UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

MAY 0 8 2012

REPLY TO THE ATTENTION OF:

LU-9J

Via certified First Class Mail and email

Mr. John Perkins, CHMM
Director, Environment, Health & Safety
Tyco Safety Products
6600 Congress Avenue
Boca Raton, Florida 33487

Re: Submittals from TYCO Safety Products - Ansul Stanton Street Facility
U.S. EPA Id. No.:WID006125215

Dear Mr. Perkins,

The U. S. Environmental Protection Agency, in consultation with the Wisconsin Department of Natural Resources and other partners, is responding to your submittals entitled "Draft Final Design Report", dated January 2012; "Hydraulic Gradient and Modeling Evaluation - Tyco Fire Products LP Facility, Marinette, WI", dated February 14, 2012; and references to subaqueous capping of contaminated sediments from the "Tyco Enhanced Sediment Removal Plan Approach", dated September 2011.

After evaluation of each submittal, EPA has made the following determinations. A full discussion of each determination is in the enclosure.

1. "Draft Final Design Report", dated January 2012 (DFDR): Under the Administrative Order on Consent, EPA's role is not to specifically approve or disapprove the DFDR. However, the Administrative Order clearly provides EPA with authority to monitor and require additional information if the submitted work plans and/or supporting information do not provide an adequate basis for Ansul to complete the selected remedy in a manner which will protect human health and the environment. Further, significant stipulated penalties are appropriate where the corrective measures are not implemented in accordance with the requirements of the Administrative Order. EPA finds that the DFDR is inadequate and wholly deficient in that it lacks details for key field activities for a 90% Design Plan. See enclosure for a complete discussion of our determination.

2. "Hydraulic Gradient and Modeling Evaluation - Tyco Fire Products LP Facility, Marinette, WI", dated February 14, 2012 (HGME): During our March 8, 2012 meeting to discuss the HGME, Tyco requested a postponement of 2012 sediment removal activities while attempting to control the vertical gradients from the Tyco site to the Menominee River. After evaluation, EPA requires Tyco to proceed with the scheduled 2012 sediment dredging to

avoid further environmental damage to the river and Lake Michigan. This includes removing contaminated sediment along the barrier wall in accordance with the EPA approved work schedule. See enclosure for a complete discussion of our determination.

3. "Tyco Enhanced Sediment Removal Plan Approach", dated September 2011 (ESPR): In preparation for sediment removal in the river, Ansul submitted two different draft work plans, the Sediment Removal Work Plan (SRWP), which follows the AOC requirements, and the an alternative Menominee River Sediment Removal Plan (AMRSRP). EPA approved the SRWP with certain conditions aimed at improving the short-term protectiveness to the river. EPA disapproved the AMRSRP (EPA, June 1, 2011), which included *in situ* capping. EPA determined that capping will violate many of the key points related to EPA's contaminated sediment remediation guidance concerning *in situ* capping (EPA, 2005) and the Administrative Order on Consent. On September 12, 2011, Ansul submitted a second alternative removal plan known as the ESRP. Tyco again proposed *in situ* capping as part of the sediment removal plan approach. EPA once again reiterates its disapproval of *in situ* capping of highly mobile and soluble organic arsenic salts in the Menominee River. See enclosure for a complete discussion of our determination.

EPA is concerned that Tyco's deficiencies and delays are so significant that they may warrant imposition of stipulated penalties and constitute performance failure. EPA expects Ansul to complete all of the work listed in the Sediment Removal Work Plan approved by EPA on June 1, 2011, in accordance with the schedule EPA approved on December 21, 2011. This includes, but is not limited to, starting contaminated sediment removal by no later than July 10, 2012. EPA reminds Ansul that stipulated penalties can accrue at up to $6,000.00 per day, per violation.

If you have any questions or concerns regarding this matter, please contact Gary Cygan, of my staff, at (312) 886-5902.

Sincerely,

Jose G. Cisneros, Chief
Remediation and Reuse Branch
Land and Chemical Division

Enclosure

cc: Kristin du Fresne, Wisconsin Department of Natural Resources;
kristin.dufresne@wisconsin.gov

Enclosure

Subject: EPA's Response to Submittals from TYCO Safety Products - Ansul Stanton Street Facility, U.S. EPA Id. No.:WID006125215

The U. S. Environmental Protection Agency, in consultation with its partners, is responding to your submittals entitled "Draft Final Design Report", dated January 2012 (DFDR); "Hydraulic Gradient and Modeling Evaluation - Tyco Fire Products LP Facility, Marinette, WI", dated February 14, 2012 (HGME); and references to subaqueous capping of contaminated sediments from the "Tyco Enhanced Sediment Removal Plan Approach (ESRP)", dated September 2011 (ESRP).

Draft Final Design Report, dated January 2012, prepared by CH2MHill

We have reviewed the DFDR and found that it is inadequate and wholly deficient in that it lacks details for key field activities for a 90% Design Plan. For instance, the document does not contain design information for removing sediment and semi-consolidated material adjacent to the containment wall nor demonstrates how Tyco will attain the remedial action level of 50 ppm arsenic. The comments below provide specific issues for Tyco to address. EPA provides additional detailed comments in Attachment 4 (Techlaw, February 2012) and attachment 3 (WDNR, 2012).

Bulkhead Stability Issue: Technical data does not support Tyco's presumption that dredging along the base of the containment wall would compromise wall stability. Tyco did not support claims of increased cost with adequate financial data. In addition, Tyco's claim of wall instability is not consistent with the company's prior statements about available dredging and wall stabilization techniques that will provide for dredging near the wall base (page 3-5, Phase 1 CMI Work Plan, Feb 2008). Various options are available to ensure that Tyco does not compromise the stability of the wall during dredging. Tyco did not consider or evaluate these options for mitigating stability impacts of toe dredging in the DFDR.

Our mutually agreed to remedy in the 2009 AOC for river sediments with arsenic concentrations at or above 50 ppm is removal. Removal eliminates greater than 100 tons (Tyco's estimate) of arsenic mass from further impacting the ecology of the river and Lake Michigan, located just downstream. Tyco constructed the containment wall as a means of cutting off on-site arsenic contaminated groundwater flow to the river to the standard of "greatest extent practicable," as required in the AOC. Claiming that the wall is not performing with 100% elimination of groundwater flow to the river is not the AOC standard for determining if the wall is effective in controlling the transport of arsenic-impacted groundwater. The potential for contaminated groundwater from bedrock re-contaminating overlying river water has been examined and that analysis is presented later in this letter (see section on groundwater gradients, below). The potential adverse impact to the surface water from bedrock flow up into the river is significantly less than that of not dredging the Turning Basin sediments in 2012. EPA does not agree with Tyco claims that wall performance prevents the initiation of planned river sediment dredging. EPA's analysis indicates that only limited portions of the wall length along the river may have stability issues (Techlaw, 2012, and attachment 5). EPA's assessment indicates that dredging of the contaminated sediment close to the wall is more feasible than Tyco concluded in its Final

Design Report. Further, our review suggests that an incremental additional cost of approximately $1,000,000 would allow dredging, with appropriate enhanced methods, to occur near the base of the containment wall. This cost assumes that only the portions of the river sheet-pile wall that require additional effort to stabilize will receive the enhanced dredge techniques. WDNR reviewed the DFDR and provided those comments to EPA. EPA is providing those comments to Tyco (Attachment 3); it should be noted that a number of their comments are pertinent to Tyco's permit applications. EPA was encouraged that Tyco met with EPA and WDNR engineers in April, 2012 to assess how dredging variations or different dredging approaches in the field will allow for maximum sediment removal this year at the near shore area. However, EPA rejects Tyco's new proposals of leaving behind 18 tons of arsenic in contaminated sediment along the containment wall and that of a year delay in completing field work.

Hydraulic Gradient Evaluation, Tyco Fire Product, LP Facility, Marinette, WI, dated February 14, 2012

We have reviewed the Hydraulic Gradient Evaluation submitted by Tyco on February 14, 2012 which documents the existence of vertical upward gradients in the river post construction of a containment wall (Tyco, 2012); this is a situation EPA and WDNR have historically contended should be expected to persist, even after construction of the containment wall. During the March 8, 2012 meeting, Tyco requested a postponement of 2012 sediment removal activities while attempting to control the vertical gradients. The following discussion explains EPA's position on why EPA does not accept or approve postponement of the 2012 sediment removal activities due to the discovery of the vertical upward gradient.

EPA examined the relative potential for environmental damage to the river based on a) adhering to the EPA approved dredging schedule, and b) allowing for a delay in dredging for one year. EPA based the following analyses on historic site data and/or measurements (see attachments 1, 2, and 5). A total of 3 samples showed concentrations of arsenic in the bedrock offsite and down gradient of the wall to be 1.5, 1.9 and 136 ppm. The 136 ppm arsenic value was found immediately adjacent to the sheet pile wall at the 8th Street slip location where significant quantities of highly contaminated sediment were stockpiled during an interim measure construction 12 years ago. Upon further review the glacial till overlying the 136 arsenic value contains only limited arsenic concentrations. Further, the mass of arsenic in the bedrock groundwater appears to be limited when compared to the mass of arsenic in the overlying semi and unconsolidated sediments. Despite the questionable significance of the 136 ppm dissolved arsenic value, assuming an average, order-of-magnitude arsenic concentration in bedrock of 10 ppm, the dissolved pore water arsenic concentrations in the down gradient river unconsolidated and semi-consolidated sediments average approximately 2700 ppm (Tyco, IM 2007). This simplified calculation using flux rates in bedrock and overlying sediments (see attachment 5) indicates that the relative arsenic loading is about 270 times as significant as any potential arsenic loading from the bedrock to the overlying materials. Alternatively, a second analysis that is based on ground-water flux rates also indicates that the primary environmental impact of the site is the loss of arsenic from the unconsolidated and semi-consolidated sediments due to advective groundwater flushing action driven by the now documented upward vertical gradients from bedrock to the river (Tyco, 2012). Therefore, based on the results of these two analyses, EPA requires Tyco to proceed with the scheduled 2012 sediment dredging to avoid further

environmental damage to the river and Lake Michigan, caused by the continued presence of the contaminated sediments.

Despite the apparent limited magnitude of the potential for significant arsenic loading from the site to the bedrock, Tyco should characterize the nature and extent of the arsenic in the bedrock as well as the bedrock's hydraulic characteristics. This effort should be done simultaneously with sediment removal in the river as required in the approved schedules. Based on data Tyco provided to EPA, it does not appear likely that arsenic contamination in bedrock would be discharged to areas of the river currently characterized as having the highest concentrations.

Tyco Enhanced Sediment Removal Plan Approach (ESRP), dated September 2011

In the interest of providing a complete response to Ansul's submissions we want to address another proposal Ansul submitted with the recent ESRP document submitted to EPA, one not provided for in the AOC, that would significantly alter elements of the river clean-up contained in the AOC and planned for in the EPA approved SRWP. The ESRP is disapprovable solely because it is not part of the AOC agreement and would significantly delay completion of the removal by November 2013. However, EPA also reviewed the ESRP using the AOC criteria for a guide. The AOC mandated that Ansul demonstrate a number of factors, including but not limited to, the economic and technical impractibility of removing contaminated sediment with greater than or equal to 50 ppm arsenic. As EPA discussed in more detail in the attached comments, Ansul did not provide this demonstration. For example, Ansul cited cost comparisons while omitting long-term costs for monitoring, operation and maintenance and contingent removal for the cap if it should fail.

The AOC also requires demonstrating that the changes to the remedy protect human health and the environment and achieve an equivalent level of protection to that of the last phase of the remedy, Monitored Natural Remediation. Ansul did not provide any definitive evidence that capping will fulfill or provide the same level of long-term protection as source removal.

EPA Opinion Regarding *in situ* Capping of Mobile and Soluble Salts & Modeling Evaluation

The EPA understands that Tyco wants to use in-river capping in lieu of sediment removal in the affected portion of the Menominee River. The contaminant of concern, water soluble arsenic, is not a material that would scientifically be considered appropriate for in-river capping. Tyco's capping proposal appears more comparable to that of capping a dissolved concentration contamination groundwater plume. To date, EPA capping projects have generally involved hydrophobic contaminants with an inherent highly restricted ability to partition into surface water; hence, dissolved phase transport through sediment caps is aggressively limited by the chemical and physical characteristics of the contaminant itself. Contrast that with the proposed capping of contaminants at the Ansul facility that are dominated by hydrophilic organic-arsenic salts. Site characterization data indicates the arsenic is highly soluble, up to 20,000 ppm and non-sorbing, and therefore, quite mobile. Dissolved arsenic concentrations documented in pore water in the river are in excess of 5,000 ppm.

The site characterization data Ansul developed over the years is substantially inconsistent with cap performance predictions provided by Tyco. Cap performance prediction modeling needs to

be consistent with site characterization data. Tyco has failed in this demonstration. The arsenic has been shown to be soluble and highly mobile moving 100's of feet over several decades since the existence of the arsenic salt pile. In contrast, the cap performance predictions indicate that 18 to 24 inches of local sediment will be an effective sorptive barrier for dissolved arsenic for 100's of years. Most significantly, the capping model presented by Tyco doesn't capture the complexities associated with local geology, hydrology or with arsenic geochemistry (Attachment 1). Also important, the cap performance model(s) submitted to EPA assumes hydrostatic conditions. This presumption has been documented to be incorrect to date by Tyco's own recently submitted field data. Therefore, modeling setup and results poorly portray the complex geology, current hydrology, and the integral geochemistry controlling contaminant fate and transport at the site. EPA includes further analysis and critical reviews of capping soluble salts in attachments 1, 2, and 5. Even if Ansul influences the vertical river gradients through on-site pumping, *in situ* capping of soluble salts will remain problematic and unapprovable.

In summary, capping will violate many of the "key points" related to EPA's contaminated sediment remediation guidance concerning *in situ* capping (EPA, 2005) and disapproved in our response to the AMRSRP letter (June 1, 2011). Therefore, EPA once again reiterates its disapproval of *in situ* capping of highly mobile and soluble organic arsenic salts in the Menominee River. Ansul is required to follow the removal approach outlined in the Sediment Removal Work Plan approved June 1, 2011, the approved schedule of work activities and dates described and approved in the Design Plan and Specifications, dated December 21, 2011, and any additional subsequent approval letters related to modifications to the SRWP.

Lastly, EPA notes the continuing flexibility and adaptiveness it has shown in making decisions since the AOC was signed in 2009. It is EPA's intention to continue using reasonable and sensible but scientifically defensible flexibility in adapting the requirements laid out in the AOC to the clean-up in the river over the next two years. One example of this is the decision EPA made that allows Tyco to stabilize hazardous dredged river sediment and convert the sediment to non-hazardous waste on-site. This decision was made in spite of the AOC requirement that Tyco transport all dredge sediment off-site to appropriate landfills. We note this decision saves Ansul a substantial amount of cost, an EPA estimated $25 to $50 million dollars.

Finally, Tyco had requested during the March 8, 2012 meeting with EPA and WDNR in Chicago, to postpone dredging field activities scheduled for 2012 by one year. For the reasons cited above, and supporting reasons provided in the Attachments, EPA does not approve this request. Given the short timeframe remaining to implement the approved SRWP, EPA encourages Ansul to concentrate its resources on implementation of the approved SRWP.

Point of contact: Gary Cygan, Geologist and Project Manager, Land and Chemicals Division, Corrective Action Section, U.S. EPA, Region 5, Cygan.gary@epa.gov

ATTACHMENTS:

1) Comments on "Cap Model for Arsenic-Contaminated Sediments Adjacent to the Tyco facility", by Dr. Rick Wilkin, Office of Research and Development, Ada, OK, dated March 18, 2012.

2) Tyco Gradient and Capping Comments, by Dave Petrovski, dated April 12, 2012.

3) Wisconsin Department of Natural Resources memo Comments Regarding Draft Final Design Report, dated March 26, 2012, J. Killian, *et al.*

4) Techlaw, Completeness Assessment of the Draft Final Design Report. Reviewed for US EPA, February10, 2012.

5) Techlaw (2012), Review of Dredging Stability Assessment for the Vertical Barrier Wall and Hydraulic Gradient Assessment. Reviewed for U.S. EPA, April 10, 2012.

REFERENCES:

Techlaw (2012), Completeness Assessment of the Draft Final Design Report. Reviewed for U.S. EPA, February 10, 2012.

Techlaw (2012), Review of Dredging Stability Assessment for the Vertical Barrier Wall and Hydraulic Gradient Assessment. Reviewed for U.S. EPA, April 10, 2012.

Tyco (2012), Status of U.S. EPA Review, Stanton Street Facility, Marinette, Wisconsin; Letter dated March 16, 2012.

Tyco (2007), Revised Phase 1 Corrective Measures Implementation (CMI) Work Plan (originally prepared, December, 007), Revised February, 2008, prepared by EarthTech for Tyco, Inc.

U.S. EPA (2005), Contaminated Sediment Remediation Guidance for Hazardous Waste Sites; EPA-540-R-05-012 OSWER 9355.0-85, December, 2005.

U.S. EPA (2011), Review of Sediment Removal Work Plan and Alternative Menominee River Sediment Removal Plan, dated December 1, 2010. Approval Letter dated June 1, 2011.

U.S. EPA (2011), U.S. EPA Comments on the Design Plan and Specifications, Preliminary Basis of Design, dated October, 2011 Letter. Comment Letter dated December 21, 2011.

WDNR (2012), WDNR Notice of unresolved issues regarding permit application letter, dated March 5, 2012; Wisconsin Department of Natural Resources, Peshtigo Service Center.

WDNR (2012), WDNR Comments regarding Draft Final Design Report, dated March 26, 2012. J. Killian, *et al.*

ATTACHMENT 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
GROUND WATER AND ECOSYSTEMS RESTORATION DIVISION
PO BOX 1198 • ADA, OK 74821

March 18, 2012

OFFICE OF
RESEARCH AND DEVELOPMENT

MEMORANDUM

SUBJECT: Comments on "Cap Model for Arsenic-Contaminated Sediments Adjacent to the Tyco Fire Products LP Facility in Marinette, Wisconsin" (12RC05-002)

FROM: Richard Wilkin, Ph.D., Environmental Geochemist
Subsurface Remediation Branch

TO: Gary Cygan, Tyco Project Manager
U.S. EPA, Region 5

Per the request for technical assistance, I have reviewed the 2-layer cap model provided by Reible et al. and the accompanying article published in *Soil and Sediment Contamination* by Lambert and Reible (2009, volume 18, pages 470-488). The calculator provides a numerical modeling tool to predict cap performance. The model accounts for advection, diffusion, and reaction within cap materials. The model also includes factors for sediment erosion, sediment deposition, sediment re-working, and bioturbation. The journal article may be of a general nature, but the text only refers to organic contaminant behavior in cap materials. There is no specific mention of arsenic or more generally of metal or metalloid contaminants. The spreadsheet does not appear to make any specific linkage to the Tyco site. It would be important to examine the spreadsheet in a form that is applicable to the site of investigation.

Some caution is warranted in using this type of model to select a cap design at the Tyco facility. In the provided model, contaminant removal is captured in a single term (partition coefficient). No demonstration is provided that this is an appropriate approach for arsenic. The uptake or sequestration behavior of arsenic depends on multiple geochemical parameters, including pH, redox state, nature of the sorbing material(s), and solute competition for adsorption sites. This assumes that arsenic removal from solution is tied to sorption/desorption equilibria rather than precipitation or co-precipitation reactions.

Unless all of this geochemical variability is captured, modeling efforts will fall short of reaching ideal design parameters. The biogeochemical behavior of arsenic is complex and is an active area of experimental, theoretical, and field-based research. Consequently, solid-aqueous

partitioning behavior of arsenic cannot be predicted with certainty from first principles. However, empirical relationships describing arsenic adsorption/desorption can be derived that are site-specific. In this sense, the nature of the cap material needs to be fully evaluated from the context of arsenic mass transfer from the aqueous phase to the solid phase over a range of anticipated conditions. The model might very well be adaptable; however, the necessary site-specific data are either not available or have not been sufficiently parameterized for inclusion to the cap model.

This review indicates that it would be worthwhile to review the spreadsheet calculator in a form that is specific to the Tyco site. Secondly, it is recommended that any site data related to arsenic sequestration be pulled into a useable form for review. Such information would include solid and aqueous phase arsenic concentrations across the site, pH, redox indicators such as arsenic speciation in the solid and aqueous phase, ground-water chemistry, and sediment mineralogy. If available, data from batch and/or column tests designed to evaluate arsenic sequestration from site-derived materials would be valuable.

If you are interested in obtaining a more detailed review of the cap model itself, this is something I would not be able to provide. If you would like, we can attempt to find that expertise in ORD. Let me know if you wish to discuss any of this.

If you have any questions concerning these comments, please do not hesitate to call me at your convenience (Wilkin: 580-436-8874). I look forward to future interactions with you concerning this site.

cc: Linda Fiedler (5203P)
Charles Maurice, Region 5
Gwen Massenburg, Region 5
David Petrovski, Region 5
Luanne Vanderpool, Region 5

ATTACHMENT 2

Date: 4/12/12

Subject: Tyco Gradient and Capping Comments

From: Dave Petrovski, Environmental Scientist, LCD

To: Gary Cygan, Tyco Project Manager, LCD

As requested, comments on the confirmed presence of vertical hydraulic gradients within the near-shore sediments at the Tyco site and Tyco's capping proposal are provided below.

Gradient Comments:

- Until recently Tyco's position was that conditions within the near shore sediments were hydrostatic and dissolved transport was dominated by diffusion (Tyco, 9/2011, Appendix A; Tyco, 12/2010, Attachment 3). In contrast, Region 5 contended that a diffusion dominated transport scenario was unlikely and the presence of gradients should be anticipated and included in the cap performance projections (U.S. EPA, 6/1/12, Attachment entitled, "Diffusion Performance Prediction for a Proposed Sediment Cap"). Tyco's hydrostatic contention rested upon construction of the facility boundary barrier wall, on-site ground-water removal and ground-water modeling. Despite Tyco's modeling prediction, the concerns of Region 5 were recently confirmed when Tyco documented the presence of vertical hydraulic gradients in the near-shore river sediments. This same ground-water model is the basis for Tyco's current contention that an enhanced rate of ground-water removal from on-site unconsolidated materials will reverse the river-ward and upward bedrock gradients in six to nine months (Tyco/Region 5/WDNR meeting of 3/8/12).

- In addition to the existence of natural vertical gradients in the river sediments, Region 5 has contended and continues to contend that the presence of natural hydraulic gradients will be augmented by intense short-term anthropogenic gradients generated by use of the Turning Basin. For example, Marinette Marine currently constructs 400-foot, deep draft ships hydraulically driven by multiple 120,000 HP engines (U.S. EPA, 6/1/2011). In addition to other vessels, these ships use the turning basin as part of the Marinette Marine testing program and should generate the intense short-term hydraulic gradients assumed by Region 5.

- Preliminary characterization of the dissolved arsenic concentrations in the bedrock offsite and down gradient of the on-site barrier wall found 1.5, 1.9 and 136 ppm. The 136 ppm arsenic value was found immediately adjacent to the 8th Street slip sheet-pile wall where significant quantities of highly contaminated sediment were previously stockpiled during a prior interim construction measure. Consequently, the 136 ppm value may not be representative of the arsenic levels in the bedrock. However, even including the 136 ppm value, the average bedrock arsenic concentration of 46.5 ppm is significantly less than the documented arsenic concentrations in the overlying semi and unconsolidated river sediment slated for remediation. Characterization data indicate these sediments have an average dissolved pore water arsenic concentration in the range of 2700 ppm (Tyco, URS, 2/2001). Assuming the ground-water flux from the bedrock to the river sediment scheduled to be dredged in 2012 equals the flux from these sediments to the river, the ratio of these two concentrations should be indicative of the relative arsenic loss to the river versus loading from the bedrock to the overlying materials. This ratio of 58 (2700/46.5) indicates a principle environmental impact within this river area is advective flushing of arsenic from the high-concentration sediments to the river and ultimately Lake Michigan. Similarly, any ongoing arsenic loss to the sediments from the bedrock appears relatively minor. This simple analysis

indicates delaying the sediment remediation work scheduled for 2012 entails a significant environmental cost. Better characterization of the bedrock arsenic concentrations would probably lower the assumed average, increase the concentration ratio and argue even more strenuously for sediment removal in 2012. These conclusions are also supported by an arsenic-river loading analyses provided by Techlaw (Techlaw, RZ2.R05035.02.ID.036, 3/14/2012).

- Tyco claims the dissolved bedrock arsenic contamination and the river-ward and upward gradients will lead to significant recontamination should the sediment remediation scheduled for 2012 proceed prior to the gradients being mitigated or reversed by the current enhanced onsite ground-water removal efforts. Implicit in this concern is the presumption that the bedrock arsenic from the site is discharging to the sediment area(s) associated with elevated arsenic and scheduled to be remediated. I am not aware however of any data that supports this supposition. It contrast, much of the arsenic found in the on-site bedrock could be discharging to the river well beyond the near shore areas currently slated for remediation. Consequently, while I agree with Tyco that the extent, intensity and mobility of the arsenic contamination in the bedrock need to be defined, I also believe the on-site bedrock discharge point(s) in the river needs clarification. In addition, due to ongoing environmental damages of delay, these investigations should not interfere with the scheduled 2012 dredging of the high-concentration river sediments at or above 50 ppm arsenic. Tyco has also claimed that modeling results indicate the enhanced rate(s) of on-site ground-water removal will reverse the river-ward and upward gradients in the bedrock within 6 to 9 months (Tyco/Region 5/WDNR meeting of 3/8/12). According to Tyco, enhanced ground water removal was initiated in February of 2012 (Tyco, 2/14/2012). As the 2012 dredging is scheduled to start in July, Tyco should be at least 5 months into a 6 to 9 month gradient-mitigation/reversal process. Therefore, these efforts should be in their latter phase and the arsenic mass still leaving the site or advecting from the bedrock to the overlying materials in the river should be limited. Consequently, this argument supports the conclusion that the potential for sediment recontamination is comparatively minimal with any potential risks overwhelmed by the environmental costs of further delay in the sediment remediation work scheduled for 2012.

- Tyco's contention that increased on-site pumping from the unconsolidated on-site materials will reverse the river-ward and upward hydraulic gradients in the underlying bedrock is questionable. Site characterization data indicates the bedrock is separated from the overlying unconsolidated materials by a layer of "compacted" low/lower permeability till (Tyco, 1/2012). The presence of the low-permeability till should significantly mitigate the hydraulic impacts in the underlying bedrock of the on-site pumping within the unconsolidated materials. In any case, the most effective and expedient way to affect bedrock gradients would entail the removal of ground water from the bedrock itself and not the unconsolidated materials above the till.

Capping Comments:

- Tyco's capping proposal is singular. To date, sediment capping projects have invariably involved hydrophobic contaminants with a restricted tendency to partition to water and a pronounced affinity to sorb to geologic and capping materials, e.g., PCBs. Consequently, dissolved phase transport through the cap is invariably aggressively limited by the chemistry of the contaminant itself. In contrast, the contaminants of concern at the Tyco facility are hydrophilic organic arsenic salts. The highly soluble nature of the arsenic has been documented by the presence of dissolved arsenic concentrations exceeding 5,000 ppm. In addition, site characterization data indicates arsenic transport at the Tyco facility has not been significantly affected by sorption, having moved hundreds of feet with migrating ground water since the 1950s (figure 14, Tyco, October 2011). This has been acknowledged by Tyco in the facility's site

characterization model, which states the "Arsenic accumulation within the SCM (semi-consolidated material layer directly above the till) primarily is attributable to … Dissolution and infiltration into groundwater beneath the site with subsequent subsurface transport (by groundwater) to the river" (Tyco, 10/2011, page 2-2).

- All of the cap performance models submitted by Tyco to date have presumed that conditions within the sediments are and will continue to be hydrostatic, and consequently arsenic transport through the cap is and will be dominated by diffusion. Even so, in the absence of arsenic sorption to cap solids, diffusion transport alone predicts the pore water concentrations at the base of the cap's biologically-active zone will exceed the State of Wisconsin's Water Quality Criteria for arsenic within 14 months and the Monitored Natural Recovery stipulation provided in the facility's RCRA order within 5 years (U.S. EPA, 6/1/11). As discussed, upward ground-water gradients have recently been identified within the sediment and glacial materials beneath the section of the river proposed by Tyco to be capped. Compared with diffusion, gradient driven advection is a much more effective transport process which results in notably shorter transit and breakthrough times. Furthermore, the documented natural hydraulic gradients will probably be supplemented by intense short-term anthropogenic gradients generated by use of the Turning Basin (e.g., the vessels of Marinette Marine include hydraulically-driven 400-foot ships powered by multiple 120,000 hp engines (U.S. EPA, 6/1/11)). Consequently, diffusion-based cap performance models provided to date by Tyco which ignore ground-water advection give highly optimistic cap-performance predictions.

- The arsenic sorption model submitted by Tyco does not capture important complexities of arsenic chemistry. Arsenic partitioning and sorption depends upon multiple geochemical parameters including; pH, redox state, and the nature of the sorbing materials (U.S. EPA, Wilkin, 3/18/2012). In addition, the Freundlich sorption isotherm used to model the sorptive capacity of the sediment does not account for limitations on the arsenic mass that can sorb to sediment solids (Fetter, 1999, page 127). This could be especially important at the Tyco facility given the elevated concentrations of dissolved arsenic at the site and the need for a thin cap (on the order of 18 inches) to possess sufficient sorptive capacity to bind high concentrations of arsenic for extended periods of time. Consequently, use of other isotherm models (e.g., the Langmuir) with a sorption capacity limit may be more appropriate at the Tyco site. These concerns are supported by data from Tyco showing sorption processes loss their effectiveness at high arsenic concentrations and the inconsistency of the cap performance predictions with the site characterization data. The site characterization data indicates the arsenic has a strong tendency to dissolve, a limited tendency to sorb and has moved with ground water at linear velocities approaching 10 feet per year. In contrast, Tyco's cap performance predictions (in the absence of ground-water flow) indicate several feet of local sediment will be an effective arsenic isolation layer for hundreds of years. Obviously, the cap performance model needs to predict both the behavior of the cap as well as explain the site characterization data.

- A contaminated sediment site associated with a highly soluble contaminant in the presence of significant natural and most probably intense short-term anthropogenic hydraulic gradients presents persuasive arguments against capping as a sediment remediation alternative. Such a conclusion is supported by current Agency guidance (U.S. EPA, 2005, EPA-540-R-05-012). For example in "Highlight 5-4: Some Key Points to Remember When Considering In-Situ Capping," "Caps may be most suitable where … ground water flow gradients are low and contaminants are not mobile…" As noted in contrast, the Tyco site is associated with a highly soluble contaminant being mobilized and flushed to the overlying river by the documented presence of significant vertical hydraulic gradients.

If you have any questions, comments or concerns, please contact me by phone (312-886-0997) or e-mail at your earliest convenience.

References:

Fetter, 1999: Contaminant Hydrogeology, 2nd edition

Techlaw, 3/14/2012: Dredging Stability Assessment and Hydraulic Gradient Assessment for the Vertical Barrier Wall, RZ2.R05035.02.ID.036.

Tyco, URS, 2/2001: Summary of Findings, 1974-2000

Tyco, 12/2010: *draft* Alternative Menominee River Sediment Removal Plan, Attachment 3.

Tyco, 9/2011: Enhanced Sediment Removal Plan Approach, Appendix A.

Tyco, 10/2011: Design Plan and Specifications, Preliminary Basis of Design, figure 14, Maximum Arsenic Concentrations in Glacial Till.

Tyco, 1/2012: Draft Final Design Report.

Tyco, 2/14/2012: Technical Memorandum, Hydraulic Gradient and Modeling Evaluation, Tyco Fire Products LP Facility, Marinette, Wisconsin.

U.S. EPA, 2005: EPA-540-R-05-012

U.S. EPA, 6/1/11: Review of "Sediment Removal Work Plan" and "Alternative Menominee River Sediment Removal Plan," dated December 1, 2010.

U.S. EPA, ORD, 3/18/2012: "Cap Model for Arsenic-contaminated Sediments Adjacent to the Tyco Fire Products LP Facility in Marinette, Wisconsin," from R. Wilkin to G. Cygan, 3/18/2012

cc: J. Cisneros

R. Clarizio

P. Ramanauskas

D. Chachakis

ATTACHMENT 3

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: March 26, 2012

TO: Gary Cygan – U.S. EPA Region V, Ansul Project Manager

FROM: Department of Natural Resources
Jim Killian – Sediment Management
Cheryl Bougie – Watershed Management
Jim Schmidt – Watershed Management, Water Evaluation
Sandy Miller – Waste & Materials Program
Kristin DuFresne – Remediation & Redevelopment Program

SUBJECT: Department of Natural Resources Comments Regarding Draft Final Design Report

The Department of Natural Resources (DNR) is in receipt of CH2MHill's January 2012 submittal titled *Draft Final Design Report*. The DNR has reviewed this document and offers the following comments:

General Comment
CH2MHill should specify whether or not one contractor will be doing both phases (2012 and 2013) of work.

Section 1.2.1
The code reference in the last paragraph should be NR 347 not 374.

Section 1.3
CH2MHill should consider using the goals and objectives in the Lower Menominee River Stage Two Update dated December 2011.

Sections 3.2.2 – 3.2.6
Details need to be provided regarding how water from the dredged material will be pumped to the temporary water treatment system located at the 6th Street Slip.

Details need to be provided regarding how spills will be handled (i.e. contingency plan).

This section of the document should reference where the water from the truck decontamination activities will go.

The DNR would like to begin reviewing the confirmation sampling plan as soon as possible.

Section 3.2.6
The reference to the Turning Basin in the first bullet should be changed to the South Channel.

Section 3.3.2
To be consistent with the 2009 EPA Administrative Order on Consent, the DNR requests that all sediment with arsenic concentrations $\geq$ 50 mg/kg removed.

The DNR believes that engineering techniques exist that will allow Tyco/CH2MHill to remove the contaminated sediment along the barrier wall.

The last paragraph in this section states that the final design will be completed prior to mobilizing for the spring 2012 work. The DNR would like to begin reviewing the final design as soon as possible.

Section 4.2
The DNR requests that the detailed work plans describing how the work will be executed be submitted to the agencies as soon as possible. (Note: The submitted schedule states that procurement of the dredging/soil stabilization contractor is scheduled to be completed by April 30, 2012.)

Section 4.6.2
The last bullet regarding sampling, analysis and documentation states results shall be submitted to CH2MHill no later than 10 days following the end of the month. This reporting would not comply with the general permit. The requirements in Section 2.4 on Page 3 of the WI-0046558-05 must be met. For the first 5 weeks of the project, data results need to be submitted within 24 hours of obtaining the results from the lab so the DNR may evaluate the initial start-up of the treatment system.

Section 4.6.4 and 4.6.5
Reference is made to complying with the discharge requirements in Section 3.4 of the subcontract document. The subcontract identifies anticipated monitoring requirements and effluent limits, actual requirements/limits could be different from what's shown here. This section should reference the WPDES general permit WI-0046558-05 that the subcontractor will be subject to. The monitoring requirements and effluent limits will be identified in the letter that grants permit coverage.

Section 4.6.6
This section states the treatment system must be operated by a licensed operator, but it also says the "operators do not have to be licensed in Wisconsin". That is incorrect. Chapter NR 114, Wis. Adm. Code, contains requirements for DNR certification of treatment plant operators. This chemical/physical treatment system would fall under the Subclass K "Special", as described in s. NR 114.08. Bruce Oman (wastewater engineer in Peshtigo 715-582-5012) or Jack Saltes (operator certification wastewater engineer in Madison 608-264-6045) can provide the details on what steps need to be taken for operator certification.

Section 5.1.1
The final design should explain how project information will be communicated with local property owners and other members of the general public.

Section 5.2.1
The DNR believes that Tyco and the dredging subcontractor are responsible for verifying that all the necessary permits have been obtained and that an erosion control and storm water management plan are completed prior to submitting the permit application. Sheet # 31 Standard Details does not comply with Wisconsin's Technical Standards for Best Management Practices.
Attached is the link to the web site: http://dnr.wi.gov/topic/stormwater/standards/const_standards.html

Section 5.2.2.4
Equipment and areas of the asphalt pad used for the stabilization of hazardous waste sediment is subject to RCRA closure requirements. Additional information will be needed to ensure RCRA closure standards are met. (Note: This issue will also be addressed in the remediation variance.)

Section 5.3.3
There doesn't appear to be any data to support the statement that lower contamination SCM will likely not need to be stabilized to render it nonhazardous.

The table referenced in the last paragraph needs to be inserted.

Section 5.3.3.1
It appears that no TCLP testing will be conducted on the lower contamination SCM to determine if stabilization is necessary to render it nonhazardous. Rather TCLP testing will be conducted after the

addition of pozzolanic reagent. The waste should be characterized at the point of generation or stabilized for arsenic leachability upon generation, same as the other sediments.

Explain the truck liner design and specifications.

Section 5.3.4
Since debris may not allow the clam shell to close tightly, more TSS would be moving in the water column. The DNR believes there may be a need to prescribe additional BMP's to control TSS in-situ.

Section 5.4.1
Any process wastewater generated by the water treatment system will need to be characterized as a hazardous or nonhazardous waste prior to shipping off-site.

Section 5.5
Have contacts and contracts with the landfill been initiated?

Will the water from decontaminating the trucks be treated?

Section 5.6
The turbidity curtains are not shown on the drawings in Appendix B as stated in the narrative.

Section 5.8
The DNR would like Tyco to consider restoration activities beyond the removal of contaminated sediment. (Note: There may be opportunities in the future for Tyco to work with the Lower Menominee River Area of Concern Citizen Advisory Council regarding this issue.)

Section 6
Table 3 referenced in the first paragraph needs to be inserted.

Section 6.1.2
This section of the document needs to be redone. The State of Wisconsin has not adopted the referenced hazardous waste exclusion. This sediment becomes a hazardous waste when dredged. Given the variability of total arsenic concentrations in the sediment, all sediment should be stabilized to remove the RCRA toxicity characteristic as well as meet Subtitle D landfill standards. Soils cannot be landfilled until LDR standards are met (5.0 mg/L Arsenic TCLP and the Universal Treatment Standards in 40 CFR 268.48 or NR 668.48 Analysis (pgs 374, 378)). (Note: Historical data indicates some VOCs may be present in the sediment.)

Language regarding the area of contamination should be revised. Ansul will be submitting a remediation variance request for storage and treatment of the sediment (the State's equivalent of a Remedial Action Plan in 40 CFR part 270 subpart H).

Section 6.4.2
The water quality sample locations do not appear to be in Appendix B.

Section 6.4.4
The Wisconsin Technical Standards should be used when designing the erosion control and storm water management plan.

Section 6.4.5
Initial comments from the DNR's Wastewater Program indicate that the existing WPDES permit for the Tyco facility will not be modified.

Section 6.4.7
Has appropriate staff been trained to identify and report the five stated listed species known to occur in the Project Area? Or will guidance be finalized soon?

Section 7.0
It is Tyco's responsibility to ensure all the permits, approvals and variances are being implemented correctly.

Section 7.1.1
To date, the DNR has not agreed to the 80 mg/L TSS above background reading. This issue is anticipated to be resolved under the Water Quality Variance.

Appendix B does not appear to depict all of the water quality sampling locations.

To date, the DNR has not agreed to the arsenic sampling approach. This issue is anticipated to be resolved under the Water Quality Variance.

Section 7.2.2
The DNR requests that the Confirmation Sampling Plan be submitted as soon as possible.

The DNR assumes the dredge operators will not have prior knowledge of the confirmation sampling locations.

Section 7.2.3
The Confirmation Sampling Plan will need to include a discussion of the method to verify the accuracy of the proposed IDW methodology (cross-validation testing). The text does not discuss the area that is to be used for SWAC calculation, however, Figure 12 shows sampling locations that represent polygons (of As concentration) outside of the actual removal areas. The section text has no discussion or statements of justification for including/excluding these polygons in the SWAC work, but it obviously should be discussed in the Confirmation Sampling Plan.

Section 7.3
The proposed sampling frequency (1 sample for every 500 cubic yards) is inadequate. During the 1999 stabilization activities for the 8th Street Slip the DNR required Tyco/CH2MHill to collect 1 sample for every 50 tons of stabilized waste. If after 500 tons of stabilized material the stabilization process was found to be completely successful, testing frequency was reduced to 1 sample for every 100 tons. The DNR believes there is more variability of sediments this time around, so frequent sampling on each sediment type may be needed before reducing the sampling frequency.

Section 7.4
This section should be updated to reflect the change from excavation to dredging in the South Channel.

Section 9.1
DNR has no major concerns with changing the remediation technology in the South Channel to dredging vs. dry excavation.

Section 9.1.2.1
The DNR is not aware of any significant releases associated with the ThyssenKrupp Waupaca Foundry property. The DNR recommends the reference to the ThyssenKrupp Waupaca Foundry be removed.

Section 9.1.2.5
It appears the addition of water treatment operations at the 6th Street Slip will close public access at that slip (drawings). Sediment remediation is also planned in late summer 2012 at the Menominee MGP site, which will likely close down the Boom Landing public launch. The public will need to be made aware of

this potential for limited access to the river during these periods. Given the potential for land contamination at the 6th Street water treatment site, will the DNR be privy to the agreement between Ansul and the City of Marinette for occupying this location?

Appendix B, Bidding Requirements and Contract Documents, Section 02 61 00
The listing in 1.03A does not list 40 CFR part 262, Standards Applicable to Generators of Hazardous Waste.

Appendix C, Stabilization Results
The samples from 2010 were homogenized in the laboratory. The DNR questions whether the samples and results are representative of the different types of sediment to be treated.

For the 2011 samples, note that of the 14 samples analyzed, only one was treated successfully to below 5.0 mg/L, that being 4.6 mg/L. Without knowing the margin of error, this sample may not indicate successful treatment either. The conclusion is there was too much water in the sediment, requiring additional reagent to be added for successful treatment, but no data is available to support that claim (no second round of analysis was conducted). Given that dewatering will only be passive, adequate analysis to show successful treatment to below 5 mg/L will be necessary, supporting the need for more sampling of treated loads than that proposed in Section 7.3 (every 500 cubic yards).

cc: Robert Rosenberger, DNR - Peshtigo
Ansul (WDNR BRRTS # 02-38-000011) Case File

ATTACHMENT 4

COMPLETENESS ASSESSMENT OF THE DRAFT FINAL DESIGN REPORT DATED JANUARY 2012

TYCO FIRE PRODUCTS LP
FORMER ANSUL INCORPORATED FACILITY
MARINETTE, WISCONSIN
EPA ID NO. WID 006125215

Submitted to

Mr. Allen Wojtas
Contract Level Contracting Officer's Representative
U.S. Environmental Protection Agency
Region 5, LP-7J
77 West Jackson Boulevard
Chicago, Illinois 60604

Submitted by:

TechLaw, Inc.
205 West Wacker Drive
Suite 1622
Chicago, Illinois 60606

TechLaw Task Order No.	**R05035**
EPA Task Order No.	**EP-G11S-00012**
Contract No.:	**EP-W-07-074**
EPA TA:	**Gary Cygan**
Telephone No.:	**(312) 886-5902**
TechLaw TOM:	**Brad Martin**
Telephone No.:	**(312) 345-8960**

February 10, 2012

COMPLETENESS ASSESSMENT OF THE
DRAFT FINAL DESIGN REPORT
DATED JANUARY 2012

TYCO FIRE PRODUCTS LP
FORMER ANSUL INCORPORATED FACILITY
MARINETTE, WISCONSIN
EPA ID NO. WID 006125215

Below is TechLaw's Completeness Assessment of the Tyco Fire Products LP (Former Ansul Incorporated Facility, Marinette, Wisconsin), Draft Final Design Report, dated January 2012 (Final Design). Based on an e-mail from Mr. Gary Cygan, EPA, dated February 2, 2012, TechLaw has focused this review on the completeness of the Final Design and has not completed a full, detailed technical review of the design. The Executive Summary to the Final Design indicates that the Final Design represents a 90 percent design phase equivalent and is intended to present the remedial actions required to meet the U.S. Environmental Protection Agency (USEPA)-approved Sediment Removal Work Plan (SRWP).

GENERAL COMMENT

1. The Final Design appears to be incomplete in several key areas. Examples of incomplete items in the Final Design are described below:

   a. The primary area of the Final Design which is incomplete is the lack of design information for removing sediment and semi-consolidated material (SCM) adjacent to the vertical barrier wall (VBW). By not proposing a removal design for these materials, the design does not appear to be consistent with U.S. Environmental Protection Agency's (USEPA's), June 1, 2011 conditional approval letter from Gary Cygan/USEPA to John Perkins/Tyco Fire Products, LP, Re: Review of Sediment Removal Work Plan and Alternative Menominee River Sediment Removal Plan (Conditions of Approval). The Conditions of Approval stated that "Not removing contaminated sediment along the toe of the containment wall due to engineering considerations does not justify as technically impracticable the removal of the contaminated sediment in the Turning Basin and transition area." In addition, as the removal of these materials adjacent to the VBW is a potentially technically challenging design feature, and a critical component of the proposed removal activities at the site, it appears that a Final Design should include this information. As presented in the Final Design, no details are provided on this design feature and the Final Design indicates that the issue will be further evaluated and discussed with the regulatory agencies. A Final Design does not appear to be an appropriate place to propose further evaluation of such a critical design issue.

   b. The Final Design references an interactive design process used between preparation of the Tyco Fire Products LP- Former Ansul Incorporated, Marinette, Wisconsin, Draft Design Plan and Specifications, Preliminary Basis of Design, dated October 2011 (PBOD) and this Final Design. However, as presented in the Final Design, there are

multiple major design changes or new design features which would typically be presented in a PDOB-type document and updated in a Final Design. The process of introducing major design components in Final Design indicates the Final Design is incomplete. The most significant examples of these changes are as follows:

i. *The proposed wet dredge of the south channel.* As proposed in the PBOD this was a dry dredge area. The PBOD stated that "Dry excavation is necessary in the South Channel, because the water depth in the South Channel is typically 1 to 2 feet, meaning barge-based mechanical dredging equipment cannot be floated into the area. In addition, the South Channel is fairly wide (100 to 200 feet), and the shoreline is heavily vegetated, so using a crane from the shoreline would be problematic for the width of the channel. Underwater sediment removal is further complicated by the presence of woody debris from historical activities in the area." A Final Design does not appear to be an appropriate place to propose such a major design change, and an iterative design process should have included this sort of design change in an earlier version of the design.

ii. *The removal of SCM near the VBW.* The PBOD included Phase IV, which allows for some semi-consolidated material (SCM) containing arsenic concentrations greater than 50 milligrams per kilogram (mg/kg) to be permanently left in place near the existing sheet pile wall along the former 8th Street Slip to avoid compromising the wall's stability. However, the Final Design has expanded this area to encompass the entire VBW. A Final Design should include design changes and improvements which address previously unresolved design issues; however, the Final Design includes an expansion of potential design issues/complications at the site; which is a further indication that the Final Design is not complete.

c. The USEPA-approved SRWP indicates that the Final Design will include a Construction Quality Assurance Plan (CQAP); however, a CQAP was not included in the Final Design.

d. The Final Design indicates in the Executive Summary that modeling and analyses of the groundwater intrusion into the previously USEPA-approved SRWP dry excavation areas is described in Section 9 of the Final Design, but a comprehensive technical memorandum (i.e., white paper) will be provided to USEPA to present the groundwater modeling parameters and results, water treatment calculations, and correlating cost estimates. It appears that this information was not submitted with the Final Design, therefore making it incomplete.

e. The modification from dry excavation to wet excavation in the South Channel requires somewhat different assessment criteria. Criteria should be employed to assure that the wet excavation techniques do not allow migration of arsenic downstream and represent a significant design consideration that would typically be included in a sampling and analysis plan (SAP). Although the administrative order of consent (AOC) allows for a delayed submission of a SAP, this information is now crucial to an assessment of the

protectiveness of the proposed wet excavation design and should be included in the Final Design in support of the proposed wet excavation approach.

f. The current level of detail in the Final Design does not convey the extent of modifications necessary to change the proposed South Channel excavation from dry dredge to wet dredge. For example:

i. It is unclear if the treatability assessment is still valid depending on the percent solids of the wet dredge soils that are anticipated.

ii. It is unclear if dewatering of the wet dredge soils (also referred to as sediment processing) will be necessary and where that would occur.

iii. It is unclear what water generating sources were used to size the water treatment plant and how the estimated volumes were determined.

iv. It is unclear exactly how sediments will be removed and what contingencies will be employed to allow for removal by utilizing either a barge-mounted standard clamshell bucket or excavator based on the limitations originally presented in the SRWP.

For completeness, the Final Design should include a crosswalk of all the associated revisions resulting from the modification of the proposed approach for sediment removal in the South Channel from a dry dredge approach to a wet dredge approach.

ATTACHMENT 5

DREDGING STABILITY ASSESSMENT
AND
HYDRAULIC GRADIENT ASSESSMENT
FOR THE
VERTICAL BARRIER WALL

TYCO FIRE PRODUCTS LP
FORMER ANSUL INCORPORATED FACILITY
MARINETTE, WISCONSIN
EPA ID NO. WID 006125215

Submitted to

Mr. Allen Wojtas
Contract Level Contracting Officer's Representative
U.S. Environmental Protection Agency
Region 5, LP-7J
77 West Jackson Boulevard
Chicago, Illinois 60604

Submitted by:

TechLaw, Inc.
205 West Wacker Drive
Suite 1622
Chicago, Illinois 60606

TechLaw Task Order No.	**R05035**
EPA Task Order No.	**EP-G11S-00012**
Contract No.:	**EP-W-07-074**
EPA TA:	**Gary Cygan**
Telephone No.:	**(312) 886-5902**
TechLaw TOM:	**Brad Martin**
Telephone No.:	**(312) 345-8960**

April, 2012

DREDGING STABILITY ASSESSMENT
AND
HYDRAULIC GRADIENT ASSESSMENT
FOR THE
VERTICAL BARRIER WALL

TYCO FIRE PRODUCTS LP
FORMER ANSUL INCORPORATED FACILITY
MARINETTE, WISCONSIN
EPA ID NO. WID 006125215

Below is TechLaw's Vertical Barrier Wall (VBW) Dredging Stability Assessment and Hydraulic Gradient Assessment (Assessment) for the Tyco Fire Products LP (Former Ansul Incorporated Facility, Marinette, Wisconsin). Dredging next to the VBW is described in the Draft Final Design Report, dated January 2012 (Final Design). The Final Design is intended to reflect the remedial actions required to meet the U.S. Environmental Protection Agency (USEPA)-approved Sediment Removal Work Plan (SRWP).

This Assessment answers specific questions posed by EPA Technical Contact (TC), Mr. Gary Cygan. The Assessment is primarily based on the following Tyco Fire Products LP (Former Ansul Incorporated Facility, Marinette, Wisconsin) documents:

- Pre-Design Remedial Engineering Report, Manufacturing and Wetlands Area, Tyco Safety Products – Ansul, Stanton Street Facility, Marinette, Wisconsin, EPA #WID 006 125 215, dated March 2007, prepared by EarthTech (Pre-Design Report);

- Response to Comments, Environmental Protection Agency Region 5, on the Phase I Corrective Measures Implementation (CMI) Work Plan (Dated December 2007), submitted February 2008, prepared by EarthTech (CMI RTCs);

- Revised (corrected pages) Phase I Corrective Measures Implementation (CMI) Work Plan (originally prepared December 2007), Revised February 2008, prepared by EarthTech; (Phase I CMI);

- Tyco Safety Products, Ansul Phase 1 Vertical Barrier Wall, Remedial Design Drawing Set, Marinette, Wisconsin, Project No. 99045, dated February 29, 2008, prepared by EarthTech (EarthTech Drawings);

- Tyco Safety Products, Ansul Phase 1 Vertical Barrier Wall, As-Built Drawing Set, Marinette, Wisconsin, Project No. 99045, dated January 22, 2010, prepared by AECOM (AECOM Drawings);

- Construction Completion Report Containment Barrier Wall Installation at the Tyco Fire Products LP Facility, dated April 2011, prepared by CH2MHill (CCR);

- Preliminary Basis of Design, Design Plan and Specifications, dated October 2011, prepared by CH2MHill (PBOD);
- Draft Final Design Report, dated January 2012, prepared by CH2MHill (Final Design); and,
- Technical Memorandum, Hydraulic Gradient and Modeling Evaluation, Tyco Fire Product LP Facility, Marinette, Wisconsin, dated February 14, 2012, prepared by CH2MHill (Tech Memo).

DREDGING STABILITY ASESSMENT STEPS

The following are EPA's four items for assessment associated with the proposed actions in the Final Design:

1. ***Assessment of VBW Stability Assumptions:***

   a. *Does Tyco's Final Design assumption that the dredging of the sediments at the VBW's toe would result in wall stability issues have merit?*

   Tyco's design assumption that dredging of sediments along the toe of a VBW could results in wall stability issues is valid. Text provided in the Phase I CMI (which addressed the design of the VBW) in Section 3.2.2 Design Assumptions - Steel Sheet Pile Bulkhead, Last Bullet in this section on Page 3-5, indicates that during future dredging, "The stability of the bulkhead structure depends on embedment into the soils at river bottom. Removing soil and/or sediment in front of the bulkhead will decrease the structure's factor of safety. If necessary, temporary supports or other measures will need to be designed and implemented to ensure that the stability of the wall is not compromised during dredging." This section includes a number of potential mitigating steps for dredging along the VBW, as summarized below:

   i. **Temporary removal of all surcharge loads:** The temporary removal of surcharge loads (originally designed for an allowance of 500 pounds per square foot – see Phase I CMI, Section 3.2.2 Design Assumptions - Steel Sheet Pile Bulkhead, Fifth Bullet in this section, First Bullet on Page 3-5);
   ii. **Temporary excavation behind wall:** Temporary excavation behind wall to reduce soil pressures (the top of wall is elevation 584.4 feet mean sea level (msl), corresponding to the 100-year flood elevation – see Phase I CMI, Section 3.2.2 Design Assumptions - Steel Sheet Pile Bulkhead, First Bullet in this section, on Page 3-4);
   iii. **Temporary pumping:** Temporary pumping to eliminate or reduce differential water pressure but the wall was designed for as much as five feet of differential water pressure to occur, with water behind the bulkhead wall five feet higher than river level (Phase I CMI, Section 3.2.2 Design Assumptions - Steel Sheet Pile Bulkhead, Fourth Bullet in this section, Last Bullet on Page 3-4);

iv. **Installation of anchors:** Installation of additional temporary or permanent anchors; and

v. **Placement of Ballast:** Overcompensation for reduced embedment depths should be based upon the measured and verified field embedment depth. Where necessary, rip rap fill could be placed on the outboard side of the sheet pile bulkhead to provide additional embedment and toe support (Phase I CMI, Section 3.2.2 Design Assumptions - Steel Sheet Pile Bulkhead, Eighth Bullet in this section, Page 3-5).

Based on information provided in the Tech Memo and presented in the March 8, 2012 meeting with EPA and Tyco, increased pumping has already been initiated at the facility and is proposed to continue, to address bedrock groundwater upwelling concerns. This increased pumping should reduce the differential water pressure at the VBW, and should increase the factor of safety for dredging soft sediments and semi-consolidated materials (SCM) along the VBW.

b. If Tyco's Final Design presumption that the dredging of the sediments at the VBW's toe would result in wall stability issues has merit, has Tyco provided sufficient documentation to support this conclusion?

The Final Design does not include supporting rationale for the instability of the VBW. Lines of evidence supported by the Phase I CMI, the AECOM Drawings, and the Final Design for why the proposed measures in the Phase I CMI are no longer warranted should be provided. Further, commissioning of a geotechnical evaluation of the VBW with respect to the proposed dredging depths should be included which also presents and evaluates alternative solutions available to temporarily support the wall during dredging activities consistent with the Phase I CMI.

It should also be noted that in the CMI RTCs, Tyco's response to EPA Comment 3 indicates that, "During the development of the Phase I Corrective Measures Implementation Work Plan, the stability of the steel sheet pile bulkhead wall in the Turning Basin was evaluated for dredging. The results of this analysis indicate adequate stability. The Menominee River Corrective Measures Implementation Work Plan will include results of this preliminary analysis, as well as further analysis and discussion regarding dredging adjacent to the vertical barrier wall." It does not appear that during the 2011-2012 timeframe, this information has been provided as indicated by the CMI RTCs.

The Pre-Design Report presents a qualitative stability assessment in Section 3.1.5, Shore Line Stability. EarthTech states that historically, shorelines along the river front have been stable. This coupled with the shoreline soil profile which shows that no soft, weak cohesive strata exists, supports their assessment that the VBW should not be susceptible to failure.

2. ***Working from Tyco's Upper-End Cost Estimate (UECE) of $6M to properly dredge all sediments greater than 50 ppm along the VBW toe as presented in the Final Design, Section 3.3.2 Bulkhead/Shoreline Stability, Pages 3-8 and 3-9:***

   a. *Evaluate Tyco's statement that 13 feet of sediment at the toe of the VBW is needed to maintain stability.*

   The response to 1.b above identifies many of the issues associated with the 13 foot embedment requirement. The AECOM Drawings, Final Design and CCR Report do not clarify to what the 13 foot requirement equates. The Phase I CMI indicated that it was supposed to be 13 feet into ***dense soils*** [emphasis added]. The Phase I CMI does not clearly identify what media qualify as dense soils. The phrase "dense soil" is not included in the AECOM Drawings or Final Design. Therefore, it is unclear what the exact embedment requirement is. Without additional clarifying information, no further assessment can be made regarding this statement. An underlying concern is the lack of consistency in terms and descriptions of the subsurface profiles layers.

   The CCR prepared by CH2MHill establishes that the installation criteria assessed was whether the sheet pile wall was driven to bedrock or refusal, defined as greater than 10 hammer blows per inch in Section 3.3 of the CCR. Hard driving conditions resulted in the sheet piles "twisting" while being driven, as described in the executive summary to Attachment 4 of the CCR. However, specific achieved embedment lengths were not included in the CCR.

   It should be noted that during assessment of the Final Design in support of the VBW stability assessment, it became apparent the 13 feet of embedment into media other than the soft sediments did not occur at each sheet pile. The Phase I CMI, Section 3.2.2 Design Assumptions - Steel Sheet Pile Bulkhead, Last Bullet in this section, on Page 3-5, states that, "Embedment depths should be measured and verified in the field," and that, "If necessary, rip rap fill could be placed on the outboard side of the sheet pile bulkhead to provide additional embedment and toe support." It is currently unclear if the embedment depth was measured and verified, and what was done with the information when, and if, the embedment into dense soils was determined not to be achieved. No discussion of rip rap fill placement is made in subsequent documents to the Phase I CMI.

   Specific instances of pile issues and an evaluation of the apparent embedment depths depicted in the Final Design are presented below.

   i. **Final Design Drawing 11B:** It would appear that sheet piles B185 to B204 are not affected by the proposed dredging; however, the current presentation makes it somewhat difficult to confirm this. Only piles B211 to B214 are affected (approximately 25 feet), so this run should be able to be dredged.
   ii. **Final Design Drawing 11C:** Some sheet piles (C5, C11, and C16) do not appear to be fully embedded below the dredge line. Sheet piles C3, C8, C37, C38, C46, and C55 appear to be the only piles which achieved the full 13 feet of embedment into

media other than surface sediments. Approximately 275 feet of wall appears to need an alternative dredging technique.

iii. **Final Design Drawing 11D:** Dredging to the SCM line for along "D-run" would not result in less than a 13 foot embedment for any of the "D-run" piles.

iv. **Final Design Drawing 11E:** The level of detail presented for the 8th Street Slip is not adequate to fully assess the dredging impacts. It is unclear how embedment depths were field verified as specified in the Phase I CMI. Dredging from Sta. 6+50 to Sta. 9+00 would appear to not impact the 13 foot embedment based solely on achievement of driving the piles to bedrock, and the SCM dredge limits; however, this may or may not be the case based on the embedment depths for the other runs of the sheet pile wall. It should be noted that this run represents the portion of the VBW where the sheet piles were installed in front of an existing bulk head wall. Approximately 300 feet of wall would need an alternative dredging technique.

v. **Final Design Drawing 11F:** None of the piles shown achieved embedment into more than 13 feet of media below the proposed SCM dredge limits. Piles SP1 to SP11 appear to have achieved an approximate embedment of seven feet. A seven foot embedment coupled with alternative measures could make dredging along this stretch of VBW feasible. It is assumed that the entire 250 foot length of wall would require an alternative dredging technique.

vi. **Final Design Drawing 11G:** Pile E32 appears to have approximately 13 feet of embedment below the proposed SCM dredge limits. As you move along the VBW alignment towards Pile E1, each pile has incrementally less embedment above the proposed SCM dredge limits and Pile E1 appears to have approximately 5 feet of embedment. It is assumed that the entire 150 foot length of wall would require an alternative dredging technique.

vii. **Final Design Drawing 11H:** Dredging to the SCM line for along "F-run" would not result in less than a 13 foot embedment for any of the "F-run" piles.

viii. **Final Design Drawing 11I:** Dredging to the SCM line for along "G-run" would not result in less than a 13 foot embedment for any of the "G-run" piles.

ix. **Final Design Drawing 11J:** Dredging to the SCM line for along "H-run" would not result in less than a 13 foot embedment for any of the "H-run" piles.

x. **Final Design Drawing 11H:** Dredging to the SCM line for along "I-run" would not result in less than a 13 foot embedment for any of the "I-run" piles.

It would appear that only limited portions of the wall have significant stability issues making dredging of the wall more feasible than indicated by the Final Design. Based on this cross-check of embedment lengths of the sheet piles presented in the Final Design, it appears that approximately 55% of the VBW has the stated 13 foot embedment length and could be dredged. It is important to note that TechLaw has not performed a geotechnical evaluation of the proposed dredging at the VBW, and believes this is a necessary step.

b. *Evaluate Tyco's statement that a 1:4 slope is necessary.*

The Phase I CMI indicates in Section 3.2.2 Design Assumptions - Steel Sheet Pile Bulkhead, Third Bullet in this section, Page 3-4, that "the river bottom was estimated to

slope away from the bulkhead at an inclination of about 7°." A 1:4 slope roughly equates to 14°. No justification in the Final Design is provided for the 1:4 slope. Consideration for achievement of removal of the maximum volume of sediments greater than 50 parts per million (ppm) should be a primary consideration for the dredged slope surface. Underwater cap surfaces are typically granular and placed via free-fall. The natural angle of repose for granular soils is 1:4. Although the final surface will need to be configured to a 1:4 slopes, excavation of sediments should not be restricted to this requirement. Leveling of the dredged surface to conform to the natural angle of response of the capping media should be a design consideration not a dredging limitation when it potentially impacts removal of media above the remedial goals.

c. *Identify and evaluate cost reducing options for these actions.*

TechLaw has identified two primary cost-reducing options for performing the dredging at the VBW. These include the following:

i. **Completion of the geotechnical engineering evaluation of the dredging at the VBW.** The cost of the geotechnical evaluation will likely be no more than 1 to 2% of the proposed $6,000,000 cost described by Ansul to shore the existing VBW; however, this evaluation should confirm that certain sections of the VBW do not need additional shoring. In addition, a geotechnical engineering evaluation of the existing VBW could clarify the design required embedment length. As previously noted, several of the exiting piles do not appear to be embedded 13 feet into media other than the soft sediments; however, VBW failure has not been reported by the facility, potentially indicating that the factor of safety and the 13 foot embedment length could be revised.

ii. **Sequencing of dredging/backfilling.** A sequenced dredging/backfilling approach for sections of the VBW where the factor of safety may be reduced to an unacceptable level by removal of the soft sediment and SCM is routinely used in the dredging industry. Again, preparation of a geotechnical engineering evaluation should include development of a formal plan for conducting a sequenced dredge/backfill, to minimize areas where dredging is truly impractical, maximize the extent of VBW that can be safely dredged using traditional and relatively cost-efficient methods, and to create cost-efficiencies by minimizing backfill volumes.

3. ***In the Final Design, Ansul provided cross-sections and cut lines for the entire length of the VBW (11-series Figures) including sheet pile numbers. Identify locations where sediment removal along the toe would not result in stability issues.***

The assessment of individual sheet pile stability and the associated concerns are expressed under assessment step 2.a.

4. ***Identify options for dredging methods or dredging sequence techniques that could be used to remove sediments at the VBW toe without compromising stability.***

a. *Sequence dredging where, for example, 25 linear feet of wall is dredged to cut line,*

bolstering material (e.g., concrete blocks or limestone rubble) is then placed next to recently dredged wall and/or covered by clean river sediment.

Sequenced dredging is a readily implementable and a proven option for removing sediments next to shoreline walls. A typical and recommended approach would be to complete a geotechnical engineering evaluation which should include development of a formal plan for conducting a sequenced dredge/backfill and recommend specific removal spacing and backfilling requirements to maintain an adequate factor of safety for the VBW.

b. *Cite examples of options provided where available*

This type of sequenced dredging has been successfully employed at similar projects, including the Kinnickinnic River Environmental Cleanup Project in Milwaukee, Wisconsin. The Kinnickinnic River project removed approximately 170,000 cubic yards of contaminated sediment including areas adjacent to a sheet pile wall.

c. *Provide order of magnitude cost estimates*

An order of magnitude estimate for the additional costs of sequenced dredging is between 50%-100% greater than traditional dredging due to the additional time required. However, the dredging along the VBW accounts for a small percentage of the total dredging proposed at the facility. In addition, as previously noted these costs could be minimized by completing a geotechnical engineering evaluation of the wall to limit the portion of the wall where sequenced dredging would be required. To develop an order of magnitude cost estimate for the sequenced dredging the following assumptions are made:

i. It is estimated that only 55% of the VBW would need a sequenced dredging approach; and that this would constitute approximately 20,000 cubic yards (CY) of materials.
ii. Dredging costs would be approximately twice the cost presented in the SRWP, or approximately $30/CY more than traditional dredging.
iii. Backfill costs for replacing dredged materials to maintain VBW stability would be approximately $40/CY and that approximately 10,000 cubic yards would be required.
iv. Additional engineering, design, and other miscellaneous construction costs would be minimal and are assumed to be captured in the above costs.

Based on these assumptions, the order of magnitude cost would be $1,000,000. It is important to note that this is not a total cost, but an incremental cost beyond the traditional dredging cost.

It should also be noted that the Tyco estimate of $6,000,000 for shoring the VBW is approximately $3,300/linear foot (lf), assuming the entire approximate 1827 foot length of wall (as shown on Figure 11A of the Final Design) needs shoring. As a comparison:

i. An order of magnitude cost estimate for installing a new sheet pile wall is $5,000/lf.
ii. Also, permanent sheet pill wall costs using RSMeans' 2004 Environmental Remediation Cost Data – Unit Price and updating these costs from 2004 to 2012

using a 2.7% inflation rate, based upon the rates published in Appendix C of Circular A-94 Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs (United States Office of Management and Budget, January 2009); yields a cost of approximately $31/square foot (sf).

HYDRAULIC GRADIENT ASESSMENT STEPS

The February 16, 2012 technical direction email document contained a series of questions TechLaw was asked to evaluate and answer. In reviewing the available documentation, it became readily apparent to TechLaw that the questions could not be answered with any degree of certainty or confidence, primarily due to the lack of site-specific data for many of the questions. This lack of available data prompted the follow-up March 14, 2012 telephone call between TechLaw and EPA, during which time EPA revised the focus of TechLaw's review. Each of the questions contained in the February 16, 2012 technical direction document is addressed to the extent practicable below. TechLaw's revised focused review is presented after the questions.

1. ***Is finding 100 ppm arsenic in the limestone bedrock joint/plane system significant given the requirement of the EPA Final decision that the wall is to "contain on-site groundwater contaminated with arsenic, to the maximum extent practicable"? Relate bedrock arsenic concentrations recently measured to arsenic values (bedrock and unconsolidated) before wall construction.***

   In early 2012, Tyco installed three new bedrock monitoring wells (MW-110D, MW-111D, and MW-112D) on the river side of the sheet-pile containment wall. Arsenic concentrations of 1.46 milligrams per liter (mg/l), 136 mg/l, and 1.9 mg/l were detected in these wells, respectively. While the detection of 136 mg/l in monitoring well MW-111D is significant, the arsenic detections in the other two wells suggest that arsenic contamination in the bedrock aquifer may not be a widespread problem. The 136 mg/l arsenic detection in well MW-110D may reflect a highly-fractured transmissive zone in the bedrock at this specific location. This explanation is further suggested by the presence of arsenic at a concentration of 54.2 mg/l in monitoring well cluster MW-109. It is also possible the elevated arsenic concentration could be the result of contaminant drag-down during the construction of the monitoring well. It should be noted that while the sheet-pile barrier wall may serve to contain arsenic contaminated groundwater onsite within the unconsolidated overburden aquifer, it will not likely do so for the bedrock aquifer since the sheet-pile wall terminates at the top of the bedrock surface. Tech Memo Figure 3 indicates that with the exception of monitoring well MW-111D, the arsenic concentrations in the new bedrock monitoring wells are similar to the concentrations in the existing monitoring wells. For example, the two bedrock arsenic concentrations (1.46 mg/l and 1.9 mg/l) are similar to the arsenic concentrations in monitoring well clusters MW-047 (1.26 mg/l) and MW-108 (1.9 mg/l).

2. ***Relate the 3 well results where arsenic concentrations were found to their locations in the river; assess this relationship.***

A comparison of the proposed dredging footprint in Drawing C-4 of the Final Design, with the arsenic concentrations for the three new bedrock wells shown in Tech Memo Figure 3 reveals that only one new bedrock well (MW-110D) is located within the proposed excavation footprint.

3. ***Estimate arsenic loading to the river by estimating the gradient and flow velocity.***

It is not possible for TechLaw to estimate the arsenic loading potential from the bedrock aquifer to the river by using the bedrock aquifer gradient and flow velocity because no bedrock hydraulic information has been provided by the facility in any of the documents available to TechLaw. It should be noted that the modeling synopsis provided in Tech Memo Attachment C (Simulations of Groundwater Interactions with the River at the Tyco Fire Products LP Facility, Marinette, Wisconsin) does not provide the hydraulic information used in the numerical simulations for the bedrock aquifer. While a rough gradient could be estimated from the existing data, the flow velocity cannot be calculated without knowledge of the bedrock hydraulic conductivity and porosity. Furthermore, any flow calculations derived for the bedrock unit would likely be subject to large errors due to the fact that groundwater flow in the bedrock unit is turbulent, and is not suitable for porous media flow calculations. However, based on conversations with EPA, TechLaw has provided preliminary "back of the envelope" arsenic loading calculations to the river from the soft sediments and bedrock horizons using very simplistic assumptions. These calculations are discussed further below.

4. ***Regarding Ansul's proposed increased pumping program:***

a. *Analyze the extent of bedrock groundwater interaction with groundwater contained with the barrier wall.*

The modeling simulations presented in Attachment C of the Tech Memo suggest that the bedrock groundwater and overlying unconsolidated overburden groundwater are in hydraulic communication, as evidence by the drawdown produced in the simulations. However, the model results are strictly a tool and cannot be used with certainty to predict the response of the bedrock aquifer to overburden pumping. There is also a concern that the lacustrine silts and glacial till units may serve to restrict groundwater flow between these overburden and bedrock units. This is discussed further in the response to item c) below.

b. *Assess the validity of Ansul's Figures 2 and 4 of Attachment C showing cross-section flow contours (beneath) the barrier wall.*

Figures 2 and 4 in Attachment C of the Tech Memo illustrate the flow nets generated by the numerical model under the baseline and steady state scenarios. While these figures are conceptually sound, they cannot be verified because the Tech Memo does not present the hydrologic parameters (e.g., all boundary conditions, hydraulic conductivity zones of each

model layer, recharge, purpose of drain cells, calibration figures and residual statistics, etc.) used in the initial model construction.

c. *Assess potential and required magnitude of increased pumping on-site to "reverse" gradients to minimize or eliminate bedrock groundwater interactions; how long would the reversal take to achieve.*

The modeling simulations presented in Attachment C of the Tech Memo suggest that increased pumping of the unconsolidated overburden groundwater will cause a reduction, and possibly a reversal, of the head values in the bedrock aquifer. However, as was pointed out in comment response 3 above, essentially no hydraulic information regarding the construction of the numerical model was provided either in the text or Attachment C of the Tech Memo. Thus, it is not possible to evaluate with any certainty whether the model solution is unique, and how accurately is will predict the bedrock behavior to pumping stresses. The effect of the overburden pumping on the bedrock aquifer can only be determined by evaluating the actual bedrock head changes due to the pumping activities (i.e., empirical data).

Furthermore, it should be noted that the extraction wells are completed within the alluvial sand and uppermost lacustrine sand/silt/clay units. The cross-sections in Tech Memo Figures 7 and 8 show that approximately 20 feet of lacustrine fine sand/silt/clay and glacial till separate the extraction wells from the bedrock unit. While Tyco does not provide the hydraulic conductivity of these units in the Tech Memo, it is not unreasonable to assume based on the lithologic descriptions that these units are characterized by fairly low hydraulic conductivity values [presumably in the range of 10-4 to 10-5 centimeters/second (cm/sec)]. As a result of this low hydraulic conductivity zone, it is possible that the drawdowns in the bedrock will not be as significant as predicted by the model. TechLaw believes that the only way to significantly impact the hydraulic heads in the bedrock aquifer would be for Tyco to install extraction wells screened within the bedrock zone. As a result, TechLaw does not feel it is appropriate to postpone the dredging activities to determine what effect the pumping operations will have on the bedrock head levels. While we agree that the increased pumping should continue, the soft sediment dredging activities should also continue as planned.

d. *Can this pumping strategy realistically be considered a long-term component of the remediation program when compared against increased costs of pumping and treatment?*

It is doubtful that a long-term pumping strategy would be a realistic component of the remediation program. At the current rates, the facility would have to manage and treat approximately 5.3 million gallons of water per year, which is an excessive cost to incur over a long timeframe.

March 14, 2012 Technical Direction Discussion

During a telephone conference call on March 14, 2012, EPA instructed TechLaw to refocus its review of the Tech Memo with regard to evaluating whether the potential upwelling of bedrock groundwater could have a negative impact on the proposed dredging operations. In

an earlier conference call with EPA on March 8, 2012, Tyco representatives commented that they did not wish to commence the soft sediment dredging operations in the Turning Basin for "fear of re-contaminating the river sediments after the dredging operations were completed." At the request of EPA, TechLaw evaluated this concern in two ways: (1) through a review of the distribution of existing arsenic concentrations in the Turning Basin sediments, and (2) through arsenic loading calculations.

1. Distribution of Existing Arsenic Concentrations

In evaluating the existing arsenic concentrations in the Turning Basin soft sediments, TechLaw examined the arsenic depth profile concentration figures presented as Figures 12 through 15 in the PBOD. Of particular interest is Figure 14, Maximum Arsenic Concentrations in Glacial Till. Figure 14 indicates that the arsenic concentration in the glacial till in the vicinity of new bedrock monitoring well MW-111D (located near sediment sample SD560) is less than 20 ppm. However, the arsenic groundwater concentration in bedrock well MW-111D as shown on Tech Memo Figure 3 was 136 ppm. The presence of arsenic at such high concentrations in the bedrock monitoring well but not in the overlying glacial till would suggest that the arsenic concentration in the well reflects either (1) the presence of soluble arsenic within the bedrock zone, or (2) contaminant drag-down during well construction activities. The presence of arsenic at a concentration of 54.2 ppm in adjacent well cluster MW-10 would suggest that the former explanation is more plausible. More importantly however, is the lack of arsenic in the overlying glacial till sediments which would suggest that upwelling of arsenic from the bedrock zone into the overlying sediments is not occurring as feared at this location. This would seem to suggest that the dredging of the Turning Basin soft sediments would not result in widespread re-contamination of the sediments from the underlying bedrock zone.

2. Arsenic Loading Calculations

As discussed in the response to question 3 above, it is not currently feasible with the available facility documents to quantitatively determine the arsenic loading potential from the bedrock aquifer into the overlying soft sediments. Information missing from this evaluation includes the groundwater flow velocities within the bedrock zone; depth and degree of fracturing; information on the interconnection and aperture diameters of the fractures; bedrock discharge points; etc. However, it is possible to estimate the relative contribution of soluble arsenic from the Turning Basin soft sediments to the overlying Menominee River, and by extrapolation, an overly-conservative estimate of the potential contribution of arsenic from the bedrock aquifer to the overlying surface water. This approach was discussed with EPA in a telephone conference call held on March 14, 2012.

In performing this evaluation, TechLaw gathered basic hydrogeologic information from the facility documents and information supplied by EPA. The vertical gradient was calculated from the information provided in Tech Memo Table 1 for the MW/PZ-112 well/piezometer cluster. Even though the potentiometric value in the deep well was anomalous due to slow recharge, the cluster exhibited a straightforward upward vertical gradient. The vertical gradient calculated from this cluster and used in the flux calculations was 0.02 ft/ft. The

cross-section area used in the flux calculations was determined through a GIS summation of the area shown as Phase I in Drawing C-4 of the Draft Final Design Report, Menominee River Sediment Project. The cross-section area was 312,150 square feet. A hydraulic conductivity value of 1 x 10-4 cm/sec (2.12 gallons per day per square feet) was used to represent soft sediments, fill, overburden and till. While this value may not be truly representative of these sediments, it is reasonable for a qualitative evaluation of the arsenic loading potential. The range of hydraulic conductivity values considered in the evaluation was derived from the RFI Investigation Report and was provided to TechLaw by EPA. These parameters yielded a vertical groundwater flux of 13,235 gallons per day, or 4,830,833 gallons per year.

In calculating the arsenic loading potential from the soft sediments, an arsenic pore water concentration of 2,700 mg/l was utilized. This value was derived from the Interim Measures Investigation Report (dated February 2001) and was provided by EPA. The pore water value used to represent the bedrock aquifer was 10 mg/l. This value was arbitrarily selected by TechLaw by comparing the arsenic concentrations detected in the three new deep monitoring wells. The product of the groundwater flux and pore water concentrations was 1.3 x E13 for the soft sediments, and 4.83 E10 for the bedrock zone. Mass conversion of these products to pounds results in an estimated mass loading rate of 108,550 pounds of arsenic per year from soft sediments, and 400 pounds of arsenic per year from the bedrock zone. It should be noted that the soft sediment loading rate is approximately 270 times the bedrock loading rate, which indicates that the threat of re-contamination of the river sediments from dredging is very small compared to the contaminant load released through the failure to dredge the sediments currently in place. It should also be noted that while the flux rate can be modified (to a greater or smaller rate), the relative loading potential will not change since it is based on the arsenic pore water concentration.