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Technical Memorandum

Date:	6 December 2010
To:	Tom Alo, Regional Water Quality Control Board
From:	Brian Hitchens, Geosyntec Consultants
Subject:	Evaluation of Alternate Cleanup goals for VOCs and TPH

This memorandum has been prepared to document the technical and economic feasibility of the remediation of volatile organic compounds (VOCs) and Total Petroleum Hydrocarbon (TPH) impacts in soil and groundwater. This evaluation is provided as an additional line of evidence for selecting the best technically and economically feasible cleanup goals for VOCs and TPH at the site which are consistent with the maximum benefit to the people of the State of California.

Cleanup Goal Evaluation

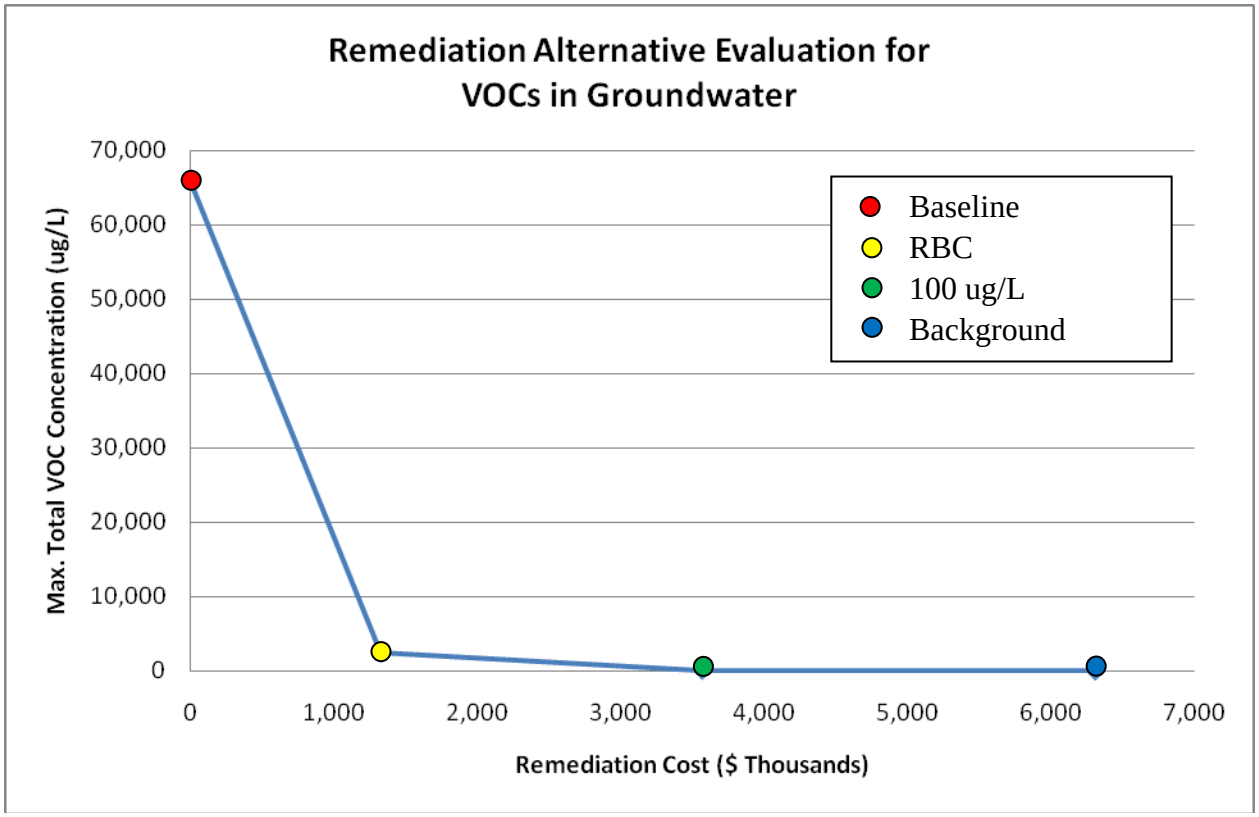
The default risk-based cleanup goals presented in the Remedial Investigation/Feasibility Study (RI/FS) are based on a commercial/industrial exposure scenario and provide goals targeted to meet a $1x10^{-5}$ incremental cancer risk and a health hazard index of 1. Break point analyses were performed across a range of residual Total VOC and TPH concentrations in both soil and groundwater to evaluate if these RBCs are consistent with the best technically and economically feasible cleanup goal and the maximum benefit to the people of the State. The concentration break points evaluated typically include Baseline (no action), the risk based criteria (RBC), a concentration between the RBC and background, and background.

Groundwater Remediation Goal for VOCs

To evaluate the maximum beneficial cleanup level for VOCs in groundwater, the required groundwater treatment area footprint was evaluated for a range of target Total VOC concentrations. These concentrations were 66,000 ug/L[1] (a no-action alternative), 2,400 ug/L

[1] Maximum total VOC concentration detected in groundwater on-Site prior to interim remedial actions, as reported in the Site Characterization Report (Geosyntec, 2005).

(maximum RBC goal[2]), 100 ug/L[3], and non-detect. The most significant break point in the residual max total VOC concentration vs. remediation cost curve is at the RBC goal.



	Treatment Area (ft2)	Max Total VOC Concentration (ug/L)	Remediation Cost ($ Thousands)[4]	Remedial Alternative
Baseline	0	66,000	0	EISB
RBC	160,000	2,400	1,300	EISB
100 ug/L	420,000	100	3,600	EISB
Non-Detect	740,000	0	6,300	EISB

[2] Risk for VOCs in groundwater at the site is driven by chlorinated VOC concentrations. The RBC for cis-1,2-Dichloroethene (cis-1,2-DCE) is 2,400 ug/L. This is the highest (i.e., most conservative) RBC of the chlorinated VOCs and was therefore used as the break point for Total VOC concentration based on remediation to RBCs.

[3] 100 ug/L is a logarithmic step between the RBC for cis-1,2-DCE and background.

[4] Remediation cost is based on the average cost of implementation of Enhanced In-Situ Bioremediation (EISB) interim actions at the site of approximately $850 per 100 ft^2

The proposed RBCs directly address potential risk to human health and the environment. There is no beneficial use to groundwater and VOC concentrations on-Site currently meet California Toxics Rule (CTR) requirements for VOCs. The interim remedial actions which have been performed at the Site to-date are capable of promoting the ongoing degradation of VOCs to below these RBC goals, eventually achieving background concentrations. Site conditions for the Site as a whole are generally reducing and are also conducive to natural degradation and reduction of VOCs over time. Historical groundwater monitoring has demonstrated that the concentrations of VOCs at the Site have stable to decreasing trends over time, and are anticipated to eventually reach background concentrations without additional remedial action beyond the RBC goal. Therefore, the RBCs are proposed as the most appropriate remediation goal for VOCs in groundwater.

Soil Remediation Goal for VOCs

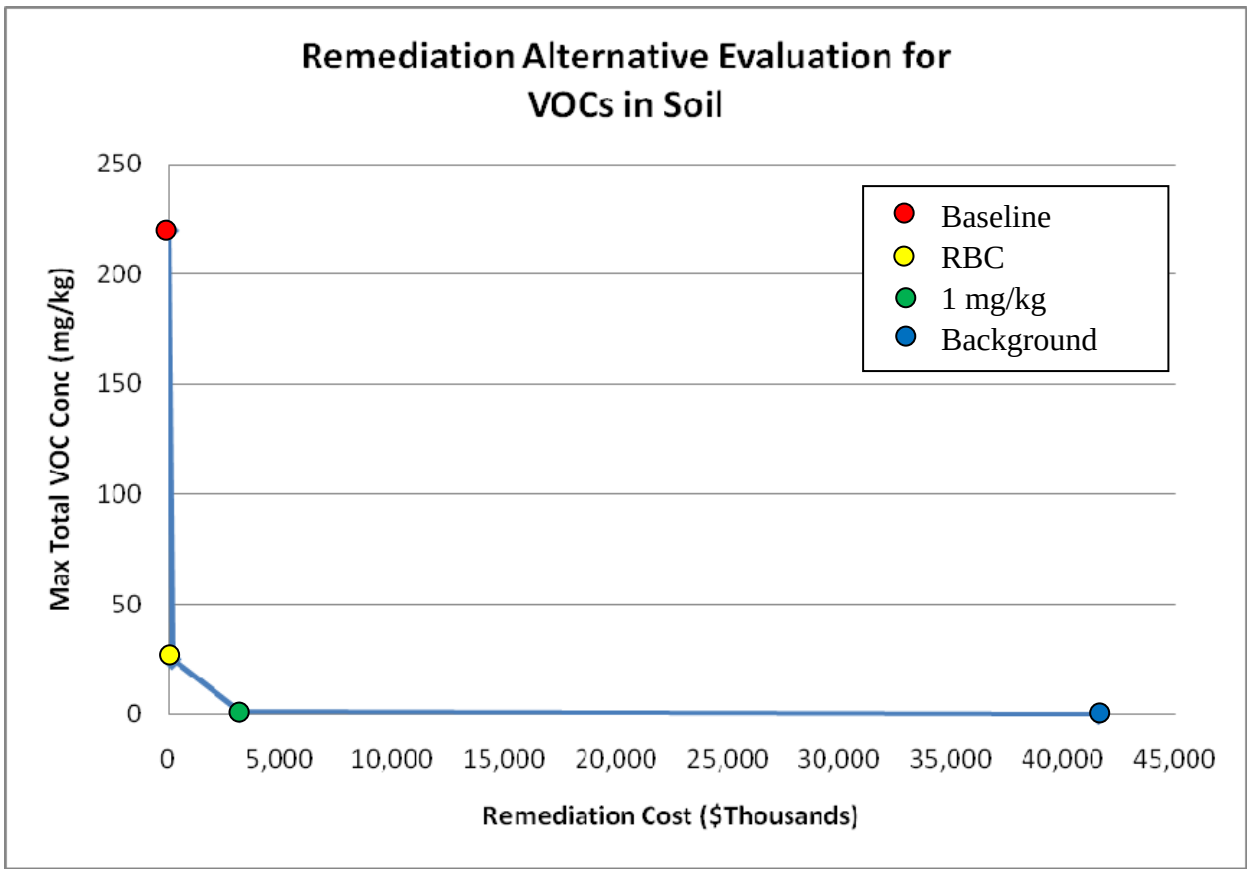
To evaluate the maximum beneficial cleanup level for VOCs in soil, the required soil treatment footprint was evaluated over a range of maximum residual Total VOC concentrations. These concentrations were 220 mg/Kg (a no-action alternative[5]), 25 mg/kg[6], 1 mg/kg[7], and non-detect. The most significant break point in the residual max total VOC concentration vs. remediation cost curve is 25 mg/kg based on the maximum potential total VOC concentration after remediation to Site-specific RBCs.

Cost analysis was based on an excavation remedial alternative, using the unit costs for excavation and disposal presented in the RI/FS (Geosyntec, 2010). Although a Soil Vapor Extraction Remedy (SVE) was considered, it was determined to be infeasible due to the shallow water table and relatively tight bay fill material at the Site.

[5] Maximum total VOC concentration measured on-Site prior to remediation activities, as presented in the Site Characterization Report.

[6] Risk for VOCs in soil at the site is driven by chlorinated VOC concentrations. The RBC for trichloroethene (TCE) is 25 mg/kg. This is the highest (i.e., most conservative) RBC of the chlorinated VOCs and was therefore used as the most conservative break point for Total VOC concentration based on remediation to RBCs.

[7] 1 mg/kg is a logarithmic step between the RBC for TCE and background.



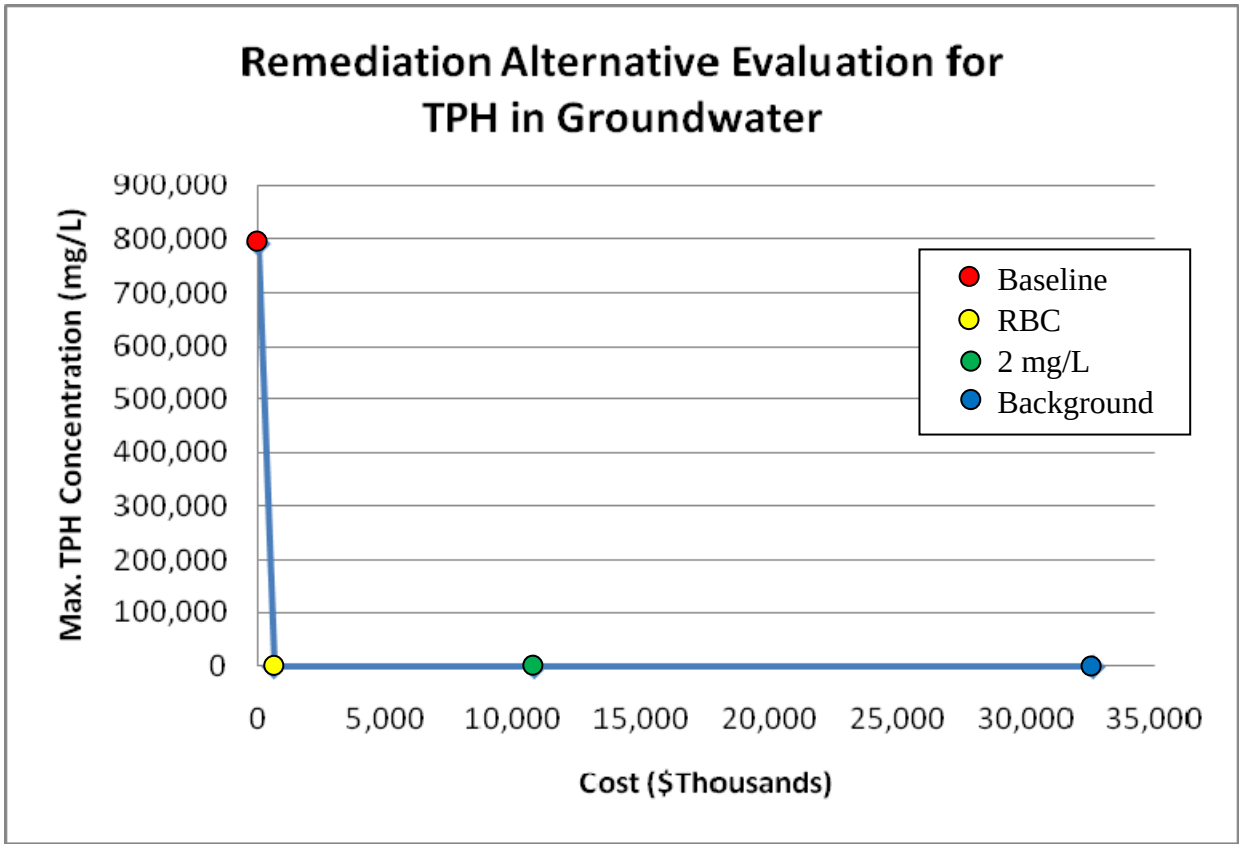
	Treated Volume (yd3)	Max Total VOC Concentration (mg/kg)	Remediation Cost ($ Thousands)	Remedial Alternative
Baseline	0	220	0	Excavation
RBC	180	25	160	Excavation
1 mg/kg	6,100	1	3,200	Excavation
Non-Detect	83,000	0	42,000	Excavation

The proposed RBC cleanup goals directly address potential risk to human health and the environment from VOCs on Site. VOC concentrations within the vadose zone are expected to continue to attenuate, eventually achieving background concentrations. The additional non-economic costs for performing large scale excavations also need to be considered, including project related greenhouse gas emissions, increased demand on finite landfill capacity, and increased truck trips and associated risk of traffic accidents. Below the RBC cleanup goal, exponentially greater excavation volumes would be required to further reduce VOC

concentrations, which are otherwise expected to naturally degrade over time. Therefore, the RBCs are proposed as the most appropriate remediation goal for VOCs in soil.

Groundwater Remediation Goal for TPH

To evaluate the maximum beneficial cleanup level for TPH in groundwater, the required groundwater treatment area was evaluated over a range of treatment area footprints based on a range of TPH remedial goals. The alternatives were 790,000 mg/L (a no-action alternative)[8], 10 mg/L[9] (the RBC), 2 mg/L[10], and non-detect. The most significant break point in the residual max TPH concentration vs. remediation cost curve is at the RBC goal.



[8] Maximum total concentration of TPH in a groundwater sample prior to remedial actions.

[9] RBCs for TPH in groundwater range from 10 mg/L for Aromatic TPH to 660 mg/L for Aliphatic TPH. Because TPH samples have not been speciated, the Aromatic RBC is used as the most conservative benchmark for Total TPH evaluation.

[10] Because non-detect for TPH in groundwater is typically 0.5 mg/L, 2 mg/L was selected as an intermediate concentration between the RBC and non-detect instead of the logarithmic step of 1 mg/L.

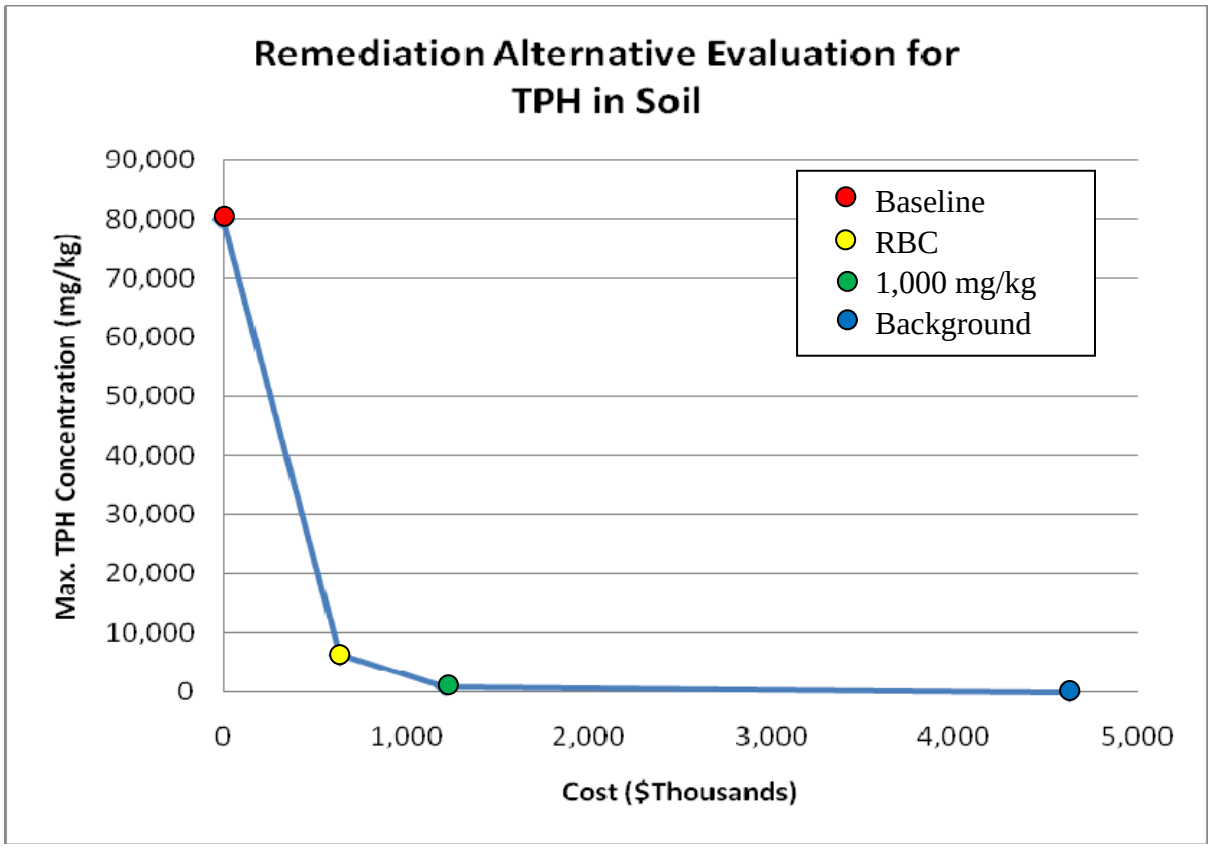
	Treatment Volume (yd3)	Max TPH Concentration (mg/L)	Remediation Cost ($ Thousands)	Remedial Alternative
Baseline	0	790,000	0	Excavation/ Groundwater Extraction
RBC	700	10	620	Excavation/ Groundwater Extraction
2 mg/kg	17,500	2	10,800	Excavation/ Groundwater Extraction
Non-Detect	54,000	0.5	32,000	Excavation/ Groundwater Extraction

Cost analysis was based on an excavation remedial alternative followed by LNAPL/Groundwater extraction, using the unit costs for excavation and disposal presented in the RI/FS (Geosyntec, 2010). Dual phase extraction/pump and treat were evaluated but not considered feasible due to the relatively tight soil physical properties and the heavy-end hydrocarbon range typically observed at the Site.

The proposed RBC cleanup goals directly address potential risk to human health and the environment from residual TPH in groundwater on Site. TPH concentrations within the groundwater are expected to continue to attenuate over time, eventually achieving background concentrations. The additional non-economic costs for performing large scale excavations also need to be considered, including project related greenhouse gas emissions, increased demand on finite landfill capacity, and increased truck trips and associated risk of traffic accidents. Below the RBC cleanup goal, exponentially greater excavation remedies would be required to further reduce TPH concentrations, with little to no incremental benefit to the people of the state. Therefore, the RBCs are proposed as the most appropriate remediation goal for TPH in groundwater.

Soil Remediation Goal for TPH

To evaluate the maximum beneficial cleanup level for TPH in soil, the required treatment area was evaluated over a range of treatment area footprints based on TPH concentrations. The alternatives were 80,000 mg/kg (a no-action alternative[11]), 6,200 mg/kg (the RBC[12]), 1,000 mg/kg[13], and non-detect <0.5 mg/kg. The most significant break point in the residual max TPH concentration vs. remediation cost curve is at the RBC goal.



[11] 80,000 mg/kg is the highest concentration of TPH in soil prior to remedial action at the Site.

[12] RBCs for TPH in soil range from 6,200 mg/kg for Aromatic TPH to 400,000 mg/kg for heavy range Aliphatic TPH. Because TPH samples have not been speciated, the Aromatic RBC is used as the most conservative benchmark for Total TPH evaluation.

[13] 1,000 mg/kg is a logarithmic step between the RBC and non-detect for TPH.

	Treatment Volume (yd3)	Max TPH Concentration (mg/Kg)	Remediation Cost ($ Thousands)	Remedial Alternative
Baseline	0	80,000	0	Excavation
RBC	760	6,200	640	Excavation
1,000 mg/kg	1,500	1,000	1,200	Excavation
Non-Detect	8,800	<100	4,600	Excavation

Cost analysis was based on an excavation remedial alternative, using the unit costs for excavation and disposal presented in the RI/FS (Geosyntec, 2010). Bioventing (injection of oxygen into the vadose zone to stimulate aerobic degradation of hydrocarbons) was evaluated but not considered feasible due to the heavy-end hydrocarbon range typically observed at the Site.

The proposed RBC cleanup goals directly address potential risk to human health and the environment from TPH on Site. TPH concentrations within the vadose zone are expected to continue to attenuate over time, eventually achieving background concentrations. The additional non-economic costs for performing large scale excavations also need to be considered, including project related greenhouse gas emissions, increased demand on finite landfill capacity, and increased truck trips and associated risk of traffic accidents. Below the RBC cleanup goal, exponentially greater excavation volumes would be required to further reduce TPH concentrations with little to no offsetting benefit to the people of the state. Therefore, the RBCs are proposed as the most appropriate remediation goal for TPH in soil.

References:

Geosyntec Consultants (Geosyntec) 2005. *Site Characterization Report, 2701 North Harbor Drive, San Diego, CA 92101*. 19 December, 2005.

Geosyntec, 2010. *Remedial Investigation/Feasibility Study 2701 North Harbor Drive, San Diego, CA 92101*. 16 August, 2010.

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