**Table 7-4. Geometric mean concentrations of non-alkylated PAHs in sediments by transect, Northwest Oil Drain Delta of the Great Salt Lake, 2000. All concentrations given in mg/kg (ppm) dry weight.**

| | *onshore < < ---* | | | | | *--- > >offshore* | | | *TEC/* |
|---|---|---|---|---|---|---|---|---|---|
| **PAHs with SQGs** | **T-1** | **T-2** | **T-3** | **T-4** | **T-5** | **T-6** | **TEC** | **PEC** | ***PEC source*** |
| 2-methylnaphthalene* | *0.073* | *0.022* | 0.012 | *0.051* | *0.044* | *0.038* | 0.020 | 0.201 | *(1)* |
| Benzo(a)anthracene | 0.083 | 0.027 | 0.013 | *0.078* | *0.060* | *0.148* | 0.108 | 1.05 | *(2)* |
| Dibenz(a,h)anthracene* | 0.129 | 0.016 | 0.012 | *0.074* | **0.138** | 0.019 | 0.033 | 0.135 | *(2)* |
| acenaphthalene* | *0.045* | *0.011* | *0.020* | *0.023* | *0.016* | *0.021* | 0.006 | 0.128 | *(1)* |
| acenaphthene | 0.029 | 0.015 | 0.005 | *0.007* | 0.004 | 0.018 | 0.007 | 0.089 | *(1)* |
| anthracene* | *0.146* | 0.031 | 0.018 | *0.137* | *0.146* | *0.123* | 0.057 | 0.845 | *(2)* |
| benzo(a)pyrene | 0.159 | 0.038 | 0.021 | 0.076 | 0.085 | 0.090 | 0.150 | 1.45 | *(2)* |
| benzo(b)fluoranthene | 0.052 | 0.046 | 0.028 | 0.154 | 0.155 | 0.082 | 0.240 | 13.4 | *(4)* |
| benzo(e)pyrene* | *0.221* | 0.058 | 0.042 | *0.324* | *0.473* | 0.095 | 0.150 | 1.45 | *(4)* |
| benzo(g,h,i)perylene | *0.337* | 0.057 | 0.032 | *0.219* | *0.329* | 0.089 | 0.170 | 3.20 | *(3)* |
| benzo(k)fluoranthene | 0.014 | 0.013 | 0.006 | 0.037 | 0.023 | 0.021 | 0.240 | 13.4 | *(3)* |
| chrysene | 0.160 | 0.075 | 0.051 | *0.451* | *0.308* | *0.202* | 0.166 | 1.29 | *(2)* |
| fluoranthene | 0.087 | 0.051 | 0.017 | 0.086 | 0.038 | 0.105 | 0.423 | 2.23 | *(2)* |
| fluorene | 0.024 | 0.014 | 0.004 | 0.019 | 0.012 | 0.023 | 0.077 | 0.536 | *(2)* |
| indeno(1,2,3-cd)pyrene | 0.117 | 0.033 | 0.019 | 0.112 | 0.161 | 0.047 | 0.200 | 3.20 | *(2)* |
| naphthalene | 0.032 | 0.014 | 0.008 | 0.021 | 0.017 | 0.019 | 0.176 | 0.561 | *(2)* |
| phenanthrene | 0.103 | 0.043 | 0.019 | 0.106 | 0.057 | *0.250* | 0.204 | 1.17 | *(1)* |
| pyrene | 0.189 | 0.096 | 0.045 | *0.453* | *0.268* | *0.356* | 0.195 | 1.52 | *(2)* |
| **Total PAH (summed)** | 2.53 | 0.772 | 0.435 | *3.38* | *2.79* | *3.07* | 1.61 | 22.8 | *(2)* |
| *#PAH>TEC* | *7* | *2* | *1* | *9* | *8* | *7* | | | |
| **#PAH>PEC** | | | | | **1** | | | | |

**KEY:**

| | |
|---|---|
| *value* | value > TEC |
| **value** | value > PEC |

**NOTES**

Threshold Effects Concentrations (TECs) and Probable Effects Concentrations (PECs) from sources as noted:

(1) Canadian Council of Ministers of the Environment (CCME, 1999)
(2) Consensus-Based Sediment Quality Guidelines (MacDonald, et al, 2000)
(3) Guidelines for the Protection and management of sediments in Ontario, Canada (Ontario, 1993
(4) TECs and PECs for benzo(e)pyrene and benzo(b)fluoranthene were assigned based on chemical structural similarity to benzo(a)pyrene (CBSQG) and benzo(k)flouranthene (CBSQG), respectively

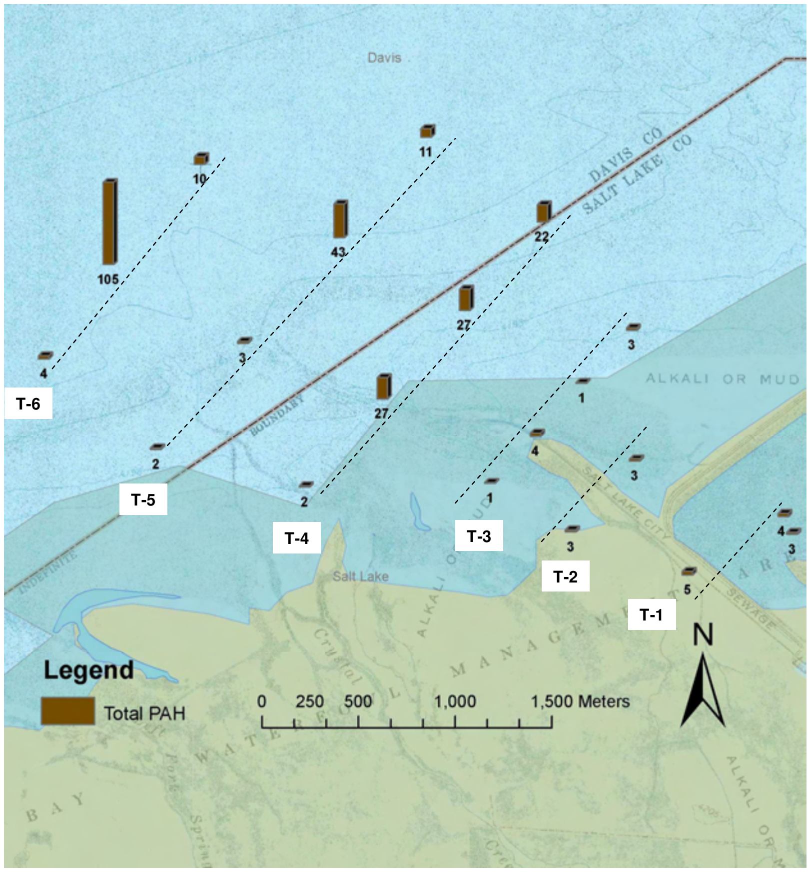


**Figure 7-7. Spatial distribution of total (summed) non-alkylated PAH concentrations (mg/kg dry weight) in sediments, Northwest Oil Drain Delta of the Great Salt Lake, 2000. Threshold effect concentration (TEC) =1.61 mg/kg; probable effects concentration (PEC) =22.8 mg/kg.**

While sediment TECs are commonly interpreted as conservative because adverse effects are "not expected" below them, an evaluation of the individual studies that form their basis indicates that adverse effects have been observed at or even below these thresholds in certain cases (D. Wall, USFWS, personal communication). Additionally, individual TECs/PECs do not address cumulative (additive or synergistic) toxicity. We found mean concentrations of 14 of 15 metals, and organic compounds including total PCBs, DDT isomers, chlordane and several PAHs (including total PAH) to be present above TECs, and nearly half of the samples had levels of some of the most toxic constituents (Pb, Hg, t-PAH) exceeding "probable" effects levels. Cumulatively, these data suggest that sediment-dwelling invertebrate and plant communities could be impaired in the NWOD delta. These impairments can lead to a decrease in abundance and diversity of food items for avian fauna that occur in the FBWMA, where the NWOD delta is located.

However, despite possible impairment, sediment-dwelling organisms and plants are present in the NWOD delta, because some of the most abundant species in the area, which are adapted to the difficult environmental conditions of the GSL's estuarine wetlands (e.g., high salinity, low oxygen, high temperatures) are also pollutant tolerant. Avian usage of food resources in the NWOD delta is also a function of the surrounding, less polluted habitats in the FBWMA, which are managed specifically for avian productivity. These conditions create a pathway for birds to be exposed to contaminants in the NWOD delta both through consumption of food items (e.g., the gut contents of macroinvertebrates, sediments attached to roots and other plant matter) and through consumption of sediments adhering to these food items. This "incidental" sediment ingestion can range from 3 – 10% of total dietary intake depending on species (Hui & Beyer 1998; Beyer et al. 2008).

The highest concentrations of almost all constituents were observed in the farthest off-shore transects. Thus, while the "nature" of contamination in the NWOD delta is better characterized as a result of this study, the "extent" of the contamination is not. Because the location of the GSL shoreline fluctuates greatly with small changes in lake elevation, the areas around the farthest transects may be exposed at lower lake levels, subsequently increasing exposure risk to benthic foraging birds.

Mercury concentrations in avian eggs collected in the Crystal Unit in 1996-1997 (discussed in Section 4.4) seem to indicate that birds exposed to sediments in this area would have increased risk of ecologically adverse effects. Elevated t-Hg concentrations were observed in black-necked stilt and American coot, both of which are highly sediment exposed and are commonly observed in the NWOD delta. However, in our follow-up investigation, which addressed a piscivorous species, Forsters' tern (see Section 6), elevated mercury concentrations were not observed. We believe this indicates that mercury uptake in the Farmington Bay wetlands does not occur through the food-chain (i.e., biomagnification through successive trophic levels) but is instead more an issue of direct sediment exposure.