JANUARY – FEBRUARY TECHNICAL REPORT
AMERICAN CYANAMID SUPERFUND SITE

CRISIS, Inc
Ira L. Whitman, P.E., PhD, Technical Advisor
Issued February 29, 2016

On January 25, 2016, Ross Stander, Executive Chairman of CRISIS Inc. and I participated in the bi-monthly telephone conference call with Pfizer, USEPA, NJDEP and Bridgewater Township. We attended in-person at the invitation of Pfizer to take advantage of the visual elements of the presentation and discussion. Pfizer's office is a trailer setup on the AmCyan Superfund site at the upland Area 8 which is the on-site waste disposal landfill portion of the site. Pfizer's offices are being dislodged from this location, as this is where the soon to be built permanent on-site ground water treatment facility with associated offices and meeting spaces will be located.

The presentation at this meeting was oriented to the site-wide remediation, known as Operating Unit 4 (OU 4), specifically 2 modules within the site-wide remediation:

- Module 6 – Impoundments 3, 4, and 5
- Module 11 – Site-wide soils, specifically the assessment of the areas requiring vapor control

It should be noted that the very difficult to treat area of Impoundments 1 & 2 are outside of OU 4. These impoundments, which I reported on largely in 2013 & 2014, are part of OU 8, for which EPA is likely 2 years away from issuing a Record of Decision (ROD). The ROD for OU 4 was issued by EPA in September 2012

The purpose of this Technical Report is to report on recent developments associated with Impoundments 3, 4, and 5, as outlined and presented by Pfizer on January 25.

1.0 BACKGROUND

Impoundments 3, 4, & 5 are located in the northeast portion of the American Cyanamid site, just east of Cuckel's Brook. These impoundments are about 1/3 mile northeast of the Raritan River at its nearest point, putting them outside the area of most significant flood hazard on the property. These 3 impoundments were used by AmCyan primarily for the disposal of process wastes, causing the contents of these impoundments to be labeled by EPA as "Principal Threat Wastes". Principal Threat Wastes are considered to be ***source materials***, defined by EPA as

Materials that include or contain hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or as a source for direct exposure.

In other words, Principal Threat Wastes are those materials that cause public health and environmental hazards through multiple pathways that, if not remediated, may increase and expand the hazards and risks associated with the waste which American Cyanamid originally "disposed of" many years ago. EPA's September 2012 Record of Decision listed the following hazardous substances among the contents of Impoundments 3, 4, & 5:

- Volatile Organic Compounds (VOCs) including benzene, chlorobenzene, toluene and xylene.
- SemiVolatiles (SVOCs) including naphthalene, 2-methylnaphthalene, nitrobenzene, etc.
- Metals including, but not limited to arsenic, cadmium, chromium, copper, lead and mercury.

I devoted a Technical Report in September 2015 to the Ecological Risk Assessment being conducted at Impoundments 13, 17 and 24, located at a different area of the site. In its September 2012 ROD, EPA compared the two groups of impoundments thusly: *In general, the concentrations of VOCs and SVOCs in Impoundments 3, 4, & 5 are significantly higher than in Impoundments 13, 17 & 24.*

In evaluating the possible remedies for Impoundments 3, 4, & 5, EPA stated on page 33 of the ROD "*For impoundment areas meeting the definition of principal threat wastes, in-situ Stabilization/Solidification (S/S) would be employed for the* ***full depth*** *of the impoundment material prior to capping (the actual depth of the treatment will be established and confirmed during the remedial design phase)".*

At this time, 3 ½ years after EPA's Record of Decision, some of the areas included in that decision are indeed in the Remediation Design phase, while others, including Module 6, are still in the process where Pre-Design Investigations are being conducted. In this report, the results of some of those investigations are being presented to the CRISIS audience.

2.0 PRE – DESIGN INVESTIGATIONS

In 2014, Pfizer conducted geophysical investigations in Impoundments 3, 4, & 5 which were necessary to understand the physical characteristics and the extent of the waste material in each of the 3 impoundments. Also in 2014 they completed Hollow Stem Auger borings in the dry areas of the impoundments to be able to assess which areas should be sampled in advance of the waste treatability studies planned for 2015.

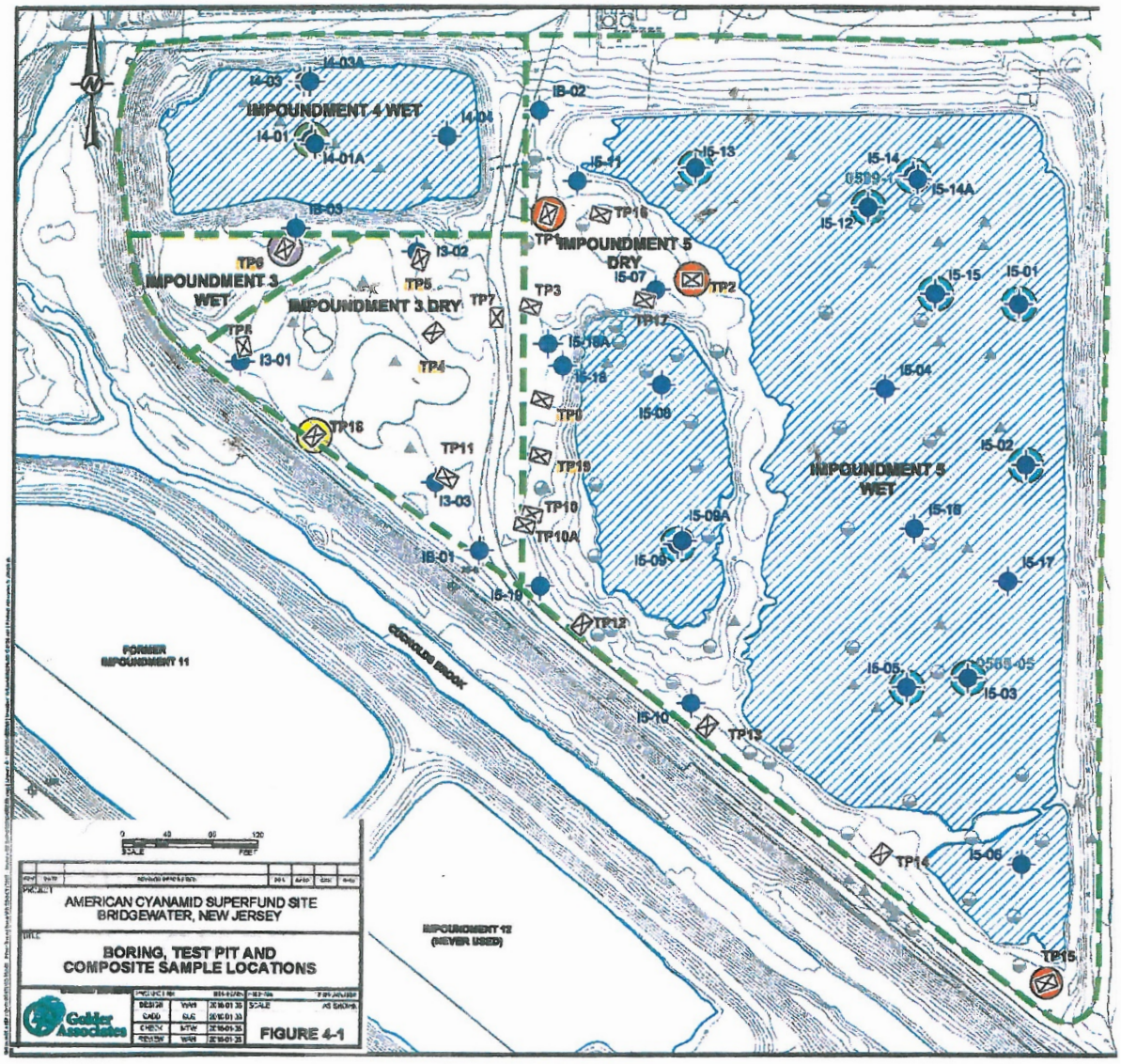
The primary pre-design investigations, planned for 2015, were treatability tests of the contents of the 3 impoundments to assess stabilization/solidification reagent mixtures (chemical additives) which would achieve the following s/s performance goals:

- Compressive strength – 40 pounds per square inch (psi)
- Hydraulic conductivity (permeability – ability of water to penetrate the material) – 1×10^{-6} cm/s (Centimeters per second – rate of water penetration)

- Leachability – 90% reduction in leaching of contaminants from the stabilized waste material

Five samples for each of 4 treatment zones were taken from the impoundments and composited. These samples were then prepared in the laboratory by adding chemical reagents and testing for the above-stated performance goals: compressive strength, hydraulic conductivity and leachability. The tests were completed in 2015 and a Technical Memorandum describing the results was prepared and sent to EPA which the agency reviewed and approved. Approval of the Technical Memorandum allowed Pfizer to subject the samples to leachability tests, and then these results were organized into a Field Sampling and Analysis Report (FSAR) reviewed and also approved by EPA.

The attached figure, taken from the January 25 presentation by Pfizer, is a map of the triangular shaped Impoundment 3, 4, & 5 area, which is approximately 8 acres in size (the scale is probably too small for you to read unless you enlarge the figure). The figure shows all of the locations where test pits were dug and borings were drilled in order to collect a representative number of samples to composite and analyze. The blue cross-hatched areas shown on the map are wet areas of the three impoundments, and the white areas on the map are dry areas which also were used for the disposal of process waste by American Cyanamid. Any reader who would like to receive an 11 x 17 inch enlargement of this map, or would like to discuss how to interpret the map should e-mail me at iwhitman@whitmanco.com.


I4-03A
I4-03
IMPOUNDMENT 4 WET
I4-01
I4-01A
I4-04
IB-02
I5-11
I5-13
I5-14
I5-14A
I5-12
I3-03
TP6
IMPOUNDMENT 3 WET
I3-02
TP5
IMPOUNDMENT 3 DRY
TP7
TP8
I3-01
TP4
TP16
TP11
I3-03
IB-01
I5-19
TP1
TP16
IMPOUNDMENT 5 DRY
I5-07
TP2
TP3
TP17
I5-10A
I5-18
TP9
I5-08
TP19
TP10
TP10A
I5-08A
I5-09
I5-15
I5-01
I5-04
IMPOUNDMENT 5 WET
I5-02
I5-16
I5-17
I5-05
I5-03
TP12
I5-10
TP13
TP14
I5-06
TP15
FORMER IMPOUNDMENT 11
CEDAR BROOK
IMPOUNDMENT 12 (NEVER USED)
0 40 80 120
SCALE FEET
AMERICAN CYANAMID SUPERFUND SITE
BRIDGEWATER, NEW JERSEY
BORING, TEST PIT AND COMPOSITE SAMPLE LOCATIONS
Golder Associates
FIGURE 4-1

Historic reports were used to determine where borings and test pits for sampling should be located. Several geophysical methods, including marine geophysics were helpful in determining the extent of waste and debris. Air monitoring was conducted during test pit excavations to evaluate the emissions from open excavations to provide data for the design of future pilot study and full scale stabilization/solidification activities

3.0 RESULTS OF RECENT TESTING

Pfizer presented EPA with a table showing ten variations of seven different additives to the waste samples, including neutralizing agents (to adjust pH), Portland Cement and other cement materials, and adsorbing agents. The test cases shown result in a compressive strength of the chemically modified waste varying from a minimum of 45 psi to a maximum of 364 psi, with the target strength being 40 psi. Likely Pfizer is showing the most positive results, other combinations of ingredients likely resulted in compressive strengths below 40 psi.

The ten test cases shown all result in a hydraulic conductivity below the target 1×10^{-6} cm/s, a target which results in water penetrating the material at a rate lower than one millionth of a centimeter per second. Some of the results are in the 10^{-8} cm/s range (10 billionth of a centimeter per second).

A second table compares the leachability for 8 key contaminants (including benzene, naphthlene and nitrobenzene) for five of the test cases. With a target of 90% reduction in the rate of leaching of contaminants, the results for these 5 test cases all attained a leachate reduction of 98% or better.

From the results presented, the pre-design investigation conducted on wastes from Impoundments 3, 4, & 5 met all of the criteria for success. Pfizer's summary of the tests stated "*A bench-scale treatability study was carried out to assess the feasibility of the S/S treatment and evaluate several mix designs for their ability to meet the three performance measures for strength, permeability and leachability in accordance with the ROD".*

Stabilization/Solidification technology has been a mainstay of hazardous site remediation under certain conditions, where waste materials are best treated and capped in place. Under the right conditions, it may be among both the most effective AND cost effective alternatives. The success of the tests conducted for Impoundments 3, 4 & 5 are positive developments in the long winding path (in its 4^{th} decade) of the remediation of the AmCyan Superfund site.

A cautionary note must be added to the positive laboratory results attained by Pfizer in its pre-design investigations. It can be quite difficult to replicate favorable results from the laboratory in the field. Conditions vary within the three impoundments being treated, the wastes are not homogeneous, and the physical challenges of mixing chemical additives into over 6 acres of liquid material stored in the three impoundments is not simple to overcome.

The impact of scaling up these treatment methods, first on a pilot treatment scale, then in the full scale at the site may seriously reduce the effectiveness of the proposed treatment so that performance goals, particularly leachability, could be very difficult to meet.

4.0 FUTURE STEPS TO REMEDIATE IMPOUNDMENTS 3, 4, & 5

The completion of the laboratory tests for Impoundments 3, 4, & 5 and the meeting of the specified performance goals puts Pfizer in a good position to move forward with the remediation of this area of concern as per the 2012 Record of Decision.

They are now looking to design and implement a field pilot test to demonstrate that it is feasible to actually add the S/S supplements tested, mix them into the waste material stored in the full impoundments, and attain similar test results.

Once the process is verified in the field and the results authenticated by EPA, we can look forward to Pfizer's undertaking the 100% design phase. Upon approval of the design, the treatment program for Impoundments 3, 4, & 5 will be implemented which, by design, should assure that these wastes will remain stabilized and solidified in place on the AmCyan site. The protections built into the design for these impoundments are calculated to prevent any exposure by the public to these Principal Threat Wastes, either on this property with limited access, through their transport from the property by runoff or flood water, or by vaporizing into the atmosphere where, at sometime, some individuals would be exposed to these vapors.

The experience with Impoundments 3, 4, & 5 also illustrates how long it takes to go from EPA's Record of Decision (2012) even to the point where the Responsible Party, Pfizer, has a good understanding how this area will be cleaned up (2016). While I do not have a complete schedule for the remediation steps yet to come, it is not too difficult to project that the design for remediating these 3 impoundments will be complete and approved by EPA in 2018, and constructed and implemented by 2021, nine full years from the September 2012 Record of Decision. Other areas of concern on the AmCyan property are on an even slower pace for completion.

CRISIS will continue to monitor progress in this remediation, and will speak out when it appears that selected elements of the remediation do not appear to be in the best interest of the public we serve. We will question Pfizer's ability to turn their laboratory results into real protections at the site given the seriously hazardous waste materials distributed over 8 acres at Impoundments 3, 4, and 5. And while we express our appreciation for the sound technical work being done by Pfizer, we will continue to express our frustration with the slow overall pace of progress in getting it done.

Ira L. Whitman, P.E., PhD
iwhitman@whitmanco.com
Technical Advisor to CRISIS, Inc
March 4, 2016