TECHNICAL BRIEFING – LAKES FEASIBILITY STUDY PICAs 015, 057, AND 164 – JUNE 2014

The document reviewed was a feasibility study (FS) for Lake Denmark (Site 54/PICA 015), Picatinny Lake (Site 53/PICA 057), and the Explosive Ordnance Pond (EOD Pond – PICA 164). Two previous documents had been submitted to regulators – an FS and a focused FS. The most recent was a Focused FS that was submitted in April 2012. An earlier track-changed version of an FS was approved by the U.S. Environmental Protection Agency (USEPA) in November 2010. The April 2012 FS version was necessary to account for several developments as follows: (1) additional sampling results from 2011; (2) a revised risk assessment (based on additional surface water and sediment data requested by the NJDEP); (3) the inclusion of fishing restrictions as part of land use controls (LUCs); and (4) the deletion of the sediment removal alternative for Picatinny Lake since the area was deemed to have acceptable risk by the Army. In the current FS only sections of the report that addressed Picatinny Lake were changed from the approved 2012 FS.

The current document reviewed was a result of discussions between the Army and regulators which resulted in some changes to the document including the addition of a third remedial alternative involving "dig and haul" of contaminated sediments. In addition the current FS includes a fifth hot spot and refers to a "Benthic Macroinvertebrate and Sediment Sampling Data Summary Report" that was previously submitted to regulators via e-mail in January 2013. The document includes the use of sediment cleanup criteria that were included in the Green Pond Brook/Bear Swamp Brook Record of Decision (ROD) and previously used TNT criteria. Finally the newest document contains the results of additional sampling conducted at Sites 63/65, 82, 108, and 113.

The Army expects that additional changes to the FS will be forthcoming from the next PBC contractor. The current PBC contractor (ARCADIS) will complete their contract in December 2014. Ted Gabel notes to the USEPA in the cover letter that the next FS will include " changes based on your comments as well as comments developed by the Army." The cover letter accompanying the FS includes Army comments as follows:

- In regard to Alternative 2 – Land Use Controls (LUCs) or Institutional Controls (ICs), any language regarding limiting exposure is deemed inappropriate and will be removed. The letter notes that "critters" do not pay attention to such boundaries.

- Comments from the Environmental Health Risk Assessment Program of the Army Institute of Public Health will be addressed including their main comment regarding the need to further address contamination that they believe is not justified.
- Update reference to fish consumption as Picatinny regulations have changed.
- The reference to the need for permits will be changed; no permits are required for a CERCLA action – only to meet substantive requirements.
- References to the Department of Engineering and Housing will be changed as that group is no longer around.
- Mr. Gabel also noted his opposition to proposing a "dig and haul" alternative.

The purpose of the FS was to determine the appropriate remedy for the lake sites. Surface water, sediment, and soil contamination were addressed for Lake Denmark whereas only surface water and sediment were addressed for Picatinny Lake and the EOD Pond. Soil for these areas is being considering separately as part of other individual sites located in those areas. The basis for the FS was numerous environmental investigations completed in each of the areas and a Human Health Risk Assessment (HHRA) and Screening-Level Ecological Risk Assessment (SLERA). In addition another site-wide study was completed in 2004 to examine the potential risks and hazards associated with fish consumption from Picatinny water bodies. Fish were collected from individual water bodies but risk assessments were performed for groups of water bodies with related characteristics. Lake Denmark, Green Pond Brook, and Picatinny Lake were considered as a single group.

For soil the New Jersey Department of Environmental Protection (NJDEP) Non-Residential Soil Remediation Standard (NRSR) was used as the level of concern (LOC). If no state criterion was available the USEPA Industrial Regional Screening Levels (IRSLs) were used as the basis for comparison. For sediment, the LOC was the lower of the Interim Sediment Quality Guidelines, New York Sediment Criteria, or the Sediment Quality Benchmark. In the absence of that criterion then NJDEP Effects Range-Low (ER-L) values were used and if none of those values were available, then the lower of the IRSL and the NRSR were used. For surface water the New Jersey Surface Water Quality Criteria were used. In the absence of those values the USEPA Tap Water Regional Screening Level (RSL) values were used. If the

Picatinny background value was higher than the selected guidance criterion, the background value was used.

HHRA

The recreational visitor was considered for all water bodies. Only a hypothetical resident was considered for Lake Denmark where soil was part of the environmental media in the FS. Soil for Picatinny Lake and the EOD Pond was considered as part of other sites surrounding the water bodies. For all water bodies the current/future on-site youth visitor (i.e., recreational) and current/future industrial/research worker were evaluated.

SLERA

As part of the SLERA ecological risks were evaluated by comparing detected concentrations in environmental media at a given site to applicable screening levels. Aquatic biota, benthic biota, and semi-aquatic wildlife (Great Blue heron, mink, and Indiana bat) were considered. In some cases where detected concentrations far exceed screening levels there is justification that "effects only occur at much higher concentrations." The utility of the SLERA is questionable given that any potential for adverse effects appears to be discounted. As a further example, the population of warm water fish in Lake Denmark is observed to be poor. This is potentially attributed to competition with other species or significant vegetation providing cover to forage fish.

Lake Denmark

Lake Denmark is a man-made lake that was created by damming a marsh in the early 1900s. The lake is approximately 174 acres in extent. A fill/excavation area was in use near the lake between approximately 1951 and 1987. Storage magazines were located at the southern end of the lake for more than 70 years. A 20 mm rifle testing range was located across the lake with the impact area approximately 5,300 feet away across the lake. The 1926 explosion was responsible for scattering unexploded ordnance (UXO) in the lake and around the surrounding area. Furthermore the lake had historically been used as an impact area for experimental mortar rounds and other explosive or pyrotechnic munitions. Like the other lakes that are the focus of the FS, Lake Denmark is managed as a

“recreational resource” with fishing from shore, by boat, or on the ice but swimming, wading, or sail boarding is not permitted.

Lake Denmark is the only one of the three water bodies in which soil was also considered as part of the FS. As such the consideration of future land-use scenarios includes both military/industrial, residential, and recreational. Other risk assessments did not focus on the residential scenario since only the water body was included. No constituents at concentrations greater than LOCs were detected in surface soil. Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, and pesticides were deteted at concentrations over the respective LOC in sediment whereas only metals and pesticides were detected above the LOC in surface water. A munitions and explosives of concern (MEC) survey was completed and the potential MEC identified as a result of that survey will be dealt with under the Military Munitions Response Program (MMRP) initiative.

As part of the HHRA, scenarios were considered for the following exposures: current and future industrial/research worker, current and future on-site youth visitor (recreational), current and future adult resident, and current and future child resident. Calculated risk values were all within the 10^{-6} to 10^{-4} range for carcinogens and for non-carcinogens the hazard index (HI) was less than 1. Lake Denmark is proposed for NFA on this basis. As discussed below for Lake Denmark, LUCs are required for all water bodies for ingestion of fish.

Despite Lake Denmark fish tissue concentrations being the lowest of all the water bodies considered, there were some hazard indices greater than 1 for non-carcinogens. For current use receptors this was due to mercury presence with some contribution from PCBs in yellow perch. The FS does note that mercury seems to be a ubiquitous compound in the environment in New Jersey and that its widespread occurrence is the reason for a statewide ban on consumption of certain types of fish. For the hypothetical future resident PCBs in large mouth bass and yellow perch contribute to the hazard index exceeding 1.

Picatinny Lake

The lake is surrounded by active, inactive, and demolished buildings. Buildings are or were in use for research and development, production, and storage. In addition there were chemical labs, steam and electric generation in one building, and a beta-tron and x-ray lab situation in another building. The water in the lake was historically used for drinking. In addition the water was used for industrial and fire fighting purposes and non-contract cooling water. All industrial discharges that had gone into the lake now got to a sanitary sewer. In the past the permitted discharges were for wastewater from cleanup of explosives (1985 to 1988), stormwater, cooling water, and unspecified discharges from two buildings. Other non-permitted discharges were debris from the 1926 explosion, solid waste, photo processing chemicals, a 1981 fuel spill, sump discharges, untreated explosive wash down, other washdown, and backup from a sewer manhole. The lake may have been used as an impact area, for underwater storage, and for disposal. Furthermore an island in the lake, Flare Island, was used for pyrotechnic testing. As a result burned material may have been deposited in the lake by the wind and there is the potential for MEC.

Compounds exceeding the LOCs in previous investigations were detected in sediment samples as follows: VOCs, SVOCs, pesticides, PCBs, and metals. One VOC, attributed to laboratory contamination, exceeded the LOCs in surface water samples as did another SVOC, also a common laboratory contaminant, in surface water. A pesticide, explosives, metals, and cyanide exceeded the LOCs in surface water samples. Despite these detections the earlier FS had noted that "the overall water quality of Picatinny Lake is good."

The most recent sampling was focused primarily on Picatinny Lake. Sediment samples were collected for analysis of metals and polycyclic aromatic hydrocarbons (PAHs). Metals analysis was for total metals and for acid volatile sulfate (AVS)/simultaneously extracted metals (SEM). Numerous samples show exceedances of LOCs for PAHs and metals. Exceedances of metals COPCs (arsenic, copper, lead, mercury, and silver) were detected in many samples with maximum exceedances occurring at between about 34 times (arsenic) and almost 1000 times (mercury) the LOC. The FS states that results are similar to those in past sampling events.

For the most recent sampling total organic carbon (TOC) and AVS/SEM data were used to evaluate bioavailability of the metals in the sediments. The sediment sampling data report states that "toxicity to benthic invertebrates is not anticipated if the result [difference between the sum of AVS and SEM normalized to TOC] is less than 130 micromoles per gram organic carbon (umol/g_{oc}), is anticipated if the result is greater than 3,000 umol/g_{oc}, and is uncertain if the result is between 130 and 3,000 umol/g_{oc}." Results are depicted on a figure. The sediment sampling data report cites three locations with results between 130 and 3,000 umol/g_{oc}; the remaining 24 samples have results below 130 umol/g_{oc}. Despite the results the sediment report states that "given the presence of elevated concentrations at discrete locations and the presence of some constituents in fish tissue, the need for limited sediment removal to address potential concerns will be considered."

A magnetic survey identified several small anomalies that could be MEC. Several linear magnetic anomalies were also detected and could be pipelines. These anomalies were investigated as part of the MMRP RI.

The original risk assessment looked at surface water as a whole but sediment and some surface water scenarios were evaluated on a site by site basis. The supplemental risk evaluation was designed to look at exposures to the lake as a whole which could be considered more representative. The supplemental evaluation was for an on-site youth visitor. Only sediment results from within 100 feet of the shoreline were utilized rather than deeper sediments which said visitor would not likely encounter. Calculated risks were within the acceptable range and the HI was less than one. Based on the "detected concentrations of analytes in the 2013 sediment samples" being "comparable to the levels included in the HHRA [2005] evaluation" the report states that conclusions of the 2005 HHRA do not change.

Ecological risks to aquatic biota, benthic biota, and semi-aquatic wildlife were evaluated by comparing detected constituent concentrations in environmental media to screening levels. Aquatic biota were determined to have no "widespread or substantial risks", this despite the detection of barium and boron exceeding screening values toxicity reference values (TRV) by more than a factor of ten. The FS states that TRVs are considered to conservative screening values at which effects could occur but are unlikely to. Organic and inorganic constituents were found to pose a risk to benthic invertebrates in isolated

areas but not to the "community overall." The report states that "based on the weight of evidence constituents in sediment do not appear to pose widespread risks to the Picatinny Lake benthic invertebrate community." A food chain analysis was performed to examine risks to semi-aquatic wildlife. Fish tissue was analyzed for a number of compounds including SVOCs, pesticides, PCBs, explosives, and metals. Pesticides, metals, and one PCB were detected. The fish tissue concentrations were used to estimate exposure concentrations that were then compared to TRVs for dietary exposure.

EOD Pond

The EOD Pond is approximately 9 acres in extent. The pond was constructed between 1945 and 1953 in what had been a marsh area. Currently the pond is inactive. In the past pesticides, flammable materials, and PCBs were stored in nearby buildings. Ordnance from the 1926 explosion may have been dumped in the pond. As with Lake Denmark and Picatinny Lake the pond is considered a recreational resource. Fishing is allowed from the shore, boats, or the ice in winter. Only non-motor boats are permitted and as with the two other water bodies discussed herein, swimming (and wading) is not permitted.

Pesticides, metals, and PCBs were detected at concentrations above LOCs in sediment samples. A single surface-water sample was found with LOC exceedances for metals. The sample was in the outfall north of the pond. Based on this single exceedance (outside the water body) the report concludes that " no constituents are detected in surface water from the EOD Pond in concentrations greater than the LOCs. The overall water quality of the EOD Pond is good."

Several anomalies were identified from a geophysical survey. No unacceptable risks were identified for the current/future on-site youth visitor for exposure to sediment or surface water (both cases for which arsenic was the risk driver). A lead blood model was done as part of the 2005 RI. Lead was not a COPC in surface water. For lead in sediment there was no concern for either the current on-site youth visitor or the current adult resident.

Several pesticides, PCBs, and some metals were identified as chemicals of potential ecological concern (COPECs) in sediment. The highest concentrations were found at the inlet and the outlet of the pond.

The conclusion of a benthic community assessment was that there did not appear to be any significant risk.

Remedial Action Objectives (RAOs)

Based on the HHRA constituents found in soil, sediment, and surface water were not deemed to pose an unacceptable risk or hazard to human health under the current and planned future land-use scenarios. However, elevated contaminant concentrations in fish tissue were deemed to pose a potential health risk for ingestion. As part of this phase of the FS several steps are completed as follows:

- Identify ARARs.
- Formulate RAOs.
- Identify chemicals of concern.
- Identify cleanup goals.
- Delineate the area of attainment.

The stated RAO had been to "control consumption of fish with concentrations of chemicals driving unacceptable risk or hazard." The chemicals of concern (COC) are those that accumulate at unacceptable concentrations in edible fish and those are mercury and PCBs. However, in this iteration of the FS the RAOs changed and apply only to Picatinny Lake.

The RAOs for Picatinny Lake, the only lake in the FS not proposed for No Further Action, are as follows:

- Address copper, lead, mercury, and silver in sediment at Sites 63/65, 82, 108, and 113 in excess of cleanup goals established under the Green Pond Brook/Bear Swamp Brook Record of Decision (ROD); and
- Adress RDX and 2,4,6-TNT in sediment at Site 157 in excess of cleanup goals, which have been established by NJDEP for Picatinny Arsenal.

Process of Identifying and Selecting Alternatives

Once the RAOs have been formulated and the attainment areas identified, the final steps in the FS are as follows:

- Identify response actions
- Perform initial screening: effectiveness, implementability, and cost

- Perform technology screening
- Develop response action alternatives
- Detailed evaluation of response actions
- Individual analysis of alternatives
- Comparative analysis of alternatives

During the detailed evaluation of response actions the remedial action is evaluated against nine criteria as follows:

1. Protectiveness of human health and environment
2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
3. Long-term effectiveness an permanence
4. Reduction of toxicity, mobility, or volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost
8. State acceptance
9. Community acceptance.

The first two criteria are the threshold criteria and "the preferred remedial alternative will be the one that satisfies the first two criteria and achieves the best combination of the remaining seven criteria." The second five criteria are considered balancing criteria and the last two are modifying criteria that do not enter consideration until the final stages of remedy selection.

Three alternatives were considered as follows: Alternative 1 – No Action, Alternative 2 – Land Use Controls (LUCs), and Alternative 3 – Sediment Removal and Off-Site Disposal. No Action was retained as a baseline for comparison to the other alternatives even though it is not a viable alternative; as the report notes "despite acceptable lakewide risks/HI [hazard indices], NJDEP and USEPA have concerns at the concentrations of some constituents in Picatinny Lake sediment near sites 65/35, 82, 108, 113, and 157." The No Action alternative is self-explanatory. Alternative 2 involves the establishment of engineering controls including signs in addition to existing site controls (perimeter fence); signs would warn of the site use restrictions at the major access points. Annual inspections would be performed to

verify condition of all LUCs and confirm that land use has not changed. For Alternative 3 sediment of concern at Sites 63/65, 82, 108, 113, and 157 (all part of Picatinny Lake) will be removed. After the removal action Picatinny Lake would be released for unrestricted use.

Costs for the three alternatives are as follows:

- Alternative 1 – No action $ 0
- Alternative 2 - LUCs $ 188,000
- Alternative 3 - Sediment Removal and Off-Site Disposal $4,750,000

Alternatives were ranked for comparison by ratings of poor, acceptable, good, or excellent for each of the evaluation criteria. An overall score was determined for each alternative. Alternatives 1 and 2 were rated adequate overall and Alternative 3 was ranked good overall.

As with other fairly recent FS documents the Army has not cited a preferred remedial alternative and seeks regulatory input along with comments from the public.