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LETTER AND U S NAVY RESPONSE TO U S EPA REGION III COMMENTS REGARDING DRAFT FEASIBILITY STUDY REPORT FOR GROUNDWATER AT SITE 22 NWS YORKTOWN VA

02/28/2011

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Federal Facility Remediation (3HS11)
United States Environmental Protection Agency
Region 3
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Subject: Response to Comments *Draft Feasibility Study Report for Groundwater at Site 22*
WPNSTA Yorktown
Yorktown, Virginia

Dear Mr. Thomson,

This letter presents responses to your comments on the subject document submitted on September 27, 2010. Comments are presented below followed by responses in italics.

GENERAL COMMENTS

1. Three of the four remedial alternatives evaluated in detail for the site include monitored natural attenuation (MNA) as a component of the alternative. The draft FS Report has not, however, presented sufficient evidence to show that MNA is a viable alternative for site groundwater, capable of remediating both chlorinated volatile organic compounds (VOCs) as well as hexahydro-1, 3, 5-trinitro-1, 3, 5-triazine (RDX) to remedial goals (RGs). Section 4.2.2, Alternative 2-Monitored Natural Attenuation and Land Use Controls, on Page 4-3, states, "Reducing conditions predominantly present at the site are favorable for biologically mediated degradation of the chlorinated [contaminants of concern] COCs and RDX." The FS Report has not, however, presented sufficient data to show that the reducing conditions are actually degrading site contaminants over times. While the presence of vinyl chloride in site groundwater is one of line of evidence to support degradation of trichloroethylene (TCE), EPA's Final Office of Solid Waste and Emergency Response (OSWER) Directive "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites" (OSWER Directive Number 9200.4-17P) indicates that a three-tiered approach should be us used to evaluate the potential efficacy of MNA as a remedial alternative. The three tiers, or lines of evidence, are as follows:

    (1) Historical groundwater data that demonstrate a "clear and meaningful trend" of decreasing contaminant mass and /or concentration over time at appropriate monitoring or sampling points.

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(2) Hydro geologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes active at the site, and the rate at which such processes will reduce contaminant concentrations to required levels . A decrease in parent products (such as TCE) coupled with an increase in daughter products (such as cis-1,2,-dichloroethene and vinyl chloride) could be used to demonstrate biodegradation.

(3) Data from field or microcosm studies which directly demonstrate the occurrence of a particular natural attenuation process at the site and its ability to degrade the contaminants of concern (typically used to demonstrate biological degradation processes only).

The OSWER Directive further states, "Unless EPA or the implementing state agency determines that historical data (Number 1 above) are of sufficient quality and duration to support a decision to use monitored natural attenuation, EPA expects that data characterizing the nature and rates of natural attenuation processes at the site (Number 2above) should be provided. Where the latter are also inadequate or inconclusive, data from microcosm studies (Number 3 above) may also be necessary." Since limited historical data have been presented to show a clear and meaningful trend of decreasing concentration over time, additional lines of evidence are necessary. Please review the FS Report to provide supporting documentation and an evaluation of the efficacy of using MNA as a remedial alternative at the site. EPA's Technical Protocol for Evaluation Natural Attenuation of Chlorinated Solvents in Groundwater (September 1998) should be consulted for this evaluation. Additional discussions should also focus on degradation processes applicable to RDX as the FS Report currently does not provide sufficient evaluation of the degradation processes applicable to this constituent. RDX metabolites and breakdown products should be identified and quantified.

Response 1: *It is the respondents understanding that EPA requests additional lines of evidence [(1) decreasing concentrations over time, (2) hydrogeologic and geochemical data, (3) data from field or microcosm studies] to support Monitored Natural Attenuation presented as the preferred alternative for Site 22 Groundwater. Substantial decreases in TCE concentrations, the presence of TCE degradation products in groundwater at the site, geochemical conditions appropriate for degradation of TCE and the presence of Dehalococcoides sp., the microbe capable of degrading TCE completely to ethene, support the viability of a MNA approach for the chlorinated VOCs at the site. However, it is acknowledged that the available data for RDX do not support the required lines of evidence for this chemical. Consequently, the recommended alternative in the FS will be modified to include an active component to address RDX at the site.*

2. No laboratory treatability studies or field pilot studies are proposed for Alternative 3, In Situ Chemical Oxidation (ISCO) and Performance Monitoring with Monitored Natural Attenuation and Land Use Controls, or Alternative 4, Enhanced Reductive Dechlorination (ERD) and Performance Monitoring with Monitored Natural Attenuation and Land Use Controls. Although neither of these alternatives is selected as the preferred alternative, all relevant technology agencies and options for a given alternatives is selected as the preferred alternative, all relevant technology and options for a given alternative should be presented so the regulatory

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agencies and the public can make a decision on the selection of an alternative. Pilot tests would likely better determine the effectiveness of ISCO and ERD, particularly with respect to remediating RDX, and to determine optimal spacing for injection locations and optimal quantities needed for substrate addition. Appendix D, Reagent Evaluation: ISCO and ERD, acknowledges that "case studies exist that show permanganate can also be effective for treating RDX", but information regarding whether or not ISCO has reported success with full-scale implementation is not provided. The section on ERD in Appendix D does not address RDX at all, so it cannot be determined whether RDX could successfully be remediated with this technology. Given the uncertainties associated with these technologies for remediating RDX, it is recommended that pilot studies be included for Alternatives 3 and 4. The cost comparison of the alternatives should take cost of pilot tests into account.

Response 2: *A laboratory treatability test for permanganate was included in the Final RI Report for Site 22 and the results of the test are included within Section 6.3.5 (CH2M HILL, 2009) and the selection of permanganate as the preferred oxidant is included within Appendix D of the FS Report. References associated with case studies using permanganate as an effective oxidant for RDX will be included in Appendix D. Because existing information is available, a treatability or pilot study is not recommended for Alternative 3.*

A recent remedy completed at Naval Research Laboratory, White Oak reduced RDX concentrations to level as high as 380 ug/L to below detection levels using an ERD approach. Based on these data, ERD is believed to be a viable remedy for RDX and no pilot test is recommended.

SPECIFIC COMMENTS

3. **Section2.2.1 Nature and Extent of Contamination Page 2-2 and 2-3:** The Analytical Results subsection states that no VOCs were detected in the four deep monitoring wells screened in the bottom 10 feet of the Yorktown-Eastover aquifer, but the FS Report does not indicate whether no not RDX was detected in the deep monitoring wells. Figure 2-1, Site-Related COCs-Detected in Groundwater, does not show any detected results for the deep wells. For clarity and to support the evaluation of remedial alternatives, please revise the FS Report to indicate whether any site COCs, including RDX, were detected in the deep monitoring wells.

Response 3: *The four deep wells at Site 22 were installed to meet the objectives of decision logic included in the Groundwater RI Work Plan for Site 22, which required collection of DPT VOC groundwater samples at the depths of the deepest membrane interface probe (MIP) electron capture device (ECD) response. ECD responses were noted at depths of approximately 85 ft bgs, which is too deep to collect DPT groundwater samples. Consequently, the deep monitoring wells were installed. No VOCs were detected in these wells and the response on the MIP was believed to be an equipment error resulting from the depths at which the MIP data were collected, which were at the limits of the functionality of the equipment. The sampling approach in the work plan did not specify collection of samples for other analytes for the DPT samples. Consequently, the wells were never sampled for explosives. Explosives are particulates and are not expected to migrate readily though the finer grained soils which lie between 20 and 40 ft bgs at the site. Because the approach taken was consistent with the sampling approach outlined in the work plan, the results are believed*

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to be acceptable to support the Feasibility Study. However, the text will be clarified to specify that no contamination was noted in the deep wells at Site 22, so the remedy is limited to the shallower intervals.

4. **Section 2.2.2. Risk Assessment, Page 2-3** Heptachlor epoxide and arsenic were identified as constituents of concern (COCs) in the human health risk assessment (HHRA), but these chemicals " were determined to be unrelated to site activities" and "no additional action is required" for these chemicals. Please revise the FS Report to provide a summary on how it was determined that heptachlor epoxide and arsenic are unrelated to site activities and require no further action (i.e., provide data that nullified the HHRA determination).

Response 4: *Section 11.3 (Conclusions and Recommendations – Site 22) of the Final Remedial Investigation Report for Groundwater, Sites 4, 21 and 22, Naval Weapons Station Yorktown, Yorktown, Virginia (CH2M HILL, 2009) summarizes the conclusions of the RI and the basis of heptachlor epoxide and arsenic requiring no additional action. A summary is presented below and a reference to the Final RI Report will be added to the FS Report.*

TCE, heptachlor epoxide, vinyl chloride, RDX, and arsenic were identified as human health COCs at Site 22. Even though arsenic was considered a human health COC under the RME exposure scenario, concentrations of arsenic did not pose risk under the CTE exposure scenario, and dissolved concentrations did not exceed the MCL. Therefore, no additional action is recommended for arsenic. Heptachlor epoxide was detected in a number of samples, but only one sample concentration (YS22-GW03 at 0.21 µg/L) slightly exceeded the MCL (0.2 µg/L). Concentrations of heptachlor epoxide at Site 22 suggest their presence is attributable to normal pesticide use and not a CERLCA-related release. Pesticides and herbicides were commonly applied to the soil at Department of Defense facilities to control pests and weeds, which may have resulted in pesticides and herbicides accumulating in environmental media. The legal application of pesticides and herbicides are not CERCLA-related releases and are, therefore, not subject to regulation under CERCLA. These details will be added to the FS Report.

The WPNSTA Yorktown Partnering Team agreed to the conclusions of the Remedial Investigation Report for Groundwater (CH2M HILL, 2009). Consequently, only TCE, vinyl chloride and RDX were carried forward to the FS, but arsenic and heptachlor epoxide were not.

5. **Section 2.2.2:** The second sentence of the first paragraph should indicate that the pathway not quantitatively evaluated in the risk assessment was vapor intrusion.

Response 5: *This edit will be made as requested.*

6**. Section 2.2.3, Conceptual Site Model, Page 2-4**: The source of groundwater contamination in the northern portion of the site, in the vicinity of wells YS22-GW02 and YS 22-GW11, is not defined. In the Sources of Contamination and Migration subsection, it is noted that "the most highly contaminated soils at Site 22 have been previously removed" and "contaminant concentrations in the groundwater…at Site 22 are likely to decrease in the future because no source is present…" Excavation areas and detected concentrations in groundwater are shown on Figure 2-1, Site-Related COCs – Detected in Groundwater; however wells YS22-GW02 and YS22-GW11, which reported concentrations of TCE, vinyl chloride, and RDX above

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screening criteria, are located north/northwest and up gradient of the closest excavation area. Based on the limited data and evaluation provided in the FS Report, it is not apparent that the source of the groundwater contamination in the northern portion of the sited has been removed. Please revise the FS Report to identify the likely source of groundwater contamination in the northern portion of the site, and indicate whether any soil contamination was identified in this area of the site.

Response 6: *All source material associated with groundwater contamination at Site 22 was removed. No additional contaminant source areas were identified upgradient of wells YS22-GW02 and YS22-GW11 during the MIP study. The RI associated with Site 4 (see FS Figure 1-2), located directly upgradient of Site 22, recommended that no additional action is necessary to address groundwater at that Site. VOCs were not detected in Site 4 monitoring wells at levels of concern during the Site 4 evaluation and the landfill has been removed and either backfilled with clean fill or restored as ponds. It should be noted that Site 4 is considered the upgradient boundary of contamination identified at Site 22 because wells screened at comparable depths at Site 4 did not contain VOCs at levels of concern. Site 4 organic detections and removal action areas are shown on attached* ***Figure 4-4*** *from the Groundwater RI Report for your review.*

7. 2.2.3, Conceptual Site Model, Page 2-5: In the discussion of the fate and transport of RDX, the FS Report states, "available literature indicates that RDX may degrade slowly under reducing conditions through intermediate degradation products." The literature sources referenced in this statement have not been cited in the FS Report. Please revise the FS Report proper citations for any documents or literature referenced.

Response 7: *The literature sources referenced in the document as well as the new information obtained from the White Oak site described in response 2 will be included in the FS.*

8. **Section 2.2.4**: The draft FS concludes that TCE, VC and RDX are considered site-related COCs because they are "present at the site."However, per Section 2.2.2., arsenic and heptachlor epoxide were "determined to be unrelated to site activities." This contradicts the rationale provided in Section 2.2.4 for identifying COCs. The draft FS should be revised so that the language explaining COC selection is consistent.

Response 8: *Please see the response to Comment 4. The text in Section 2.2.4 will be modified to read, "TCE and VC posed risk under future exposure scenarios and exceed MCLs. No MCL exists for RDX, but the concentrations pose risk under future exposure scenarios. Based on the conclusions of the Final Remedial Investigation Report for Groundwater at Sites 4, 21 and 22 (CH2M HILL, 2009), additional remedial action is necessary to address TCE, VC and RDX only. Remedial alternatives to address these three COCs are addressed in subsequent sections of this report."*

9. **Figure 2-1, Site-Related COCs-Detected in Groundwater**: Figure 2-1 shows that concentrations of TCE, vinyl chloride, and RDX were detected above screening criteria in the northernmost up gradient shallow wells (YS22-GW02 and YS22-GW11). It is not apparent from this figure that the upgradient extent of contamination in groundwater has been defined. If wells from Site 4, located

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immediately north of the Site 22, are being used to define the up gradient extent of contamination in groundwater and show that it is adequately bounded. If there are no Site 4 wells screened at appropriate depths and locations to serve as upgradient boundary wells, additional monitoring wells north of Site 22 may be necessary.

Response 9: *Please see the response to Comment 6. The text of the FS will be modified to clarify that Site 4 is considered the upgradient boundary of contamination identified at Site 22. Monitoring wells installed at Site 4 at comparable depths than at Site 22 did not contain VOCs at levels of concern, MIP data does not identify source areas upgradient of existing well data at Site 22, and the Site 4 landfill has been removed.*

10. **Figure 2-1, Site-Related COCs-Detected in Groundwater**: A note on this figure indicates that concentrations shaded in green exceed regional screening levels (RSLs); however, this approach was not consistently applied. For example, TCE concentrations in wells YS22-GW08, YS22-GW05, and YS22-GW02 are shaded green; however all detected concentrations in these wells are below the TCE RSL of 1.7 ug/1 provided on the figure. Please revise Figure 2-1 to address these discrepancies. In addition, provide the source of the TCE RSL of 1.7 micrograms per liter (ug/1) as the published TCE RSL is 2.0 ug/1.

Response 10: *The figure will be modified as requested. The screening values shown on the figure are from the RI report and will be modified to reflect current RSLs in the FS.*

11. **Figure 2-2, Field Parameters and Geochemistry Results**: Dissolved oxygen (DO) measurements were not collected at two of the shallow wells (i.e., YS22-GW10, YS22-GW02). Please revise Figure 2-2 to include a note to explain why DO measurements were not collected at wells YS22-GW10 and YS22-GW02.

Response 11: *The following footnote will be added to the subject figure: "Readings were not collected by the field team at these locations due to improper readings from the DO meter."*

12. **Section 2.2**: On page 2-2 state that Trichloroethene (TCE) was detected in samples from 9 of the 12 shallow monitoring wells (maximum concentration of 650 micrograms per liter from YS22-GW-10). Figure 1-4 aquifer potentiometric surface map shows well YS22-GW-10 as the most down gradient well from site 22. There is no data to delineate the TCE plume at the south of Site 22.

Response 12: *YS22-GW10 was installed as far downgradient as was permissible by drilling equipment. There is a 20 ft drop in elevation between this well and the wetland area to the south. Consequently, the downgradient edge of the plume is considered the surface water, where concentrations of TCE were either non-detect or low detections (2.1 µg/L was the only detection). In addition, groundwater concentrations of site-related COCs do not exceed BTAG screening values. See response to Comment #13.*

13. **Section 2.2.2**: On page 2-4 states that no contaminants of concern (COC) for ecological receptors were identified for surface water or sediment at Site 22. Similarly, no COCs were identified for food web exposures. Thus, risks to ecological receptors were considered acceptable. No further action was recommended for ecological receptors at Site 22. It is unclear from this statement if potential future risk from discharging groundwater was addressed as part of the ecological risk assessment (ERA). Figure 2-1 shows that groundwater from wells 04, 10, and 11 have

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trichlorethene (TCE) concentrations of 69 micrograms/liter (ug/1), 650 ug/1, and 160 ug/1, respectively, in excess of EPA BTAG screening levels for freshwater (21 ug/1) indicating that ecological risk is possible should this groundwater discharge into adjacent creeks. If this migration pathway was not addressed as part of the ERA, it will need to be addressed as part of the FS.

Response 13: *The ecological risk assessment does not directly evaluate the potential future risk from discharging groundwater but it does incorporate seep samples and evaluates the downgradient water body (Felgates Creek) to which groundwater would discharge. The maximum concentration of TCE observed in seep samples was 1.0 ug/L, which is well below both the freshwater (21.0 ug/L) and marine (1,940 ug/L) BTAG surface water screening values. In addition, it should be noted that surface water flow within the Eastern Branch of Felgates Creek reverses because of tidal fluctuation and the BTAG screening value for TCE discussed within Comment #13 is associated with freshwater; the BTAG marine-based screening value for TCE in water is 1,940 ug/L, which was the value used in the ERA. Based upon the data in Table 9-1 of the final RI, the salinity of Felgates Creek in the vicinity of the site is 15 ppt or greater, which indicates that the water in any potential discharge areas to the creek is marine (10 ppt or greater salinity is generally considered the cutoff between brackish and marine waters). As a result, concentrations of TCE, vinyl chloride, and RDX in Site 22 groundwater do not exceed the screening values used within Table 9-10 of the Site 22 Final RI (November, 2009) and concentrations directly measured within surface water are also less than the applicable screening values (all of these chemicals were also not detected in creek sediment, where any groundwater discharge would first occur). Consequently, there are currently no unacceptable risks to ecological receptors resulting from groundwater discharges. However, an RAO will be added to the FS to ensure groundwater concentrations are not increasing to levels that may pose unacceptable risk to ecological receptors in adjacent surface water bodies.*

14**. Figure 2-3 Conceptual Site Model (CSM**): This figure shows the approximate extent of TCE and RDX in groundwater exceeding their applicable remedial goals (RG)s, but the figure does not show the extent of vinyl chloride (VC) exceeding its remedial goal. Section 3.3.1 explains that the laboratory detection limit of 10 ug/L was higher than the VC RG (2ug/L). Since vinyl chloride is also a site COC, it should be included on the figure to show extent of VC exceeding laboratory detection limit. In addition, a note explaining why VC exceeding its RG cannot be depicted should be included on the figure. Please revise Figure 2-3 accordingly.

Response 14: *The suggested edits to Figure 2-3 will be made as requested. However, it should be noted that the concentration of vinyl chloride exceeded the MCL and laboratory detection limit in only one location (YS22-GW11). Consequently, the area of the exceedance will possibly underestimate actual concentration exceeding the MCL. The footnote suggested will clarify that the reporting limit was higher than the RG.*

15. **Section 3.2, Remedial Action Objectives, Page 3-2**: The Remedial Action Objectives (RAOs) for the site are too general. EPA's RI/FS Guidance states that RAOs should be as specific as possible without limiting the range of potential alternatives. RAOs should also specify the following: the contaminant(s) of concern, exposure routes and receptors, and an acceptable contaminant level or range of levels for each exposure route (i.e., RGs). Revise the FS Report to develop more

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specific RAOs for the site which include the above-noted items. The RAOs should reduce contaminant concentrations in groundwater to site-specific RGs, rather than "to the maximum extent practicable."

Response 15*: In order to address this comment in consideration of the Navy's Guidance for Optimizing Remedy Evaluation, Selection and Design, and in consideration of Comment 15, the RAOs will be modified as follows:*

- *To reduce contaminant concentrations in groundwater to established remedial goals (RGs) for TCE, VC, and RDX*
- *To maintain land use controls to prevent human (residential and construction worker) exposure to groundwater until risk-based RGs are met*
- *To ensure groundwater concentrations are not increasing to levels that may pose unacceptable risk to ecological receptors in adjacent surface water bodies*

16. **Section 3.2** on page 3-2 states that the remedial action objectives (RAO) for the protection of human health and the environment for groundwater are to reduce contaminant concentrations in groundwater to the maximum extent practicable and maintain land use controls until contaminant concentrations in groundwater allow for unlimited use and unrestricted exposure at Site 22. An additional RAO should be to prevent the migration of contaminated groundwater to adjacent surface water bodies to prevent exposure and potential risk to ecological receptors. The development of preliminary remedial goals discussed in Section 3.3.1 will also need to address this issue to protect ecological receptors in adjacent surface water bodies. As discussed above, an additional RAO is warranted since TCE concentrations in three groundwater wells exceed EPA BTAG screening levels for freshwater.

Response 16: *Please see response to comment 13 and15.*

17.**Section 3.3, Applicable or Relevant and Appropriate Requirements (ARARs), Pages 3-2 and 3-3:** This section includes a discussion of ARARs but it does not mention whether there is an guidance or other recommended federal, state, or local criteria that should be identified as "to be considered" (TBC) criteria in the development of remedial action alternatives. TBCs are not generally enforceable but are advisory. An example of a TBC would be us of EPA RSLs or Health Advisories for specific chemicals in determining action or cleanup levels. Please revise the FS Report to identify and include a discussion of potential TBCs.

Response 17: *The FS ARARs tables will be revised to include To Be Considereds (TBCs).*

18.**Section 3.3.1, Development of Risk-Based Preliminary Remedial Goals, Page 3-4**: The second paragraph under the Human Health Remedial Goals subsection notes that "the same exposure assumptions used in the HHRA to estimate intake via ingestion, dermal contact, and inhalation from groundwater were used for the risk-based cleanup goal calculations" for RDX. Please revise the FS Report to document the exposure assumptions used so that the PRG calculations for RDX can be verified, and to assure that the most up-to-date and adequately protective exposure parameters were used.

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Response 18: *Further detail will be provided on the calculation of the risk-based cleanup goal for RDX. Since the hazards and risks calculated in the HHRA included in the RI were used to derive the risk-based cleanup goal for RDX (as shown in Appendix B), the exposure factors and toxicity values used in the HHRA to calculate the hazards and risks will be added to Appendix B.*

19. **Section 3.3.1, Developments of Risk-Based Preliminary Remedial Goals, Page 3-4:** Under the Extent of Site-Related COCs Exceeding RGs subsection, the statement "Couldn't we at least show where VC exceeded 10?" should be removed from the FS Report since it appears to be an artifact of the internal review. Please revise the FS Report.

Response 19: *The suggested edit will be made as requested.*

20. **Section 3.3.1**: Contrary to the first sentence, risk-based PRGs were not developed for TCE and VC in groundwater because MCLs are available. (Refer to the second paragraph in this section.) The first paragraph should be modified to reflect this.

Regarding the paragraph describing the extent of site-related CoCs exceeding RGs, the following points should be noted:

- The analytical detection limit for VC should be low enough to ensure the remediation goal (2ug/L) is met. A detection limit of 10 ug/L is not sufficient.
- Because of high detection limits for VC, the draft FS assumes that the VC isoconcentration contours are similar to TCE. However, VC is much lighter than TCE and, presumably, has the potential to move faster than TCE in groundwater.

Response 20: *The first sentence of the section will be clarified to indicate that a risk-based PRG was calculated for RDX while MCLs were selected as RGs for TCE and vinyl chloride. It is noted that the analytical detection limit for vinyl chloride in future rounds of sampling must be low enough to ensure that the RGs are met (<2 ug/L). While it is acknowledged that VC is lighter than TCE and may migrate faster, given the low detected concentrations of TCE in the one location in which it was detected and the extent of the TCE plume which is assumed all the way to the Eastern Branch of Felgates Creek, it is believed that making the assumption that VC is present throughout the extent of the TCE plume is sufficiently conservative to adequately evaluate remedial alternatives.*

21**. Section 4.2.2, Alternative 2- Monitored Natural Attenuation and Land Use Controls, Page 4-3**: The third full paragraph on this page describes calculations first-order decay rates, and the estimated time frame to achieve remedial goals under Alternative 2. No supporting documentation of these calculations has been provided. The FS Report has not provided the 1997 or 2006 data nor has it described exactly which decay rates were used to calculate the estimated time frame to achieve remedial goals (i.e., the site-specific decay rates or theoretical rates). Additionally, the estimated time frame for achieving RGs is a factor in selecting a remedial alternative, it is imperative that all COCs be considered when estimating a time frame for cleanup. Please revise the FS Report to calculate decay rates and time frame estimates for all COCs, including RDX and vinyl chloride, and provide supporting documentation for all calculations. This comment also applies to clean up estimates for Alternatives 3 and 4.

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Response 21: *Analytical data was collected in 1996 and 2007 not 1997 and 2006 respectively, as stated within the FS Report. The 2007 data was included in the Final RI Report for Groundwater at Site 22 (CH2M HILL, 2009) and the 1996 data was included in the Round 2 RI Report – Site 22 (Baker, 2001a). Using Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies (EPA, 2002), the site-specific decay rate for TCE and RDX was calculated using monitoring wells that displayed a decreasing detected concentration between the two events. Vinyl chloride was non-detect in 2007 so degradation rates and time to achieve RAOs durations were not calculated but were assumed to be comparable to TCE. These site-specific decay rates were compared to theoretical decay rate ranges (EPA, 2002) to facilitate professional judgment in evaluating the timeframe to achieve the RAOs for each alternative. The site-specific decay rates for TCE were within theoretical decay rate ranges while the site specific decay rate for RDX was slightly slower than theoretical ranges.*

Using professional judgment and existing site conditions, it was assumed that Alternative 3 and 4 would take 4 and 8 years, respectively, to reduce the site-related COC concentrations below100 ug/L utilizing active treatment. Following, active treatment of ISCO or ERD, monitored natural attenuation would take an additional 21 years to achieve the RAOs using the same assumptions and professional judgment as discussed above.

A summary table which includes the site-specific decay rates and time to achieve RAOs for TCE will be included within the Draft Final FS Report. Calculations for RDX will be removed from the report, because RDX concentrations did not decrease consistently across the site based on available data. The conclusions of the report will be updated to reflect these modifications and in accordance with Comment 1, an additional alternative will be added that will allow for MNA of chlorinated VOCs and active treatment of RDX.

22**. Section 4.2.2, Alternative 2- Monitored Natural Attenuation and Land Use Controls, Page 4-3:** The last paragraph on this page discusses the proposed monitoring associated with Alternative 2. The FS is not proposing to monitor groundwater in the deep wells onsite nor is it proposing to monitor surface water concentrations. Although no VOCs were detected in the deep wells during the previous investigation as noted on Page 2-2, it is recommended that at least a subset of the deep wells be included in the monitoring program, possibly on a reduced sampling schedule, to verify that contamination is not migrating vertically and beyond its current configuration. Additionally, it is recommended that surface water samples be collected at the leading edge of the plume to verify that groundwater is not discharging to surface water at potentially unacceptable levels. Further, no degradation products of RDX have been proposed for analysis. Therefore, it is unclear how the degradation of RDX will be monitored. Please revise the FS Report to incorporate sampling of deep wells and surface water into the monitoring plan, or provide adequate justification for not including this sampling. Additionally, please propose to monitor RDX degradation products in an effort to better monitor its degradation, or provide justification for not doing so. This comment also applies to Alternatives 3 and 4 since periodic monitoring has also been proposed for these alternatives.

Response 22: *A subset of the deep wells will be included in the monitoring program associated with each alternative, on a reduced sampling schedule, to verify that contamination is not migrating vertically and beyond its current configuration.*

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Based on the conclusions of the Final Remedial Investigation Report for Groundwater, Sites 4, 21 and 22, the WPNSTA Yorktown Partnering Team agreed to no further action to address surface water and sediment at Sites 4, 21 and 22. There were no unacceptable risks for surface water and sediment in adjacent water bodies at the sites. However, consistent with the proposed modification to the RAOs in the response to comment 15 above, it is recommended that groundwater monitoring of the most downgradient wells include evaluation to ensure that concentrations in these wells do not increase beyond the levels present during the RI and exceed BTAG screening values. If concentrations in these wells do increase or exceed BTAG screening values, it is recommended that further evaluation of surface water and sediment be completed.

RDX degradation intermediates such as nitroso-dinitro-hexahydro-1,3,5-triazine (MNX), dinitroso-hexahydro-1,3,5-triazine (DNX), and tri-nitroso-hexahydro-1,3,5-triazine (TNX) are transient in groundwater (Larese-Casanova and Scherer, 2007). Consequently, monitoring of these chemicals is not proposed. However, monitoring of ammonia, a less transient byproduct of RDX degradation, will be included in the monitoring strategies for all alternatives included in the FS.

23. **4.2.2** Page 4-3, Iron and manganese are identified as "…sensitive metals." The reasons iron and manganese are sensitive metals need to be provided.

Response 23: *Iron and manganese are considered "sensitive metals" due to their role in the microbiological redox sequence (see attached). Bioavailable forms of oxidized species of these metals (such as ferric oxyhydroxide minerals and manganese oxides) are readily used as electron acceptors by groundwater bacteria. The presence of these metals in reduced form is good indicators of the occurrence of iron- and manganese-reduction bioactivity in an aquifer and useful in helping gauge the overall redox conditions in an aquifer. Additional clarification will be added to the text.*

24. **Section 4.2.2:** Alternative 2 MNA states that reducing conditions predominantly present at the site are favorable for biological remediation of the chlorinated COCs and RDX, however, the draft FS fails to present a technical course of action that allows converging lines of evidence to be used to scientifically document the occurrence of natural attenuation and to quantify the rate in which it is according. As mentioned above, the EPA OSWER Directive 9200.4-17 (1997) identify 3 lines of evidence that can be used to estimate natural attenuation of chlorinated hydrocarbons, including:

a) Historical ground water and/or soul chemistry data demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring or sampling points. (in the case of groundwater plume, decreasing concentration should not be solely the result of plume migration.)

b) Hydro geologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation process active at the site, and the rate at which those processes will reduce contaminant concentrations to require levels. For example, characterization data may be used to quantify the rates of contaminants sorption, dilution or volatilization or to demonstrate and quantify the rates of biological degradation processes occurring at the site.

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c) Data from field or microcosm studies (conducted in or with actual contaminated site media) which directly demonstrate the occurrence of a particular natural attenuation process at the site and its ability to degrade the contaminants of concern.

Unless EPA or the implementing state agency determines that historical data (paragraph (a) above are of sufficient quality and duration to support a decision to use MNA, EPA expects that data characterizing the nature and rates of natural attenuation processes at the site (paragraph (b) above) should be provided. Where the latter are also inadequate or inconclusive, data from microcosm studies (paragraph (c) above) may also be necessary.

Response 24: *See response to comment 1.*

25**. Section 4.2.3, Alternative 3- In Situ Chemical Oxidation and Performance Monitoring with Monitored Natural Attenuation and Land Us Controls, Page 4-5:** A pre-design investigation to refine the extent of contamination in groundwater had been proposed as part of Alternative 3. This investigation would include collecting groundwater samples at 64 locations along four transects. The proposed sample locations have not been shown on a site figure that show the proposed boring locations and transects in relation to the existing contamination.

Response 25: *The pre-design investigation would include a total of four north-to-south transects. Transects would be located parallel and approximately 15-ft and 45ft west and east of an imaginary line between YS22-GW10 and YS22-GW11. Further locations and or transects may be required following the initial four transects to identify TCE, RDX, or VC concentrations along the perimeter of transects which exceed 100 µg/L.*

Assumptions associated with the pre-design investigations included within the FS Report are included to facilitate alternative cost comparison. A separate pre-design investigation work plan would be submitted for agency approval following a ROD for Site 22 groundwater where a figure would be prepared of the proposed boring locations and transects in relation to the existing contamination.

26. **Section 4.2.3**: Alternative 3 ISCO states that prior to design of the ISCO alternative, a pre-design investigation is recommended to refine the lateral and vertical extent of site related groundwater COCs in the vicinity of the target treatment areas. Please not that this pre-design investigation must be performed irrespective of the remedy selected.

Response 26: *A pre-design investigation is included within Alternative 3 and 4 to facilitate design and refine the target treatment area requiring active treatment associated with these remedial alternatives. Since Alternative 2 does not include a target treatment area, a pre-design investigation is not required since sufficient data exists to implement remedial alternative.*

27. **Section 5, Detailed Evaluation of Alternatives, Pages 5-1 through 5-10**: The FS Report has not included a detailed discussion of the individual alternatives with respect to the first seven of nine evaluation criteria. Only a summary table has been presented (Table 5-2, Detailed Evaluation of Remedial Alternatives). EPA's RI/FS

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Guidance states, "The analysis of individual alternatives with respect to the specified criteria should be presented in the FS report as a narrative discussion accompanied by a summary table…This discussion should focus on how and to what extent, the various factors within each of the criteria are addressed. The uncertainties associated with specific alternatives should be included when changes in assumptions or unknown conditions could affect the analysis." Please revise the FS Report to present a narrative discussion of the alternatives against the evaluation criteria in consideration of the factors described in the RI/FS Guidance.

Response 27: *The narrative discussion will be added to the Draft Final FS as requested.*

28. **Section 5.2**: Page 5-5, eight sustainability metrics for NAVFAC are bulleted and include ecological impacts. According to Table 5-1, ecological impacts are only associated with short-term effectiveness. It is uncertain why ecological impacts are not included under long-term effectiveness and permanence. Protection of ecological receptors is equivalent to environmental protectiveness and is a threshold criterion and cannot only be considered over just the short term. This apparent deficiency must be addressed.

Response 28: *EPAs comment is unclear to the respondents. One of the eight Navy sustainability metrics, ecological impacts, is listed through all nine NCP criteria. The "Environmental Impacts" which may include a much broader range than just ecological receptors, is listed only as subcriteria to the NCP criteria "short-term effectiveness". In addition, environmental impacts are not subcriteria of long-term effectiveness and permanence but only subcriteria of short-term effectiveness. Furthermore, Sustainable Remediation Tool (SRT) does not evaluate ecological impacts so another tool or mechanism would need to be used to quantify this metric.*

29. **Section 6** on page 6-1 states that the cost versus benefit (such as length of time, sustainability) comparison indicated that although Alternative 2 takes longer to reach RAOs, it is more cost effective and more sustainable than the other alternatives presented. Therefore, Alternative 2 is the preferred alternative for remediation of groundwater contamination at Site 22. EPA BTAG agrees with the selection of this alternative provided the short term risk to ecological receptors from discharging groundwater in excess of BTAG screening levels is addressed.

Response 29: *Please see responses to comments 1, 13, 15 and 16.*

30. **Appendix A, ARARs**: The site is located adjacent to the Eastern Branch of Felgates Creek and its unnamed tributary, yet Appendix A has not identified ARARs specific to wetlands and floodplains. Please revise the FS Report to clarify whether ARARs for wetlands or floodplains would apply to the site, and identify specific ARARs.

Response 30: *The wetland areas adjacent to the site will remain undisturbed during remedies discussed in all evaluated alternatives. Consequently, no ARARs associated with wetlands or floodplains apply. A statement in regards to this will be added to the FS Report.*

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31**. Appendix C, Preliminary Cost Estimates, Alternative 2: MNA and LUCs**: The following comments were generated with respect to Alternative 2's cost estimate:

- For Operation and Maintenance Costs (Years 1 through 4), 14 annual land use control inspections are estimated. It appears that only four annual inspections would be needed for Years 1 through 4. Please address this discrepancy and revise the cost estimate as appropriate.
- For Operation and Maintenance Costs (Years 5 through 34), 14 annual land use control inspections are estimated. It appears that several additional annual inspections would be needed since Years 5 through 34 spans 30 years. Please address this discrepancy and revise the cost estimate as appropriate.

Please note that Alternatives 3 and 4 also include the incorrect number of annual land use control inspections and should be corrected as well.

Response 31: *Assumptions for inspections will be modified to assume quarterly inspections for the first 5 years and annual inspections for the remainder of the performance monitoring period.*

32. Appendix C, Preliminary Cost Estimates, Alternative 3: ISCO and Performance Monitoring with MNA and LUCs: The following comments were generated with respect to Alternative 3's cost estimate:

- Item Number 8 under "Key Assumptions" indicates that monitoring will be conducted until RAOs are achieved (34 years). According to Section 4.2.3, RAOs for Alternative 3 should be achieved within 25 years, not 34. Please address this discrepancy and revise the cost estimate as appropriate.
- Item Number 9 under "Key Assumptions" states that "sensitive inorganic constituents" would be analyzed, but the specific constituents to be analyzed have not been defined. Please define the sensitive inorganic constituents that will be analyzed.
- Item Number 14 under "Key Assumptions" references bench-scale studies for information pertaining to the permanganate oxidant demand, but it is unclear to which specific bench-scale studies this comment refers. Please provide further information on the bench-scale studies.

Response 32:

- *Item Number 8 under "Key Assumptions" will be revised to "Monitoring will be conducted annually until RAOs are achieved (25 years)."*
- *Item Number 9 under "Key Assumptions" will state the sensitive inorganic constituents include alkalinity, total organic carbon [TOC], nitrate, nitrite, sulfate, sulfide, methane, ethane, ethene, iron [Fe], manganese [Mn].*
- *A bench-scale study permanganate oxidant demand was included in the Final RI Report for Site 22 and the results of the test are included within Section 6.3.5 (CH2M HILL, 2009).*

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Please feel free to contact me should you have any additional questions.

Sincerely,

CH2M HILL

William J. Friedmann Jr.

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Activity Manager

cc: Mr. Wade Smith/VDEQ
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