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BASE REALIGNMENT AND CLOSURE
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Ms. Christine Williams
U.S. Environmental Protection Agency, Region I
1 Congress Street Suite 1100 (HBT)
Boston, MA 02114-2023

Dear Ms. Williams:

This letter is in response to your letters of November 03 and December 23, 2008 that request re-performance of well development and groundwater sampling performed in accordance with the final QAPP at Site 16 (OU 9). This request was made pursuant to sections 7.9(a) and 7.10 of the Federal Facilities Agreement. The Navy believes that these are inappropriate citations since (1) the document is not final, and (2) the work requested is within that contemplated by the FFA. The Navy notes that we are currently at the review stage as provided in section 7.6 (e)(2).

The Navy's detailed response to the technical issues presented in the EPA letters are provided in enclosures (1) and (2). The information provided in the enclosures also reflects discussions between EPA and Navy during the November 25, 2008 teleconference regarding hydrogeological issues at Site 16. The following overview summarizes the Navy's concerns and presents our position regarding the potential contribution of upgradient source areas on groundwater quality in the Site 16 area.

Navy Review of EPA Technical Comments

While some of the technical comments presented in the referenced correspondence are valid, many are based on incomplete or inaccurate data analysis and/or an over emphasis of uncertainties regarding the existing remedial investigation (RI) data. The following three items exemplify the Navy's technical concerns regarding the assessment provided by the EPA reviewers:

1. **The EPA reviewers are including "noise" data in slug test evaluations presented in the December 23, 2008 correspondence.** As detailed in enclosure (2), this approach is incorrect and has caused the reviewers to conclude that well seals installed in nearly all of the newly installed, upgradient monitoring wells have been compromised and are allowing groundwater from shallower zones to migrate downward to the screened interval of the monitoring well. (Further complicating this issue is the point that the EPA reviewers are also mis-gauging the effects of well installation procedures actually used at the site [i.e., driving casing and augering are two completely different techniques and are not interchangeable as implied by EPA comments]). Thus, the reviewers

conclude that the integrity of the groundwater samples collected from the wells has been compromised.

2. **The EPA reviewers are selecting hydraulic conductivities values for purposes of demonstrating hydraulic connection based on single lithologic types within the screened zone without regard to all lithologies screened or the interpreted depositional features.** This overly simplified approach has limited utility (at best) given the complex lithologies present at Site 16. However, the approach was used to propose the hydraulic conductivities anticipated to be present by the EPA at particular wells (December 23, 2008 correspondence). This caused the reviewers to conclude that the hydraulic conductivities presented in the draft Phase III RI report were inaccurate. (Please note that the hydraulic conductivity values estimated in the draft Phase III report for the newly installed wells are consistent with both the range of values reported in the literature for observed lithologies and the ranges obtained in similar lithologies across Site 16.)

3. **The EPA reviewers are using anomalous data to construct water elevation figures for the Site 16 area.** In the draft Phase III RI report, the Navy determined that certain recorded groundwater elevations were not representative since they were obviously incorrect when compared to previous data sets. Despite this, the EPA reviewers still insisted on using the incorrect data to construct their own set of groundwater elevation contours. The resulting erroneous water elevation figures are then used to conclude that preferential groundwater flow patterns are present in certain areas and that these patterns impact groundwater and contaminant flow within the Site 16 area.

The Navy is also troubled by the fact that the EPA's technical comments on the RI report do not complement one another to form a coherent conceptual understanding of Site 16. For instance, while the EPA reviewers question the representative nature of the groundwater samples collected from the newly installed upgradient wells, this alone does not suffice as evidence that the upgradient pathway is an important pathway to consider. Data upgradient and downgradient of these locations do not support the theory that elevated concentrations of CVOCs are present to significantly alter the Site 16 conceptual model. Furthermore, real time Color-Tec® data collected during monitoring well installation suggests that there are no significant contaminant concentrations at the upgradient overburden or shallow bedrock locations. Additionally, the conclusion that all newly installed wells are flawed when the same installation technique has been used for over 200 wells at Site 16 with success is not supported.

Conceptual Site Model for Site 16

One of the fundamental disagreements on the conceptual site model for Site 16 is the source of CVOC contamination to the deep overburden aquifer. The EPA has stated that it does not believe any significant contamination can reach the groundwater in the deep zone in the eastern portion of former Building 41 from a release at the former solvent still. In addition, EPA has stated it believes the most likely source of this contamination is from either the Nike PR-58 site and/or the "North Central Area". In fact, EPA devotes significant detail to provide evidence that contaminant transport from the upgradient PR-58 Nike Site is not only happening but is the

most important pathway to consider. The Navy is not persuaded by EPA's comments and does not agree that this is an important pathway to understand relative to the contaminant distribution at Site 16. Further elaboration on these points will be provided in the Navy response to EPA comments on the Draft Phase III RI report.

While the Draft Phase III RI report clearly outlines the Navy's conceptual model for Site 16 (and adjacent areas), portions of this model concerning the upgradient and former Building 41 area are relevant for re-presentation here. Although the Navy believes that low-level groundwater contamination (most likely less than 25 ppb total CVOC) is entering Site 16 in the general vicinity of the Thompson and Davisville Road intersection, this contamination has a negligible affect on the overall distribution of contamination at Site 16. Based on multiple lines of complementary data, the Navy has developed the following conceptual site model for the release of contaminants from the Building 41 area to the deep overburden:

- Contamination released at the former solvent still (and other release points in the general Building 41 area) migrated downward, reaching the deep overburden zone just west of the eastern extent of the former Building 41. Evidence for this transport process is observed in many different forms and in the environmental media. Data presented on potentiometric maps and vertical flow nets, the vertical gradient analyses, and the data garnered from multiple constant rate tests demonstrate the hydraulic connections throughout the former Building 41 area. The results of the hydrogeological analyses are supported by the observed distribution of CVOC contamination in soil, groundwater, vadose zone soils, and soil gas.

- While it is certainly true that the current distribution of soil and groundwater contamination do not demonstrate a hot spot of contamination around the former solvent still with uniform decreasing concentrations downgradient, this should also not be expected given the amount of time that has passed since the release and the migration properties of the contaminant plume(s). In general, residually, the highest soil and groundwater contamination is observed upgradient of the eastern edge of former Building 41 and downgradient of the former solvent still, while the overall distribution of soils and groundwater data clearly show an origination in the solvent still area.

Multiple lines of complementary data demonstrate that physical processes do occur within the former Building 41 area that can adequately explain the contamination observed in the deep overburden (and shallow bedrock) in the eastern edge of former Building 41 (i.e., driving forces are evident based on vertical flow analysis and flow directions based on vertical flow nets). Furthermore, the weight of evidence suggests that this pathway is more plausible than long distance travel from an off-site source with localized discharge between shallow bedrock and deep overburden groundwater zones. Because the EPA has not accepted the Navy's multiple lines of complementary data as plausible, we believe there has been an over-emphasis on the importance of upgradient data and undue scrutiny on the well installation procedures as a means to discount the Navy's position. While the Navy agrees that it is important to obtain representative and useable data to fully understand the site conceptual model, it is our belief that further work at the upgradient locations will not yield pertinent information that would impact the conceptual site model for Site 16.

Conclusion

Based on information discussed above and in enclosures (1) and (2), the Navy does not believe the re-performance of work is necessary to complete the Remedial Investigation for Site 16. We suggest that discussions continue to determine if additional sampling is necessary for completion of the Feasibility Study and/or Remedial Design for the Site.

In your December 23, 2008 letter, EPA stated its belief that costs have been a deterrent for the Navy in reaching a resolution to these issues. Please note that cost is not part of the Navy's rationale for deciding not to implement the EPA's recommendations. Rather, the EPA reviewers have not provided a persuasive, consistent technical rationale to support the need for the additional work. While cost is always a consideration, and the cost to re-perform the requested work is significant, when valid requests are appropriately supported by sound technical analyses, the work is generally performed, even if the Navy does not fully agree with the regulator's hypotheses regarding site contamination. It should be also noted that the Navy routinely performs work above and beyond the stated goals and intents of QAPPs. The Navy's decision to screen soil every 5-feet with Color-Tec® and perform multiple constant rate tests, etc. during the Phase III RI Investigation at Site 16 or to voluntarily increase monitoring frequency and analytical sampling during the LTMP at Site 07 in order to increase the conceptual/practical understanding of site conditions exemplify this fact. Both of these actions added significant costs to the referenced investigations. Please note that should the Navy eventually elect to scope the requested work as part of the FS and/or Remedial Design, such work will be scoped through the UFP-SAP process so that the objectives of data collection and the intended use of the data are clearly established and understood by all parties prior to data collection.

If you have any questions, please do not hesitate to contact the Remedial Project Manager, Mr. Curt Frye, at 215-897-4914.

Sincerely,

David Barney
BRAC Environmental Coordinator
By direction of BRAC PMO

Enclosures:
1. Navy Response to EPA Letter - Technical Memorandum dated November 3, 2008
2. Navy Response to EPA Letter - Technical Memorandum dated December 23, 2008

Copy to:
Curt Frye, NAVFAC Midlant
Richard Gottlieb, RIDEM
Kathleen Campbell, CDW (2 copies)
Steven King, Quonset Development Corporation
Jon Reiner, Town of North Kingstown
Ellen Iorio, U.S. Army Corps of Engineers
Joe Logan, TtNUS Pittsburgh
Lee Ann Sinagoga, TtNUS Pittsburgh
Scott Anderson, TtNUS Pittsburgh
Steve Vetere, TtNUS Boston

Enclosure (1)

Navy Response to EPA Letter - Technical Memorandum Monitoring Well Development, Stabilization, and Sampling OU9 Phase III Remedial Investigation (RI) – New Monitoring Wells, Former Davisville - Naval Construction Battalion Center, North Kingstown, RI dated November 3, 2008

The Navy does not concur with the EPA conclusions concerning the representativeness or usability of the data collected from the newly installed wells in the upgradient area during the Phase III RI. The Navy does acknowledge that few groundwater quality parameters reported for some of the upgradient wells sampled during the Phase III remedial investigation (RI) event (particularly pH and turbidity) are outside ranges typically reported for ambient groundwater conditions. Explanations for these variations are provided in this document. However, it should be noted that the Phase III well development and sampling were conducted per the Phase III Quality Assurance Project Plan (QAPP) prepared for Site 16. The EPA previously reviewed the QAPP but did not submit any comments with regard to the detailed well development and sampling protocols contained therein.

The Navy has carefully considered the EPA's requests and explanations, keeping in mind the stated intentions of the QAPP and whether the requested work will result in changes to the conclusions of the RI and/or affect the Feasibility Study (FS) for Site 16. Despite the fact that EPA can cite documentation that is inconsistent with the approved methodologies and techniques performed during the Phase III RI, this does not provide grounds to invalidate the methodologies and procedures employed or even to dismiss the resultant data. A point-by-point response to the issues raised within the Technical Memorandum has not been provided, however key aspects where significant issues with EPA interpretations and/or conclusions occur are provided in the following items:

- **Introduction** (Page 1)

The Navy acknowledges that EPA has on several occasions during the Triad teleconferences expressed the opinion that insufficient volumes of water were removed during well development. However, EPA has not previously expressed a concern regarding the time interval between well development and sample collection. The focus of previous EPA well-development comments has consistently been on the volumes of water removed regardless of the passage of time since well installation. In fact, EPA stated during the Triad Teleconference held December 11, 2007 that four to five years may not be enough time to remove lost drilling water from an installed well (the EPA was specifically expressing concerns regarding MW16-14R). While the Navy appreciates the technical review provided in the November 3, 2008 correspondence, a more appropriate time to discuss well development and sampling

methodologies would have been during the review and comment cycles conducted in support of the Phase III RI QAPP.

- **Background** (Pages 1 to 3)

There are two major inconsistencies and/or errors within the background section provided by EPA. The first concerns whether ambient groundwater conditions can be determined based on stabilization parameters. In the first paragraph of the background text, the EPA states that stabilization criteria alone cannot be used to conclude that ambient conditions have been achieved. In support of this assumption, the fourth paragraph summarizes four conditions that when met, well development is considered complete in the opinion of EPA. The Navy agrees that more than stabilized parameters of groundwater quality should be considered, but does not agree with the volume requirements suggested by EPA. While the Navy acknowledges that the volume requirements originate from a guidance document that outlines standard procedures, EPA is misinterpreting the intent of the guidance document. The aspects summarized by EPA are meant to provide guidance for development of a site-specific technique, not act as the plan. The Navy believes that evaluation of the stabilized groundwater parameters does allow one to conclude whether ambient conditions have been reached (with proper considerations to water loss – such as neutral pH, generally high DO). The second error within the background section is the referencing of the use of augers for well installation. While it is agreed that augers can cause smearing, augers were not used during well installation at Site 16. Consequently, any discussions/comments regarding the impact of well auguring on data quality are irrelevant.

- **Upgradient Wells** (Pages 3 and 4)

Table 1 presented by EPA has multiple errors and/or exclusions. A summary of the corrections are as follows:

- Water Loss Column
  - MW16-13R - 50 gallons lost in screened zone, 350 gallons lost from 44 to 66 ft bgs, above the screened zone
  - MW16-82D – 350 gallons lost from 64 to 74, above the screened zone, ~100 gallons lost in screen zone
  - MW16-84D – 50 gallons lost in screened zone, 350 gallons lost below screen zone (include in 84R total rather than 84D).
  - MW16-84R – 1550 gallons lost in screened zone (includes 350 from the water lost during drilling of 84D)
  - MW16-86R – 500 gallons of water lost in screened zone

- Water Removed Column
  - MW16-83R – per the well development forms, 100 gallons removed
  - MW16-86R – per the well development form, 500 gallons removed. The calculated value is an error and appropriate changes will be made to the field form.
- Deficit-UFGS Column
  - This column is not agreed to be a standard to measure completeness of well development and is not based on the approved Phase III QAPP. Column will not be considered.
- Comments Column
  - The DO presented by EPA is a semi-quantitative value obtained from the groundwater quality probe during low-flow groundwater sampling. As stated in the approved Phase III QAPP, page 2-11 "Dissolved oxygen (DO) and oxidation-reduction potential (ORP) will also be measured in each well but will not be used to demonstrate stabilization because they are less reliable indicators of stability…" Per concerns about DO and the EPA recommendation to use this data as an indicator of well stabilization, the Navy also collected DO data using Chemetrics® color-metric test kits and presented the results in the notes section of the groundwater sampling forms. EPA did not include any of these results in Table 1, nor did the Agency provide a discussion as to why the semi-quantitative probe data should be used rather than the color-metric data. DO at all Site 16 groundwater wells MW16-82 to MW16-86 were less than 1 mg/l; the EPA has previously indicated that this value would be reflective of ambient conditions for groundwater at Site 16 (December 11, 2007 Triad Teleconference).

The Navy agrees with the EPA conclusion that, based on data presented in Table 1, a minimal sampling break occurred between well development and sampling. In all cases, however, the sampling break recorded is consistent with the minimum break specified in the approved Phase III QAPP. Additionally, the EPA notes that, in many wells, extremely high turbidity was noted at the time of sample collection. The EPA states that the observed turbidity may or may not impact volatile organic sample analysis results. The Navy agrees that, theoretically, high turbidity may indicate that water flow through the screen of a well is impeded (i.e., reduced permeabilties and lower hydraulic connection between aquifer and well). However, it should not be automatically assumed that the fines observed during development/sampling occur throughout the entire well screen or that the observation of high turbidity indicates a fatal flaw in well construction. Alternatively it is plausible that the fines originate over a small portion of the screened zone, are a function of the lithological unit (or a

portion thereof) in which the well screen was installed (i.e., not a function of well construction), and may have a negligible effect on sample results (e.g., such as can occur when "flowing sands/silts" are present).

As noted above in the Table 1 edits for the RI information provided for MW16-86R, there is an error in the well development field form for this well. There should be an additional entry at 8:35 that the flow rate was reduced to 0 (pump turned off). There was no continuous pumping between 8:30 and 16:30. Water was removed periodically throughout this time frame, either through pumping or with a stainless-steel bailer. The total amount of water removed is accurately presented in the notes portion of the field form (i.e., 500 gallons were removed). These corrections negate the necessity to respond to EPA comments that additional problems may have occurred due to excessive pumping. However, the Navy is perplexed by this EPA comment because the EPA also notes that pH and DO readings were elevated for this well and, based on the December 11 Triad Conference call, the approach recommended to remedy these elevated readings would be continued well development until ambient groundwater conditions were reached, regardless of volumes pumped.

- **Hydraulic Conductivity** (Pages 4 to 6)

The EPA comments suggest that the calculated hydraulic conductivities at MW16-82D and MW16-82R may be wrong, and suggest the actual values may be significantly higher than those estimated and presented in the RI. The EPA's analysis is based on observations/interpretations of lithologies and/or number of fractures versus actual data recorded during the numerous slug tests conducted during the RI for Site 16. However, the EPA did not comment on any problems/inadequacies in data collection or the subsequent data interpretation that would lead one to believe that the slug testing/data interpretation was performed incorrectly. In fact, EPA (Mr. Bill Brandon) agreed during the November 25, 2008 Triad teleconference call that the hydraulic conductivities based on slug test data collected for Site 16 do conform to ranges presented in peer reviewed literature for the lithologies observed at the site and within the screened lithologies. While the Navy also agrees that the calculated values represent the low end of the ranges presented, they do in fact lie within observed ranges and should be accepted until such time as the relevant slug test data collection/interpretation protocols are determined to be in error.

- **Groundwater Flushing Time** (Pages 6 and 7 and Table 2)

From a procedural prospective, the Navy agrees with the methods and calculations provided by EPA in its November 3rd correspondence. The Navy also generally agrees with the stated limitations of the method provided as well. However, the Navy does not agree that these limitations result in the requirement to remove three times

water loss or that such a requirement has been long established. Also, since there are errors in Table 1 (or at least a difference of opinion as to what volume of lost water should be used in the days-to-flush calculations), the EPA resultant days-to-flush numbers will differ from Navy calculated days-to-flush numbers. Specifically, the EPA has included water loss in areas outside of the screened zone as part of the water loss to consider when calculating days-to-flush. This is particularly important in the calculation of days-to-flush numbers for MW16-82D. While the Navy agrees that some portion of the approximately 350 gallons lost between 64 and 74 feet bgs will impact the screened zone (79 to 94 ft bgs), the volume is most likely much less than 350 gallons.

Also, as noted by the Navy during the November 25, 2008 conference call, the EPA days-to-flush calculations presented in Table 2 are based on hydraulic conductivity values (presented in the RI) that the Agency has suggested are inaccurate in preceding comments. If the EPA believes that the RI hydraulic conductivity values are incorrect, it would be more appropriate and logical for the Agency to use EPA estimated values in the calculations. However, it should be noted that when MW16-82D is adjusted for actual water loss within the screened zone, it is apparent from Table 2 that all locations except MW16-83D have had enough time to flush out over 3 full water loss volumes.

- **Down Gradient Wells** (Pages 7 and 8)

The Navy acknowledges the comments provided on the Phase III monitoring wells 87 through 90. However, since none of the topics presented on pages 7 and 8 pertain to the EPA request for the re-sampling and re-development of the select Site 16 wells and most topics are re-iterated in the November 17, 2008 EPA Comments on the Phase III RI, no responses to EPA comments is provided at this time. The issues will be addressed in the responses prepared for the referenced November 17th comments.

- **Direct Push Technology (DPT) Wells Converted to "Permament" Wells** (Pages 8 and 9)

EPA has requested re-sampling of MW16-73D (and presumably of MW16-75D) because of the Agency's concerns regarding the Phase III development and sampling of these wells. The background and rationale for the focused development that occurred at the DPT wells is provided in the Phase III RI, Section 2.12.2.4, page 2-34. While the section accurately describes the procedures employed, additional specific details may allay concerns regarding the data quality of samples collected from these wells. While surging across the well screen was performed, the surging was conducted using a ¼-inch diameter sampling tube and essentially consisted of a "surged" rate relatively similar to the rate used while sampling. As observed in the well development logs for the DPT wells (Appendix B.7.3 of the Phase III RI), the

surge rate during development varied between approximately 140 ml/minute to 600 ml/minute; most wells were surged using rates approaching 600 ml/minute. During sampling, the rates were reduced somewhat to between 100 ml/minute to 200 ml/minute. In summary, there was no surging with a large diameter device across the well screen and the rates used to surge were within or very close to those specified in low-flow sampling protocols (up to 500 ml/minute).

The Navy agrees with the EPA position that surging can cause issues if the appropriate sampling break is does not occur. As noted by the EPA this would be more of a problem when low level contamination is an issue than when high level contamination is an issue. But, as described above, the surging performed during the Phase III field event used pumping rates generally consistent with low-flow protocols and therefore, the surging process should not produce problematic and unusable results, even at low concentrations.

Finally, with regard to the EPA suggestion that MW16-73D "appears" to be 10 to 20 feet above the top of rock, this conclusion is based on multiple EPA assumptions and is derived from EPA data interpretation from seismic studies. The Navy agrees that the well cannot be confirmed to be screened at the bedrock interface given the installation technique employed but does believe it to be screened within the deep overburden zone and that samples collected from the well are representative of CVOC concentrations in the deep overburden zone. It would be entirely likely that well installation with drive-and-wash may reach deeper depths but that depth is not known.

- **Ground Water Flow Patterns** (Pages 9 and 10)

The Navy acknowledges the alternative interpretations of the groundwater flow patterns presented by EPA in Figures 1 to 3 of the Technical Memorandum. However, the Navy cannot concur that the groundwater flow interpretations presented by EPA because they are based, in part, on anomalous data readings. Specifically, the EPA's figures were constructed using a few data points that are clearly not representative of typical groundwater elevations for Site 16 (specifically, inclusion of anomalous data for MW16-09D and EA-111R). Why the data are not representative is unknown; however, the outliers are most likely attributable to errors in recording the depths to water during the synoptic groundwater event. In any case, the data in question are clearly outliers when one examines the many years of water level measurements available for Site 16. The inclusion of non-representative data significantly alters the interpretations of groundwater flow and leads to a misinterpretation of the groundwater flow patterns occurring at Site 16. The following narrative and table provides further information regarding the anomalous data points.

When preparing the Phase III RI deep overburden groundwater potentiometric map based on the November 12 and 13, 2007 data set, the Navy concluded that the groundwater elevation datum for MW16-09D was an outlier. Additionally, when preparing the shallow bedrock potentiometric map for the same date, it was determined that the datum of EA-111R was also anomalous. As such, these data were not used in the construction of the potentiometric surface maps for the deep and shallow bedrock zones. The following table summarizes the data utilized and the analysis performed to determine that the data points were outliers and should not be used to construct groundwater potentiometric figures:

Table 1. Groundwater Elevations and Comparisons of Data for Suspect wells Versus Surrounding Wells.

Well Number	03/29/01	05/02/01	11/20/02	03/24/03	4/7/2004 (shallow wells 4/9/04)	Supp. Phase II Sampling (9-11/2004)	11/9/04-11/15/04	5/15/07-5/16/07	7/14/07-7/15/07	11/12/07-11/13/07
MW16-09D	15.99	16.60	14.78	16.13	15.78	15.42	15.01	16.92	15.40	9.74
MW16-10D	16.59	17.33	14.63	16.09	15.67	15.48	15.06	16.92	15.57	13.26
MW16-13D	16.51	17.01	14.45	15.42	15.43	15.18	14.67	16.60	15.01	12.55
MW16-30D				15.75	15.46	14.97	14.67	16.64	15.08	12.62
PGU-Z3-10D		17.60	14.91	16.27	15.96		15.20	17.06	15.68	13.42
EA-111D			15.35	19.47			18.43	20.61	19.26	16.92
EA-111R			15.24	19.27			18.24	20.53	19.16	15.32
Comparison of MW16-09D to surrounding wells										
09D to 10D	-0.60	-0.73	0.15	0.04	0.11	-0.06	-0.05	0.00	-0.17	**-3.52**
09D to 13D	-0.52	-0.41	0.33	0.71	0.35	0.24	0.34	0.32	0.39	**-2.81**
09D to 30D				0.38	0.32	0.45	0.34	0.28	0.32	**-2.88**
09D to PGU		-1.00	-0.13	-0.14	-0.18		-0.19	-0.14	-0.28	**-3.68**
Comparison of EA-111R to EA-111D										
111R to 111D			-0.11	-0.20			-0.19	-0.08	-0.10	**-1.60**

As summarized above, the groundwater elevation data collected during the November 2007 synoptic event for the suspect wells are clearly anomalous since the degree of variation noted in suspect wells is clearly more pronounced than that reported for the surrounding wells. While there are variations and sometimes reversals in gradient directions between the wells being compared, the values produced with the November 2007 data are clearly distinct and not representative of typical groundwater flow conditions.

Additionally, while the Navy agrees conceptually with the methodologies and techniques used by EPA to produce Figure 2, the Navy does not agree that including non-representative groundwater elevation data in an average calculation is a valid

approach to evaluate whether the groundwater elevation is anomalous. Specifically, the inclusion of the non-representative November 2007 groundwater elevation datum of 9.74 feet msl for MW16-09D produces an average value that is biased low. When this anomalous groundwater elevation is removed, the average groundwater elevation is 15.33 ft msl, compared to the EPA calculated average value of 14.21 ft msl (determined including the anomalous data point). The inclusion of the anomalous datum results in a completely different representation of "average" flow patterns in this area of Site 16. Most notably, the water level at MW16-09D is higher than PGU-Z3-10D and MW16-30D; this would not support interpretation of the large concave inflection depicted on EPA Figure 2. In summary, there are 10 rounds of groundwater elevation data available for MW16-09. The EPA's Figure 2 is based on an average value that is biased low due to the November 2007 outlier. It should be noted that, while the large inflection point presented in Figure 2 is not supported by the majority of the available data, the Navy does agree that groundwater flow does enter Site 16 from the upgradient area generally through this area.

Additionally, since EPA used non-representative data at EA-111R to re-interpret the shallow bedrock potentiometric map for November 2007, the Navy does not concur with or accept the figure as presented. The Navy also notes that the assumption of linear interpolation between MW16-86R and EA-111R is extreme and most likely not accurate. The potentiometric surface map for the shallow bedrock should be constructed with more consideration of data for MW16-83R, MW16-82R, MW16-55R and EA-110R as well as overall the groundwater flow patterns in the deep overburden.

- **Recommendations** (Page 10)

The Navy does not agree with the rationale provided by EPA to justify the request, therefore no EPA recommendations will be enacted.

Navy Position on Upgradient Wells Requested for Resampling and Redevelopment

As stated previously, the Navy agrees that Phase III RI data reported for some of the newly installed wells in the upgradient area (particularly pH and turbidity data) are outside typical ranges anticipated for ambient groundwater. However, the Navy does not agree with the EPA conclusion that DO values are not representative of ambient groundwater conditions. The EPA conclusion is based on the Agency's evaluation of DO readings from groundwater flow-through cell meter, not DO data recorded using Chemetrics® methodology. The latter methodology demonstrated the DO to be less than 1 mg/l at all sampling locations tested (a reasonable indication that ambient conditions were achieved). While multi-function flow-through cell meters are typically used during a field sampling events, data from the DO probe component of the meter are often found to be unreliable. Consequently, the Phase III QAPP specifically stated that data from

such probes would not be used to determine groundwater stabilization/attainment of ambient conditions. With regard to the turbidity data, the elevated Phase III turbidity readings do suggest that further well development and re-sampling could be beneficial. However, neither the EPA nor the Navy has concluded that high turbidity would automatically produce invalid or unusable VOC results, the primary target compounds of the Site 16 investigation. Such readings may simple reflect the characteristics of the subsurface unit screened. Additional redevelopment may or may not result in samples that are less turbid. The elevated pH readings are the most complex to interpret and resolve as discussed in the following paragraphs.

While the Navy agrees that elevated pH is not consistent with ambient groundwater conditions, it is likely that the elevated pH readings are a function of conditions in the *immediate* vicinity of the screened zone and not a consequence of drilling water loss or improper well construction. The analyses of the groundwater quality in the upgradient wells shows DO levels less than 1 mg/l and generally a low or negative ORP, both characteristic of reducing conditions. In contrast, drilling water, which was pumped from a fire hydrant at high rates into a temporary storage tank, would clearly not have a DO reading less than 1 mg/l and negative ORP. The low DO readings and negative ORP values indicate that lost drilling waters are not displacing ambient groundwater in the immediate vicinity of the well screen.

It should be noted that the observation of elevated pH readings in *newly* installed deep overburden and shallow bedrock wells is not new to the environmental investigations at NCBC Davisville. One explanation is that the elevated pH readings are due to water passing around the bentonite cement grout (which is assumed to finger-out from the drilled hole in porous and fractured areas) during aggressive well development. For example, pH readings reported for both MW16-83 wells (R and D), were less than 6.5 prior to well development, and then generally steadily increased during well development. Elevated pH readings were also reported for existing wells that previously demonstrated typical ambient pH conditions *after a redevelopment* (as is noted in data reported for MW-Z4-02D during the Phase III RI). These observations strongly suggest that aggressive well development causes the elevated pH readings. For most wells demonstrating elevated pH readings post initial well development, subsequent groundwater sampling several months later showed pH readings declining/returning to ambient conditions. This observation was noted even for the deep overburden and shallow rock wells at MW16-82 (one of EPA's high priority wells) when sampling was not conducted until several months after well development; pH readings were also observed to decrease from high values obtained during well development (8.12 for 82D and 8.77 for 82R) compared to lower values recorded during groundwater sampling (7.74 for 82D and 8.33 for 82R). Although pH readings recorded during sampling at both wells at MW16-82 were still elevated with respect to expected ambient conditions, the readings were only slightly elevated and it is highly unlikely that the slightly elevated pH values would have compromised the integrity of the CVOC results.

It is interesting to note that the elevated pH values occur at both wells at locations MW16-84 and MW16-86 only during groundwater sampling; pH readings remained generally characteristic of ambient groundwater during well development (although the pH readings did increase during well development at MW16-84R and MW16-86D). Since significant water loss occurred at both of these locations at zones essentially between and/or overlapping the two screened zones, it is plausible again that the action of well development caused the elevated pH values.

Upon initial inspection of the data, one might conclude that the elevated pH readings referenced above may indicate that the bentonite seals are compromised at the newly installed upgradient wells, causing the elevated pH readings (in addition to or instead of the proposed cement bentonite grout as the source). However, inspection of the well completion forms shows that a 3-foot bentonite seal (approximately) was installed during well construction. Also, only pH readings for the newly installed upgradient wells seem to be persistently elevated. Closer examination of the techniques used to install the upgradient wells suggests an alternate explanation for the elevated pH readings. Specifically, at the request of the EPA, the upgradient wells were installed in a manner that minimized the gap between the bottom of the deep overburden well screen and the top of the shallow rock well screen. Thus, at all upgradient well pairs, the bentonite seal from the shallow bedrock well was installed within the same depth as the screened zone of the deep overburden well. When the deep wells were developed, the submersible pump was place approximately 1 foot from the bottom of the well. Consequently, the samples collected from the deep overburden well were of groundwater at the same general depth interval where the bentonite seal from the adjacent shallow bedrock well was installed.

Enclosure (2)

Navy Response to EPA Letter - Technical Memorandum NCBC Site 16 Aquifer Flushing and Ground Water Sampling Issues – New Wells dated December 23, 2008

A significant Navy concern is the continually changing interpretation of data and subsequently, the work requested to resolve the perceived insufficiencies identified by EPA. We are concerned that even if the work were performed as outlined by EPA in correspondence dated December 23, 2008; the results would not be considered definitive in terms of producing representative groundwater data for Site 16. Additionally, EPA has not reconciled comments presented in EPA correspondence dated November 3, 2008 versus EPA comments presented in correspondence data December 23, 2008.

A second significant Navy concern is that portions of the rationale(s) provided by EPA reviewers in the technical memorandum to support the most recent EPA request rely on incorrect data analyses and assumptions. The following three primary technical concerns are identified:

1. **The EPA reviewers are selecting values of hydraulic conductivities for evaluation of hydraulic connection based on single lithologic types within the screened zone without regard to all lithologies screened or interpreted depositional features.** This is most evident at MW16-82 where the deep overburden well is interpreted to be screened within a glacial till. While gravels and sands are certainly present and do occur over several feet of the screened zone, they are just one component of till. As a consequence of this approach, an inaccurate comparison of site-specific data to accepted peer-reviewed literature data occurs, resulting in erroneous conclusions.

   It should be noted that this data "pitfall" is cautioned in the same open file report from USGS that the EPA reviewer relies upon to propose appropriate values of hydraulic conductivity for comparisons. Specifically, page 7, first sentence of the third paragraph states "Ranges of hydraulic conductivity for individual lithologies frequently are not useful constraints because many aquifers are a heterogeneous mixture of many lithologies." The first sentence of the fifth paragraph on the same page states "The sorting of unconsolidated sediments largely controls the expected range of hydraulic conductivity." In other words, one should not use single lithologic types to determine if the calculated hydraulic conductivity is in error with anticipated values when more than one lithology type are screened within a well. Under the sub-topic "Error Checking", on page 12, first paragraph, it is stated "The thresholds for subjectively defined errors,

such as the range of hydraulic conductivity associated with an aquifer material, are intended to be modified by the user." Compared to hydraulic conductivity results as presented in Table 3-8 of the Phase III Remedial Investigation Report, the calculated values of hydraulic conductivity for the newly installed upgradient wells are consistent with wells across Site 16 within the same hydrostratigraphic zones and screened lithologies (also consult Table 3-1 for summary of screened materials).

2. **The EPA reviewers are mis-gauging the impact of the drilling method used to install wells at Site 16 as problematic**. While all drilling methods will disturb/alter the hydraulic characteristics of the aquifer adjacent to the borehole, the drive and wash method used at the site actually creates the least amount of disturbances compared to other drilling methods ("A Statistical Evaluation of Formation Disturbance Produced by Well-Casing Installation Methods", Morin et. al, 1988). Please note that no augers were used during well installation at Site 16. The methodology used to advance (drive) the well casing actually minimizes the transport of finer grained soils from higher elevations. Furthermore, advancing casing is a completely different technique from advancing augers and therefore, suggestion by the EPA reviewer that these are interchangeable (by use of placing "(or auger)" at the bottom of page 3) is not concurred with.

3. **The EPA reviewers are including "noise" data in slug test analyses. The reviewer's assumption appears to be that all data recorded in the pressure column (data recorded from pressure transducer in datalogger) can be used to represent actual feet of water in the well**. According to "The Design, Performance, and Analysis of Slug Tests", J.J.Butler, page 36, speaking of the disadvantages of using a solid slug to displace water during a slug test: "First, there may be a considerable amount of early-time "noise" in the response data.... The large fluctuations in the initial readings from the transducer are a result of at least two phenomena: (1) the movement of the slug causes short-term dynamic pressure disturbances that may be quite large in magnitude; and (2) the transducer and its cable may be entangled with/hit by the slug during the initiation phase." Both examples provided by EPA (Figures 1 and 2) show the initial displacement greater than the known volume of the slug rod, a key indicator that this data is "noise" from the dynamic pressure wave. In fact, this noise is typical across many, if not most, of the slug tests performed across the Davisville Site (i.e., the slug test responses exhibit more than volume displaced and occur over similar time frame).

   Further evidence that this data is noise is provided in an analysis of the slug tests performed at MW16-84D. Two tests were performed, each consisting of a

falling and subsequent rising head tests. The first test was performed October 23, 2007 while the second test was performed on January 24, 2008. The second test was performed to verify the results of the first test since this well lies in an important pathway connecting the upgradient areas to the former Building 41 area. Comparison of the overall response curve for both tests for both falling and rising tests demonstrate nearly identical responses in overall shape and length of test. As such, the range of calculated hydraulic conductivities is quite good (3.91 and 2.79 ft/day for falling head tests, 4.74 and 4.12 ft/day for rising head tests) with respect to one another. The “noise” in each test is different, with a clearly observable difference between the first and second test. Specifically, the duration and “shape” of the noise response is not reproducible even though the same exact technique of displacing 3-feet of water in either rising or falling head tests was performed in each of the two tests. If the well seal were non-existent as claimed by the EPA reviewer, the response should be nearly identical for all four tests preformed. The reproducible data from both tests for the overall response and irreproducible noise data is definitive evidence that the tests were well performed, results reliable and “noise” does not affect determination of the hydraulic conductivity.