

**APPENDIX C – DETAILED DISCUSSION OF SITE SAMPLING INVESTIGATIONS AND ENVIRONMENTAL CONTAMINATION DATA**

## APPENDIX C

### DETAILED DISCUSSION OF SITE SAMPLING INVESTIGATIONS AND ENVIRONMENTAL CONTAMINATION DATA

This appendix contains detailed information on the sampling studies, environmental contaminant data, and data trends that ATSDR evaluated for the public health assessment. The information presented here supplements that discussed in the Environmental Contamination and Other Hazards section of the public health assessment.

#### C.1. On-Site Contamination

##### C.1.1. Soil

Surface and subsurface soil data were collected at and near the Stauffer Chemical Company (SCC) site during a number of site investigations including

- *Expanded site investigation (ESI) (1988)*: to collect soil and water samples from on- and off-site locations to support EPA's completion of hazard ranking system (HRS) documentation (NUS 1989).
- *Listing site inspection (1989)*: to augment existing data to provide the necessary data for a scoring of the site using the revised HRS (NUS 1991).
- *Site soil characterization study (1990)*: to conduct extensive characterization of site soils, including radiologic evaluations (PBS&J 1990; Weston 1990a, 1990b).
- *Environmental sampling program (1990)*: follow-up sampling activities to sampling reported by Weston (1990a, 1990b) to further characterize soils for radium-226 and various organic and inorganic constituents (Weston 1990c).
- *Elemental phosphorus borings program (1991)*: to identify phosphorus associated with buried wastes (Weston 1991).
- *RI (1993)*: to confirm the results of past investigations and address identified data gaps to more completely delineate the nature and extent of site contamination (Weston 1993).
- *Gulfside Elementary School environmental monitoring program (1996–1997)*: to evaluate conditions of the surface soils at Gulfside Elementary School, which is directly north of the SCC site (Weston 1996; EE&G 1997a, 1997b).
- *Soil/slag leachability study (1997)*: to determine the extent of contaminant leaching from soil and slag in the slag processing area (Parsons 1997).

- *Radiologic incident reports (1997–1998)*: set of 28 radiologic incident final reports summarizing findings of “slag” radiation concentrations in several area homes, schools, and businesses (FDOH 2002).
- *Sitewide asbestos sampling (1998)*: as a follow up to the sampling conducted as part of the Parsons 1997 study. A comprehensive survey of the site soils for the presence of asbestos (Parsons 1998).
- *Slag sampling (1998)* to identify radiologic and nonradiologic contaminants in specified households, schools, driveways, yards, and area roadways (EPA 1999a).
- *Background levels of arsenic and beryllium (1999)*: to sample soils from undisturbed on-site areas to better characterize on-site background arsenic and beryllium levels (Parsons 1999).

Six categories of “soils” were sampled during one or more of these investigations:

- surface and subsurface soils from the former ponds and an on-site drainage ditch,
- on-site slag material (e.g., surface soils from the slag pits and storage area, as well as roadway materials),
- surface and subsurface soils from other areas of the site,
- on-site asbestos sampling of surface and subsurface soils,
- off-site soils (including data from the Gulfside Elementary School), and
- off-site building materials containing slag.

#### **C.1.1.1. Former Pond Soils and Dredged Soils**

The following soil sampling programs were conducted as part of site investigations and include analyses of soils or dredge material taken from the former ponds. Not all of the samples obtained for each study were analyzed for the same contaminants.

Because several sampling events were conducted by different investigators, the designation of the sampling locations has changed over the years. Table 2 in Appendix B describes the pond designations used in the various studies. Both Table 1 and Figure 4 (in Appendix B) use the pond designations from the *Site Soil Characterization Study* (PBS&J 1990, Weston 1990a, 1990b).

- In January 1988, NUS Corporation collected eight samples from former ponds and dredge piles as part of an ESI. These eight samples were as follows: two composited surface soil samples from two former ponds; two subsurface samples (from the “saturated zone”) from two ponds; one composited surface soil sample from one dredge pile; and three samples from a second dredge pile, each taken at a different subsurface depth (4, 10, and 15 feet). Three samples were also obtained from a drainage ditch running along the northwest border of the site down into Meyers Cove. Samples were analyzed for EPA Contract Laboratory Program (CLP) organics and inorganics (NUS 1989).
- In April 1989, NUS Corporation collected additional surface and subsurface soil samples from six of the ponds, as well as from the two piles of dredged pond material. Three

samples were taken from each pond/pile. Samples were analyzed for target analyte list (TAL) inorganics (NUS 1991).

- In November 1989, Post, Buckley, Schuh, Jernigan, Inc. (PBS&J) conducted a radiologic evaluation of the site. PBS&J performed an EGR survey of several areas of the site, including the former settling ponds in the southeast property and the dredged material piles. The surface and subsurface pond and dredged material soils were also analyzed for the presence of radium-226 (PBS&J 1990). This study is documented as part of the *Site Soil Characterization Study* (Weston 1990b).
- Between December 1989 and April 1990, Weston was contracted to perform soil sampling activities at the site. Composite depth samples were collected from 16 of the ponds and analyzed for arsenic, cadmium, chromium, lead, cyanide, fluoride, chloride, total phosphorus, and radium-226. Six of these ponds were also analyzed by the environmental pollutants (EP) toxicity and toxicity characteristic leaching procedure (TCLP) tests for the RCRA metals. Soils from four of these ponds were analyzed for radium-226 at the surface, midpoint, and bottom of their respective borings. Each of the 17 former pond areas were examined to determine the presence of elemental phosphorus (Weston 1990a). This study is documented as part of the *Site Soil Characterization Study* (Weston 1990b).
- In September 1990, Weston performed additional sampling of the surface soils from two of the ponds. These samples were analyzed for hazardous substance list (HSL) organics and inorganics (Weston 1990c).
- In June 1991, Weston performed additional borings in and around the areas of the former ponds to determine the presence of elemental phosphorus (Weston 1991).
- In March 1993, Weston analyzed four surface soil samples taken from three ponds, as well as one surface soil sample taken from a previous location of dredged pond material on the southeast property. This sampling was performed as part of the RI. The samples were analyzed for TAL metals, cyanide, fluoride, phosphorus, and total compound list (TCL) VOCs, SVOCs, pesticides and PCBs (Weston 1993).

Table 2 in Appendix B summarizes the findings of these pond and dredged material soil studies. The pond data summarized here include both surface soil and subsurface soil samples.

Highlights of the Table 2 data summary are presented here, including observed trends and details of sample locations:

- Five VOCs were detected in at least one of the eight samples. All detected VOCs were well below the ATSDR CVs. Acetone and methylene chloride were detected in more than half of the samples. The remaining VOCs were each detected in only one or two samples.

- Thirteen SVOCs were detected in at least one sample of the eight that were analyzed. Benzo[a]pyrene was detected slightly above the CV (0.1 ppm) in three samples with concentrations between 0.11 and 0.15 ppm. These samples were surface soils taken from ponds 49a, 49c, and 49D. Surface soil collected from pond 48 in March 1993 contained concentrations of three SVOCs at concentrations above their respective CVs: benzo[a]anthracene, benzo[b]fluoranthene, and indeno[1,2,3,-cd]pyrene.

The remaining SVOC concentrations were below ATSDR CVs. Five SVOCs were detected in at least 50 % of the samples: benzo[g,h,i]perylene, benzo[k]fluoranthene, chrysene, di-n-butyl phthalate, and fluoranthene.

- Seven samples were analyzed for pesticides and PCBs. Arochlor-1248 was the only PCB detected in any of these samples (one sample). The sample concentration exceeded the CV. No pesticides were detected in the samples.
- Fifty-nine samples were analyzed for various metals. Antimony was detected at concentrations above the ATSDR CV in 10 of 15 samples analyzed for this contaminant. The maximum value was 52 ppm in a surface soil sample from pond 51. The other samples with antimony concentrations above the CV were taken from the saturated zone depths of ponds 39 and 42; surface soils of ponds 49A, 49C, and 48; and subsurface soils taken from pile 2. Pile 2 contains dredged soils from several of the ponds located in the southern portion of the main production area.
- Arsenic was detected at concentrations above the CV in 48 of the 59 samples. The maximum concentration detected was 340 ppm arsenic in soil from the saturated zone of pond 42. Arsenic was detected at concentrations above the CV in all but the following pond/pile locations: dredged soil from pond 39 (pile 1); ponds 44A, 44B, 45, 48, and 52; and soil from the former dredged material pile location (pile 4).
- Cadmium was detected in 54 of the 59 samples; 47 of these samples showed concentrations above the CV (10 ppm). The maximum concentration was 66 ppm in a subsurface sample taken from pond 39 (from the saturated zone). Concentrations of cadmium were below the CV or not detected in the following locations: piles 1 and 4 and ponds 44a, 44b, 48, and 52.
- Chromium was detected in all but one of the 59 samples. Only one sample, however, slightly exceeded the CV for chromium (200 ppm) and came from the surface soils of pond 48. This sample contained 226 ppm chromium.
- Lead was detected in all 59 pond/pile samples; however, only two samples had concentrations exceeding the ATSDR CV. Surface soils from ponds 48 and 49C had 900 and 440 ppm lead, respectively. Previous composite depth samples from these ponds taken in December 1989 showed lower concentrations of lead (i.e., 14.5 ppm in pond 48 and 70.5 ppm in pond 49C).

- Thallium was detected in 32 of 42 samples analyzed for this metal; 31 of these samples had concentrations exceeding the ATSDR CV (4 ppm). The maximum concentration was 37 ppm, and was found in a subsurface soil sample from pile 2 in April 1989 (depth: 8 feet). Surface soils taken from this pile during the same sampling effort showed similar concentrations of thallium (28 and 32 ppm). A previous subsurface soil sample taken from this pile in January 1988 also tentatively showed a concentration of 31 ppm at a depth of 15 feet.
- Fluoride was detected in all 32 samples analyzed for this contaminant. Four of these samples had concentrations that exceeded the ATSDR CV for sodium fluoride (3,000 ppm). The maximum concentration (410,000 ppm) was found at the saturated zone of pond 39. The remaining three fluoride concentrations that exceeded the CV were significantly less than the maximum. One sample measured 5,280 ppm and was a composite sample from several depths of pond 45. The CV was also exceeded in composite samples from ponds 49A and 49C (3,170 and 3,120 ppm, respectively).
- Chloride was detected in more than half of the samples analyzed for this contaminant. Cyanide was detected in few samples, and all measured concentrations were less than the CV. Twenty-seven samples were analyzed for total phosphorus.
- In December 1989 and in June 1991, borings were obtained from several pond locations to determine the presence of elemental phosphorus. Elemental phosphorus was found in borings from ponds 44A, 44B, 47, 48, 49D, and 50 in December 1989 at depths ranging from 3.5 to 14.8 feet below ground surface (bgs). The maximum concentration of total phosphorus was 121,000 ppm in surface soils taken from pond 49D. In June 1991, elemental phosphorus was found in three areas next to ponds 46B and 47 at depths ranging from 10 to 24 feet bgs. This area is where waste drums containing roaster fines (i.e., calcined phosphate sand, elemental phosphorus, and sandy clay/water) were formerly buried (NUS 1989).
- Thirty-two samples were analyzed for radium-226. The ATSDR CV (5.4 Bq/kg) was exceeded in 30 of these samples. The maximum concentration of radium-226 was 1,258 Bq/kg in two composite samples taken from several depths of ponds 44A and 45. Only two samples from the lower depths of ponds 39 and 47 contained radium-226 below the detection limit.

Most of the maximum concentrations of contaminants detected in the pond soils were found in surface samples. The contaminants most frequently at levels detected above available ATSDR CVs were several SVOCs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, and fluoranthene), several metals (antimony, arsenic, cadmium, lead, and thallium), fluoride, and radium-226. The following metals were detected in at least 50% of the samples, but were all below the respective ATSDR CV: aluminum, barium, beryllium, copper, iron, manganese, mercury, nickel, selenium, silver, vanadium, and zinc. Few VOCs/SVOCs and pesticides/PCBs were detected; of those detected, most were at levels below their respective CVs.

Overall, soils sampled in the ditch indicated little contamination (NUS 1989). No VOCs or SVOCs were detected in the one sample analyzed for these contaminants. One sample (taken closest to the cove) had a sodium concentration (20,000 ppm) that was slightly higher than the maximum found in the pond soils or other on-site surface soils (on-site surface soil results are discussed later in this section). The remaining metals and other inorganics analyzed in the samples were either not detected or detected at concentrations below the respective CVs and below the maximum concentrations found in the pond soils and other on-site surface soils. The three ditch soils were also analyzed for gross alpha and beta radiation; in all three, levels of radiation measured were within the readings found for other on-site surface soils.

#### **C.1.1.2. Slag (On-Site)**

The following soil sampling programs were conducted as part of site investigations and include analyses of slag material taken from the slag pits and slag storage area. The soil sampling locations are shown in Figure 4. Not all of the samples obtained for each study were analyzed for the same contaminants.

- In November 1989, PBS&J conducted a radiologic evaluation of the site. PBS&J performed an EGR survey of several areas of the site, including the slag storage area in the North property. The surface and subsurface soils were also analyzed for the presence of radium-226 (PBS&J 1990). This study is documented as part of the *Site Soil Characterization Study* (Weston 1990b).
- Between December 1989 and April 1990, Weston was contracted to perform soil sampling activities at the site. Two surface soil samples from the slag pits and four surface soil samples from the slag storage area were analyzed for arsenic, cadmium, chromium, lead, cyanide, fluoride, chloride, and total phosphorus. One of the slag pit samples and six additional surface soil samples from the storage area were analyzed for radium-226 (Weston 1990a). This study is documented as part of the *Site Soil Characterization Study* (Weston 1990b).
- In March 1993, Weston analyzed one surface soil sample taken from the slag pit area. This sampling was performed as part of the RI. The sample was analyzed for TAL metals, cyanide, fluoride, phosphorus, and TCL VOCs, SVOCs, pesticides, and PCBs (Weston 1993).
- In September 1997 Parsons conducted a study to determine the extent of contaminant leaching from soil and slag in the slag storage area. A field radiation survey was conducted over the entire slag storage area. Three slag samples were then taken from areas with the highest radiation readings and analyzed for TAL metals, other inorganics, and radionuclides. These samples were also analyzed by the synthetic precipitation leaching potential (SALP) protocol (Parsons 1997).
- In July 1998, EPA Region 4 conducted a survey of several off-site materials containing slag. As part of this study, one sample from the on-site slag pile was taken for the purposes of microscopically fingerprinting the community slag materials to the Stauffer

slag. This on-site sample was analyzed for the following metals and other inorganics: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc, fluoride, and radium-226 (EPA 1999a).

Table 3 in Appendix B summarizes the findings of the on-site slag studies. This table excludes data obtained from the slag-containing road materials. The on-site road material data are discussed at the end of this section.

Highlights of the Table 3 data summary are presented below:

- Only one sample (from the slag pit) was analyzed for VOCs, SVOCs, pesticides, and PCBs. No VOCs were detected in the sample. Benzo[a]pyrene was detected at 0.11 ppm, which is slightly above the ATSDR CV. An additional ten SVOCs and four pesticides/PCBs were detected in the sample at concentrations below the CV.
- Arsenic was detected in only 2 of the 11 samples analyzed for this contaminant. One of these samples (collected from the slag pit) contained arsenic at a concentration (4.2 ppm) that exceeded the CV.
- Cyanide was detected in 7 of 10 samples at a maximum concentration of 6.5 ppm. Fluoride and total phosphorus were detected in all 11 samples analyzed; the maximum concentrations were 1,920 and 48,500 ppm, respectively. The maximum concentrations for all three contaminants were found in samples taken from the slag storage area.
- Only one sample (from the slag storage area) was analyzed for gross alpha and beta radiation. This sample showed concentrations of 9,990 and 4,590 Bq/kg, respectively. All 12 samples analyzed for radium-226 had concentrations exceeding the CV. The maximum radium-226 concentration was 2,730 Bq/kg in a sample taken from the slag storage area.

Thirteen metals were detected in at least 50% of samples analyzed: aluminum, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, vanadium, and zinc. These were all detected below the respective CVs.

One study examined on-site road materials that were constructed from the slag. This study collected two samples of roadbed material at a depth of 1 foot and another at a depth of 4 feet (Weston 1993). All of these samples were obtained from the roadway along the western border of the site. These samples were analyzed for metals, cyanide, fluoride, total phosphorus, and radionuclides. The findings are summarized below:

- The road samples contained arsenic at concentrations ranging from 0.54 to 4.1 ppm, which are above ATSDR's CV.
- Several other metals were detected at higher concentrations in some or all of the road samples when compared with the slag samples discussed previously. All three road



samples contained elevated concentrations of calcium (113,000–128,000 ppm), magnesium (1,670–1,870 ppm), potassium (862–2,340 ppm), selenium (0.98–2.8 ppm), and sodium (1,610–1,990 ppm). In addition, the 4-foot sample contained higher concentrations of mercury (0.14 ppm), thallium (1.3 ppm), and zinc (281 ppm). Finally, one of the 1-foot samples and the 4-foot sample contained between 1.5 and 1.6 ppm silver. The remaining metals, as well as the cyanide, fluoride, and total phosphorus concentrations were within the ranges detected for the slag.

- The gross beta radiation levels detected in the road materials were above those detected in the slag sample discussed previously. These levels ranged from 7,220 to 7,896 becquerels/kilogram (Bq/kg). The gross alpha radiation and radium-226 levels were below those of the slag samples.
- The road materials were also sampled for radon-222 (1,140–1,200 Bq/kg) and polonium-210 (818–1,820 Bq/kg). The polonium-210 concentrations exceeded ATSDR's CV (210 Bq/kg).

#### **C.1.1.3. Surface Soil**

The following soil sampling programs were conducted as part of site investigations and include analyses of on-site surface soils material taken from locations around the site. These data exclude soils previously discussed (those taken from the former ponds, from dredged pond material, and samples obtained from the slag pits and slag storage area). Figure 1 in Appendix A shows the layout of the Stauffer site. Not all of the samples obtained for each study were analyzed for the same contaminants.

- In January 1988, NUS Corporation collected one surface soil sample from a wooded area on the northeast property. This sample was used to establish background surface soil conditions and analyzed for EPA CLP organics and inorganics (NUS 1989).
- In April 1989, NUS Corporation collected an additional two surface soil samples from the wooded area on the northeast property. These samples were used to establish background surface soil conditions and were analyzed for aluminum, calcium, chromium, iron, lead, and manganese (NUS 1991).
- In November 1989, PBS&J conducted a radiologic evaluation of the site. PBS&J performed an EGR survey of several areas of the site. In addition, six surface soils were analyzed for the presence of radium-226 (PBS&J 1990). This study is documented as part of the *Site Soil Characterization Study* (Weston 1990b).
- Between December 1989 and April 1990, Weston was contracted to perform soil sampling activities at the site. Fifty-two surface soil samples from various locations on the site were analyzed for arsenic, cadmium, chromium, lead, cyanide, fluoride, chloride, and total phosphorus. Twenty-three surface soils were analyzed for radium-226 and 16 were analyzed for VOCs, SVOCs, pesticides, and PCBs (Weston 1990a). This study is documented as part of the *Site Soil Characterization Study* (Weston 1990b).

- In September 1990, Weston performed additional sampling of three surface soils from one location previously sampled in December 1989. These samples were analyzed for radium-226 (Weston 1990c).
- In March 1993, Weston analyzed seven surface soil samples for TCL VOCs and SVOCs; 12 samples for TCL pesticides and PCBs; 14 samples for TAL metals; 18 samples for cyanide, fluoride, total phosphorus; and one sample for radionuclides. This sampling was performed as part of the RI (Weston 1993).
- In September 1997, Parsons conducted a study to determine the extent of contaminant leaching from soil and slag in the slag storage area. Six surface soil samples were obtained from three areas of the site and analyzed for the TAL metals, other inorganics, and radionuclides. Three of these samples were also analyzed by the SALP protocol (Parsons 1997).
- In May 1999, Parsons conducted sampling of 18 surface soils from various undisturbed locations on the site to establish background concentrations of arsenic and beryllium (Parsons 1999).

Table 4 in Appendix B presents a summary of the on-site surface soil data. Thirteen contaminants exceeded their respective CVs in the surface soils: benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenzo[a,h]anthracene, indeno[1,2,3-cd]pyrene, antimony, arsenic, cadmium, iron, thallium, vanadium, fluoride, and radium-226. One sample from the southeast property was also analyzed for polonium-210, which exceeded the CV. The maximum concentrations found in the other on-site surface soils were primarily from parts of the main production area and the northeast property. Interestingly, two of the samples with maximum contaminant concentrations were from undisturbed portions of the site and were intended to establish background concentrations of contaminants in the on-site surface soils.

The main contaminants of concern were arsenic, cadmium, thallium, fluoride, and total phosphorus. These include contaminants that were detected most frequently above ATSDR CVs and/or by the greatest margin (e.g., arsenic, cadmium, and thallium), as well as those associated with site operations (e.g., fluoride, total phosphorus) in the on-site surface soils .

Highlights of the Table 4 data summary follow:

- Ten VOCs were detected in at least one of the 22 samples analyzed; none of these concentrations exceeded the ATSDR CV. Methylene chloride was the only VOC detected in more than 50 % of the samples.
- Twenty-nine SVOCs were detected in at least 1 of the 24 samples analyzed for various SVOCs. Two locations within the main production area and one location in the northeast property consistently showed concentrations exceeding the CV for the following contaminants: benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenzo[a,h]anthracene, and indeno[1,2,3-cd]pyrene.

- Benzo[a]anthracene was detected at concentrations above the CV (0.87 ppm) in four of the samples. The maximum concentration was 2.9 ppm in a sample collected from the eastern portion of the main production area of the site (near the railroad track). Another sample from the same location also slightly exceeded the CV (0.88 ppm). The remaining two surface soil samples that contained elevated concentrations of this contaminant were collected from the main production area (between the water tower and railroad track) and northeast property (near pond 39).
- Benzo[a]pyrene was detected at concentrations exceeding the CV in six surface soil samples and indeno[1,2,3-cd]anthracene exceeded the CV in four samples. The maximum concentrations were 2.7 ppm benzo[a]pyrene and 3.1 ppm indeno[1,2,3-cd]anthracene. Both of these maximum concentrations were in one sample from the main production area (between the water tower and railroad track).
- The CV was exceeded for benzo[b]fluoranthene in four samples. The maximum concentration was 4.3 ppm. Dibenzo[a,h]anthracene was detected in only 3 of the 23 samples that were analyzed; however, all three of these samples contained concentrations that exceeded the CV. The maximum concentration was 0.34 ppm. Both of these maximum concentrations were found in a sample from the northeast property (near pond 39).
- Five pesticides/PCBs were detected in the 28 samples analyzed; however, each of these contaminants was found in less than 25% of these samples. The most frequently detected contaminant was a pesticide (p,p-DDT), detected in six of the samples. The maximum concentration was 0.013 ppm obtained in a composite surface soil sample taken from the eastern portion of the northeast property. The maximum concentration of p,p-DDT is well below the CV (2 ppm).
- Ninety-one samples were analyzed for various metals. Antimony was detected above the ATSDR CV in four of 21 samples analyzed for this contaminant. The maximum value was 48.9 ppm in a surface soil sample from the main production area of the site (near the railroad track between the clarifier and the road along the western border). Another sample from this same location also had an elevated concentration of 32.3 ppm. The remaining two samples with antimony concentrations above the CV were taken from the main production area (between K.V.A. substation and pond 42) and the northeast property (near pond 39).
- Arsenic was detected above the CV in 30 of 91 samples. The maximum concentration detected was 140 ppm in soil from an area near pond 39 in the northeast property. This sample also showed the maximum concentration found for cadmium (59 ppm), which also exceeded the CV. Cadmium was detected in 45 of the 73 samples; seven of these samples showed concentrations above the CV. The mean detected concentration for cadmium was 8.0 ppm.
- Only two samples were obtained in which arsenic was detected at concentrations below the CV (arsenic was not detected in 59 samples). These two samples were both taken

from a relatively unused location in the northeastern portion of the main production area. Both of these samples were analyzed to determine background concentrations of arsenic in the surface soils on site. The mean detected concentration for arsenic was 20 ppm.

- Iron was detected in all 17 samples analyzed for iron. Concentrations in two of these samples exceeded the CV for iron (23,000 ppm) and came from the surface soils in the main production area (one between K.V.A. substation and pond 42 and one between the clarifier and the road along the western border). Both of these samples showed similar concentrations that were the highest detected (between 42,900 and 44,800 ppm).
- Thallium was detected in 9 of 21 samples analyzed for this metal; four the samples had concentrations exceeding the ATSDR CV (4 ppm). The maximum detected concentration was 15 ppm; this concentration was found in the northeast property near pond 39. The remaining three samples containing elevated concentrations of thallium were obtained from the main production area (near the railroad tracks between the clarifier and the road along the western border) and the northeast property. The mean detected concentration of thallium was 6.4 ppm.
- Vanadium was detected in all 15 samples analyzed. The maximum concentration was found in a surface soil sample from the main production area (between the clarifier and the road along the western border); this concentration slightly exceeded the CV (200 ppm). The maximum concentration of vanadium was 252 ppm.
- Fluoride was detected in 75 of 77 samples analyzed for this contaminant. Only one of these had a concentration that exceeded the ATSDR CV. The maximum concentration (4,230 ppm) was found in a surface soil sample from a central location in the main production area of the site. The mean detected concentration of fluoride was 474 ppm.
- Seventy-six samples were analyzed and contained phosphorus (as total phosphorus). The maximum concentration of total phosphorus was 84,800 ppm in surface soils taken from the eastern portion of the main production area of the site (near railroad track). The mean detected concentration of total phosphorus was 24,600 ppm.
- Seven samples were analyzed for gross alpha and beta radiation. These samples showed concentrations of between 77 and 29,800 Bq/kg gross alpha radiation and between 67 and 17,800 Bq/kg gross beta radiation.
- All 39 samples analyzed for radium-226 had concentrations exceeding the CV. The maximum radium-226 concentration was 1,813 Bq/kg in a sample taken in December 1989 from an area in the northwestern portion of the main production area. A subsequent sampling effort obtained three more samples from this location less than a year later (Weston 1990c). The radium-226 concentrations in the 1990 sampling were significantly less, ranging from 67 to 100 Bq/kg.
- One sample from along the southwestern corner of the site (in the southeast property) was also analyzed for polonium-210 and radon-222 (this was the only on site surface soil

analyzed for these radionuclides). The polonium-210 concentration (7,522 Bq/kg) greatly exceeded the CV (200 ppm).

The following SVOCs and metals were detected in at least 50% of the samples, although the concentrations did not exceed the CV: benzoic acid, chrysene, di-n-butyl phthalate, fluoranthene, pyrene, aluminum, barium, beryllium, chromium, cobalt, copper, lead, manganese, nickel, selenium, and zinc.

#### **C.1.1.4. Subsurface Soil**

The following soil sampling programs were conducted as part of site investigations and include analyses of on-site subsurface soils taken from several locations around the site. These data exclude soils previously discussed (those taken from the former ponds, dredged pond material, and surface soils obtained from the slag pits and slag storage area). Figure 1 in Appendix A shows the layout of the SCC site. Not all of the samples obtained for each study were analyzed for the same contaminants.

- In January 1988, NUS Corporation collected 18 subsurface soil samples from several locations on the site. These samples were analyzed for EPA CLP organics and inorganics (NUS 1989).
- In November 1989, PBS&J conducted a radiologic evaluation of the site. PBS&J performed an EGR survey of several areas of the site. In addition, 12 subsurface soil samples were analyzed for radium-226 (PBS&J 1990). Samples were collected from two depths at six areas of the site. This study is documented as part of the *Site Soil Characterization Study* (Weston 1990b).
- Between December 1989 and April 1990, Weston was contracted to perform soil sampling activities at the site. Fifty-one subsurface soil samples from various locations on site were analyzed for radium-226 (Weston 1990a). This study is documented as part of the *Site Soil Characterization Study* (Weston 1990b).
- In September 1990, Weston performed additional sampling of 35 subsurface soils from various locations previously sampled in December 1989. These samples were analyzed for arsenic, cadmium, chromium, lead, cyanide, fluoride, chloride, and total phosphorus. Thirteen samples were analyzed for radium-226 (Weston 1990c).
- In March 1993, Weston analyzed two subsurface soil samples for TCL VOCs, SVOCs, pesticides, and PCBs; eight samples for TAL metals, as well as cyanide, fluoride, and total phosphorus; and one sample for radionuclides. This sampling was performed as part of the RI (Weston 1993).
- In September 1997, Parsons conducted a study to determine the extent of contaminant leaching from soil and slag in the slag storage area. Eighteen subsurface soil samples were obtained from several areas of the site, including the slag storage area. These were

analyzed for the TAL metals, other inorganics, and radionuclides. Three of these samples were also analyzed by the SALP protocol (Parsons 1997).

Five contaminants exceeded their respective CVs in the subsurface soils: antimony, arsenic, cadmium, thallium, and fluoride. More specific findings of the subsurface soil sampling are presented below:

- One subsurface soil sample taken from the saturated zone of a wooded area in the northeast property showed a slightly higher concentration of toluene (0.066 ppm, based on presumptive evidence) than the maximum measured in any of the surface soils; however, it is significantly less than the ATSDR CV for toluene (1,000 ppm).
- Two locations showed antimony concentrations that slightly exceeded the CV (20 ppm) at depths of 1.5 and 8 feet. The concentrations ranged from 22.6 to 29.3 ppm and were located near ponds 42 and 39, respectively.
- Nineteen subsurface soil samples of the 79 analyzed contained arsenic at a concentration exceeding the CV. The highest measured subsurface concentrations slightly exceeded the maximum surface soil concentration and ranged from 146 to 160 ppm. These were obtained from depths of 1.5 and 4 feet in areas near pond 39, as well as between the clarifier and the road along the western border of the property.
- Four subsurface soils contained concentrations of cadmium that exceeded the CV. These concentrations ranged from 18.6 to 78 ppm. Two of these samples contained concentrations that exceed the maximum surface soil concentration. The samples were obtained from the northeast property, near pond 39.
- One subsurface soil sample contained a concentration of magnesium that was slightly higher than the maximum surface soil concentration. This sample measured 4,500 ppm at a depth of 4 feet and was from an area between the clarifier and the road along the western border of the property. This same sample also contained a higher concentration of mercury (1.1 ppm, based on presumptive evidence); however, this concentration is well below the CV for mercury (20 ppm).
- The CV for thallium was exceeded in five subsurface soil samples taken from the main production area between the K.V.A. substation (depth: 6 feet), south of pond 42 (depth: 8 feet), and in the northeast property near pond 39 (depth: 1.5 feet). The northeast property samples contained thallium concentrations (between 15.9 and 18 ppm) that slightly exceeded the maximum surface soil concentration.
- Two subsurface samples contained fluoride concentrations that exceeded the CV and the maximum concentration measured for surface soils. These samples were both taken at a depth of 4 feet. One sample was obtained from an area between the clarifier and the road along the western border and measured 260,000 ppm fluoride. The other sample was from the wooded area in the northeast property and measured 19,000 ppm (this sample was obtained to establish background concentrations in the subsurface soils).

Other metals tested were either not detected or detected at concentrations within the ranges generally found in site surface soils. Virtually all of the subsurface soils showed low concentrations (less than their CVs) of VOCs, SVOCs, pesticides, and PCBs.

### ***C.1.2. Groundwater***

Many groundwater investigations have been conducted at the Stauffer site over the years. Evaluating the findings of these groundwater investigations provides a better understanding of the nature and extent of groundwater contamination associated with the site, including the vertical and lateral extent of contamination. Although groundwater in the shallow aquifer beneath the site is contaminated with site-related substances (e.g., various metals, fluoride, phosphorus, sulfate, and radiologic contamination), migration off site and to the deeper aquifer that serves as a drinking water source for some area residents does not appear to be extensive.

Studies in which groundwater was evaluated included:

- *Evaluation of Existing Waste Sludge Lagoon System (hydrogeologic investigation)* (PBS&J 1982).
- *Hydrogeologic investigation (1987)*: to conduct water level and hydraulic conductivity testing to characterize the surficial and Floridan aquifers beneath the site (Seaburn and Robertson 1988).
- *ESI (1989)*: to collect soil and water samples from on-site and off-site locations to support EPA's completion of HRS documentation. Installed groundwater monitoring wells; performed a land survey and geophysical investigation (NUS 1989).
- *NPL listing site inspection (1991)*: to augment existing data to provide the necessary data for a scoring of the site using the revised HRS (NUS 1991).
- *RI (1993)*: to confirm the results of past investigations and address identified data gaps to delineate the nature and extent of site contamination (Weston 1993).
- *SMC groundwater monitoring program (1987–present)*. To monitor seven surficial wells on a semiannual basis.
- *Baseline groundwater evaluation*: to characterize groundwater conditions up gradient (background) and down gradient (toward the river) of source areas (Parsons 1999).
- *Private well sampling (1990, 1997, 1999, and 2001)*: conducted by FDOH in support of its underground storage tank program and/or in response to requests from area residents. Thirty-six nearby wells sampled.

- *Final data evaluation report*: conducted by Black & Veatch Special Projects Corporation (Black & Veatch 2000) to independently assess groundwater contamination migration and impacts.
- *Summary of on-site and off-site groundwater investigations (2001)*: conducted by Flow Science, Inc. to capture key findings of all site-related groundwater studies (Flow 2001).
- *2002 and 2003 groundwater studies*: conducted by Parsons Engineering Science, Inc. (Parsons) to perform site-wide groundwater characterization studies to further evaluate groundwater flow, connectivity between the aquifers, and overall groundwater quality in the shallow and deeper aquifers (Parsons 2004).
- *Geophysical studies (2003)*: conducted by O'Brien & Gere to evaluate whether sinkholes or karst features are present or may form in the future (O'Brien & Gere 2004).

The scope and findings of these studies are detailed in the remainder of this section.

#### **C.1.2.1. Monitoring Wells**

The following groundwater sampling programs were conducted as part of site investigations or routine monitoring by SMC. In general, the objective of each of these programs was to measure the nature and extent of site groundwater contamination, including the potential for off-site migration. Because several sampling events were conducted by different investigators, the designation of the sampling locations has changed over the years. Table 6 in Appendix B describes the well designations used in the various studies. The data summary tables and Figure 5 in Appendix A (monitoring well locations) use the well designations from the RI.

- SMC has had a groundwater monitoring program in place since 1987. As part of this program, SMC has been testing seven surficial monitoring wells (M-1 through M-7). From 1987 through 1990, SMC sampled these wells quarterly; subsequent sampling has been on a semiannual basis. Samples collected as part of this program are analyzed for the following chemical parameters: aluminum, antimony, arsenic, barium, boron, chromium, fluoride, iron, lithium, manganese, nickel, ortho-phosphate, and sulfate. In addition, the following radiologic analyses are conducted: gross alpha and beta, radium-226, radon-222, and polonium-210. SMC submits semiannual reports with monitoring results to the Florida Department of Environmental Regulation (FDER), which oversees this monitoring program. Only samples collected for ortho-phosphate analysis are filtered as is required by the method.
- In January 1988, NUS Corporation collected 26 on-site groundwater samples as part of an ESI. Ten samples were from temporary monitor well boreholes, 4 from newly installed Floridan aquifer wells, 5 from newly installed surficial wells, and 7 from existing wells initially installed by Stauffer as part of the FDER quarterly monitoring requirements. Samples were analyzed for EPA CLP organics and inorganics, as well as radon. In addition to the monitoring wells, one on-site “industrial well” (no. 14) was



sampled for metals, cyanide, and fluoride. Samples were also collected from three public wells and three private wells (see below) (NUS 1989).

- In April 1989, NUS Corporation collected an additional 20 groundwater samples, including 16 from existing monitoring wells and 4 from nearby private wells. Samples were analyzed for TCL organics and TAL inorganics (NUS 1991).
- Between March 17 and April 22, 1993, Weston conducted the following groundwater investigation activities as part of the site RI (Weston 1993):
  - ▶ Four additional monitoring wells and five temporary well points were constructed in the surficial aquifer.
  - ▶ Groundwater samples were collected from the four new monitoring wells, the 11 existing surficial aquifer monitoring wells, and 3 existing Floridan aquifer monitoring wells (April 1993). Groundwater samples collected from the four new wells (MW93-1 through MW93-4) and existing wells (MW-1S, MW-01F, MW-9S, and MW-02F) were analyzed for TCL and TAL parameters. Newly installed well MW93-5 and the remaining monitoring wells (MW-2ES, -4ES, -5ES, -6ES, -7ES, -8ES, -7S, -10S, -3F, and -4F) were analyzed for TAL and radiologic parameters (gross alpha and beta, radon 222, polonium 210, and radium 226). All groundwater samples were analyzed for fluoride, cyanide, and total phosphorus.

On the basis of findings from the March/April 1993 investigations, the following supplemental groundwater investigation activities occurred:

- ▶ One additional monitoring well and three piezometers were constructed in the surficial aquifer.
- ▶ Groundwater samples were collected from the two background wells, the new monitoring well, and the Floridan aquifer monitoring well across the Anclote River from the site (July 1993).
- ▶ In 1998 and 1999, Parsons implemented a sampling program to establish conditions in the surficial aquifer both up gradient and down gradient (at the shoreline) from the contaminant source areas on site. Four new surficial aquifer monitoring wells (MW-98-1 through MW-98-4) were installed to expand the existing network of on-site monitoring wells (Parsons 1999). MW-98-2 was installed as a replacement well for MW-93-3. Groundwater samples were analyzed for TAL metals, cyanide, fluoride, total phosphorus, elemental phosphorus, and radiologic parameters (gross alpha and beta, polonium-210, radium-226, and radon-222). The 1998 and 1999 samples were the first samples to be analyzed for “elemental phosphorus” (using gas chromatography).
- ▶ In 2002 and 2003, Parsons expanded the monitoring well network on site to further characterize groundwater quality conditions. This involved installation of

14 new monitoring wells to each aquifer<sup>1</sup>. These wells were tested between August 2002 and February 2003 and analyzed for metals, cyanide, fluoride, sulfate, total phosphorus, elemental phosphorus, and radiologic parameters (gross alpha, gross beta, radium-226, radon-222, and polonium-210).

Table 7 (surficial aquifer) and Table 8 (Floridan aquifer) in Appendix B summarize groundwater data sampled from on-site monitoring wells. Two additional monitoring wells, located southwest of the site on the other side of the Anclote River (MW-11S and MW-04F), are not included in these summaries, but are discussed below as appropriate. No potable water supplies currently exist on site; therefore, no one is ingesting or otherwise coming in contact with groundwater beneath the site. Tables 7 and 8 present the range of contaminant concentrations detected in each aquifer during the various sampling rounds. Unless otherwise noted, the number of samples represent a unique sampling event, which includes multiple samples from individual monitoring wells. The tables also compare the maximum detected concentrations to health-based CVs.

Highlights of the groundwater monitoring well data analyses are presented below:

#### ***C.1.2.1.1. Shallow Aquifer***

- ▶ The contaminants most frequently exceeding ATSDR CVs (in greater than 40%–50% of the samples) include arsenic, fluoride, and radon-222. Other contaminants exceeding ATSDR CVs in one or more samples include aluminum, antimony, boron, cadmium, chromium, iron, lead, lithium, manganese, nickel, selenium, thallium, vanadium, zinc, sulfate, gross alpha, and radium-226.
- ▶ MW93-3 (south of lagoon 5) and MW-8ES were the locations of many of the maximum detected concentrations. MW93-3 appears to be within disposal materials associated with pond 42 and was replaced by MW-98-2 in 1998 (Flow 2001). MW-8ES is located downgradient of the lagoons and calcium fluoride storage areas. Note that the one off-site monitoring well (MW-11S), located south of the site on the opposite side of the Anclote River, reported some elevated hits during the 1988 NUS study; however, the results from this study are considered “suspect.” Sample results from subsequent samples of arsenic, fluoride, and phosphorus in this off-site monitoring well were 10–100 times lower. Flow (2001) points out that measured concentrations of several contaminants during the 1988 NUS study exceed the highest concentrations recorded in on-site wells during the more than 10 years of groundwater sampling that have followed.
- ▶ Arsenic was elevated (above ATSDR CVs) in the highest percentage of samples tested, but no distinct plume was identified. The highest detection of arsenic (980 ppb) was detected in MW93-3 in 1993. In the past 5 years (1998 to 2003), arsenic detections have ranged from 2 ppb to 180 ppb (MW-02-10S).

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<sup>1</sup>In October 2003, three additional monitoring wells were installed in the Upper Floridan aquifer and four additional monitoring wells were installed in the surficial aquifer for use in measuring groundwater elevations.

- ▶ The highest detected concentrations of fluoride (71,000 ppb and 75,000 ppb) were detected in MW-3ES (down gradient of the calcium fluoride deposit) and MW-02-10S (adjacent to Pond 49A), respectively. Not surprisingly, calcium concentrations (up to 2,300,000 ppb) were also highest in MW-3ES. Elevated fluoride levels have remained fairly localized at and near the pond areas on the site.
- ▶ Radon-222 was detected at concentrations above its CV (EPA's MCL of 300 pCi/L) in 47% of the samples, with up to 11,600 pCi/L detected in MW-3ES. "Background" concentrations reported in the surficial aquifer were on the order of 1,000 pCi/L.
- ▶ Total phosphorus concentrations were detected as high as 380,000 ppb down gradient of the lagoons and the calcium fluoride storage areas and 280,000 ppb adjacent to Pond 49A (MW-02-10S). "Background" phosphorus concentrations ranged from 25 ppb (MW-7ES) to 1,900 ppb (also in MW-7ES).
- ▶ Sulfate, analyzed only as part of the SMC monitoring program and the more recent (2002/2003) groundwater studies, was detected at concentrations above NSDWR in approximately 30% of tested samples. The maximum concentration (2,400,000 ppb) was detected in the MW-8ES. The only other location where sulfate detections exceeded NSDWR was MW2-ES, downgradient of the calcium fluoride deposit (near Pond 39), on the northern parcel.

#### ***C.1.2.1.2. Floridan Aquifer***

- ▶ Up until 2002, only two Floridan aquifer wells had been installed at or near source areas (MW-2F and MW-3F) and these wells were sampled only three times (1988–1993). Two other Floridan aquifer monitoring wells were installed in the site area—MW-1F and MW-4F. However, MW-1F is designated as background and MW-4F is south of the Anclote River. Interestingly, the highest concentration of many of the metals (including arsenic) and gross alpha were detected in MW-4F (1988). However, as mentioned previously, the 1988 NUS data are considered suspect. Therefore, these samples offered minimal insights regarding the quality of the Floridan aquifer at and near the site.
- ▶ Monitoring wells installed in 2002 provide wider site coverage and enabled a more comprehensive review of the groundwater quality in the deeper Floridan aquifer.
- ▶ Few detected concentrations of contaminants exceeded ATSDR CVs in tested wells in the Floridan aquifer. Arsenic and radon-222 were the only two substances detected consistently (in more than 50% of available samples) at concentrations above ATSDR CVs.

- ▶ Site-related contaminant concentrations were generally not elevated in the Floridan aquifer compared with the surficial aquifer. However, elevated concentrations of fluoride were reported in nested wells in the eastern portion of the south parcel. In recent sampling rounds, fluoride was detected up to 75,000 ppb (MW-02-10S) in the shallow aquifer and up to 12,000 ppb in the Floridan aquifer (MW-03-2F and MW-03-3F). This is the area of the site where no semi-confining unit exists between the shallow and upper Floridan aquifer (Parsons 2004).
- ▶ The highest concentration of radon-222 (2,536 pCi/L) was detected in MW-1F (designated “background”). The highest detected radon-222 concentration in, at, or near source areas was 1,220 pCi/L (MW-03-5F), downgradient of the calcium fluoride deposit near Pond 39.
- ▶ One additional Floridan well not included in any of the summary samples is IW-01 (a Stauffer industrial well) was sampled in 1988 for metals, cyanide, and fluoride. All detections were below ATSDR CVs.

To more closely study the possible relationship between site-related contaminants in the surficial and Floridan aquifers, ATSDR examined the sampling results of the “nested” wells (i.e., wells in the same location, screened in both the surficial and Floridan aquifers). Studying the potential connectivity between the aquifers was a primary focus of recent groundwater studies (Parsons 2004). ATSDR also studied the lateral extent of contamination in both aquifers by evaluating groundwater quality in perimeter wells (east, west, and south of source areas) and in the wells designated “background” (i.e., to the north/northeast of source areas); this analysis helped ATSDR to more fully understand the significance of substance concentrations detected in nearby private wells. The contaminants that were selected for further analysis were arsenic, lead, fluoride, and phosphorus. Arsenic and lead were selected because these were the two of the few constituents elevated in off-site private wells. Fluoride and phosphorus were selected because they are site-related contaminants.

As mentioned above, the only portion of the site in which site-related contaminants appear to be found in both the shallow and Floridan aquifer is in the eastern portion of the south parcel, where both fluoride and total phosphorus concentrations were elevated in shallow and deep wells. Fluoride was detected as high as 75,000 in the shallow aquifer (MW-02-10S) and 12,000 ppb in the Floridan aquifer (MW-03-2F and MW-03-3F). Phosphorus was also reported at elevated levels in MW-03-2F and MW-03-3F. However, fluoride levels were not shown to be elevated in the private wells tested east of the site. This observation is likely explained by the southwesterly direction of groundwater flow. Private wells were not tested for total phosphorus.

Results from the monitoring wells in the eastern portion of the south parcel outside of the source areas (e.g., ponds) generally indicate lower arsenic and lead concentrations than those detected at or down gradient of source areas. The highest concentration of arsenic and lead detected in non source areas at the site perimeter (MW-93-2 and MW-10S) were 3.8 ppb and 57 ppb, respectively. Lead was detected as high as 680 ppb at or near source areas. Total phosphorus concentrations in source areas in the eastern portion of the site ranged from 3,000 to 280,000

ppb. Wells outside of source areas on the eastern perimeter of the site (MW-93-2 and MW-10S) reported phosphorus concentrations ranging from 42 to 1,600 ppb. Again, total phosphorus was detected as high as 380,000 ppb in the plant production areas (MW-8ES); total phosphorus concentrations ranged between 37 and 1,900 ppb in background wells.

#### **C.1.2.2. Plant Water Supply Wells**

Sampling of the SCC facility's water supply wells was conducted periodically from 1948 to 1982 by SCC. The contaminant data for these wells are discussed in the Environmental Contamination and Other Hazards section of this document.

### **C.2. Off-Site Contamination**

#### **C.2.1. Soil**

Several studies investigated soils, as well as road and building materials, off of the SCC site. All of the areas are accessible to the public and include public roads, private residences, schools, a recreation complex, a government building, and commercial facilities. Not all of the samples obtained for each study were analyzed for the same contaminants.

- ▶ In April 1989, NUS Corporation collected two surface soil samples from areas in front of and behind Gulfside Elementary School. These samples were analyzed for aluminum, calcium, chromium, iron, lead, and manganese (NUS 1991).
- ▶ In November 1989, PBS&J conducted a radiologic evaluation of the site. As part of this evaluation, PBS&J performed an EGR survey of a commercial property across the southeastern fence line. In addition, one surface soil sample and two subsurface samples from this location were analyzed for the presence of radium-226 (PBS&J 1990). This study is documented as part of the *Site Soil Characterization Study* (Weston 1990b).
- ▶ In July 1993, Weston analyzed four surface soil samples obtained from the Gulfside Elementary School for TAL metals, cyanide, fluoride, total phosphorus, and radionuclides. This sampling was performed as part of the RI (Weston 1993).
- ▶ In February 1996, Weston conducted additional surface soil sampling of soils around Gulfside Elementary School as part of the RI. Ten surface soil samples were analyzed for TAL metals, cyanide, fluoride, and total phosphorus. Twelve samples were analyzed for radionuclides (Weston 1996).
- ▶ Between July and August 1997, Evans Environmental & Geological Science and Management, Inc. (EE&G) conducted surface soil sampling at Gulfside Elementary School to determine baseline phosphorus concentrations and pH levels at the school. Fourteen surface soil samples from six locations around the school were analyzed for ortho-phosphorus and total phosphorus. Twenty surface soil samples (coinciding with the

Weston 1996 sampling locations) were analyzed for the presence of asbestos (EE&G 1997a).

- ▶ In September 1997, EE&G conducted additional sampling of construction materials used at Gulfside Elementary School that were believed to contain slag from the Stauffer site. In this study, four soil samples from beneath roadways around the school property were analyzed for radionuclides. In addition to these, samples of the roofing material and asphalt were also analyzed for radionuclides (EE&G 1997b).
- ▶ Between July 1997 and March 1998, the FDOH Bureau of Radiation Control conducted investigations at 25 off-site locations in the surrounding community in response to citizen concerns about the existence of slag material in their buildings and/or driveways. These locations consisted of residences, commercial properties, a recreational complex, and a school (not Gulfside Elementary School). Most of these investigations involved examination of EGR emitted from the materials. Soil, driveway, and roadway materials from two locations were also sampled for radium-226 (FDOH 2002).
- ▶ In July 1998, EPA Region 4 conducted a survey of several materials containing slag located off site. As part of this study, one sample from the on-site slag pile was taken for the purposes of microscopically fingerprinting the community slag materials to the SCC slag. Twenty-five off-site samples were analyzed for the following metals and other inorganics: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc, and radium-226 (EPA 1999a).
- ▶ In May 1999, Parsons conducted sampling of five surface soils from off-site fill material suppliers. These samples were analyzed for arsenic and beryllium to determine the feasibility of using these soils for future remediation activities on the site. (Parsons 1999).

#### **C.2.1.1. Gulfside Elementary School**

Table 11 in Appendix B presents a summary of the surface soils analyzed from Gulfside Elementary School. Samples were analyzed for metals, other inorganics, radionuclides, and asbestos. Highlights of the Gulfside Elementary School data summary are presented below:

- ▶ Arsenic slightly exceeded the CV (0.5 ppm) in 1 sample of the 14 analyzed. This sample was obtained from the front yard of the school and measured 0.6 ppm arsenic. Another eight samples showed concentrations of arsenic below the CV, ranging from 0.13 to 0.43 ppm.
- ▶ Ortho-phosphorus was detected in only 2 samples of 14 analyzed. These samples were obtained from the side of the school building/patio and the back fields, measuring 6.9 and 7.3 ppm ortho-phosphorus, respectively.

- ▶ Radium-226 was measured above the CV (5.4 Bq/kg) in all 15 samples analyzed. The maximum concentration was detected in the front yard sample and measured 59.2 Bq/kg. The asphalt on the roads around the school, as well as the roofing material, also contained radium-226 above the CV, as did the soils beneath the roads. The concentrations in the asphalt, roofing material, and soils were 6.7, 12, and between 45.5 and 73.6 Bq/kg, respectively.
- ▶ The soils beneath the roads also showed higher concentrations of radon-222 when compared with the maximum SCC surface soil concentration. These concentrations ranged from 73.3 to 77.0 Bq/kg.
- ▶ The Gulfside Elementary School building materials sampled (e.g., asphalt, roofing material) contained far lower concentrations of the contaminants found in the on-site slag material.

#### **C.2.1.2. Other Off-Site Soils**

Several other locations in the community surrounding the SCC site were examined, mostly in response to citizen concerns that slag material was used in the construction of their homes, driveways, and roadways. Highlights of the off-site data summary are presented below:

- ▶ The surface soil from six locations in July 1998 contained concentrations of arsenic that were higher than the CV, ranging from 0.612 to 4.85 ppm. Arsenic was detected in 26 of the 31 samples analyzed. The highest concentrations were in the pavement and road base materials of Bluff Boulevard. The Bluff Boulevard arsenic concentrations were similar to the maximum concentrations in the on-site slag material. The remaining metals analyzed in this study all were below the respective CVS (EPA 1999a).
- ▶ In May 1999, five off-site locations that store fill material used by several surrounding communities were sampled for arsenic and beryllium. Arsenic was not detected in any of the samples. Beryllium was detected in four of the samples, with concentrations ranging from 0.08 to 0.14 ppm (Parsons 1999). The purpose of this study was to determine the feasibility of using these resources in future site remediation activities.
- ▶ All 29 samples analyzed for radium-226 showed concentrations above the CV, ranging from 8.29 to 2,600 Bq/kg. These concentrations were all below the maximum in the on-site slag material. The maximum concentrations were found in road material obtained from Bluff Boulevard and Gulfview Road. No other radionuclide was analyzed for off-site soils or building materials.
- ▶ Several other contaminants exceeded the maximum concentrations found in the slag material at the Stauffer site. These contaminants include aluminum, antimony, barium, cobalt, copper, mercury, selenium, silver, thallium, and vanadium. All of the off-site samples contained concentrations of these contaminants below their respective CVS. Several of the maximum concentrations were from the pavement and/or roadbed

materials used on Bluff Boulevard, Anclote Road, and Gulfview Road. Other samples with relatively high concentrations were from residential slab and driveway materials.

### **C.2.2. Groundwater**

#### **C.2.2.1. Private Wells (Off-Site)**

Thirty-eight private wells (residential, commercial, and irrigation) have been sampled in the Stauffer site area since 1988. These sampling events consisted of the following:

- ▶ NUS Corporation collected six off-site groundwater samples as part of EPA's ESI in 1988. These samples were from private and public wells within a 4-mile radius of SCC (NUS 1989). Samples were analyzed for metals, cyanide, fluoride, gross alpha and beta radiation, and radon-222.
- ▶ The FDOH/Pinellas County Health Department collected and analyzed samples from private wells near the site in 1990, 1997, 1999, 2000, and 2001. Sampling was triggered in combination by Florida's SuperAct Underground Storage Tank Program and individual resident requests for follow-up sampling. Most samples were analyzed for selected VOCs/SVOCs (methyl tertiary-butyl ether, naphthalene, bis(2-ethyl hexyl)phthalate, and chloroform), metals, fluoride, chloride, sulfate, nitrate/nitrite, and radiologic parameters (gross alpha and beta radiation, radium-226, and radium-228).

The sampling data for the residential, commercial, and irrigation wells is summarized in Tables 13, 14, and 15 (Appendix B), respectively. Specific findings from the private well sampling events are highlighted below.

##### **C.2.2.1.1. Residential Wells**

- ▶ Trace concentrations of VOCs and SVOCs were detected in residential wells, with only bis(2-ethylhexyl)phthalate (detected up to 7.6 ppb) exceeding its ATSDR CV (3 ppb).
- ▶ Of the metals detected above ATSDR CVS, arsenic and lead were the most frequently detected. The remaining metals were detected at concentrations below or within the same order of magnitude of CVS.
- ▶ Arsenic was detected below its enforceable drinking water standard (10 ppb) in all but one sample with a concentration of 24 ppb (well 16, northwest of the site). All reported concentrations exceeded ATSDR's CREG for arsenic (0.02 ppb). Background concentrations of arsenic have not been well defined in the Floridan aquifer. The only up gradient monitoring well in the deeper aquifer (MW-1F) showed arsenic as "not detected" (less than 1.2 ppb) during the RI. Earlier samples from that well (1988 and 1989) also indicate no detection of arsenic, but detection limits are not reported.



- ▶ Lead was detected in 24 of the 38 samples, but only 4 samples had concentrations exceeding the CV for lead. The highest detected concentration (270 ppb) was detected in a well south of the river (well 14). The same well was tested four other times within a year's time, with lead reported at concentrations between 1.2 and 4.6 ppb. The next highest concentration (160 ppb) was detected in another well south of the river (well 10), but the well was sampled only once. Other wells tested on the same street, however, had lead concentrations ranging from 0.12 to 4.6 ppb. The remaining two samples only slightly exceeded the CV for lead.
- ▶ Only 1 of the 36 samples tested detected radiologic contamination exceeding an ATSDR CV. Gross alpha radiation was detected in 2000 sampling at  $26.2 \pm 5$  pCi/L in well 11 south of the Anclote River.

#### **C.2.2.1.2. Commercial Wells**

- ▶ Trace concentrations of VOCs and SVOCs were detected in potable wells; only bis(2-ethylhexyl)phthalate (detected up to 4.4 ppb) exceeded its ATSDR CV (3 ppb) in one commercial well east of the site (well 3).
- ▶ Arsenic was the only metal detected at concentrations that consistently exceeded its CV. However, arsenic was only detected in two samples at concentrations exceeding its drinking water standard—both from wells east of the site (wells 2 and 8). In one of these wells, arsenic was reported at 8.9 and 9 ppb during two other sampling events in the same well. The other well was sampled just once.
- ▶ Other inorganics exceeded CVS in only one or two samples (iron, nickel, thallium, zinc, chloride, and sulfate) and at concentrations less than 3 times the CV.
- ▶ Gross alpha radiation and radium-226 were detected in two samples (wells 7 and 2, respectively) at concentrations slightly exceeding their respective CVS.
- ▶ Sulfate was detected at concentrations above its CV (250,000 ppb) in two samples. Detected concentrations of 270,000 and 650,000 ppb were found in wells 3 and 27, respectively. Only 1990 and 1997 samples were analyzed for sulfate.

#### **C.2.2.1.3. Irrigation Wells**

- ▶ No VOCs or SVOCs were detected in irrigation wells.
- ▶ Of the eight irrigation wells sampled, arsenic concentrations in six samples (maximum detected concentration reported at 4.4 ppb) exceeded the ATSDR CV.
- ▶ Only two other inorganics exceeded their respective CVS (zinc and chloride) by less than two times.

- ▶ No radiologic parameters exceeded CVS in the irrigation wells tested. Natural uranium was analyzed for in two irrigation wells and detected at a maximum concentration of  $0.3 \pm 0.5$  pCi/L, which is substantially below the CV.<sup>2</sup>

### ***C.2.3. Surface Water (Anclote River)***

For the past 15 years, the surface water around the SCC site has been monitored and tested to establish whether the site has adversely affected the quality of the water in the Anclote River. Two discrete studies were conducted as a part of site investigations in addition to ongoing semiannual monitoring conducted by SMC. Although most of the surface water was sampled from the Anclote River upstream, adjacent to, or downstream of the site, one sample was taken from a tidal lagoon adjacent to the site on the southeast shoreline (SW-05; NUS 1989). Because sampling events were conducted by different investigators, multiple sampling location designations were used over the years. Table 24 in Appendix B describes the location designations used in compiling data from the different studies. Figure 7, Appendix A shows approximate surface water sampling locations from the various studies.

- ▶ *Final ESI (NUS 1989)*. The purpose of the ESI was to collect soil and water samples from both on-site and off-site locations to obtain the data necessary to support EPA’s completion of HRS documentation.

NUS Corporation collected and analyzed seven surface water samples from the Anclote River. Two samples were taken upstream of the site, two adjacent to the site (including one from a tidal pond connected to the Anclote River by a culvert), one in Meyers Cove, and two downstream of the site. The far upstream and downstream samples were taken to evaluate the background concentrations in the river and the Gulf of Mexico. Each sample was tested for metals, fluoride, and phosphorus concentrations.

According to investigators, the only contamination attributable to the site discovered from any of the samples was in the tidal pond (sampling location SW-05). The pond is adjacent to the site at the dredge disposal area. The location showed elevated concentrations of barium, chromium, lead, fluoride, and phosphorus (NUS 1989).

- ▶ *RI (Weston 1993)*. The RI was undertaken by Weston in 1993 to confirm the results of past investigations and address specific data gaps to more fully determine the nature and extent of site contamination. From March 29 to April 4, 1993, 18 samples were collected at 12 locations (“transects” were taken at 3 of the locations) to further evaluate surface water conditions. The samples were taken from two depths (0.3 meters below the surface and 1 meter above the bottom) and pooled to avoid the surface microlayer, depths prone to contamination by sediment resuspension, and freshwater lenses. Of the 12 sample

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<sup>2</sup>Reported as “natural uranium.” ATSDR used the CV for uranium, as reported in the Final Rule for National Primary Drinking Water Regulations: Radionuclides (December 2000). MCL is 30 ppb, which “typically” corresponds to 27 pCi/L.

locations, 5 were upstream of the site, 2 adjacent to the site, and 5 downstream of the site. The transect samples were collected upstream of the site, adjacent to the site, and in Meyers Cove. Each transect was made up of three samples taken from the shore outward; the samples were designated A, B, and C, with A being closest to the shore.

All samples were taken at low tide and analyzed for TAL metals, fluoride, and phosphate-phosphorus. Three samples (SW-1, 7B, and 11) were also analyzed for TCL analytes including VOCs, SVOCs, and pesticides. In addition, a profile of conductivity, temperature, and depth (CTD) was taken to evaluate vertical mixing.

Weston (1993) concluded that surface water contaminant concentrations measured during the RI were consistently lower than those measured during the ESI or in the SMC monitoring discussed below; Weston attributes these differences to differences in sampling procedures. Both the ESI (NUS 1989) and SMC semiannual investigations test water on the surface, whereas the RI intended to avoid the surface and freshwater lenses by averaging samples from two depths to achieve a more representative sample and avoid concentrations of contaminants on the surface.

- ▶ *Ongoing Surficial Groundwater Monitoring Program (SMC 1987 to present).* Since 1987, SMC has sampled two locations in the Anclote River—one just upstream of the site and one in Meyers Cove. From 1987 to 1990 SMC sampled quarterly; subsequent sampling has been semiannually. This sampling is conducted in conjunction with SMC's on-site groundwater monitoring program.

The river samples are taken at low tide upstream of the site (roughly in line with the southeastern property line approximately 75 to 100 feet from shore) and downstream (in Meyers Cove, generally taken downstream of the calcium fluoride sludge ponds, 75 to 150 feet off the north shoreline). This sample has been included with "Meyers Cove" samples in ERG's analysis. Field measurements of temperature, water level, pH, and conductivity are taken in addition to laboratory analysis of metals, fluoride, sulfate, phosphorus, and radiologic parameters. SMC collected samples in conformance with FDEP-approved Comprehensive Quality Assurance Plan. Samples are taken biannually, once in January or February and again in July or August.

Tables 16, 17, 18, and 19 in Appendix B contain the combined surface water data for the Anclote River system (upstream of the site, adjacent to the site, Meyers Cove, and downstream of the site, respectively) from all of the above-mentioned studies. These tables list the results for substances (chemical and radiologic) that were detected at least once. ATSDR compared all measured values of contaminants in surface water with available CVS for drinking water. The use of drinking water CVS serves as a very conservative approach to screening surface water contaminants. As noted before, the Anclote River is not used as a source of drinking water, although it contains popular fishing, boating, and swimming areas.

The sampling results revealed the following:

- Of the chemical and radiologic parameters tested, only antimony, arsenic, boron, chromium, iron, lead, thallium, vanadium, fluoride, sulfate, gross alpha, and gross beta, and radium-226 were detected at concentrations that exceeded available CVS (each to varying degrees). Phosphorus/phosphate and polonium-210 (tested in upstream and Meyers Cove only) were also detected, but no CVS are available.

Calcium, magnesium, potassium, and sodium detected throughout the areas of the river tested at generally consistent concentrations. These are naturally occurring elements and essential nutrients and their presence at detected concentrations in an estuarine system would be expected. Therefore, no further discussion of these substances is provided in this section.

- Organic compounds do not appear to be an issue in the river, although only three samples were tested for organics (during the RI). Only trace concentrations of acetone and toluene, which are common laboratory contaminants, were detected.
- No distinct contamination patterns were observed across upstream, adjacent, Meyers Cove, and downstream areas. The following trends are notable:
  - ▶ *Upstream areas.* As shown in Table 16, most substances were detected at concentrations well below CVS, with the exception of antimony, arsenic, boron, fluoride, sulfate, gross alpha and beta radiation, and radium-226—where maximum detected concentrations exceeded CVS by approximately 10 to 300 times.
  - ▶ Because one of the SMC data points was directly upstream of the site, many of the upstream samples and maximum detected concentrations are from the SMC data set. It is possible that the site had a greater influence on this location than on other upstream locations.
  - ▶ *Areas adjacent to Stauffer.* Table 17 summarizes the concentrations of the various contaminants detected adjacent to the Stauffer site. Data represent surface water conditions in 1988 and 1993 only. No samples were taken directly adjacent to the site by the SMC during its semiannual surface water monitoring. As a result, only six sampling locations are considered in this grouping. CVS were exceeded for arsenic, chromium, iron, lead, vanadium, fluoride, and gross alpha and beta radiation. With the exception of fluoride, the maximum concentration for each of these contaminants was detected in the tidal lagoon adjacent to the site.
  - ▶ *Meyers Cove.* Table 18 in Appendix B summarizes the concentrations of the contaminants detected in Meyers Cove. The SMC semiannual monitoring program took a sample just downstream of the site in Meyers Cove on a semiannual basis and, as a result, much of the Meyers Cove data are SMC data. Water collected in Meyers Cove exceed CVS for antimony, arsenic, boron, iron, fluoride, sulfate, and gross alpha and beta radiation. Detected concentrations in Meyers Cove appear to be generally consistent with those reported upstream.

Note that this comparison becomes largely a comparison of SMC’s “upstream” and “downstream” samples.

- ▶ *Downstream areas.* Table 19 in Appendix B summarizes the concentrations of the contaminants detected downstream of Meyers Cove. A total of nine samples, collected in 1988 and 1993, comprise the downstream grouping. The only CV exceedances were for arsenic and thallium, both detected in 1988 samples. The available data suggest that the site has not affected the water quality further down river. No sampling of downstream areas are available, however, after the RI sampling in 1993.

An elaboration of substance-specific trends in the aforementioned areas is presented below:

- *Antimony* exceeded its CV (4 ppb) in 5 of 46 samples upstream (up to 850 ppb) and 8 of 52 samples in Meyers Cove, at concentrations up to 860 ppb.
- *Arsenic* was detected at concentrations exceeding its CV in a portion of samples collected throughout the river. The maximum detected concentration was an “estimated” measurement of 500 ppb from a downstream sample analyzed in 1988; however, this was the only detection in the nine samples tested downstream. Arsenic was detected more frequently in Meyers Cove (10 of 52 times), adjacent to the site (5 of 6 times), and upstream (8 of 46 times). The next-highest concentration of 48 ppb (detected in the tidal lagoon adjacent to the site) also represents an estimated value from the 1988 NUS sampling; all other detected arsenic concentrations were below 6 ppb. Many of the SMC measurements for arsenic were “non-detects” (with reported detection limits ranging from 1 to 30 ppb).
- *Boron* exceeded its CV of 600 ppb in all 34 samples taken upstream and all 47 taken in Meyers Cove, with maximum detected concentrations of 5,800 and 4,500 ppb, respectively. Only the SMC sampling included boron analysis; therefore, boron was not analyzed for in any of the samples taken further upstream, adjacent to, or downstream of the site. Boron is found widely in nature, with levels in seawater approximately 4,500 ppb, generally comparable to detected levels in samples from the brackish Anclote River (ATSDR 1992/Tox Profile).
- *Chromium* was detected infrequently throughout the river. It only exceeded its CV (30 ppb) in two samples, one upstream (46 ppb) and one adjacent to the site (80 ppb).
- *Iron* was detected frequently in all stretches of the river. Although detected concentrations in Meyers Cove and adjacent to the site were up to 10 times higher than those detected in upstream or downstream samples, the CV for iron (11,000 ppb) was exceeded just one time in each of these areas (14,000 and 28,000 ppb, respectively).

- *Lead*, detected in approximately half of the 32 samples tested for it in the river, was only detected in one sample (adjacent to the site) at a concentration (150 ppb) exceeding its CV (15 ppb).
- *Thallium* exceeded its CV (0.5 ppb) downstream of the site in the only two samples in which it was detected. The highest detected concentration was an estimated value of 300 ppb from a sample collected in the 1988 NUS ESI. Thallium was sampled in each section of the river, but not measured above the detection limit in any other samples.
- *Vanadium* was detected in only one location adjacent to and one location downstream of the site. The concentration adjacent to the site (370 ppb) only slightly exceeded its CV (260 ppb).
- *Fluoride* was detected throughout the river areas tested and exceeded its CV (4,000 ppb) in approximately half the samples in which it was detected. Detected concentrations did not vary greatly in different portions of the river, although no CV exceedences occurred in downstream samples.
- *Sulfate* was consistently detected at concentrations above its CV (250,000 ppb) in Meyers Cove (45 of 47 samples) and upstream of the site (34 of 34 samples), at maximum detected concentrations of 2,980,000 and 5,200,000 ppb, respectively. Only the SMC sampling included sulfate analysis; therefore, it was not analyzed for in any of the samples taken further upstream, adjacent to, or downstream of the site.
- Of the *radiologic parameters* tested, gross alpha and beta radiation were consistently detected at concentrations above CVS in samples collected throughout the river. Radium-226, analyzed for only in SMC samples collected in Meyers Cove and upstream, exceeded the CV in nearly all samples collected in upstream areas but only once in Meyers Cove. Polonium-210 was also detected in most samples for which it was tested, just upstream of the site and in Meyers Cove.

## C.2.4. Sediment (Anclote River)

### C.2.4.1. Sediment Data

Four site-related studies included sampling and analysis of sediments from the Anclote River. This section includes a summary of the four major sediment studies conducted to date and their major findings. Because sediment is so closely linked with the surface water, many of the studies sampled surface water and sediment at the same time and from the same locations. As with surface water, because sampling events were conducted by different investigators, multiple sampling location designations were used across studies. Table 25 in Appendix B describes the sample designations used in compiling data from the different studies. Figure 8 in Appendix A shows sediment sample locations.

- *Final ESI (NUS 1989)*. The ESI was conducted to provide necessary data for scoring using revised HRS. As part of the ESI, NUS collected 10 sediment samples from the Anclote River and a local drainage ditch.<sup>3</sup> These samples were analyzed for metals, cyanide, fluoride, phosphorus, and gross alpha and beta radiation.
- *Listing Site Inspection (NUS 1991)*. The NPL listing site inspection was conducted to obtain additional information to support scoring of the site using the revised HRS. NUS collected 14 sediment samples along the Anclote River on April 17–18, 1989. These samples were analyzed for TCL organics and metals.
- *Sediment Sampling Program (Weston 1991)*. Thirteen sediment samples were taken in the Anclote River on April 4–5, 1991, to characterize sediments upstream, adjacent to, and downstream of the site. Five of these samples were collected upstream along the same bank as the site; four adjacent to the site, and four downstream; sample SED 14 was 200 yards downstream of the boat dock adjacent to Pasco County Park. Each sample was analyzed for TAL metals, fluoride, and phosphate-phosphorus.
- *RI (1993)*. This study was conducted to confirm the nature and extent of site-related contamination and to fill data gaps. Sediments were collected during two sampling events (March/April 1993 and July 1993) by Spaulding Environmental Associates of Wakefield, Rhode Island. The first sampling event was similar to the previous studies in that it sampled surface sediments. From March 29 to April 4, 1993, 18 samples were taken in the river, at the same location as the surface water samples. Each sample was taken at an interval of 0–2 centimeters and analyzed for fluoride, phosphate-phosphorus, TOC, and grain size. Three samples (SD-1, -7B, and -11) were also analyzed for TAL organic components. The second sampling event occurred from July 26 to 29, 1993, and included twelve 12-inch sediment cores collected in Meyers Cove and other areas adjacent to the site. Samples were taken from four transects 25 to 200 feet from shore. The core samples were analyzed for metals, fluoride, phosphorus, radiologic parameters, and grain size.

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<sup>3</sup>The “sediment” samples from the local drainage ditch are not included in this section. Rather, these samples were compiled and described in the soil contaminants section.

Investigators indicated that most elevated metals concentrations were generally associated with higher TOC concentrations and fine-grained sediment—higher concentrations of contaminants were found in finer sediments (“ooze,” mud, sandy mud) with high organic content. Fine sediments increased with proximity to Meyers Cove. Fine sediments are generally indicative of a depositional area. If sediments are being deposited, it is likely, but not certain, that contaminants are bound to sediments and are less likely to be resuspended or transported in the tidal cycle. Such an assessment is consistent with the fact that Meyers Cove is protected, shallow, and has low tidal current speeds. Sand dominated all other locations. The bottom sediments were all at least 77% sandy material except at station SD-07A, where the grain size was clay (46%) and silt (44%) (Weston 1993).

Tables 20, 21, 22, and 23 in Appendix B summarize available sediment data from the Anclote River (upstream of the site, adjacent to the site, Meyers Cove, and downstream of the site, respectively). ATSDR examined data from the four separate studies mentioned above and compared measured concentrations of contaminants in sediment with available CVS. As noted previously, because listed CVS are those used for soil and people contact soil more frequently than sediment, CVs serve as a protective screen.

Key findings are highlighted below beginning with trends found across the river and also addressing chemical specific trends where possible:

- Of the chemical and radiologic parameters tested, only arsenic, fluoride, thallium, methylethyl ketone, toluene, radium-226, and polonium-210 were detected at concentrations above their CVS, each to varying degrees. Phosphate-phosphorus, total phosphorus, gross alpha and beta radiation, radon-222, and TOC were also detected in parts of the river but do not have available CVS.
- The following trends are notable in each specific area of the river:
  - ▶ *Upstream sediment.* Table 20 in Appendix B summarizes the concentrations of the various substances detected in the sediment upstream of the Stauffer site. In the four investigations, 18 samples were collected, although not all locations were measured for every contaminant. CVS were exceeded only for arsenic and for one fluoride sample.
  - ▶ *Adjacent sediment.* Table 21 in Appendix B summarizes the concentrations of the contaminants detected in the 18 sediment samples collected adjacent to the Stauffer site. As with the upstream samples, CVS were only exceeded for arsenic and fluoride (in a single sample).
  - ▶ *Meyers Cove sediment.* Table 22 in Appendix B summarizes the concentrations of the various contaminants detected in the sediment from Meyers Cove. Although only arsenic, fluoride, radium-226, and polonium-210 exceeded their CVS, Meyers Cove tended to have higher concentrations than any other location on the



river for the majority of the contaminants including aluminum, arsenic, barium, chromium, silver, vanadium, zinc, phosphate-phosphorus, and total phosphorus. Of the samples collected in Meyers Cove, sample SC-SD-04, collected in 1988 approximately 15 feet from shore, showed the highest concentrations of multiple metals, fluoride, and total phosphorus.

- ▶ *Downstream sediment.* Table 23 in Appendix B summarizes the concentrations of contaminants detected in the sediment downstream of the site. Thallium was detected in a single sample at a concentration 1,000 times its CV. This was the only sample of sediment in which thallium was detected in the river and appears to be an anomaly. Arsenic was detected at concentrations above its CV, as it was in all other locations of the river. Downgradient sample locations near the mouth of the river indicated no elevated contaminant concentrations.
- An elaboration of substance-specific trends is presented below:
  - ▶ Taking into consideration data from every location, of all the contaminants tested, only *arsenic* was consistently detected at concentrations above its CV. Although arsenic was detected above CV in all sections of the river, samples taken both adjacent to the site and in Meyers Cove seem to have consistently higher detected concentrations and occur more frequently than either up or down stream.
  - ▶ *Fluoride* exceeded its CV in one sample at each of the upstream, adjacent, and Meyers Cove regions. The highest fluoride concentration was an estimated value from a sample upstream of the site 6 times greater than its CV. All three of the concentrations over the CV were part of the same study (NUS 1989) and were laboratory estimated quantities. With those three exceptions, fluoride concentrations in Meyers Cove are generally higher than concentrations elsewhere in the river. The 1991 sediment sampling program and 1993 RI measurements for fluoride were significantly and consistently lower than those measured by NUS for the ESI in 1989. According to investigators, if values measured away from the site area during the RI are considered background values, then those found in close proximity to the site are elevated (Weston 1993).
  - ▶ Concentrations of *phosphate-phosphorus, total phosphorus, and TOC* are highest at Meyers Cove. Although phosphorus is measured the highest and is elevated near or in Meyers Cove according to all studies, it is otherwise variable throughout the rest of the river and does not indicate a consistent pattern.
  - ▶ *Gross alpha and beta radiation* are higher in Meyers Cove than other portions of the river. *Radium-226 and polonium-210* were also highest in Meyers Cove. According to Weston (1993), gross alpha and beta radiation might be expected to have a large background concentration in a high phosphorous area such as southwestern Florida. The phosphorus-bearing formations in west central Florida (Bone Valley and Hawthorn formations) could cause not only elevated phosphorus concentrations but also unusually high numbers of uranium series

isotopes in surface waters all the way out to the continental shelf (Weston 1993). Concentrations of uranium series isotopes generally increase with proximity to the SCC site but are reportedly low for such a high phosphorus area (Weston 1993).