5 FATE AND TRANSPORT

This section discusses the potential routes of migration and a summary of the overall understanding of site media.

5.1 Baseline Risk Assessment

Exponent prepared a baseline risk assessment (BLRA) using the 2008 RI data. Previously collected data was not used to support this assessment. The BLRA is included in Appendix D.

Potential risks were evaluated for the following media:

- Sediment;
- Surface water; and
- Boat Island soil.

The BLRA was prepared in accordance with the Multi-Site Risk Assessment Framework (RAF) (Exponent, September 2007), the USEPA-suggested revised sediment hierarchy (provided in USEPA's RAF comments dated December 20, 2007) and Appendix D-1 of the RI/FS Work Plan (NRT, December 2008). The BLRA focused on the media and receptors of concern identified in the RI/FS Work Plan (NRT, December 2008) which are also discussed in Appendix D. The BLRA evaluated the current and reasonably foreseeable future conditions for the River OU that may result in human health and ecological exposures to MGP-affected sediment. Hypothetical conditions considered include: flood scour events, recreational boat propeller wash, and seasonal installation and removal of boat docks. As noted in Sections 2.4 and 4.2, the sediment is relatively stable and the area is net depositional. Remedial actions associated with the Sheboygan River and Harbor Superfund Site is also considered as a future event across the Campmarina River OU, which may remove 2 feet or more of sediment containing elevated concentrations of PCBs followed by backfilling.

Screening levels, based on USEPA guidance documents, were used to preliminarily identify media that presented a potential unacceptable risk to human health and/or ecological receptors present, and identify media which required additional consideration in the BLRA.

5.2 Refined CSM

The refined CSM was developed using the 2008 sediment, surface water, and Boat Island soil data and the observations from the August 2008 site reconnaissance. As described in the Multi-Site CSM (September 2007), the CSM is refined as data are generated. The post-RI or refined CSM is included in the BLRA, Appendix D.

As described in the BLRA, the residential (i.e., unrestricted and unlimited access scenario) and outdoor worker scenarios were used as screening levels for Boat Island soil. The residential scenario was also used to assess human health exposure to sediment as a conservative estimate of exposure under recreational exposure scenarios because recreational use screening values for sediment do not exist. Similarly, surface water was screened using a drinking water standard.

5.3 Media of Concern

This section incorporates the previously collected data and the 2008 RI data to assess the media that required further assessment with respect to public health, welfare or the environment (described in the RI/FS Work Plan (NRT, December 2008) and Technical Letter Report (NRT, March 2007). Results of the BLRA results are highlighted within the discussion.

5.3.1 Sheboygan River Sediment

Soft/loose sediment deposits within the Sheboygan River consist of layered fine-grained and coarse-grained materials, up to 89 inches thick, with significant amounts of total organic carbon that will sequester PAHs, making them less bioavailable to benthic organisms. The River OU is located in a generally depositional area based on velocity estimates, bathymetry, field observations, and work performed in conjunction with the SR&H. Underlying the soft/loose sediment are parent materials generally comprised of clay and silt with varying amounts of sand and gravel, under which is a continuous layer of clay interpreted as a glacial diamicton.

MGP-residuals (as visually noted by stained to oil-wetted sediments) were observed along the eastern shoreline of the Sheboygan River immediately adjacent to the Upland OU (Sheet 1), and limited extent of the western shoreline, often in layered intervals (i.e., non-continuous in a boring). Oil-wetted sediment was confined to two areas within the Sheboygan River: the eastern shoreline adjacent to the former MGP,

and in two isolated non-contiguous spots near the middle of the river just downstream of the Pennsylvania Avenue Bridge.

The analytical data indicates the highest concentrations of PAHs are overlain with cleaner sediment deposits, suggesting a depositional environment, and that the MGP-residuals are relatively immobile and stable. Under hypothetical future conditions, there is potential for subsurface sediment to be exposed during flood scour events, recreational boat propeller wash, and seasonal installation and removal of boat docks; this exposure is expected to be limited to the top 1-2 feet of existing sediment. The area of affected sediment is generally consistent with the sediment investigation performed in 1995/1996 (Appendix A-2) with the exception of stained sediment downstream of Boat Island in the center of the river and the western shore, both of these areas were not investigated as part of the 1995/1996 work. In addition, the 2008 recorded thickness of soft/loose sediment is generally consistent with the 1995/1996 data. Although the 1995/1996 work did not maintain strict vertical control, the comparison of relative soft/loose sediment thickness and the community input regarding shoaled-in channels further suggest this is a depositional area and sediment is relatively immobile and stable.

Based on the ambient PAH concentration used to make field decisions, the extent of affected sediments has been adequately determined. The BLRA (Appendix D) refines this area into zones of potential exposure for use in evaluating remedial alternatives in the FS.

The BLRA evaluated Sheboygan River sediments for recreational human health users and benthic invertebrates. Figure 9 in the BLRA (Appendix D) provides the zones of exposure based on benthic invertebrates exposed to PAH concentrations in the surface (0 to 6 inch interval), Figure 10 provides the zones of exposure based on the near subsurface sediment (6 to 30 inches below top of mudline), and Figure 11 provides the zones of exposure based on hypothetical removal of the top 2.5 feet of sediment. Related risk assessment results include:

- There is no current risk to human health receptors, based on the lower concentrations of MGP-residuals in the surface sediment and the recreational use. Additionally, there is no anticipated risk to human receptors based on potential future exposure to near-surface sediments.
    - For the current conditions, using sediment samples at 0–6 in., the cancer risk estimate summed across all pathways is 8×10^{-6}, and the noncancer hazard index is 0.003.

- For hypothetical future conditions, using sediment samples at 6–30 in., the cancer risk estimate summed across all pathways is 2×10^{-5} and the noncancer hazard index is 0.01.

- As part of an uncertainty analysis, calculations were also performed incorporating a mutagenic mode of action age-dependent adjustment factor. These calculations yielded cancer risk estimates of 8×10^{-6} (for surface sediments, current conditions) and 8×10^{-5} (for near-surface sediments, future conditions).

- Thus, cancer risk estimates under the current and hypothetical future scenarios are within the risk range of 1×10^{-6} to 1×10^{-4}, the range in which further evaluation is generally not warranted and noncancer hazard indices are well below the level at which further evaluation is warranted.

- The current surficial sediment presents little risk to the benthic invertebrates and is consistent with the ambient conditions (based on concentration and biological responses).

- Near subsurface sediment, if exposed in the future, presents potential risk to benthic invertebrates as compared to ambient conditions, generally associated with the eastern shore of the Sheboygan River and downstream of the Pennsylvania Avenue Bridge.

5.3.2 Surface Water

Surface water adjacent to the former MGP within the Sheboygan River had not been previously assessed. Analytical results in the river are generally low to non-detect (Tables 17 through 19). Related risk assessment results include:

- Sheens have been observed on the surface water adjacent to the eastern shore of the river. This near shore area with borings where sediment was oil-coated or oil-wetted will be addressed as part of the sediment remedy.

- The baseline human health risk assessment indicates the concentrations from the surface water in the river do not pose a health concern.

- The baseline ecological risk assessment indicates the concentrations from the surface water are below conservative drinking water standards and in the river do not pose a risk.

5.3.3 Boat Island Soil

Surface soil collected on Boat Island had not been previously assessed. Analytical results indicate generally low to non-detect concentrations with the exception of benzo(a)pyrene (Tables 13 through 15). Related risk assessment results include:

- The baseline human health risk assessment indicates the concentrations from the surface soil do not pose a health concern. A semi-quantitative evaluation indicated that under a recreational scenario, surface soil concentrations measured at this site are not likely to be associated with calculated cancer risks that exceed the 10^{-6} range.

- The ecological risk was not assessed due to the lack of ecological habitat on Boat Island.