Evaluation of Site-Specific Criteria for Determining Potability and Cleanup Goals for Impacted Groundwater

This paper presents considerations used to evaluate site-specific criteria for determining groundwater potability and cleanup goals for impacted groundwater at Navy Environmental Restoration (ER) sites. The approach is based on the report *Classification of Shallow Caprock Groundwater at Navy Oahu Facilities* (NAVFAC, 2007), which was developed by the Naval Facilities Engineering Command Pacific (NAVFAC Pacific[1]) in conjunction with the U.S. Environmental Protection Agency (USEPA) and the Hawaii Department of Health. There are other valid approaches for evaluating potentially-impacted groundwater. Consequently, this paper is provided for informational purposes and may not be applicable to all ER sites in all regions. For region-specific information on addressing impacted groundwater contact your technical support representative.

Executive Summary

Evaluation of potentially-impacted groundwater is a key component of site assessments conducted under the Navy's ER program. Groundwater beneficial uses are a key component of the site-specific human health and ecological risk assessments, and ultimately the clean-up goals (if warranted). The expectation established in the National Contingency Plan (NCP) is that that contaminated groundwater will be returned to its beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site. Once the beneficial uses of groundwater are determined, that information can be incorporated into the conceptual site model (CSM) for use in subsequent aspects of the investigation and remedial decision-making process.

The beneficial uses of groundwater are identified using USEPA criteria, state criteria, and through consideration of site-specific factors. The USEPA criteria are presented in *Draft Final Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy* (USEPA, 1986). In this document, three groundwater classifications[2] are identified:

- **Class I Groundwater** – A vulnerable aquifer that is an irreplaceable source of potable water or water that is ecologically vital.
- **Class II Groundwater** – A current or potential source of potable water or water that has other beneficial uses.
- **Class III Groundwater** – Not a potential source of potable water and is of limited beneficial use.

State criteria may be present in the form of a USEPA-endorsed Comprehensive State Groundwater Protection Program (CSGWPP), or other state plans. Most states are no longer pursuing formal approval of a CSGWPP, but virtually all states are pursuing at least some of the individual elements necessary for

[1] Contributions and editing were provided by the NAVFAC Risk Assessment Workgroup (RAW) and PIONEER Technologies Corporation http://www.uspioneer.com.

[2] Some states have established their own groundwater classification system via Comprehensive State Ground Water Protection Programs (CSGWPPs). The USEPA has endorsed development of CSGWPPs and stipulates that deference will be given to these state programs if they are at least as restrictive as those developed by the USEPA.

comprehensive ground water protection. Site-specific factors (e.g., vulnerability of the aquifer, historical groundwater use, etc.) are also used to identify the beneficial uses of groundwater.

Once the beneficial uses of groundwater have been identified and incorporated into the CSM, human health risk assessments (HHRAs) and ecological risk assessments are conducted (as appropriate) to determine if risk associated with groundwater exposure is above target risk levels. If the project team identifies potentially unacceptable risks, then risk-based groundwater remediation goals are calculated for the chemicals of concern (COCs) identified. These risk-based goals are derived to be consistent with the CSM to ensure that potential risks posed by all complete exposure pathways (e.g., inhalation of groundwater vapors from vapor intrusion, dermal contact, irrigation, etc.) are addressed. These risk-based remediation goals are one of several considerations when the site remediation goals are evaluated during the Feasibility Study (FS). Remediation goals considered in the FS may include federal and state Maximum Contaminant Levels (MCLs) or non-zero MCL Goals (MCLGs) established under the Safe Drinking Water Act (SDWA - 40 CFR part 141), background concentrations, and other Applicable or Relevant and Appropriate Requirements (ARARs) such as existing state and federal surface water criteria.

Site remediation goals are evaluated in the FS and are selected based on state concurrence and community acceptance, incorporating the nine Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) criteria. The determination of groundwater classification/beneficial use can play a significant role in the ultimate remedy and remedial action and can be a contentious issue with all stake holders.

Key Issues and Concepts

- ☑ Identification of the beneficial uses of the impacted groundwater is the first step in an evaluation.

- ☑ Under CERCLA, urgency for restoring groundwater quality is based in large part on its vulnerability, current or projected use, and value. The goal is to return groundwater to its beneficial uses within a reasonable timeframe.

- ☑ The USEPA document, *Guidelines for Ground-Water Classification Under the EPA Groundwater Protection Strategy* (USEPA, 1988) provides an approach for classifying groundwater as Class I, II, or III. Class I groundwater is considered an irreplaceable source of potable water or is ecologically vital. Class II groundwater is a current or potential source of potable water or a water that has other beneficial uses. Class III groundwater is not a potential source of potable water and is of limited beneficial use. The threshold criteria for the USEPA to classify groundwater as a potential drinking water source are a total dissolved solids (TDS) concentration less than 10,000 milligrams per liter (mg/L) and a minimum well yield of 150 gallons per day. Groundwater that does not meet these criteria are usually classified as Class III.

- ☑ The USEPA has endorsed development of CSGWPPs and stipulates that deference will be given to these state programs if they are at least as restrictive as those developed by the USEPA (USEPA, 1997). USEPA provides guidance for preparing CSGWPPs in the Final Comprehensive State Ground Water Protection Program Guidance (USEPA, 1992). In the absence of an EPA-endorsed CSGWPP, appropriate groundwater remediation goals are determined through a cooperative effort between the Navy, USEPA, and the appropriate state regulatory agency, as applicable.

- ☑ Site-specific factors should be considered in conjunction with the groundwater classification in order to identify the groundwater beneficial uses.

- ☑ Remediation goals for groundwater with limited beneficial use are typically less stringent than goals for groundwater that represents a current or potential potable water supply or supports important ecological resources.

- ☑ If groundwater is a current or potential drinking water source, then the need for remediation is determined in part based on a comparison to MCLs or risk-based remediation goals for those chemicals that do not have MCLs.

- ☑ Risk-based groundwater remediation goals can be derived based on the CSM and results of human health and ecological risk assessments. These risk-based goals are derived based on the CSM to ensure that threats posed by complete exposure routes (e.g., inhalation of volatiles in groundwater due to vapor intrusion, dermal contact, irrigation, etc.) are eliminated, and any significant ongoing degradation of the groundwater from contaminant migration is mitigated.

- ☑ If the HHRA indicates that remediation is warranted to protect Class I or Class II groundwater that is a current or potential source of drinking water, then MCLs or non-zero MCLGs established under the SDWA, should be attained by remedial actions unless risk management can be achieved through use of land use controls (LUCs) that limit groundwater use as a potable source and/or an accepted risk management plan.

- ☑ MCLs may be waived as remedial action goals if they are technically impracticable. Additional waivers are discussed in 40 CFR.430 (f)(1)(ii)(C).
- ☑ Remedies should ensure that migration of contaminated groundwater does not adversely impact other groundwater, surface water, or pose an unacceptable ecological risk.

1.0 Introduction

This paper presents an approach for identifying the beneficial uses of groundwater and for identifying groundwater remediation goals for ER sites. Identification of the groundwater beneficial uses is the first step in an investigation since it forms the basis of the CSM. For example, if the maximum beneficial use of the groundwater is drinking water, then this pathway is evaluated in the HHRA. Since returning groundwater to its beneficial use is one of the goals of CERCLA remediation, determining the beneficial uses is a necessary step in identifying appropriate remediation goals. The steps involved in the process of assessing beneficial groundwater uses and identifying remediation goals are presented in Figure 1 and are discussed in the following sections.

> There are other valid approaches for evaluating groundwater exposure pathways. Consequently, this paper is provided for informational purposes and may not be applicable to all ER sites.

2.0 Evaluation of USEPA and State Criteria for Determining Groundwater Beneficial Uses

Beneficial uses of groundwater at ER sites is assessed based on a combination of criteria established by the USEPA and states (if applicable) and should be completed as a partnership between the Navy, USEPA, and state agencies, as appropriate. It is important to ensure that the different regulatory criteria for groundwater classification are integrated and appropriately applied to federal lands..

USEPA Criteria for Classifying Groundwater

The USEPA document, *Guidelines for Ground-Water Classification Under the EPA Groundwater Protection Strategy* (USEPA, 1986) identifies three classes of groundwater:

- **Class I** – A vulnerable groundwater body that is an irreplaceable source of potable water or is ecologically vital.
- **Class II** – Groundwater body is a current or potential source of potable water or a groundwater body that has other beneficial uses.

- **Class III** – Groundwater body is not a potential source of potable water and is of limited beneficial use.

Note: Groundwater that meets the USEPA criteria for a current or potential-future potable water source is classified as either Class I or Class II. Groundwater may also be categorized as Class I or Class II if it supports sensitive or protected habitat, animals, and plants (i.e., federal or state-listed threatened or endangered species). Such groundwater may discharge to surface-water resources such as wetlands, springs, streams, rivers, wildlife refuges, harbor waters, or the ocean. Additional beneficial uses may include agricultural use, industrial supply, groundwater replenishment, and freshwater recharge. The only "beneficial" uses compatible with Class III groundwater, are those associated with mining or waste disposal via underground injection; therefore, if groundwater serves a beneficial purpose other than these two, then the groundwater cannot be considered a Class III aquifer.

The USEPA document, *Guidelines for Ground-Water Classification Under the EPA Groundwater Protection Strategy* (USEPA, 1986) classifies groundwater as a "potential source of drinking water" if it is "capable of yielding a quantity of drinking water to a well or spring sufficient for the needs of an average family." This yield is established as 150 gallons per day (gpd) sustainable throughout the year. Groundwater is considered suitable for drinking if it contains a TDS concentration of less than 10,000 mg/L, which can be used without treatment, or that can be treated using methods reasonably employed in a public water system (USEPA, 1986).

State Criteria for Classifying Groundwater

In addition to USEPA criteria, if state groundwater classification guidelines exist they should be considered when evaluating the potential beneficial use of a drinking water source and identifying appropriate approaches for classifying groundwater at Navy ER sites. State criteria may be present in the form of an USEPA-endorsed CSGWPP, or other state plans. By default USEPA-endorsed CSWPPs are at least as stringent as USEPA's Groundwater Strategy, but if another type of state groundwater classification plan is in use, it needs to be carefully evaluated to determine if cleanup decisions based on it would be less protective than decisions based on the EPA classification strategy. The NCP Preamble advises that where State and USEPA classifications result in different groundwater use scenarios, the classification leading to the more stringent remediation goals should be used. Thus, groundwater at a given site is generally assumed to be a future source of drinking water if designated as such by the State or if considered to be a potential source of drinking water under the 1986 Classification Guidelines. When the potential for potable use is in question, groundwater classification should be determined through a cooperative effort between the Navy, the USEPA, and the appropriate state regulatory agency, as applicable; this evaluation should consider the types of site-specific criteria discussed in Section 3.0.

3.0 Evaluation of Site-Specific Criteria for Determining Groundwater Beneficial Uses

Groundwater that is currently used as a source of drinking water does not require additional site-specific analysis to determine beneficial use; remediation goals for these sites should be developed assuming that groundwater ingestion is a complete exposure pathway in the HHRA. However, if groundwater is merely a potential drinking water source, then site specific analysis may be warranted. By default, the USEPA considers all groundwater to be a potential source of drinking water until it is demonstrated that it is not reasonably anticipated to be a drinking-water source based on an evaluation of site-specific factors. Beyond the basic yield and TDS criteria discussed above, there are a variety of site specific criteria that influence beneficial use determinations. If the potential for use as a drinking water source is in doubt, project teams should perform an evaluation of these site-specific criteria to refine the CSM. The use of site-specific factors should be discussed and agreed upon with the involved regulatory agencies. Additional direction on the evaluation of site-specific criteria can be found in USEPA's Final Comprehensive State Ground Water Protection Program Guidance (USEPA, 1992).

Example site-specific characteristics to be considered when determining the potential beneficial use(s) of groundwater are discussed below; they include:

- Local hydrogeology and potential for groundwater well development
- Potential for impacted groundwater from the site to contaminate another potable water source
- Vulnerability of the groundwater to contamination and the availability of alternate sources of drinking water
- Ecological vitality of groundwater
- Historic use of groundwater
- Groundwater chemistry or existing widespread contamination
- The existing standards and controls for potable water development

Local Hydrogeology and Potential for Groundwater Well Development

The hydrogeology of the site and surrounding area is important and should be considered to determine whether or not it is feasible or economical to develop groundwater for potable purposes, and to confirm that undesirable changes (e.g., seawater intrusion, unacceptable decline in hydraulic head) will not be induced at the anticipated pumping rates (NAVFAC, 2007). The major hydrogeologic parameters that should be evaluated (if data are available) include aquifer type, aquifer media or subsurface material, aquifer boundaries, depth to groundwater, aquifer thickness, recharge rate, hydraulic properties, potentiometric head elevation, groundwater flow direction, sustainable yield, proximity to saltwater and vulnerability to seawater intrusion, and tidal influence (USEPA, 1986).

Potential for Impacted Groundwater from the Site to Contaminate Another Potable Water Source

If hydrogeologic conditions could allow impacted groundwater from the site to contaminate another source of groundwater or surface water that represents a current or potential source of drinking water (i.e., Class I or Class II), the impacted site groundwater should be evaluated as if it is a current or potential source of drinking water. Hydraulic connectivity to down gradient and underlying aquifers should be evaluated. This is evaluated by identifying the characteristics of the confining strata that separates the site groundwater from the known (or potentially) potable source (NAVFAC, 2007).

Vulnerability of Groundwater to Contamination

The vulnerability of undeveloped groundwater to contamination should be evaluated to determine if the groundwater is likely to be developed for potable purposes. The parameters assessed to evaluate this are current and future land use; availability of other sources of drinking water; the proximity of the groundwater source to industrial, commercial, and agricultural areas; potential for saltwater intrusion,; and the proximity to landfills, other waste disposal sites, underground tanks, pipelines, and underground injection wells. The depth to groundwater and the overlying substrata and its hydraulic conductivity are also important factors. Groundwater that is highly susceptible to contamination generally should not be developed for potable water supply if other sources are available (NAVFAC, 2007).

Ecological Vitality of Groundwater

The criteria for “ecologically vital” are subject to interpretation by the involved regulatory agencies, and will most likely be a negotiated on a site-by-site basis. Groundwater may be classified as ecologically vital if it:

- directly or indirectly supports a habitat used by a federal or state-listed threatened or endangered species,
- provides water to a wetlands area, or
- in any other way provides a critical resource for ecological life in the area.

Historic Use of Groundwater

The historic use of groundwater may help identify potential and feasible future use of groundwater. Where data are available, the former users of the water source, the period(s) of use, well characteristics, and reasons for discontinued use (if applicable) should be identified (NAVFAC, 2007).

Groundwater geochemistry or existing widespread contamination

Some groundwater contains naturally high levels of minerals, salts, or radionuclides that make it unsuitable for use as a drinking water source. USEPA allows aquifers that meet criteria for yield and TDS to be exempted as potable sources on the basis of chemistry. If groundwater quality is impaired by naturally occurring constituents or contaminated by human activity (i.e., local or regional anthropogenic impact) to the extent that groundwater cannot be cleaned up using methods reasonably employed in public water system treatment, then it is considered unsuitable for development as a drinking water source. (USEPA 1986).

Existing Standards and Controls for Potable Water Development

The potential for groundwater to be developed for drinking water purposes based on state and local procedures, standards, and restrictions should be evaluated. Well construction standards dictate requirements and recommendations for well siting, drilling and construction methods, minimum water quality and sustainable yield, and water-quality testing. Restrictions on water development may include LUCs such as engineering controls (e.g., physical barriers intended to limit access to and use of a property), and institutional controls (e.g., administrative and/or legal devices instituted to ensure restrictions on land use and development). The degree of notice, monitoring, and enforcement of such standards and controls indicates whether a groundwater resource could be developed for drinking water purposes. .

4.0 Development of Remediation Goals for Groundwater

Remediation goals are developed for groundwater based on the designated beneficial use, the results of a HHRA/ecological risk assessment (as appropriate), and through consideration of other sources of criteria typically considered in the FS (e.g. ARARs). The results of the risk assessment generally determine if an unacceptable risk exists and establishes the need for development of remediation goals. The process used to identify groundwater remediation goals is presented in Figure 1 and is discussed below.

Development of Remediation Goals Based on Site-Specific Human Health and Ecological Risk Assessment Results

After the groundwater beneficial uses have been identified, a human health and ecological risk assessment should be performed (as appropriate) to quantify the potential risks. Guidance for assessing risks to human health and ecological receptors associated with groundwater exposure pathways is provided in the:

- Navy's Human Health Risk Assessment Guidance (http://www-nehc.med.navy.mil/HHRA/process/index.htm)
- Navy's Ecological Risk Assessment Guidance (http://web.ead.anl.gov/ecorisk/)

Figure 2 presents a CSM identifying potential groundwater exposure pathways that are typically evaluated in an HHRA. In the HHRA, target risk levels of $1x10^{-6}$ to $1x10^{-4}$ for cancer risk and 1 for a noncancer hazard index are typically used as a basis for determining the potential need for remediation. If groundwater is a current or potential drinking water source, then USEPA expects that groundwater concentrations will also be compared to MCLs when determining the potential need for remediation. If

results of the risk assessment indicate risk above site-appropriate levels of concern, then risk-based remediation goals are calculated for incorporation into the FS.

Additional Remediation Goals and Remediation Considerations Addressed in the Feasibility Study

Additional remediation goals for a site that are considered in the FS include the following:

- Background groundwater concentrations,
- MCLs and MCLGs – when groundwater is a current or potential source of drinking water,
- ARARs for the site (e.g., federal and/or state surface water criteria for sites where groundwater discharges to surface water) – depending on groundwater classification and an evaluation of site-specific factors,
- Economic feasibility of achieving specific remediation goals,
- Technical practicability of achieving specific remediation goals.

Other Considerations when Making Risk Management Decisions

USEPA and other regulators do not generally allow consideration of overlying land use or control when evaluating whether groundwater may serve as a drinking water source in the future, but land use is an important consideration in risk management decisions. The following site specific criteria are not part of the beneficial use evaluation, but they may be useful when making risk management decisions and when negotiating remedial options and timeframes with regulators.

Department of Defense Drinking Water Criteria

The DoD has established criteria for identifying new, suitable sources of drinking water for military facilities (DoD, 2005). According to these criteria, a maximum TDS concentration of 600 mg/L in groundwater is deemed acceptable for potable drinking water. Other DoD guidance states that "in general" TDS should not exceed 500 mg/L, with 1,000 mg/L as the approximate upper limit: for drinking water (DoD, 2004). According to the DoD, it is unlikely that groundwater with TDS values greater than 1,000 mg/L would be developed by DoD for drinking water purposes until more suitable resources were exhausted (DoD, 2004). Even though the groundwater source may meet USEPA or state drinking water criteria for TDS and yield, if the groundwater source is not suitable for use by DON as a potable water source, then it is unlikely to be developed as a drinking water source as long as DON maintains control of the area.

Projected Water Demands of the Area

The projected water demands in and around an ER site are strongly dependent on property development and population growth. If projected drinking water demands cannot be met by current water sources, then more pressure may be placed on developing groundwater as a future source of potable water. Other factors to be considered are the future availability of drinking water from sources outside the site, military water rights, and agreements with the state for potable water use and development, and whether water treatment is a viable option within the site (NAVFAC, 2007).

Jurisdictional Control

Federal property is owned by the United States government, and jurisdictional control and duties to administer to federal property may be granted to the Navy at ER sites. Jurisdictional control evaluates the degree of control held by the Navy over water development, and if the Navy, as caretaker of the ER property, exercises control and adequately monitors uses of the property, then unauthorized use of the groundwater for drinking water purposes will be unlikely (NAVFAC, 2007). When the Navy has jurisdictional control, remedial alternatives that include LUCs may be appropriate.

Final Selection of Remediation Goals

Several considerations factor into the final selection of groundwater remediation goals. The selection of remediation goals is discussed below in terms of the beneficial uses of groundwater.

- Class I or Class II Potable Groundwater: If groundwater at an ER site is classified as Class I or Class II potable groundwater, then the groundwater remediation goals should be consistent with federal and state MCLs or non-zero MCLGs established under the SDWA (40 CFR part 141). For those constituents that have MCLs, MCLs are considered protective even if they represent concentrations that result in risk estimates higher than the HHRA target risk values. MCLs may be waived as remedial action goals if such goals are technically impracticable. Additional waivers are discussed in 40 CFR.430 (f)(1)(ii)(C). How about ACL issues??

- Other Class I or Class II Groundwater: Class I and Class II aquifers that have been designated on the basis of their discharge to an ecological habitat and that are not potential potable water sources based on the evaluation of site-specific factors and other criteria should have remediation goals developed based on the CSM and the appropriate ecological use or on non-ingestion human exposures. Where appropriate, factors such as potential surface water discharge, direct exposure to shallow groundwater sources through activities such as construction or vapor intrusion into buildings from volatile organic compounds in groundwater, should be considered in the development of risk-based remediation goals. Other state-specific ARARs may also apply. Other site-specific clean-up goals may be identified in the HHRA, the ecological risk assessment, or other regional use considerations such as industrial or agricultural use (consistent with the CSM), as appropriate.

- Class III Groundwater: Class III Groundwater is not potable, does not have the potential to impact potable sources, and has limited potential for beneficial use, therefore, remediation goals are not required to be consistent with MCLs or non-zero MCLGs. Where appropriate (e.g., consistent with the CSM), factors such as potential surface water discharge, direct exposure to shallow groundwater sources during construction, or vapor intrusion into buildings from volatile organic compounds in groundwater should be considered in development of risk-based remediation goals. Other state-specific ARARs may also apply.

The final selection of groundwater remediation goals for a site should also incorporate consideration of background concentrations, the economic feasibility of achieving specific remediation goals, and the technical practicability of achieving specific remediation goals. If restoring beneficial use throughout an aquifer is impracticable, then it may be appropriate to achieve protectiveness and manage risk through the use of institutional controls and/or engineering controls.

5.0 References

DoD (Department of Defense), 2004. Unified Facilities Criteria (UFC) 3-230-07A: Design: Water Supply: Sources and General Considerations. January 2004.

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NAVFAC (Naval Facilities Engineering Command), 2007. Classification of Shallow Caprock Groundwater at Navy Oahu Facilities, Oahu, Hawaii. Comprehensive Long-Term Environmental Action Navy Contract Number N62742-94-D-0048, CTO 0099. June 2007.

USEPA (United States Environmental Protection Agency), 1986. Draft Final Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy. 813R86001. December 1986.

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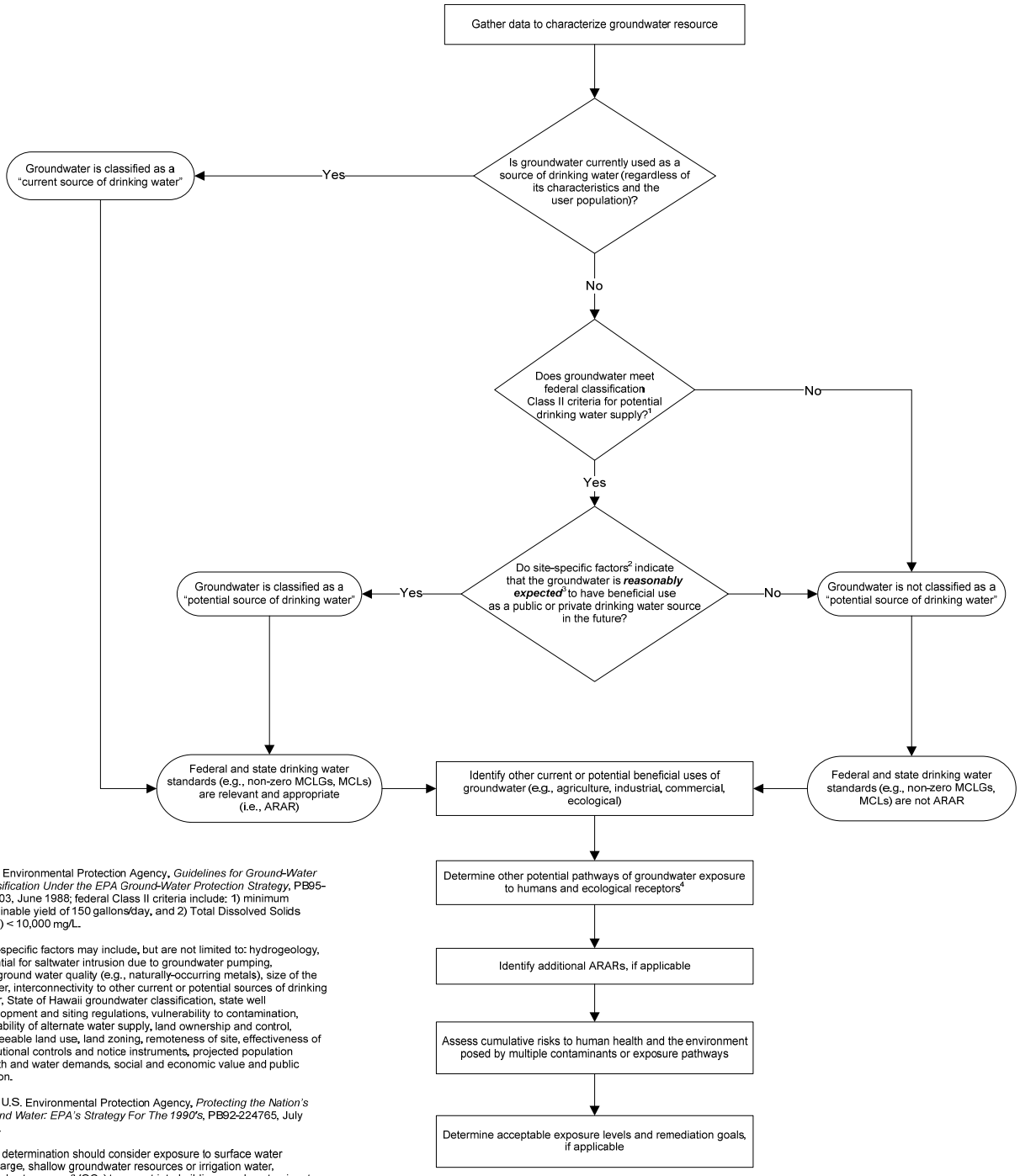
USEPA (United States Environmental Protection Agency), 1992. Final Comprehensive State Ground Water Protection Program Guidance. U.S. EPA Office of the Administrator Publication EPA-100-R-93-001. December 1992.

USEPA (United States Environmental Protection Agency), 1997. The Role of CSGWPPs in EPA Remediation Programs. OSWER Directive 9283.1-09. April 4, 1997.

Figure 1

Groundwater Classification and Identification of Remediation Goals



[1]U.S. Environmental Protection Agency, *Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy*, PB95-169603, June 1988; federal Class II criteria include: 1) minimum sustainable yield of 150 gallons/day, and 2) Total Dissolved Solids (TDS) < 10,000 mg/L.

[2]Site-specific factors may include, but are not limited to: hydrogeology, potential for saltwater intrusion due to groundwater pumping, background water quality (e.g., naturally-occurring metals), size of the aquifer, interconnectivity to other current or potential sources of drinking water, State of Hawaii groundwater classification, state well development and siting regulations, vulnerability to contamination, availability of alternate water supply, land ownership and control, foreseeable land use, land zoning, remoteness of site, effectiveness of institutional controls and notice instruments, projected population growth and water demands, social and economic value and public opinion.

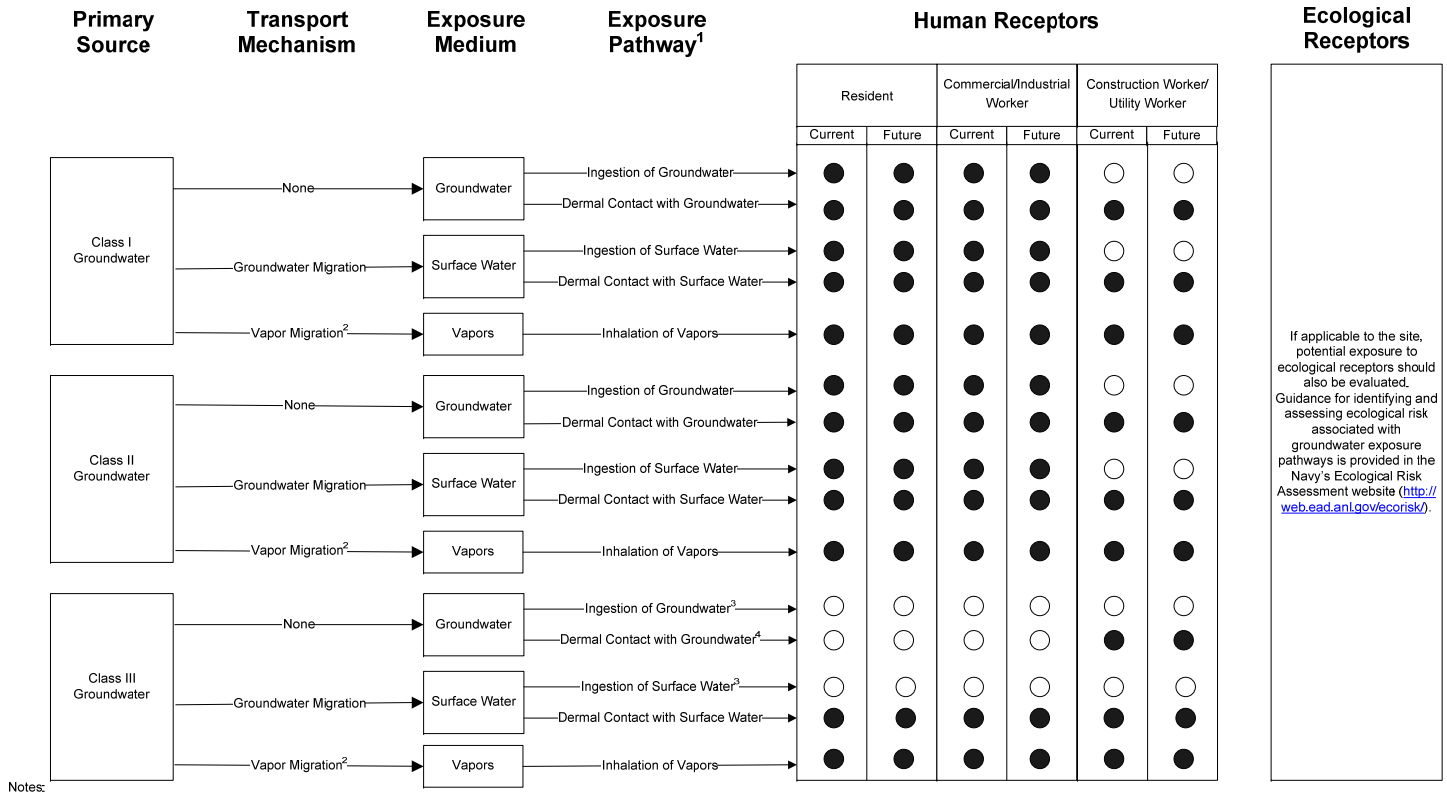
[3]See U.S. Environmental Protection Agency, *Protecting the Nation's Ground Water: EPA's Strategy For The 1990's*, PB92-224765, July 1991.

[4]This determination should consider exposure to surface water discharge, shallow groundwater resources or irrigation water, groundwater vapor (VOCs) transport into buildings, and contaminant plume migration.

Source: Naval Facilities Engineering Command: Classification of Shallow Caprock Groundwater at Navy Oahu Facilities, Oahu, Hawaii. June 2007

Figure 2

Conceptual Site Model: Potential Groundwater Exposure Pathways



Notes:
[1] Exposure pathways identified in this figure are those most commonly evaluated in a risk assessment. Local regulatory agencies may require evaluation of additional exposure pathways.
[2] This transport mechanism is only considered when groundwater is impacted with volatile organic chemicals or other chemicals that may act through vapor intrusion, such as mercury and PCBs.
[3] This pathway is considered incomplete for all receptors because Class III groundwater is not a potable source of water.
[4] This groundwater pathway is only considered when shallow groundwater is impacted. Shallow groundwater is typically considered to be less than 10 feet bgs, but this designation may differ based on site-specific negotiations.

KEY

● = Potentially-Complete Exposure Pathway

○ = Incomplete Exposure Pathway