Cal/EPA

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APPENDIX A
Guidance on Data Collection Requirements for the Evaluation of Residual Free Product or Light Non-Aqueous Phase Liquid (LNAPL) on Groundwater (July 1998)

This guidance is an appendix to the RWQCB "*Interim Guidance on Required Cleanup at Low-Risk Fuel Contaminated Sites*" dated April 1, 1996. There are a number of issues which should be adequately addressed before the San Diego Regional Water Quality Control Board (RWQCB) staff can properly evaluate a request to cease removal of "*free product*" or "*light non-aqueous phase liquids"* (or ***LNAPL***) from the groundwater at petroleum contaminated sites. The specific answers to the questions listed below will help address the issues of technical and economic feasibility of site remediation, and allow the RWQCB staff to make an informed decision regarding actual risks to human health and environmental receptors posed by the environmental pollution remaining at sites. The following minimum information should be included in corrective actions plans (CAPs), where LNAPL is present at the site:

1. *Identify the beneficial uses of groundwater and surface water for the hydrologic basin where the site is located (RWQCB, 1994).* Complete the information on FORM 1 (attached) to answer the appropriate questions.

2. *Evaluate the extent and impacts of the LNAPL pool on and off-property.* Provide an estimate of the total volume of LNAPL present on groundwater and estimate the age of the release at the site. Provide a list of assumptions and the calculations in the text (also see discussion of methodologies by USEPA, 1996).

   Provide a map clearly illustrating the estimated footprint of the LNAPL pool, on-site and adjacent land uses, locations of surface improvements, buildings, and subsurface utilities (and estimated depth of subsurface utilities) located on-site and adjacent to the site. The text should also provide an evaluation of general plan designations, land use zoning categories, and potential adverse impacts on projected land uses.

3. *Evaluate the historical observations of free product.* Provide a table of observed maximum thickness (in ft) of LNAPL over time. The narrative should include an evaluation of effects of water table fluctuations on the history of LNAPL occurrence in groundwater wells. A graph of variations in depth to water and LNAPL thickness with time, for each affected well, should be included in the report. Include the well number, date of observation, depth to top of well screen, depth to top of LNAPL, depth to water, and calculated/measured thickness of observed LNAPL.

4. *Evaluate hydrogeological characteristics affecting advective contaminant transport and attenuation mechanisms, and plume stability at the site.* For all basins, the minimum information shall include: estimates of the direction of groundwater flow and the proximity and withdrawal rates of groundwater users and dewatering projects. For sites located in basins with designated beneficial uses of groundwater (RWQCB, 1994), or within 1,000 feet of a sensitive receptor *(e.g., surface waters)* in basins where designated beneficial uses of groundwater do not exist, the evaluation shall include estimates of the range of site-specific soil pore-water velocity(ies) (in feet per year) for the aquifer at the site (see FORM 2 attached). The associated discussion shall include a comparison of the estimated site-specific rate(s) of contaminant transport and contaminant attenuation rates to evaluate potential impacts to the nearest sensitive receptor(s). Provide a list of assumptions, references, and calculations with the text.

5. *Provide an evaluation of technical feasibility of removing all LNAPL from groundwater at the site.* This analysis should include a reasonable estimated rate of LNAPL removal. This may be based upon observed site-specific LNAPL recovery rates and/or derived from historical operation of the LNAPL recovery system (if present) at the site. For example, the time frame for removal of free product may be estimated as:

$$\frac{\text{Volume of LNAPL (gallons)}}{\text{LNAPL Removal Rate (gal/day)}} = \text{No. of days to remove}$$

These data should be converted to appropriate units of time (*e.g.*, years, days, *etc*) for convenience. Also see discussion of this topic provided by USEPA (1996). Provide a list of assumptions and the associated calculations with the text.

6. *Provide an estimate of the economic feasibility of removing all LNAPL from groundwater at the site.* The estimate should include data from past operations of free product removal systems at the site, if available. Future
capital improvements and O&M costs should be estimated for completion of free product removal at the site. Provide a list of assumptions and a table of itemized estimated costs with the text.

7. *Tabulate the characteristics of the waste(s) left in-situ , including the type of LNAPL (e.g., gasoline, diesel fuel, etc), and the chronology of past efforts to remove LNAPL from groundwater at the site.* The information provided should include the following:

    a) Solubility of the fresh product *versus* on-site LNAPL.
    b) Estimated/measured content of fuel constituents in the fresh product and residual concentrations observed in LNAPL currently at the site.
    c) Vapor pressure of the fresh product *versus* on-site LNAPL.
    d) A chronology of attempts to remove LNAPL from the site, including a short description of limitations encountered and an estimated total volume recovered to date.

    Some of these data may be derived from a combination of site-specific measurements and data cited from available technical references, as appropriate.

8. *Provide an evaluation of the environmental persistency of water quality impairment at the site.* Provide an estimate for the length of time (in years) the residual LNAPL (concentrations of product above solubility limit) will remain at the site. This may be done by modeling explicit attenuation processes and/or using site-specific chemical parameters (*e.g.,* ratios of constituents, *etc*.) indicative of LNAPL attenuation. Provide a list of rationale, assumptions, and associated calculations with the text.

9. *Provide an evaluation of risks to human health from exposure to product and/or vapors from the residual LNAPL*. Provide results and map from a vapor survey(s) of soils and/or utilities located at/adjacent to the site. Provide a list of assumptions and any associated calculations with the text (*e.g*., USEPA, 1989). The discussion in the text should also include an evaluation of potential impacts to water resources in basins where groundwater development projects are planned (for examples see SDCWA, 1997), persistence and permanence of potential adverse effects on surface water/groundwater quality, and beneficial uses of water resources.

10. *Provide an evaluation of risk from fire and explosion hazards associated with residual LNAPL and/or associated vapors from the site*. Provide specific narrative rationale, tabulated on-site measurements, and a site plot plan with vapor survey results (for utilities) to support the stated conclusions in the text.

11. *Provide an evaluation of risks to environmental (including ecological) receptors from exposure to product and/or vapors from residual LNAPL.* Discuss the proximity of the wastes at the site to surface waters and potential/actual hydraulic connections between groundwater and surface water resources. Provide a list of assumptions and any associated risk calculations with the text.

The responsible party(ies) should provide the requested information in a corrective action plan (CAP) or a *"short and concise"* letter with the limited number of attachments (or appendices) containing the information requested above. The attached references section includes a short list of references of current State requirements for water quality protection and technical references which may help with preparation of the information requested above.

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REFERENCES

County Water Authority (SDCWA), 1997, San Diego County Water Authority Groundwater Report, dated June 1997.

RWQCB, 1994, Water Quality Control Plan for the San Diego Basin (9), dated September 8, 1994.

RWQCB, 1996, Regional Board Supplemental Instructions to State Water Board December 8, 1995, Interim Guidance on Required Cleanup at Low-Risk Fuel Contaminated Sites, dated April 1, 1996.

State Water Resources Control Board, 1996, Resolution No. 92-49: Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304, dated October 2, 1996.

US Environmental Protection Agency (USEPA), 1996, How to Effectively Recover Free Product at Leaking Underground Storage Tank Sites: A Guide for State Regulators. EPA 510-R-96-001, dated September 1996.

US Environmental Protection Agency (USEPA), 1993, Guidance for Evaluating Technical Impracticability of Ground-Water Restoration. Directive 9234.2-25, dated September 1993.

US Environmental Protection Agency (USEPA), 1989, Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A). EPA/540/1-89/002, dated December 1989.

BENEFICIAL USES OF WATER RESOURCES
Data Entry Form

Site **NAME:** _____

Site **ADDRESS:** _____

CITY/COUNTY/ZIP: _____

Nearest Major Cross-Streets: _____

_____

Hydrologic Unit **NAME** and **BASIN NUMBER:** _____
(*e.g.* San Diego Mesa, HU 8.20)

Nearest Surface Water (**NAME**)**:** _____

Approximate distance to Surface Water (in feet): _____

Ground Water Exempted from MUN (RWQCB, 1994[1]): ☐ YES ☐ NO

Sensitive Aquifer (RWQCB, 1996[2]): ☐ YES ☐ NO

Designated Existing or Potential Beneficial Uses of Surface Water (check all that apply[1])

☐ MUN ☐ AGR ☐ IND ☐ PROC ☐ GWR ☐ FRSH ☐ POW ☐ SPWN

☐ REC1 ☐ REC2 ☐ BIOL ☐ WARM ☐ COLD ☐ WILD ☐ RARE

☐ NAV ☐ EST ☐ MAR ☐ COMM ☐ AQUA ☐ MIGR ☐ SHELL

Designated Existing or Potential Beneficial Uses of Ground Water (check all that apply[1])

☐ MUN ☐ AGR ☐ IND ☐ PROC ☐ FRSH ☐ GWR

[1] RWQCB, 1994, Water Quality Control Plan for the San Diego Basin (9), dated September 8, 1994.

[2] RWQCB, 1996, Regional Board Supplemental Instructions to State Water Board December 8, 1995, Interim Guidance on Required Cleanup at Low-Risk Fuel Contaminated Sites, dated April 1, 1996.

Groundwater Velocity Calculations

Estimate velocity of groundwater from Darcy Equation:

$$V_W = K_h (I) / \theta$$

V_W = velocity of groundwater

K_h = hydraulic conductivity

I = groundwater gradient

θ = saturated porosity

Saturated porosity (%):
(list the source of this information: laboratory measurement, reference text, other - provide explanation)

Hydraulic conductivity (also specify units):
(list the source of this information: laboratory measurement, aquifer pump test, aquifer slug test, reference text, other - provide explanation)

Groundwater gradient (unitless):
(list the source of this information: site-specific measurement, reference text, other - provide explanation)

Groundwater velocity - V_{YR} (ft/year):

Distance to nearest sensitive receptor (e.g., water well(s), surface water, habitat area)(in ft):

Estimated time of travel to nearest receptor (Distance / V_{YR}) in years:

Provide an evaluation of mitigating attenuation factors, if any at this site. Include a list of assumptions and associated calculations as necessary to support the analysis. Attached other sheets as necessary.

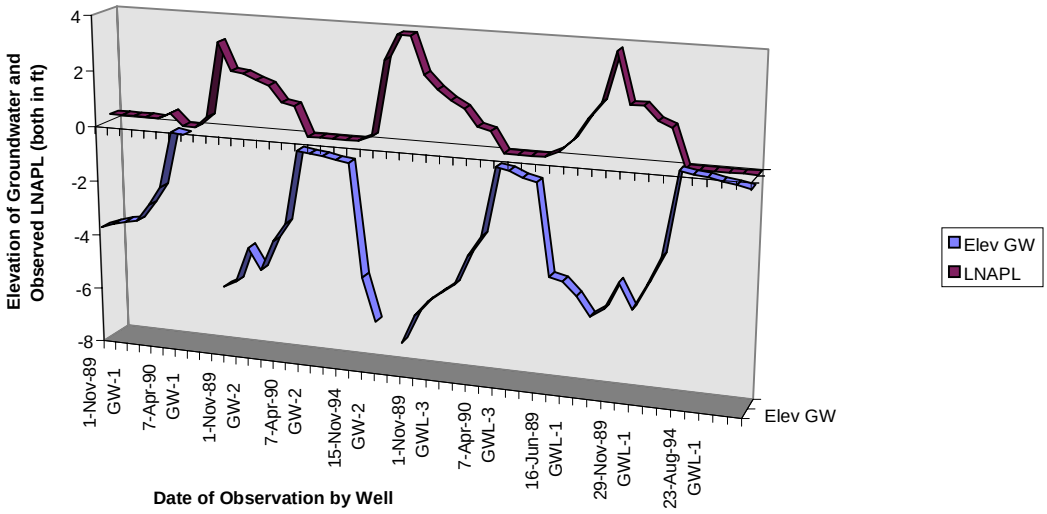

Figure 1

San Diego RWQCB LNAPL GUIDANCE Figure 1: May 1998