT. However, there are no specific criteria listed for those parameters that determine when or to what extent the tray air strippers are to be used.

EPA could try to cite Section III.B.1 of the draft permit, which states "To ensure that the effluent limits set forth in this permit are not violated at times other than when routine samples are taken, the Permittee must collect additional samples at the appropriate outfall whenever any discharge occurs that may reasonably be expected to cause or contribute to a violation that is unlikely to be detected by a routine sample…", in order to attest that the permit is adequately protective against selective sampling. However, that language is very uncertain and open to interpretation considering that there is not even an established permit effluent limit for TAqH and considering that it could be difficult to claim whether or not running the air strippers or the BTT operations during any particular time may "reasonably" be expected to cause a violation of the TAH effluent limits.

Running the seven-tray air strippers entails operating the RTO for treatment of that air discharge stream, and the RTO requires a significant amount of propane fuel. Therefore, there could be financial incentive to minimize use of the tray strippers during non-sampling days. Also, considering that the maximum treatment capacity of approximately 5.5 MGD is little more than half of the proposed maximum permit limit of 10.1 MGD, it would be appropriate to require that sampling for TAH and TAqH occur any day at which the flow rate exceeds the 3,850 gpm (5.54 MGD) maximum capacity of three shallow-tray air strippers operating in parallel.

In addition, given the increased percentage of rain and snow melt that the system will be treating and the unknown ability of the BTT to maintain effective treatment with the increased variability in salinity of the wastewater, as discussed above, it would be appropriate to monitor BTT effluent during or following significant rainfall or snowmelt.

Therefore, we propose that Section III.B of the permit (or other applicable section) include a requirement that sampling for TAH and TAqH (and TROG if the DAF system is affected) be conducted as necessary to reflect all significantly different treatment system operational conditions during the month (e.g., tray air strippers on and off, BTT operational and non-operational, wastewater flow rates exceeding the 3,850 gpm maximum capacity of the tray air strippers) including sampling following any one weather event during the month when the percentage of fresh water (rainfall and snowmelt) exceeds a significant percentage (e.g., 25%) of the daily flow volume.

If for some reason EPA is reluctant to incorporate these clarifications for representative sampling into the permit, we propose that the Permit at least include language that Alyeska must maintain records of all wastewater treatment operational conditions and report a summary of those operational conditions in a cover letter that is provided with each monthly DMR submittal. In that manner, it can be tracked over time whether the weekly and monthly sampling are truly conducted at times that represent a full range of BWTF operational conditions.

Summary Concerns and Recommendations

The BWTF is designed to recover oil from ballast water and to treat runoff from rainfall and snowmelt, crude storage draws, and miscellaneous site process waters introduced through the IWSS prior to discharge into the waters of Port Valdez. Since the last NPDES issuance, the BWTF has undergone a significant reduction in volumes processed which has necessitated a system redesign. With onsite waste products becoming equal or more dominant in proportion to the (now cleaner) ballast water, we don't know what to expect or to be monitoring for. Oily ballast water will comprise only 25-55% of the future influx and the onsite IWSS influents are likely to be much more variable in composition than the consistently-oiled ballast water. The BWTF has historically been a saline system with tankers emptying up to 20 MGD of oceanic water into the process. With reduced ballast input and record rain and snowfalls within the last few years, how do the quickly changing saltwater/freshwater conditions affect the bacteria living in the BTT? Likewise, with lower hydrocarbon loadings into the BTT, will the bacteria become starved during periods of low ballast-water flow?

We also have concerns about the modeling and assessing potential impacts to nearby sediments and surface waters because all the modeling efforts are based on a single day's data of stratified conditions. Certainly during the winter months the receiving waters are well mixed from surface to bottom, and there is evidence from PWSRCAC studies that oil has accumulated in nearby sediments and intertidal mussels.

As mentioned in the last NPDES review, we again strongly advise analyzing effluent and environmental samples for the full suite of alkylated PAH. The current practice, reporting just a subset (<4-10%) of the PAH suite, seriously compromises the ability to understand BWTF efficacy, output composition, and the effluent's transport-and-fate in the environment.

The requirement for Benthic Biological Monitoring has been removed from the EMP in spite of the fact that the shallow stations' abundance, biomass, and the number of taxa were overall lower at stations near the diffuser compared to reference stations. This decision was justified by the absence of direct correlation with measured hydrocarbon components in the sediments, but we suggest that better correlations may have been obtained with sediment hydrocarbon chemistry had a more representative suite of alkylated PAH been examined.

Based on DMRs, the treatment processes are capable of achieving the applicable Total Aromatic Hydrocarbons (TAH; effectively BTEX) and Total Aqueous Hydrocarbon (TAqH) water quality criteria at the edge of the mixing zone. However, we again question the permit terms denying the need for TAqH limits justified by adequacy of past operational conditions (Appendix B, Section A.5 of the Fact Sheet) and strongly suggest the need for additional monitoring during special events. We recommend increased monitoring and reporting for both TAH and TAqH during all significantly different treatment system operational conditions during the month (e.g., tray air strippers on and off, BTT operational and non-operational, wastewater flow rates exceeding the 3,850 gpm maximum capacity of the tray air strippers) including sampling following any one weather event during the month when the percentage of fresh water (rainfall and snowmelt) exceeds a significant percentage (e.g., 25%) of the daily flow volume.

As a result of these and other concerns raised in this review, the following list summarizes what we believe are the most important changes that should be implemented in the new Permit:

1. We suggest a special study to characterize the effluent stream from the redesigned system under various flow and seasonal conditions to more fully understand the BWTF constituents and treatment efficacy.
2. Considering the industrial origins of the waste, we also support precautionary, periodic scans of the outfall effluent for heavy metals and persistent organic pollutants.
3. We recommend collecting seasonal receiving-water-column structure data (CTD) at the diffuser location to create a more realistic model and thus better assurance of mixing compliance within the permitted mixing zone.

4. Regarding residues, the permit says no sludge, solid, or emulsion shall be deposited beneath or upon the surface of the water, within the water column on the bottom, or upon adjoining shorelines. LTEMP and EMP studies clearly show that oil residues have accumulated in the sediments (and LTEMP intertidal mussels) as determined by PAH analyses, but these facts weren't considered in the permit.
5. We strongly advise analyzing effluent and environmental samples for the full suite of alkylated PAH. The modified EPA 8270D method is the standard regulatory, research, and industry practice for unambiguously tracking petroleum products in the environment. By only focusing on the EPA Priority Pollutant PAH components with EPA Method 625 (as stipulated in the current and proposed Permit), greater than 90% of the PAH burden in the effluent is being ignored.
6. It would serve the credibility of the EMP's benthic monitoring component to acquire the historic alkylated PAH data (available at TDI) and reevaluate the conclusions. As the PAH components in the BWTF effluent are anticipated to continue declining, it will be even more important to utilize the more sensitive and comprehensive analytical methods presenting the full suite of alkylated PAH to document the changes in sediment PAH composition and concentrations over time.
7. Based on past DMR reporting data, the treatment processes are capable of achieving the applicable Total Aromatic Hydrocarbons (TAH; effectively BTEX) and Total Aqueous Hydrocarbon (TAqH) water quality criteria at the edge of the mixing zone. However, consistent operational practices for the BWTF have not been defined in the draft permit or in supporting documentation. Therefore, the permit should be modified to clarify that Alyeska shall provide an updated best management practices (BMP) plan with a description of operational conditions [e.g., clarify what parameters and measured values indicate that the biological treatment tanks (BTTs) are not operating efficiently and clarify the numeric criteria for when the tray air strippers are to be activated and at what flow rate].
8. Related to changing operational conditions of the BWTF, the language in the proposed draft permit to ensure representative effluent sampling is insufficient. More specific language in the NPDES permit should be added to clarify that the required weekly and monthly sampling will be conducted to reflect differing operational conditions encountered during the month (e.g., with tray air strippers both on and off, under differing salinity conditions during and after storm events, etc.). That clarification of effluent sampling during differing operational conditions should also be provided by Alyeska in their updated BMP plan. The permit should further stipulate that Alyeska maintain records of all operational conditions utilized during the month, and that the specific operating conditions in effect during all sampling events be documented for inspection by EPA and/or ADEC, if requested.
9. Despite the facility's seemingly excellent performance, it seems antithetical to issue a discharge permit for an oil terminal without establishing TAqH limits. When EPA determined that limits were not needed based on review of historical data, the TAqH values were based on the sum of BTEX and EPA Method 625 Priority Pollutant PAH analytes (which were mostly below MDL). We suggest that this evaluation be reconsidered during the next permit renewal process utilizing TAqH data that include the full suite of alkylated PAH recommended in this review.

Typos or Errata

Several apparent discrepancies, typos, or other possible errors were observed during our review of the permit and supporting documents. These are highlighted below:

- The Outfall 001 Mixing zone is 50-meter radius circle centered at the discharge point from the sea floor to the surface, but it stops 14 m below the receiving water surface. Likewise it does not include the bottom sediments which remain subject to protection under AWQS. This is different from the mixing zone application, which specifies the upper limit of the mixing zone is 50 m below the water surface. Please clarify.
- In a similar vein, how can you have a 50 m cylindrical mixing zone over a diffuser that is 63 m long?
- On p 25 of the Fact Sheet, there may be a mistake. It says twice per year monitoring for TROG is retained from previous permit, but elsewhere monthly monitoring is specified. Which is it?
- The footnotes for Table 5 of the Fact Sheet are actually for Table 4 for Outflow 001. Is there another set of footnotes that are specific for Outflow 002?
- The positions of the BWTF Outfall 001 and the Sanitary Waste Outfall 002 in Figure A-2 of the Fact Sheet (and elsewhere throughout the supporting documentation) do not agree with the coordinates given in the permit when plotted in Google Earth. The 001 Outfall is shown about 55 m too far to the west, and the 002 Outfall is shown immediately to the west of the peninsula around the boat harbor, whereas it plots due N of the peninsula 87 m away (32 m offshore). Please state the confirmed coordinates and relevant datum.
- Table B-1 (p 47 of the Fact Sheet) says TAH criteria for Outfall 001 is 10 µg/L (based on applicable Alaska Water Quality Standards). Elsewhere (Table 1 (p 11) it is listed as 0.21 mg/L (monthly average limit) or 0.73 mg/L (maximum daily limit). Please clarify. On page 52 of the Fact Sheet, reference is made to a Technical Support Document (which we didn't have immediate access to), and in this context it would be preferable to simply state in the Fact Sheet how the values are derived and not make the public ferret out an obscure document and then rerun the calculations. Likewise, the 002 Outfall pH range is 6.5-8.5 in Table B-1 and 6.0-9.0 in Table 2 (p13).
- The volumes of everything in the BMP Plan Table 2-1 appear to be too high. It estimates 5.5 to 5.8 MGD while the actual DMR data show closer to 2 MGD being discharged. Why the major discrepancy? Also, the percent ballast water in Table 2-1 ranges from 71-76%, while a value of 25-55 % is estimated on p 18 of the mixing zone permit application.
- Section IV.D.5 (p 18 of the Fact Sheet) appears to list incorrect maximum and average concentrations of TAqH. "The maximum daily value measured during the existing permit was 1.8 µg/L and a mean value of 0.9 µg/L." These values do not agree with the higher concentrations (and believed to be closer to the correct values) listed in Appendix B (p 50) "The maximum concentration measured was 0.018 mg/L [18 µg/L] and, mean value was 0.006 mg/L [6 µg/L]." Please clarify.

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