14432 SE Eastgate Way, Suite 100
Bellevue, Washington 98007
tel: 425 519-8300
fax: 425 746-0197

March 1, 2012

Karl Kunas, PE
U.S. Army Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Subject: Revised Response to Comments on the December 1, 2011 Well 12A Operational Pumping Test Workplan - Well 12A Superfund Site, Tacoma, Washington

Dear Mr. Kunas:

CDM Federal Programs Corporation (CDM Smith) has prepared the following responses to comments received on the Well 12A Operational Pumping Test Workplan dated December 1, 2011. Responses have been revised as discussed in the February 24, 2012 weekly project call. Comments are organized by commenter and responses appear below each comment in italic font.

## Michael Kuntz, Washington State Department of Ecology – December 19, 2011

General Comments

A transient numerical model is not practical for evaluating Well12A pumping scenarios. Definitive results are not possible given the modeling history at the site, uncertainty in the model domain and critical data gaps. A transient model has significant obstacles in applying real-time data and is not practical for the City of Tacoma to manage pumping at Well 12A in post remedial conditions.

***Response: References to the transient model have been removed from the workplan. It is not intended within the scope of the workplan that the model will be updated, nor is it the primary purpose of the aquifer performance test. The data obtained during this test and from other wells installed as part of the overall project could be used in the future to refine the existing numerical groundwater model and provide a tool for evaluating Well 12A pumping scenarios.***

A groundwater monitoring well network between the contaminant sources and well12 A would provide the City of Tacoma a real-time format for managing long-term pumping of Well 12A. The value of the proposed pumping test at Well12A is applying aquifer evaluation to the region between the contaminant source(s) and Well 12A to design and operate the monitoring well network.

***Response: Agreed. The pumping test data could be used to optimize the monitoring well network between the Time Oil property and Well 12A; however, this is not one of the primary objectives of the pumping test and is beyond the planned scope for this activity. Section 1.1 of the work plan will be***

***modified to include this as a potential secondary benefit and potential future data use in the event that the project team or others (e.g., City of Tacoma) elect to perform the work.***

Optimizing a groundwater monitoring network for long-term management of pumping at Well 12A would include phasing the pump test with the installation of additional wells between the well and contaminant source(s). Transducers in select wells could convey monitoring data by radio telemetry to the City of Tacoma. Finally, a transient model would not be practical for assessing remedial action, and selecting potential monitoring well locations for the reasons cited above.

***Response: Agreed. Additional wells are planned to be installed between Well 12A and the contaminant source(s) over the course of the project. The aquifer performance test will likely provide useful information for selecting the optimum locations (vertically and horizontally) for future wells; however, this is not the primary objective of the pumping test. See the response to the first general comment regarding reference to the transient model. No change in the text is planned.***

Uncertainty and critical data gaps

1. The direction of groundwater flow across the monitored portion of the site reported to vary 90 degrees; from the northeast to the southeast. Please refer to the 1999 Groundwater Summary Report, attached Figure No. 1 taken from report, and attached Figure No. 2 showing the recent groundwater flow direction.

   The 90 degree variance can be visualized by consulting attached Figure No. 3 which shows the axis and orientation of the capture zone with (1986) groundwater data and the axis of the capture zone with the recent groundwater data. This 90 degree variance is too great for a transient model to yield definitive results given the current data base and Comment No. 3 b) below.

   Although the proposed pump test rate of 3,000 gallons per minute will tend to override the rotation effect it is certain this rate would not be employed during post remedial conditions because of residual groundwater contamination. Realistically a much smaller rate would pull contamination toward or into Well 12A with the GETS not operating. The smaller the pumping rate the greater the rotational effect consequently the rotational effect is significant for the City of Tacoma to manage long-term pumping at Well 12A.

***Response: Due to the overall flat nature of the local groundwater gradient in the vicinity of the site, estimated groundwater gradients are sensitive to the number and location of wells used to define the gradient. The most recent calculation of a southeasterly groundwater gradient that you refer to was generated using the three well clusters located in the vicinity of the Time Oil Source Area that include the***

***newly installed MW-309 though MW-314. These well clusters include wells screened at the same elevations to minimize the effect of vertical gradients on the interpretation of horizontal gradients. Results from this evaluation may not be directly comparable to those of previous reports where a different set of wells (over a much larger area and screened at varying elevations) was used to interpret the gradient. See the response to the first general comment regarding the transient model. No change in the text is planned.***

***The City of Tacoma, as do most water purveyors, size pumps to operate at a specific rate for maximum efficiency. The optimum flow rate at maximum efficiency for Well 12A has been reported to be about 3,000 gpm. Therefore, it is unlikely the City would reduce this flow rate to something less than the optimized flow rate. It is less efficient, resulting in higher energy costs per pumped volume and it can damage the pump to run lower than optimized performance specifications. Our understanding is the City either has the well on (pumping at 3,000gpm) or off. No change in the text is planned.***

2. The current numerical model was used for a capture zone analysis in 2005. Cell density for the model is greatest in the vicinity of the extraction wells where the density of hydrogeologic and stratigraphic data is by far the greatest in the model domain.

   Using the 2005 model for evaluating pumping scenarios at Well 12 A would not be logical because the there are only three control points for hydrogeology and stratigraphy within a 1000 foot radius of Well 12A. Please refer to attached Figure No. 4 for control points at Well 12A.

   Since 2005 no new control points for hydrogeology and stratigraphy have been installed within a 1000 foot radius of Well 12A. Consequently, it is not logical to attempt to develop a transient model for pumping simulation at Well12A because control points in the vicinity of Well 12 A are lacking. (Please refer to comment 3 b) below)

***Response: See the response to the first general comment regarding the transient model. No change in the text is planned.***

3. The following are taken from the 2005 Capture Zone Analysis Report:

   a) Section 5.0: "Before additional wells are installed to achieve the target capture zone, additional groundwater modeling is needed to help evaluate new extraction well placement and different pumping scenarios to optimize the GETS operation."

   b) Appendix H, Section 5.0 "In areas within the model domain, insufficient data are a potential issue. In areas of sparse data, multiple lithologic scenarios may be employed to provide

numerical solutions; however, the model represents a single scenario."

In regard to the above, the numerical model was not conceived nor intended to evaluate pumping scenarios at Well 12A. The citation in Appendix H has not been expanded and has a critical bearing on an attempt to develop a transient numerical model.

***Response: See the response to the first general comment regarding reference to the transient model.***

4. Control on vertical gradients in the vicinity of Well 12A is inadequate. Recently, several monitoring wells were installed in the vicinity of the former Time Oil Building. One purpose for the wells is to compensate for the vertical groundwater gradient. The wells are installed in a ten acre area. There are no "vertical control wells" in the vicinity of Well 12A.

***Response: The existing wells that are near Well12A and are planned to be monitored during the aquifer test are: CBW-5, 6, 9, and 11. Wells CBW-6, CBW-9 and CBW-11 are completed at similar elevations near the base of the upper aquifer. The well CBW-5 is completed in the upper portion of the lower aquifer, thus creating some measure of vertical control in the immediate vicinity of the Well 12A. We agree that additional nested pairs or well clusters would be beneficial; however, we do not believe they are required to accomplish the objectives of the aquifer pumping test. No additional wells are planned to be installed near Well 12A at this time. No change in the text is planned.***

<u>Objective No. 2</u>

5. The value of objective No. 2 to provide an estimate of the influence of Well 12 A pumping on the selected remedies, is not transparent and requires elaboration to address the following:.

    a. Enhanced bioremediation is governed by the contaminant distribution within the low-permeability unit and the injection and maintenance of fluid into the low permeability unit. How would information interpreted from a pump tests at well 12 A be used to evaluate these two phenomena?

    b. In-situ thermal remediation takes place over an area of approximately a half acre that is approximately 2000 feet distant from Well 12A. The remedy is governed by: 1) contaminant distribution, 2) temperature, 3) heat flow, and 4) local groundwater containment either by the GETS or a new pumping system. How would information interpreted from a pump tests at well 12 A be used to evaluate these four phenomena?

If objective No. 2 is directed to conditions at the site after the remedies have been completed then a groundwater monitoring approach is superior to a transient model for evaluation. What is the value of adding the expense of a transient model to the budget for long-term monitoring?

***Response: The aquifer performance test will provide data to estimate the radius of influence from well 12A pumping under normal operating flow rates under steady state conditions. The intent of objective No. 2 is to state that these data can be used to provide general estimates of the effect of pumping on the selected remedies. The comments raised here are valid considerations that will be addressed during future workplans relating to the remedial design phase of the project. Also, see the response to the first general comment regarding the transient model. No change in the text is planned.***

Monitoring Well Approach for Well 12 A Pumping Scenarios

6. This following approach might be used by the City of Tacoma to aid in their real-time assessment of pumping at Well 12 A. Groundwater levels taken in a monitoring well network solely in 2000 foot interval between the contaminant sources and well 12A are used to establish a representative flow pattern to Well 12A. The network would require new wells to be installed between CBW-1 and Well 12A. Please refer to attached Figure No. 5 for area of new well location.

   Water level measurements taken by transducers in select wells are conveyed by radio telemetry to the City of Tacoma. This data along with routine groundwater analysis can be used to evaluate the pumping rate and make necessary adjustments.

   Over the long-term the representativeness of real-time approach would increase with an expanded data base. This approach automatically accounts for any gradients induced by other pumping wells and should be relatively easy for the City of Tacoma to operate. Installing new monitoring wells between CBW-1 and Well 12A prior to the pump test would provide invaluable information to this approach.

***Response: The questions raised in this comment are beyond the scope of the workplan. Although good points are raised in this comment, we do not plan to install any new monitoring wells prior to beginning the pump test or provide recommendations to The City of Tacoma regarding their real-time assessment of pumping at Well 12A. The following list summarizes the activities that are planned with the City: 1) Recommendations on the operation of Well 12A to avoid adverse effects on the remedy, 2) Coordination on timing for bioremediation amendment injection, and 3) Remedy information sharing. No change in the text is planned.***

7. A transient model requires transient conditions for calibration. The numerical model domain for the capture zone analysis is approximately 6.4 square miles. Synoptic groundwater levels have been taken recently and in 2008 the general vicinity of the Time Oil Building. Water level elevations increased dramatically from 2008 to the present. Beyond the general vicinity of the building there are no pairs of synoptic water level measurements. Nor are there pairs of synoptic measurements throughout the 6.4 square miles of the numerical model domain. Given the above, it would seem the data base necessary for calibrating a transient model does not presently exist. If the data base for calibration doesn't exist, please briefly describe the general nature and general level of effort necessary to obtain the data base.

***Response: See response to the first general comment regarding the transient model.***

8. Section 3.0 in Appendix H of the Capture zone Analysis contains a two paragraph description of the sensitivity analysis and validation for the numerical model including treatment and interpretation of the data. Such a description would not be expected to be presently prepared for a transient model for the Well 12 A site. However, would you please briefly describe the general nature of the data used for calibrating and validating a transient model that might be used for the Well 12A site?

***Response: See response to the first general comment regarding the transient model.***

## Sharon Gelinas, United States Army Corps of Engineers – December 21, 2011

1. Section 1.1, Page 1-1. I don't remember anything about refining the numerical groundwater model in the technical proposal for this project. Is this something that has been added to the scope? Depending on the model revisions (i.e. incorporating the new hydrostratigraphy conceptual model, aquifer test data, etc) this could be a significant effort, although it could provide valuable information.

***Response: References to the transient model have been removed from the workplan. It is not intended within the scope of the workplan that the model will be updated, nor is it the primary purpose of the aquifer performance test. The data obtained during this test and from other wells installed as part of the overall project could be used in the future to refine the existing numerical groundwater model and provide a tool for evaluating Well 12A pumping scenarios.***

2. Section 2.2.2. How do the wells selected for the aquifer test relate to the wells used for the gradient analysis/mass flux determination? Are the same well clusters and zones being used?

***Response: Yes, wells MW-309 through MW-314 were installed to create clusters at existing well locations to establish vertical control of the groundwater gradient and provide data for the mass flux***

***determination. Wells at these clusters are being used in the aquifer pump test as shown on Table 2-1 and Figure 2-1. No change in the text is planned.***

3. Section 2.3.3. How often will Well 12A flow rates be checked and how will this be accomplished - does CDM call TPU? Will TPU be available 24 hours per day to verify constant flow rates?

***Response: TPU has a flow meter in the well house and CDM Smith will have access to the well house. Flow rates are recorded continuously on a telemetry system that will be available from TPU and CDM Smith will manually check the flow meter on the same schedule for non-instrumented wells as shown on Table 2-1. The workplan and table have been updated to include observation of the flow meter in the well house as part of the schedule.***

4. Section 2.3.3. Will the field plots of time versus drawdown be from manual water level measurements or from transducer data that has been periodically downloaded?

***Response: The field plots of time versus drawdown will be created from manual water level measurements collected according to the schedule on Table 2-1. No change in the text is planned.***

5. Section 2.3.3. The text states that field personnel will be on-site during the work day for the pumping phase; however, manual water level measurements are required at 2-hour (non-instrumented) and 4-hour (instrumented) increments. Will there be personnel present after normal work hours to complete these measurements?

***Response: The text in the workplan has been updated to match the schedule shown on Table 2-1. Manual measurements will only be conducted by staff between the hours of approximately 0900 and 1600 hours. During times outside normal work hours the data will be from instrumented wells only and will not include data from manual measurements.***

6. Figure 2-1. Specify Tier 1 and Tier 2 wells on the figure.

***Response: The Figure 2-1 has been updated to specify Tier 1 (instrumented) and Tier 2 (non-instrumented) wells.***

7. Table 2-1. In the notes, the manual monitoring schedule for wells not instrumented during Phase 3 states 2 hrs for the first 8 hours. The text states that all manual measurements will be at 2 hour increments for non-instrumented wells and 4 hour increments for instrumented wells. Please revise.

***Response: The text in Section 2.3.3 of the workplan has been modified to say that manual measurements for non-instrumented wells will be at 2 hour intervals between the normal work hours of 0900 and 1600. The reference to manual measurements occurring at 4 hour increments in instrumented wells has been removed from the text for consistency with Table 2-1.***

8. Table 2-1. Add a note that the closest monitoring well CBW-6 has manual water level measurements collected logarithmically for the first 2 hours of pumping.

***Response: The Table 2-1 has been updated to include this note.***

9. Are there any additional health and safety concerns for this work not covered by project APP/Site Safety and Health Plan? I was primarily thinking of night shift work, if that is going to occur.

***Response: See response to Comment 5 regarding normal work hours. We are not aware of any additional health and safety concerns for this work not covered by the project APP.***

## Howard Orlean, United States Environmental Protection Agency – January 6, 2012

1. EPA is concerned that the ASTM D 4043 – 96 (2010) is an appropriate reference since it is copyrighted. As far as we understand, this method/guidance cannot be copied and included in the plans. Similar
methods should be available in other documents which are public domain.

***Response: The cited reference will be revised to the Washington State Department of Health Standard Procedures for Aquifer Pumping Test Operation and Analysis found in Appendix E of the publically available December 2009 Water System Design Manual.***

2. Some of the criteria proposed are based on the well capacity of 2,986 gpm (section 2.1), which is not a problem if it is met, but it seems more critical to have consistency rather than to keep that design
rate of discharge. Note that in section 2.3.3, under quality control, the test would be required to be within 5% of design withdrawal rate, or if not within 10% would require termination of the pump test. These criteria may set the test up for failure if it cannot be reached or maintained. It seems more important to have a long term, consistent pumping rate, than just a high end design rate that must be kept and may be variable. It may make more sense to have the well turned on to a lower than design rate, and to use that rate as the baseline which would be the basis for that 5% to 10% variation. No matter what, the value of 2,986 gpm seems way too precise a number.

***Response: This rate is the design flow for Well 12A as reported by the City of Tacoma. Agreeably, the rate is precise, but the flow during the test will be maintained at, or very near, this rate. We do not believe this rate, or a rate near to it, to be unachievable, pumps are designed to be steady and a good aquifer performance test relies in its constant flow rate. Once it is turned on, via telemetry, the flow is expected to remain at or near this rate constantly for the long-term pumping test, which is representing***

***typical operational pumping rates for Well 12A. The intent is to conduct the pump test under the same conditions that the City would ordinarily operate Well 12A.***

3. The distance between the Time Oil area wells and the 12A well is significant, and it may be good to have other well(s) with dataloggers, such as maybe CBW-10 or CBW-4 (but that does not seem as useful due to location) to also obtain information during the pump test. That could give us another control between South Tacoma Way and 12A (or CBW-6).

***Response: We agree that an additional instrumented well located between CBW-6 and South Tacoma Way in the general direction of the Time Oil building would provide beneficial data. Based on review of anticipated costs for additional instrumentation, we believe there is available equipment budget to procure an additional datalogger/sensor for monitoring CBW-10 continuously throughout the testing phases. The work plan text, table and figure 2 have been revised to reflect this additional instrumentation.***

4. EPA is not sure that CH2M-3 will have much of a response because of its distance from Well 12A. Why not use CH2M-2 instead for a transducer? It may be that CH2M-3 can be done with the manual
measurements if still considered necessary.

***Response: The purpose of CH2M-3 is a background well to measure ambient aquifer conditions outside the influence of Well 12A. This information will be used to quantify fluctuations in the aquifer not directly caused by Well 12A pumping. While we recognize that CH2M-3 is unlikely to record changes from the pumping well, the natural changes to the aquifer are anticipated to be subtle and continuous throughout the test phases. We believe this information should be captured on a continuous basis with an instrumented background well to accurately correct the subtle and continuous changes caused by barometric and/or seasonal flux that occur in monitoring wells after their response to pumping reaches steady state conditions.***

5. Is the Pierce County weather station at Spanaway Lake the closest web accessible weather station to the site? Seems like if there is a web accessible weather station to the west of the site it might be more
appropriate to use.

***Response: The workplan has been amended to read that data will be downloaded and reviewed from Pierce County's Tacoma #1 station located at 47°15'N / 122°25'W (approximately 2.5 miles northeast of the site).***

Should you have any questions or need further assistance, do not hesitate to contact me at (610) 263-2617 or Dominic Giaudrone at (425)-519-8326.

Very truly yours,

for

Aaron R. Frantz, P.E., P.G., BCEE
Project Manager
CDM Federal Programs Corporation

cc: Howard Orlean, USEPA
Kira Lynch, USEPA
Rene Fuentes, USEPA
Chris Maurer, Ecology