RECORD OF DECISION

Tin Products - Red Bank Creek

Red Bank, Lexington County, South Carolina

United States Environmental Protection Agency
Region 4
Atlanta, Georgia

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Tin Products - Red Bank Creek
City of Red Bank, Lexington County, South Carolina

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) documents the U.S. Environmental Protection Agency's (EPA's) selection of a remedial action to address the organotin contaminated sediments and surface water in the creeks and lakes/ponds associated with the site, and the potential human health and ecological risk, in accordance with the requirements of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA), 42 U.S.C. §9601 et seq. and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300. This decision document explains the factual and legal basis for selecting the remedy for the site.

The South Carolina Department of Health & Environmental Control (DHEC) has been consulted on the planned remedial action in accordance with CERCLA §121(f), 42 U.S.C. §9621(f), and concurs with the selected remedy at this site.

DESCRIPTION OF THE SELECTED REMEDY

EPA has determined that No Action is necessary to address the contamination at the Site. The Site poses no unacceptable current or potential threat to human health or the environment. Monitoring of aquatic life and organotin concentrations in the sediment and surface water will be conducted to verify that aquatic life continue to recover.

DECLARATION OF STATUTORY DETERMINATIONS

EPA has determined that its response action at this Site is complete. Because this is a decision for No Action, the statutory requirements of CERCLA Section 121 for remedial actions are not applicable and no statutory five year review will be undertaken.

Winston A. Smith (signature) — 9-22-03

Winston A. Smith
Director
Waste Management Division

Date

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1.0 SITE LOCATION AND DESCRIPTION

The Tin Products - Red Bank Creek Site, hereafter referred to as the "Site, is located in eastern Lexington County, South Carolina, southwest of Columbia, South Carolina. For the purposes of this investigation, the site consists of the portions of Red Bank and Congaree Creeks located downstream from the waste water treatment plant discharge pipe where the organotin contaminated waste water was released into the creek system. The Tin Products plant and the WWTP are also implicated with this release but were not specifically included in the definition of the site because of the nature of the release. The primary exposure pathways of concern were directly related to the discharge of contaminated liquids into the creek system, and not the transportation of these liquids through the sewer system. Both the Tin Products plant and the WWTP discharge pipe are being addressed by EPA's removal personnel under a separate action.

This investigation began at the point where the wastewater discharge pipe enters Red Bank Creek at the confluence of Muddy Springs Branch and Red Bank Creek, near the intersection of Robbie Road and Muddy Springs Road in Lexington, South Carolina. Red Bank Creek flows eastward approximately 1.9 miles into Crystal Lake and east (downstream) from the Highway 6 bridge. Crystal Lake is approximately 0.7 mile long and is approximately 18 feet deep near the dam on the eastern end. From the dam at Crystal Lake, Red Bank Creek continues for approximately 2.8 miles before emptying into Durham Pond. Durham Pond is approximately 0.6 mile long and approximately 8 feet deep near the dam on the eastern end. From the eastern end of Durham Pond, Red Bank Creek continues to the east approximately 1 mile before converging with Congaree Creek and Pole Branch. From this point, the creek is now called Congaree Creek and has a much broader flood plain. From the source area down to Congaree Creek, Red Bank Creek is about 8 feet wide, but widens significantly (over 30 feet wide in some locations) at the confluence with Congaree Creek. From the confluence of Red Bank Creek with Congaree Creek, Congaree Creek flows eastward approximately 9 miles to the Congaree River (DHEC, 2000; USGS, 1982). The site stretches through primarily rural, residential, and undeveloped land which includes portions of Red Bank Creek and also includes Crystal Lake, Durham Pond, and Congaree Creek.

2.0 HISTORY AND ENFORCEMENT ACTIVITIES

On February 12, 2000, local residents began reporting dead fish along Red Bank Creek. The South Carolina DHEC initially responded to the incident and tracked the source of the spill to the Tin Products, Inc., facility. Sometime during late January or early February 2000, personnel from the Tin Products facility released an unknown quantity of organotin compounds (trioctyltin and tributlytin) into their sewer lift station. As a result of the release, the organotin contaminated wastewater traveled through the sewer system to the Lexington County Joint Municipal Water and Sewer Commission (LCJMWSC) Waste Water Treatment Plant (WWTP) at Two Notch Road. The organotin contaminated wastewater killed off or substantially reduced the Plant's digestion microbes rendering the WWTP ineffective. What was normally treated water was released via the WWTP effluent into Red Bank Creek. Consequently, the WWTP was closed on February 28, 2000, and the

WWTP discharge pipe which discharges into Red Bank Creek was plugged.

The City of Cayce shut down a drinking water intake on Congaree Creek upon hearing about the release. This intake was located approximately 12 miles downstream of the release. DHEC issued an advisory warning against activities such as swimming, fishing, irrigating, or allowing pets and farm animals to have any contact with water in the posted areas of Red Bank and Congaree Creeks. To date, neither the WWTP nor the Cayce drinking water intake has reopened.

At DHEC's request, EPA's Emergency Response Program responded to the release incident on March 1, 2000, to evaluate the need for an alternate drinking water supply for the City of Cayce, and to perform a release investigation. As a result of their investigation, EPA's Emergency Response Program concluded that no emergency action was warranted for the creek systems.

The Tin Products plant was closed by DHEC in 2001 following several environmental incidents which occurred at the plant site. The first incident was the release of organotins to the sewer system in February 2000 which resulted in the fish kill at Red Bank and Congaree Creeks. The second incident consisted of a fire at the Tin Products plant on in February 2001 involving a scrubber vessel and several process lines. The third incident occurred in July 2001 and consisted of a spill of 4000 gallons of liquid containing acid and arsenic at the plant site. Tin Products abandon the plant property in 2002.

2.1 Additional Investigations

DHEC has conducted numerous sampling efforts in the creeks and areas associated with the Tin Products plant site. On February 13, 2000, DHEC received a complaint from a resident living near the WWTP about a colored discharge coming from the Tin Products plant. DHEC conducted an investigation and confirmed the discharge. During a subsequent visit on February 14, 2000, an unusual odor at the WWTP was traced to the lift station at Tin Products, Inc., where an unidentified foam was observed.

On February 15, 2000, DHEC, personnel also investigated the fish kill on Crystal Lake, collecting water samples and fish tissue samples. Three days later they expanded their sampling to include the WWTP, Red Bank Creek, Crystal Lake, Durham Pond, and Congaree Creek. Analyses indicated the presence of organotin compounds at most of the sampling stations. As a result of an apparent chemical release from the WWTP outfall, DHEC also conducted a macroinvertebrate assessment in Red Bank Creek in February 2000. This assessment concluded that Red Bank Creek was severely impacted downstream of the WWTP outfall and that Congaree Creek was found to show a slight impact immediately downstream of the confluence with Red Bank Creek.

On March 6, 2000, DHEC collected additional samples for toxicity testing from Red Bank Creek and the Congaree River. The results demonstrated reduced survival and reproduction of the test species in samples collected downstream of the WWTP outfall. Electro fishing results collected by DHEC at Crystal Lake and Durham Pond in March 2000 indicated that 1) most if not all of the fish had been killed, and 2) fish tissues contained measurable concentrations of organotin compounds.

Lexington County has also performed investigations of the organotin release to Red Bank Creek. During 2000 and 2001 Lexington County collected fish & mussel tissue samples from areas along Red Bank Creek. Their initial sampling event yielded their highest concentrations of butyltins, while the later sampling revealed an approximate 50 percent decline in butyltin concentrations.

EPA's emergency response personnel performed a removal action at the Plant site beginning in May 2002 and ending in October 2002. Removal actions consisted of decontaminating the plant, demolishing stannic chloride and organotins facilities, recycling the metals and removal of residual waste materials. Tanks and vessels were decontaminated and left on site for future owners. The total cost of the removal action was $2,075,230.

2.2 Remedial Investigation

EPA also began a Remedial Investigation of the Site in September 2000. The decision to perform this investigation was based on the high toxicity values for organotins on aquatic organisms, the persistent nature of organotins in marine environments, and the absence of investigations supporting the behavior of organotins within freshwater environments. The Remedial Investigation focused primarily on the discharge to surface water, but also included a limited investigation of groundwater at or near the point where the discharge pipe enters Red Bank Creek.

At EPA's request, two additional investigations were performed at this Site. The U.S. Army Engineer Research and Development Center Coastal and Hydraulics Laboratory, performed an assessment of sediment transport characteristics along Red Bank Creek. Only the initial phase of this investigation was completed. Because the human health and ecological risk assessments did not demonstrate significant risk justifying remedial action, there was no need to complete the final phase of the sediment transport modeling. The second investigation was performed by United States Geological Survey (USGS) who evaluated the biodegradation of tributyltin in sediments along Red Bank Creek. The USGS investigation is discussed in detail later within this Record of Decision.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Community concern for the Site has been ongoing since 1994. Residents initially voiced opposition to the building of the Tin Products plant when it was proposed for construction in 1994, primarily because of past practices of its parent company Cardinal Chemical. Following the news reports of the fish kill associated with the release of organotins in February 2000, and the plant fire in 2001, community concern for this Site has remained moderate to high.

To address these concerns, EPA developed a Community Relations plan which included community interviews, an availability session and an RI/FS kick off meeting. The community interviews were performed during May 1-3, 2001. EPA held a kick off meeting on May 3, 20001, to summarize EPA's response actions to date and to outline plans for the Remedial Investigation. The availability session was held on April 10, 2001, primarily to meet with property owners to discuss property access issues during the RI/FS sampling event.

After completing the Remedial Investigation, EPA established an information repository at EPA Region IV, and at the Lexington County Main Branch Library. A notice was published in both the *The State* and *Lexington County Chronicle & The Dispatch News* indicating the availability of the information repository and the opening of the public comment period which began on June 18, 2003 and ended on July 18, 2003.

On June 19, 2003, EPA held a public meeting at the Red Bank Elementary School to discuss the results of the remedial investigation and the Proposed Plan for the Site. EPA received comments on the Proposed Plan, and responded to questions from area residents and other interested parties. Public interest for the site was considerable based on the number of residents which attended the meeting and the comments presented during the meeting. Several written comments were submitted during the public comment period. Responses to these comments are provided as Appendix C.

4.0 SCOPE AND ROLE OF NO ACTION REMEDY

This Record of Decision reflects EPA's determination that no CERCLA action is required at the Tin Products - Red Bank Creek Site. The risk assessments concluded that conditions at the Site pose no unacceptable risk to human health and the environment. Based on the levels of organotins that were detected in the soils, sediments, surface water, and groundwater, and the unlikely future exposure to the groundwater in a limited area immediately adjacent to the discharge pipe, EPA has determined that the potential for adverse ecological and human health risks from the site are unlikely. Limited monitoring of the sediment for organotin concentrations, and monitoring of aquatic organisms to verify their repopulation will be conducted. The scope and frequency of the monitoring will be adjusted as necessary, based on the sampling results. This monitoring is not to be interpreted as a Monitored Natural Attenuation remedy.

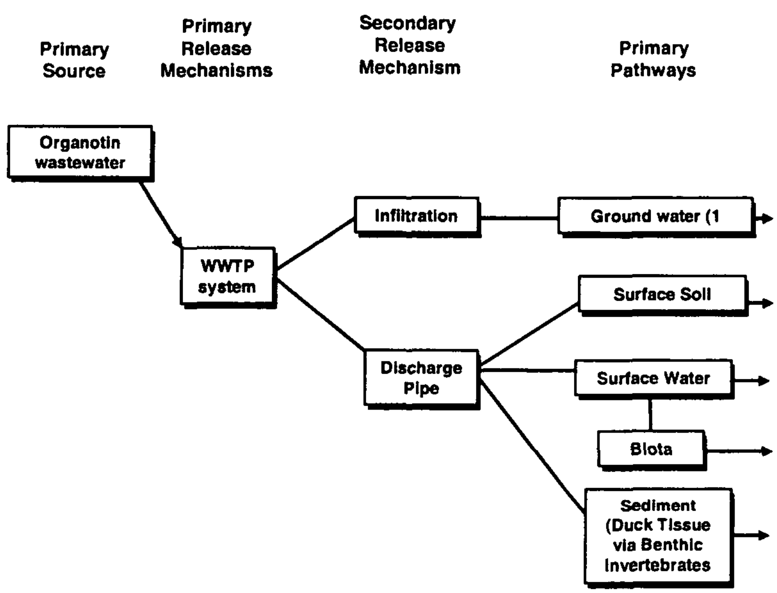
5.0 SUMMARY OF SITE CHARACTERISTICS

The Remedial Investigation focused primarily on surface soil, surface water and sediment in the Red Bank and Congaree Creeks, and to a limited extent the groundwater quality in the general area where the discharge pipe entered Red Bank Creek.. The Conceptual Site Model can be seen in Figure G-2. The primary source was the organotin contaminated liquid generated by the Tin Products Plant. The Tin Products plant discharged the organotin contaminated liquid into the WWTP system (primary release mechanism). The WWTP system in turn released the organotin contaminated liquid into Red Bank Creek (secondary release mechanism). This secondary release mechanism resulted in the primary exposure pathways of concern presented in the Conceptual Site Model.

The majority of the contaminated liquid was flushed out of the WWTP system and the creek systems (Red Bank Creek and Congaree Creek) after the February 2000 discharge from the Tin Products Plant. The nature of the primary release mechanism (i.e. liquids into the sewer system) did not result in extensive contaminant migration beyond the actual WWTP discharge pipe as discussed later in Section 5.4. The bulk of the contaminant mass remaining at this site is located primarily in the creek sediments.

All of the surface soil, surface water, sediment, and groundwater samples were analyzed for the following organotin compounds: tetrabutyltin, tributyltin, dibutyltin, and monobutyl tin. Additionally some octyltins were detected as miscellaneous compounds (tetraoctyltin and trioctyltin only). In addition to the organotin analysis, a percentage of the samples were also analyzed for the

Figure G-2
Human Health Conceptual Site Model
Tin Products/Red Bank Creek Site
Lexington, Lexington County, South Carolina



POTENTIAL HUMAN RECEPTORS

EXPOSURE ROUTE	CURRENT/FUTURE: Child Swimmer	Adult Swimmer	Adolescent Swimmer	Adolescent Visitor	Adult Resident	Child Resident	Recreational Fisher	Hunter
Ingestion					•	•		
Inhalation					•	•		
Dermal Contact					•	•		
Ingestion	•	•	•	•	X	X		•
Inhalation	•	•	•	•	•	•		•
Dermal Contact	•	•	•	•	X	X		•
Ingestion	X	X	X	X	X	X		
Inhalation	•	•	•	•	•	•		
Dermal Contact	X	X	X	X	X	X		
Ingestion							X	
Inhalation							•	
Dermal Contact							•	
Ingestion								X
Inhalation								•
Dermal Contact								•

X Pathway was quantitatively evaluated
• Pathway was qualitatively evaluated
(1) No chemicals of concern were retained for groundwater

following Contract Laboratory Target Compound List (TCL) and Target Analyte List (TAL) parameter groups: volatile organics, semivolatile organics, pesticides/PCBs, metals, cyanide, and tin.

The investigation performed by United States Geological Survey evaluated the biodegradation of tributyltin in sediments along Red Bank Creek. A summary of the USGS investigation is provided later within this section.

5.1 Soil

A total of 9 surface soil samples were collected during the Phase I RI field investigation and submitted for chemical analysis. While all nine samples were analyzed for organotins, three of the surface soil samples collected were analyzed for the TCL/TAL groups. The soil sampling locations are presented in Figure 5-1.

5.1.1 TCL/TAL analysis

Analyses of the three surface soil samples did not detect any analytes above EPA Region 9 (Preliminary Remediation Goals) PRGs, or above two times background. In absence of an established screening value for inorganic analytes in soil, the average background concentration of each analyte was calculated and multiplied by 2 and used as a benchmark to determine relatively elevated concentrations of those analytes. Tables 5-2 (inorganic data) and 5-3 (organic data) present detects of all the TCL/TAL data for surface soils collected during the Phase I RI investigation

5.1.2 Organotin analysis

Each of the 9 surface soil samples were analyzed for organotin compounds (monobutyltin, dibutyltin, tributyltin, and tetrabutyltin) and screened against residential soil PRG of 18,000 ug/kg for tributyltin oxide. Tables 5-4 present detects of all the organotin data for surface soils.

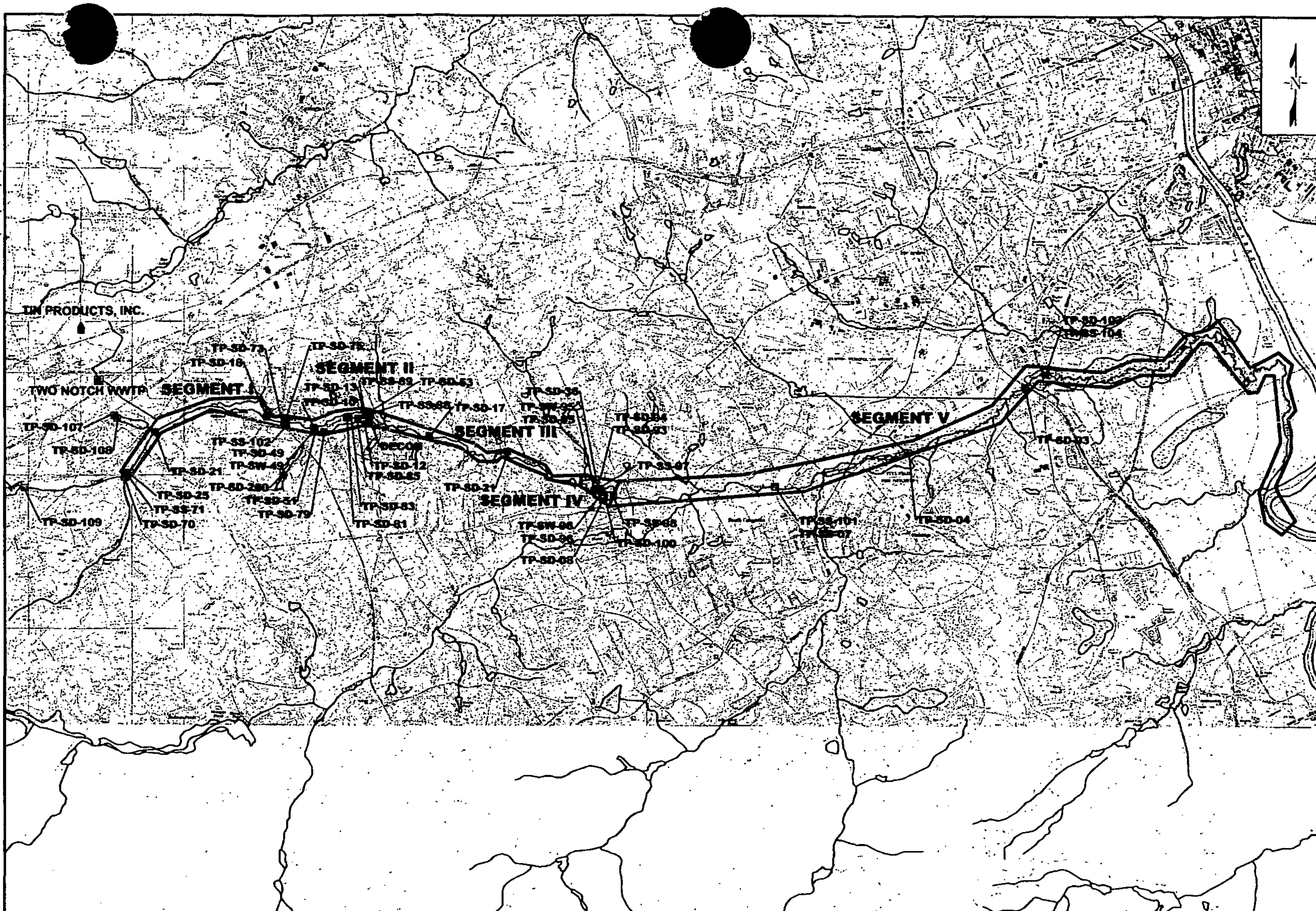
Analyses of these surface soil samples did not detect any analytes above the residential soil PRG value. The only detectable concentrations of organotin compounds were in samples TP-SS-102 (near the Beaver Pond Area), TP-SS-101(adjacent to the former Pine Street Swimming Hole, and TP-SS-104 (within the unnamed recreation area near the intersection of Highway 321 and Congaree Creek). Monobutyltin was detected in TP-SS-102 (33 ug/kg) and TP-SS-104 (14 ug/kg). None of the organotin detections exceeded the residental soil PRG of 18,000 ug/kg.

5.2 Sediment

A total of 51 sediment samples (including duplicate samples) were collected during the Phase I RI field effort. Of these 51 sediment samples, 40 (including all of the duplicates) were collected from approximately 0 to 2 inch interval for comparison to the historical sampling depths. The remaining 11 sediment samples were from collected from approximately 2 inches to 4 inches to observe a potential vertical profile of organotin contamination in these areas.

The rationale for selecting the sediment sampling locations fell into one of the following three categories. First, samples were re-collected at the locations of previous investigations to determine if sediment-bound organotin concentrations have changed over time. These stations consisted of TP-

CAD DWG NO: Location_1.dwg
DATE: 02-07-02
PLOT SCALE: 1=1
ORIGINAL DWG SIZE 11 x 17
LOCATION: 48135\109\Final\Maps
MOST RECENT REVISION DATE ...3-03
DRAFTERS INITIALS: ACM



LEGEND

RI STREAM SEGMENTS

ROADS

STREAMS

PIPELINES

SD - SEDIMENT

SW - SURFACE WATER

SS - SURFACE SOIL

TP - TIN PRODUCTS

TIN PRODUCTS/
RED BANK CREEK

LEXINGTON COUNTY, SOUTH CAROLINA

SCALE: 1"= 2000'

BV	TIN PRODUCTS/RED BANK CREEK LEXINGTON COUNTY, SOUTH CAROLINA	SEGMENT AND SAMPLE LOCATION MAP	FIGURE 5-1

59 0010

SD-21, TP-SD-18, TP-SD-10, TP-SD-49, TP-SD-51, TP-SD-53, TP-SD-13, TP-SD-17, TP-SD-36, TP-SD-08, TP-SD-100, TP-SD-04, TP-SD-07, and TP-SD-03. These samples are referred to as over-time comparison samples. Second, some sample locations were designated for sampling with a coring device in order to evaluate the vertical profile of contamination in areas assumed to be located in sediment traps. Eleven of the sediment samples were collected over the 0-2 inch and 2-4 inch interval and used to evaluate the vertical profile of contamination (TP-SD-36, TP-SD-93u, TP-SD-94u, TP-SD-100u, TP-SD-75, TP-SD-49, TP-SD-81, TP-SD-83, TP-SD-85, TP-SD-12, and TP-SD-17). This deeper sampling interval was selected primarily to establish a concentration differential, and was not intended to establish the maximum depth of contamination. More specifically the selection of the 2-4 inch interval was made to evaluate the organotin concentrations immediately beneath the 0-2 inch sediment interval for areas in and immediately downstream of historically high areas of sediment contamination. The locations and sampling depths were made without the benefit of any site specific sedimentation study. Third, some of the samples were collected from areas with high human contact potential as suggested in the Human Health Risk Screening report that was submitted to EPA Region 4 on January 2, 2001 (Black & Veatch , 2001b). All sediment sampling locations are presented in Figure 5-1

5.2.1 TCL/TAL analysis

A total of fifteen out of fifty one sediment samples were analyzed for TCL/TAL parameters. Tables 5-6 through 5-13 present detects of all the TCL/TAL data for sediments. All of these samples were collected from the 0 to 2-inch depth range. Three of these samples contained constituents exceeding established screening criteria [EPA Region 4 Sediment Screening Values (SSVs)] (EPA, 2001a). These samples consisted of samples TP-SD-10, TP-SD-76 and sample TP-SD-106. Sample TP-SD-10, ~~was~~ collected near the headwaters of Crystal Lake, contained an estimated 920 ug/kg of bis(2-ethylhexyl) phthalate which exceeded the EPA Region 4 SSV of 182 ug/kg. Sample TP-SD-76, collected from the beaver dam area, contained several polyaromatic hydrocarbons that exceeded ecological screening values. These include benzo(a)anthracene (360 mg/kg), chrysene (390 mg/kg), fluoranthene (840 mg/kg), phenanthrene (490 mg/kg), and pyrene (730 mg/kg). Sample TP-SD-106, collected from Congaree Creek near its confluence with Congaree River, contained 65 mg/kg of lead which exceeded EPA Region 4 SSV of 30.2 mg/kg.

Several sediment samples contained inorganic constituents in excess of two times the established average background concentration for this site. These samples consisted of TP-SD-10/10D, TP-SD-21, TP-SD-49, TP-SD-53/53D, TP-SD-76, TP-SD-81, TP-SD-92, TP-SD-95, TP-SD-106, and TP-SD-107. Several inorganic constituents were detected throughout the site in concentrations greater than two times background; however, all inorganics except one detect of lead in sample TP-SD-106 were below established screening criteria. While the frequency of inorganic detections above background suggests these analytes likely originated from the WWTP discharge into Red Bank Creek, their low concentrations in sediment do not indicate a problem.

5.2.2 Organotin analysis

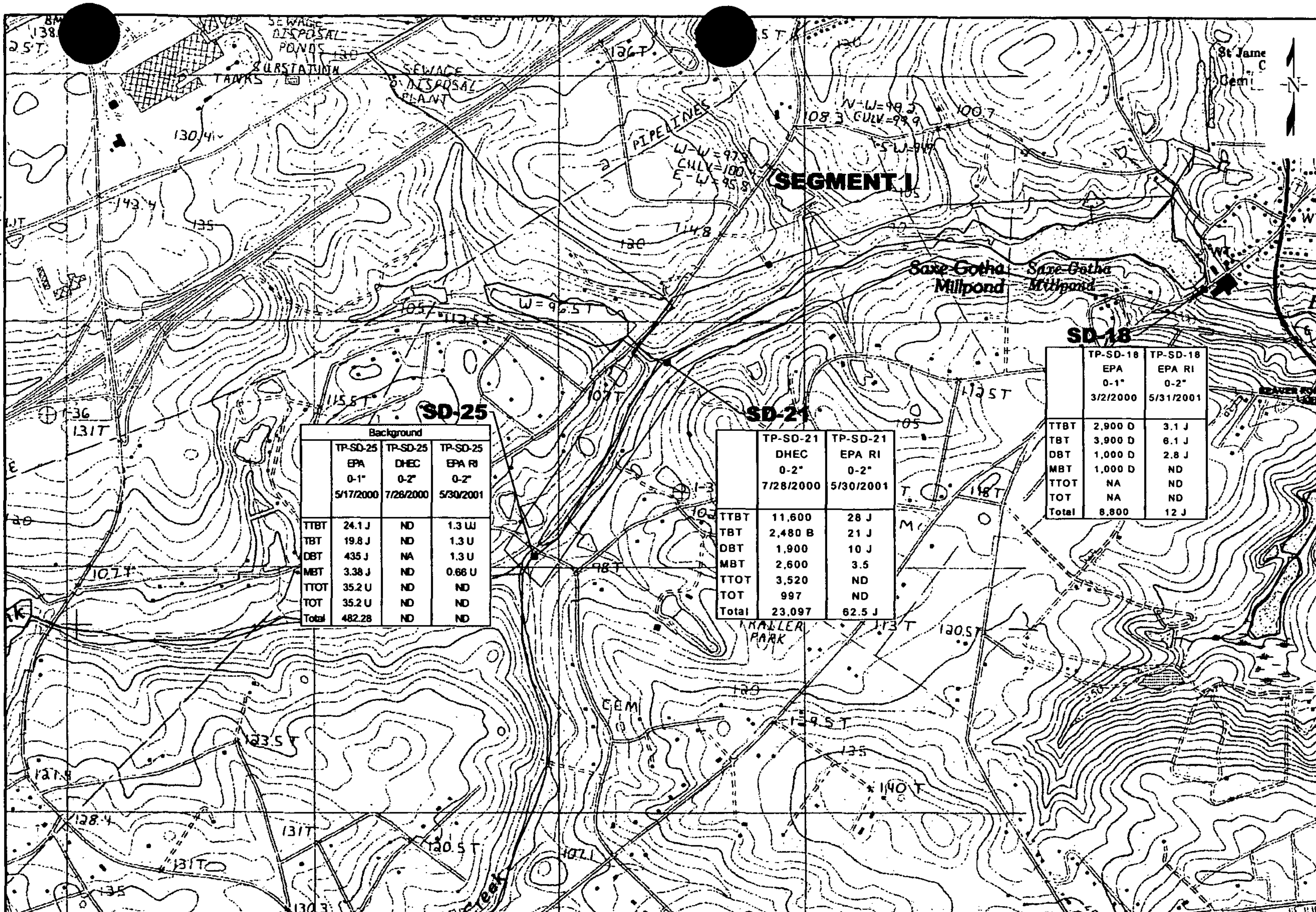
All of the 51 sediment samples collected were analyzed for organotin compounds, with a limited number of samples analyzed for elemental tin. Tables 5-14 through 5-18 present detects of all the organotin data for sediment samples collected during the Phase I RI investigation. The analytical results demonstrate that the majority of these sediment samples contained organotins. For clarification and ease of discussion, only the sediment samples which exceeded an ecological PRG value of 722 ug/kg total tributyltins (derived from the Ecological Risk Assessment) are discussed in the following paragraphs. No sediment PRG values for human health exist at this time because EPA Region IV Guidance (EPA 1995) states that sediment covered by surface water is likely to be washed off before significant exposure occurs. However, in consideration of the extensive recreational activities associated with Crystal Lake and Durham Pond, the sediment samples were screened against the tributyltin oxide PRG of 18, 000 ug/kg. This represents a very conservative approach which would overestimate the site risk.

Samples TP-SD-75 and TP-SD-73 contained the highest concentration of organotins throughout the investigation area. Both of these samples were located in the beaver dam area upstream from Crystal Lake and were collected from 0-2 inch sampling depth range. Sample TP-SD-75 contained the highest concentrations of each octyltin compound detected and the highest butyltin compound concentrations except monobutyltin which was higher only in TP-SD-73. The total combined organotin concentration for TP-SD-75 is estimated at 44,370 ug/kg and the second highest total organotin concentration (7,590 ug/kg) was identified in TP-SD-73. Sampling results from station TP-SD-75 at 2- 4 inch sampling depth demonstrated the third highest total organotin concentrations (3,592 ug/kg) detected in the investigation area. Total organotin concentration in samples TP-SD-76 (947 J ug/kg) also exceeded the 722 ug/kg ecological screening value. All of these sampling results are from the Phase 1 sampling investigation performed in June 2001.

No consistent pattern of organotin distribution was observed in the sediment except that it appears that the relatively low energy of Red Bank Creek upon entering Beaver Pond Area, and to a lesser extent Crystal Lake, may have slowed stream flow significantly for a substantial portion of organotin-laden sediment to fall out of suspension, or additionally, perhaps the slower flowing conditions in this portion of Red Bank Creek may have facilitated organotins from the spill to remain in contact with sediment in the Beaver Pond Area for a longer period of time. The Beaver Pond Area has higher organotin concentrations than any other area of the site that was sampled. This is not surprising considering that Beaver Pond Area is the first sediment trap downstream from the WWTP discharge into Red Bank Creek.

It is worth mentioning that each sediment sample with detects of organotin compounds in the 2 to 4-inch depth range contained lower organotin concentrations than those collected at the same location in the 0 to 2-inch depth range with one exception. Sediment sample TP-SD-81 (2 to 4-inch depth) had higher concentrations of each organotin compounds detected than those in the 0 to 2-inch depth range at the same location, although the difference in total organotin concentrations (16.3 ug/kg versus 24.2 ug/kg) is small. However, this does suggests possible sedimentation may have occurred in the general area of sample location TP-SD-81.

5.2.3 USGS degradation study



Background			
	TP-SD-25 EPA 0-1" 5/17/2000	TP-SD-25 DHEC 0-2" 7/26/2000	TP-SD-25 EPA RI 0-2" 5/30/2001
TTBT	24.1 J	ND	1.3 UJ
TBT	19.8 J	ND	1.3 U
DBT	435 J	NA	1.3 U
MBT	3.38 J	ND	0.66 U
TTOT	35.2 U	ND	ND
TOT	35.2 U	ND	ND
Total	482.28	ND	ND

	TP-SD-21 DHEC 0-2" 7/28/2000	TP-SD-21 EPA RI 0-2" 5/30/2001
TTBT	11,600	28 J
TBT	2,480 B	21 J
DBT	1,900	10 J
MBT	2,600	3.5
TTOT	3,520	ND
TOT	997	ND
Total	23,097	62.5 J

	TP-SD-18 EPA 0-1" 3/2/2000	TP-SD-18 EPA RI 0-2" 5/31/2001
TTBT	2,900 D	3.1 J
TBT	3,900 D	6.1 J
DBT	1,000 D	2.8 J
MBT	1,000 D	ND
TTOT	NA	ND
TOT	NA	ND
Total	8,800	12 J

END

RI STREAM SEGMENTS
ROADS
STREAMS
PIPELINES

SD - SEDIMENT
SW - SURFACE WATER
SS - SURFACE SOIL

TTBT - Tetrabutyltin
TBT - Tributyltin
DBT - Dibutyltin
MBT - Monobutyltin
TTOT - Tetraoctyltin
TOT - Trioctyltin
Total - Total organotin compounds detected (in ppb)

NA - Not Analysed
ND - The analyte was analyzed for but was not detected above the reported sample quantitation limit.
U - The analyte was analyzed for but was not detected above the reported sample quantitation limit. The value is the sample quantitation limit.
J - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

DHEC - South Carolina Department of Health and Environmental Compliance.

LC - Lexington County Joint Water and Sewer Commission. Samples were collected by a subcontractor.

EPA - U.S. Environmental Protection Agency. Samples were collected by the agency or an agency contractor.

All concentrations are listed in parts per billion (ppb)

TIN PRODUCTS/
RED BANK CREEK

LEXINGTON COUNTY,
SOUTH CAROLINA

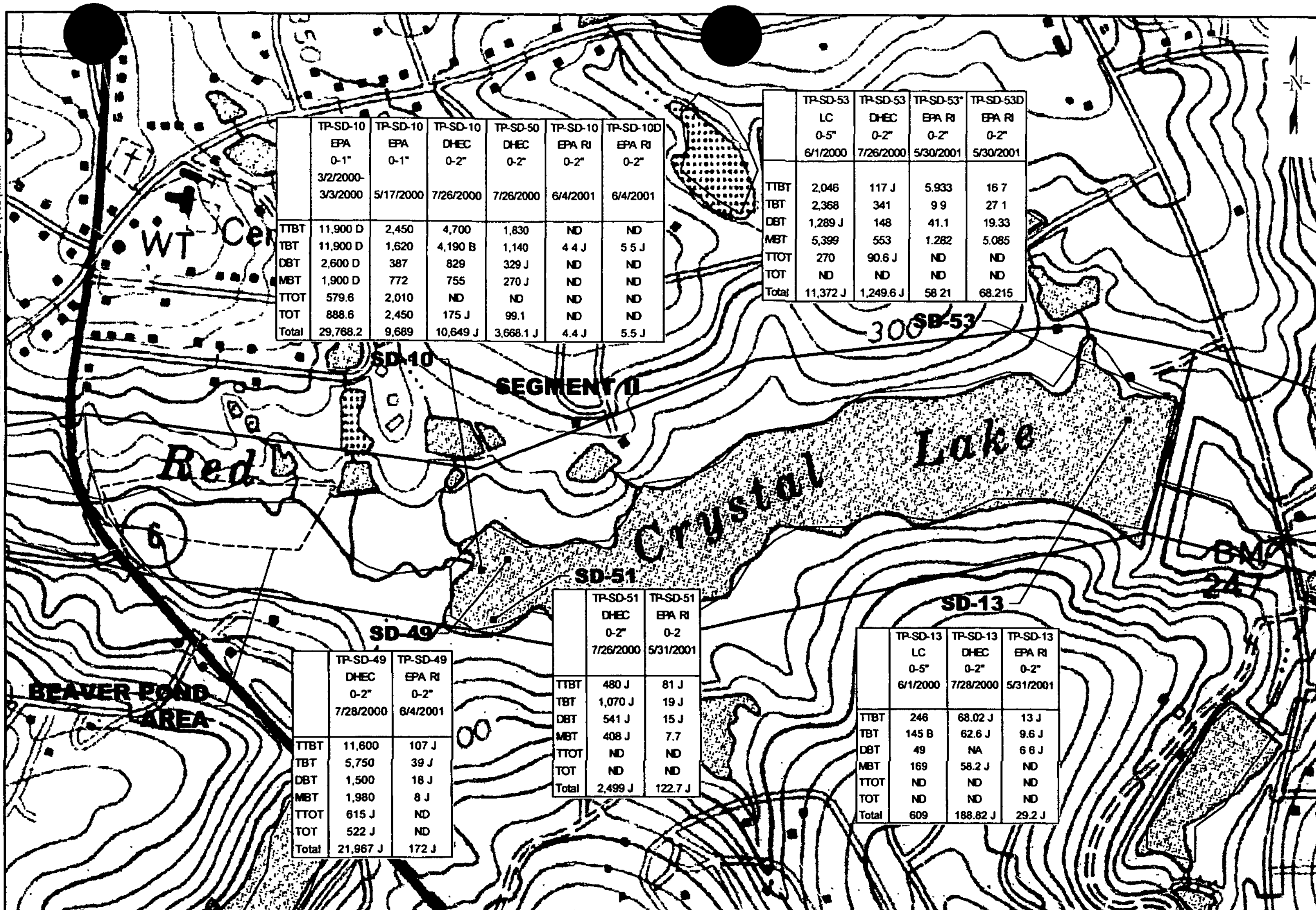
SCALE: 1"= 1300'

TIN PRODUCTS/RED BANK CREEK
LEXINGTON COUNTY, SOUTH CAROLINA

SEGMENT I - SEDIMENT ORGANOTIN CONCENTRATIONS OVER TIME
JUNE 2001 - REMEDIAL INVESTIGATION

FIGURE
5-14

CAD DWG NO: OTin_SD_OT_N.dwg ORIGINAL DWG SIZE 11 x 17 MOST RECE... ISION
DATE: 02-07-02 ACM REVISION DA... 3-28-03
PLOT SCALE: 1=1 LOCATION: R:\48135\109\RIFinal DRAFTERS INITIALS: ACM



	TP-SD-10 EPA 0-1" 3/2/2000-3/3/2000	TP-SD-10 EPA 0-1" 5/17/2000	TP-SD-10 DHEC 0-2" 7/26/2000	TP-SD-50 DHEC 0-2" 7/26/2000	TP-SD-10 EPA RI 0-2" 6/4/2001	TP-SD-10D EPA RI 0-2" 6/4/2001
TTBT	11,900 D	2,450	4,700	1,830	ND	ND
TBT	11,900 D	1,620	4,190 B	1,140	4 4 J	5 5 J
DBT	2,600 D	387	829	329 J	ND	ND
MBT	1,900 D	772	755	270 J	ND	ND
TTOT	579.6	2,010	ND	ND	ND	ND
TOT	888.6	2,450	175 J	99.1	ND	ND
Total	29,768.2	9,689	10,649 J	3,668.1 J	4.4 J	5.5 J

	TP-SD-53 LC 0-5" 6/1/2000	TP-SD-53 DHEC 0-2" 7/26/2000	TP-SD-53* EPA RI 0-2" 5/30/2001	TP-SD-53D EPA RI 0-2" 5/30/2001
TTBT	2,046	117 J	5.933	16 7
TBT	2,368	341	9 9	27 1
DBT	1,289 J	148	41.1	19.33
MBT	5,399	553	1.282	5.085
TTOT	270	90.6 J	ND	ND
TOT	ND	ND	ND	ND
Total	11,372 J	1,249.6 J	58 21	68.215

	TP-SD-49 DHEC 0-2" 7/28/2000	TP-SD-49 EPA RI 0-2" 6/4/2001
TTBT	11,600	107 J
TBT	5,750	39 J
DBT	1,500	18 J
MBT	1,980	8 J
TTOT	615 J	ND
TOT	522 J	ND
Total	21,967 J	172 J

	TP-SD-51 DHEC 0-2" 7/26/2000	TP-SD-51 EPA RI 0-2 5/31/2001
TTBT	480 J	81 J
TBT	1,070 J	19 J
DBT	541 J	15 J
MBT	408 J	7.7
TTOT	ND	ND
TOT	ND	ND
Total	2,499 J	122.7 J

	TP-SD-13 LC 0-5" 6/1/2000	TP-SD-13 DHEC 0-2" 7/28/2000	TP-SD-13 EPA RI 0-2" 5/31/2001
TTBT	246	68.02 J	13 J
TBT	145 B	62.6 J	9.6 J
DBT	49	NA	6 6 J
MBT	169	58.2 J	ND
TTOT	ND	ND	ND
TOT	ND	ND	ND
Total	609	188.82 J	29.2 J

END

RI STREAM SEGMENTS

ROADS

STREAMS

PIPELINES

SD - SEDIMENT
SW - SURFACE WATER
SS - SURFACE SOIL

TTBT - Tetrabutyltin
TBT - Tnbutyltin
DBT - *Dibutyltin*
MBT - Monobutyltin
TTOT - Tetraoctyltin
TOT - Trioctyltin
Total - Total organotin compounds detected (in ppb)

NA - Not Analysed
ND - The analyte was analyzed for but was not detected above the reported sample quantitation limit.
U - The analyte was analyzed for but was not detected above the reported sample quantitation limit. The value is the sample quantitation limit.
J - The analyte was positively identified; the associated numencal value is the approximate concentration of the analyte in the sample

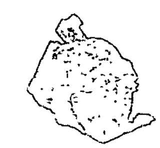
DHEC - South Carolina Department of Health and Environmental Compliance.

LC - Lexington County Joint Water and Sewer Commission. Samples were collected by a subcontractor.

EPA - U.S. Environmental Protection Agency. Samples were collected by the agency or an agency contractor.

All concentrations are listed in parts per billion (ppb)

TIN PRODUCTS/
RED BANK CREEK



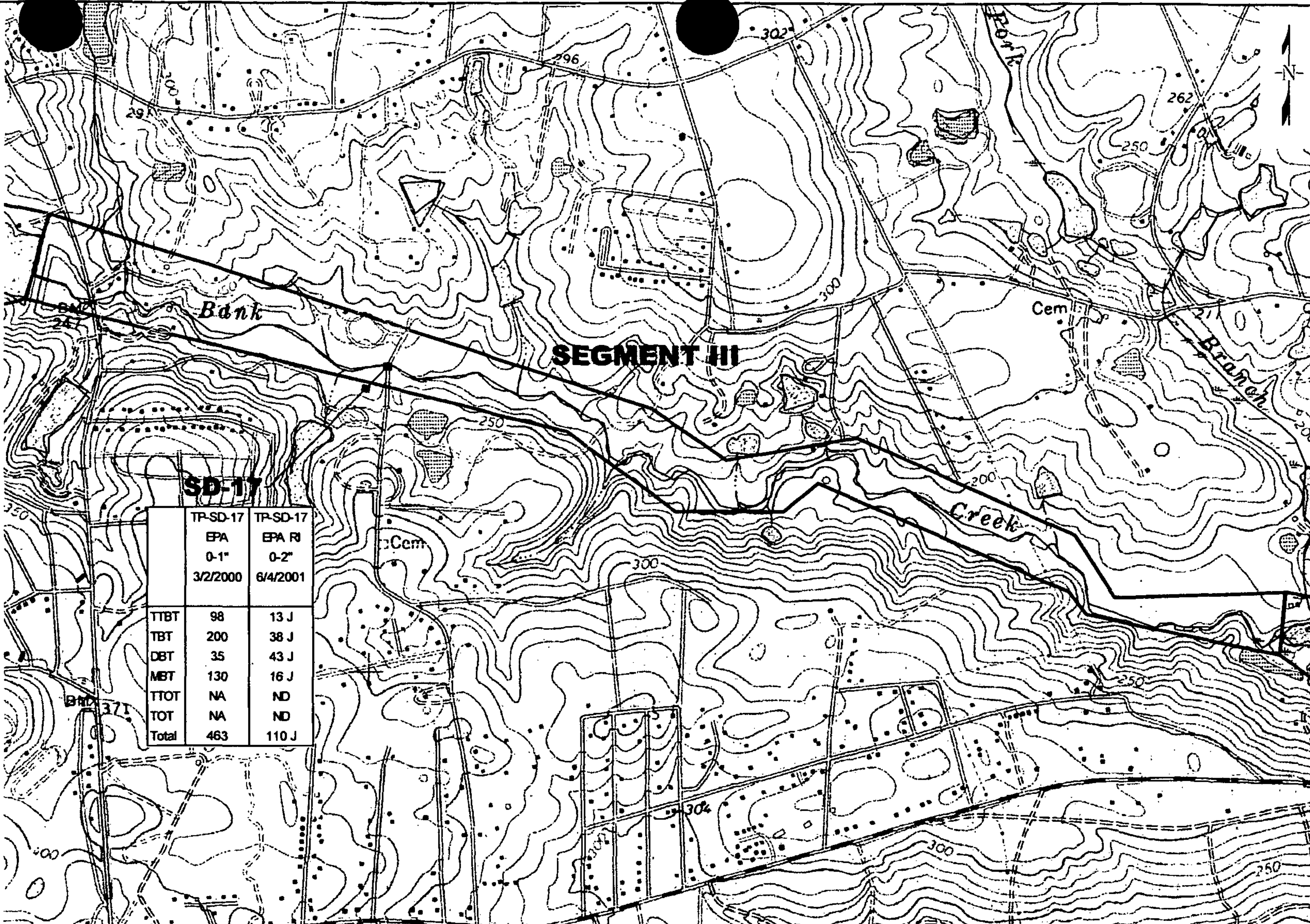
LEXINGTON COUNTY, SOUTH CAROLINA

SCALE: 1"= 500'

TIN PRODUCTS/RED BANK CREEK
LEXINGTON COUNTY, SOUTH CAROLINA

SEGMENT II - SEDIMENT ORGANOTIN CONCENTRATIONS OVER TIME
JUNE 2001 - REMEDIAL INVESTIGATION

FIGURE
5-15



	TP-SD-17 EPA 0-1" 3/2/2000	TP-SD-17 EPA RI 0-2" 6/4/2001
TTBT	98	13 J
TBT	200	38 J
DBT	35	43 J
MBT	130	16 J
TTOT	NA	ND
TOT	NA	ND
Total	463	110 J

LEGEND

RI STREAM SEGMENTS

ROADS

STREAMS

PIPELINES

SD - SEDIMENT
SW - SURFACE WATER
SS - SURFACE SOIL

TTBT - Tetrabutyltin
TBT - Tributyltin
DBT - Dibutyltin
MBT - Monobutyltin
TTOT - Tetraoctyltin
TOT - Trioctyltin
Total - Total organotin compounds detected (in ppb)

NA - Not Analysed
ND - The analyte was analyzed for but was not detected above the reported sample quantitation limit.
U - The analyte was analyzed for but was not detected above the reported sample quantitation limit. The value is the sample quantitation limit.
J - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

DHEC - South Carolina Department of Health and Environmental Compliance.

LC - Lexington County Joint Water and Sewer Commission. Samples were collected by a subcontractor.

EPA - U.S. Environmental Protection Agency. Samples were collected by the agency or an agency contractor.

All concentrations are listed in parts per billion (ppb)

TIN PRODUCTS/
RED BANK CREEK

LEXINGTON COUNTY,
SOUTH CAROLINA

SCALE: 1"= 1100'

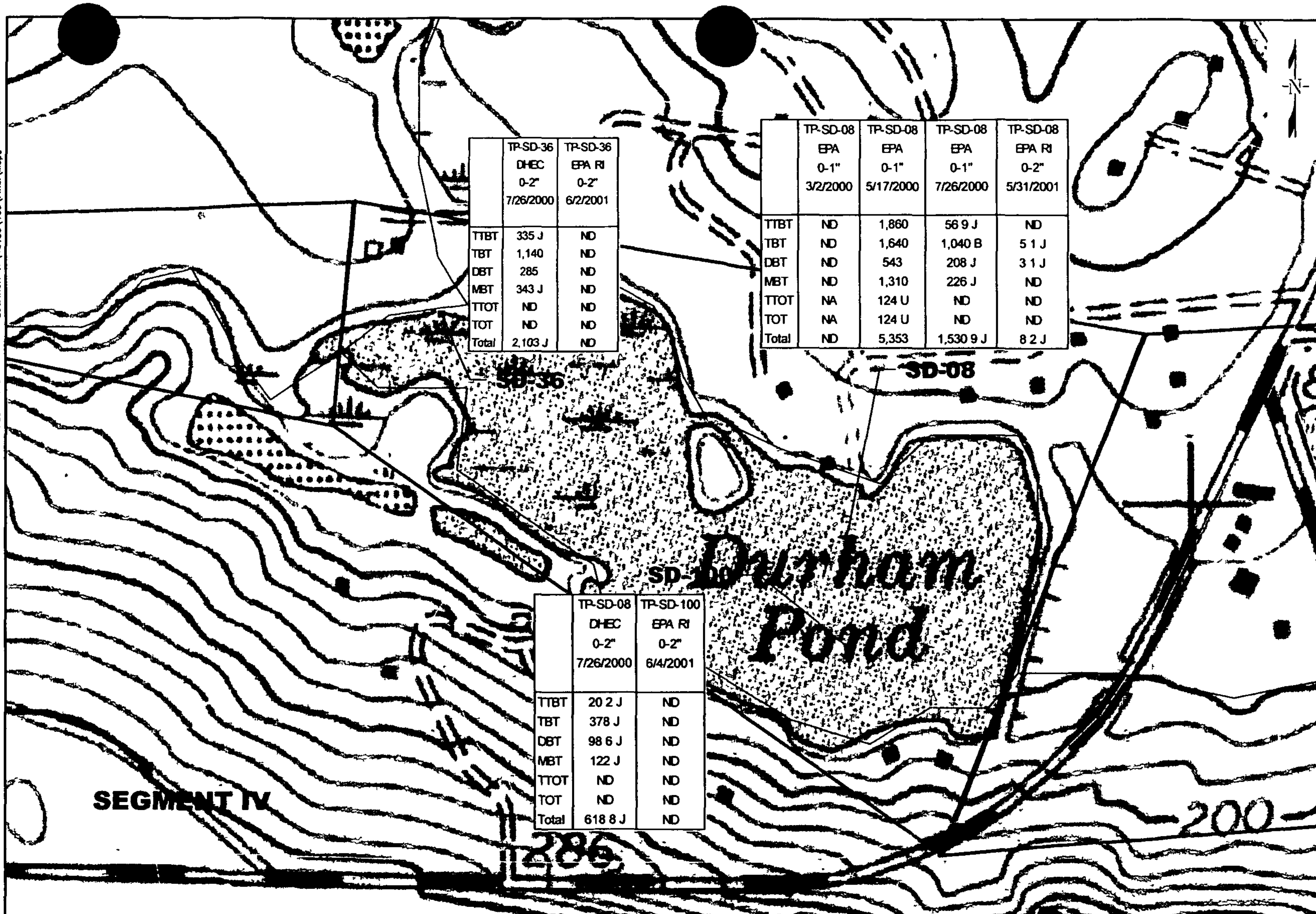
TIN PRODUCTS/RED BANK CREEK
LEXINGTON COUNTY, SOUTH CAROLINA

SEGMENT III - SEDIMENT ORGANOTIN CONCENTRATIONS OVER TIME
JUNE 2001 - REMEDIAL INVESTIGATION

FIGURE
5-16

59 0015

CAD DWG NO OTIn_SD_OT dwg DATE 02-07-02 ACM PLOT SCALE 1=1 ORIGINAL DWG SIZE 11 x 17 LOCATION R:\48135\109\Final\Maps MOST RECENT REVISION DATE 03-13-03 DRAFTERS INITIALS ACM



	TP-SD-36 DHEC 0-2" 7/26/2000	TP-SD-36 EPA RI 0-2" 6/2/2001
TTBT	335 J	ND
TBT	1,140	ND
DBT	285	ND
MBT	343 J	ND
TTOT	ND	ND
TOT	ND	ND
Total	2,103 J	ND

	TP-SD-08 EPA 0-1" 3/2/2000	TP-SD-08 EPA 0-1" 5/17/2000	TP-SD-08 EPA 0-1" 7/26/2000	TP-SD-08 EPA RI 0-2" 5/31/2001
TTBT	ND	1,860	56 9 J	ND
TBT	ND	1,640	1,040 B	5 1 J
DBT	ND	543	208 J	3 1 J
MBT	ND	1,310	226 J	ND
TTOT	NA	124 U	ND	ND
TOT	NA	124 U	ND	ND
Total	ND	5,353	1,530 9 J	8 2 J

	TP-SD-08 DHEC 0-2" 7/26/2000	TP-SD-100 EPA RI 0-2" 6/4/2001
TTBT	20 2 J	ND
TBT	378 J	ND
DBT	98 6 J	ND
MBT	122 J	ND
TTOT	ND	ND
TOT	ND	ND
Total	618 8 J	ND

LEGEND

RI STREAM SEGMENTS
ROADS
STREAMS
PIPELINES

SD - SEDIMENT
SW - SURFACE WATER
SS - SURFACE SOIL

TTBT - Tetrabutyltin
TBT - Tributyltin
DBT - Dibutyltin
MBT - Monobutyltin
TTOT - Tetraoctyltin
TOT - Trioctyltin
Total - Total organotin compounds detected (in ppb)

NA - Not Analysed
ND - The analyte was analyzed for but was not detected above the reported sample quantitation limit
U - The analyte was analyzed for but was not detected above the reported sample quantitation limit. The value is the sample quantitation limit.
J - The analyte was positively identified, the associated numerical value is the approximate concentration of the analyte in the sample

DHEC - South Carolina Department of Health and Environmental Compliance

LC - Lexington County Joint Water and Sewer Commission Samples were collected by a subcontractor

EPA - U S Environmental Protection Agency Samples were collected by the agency or an agency contractor

All concentrations are listed in parts per billion (ppb)

TIN PRODUCTS/ RED BANK CREEK

LEXINGTON COUNTY, SOUTH CAROLINA

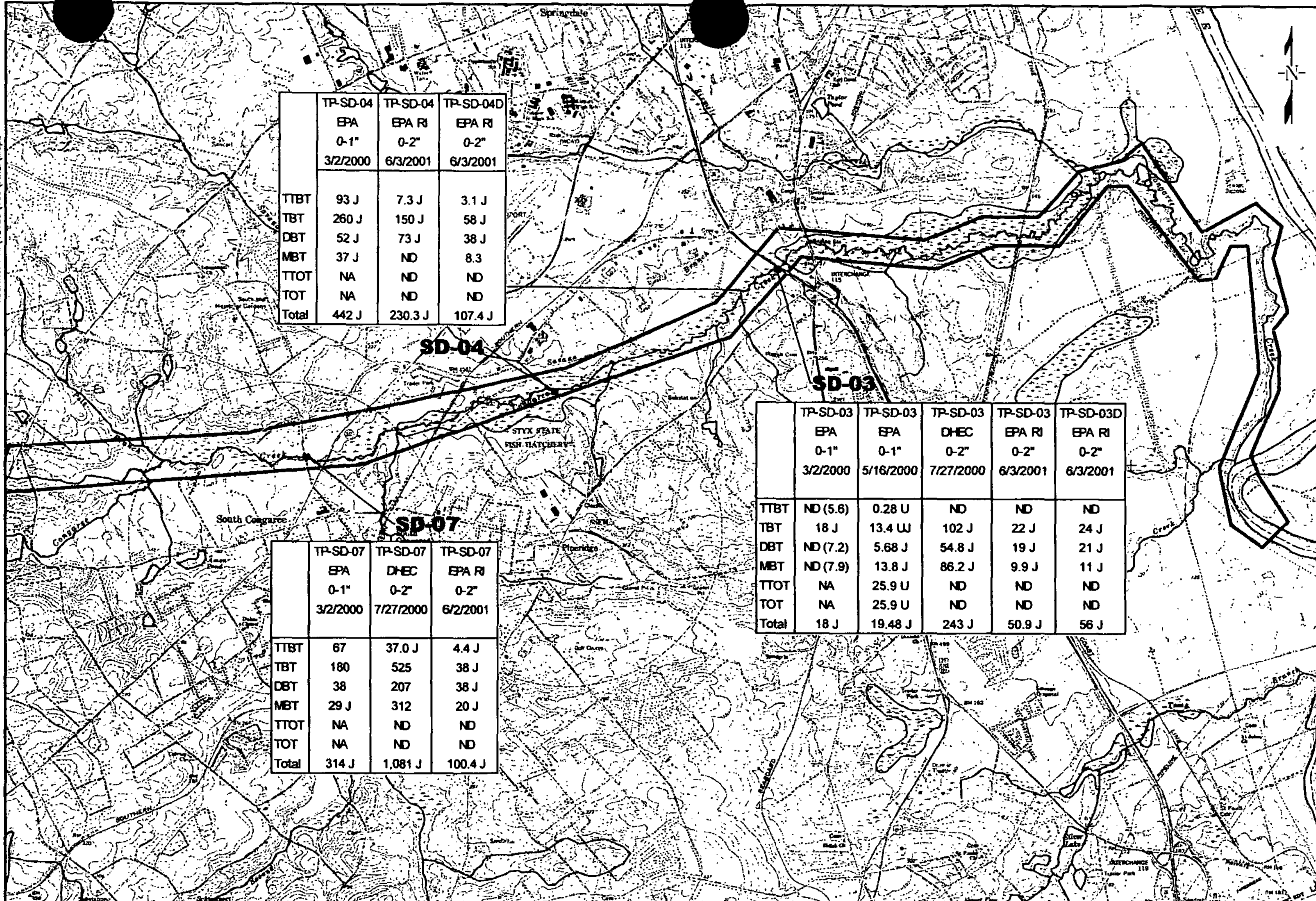
SCALE 1"= 300'

TIN PRODUCTS/RED BANK CREEK
LEXINGTON COUNTY, SOUTH CAROLINA

SEGMENT IV - SEDIMENT ORGANOTIN CONCENTRATIONS OVER TIME
JUNE 2001 - REMEDIAL INVESTIGATION

FIGURE 5-17

CAD DWG NO: 0Tin_SD_0T.dwg DATE: 02-07-02 ACM PLOT SCALE: 1=1
ORIGINAL DWG SIZE 11 x 17 LOCATION: R:\48135\109\Final\Maps
MOST RECENT REVISION REVISION DATE: 03-13-03 DRAFTERS INITIALS: ACM



SD-04

	TP-SD-04 EPA 0-1" 3/2/2000	TP-SD-04 EPA RI 0-2" 6/3/2001	TP-SD-04D EPA RI 0-2" 6/3/2001
TTBT	93 J	7.3 J	3.1 J
TBT	260 J	150 J	58 J
DBT	52 J	73 J	38 J
MBT	37 J	ND	8.3
TTOT	NA	ND	ND
TOT	NA	ND	ND
Total	442 J	230.3 J	107.4 J

SD-03

	TP-SD-03 EPA 0-1" 3/2/2000	TP-SD-03 EPA 0-1" 5/16/2000	TP-SD-03 DHEC 0-2" 7/27/2000	TP-SD-03 EPA RI 0-2" 6/3/2001	TP-SD-03D EPA RI 0-2" 6/3/2001
TTBT	ND (5.6)	0.28 U	ND	ND	ND
TBT	18 J	13.4 UJ	102 J	22 J	24 J
DBT	ND (7.2)	5.68 J	54.8 J	19 J	21 J
MBT	ND (7.9)	13.8 J	86.2 J	9.9 J	11 J
TTOT	NA	25.9 U	ND	ND	ND
TOT	NA	25.9 U	ND	ND	ND
Total	18 J	19.48 J	243 J	50.9 J	56 J

SD-07

	TP-SD-07 EPA 0-1" 3/2/2000	TP-SD-07 DHEC 0-2" 7/27/2000	TP-SD-07 EPA RI 0-2" 6/2/2001
TTBT	67	37.0 J	4.4 J
TBT	180	525	38 J
DBT	38	207	38 J
MBT	29 J	312	20 J
TTOT	NA	ND	ND
TOT	NA	ND	ND
Total	314 J	1,081 J	100.4 J

GEND

RI STREAM SEGMENTS
ROADS
STREAMS
PIPELINES

SD - SEDIMENT
SW - SURFACE WATER
SS - SURFACE SOIL

TTBT - Tetrabutyltin
TBT - Tributyltin
DBT - Dibutyltin
MBT - Monobutyltin
TTOT - Tetraoctyltin
TOT - Trioctyltin
Total - Total organotin compounds detected (in ppb)

NA - Not Analysed
ND - The analyte was analyzed for but was not detected above the reported sample quantitation limit.
U - *The analyte* was analyzed for but was not detected above the reported sample quantitation limit. The value is the sample quantitation limit.
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DHEC - South Carolina Department of Health and Environmental Compliance.

LC - Lexington County Joint Water and Sewer Commission. Samples were collected by a subcontractor.

EPA - U.S. Environmental Protection Agency. Samples were collected by the agency or an agency contractor.

All concentrations are listed in parts per billion (ppb)

TIN PRODUCTS/
RED BANK CREEK

LEXINGTON COUNTY,
SOUTH CAROLINA

SCALE: 1"= 3300'

TIN PRODUCTS/RED BANK CREEK
LEXINGTON COUNTY, SOUTH CAROLINA

SEGMENT V - SEDIMENT ORGANOTIN CONCENTRATIONS OVER TIME
JUNE 2001 - REMEDIAL INVESTIGATION

FIGURE
5-18

Sampling events between mid-2000 and mid-2001 revealed a substantial decrease in bed sediment concentrations of organotins. The site wide decrease in organotin concentrations suggests that degradation of organotins is occurring at this site, and may be related to bed sediment microbial biodegradation. In order to evaluate the role that microbial processes have in decreasing total organotin concentrations, the USGS created laboratory microcosms that contained bed sediment

The USGS collected bed sediment samples from the beaver ponds and Crystal Lake, spiked the samples with a known concentration of tributyltin chloride, and periodically analyzed for tributyltin and the degradation intermediates dibutyltin (DBT), monobutyltin (MBT), and tin during an eight week study. The USGS results indicated that TBT degradation occurred in both sediment samples with the beaver pond (TP-SD-75) and Crystal Lake (TP-SD-53) sediment samples demonstrating a half-life of 3.5 days and 350 days respectively. Additionally as the TBT concentrations decreased, the concentrations of elemental tin increased over time for both samples. The decreasing concentrations of organotin combined with the increasing concentrations of elemental tin observed with this controlled laboratory setting demonstrate that biodegradation of organotins does occur within these sediment samples.

5.2.4 Organotin concentration over time

A comparison of organotin concentrations over time in sediment was performed at common sampling locations. To aid in this comparison several of the samples collected during Phase I of the RI were intentionally collected at discrete intervals (0-2 inches) and locations similar or identical to those collected in previous investigations. The stations which were utilized for evaluating organotin concentrations over time consisted of stations TP-SD-21, TP-SD-18, TP-SD-10, TP-SD-53, TP-SD-49, TP-SD-51, TP-SD-13, TP-SD-17, TP-SD-36, TP-SD-08, TP-SD-100, TP-SD-04, TP-SD-07, and TP-SD-03. Figures 5-14 through 5-18 include table inserts listing the organotin concentrations over time. The Phase II samples from the RI were not used in this comparison because they were "grab" samples supporting the ecological risk assessment and lacked any controlled interval (depth) during the sample collection.

The analyses demonstrate that the total organotin concentrations have consistently decreased over time for all of these stations. The largest decrease was observed in sample station TP-SD-10 which decreased from 29,768 ppb in March 3, 2000, to 5.5 ppb in June 4, 2001. The second largest decrease was noted at sample station TP-SD-21 which decreased from 23,097 ppb in July 28, 2000 to 62 ppb in May 30, 2001.

If the contaminant mass was not degrading but was migrating downstream, then some portion of the downstream sampling stations should reflect concentrations comparable to the higher concentrations initially seen upstream. This was not the case. A comparison of the sample analysis immediately downstream of station TP-SD-10, collected 15 months after the initial sampling did not show contaminant mass concentrations comparable to station TP-SD-10. Station TP-SD-10, located in the headwaters of Crystal Lake, had a total organotin concentration of 29,768 ppb in March 3, 2000. Followup sampling in June 2001 was performed to evaluate sediment immediately downstream from this sample and consisted of nine additional sampling points spread over 1,100 linear feet of sediment immediately downstream from this station. None of the downstream samples had organotin concentrations greater than 229 ppb in the 0-2 inch sampling interval. Additionally, five of these sampling stations included the 2-4 inch sampling interval and demonstrated no total organotin concentration greater than 24 ppb. Sample results obtained from Durham Pond also demonstrated similar results. If contaminated sediments were migrating downstream rather than degrading, the contaminant mass should have been present in one or more of the downstream samples. While this is not definitive proof of degradation in and of itself, it is one line of evidence which supports the case for degradation.

The USGS study also provides an additional piece of information which supports the occurrence of degradation separate from the actual "in laboratory" degradation study: specifically the two additional sampling events (March 2002 and January 2003) for stations TP-SD-75 and TP-SD-53. Because the USGS collected the samples by grab collection method, the results were not directly comparable to the discrete interval (0-2 inches) sampling performed by EPA. However, the two sampling events performed by the USGS can be compared to one another. A comparison of data for station TP-SD-53 over time shows that while there was little change in the total organotin concentration (from 404.5 ug/kg to 391.1 ug/kg), there was a significant shift in the individual organotin concentrations, and this shift is consistent with the pattern associated with degradation. For example, the concentration of the highest butylated organotin (tetrabutyltin) decreased from 348 ug/kg to 0.9 ug/kg. Meanwhile the concentrations of tributyltin and monobutlytin, both of which are degradation products of tetrabutlytin, demonstrated an increase of 23.5 ug/kg and 324.3 ug/kg respectively. The concentration of elemental tin, the final degradation product associated with organotins, was also observed to increase from 316 ug/kg to 21700 ug/kg at this station. Similar results were also observed for sampling station TP-SD-75 over this same time period.

Theoretically it could be argued that the initial contamination present in the sediments could have migrated to points in between the sampling stations used in subsequent sampling events. While such a migration pattern could be possible, it is not probable given the extensive number of sampling locations used at this site. The migration theory would also not adequately explain the concentration shift observed in the individual organotins over time or the increase in the elemental tin concentrations, both of which are indicative of degradation, and were corroborated by the ex-situ laboratory test performed by the USGS.

It could also be argued that extensive sediment redeposition could have occurred in such a manner as to dilute or even cover the contaminated sediments. For such an event to occur, the deposition would have to occur uniformly across every sampling station for the entire site. While this could be possible, it is not a probable occurrence given the large number of sampling stations and the variations in locations which included both high stream flow and low stream flow conditions.

5.3 Surface Water

A total of 14 surface water Samples (including 1 duplicate) were collected during the RI field effort.

All 14 of the surface water samples were analyzed for organotin compounds and 8 were analyzed for CLP/RAS parameters. One duplicate sample (TP-SW-53) was analyzed for both organotin compounds and CLP/RAS parameters. Background samples TP-SW-25 and TP-SW-70 were co-located with sediment background samples. The surface water sampling locations are presented in Figure 5-1.

5.3.1 Surface water TCL/TAL analysis

Analyses of the 8 surface water samples designated for TCL/TAL did not detect any organic compound exceeding screening criteria. Other than some miscellaneous compounds, acetone was the only organic compound detected in surface water samples. Acetone is a common laboratory contaminant. The surface water data was screened against drinking water MCLs. In the absence of a MCL, the EPA Region 4 Ecological Risk Assessment Bulletins, Supplement to RAGS (updated November 30, 2001), Freshwater Surface Water Screening Values were used (EPA, 2001a). In absence of an MCL or Freshwater Surface Water Screening Value, the average background concentration of each analyte was calculated and multiplied by 2 and used as a benchmark to determine relatively elevated concentrations of those analytes (EPA, 2001b). Tables 5-20 and 5-21 present the detects of all the organic TCL/TAL data for surface water samples collected during the RI investigation and are provided in appendix A.

For inorganic analyses, the background concentrations of iron exceeded the secondary MCL (300 ug/L) for drinking water. The highest concentration of iron (1,300 ug/L) was detected in TP-SW-108, located adjacent to the WWTP discharge pipe. Aluminum also exceeded the secondary MCL of 200 ug/L in all but one sample. Lead was detected above the ecological freshwater screening value (1.32 ug/L) in every sample (including background sample TP-SW-25) except TP-SW-107 and TP-SW-108, however, none of the concentrations approached the groundwater action level for lead (15 ug/L).

5.3.2 Surface water organotin analysis

All 14 surface water samples collected were analyzed for organotin compounds. Table 5-22 presents the results of surface water sampling and is provided in Appendix A. None of the surface water samples collected in Phase I or Phase II activities exceeded the human health screening value of 11 ug/L for total organotin concentrations. This screening value was derived from EPAs drinking water MCL for tributyltin oxide (11 ug/L). The application of the MCL for tributyltin oxide to the total organotin concentrations represent a conservative approach to screening surface water analysis. The surface water sampling results were also compared to EPAs surface water screening value for ecological receptors (tributyl tin at 0.026 ug/L).

Surface water samples collected from the Beaver dam area and Crystal Lake contained the highest organotin compound concentrations detected in surface water, particularly from sample TP-SW-76 (0.425 ug/L total organotins) collected from the Beaver Pond Area. TP-SW-76 was also the only surface water sample that contained detectable concentrations (estimated) of tetrabutyltin. Analyses indicate that each of these samples contain butyltin compounds. Because surface water samples TP-SW-49, TP-SW-53, TP-SW-76, and TP-SW-83 exceeded EPA's ecological screening value for tributyl tin (0.026 ug/L), surface water was included as an exposure pathway within the ecological risk assessment.

Both surface water samples collected from Durham Pond contained butyltin compounds. A noticeable decrease in tributyltin concentrations (1 order of magnitude) is observed when comparing concentrations in the Beaver dam area with those in Durham Pond. Other butyltin compounds detected (monobutyltin and dibutyltin) remain at about the same concentrations. No organotin compounds were detected in any of the of surface water samples collected upstream from the Beaver dam area or downstream of Durham Pond.

5.4 Groundwater

Three groundwater sampling events have occurred in association with the Tin Products/Red Bank Creek investigation. Two of the three investigations were conducted by EPA Region IV Science & Ecological Support Division (SESD) to sample local potable wells. The first investigation was conducted by SESD in September 2001 and included the collection of groundwater samples from 6 private groundwater wells. All of the samples collected were analyzed for butyltin compounds and select wells were analyzed for metal analytes, volatile compounds, and extractable compounds. The total organotin concentrations were screened against EPAs drinking water MCL for tributyltin oxide (11 ug/L).

Results from most of the samples were unremarkable; however, butyltin analyses of potable well sample TP-PW-03 indicated the presence of monobutyltin (0.29 ug/L). A second investigation, consisting of confirmatory sampling of this well, was performed in December 2001. Analyses of the confirmatory sample did not indicate the presence of any organotin compounds. This investigation is summarized in an Sampling Results Memorandum dated November 26, 2001, and provided as Appendix D.

As a result of the monobutyl tin detected in private well TP-PW-03 in September 2001, EPA decided that a focused sampling effort in the vicinity of that property was necessary in order to evaluate the groundwater quality in the general vicinity of the WWTP discharge pipe. For this reason the third groundwater sampling event was conducted in June 2002. This sampling event included the following:

- The installation of three temporary wells installed adjacent to the WWTP discharge pipe (TP-GP-01, TP-GP-02, TP-GP-03). One subsurface soil sample and one groundwater sample was collected from each well;

- The collection of groundwater samples from four potable wells (TP-PW-003, TP-PW-005, TP-PW-007, and TP-PW-008) in the general vicinity of the WWTP discharge pipe;

- The collection of one surface water sample from a spring near private well TP-PW-003;
- The collection of two sediment samples taken from within the WWTP discharge pipe. This is the pipe which previously transported waste water from the WWTP to Red Bank Creek and is now plugged;
- The collection and analysis of the PVC pipe that was once part of the pump system for potable well TP-PW-003. Because organotins are used in the manufacturing of PVC, this pipe was sampled to rule it out as a potential source of organotins.

Analysis of the groundwater samples collected during this third sampling event indicated that two of the three groundwater samples collected from the temporary well locations (TP-GP-01 and TP-GP-03) contained organotin compounds. Sample TP-GP-01 contained several organotins with the total organotin concentration of 12 ug/L, while sample TP-GP-03 had a single organotin compound (monobutyltin) at a concentration of 0.32 ug/L. None of the groundwater samples collected from the four potable wells, including resampling of TP-PW-03 which initially contained monobutyl tin, contained any detectable concentration of organotin compounds. The results of this sampling event are summarized in the Trip Report for Additional Sampling dated November 7, 2002, and provided as Appendix E.

None of the subsurface soil samples collected from the temporary well locations contained any organotin compounds. Additionally the surface water sample collected from the spring located near the private well did not contain organotin compounds. No detectable levels of organotins were observed in the analysis of the PVC pipe sample.

Both of the sediment samples collected from within the WWTP discharge pipe did contain organotin compounds, primarily butyltins. The total organotin concentrations in each of these two sediment samples exceeded the ecological PRG of 772 ug/kg. Analyses of both sediment samples also indicated the presence of inorganic analytes at concentrations below EPA Region 9 PRGs for residential soil, in addition to several miscellaneous compounds. Sediment within the WWTP discharge pipe is a potential organotin source to local groundwater since liquid within the pipe is also in contact with sediments and could potentially release into the environment over time. The likelihood of this occurring is largely dependent upon the integrity of the WWTP discharge pipe and associated pipe joints as well as the quantity of liquid within the WWTP discharge pipe. Because the sediment and liquid within the pipe constitute a potential source, EPA's emergency response personnel will remove the source materials from the WWTP discharge pipe in a removal action.

6.0 SUMMARY OF SITE RISKS

Based upon the results of the RI, a baseline risk assessment was conducted to estimate the risks associated with current and future site conditions. The baseline risk assessment estimates the human health and ecological risk which could result from the contamination at the site, if no remedial action were taken.

6.1 Land Use

The site is comprised of approximately 14 miles of surface water and sediment along Red Bank Creek and Congaree Creek, located in a rural urban land use setting containing mixed residential, industrial, and agricultural parcels. The majority of the site is in a rural-residential setting with scattered industrial and agricultural use in the area. A privately owned recreational area consisting of a sand beach, swimming area, and beach house is located along the northern shore of Crystal Lake. Durham Pond is also used for recreational purposes including swimming, fishing, boating and hunting. Anticipated future land use options for the site, projected for the purposes of the Baseline Risk Assessment, is the same as the current use - mixed residential, industrial, and agricultural.

6.2 Human Health Risk Assessment

A four-step process is utilized for assessing site-related human health risks for a reasonable maximum exposure scenario: *Hazard Identification*--identifies the contaminants of concern at the site based on several factors such as toxicity, frequency of occurrence, and concentration. *Exposure Assessment*--estimates the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures, and the pathways (e.g., contact with sediments) by which humans are potentially exposed. *Toxicity Assessment*--determines the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure (dose) and severity of adverse effects (response). *Risk Characterization*--summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site-related risks.

The constituents retained as Contaminants of Potential Concern (COPCs) for the human health risk assessment are as follows: aluminum (surface soil), monobutyl tin, tributyl tin (surface water), total tributyl tin (duck consumption via human food chain), and dibutyl tin, monobutyl tin, tetrabutyl tin, and tributyl tin (fish consumption via human food chain. COPCs were evaluated for sediment and groundwater but were not retained because the detected concentrations were all well below the applicable screening levels. Site-specific exposure information was unavailable; therefore, default exposure assumptions and professional judgment were used to select exposure assumptions for the various receptors evaluated in the risk assessment.

Human exposures to sediment would not usually be evaluated quantitatively because sediment which is covered by surface water is likely to be washed off before significant exposure occurs (EPA Region 4 guidance, 1995). However the sediment at this site was evaluated quantitatively because of the large beach and wading area along Crystal Lake which would promote prolonged contact with sediment. Therefore the sediment concentrations were evaluated within the Risk Assessment in a manner similar to the exposure assessment used for soils and referenced as "dry sediments". Ultimately surface water is believed to be the major source of potential exposure to human receptors, followed by "dry sediment", and surface soil.

The Human Health Risk Assessment assumed that current and future receptors at the site are limited to visitors, residents, recreational swimmers and waders, hunters, and recreational fishers. This report quantitatively or qualitatively evaluates potential risks from exposure to COPCs in surface water, sediment (recreational areas), surface soil, subsurface soil, groundwater, and consumption of duck and fish.

The exposure pathways for this site were developed to reflect the potential for exposure to hazardous substances based on the present uses, potential future uses, and location of the Site. The site is comprised of approximately 14 miles of surface water and sediment along Red Bank Creek and Congaree Creek. The majority of the site is in a rural-residential setting with scattered industrial and agricultural use in the area. A privately owned recreational area consisting of a sand beach, swimming area, and beach house is located along the northern shore of Crystal Lake.

The following is a brief summary of the exposure pathways evaluated. A more detailed description can be found in Section 6 of the Remedial Investigation Report, 2003. Incidental ingestion and dermal contact with surface water was evaluated to reflect exposure for an adolescent who may wade and play in Crystal Lake for 52 days/year for 10 years (current and future exposure scenario for swimmer). The corresponding values for an adult were 45 days/year for a 24 year period. Incidental ingestion of sediments and dermal contact was also evaluated for these receptors. For each pathway evaluated, a reasonable maximum exposure estimate was generated corresponding to exposure to the average and the maximum concentration detected in that particular medium.

The hazard index was calculated for each pathway as EPA's measure of the potential for non-carcinogenic health effects. A hazard quotient is calculated by dividing the exposure level by the reference dose (RfD) or other suitable benchmark for non-carcinogenic health effects for an individual compound. Reference doses have been developed by EPA to protect sensitive individuals over the course of a lifetime and they reflect a daily exposure level that is likely to be without an appreciable risk of an adverse health effect. RfDs are derived from epidemiological or animal studies and incorporate uncertainty factors to help ensure that adverse health effects will not occur. The hazard quotient is often expressed as a single value (e.g. 0.3) indicating the ratio of the stated exposure as defined to the reference dose value (in this example, the exposure as characterized is approximately one third of an acceptable exposure level for the given compound).

Excess lifetime cancer risks were evaluated for each exposure pathway by multiplying the exposure level with the chemical specific cancer factor. Cancer potency factors have been developed by EPA from epidemiological or animal studies to reflect a conservative "upper bound" of the risk posed by potentially carcinogenic compounds. That is, the true risk is unlikely to be greater than the risk predicted. The resulting risk estimates are expressed in scientific notation as a probability (e.g. 1×10^{-6} for 1/1,000,000) and indicate (using this example), that an average individual is not likely to have greater that a one in a million chance of developing cancer over 70 years as a result of site-related exposure as defined to the compound at the stated concentration. Current EPA practice considers carcinogenic risks to be additive when assessing exposure to a mixture of hazardous substances.

Tables 7.1 through 8.14 depict the noncarcinogenic and carcinogenic risk summaries for each media evaluated and are presented in Appendix A. Tables 7.1 through 7.11 depicts the noncarcinogenic risk summary for the contaminants of concern in surface water, soil, and dry sediment (ingestion and dermal contact) using the average and the reasonable maximum exposure (RME) scenarios. Tables 7.12 through 7.14 depict the noncarcinogenic risk summary for the contaminants of concern associated with the consumption of duck and fish by recreational fishers and hunters using the average and the reasonable maximum exposure (RME) scenarios. Likewise tables 8.1 through 8.14 depict the carcinogenic risk summaries.

Calculated risks and hazards were all below applicable thresholds (a total HI greater than 1 and a cumulative excess lifetime cancer risk of 1E-04) for the site except for the ingestion of fish and duck. Recreational exposure to surface water through swimming and wading does not present a significant hazard. In accordance with Region 4 guidance, it was assumed that any exposure to sediment would also be insignificant because it would likely be washed off of the skin. The sediment samples collected in Crystal Lake, Segment 2, are located in shallow water in the beach area (currently drained). Therefore, these sediment samples were evaluated as surface soil and subsurface soil. Contact with the soil/dry sediment in Segment 2, did not present a significant hazard for the adult and child residents. A recreational fisher who eats 25 grams (about 0.9 ounces) of fish caught in Crystal Lake for 350 days per year had a hazard index of 1.1, which is slightly above the level of concern. A hunter who eats 36.5 grams (about 1.3 ounces) of duck for 20 meals per year would have a hazard index of 0.99.

6.3 Ecological Risk Assessment

A Screening Level Ecological Risk Assessment (SLERA) was initially performed to evaluate the ecological risk. Available data from DHEC, Lexington County, and EPA were used for this assessment. The SLERA incorporated steps 1 and 2 of the 8-step EPA ecological risk assessment process. The SLERA was limited to organotin compounds and to the available data from EPA (sediment data) and limited biota data from South Carolina DHEC. The SLERA verified aquatic receptors were exposed to organotin concentrations that caused mortality.

Based on the conclusions presented in step 2, a Problem Formulation document (step 3) was developed. The Problem Formulation document outlined a plan for completing the remainder of the 8 step ecological process for this site. Assessment endpoints were identified in the Problem Formulation document along with data gaps needed to address the assessment endpoints. The data gaps consisted of determining the organotin concentrations at specific locations within the watershed, evaluating benthic community structure including survival, growth, and reproduction of benthic amphipods, and assessing the potential for organotin bioaccumulation. These data gaps were addressed by performing a Phase II sampling event, toxicity testing, a benthic macroinvertrbrate survey, and food chain modeling.

A Baseline Ecological Risk Assessment (BERA) was completed using the data from the Phase II sampling event. This data was used to support the toxicity testing, the benthic macroinvertebrate survey, and the food chain modeling. The BERA concluded that there are no significant environmental risks currently associated with the site. The toxicity study indicated no statistically significant reduction in benthic amphipod survival, growth, and reproduction when exposed to the highest organotin-contaminated sediment collected during the Phase II field effort. This indicates that the maximum organotin concentrations did not produce toxic effects to benthic amphipods. The benthic macroinvertebrate populations in the Red Bank Creek system apparently are recovering, based on benthic community survey data. The number of individual benthic invertebrates recovered from samples increased from 48 immediately after the spill to 366 in April 2002. The results of the food chain modeling in the BERA initially suggested a low level of risk to the green heron, however calculation errors were noted in the final BERA. Correction of these errors (average body weight, ingestion rate and conversion of dry weight to wet weights) resulted in a Hazard Quotient less than 1. Therefore there is no significant risk to ecological receptors associated with this site.

6.4 Summary of site risk

The Site specific conditions at the Tin Products Red Bank Creek Site support the decision to take no action at this site. The primary exposure pathways evaluated for this site, as outlined in the Conceptual Site Model, consisted of surface soil, surface water, sediment, and groundwater pathways associated with the discharge of contaminated liquids into the creek system. The exposure pathways associated with the primary release mechanism (i.e. liquids into sewer system) were not considered to be significant or realistic.

None of the COPCs at the site are classified as carcinogens. Therefore, no carcinogenic risks are associated with this site. Hazard quotients were all below applicable thresholds except for the ingestion of fish and duck. In order for a fisher or hunter to exceed this threshold, they would have to consume more than 25 grams (about 0.9 ounces) of whole fish for 350 days per year, or eat 36.5 grams of duck for 20 meals per year. Because neither of these exposure scenarios are likely, no unacceptable risks are expected to occur.

Results of the Baseline Ecological Risk Assessment (BERA) concluded that there are no significant environmental risks currently associated with the site. This is supported by the results of the toxicity testing, the bioaccumulation results, and the food chain modeling.

In summary this site is not expected to present an imminent and substantial endangerment to public health, welfare, or the environment at the present time or in the future. Therefore, a no action decision has been chosen for this site.

6.5 Uncertainties in Exposure Pathways and Parameters

The reference dose (RfD) for tributyl tin oxide was substituted for all organotin compounds. In general, a calculated RfD is likely overly protective and results in an overestimation of noncarcinogenic risk. This occurs as a result of the developmental process of the RfD. There are no data available to evaluate the concentration of organotins in duck. Exposure to duck was evaluated through invertebrates in direct contact with the sediment. It was conservatively assumed that 100 percent of organotin ingested from invertebrates is retained in the duck. This is likely to overestimate risk from ingestion of duck. Also, the risk assessment evaluated ingestion of whole fish. This may result in an overestimation of risk since humans usually consume fillets.

The evaluation of the exposure pathways associated with the primary release mechanism (i.e. discharge of contaminated liquids into the sewer system) was limited to a 1000 foot section of the WWTP discharge pipe. If the structural integrity of this pipe varies in other sections, then the risk may be underestimated for this exposure pathway.

7.0 DESCRIPTION OF NO ACTION REMEDY

There are no construction activities associated with the No Action decision. Monitoring of aquatic life and organotin concentrations in the sediment and surface water will be conducted to verify that aquatic life continue to recover.

The Site specific conditions at the Tin Products Red Bank Creek Site support the decision to take no action at this site. There are no carcinogenic risks are associated with this site, and the hazard quotients for non-carcinogens were all below applicable thresholds using reasonable exposure scenarios for humans. Results of the Baseline Ecological Risk Assessment (BERA) concluded that there are no significant environmental risks currently associated with the site. This is supported by the results of the toxicity testing, the bioaccumulation results, and the food chain modeling.

8.0 DOCUMENTATION OF SIGNIFICANT CHANGES

EPA presented a Proposed Plan on June 18, 2003 for the site based on the results of both the human health risk assessment and ecological risk evaluation performed as part of the remedial study. The Proposed Plan described EPA's proposal to take no action under CERCLA at the Tin Products Red Bank Creek . No significant changes have been made to the No Action recommendation described in the Proposed Plan.

Additional information about the Tin Products plant, located on Bonhomme Richard road, has been forwarded to EPA by the South Carolina Department of Health and Environmental Control. This additional information indicates that organotin contaminated soils are present at the plant site. This information may be useful for a future investigation of the Tin Products plant but it would not impact the decision for this ROD. With the closure of the WWTP discharge pipe, any contaminate source located at the Tin Products plant would not be able to migrate into the surface waters of Red Bank Creek.

9.0 STATE CONCURRENCE

The South Carolina Department of Health and Environmental Control (DHEC) has reviewed the preferred alternative and has indicated its support for the No Action decision. DHEC concurs with the selected remedy for the Tin Products Red Bank Creek Site. A copy of the declaration of concurrence is attached as Appendix B.

APPENDIX A
DATA TABLES

Table 5-2
Tin Products/Red Bank Creek
Surface Soil Sampling Results - CLP Inorganic Data
Lexington County, South Carolina

BVSPC Sample ID	EPA Region 9 PRGs	TP-SS-71 (Background)	2X Background	TP-SS-88	TP-SS-98
Stream Segment		I		II	II
Collection Depth		<1'		<1'	<1'
Metals (mg/kg)					
Aluminum	7,600	16000	32000	1800 J	2500 J
Barium	540	50	100	12	8.3
Calcium	NE	440	880	200	110
Chromium	10,000/30*	18	36	1.8	2.7
Cobalt	470	0.79 U	1.58	0.29	0.25 U
Iron	2,300	5600 J	11200	1400	1100
Lead	400	19	38	12	6.4
Magnesium	NE	400	800	50	40
Manganese	180	30	60	14	6.8
Nickel	160	3.6 U	7.2	0.78	0.43
Potassium	NE	300	600	100	100
Sodium	NE	400 U	800	120	110
Vanadium	55	36	72	3.2	5.3
Zinc	2,300	16	32	5	5.5

NOTES:

EPA Region 9 PRGs — EPA Region 9 Preliminary Remediation Goals for residential soil, 2000 Update.
Noncarcinogenic values are adjusted by 0.1 per EPA Region 4 guidance, except for lead.

mg/kg — milligrams per kilogram

NE — A PRG has not been established for this constituent.

* — PRGs provided for chromium III and chromium VI, respectively.

U — Material was analyzed for but not detected. The number is the minimum quantitation limit.

J — Estimated value.

Shading indicates concentration exceeds EPA Region 9 PRGs.

Table 5-3
Tin Products/Red Bank Creek
Surface Soil Sampling Results - CLP Organic Data
Lexington County, South Carolina

BVSPC Sample ID	EPA Region 9 PRGs	TP-SS-71 (Background)	TP-SS-88	TP-SS-98
Stream Segment		I	II	II
Collection Depth		<1'	<1'	<1'
Volatile Organics (ug/kg)				
Acetone	160,000	360 J	370 J	80
Methyl Ethyl Ketone	730,000	25 J	29 U	11 U
Miscellaneous Volatile Organics (ug/kg)				
Unknown Compounds/#	NE		160 J/3	9 J/1
Ethanol	NE			53 NJ
Extractables (ug/kg)				
Benzaldehyde	160,000	8800 U	100 J	79 J
Fluoranthene	230,000	8800 U	66 J	380 U
Phenanthrene	NE	8800 U	61 J	380 U
Phenol	3,700,000	8800 U	390 U	42 J
Pyrene	230,000	8800 U	110 J	380 U
Miscellaneous Extractables (ug/kg)				
1,4-Cyclohexadiene, 1-Methyl	NE		980 NJ	
Benzene, Butyl-	NE		310 NJ	
Bicyclo [3.1.1] Heptane, 6,6-D	NE		670 NJ	
Bicyclo [3.1.1] Heptan-3-ol, 6	NE		410 NJ	
1,3,6-Octatriene, (E,E)-	NE		280 NJ	
Unknown Compounds/#	NE		830 J/4	
Vanillin	NE		380 NJ	
Hexadecanoic Acid	NE		740 NJ	
5.Beta., 8.Beta.H,9.Beta.H,10	NE		320 NJ	
Naphthalene, 6-Ethyl-1,2,3,4	NE		160 NJ	
5.Beta., 8.Beta.H,9.Beta.H,10	NE		140 NJ	
Naphtho [2,1-B] Furan-2 (1H) -On	NE		170 NJ	

Table 5-3 (Continued) Tin Products/Red Bank Creek Surface Soil Sampling Results - CLP Organic Data Lexington County, South Carolina				
BVSPC Sample ID	**EPA Region 9 PRGs**	**TP-SS-71 (Background)**	**TP-SS-88**	**TP-SS-98**
Stream Segment		**I**	**II**	**II**
Collection Depth		**<1'**	**<1'**	**<1'**
Miscellaneous Extractables (ug/kg) (Continued)				
3,4-Octadiene, 7-Methyl	NE		140 NJ	
Oleic Acid	NE		430 NJ	
Tricyclo [R.3.0 07,9] Nonane,	NE		940 NJ	
Octadecanoic Acid	NE		1100 NJ	
1-Pheananthrenecarboxylic Acid	NE		470 NJ	
5.Alpha.-Pregn-16-En-20-one	NE		470 NJ	
1-Pheananthrenecarboxylic Acid	NE		750 NJ	
(1-Chlorovinyl) Triethylsilan	NE		730 NJ	
Octadecanal	NE		400 NJ	
Docosanoic Acid	NE		650 NJ	
1-Heptadecene	NE		2300 NJ	
1-Docosene	NE		600 NJ	660 NJ
Gamma.-Sitosterol	NE		2700 NJ	
Pesticides/PCBs (ug/kg)				
4,4'-DDT (P,P'-DDT)	1,700	48 U	14	3.8 U

NOTES:

EPA Region 9 PRGs — EPA Region 9 Preliminary Remediation Goals for residential soil, 2000 Update
Noncarcinogenic values are adjusted by 0 1 per EPA Region 4 guidance
ug/kg — micrograms per kilogram
NE — A PRG has not been established for this constituent
Blank spaces indicate the miscellaneous compound was not detected in subject sample
U — Material was analyzed for but not detected The number is the minimum quantitation limit
J — Estimated value
N — Presumptive evidence of presence of material

Table 5-4
Tin Products/Red Bank Creek
Surface Soil Sampling Results - Organotin Data
Lexington County, South Carolina

BVSPC Sample ID	EPA Region 9 PRG	TP-SS-71 (Background)	TP-SS-109	TP-SS-102	TP-SS-88	TP-SS-89	TP-SS-89 (Duplicate)	TP-SS-97	TP-SS-98	TP-SS-101	TP-SS-104
Stream Segment		I	I	II	II	II	II	IV	IV	V	V
Collection Depth		<1'	<1'	<1'		<1'	<1'	<1'	<1'	<1'	<1'
Organotin Compounds (ug/kg)											
Monobutyltin	18,000*	0.55 UR	14	33	0.03 U	0.29 U	0.29 U	0.30 U	0.28 U	0.35 U	14
Dibutyltin	18,000*	1.1 U	3.2 J	14 J	0.05 U	0.57 U	0.58 U	0.60 U	0.56 U	3.6 J	3.2 J
Tributyltin	18,000*	1.1 U	0.89 U	6.5 J	0.05 U	0.57 U	0.58 U	0.60 U	0.56 U	2.7 J	0.89 U
Tetrabutyltin	18,000*	1.1 UJ	0.89 UJ	8.1 J	0.05 UJ	0.57 UJ	0.58 UJ	0.60 UJ	0.56 UJ	0.69 UJ	0.89 UJ
Miscellaneous Organotin Compounds (ug/kg)											
Trioctyltin	18,000*	110 UJ	89 UJ	76 UJ	5.1 UJ	57 UJ	58 UJ	60 UJ	56 UJ	69 UJ	89 UJ
Tetraoctyltin	18,000*	110 UJ	89 UJ	76 UJ	5.1 UJ	57 UJ	58 UJ	60 UJ	56 UR	69 UJ	89 UJ

NOTES:

ug/kg micrograms per kilogram

* A PRG has not been established for this compound. Therefore, the PRG for tributyl tin oxide is used.

U Material was analyzed for but not detected The number is the minimum quantitation limit.

J Estimated value.

N Presumptive evidence of presence of material

R QC indicates that data is unusable

Table 5-6 Tin Products/Red Bank Creek Segment I - Sediment Sampling Results - CLP Organic Data Lexington County, South Carolina						
BVSPC Sample ID	**Sediment Screening Value**	**TP-SD-70 (Control)**	**TP-SD-25 (Control*)**	**TP-SD-21**	**TP-SD-107**	**TP-SD-108**
Collection Depth		**0-2"**	**0-2"**	**0-2"**	**0-2"**	**0-2"**
Volatile Organics (ug/kg)						
Acetone	NE	26 UJ	90 J	30 UJ	20 J	69 J
p-Isopropyltoluene	NE	1 2 UJ	9 0 J	3 3 J	NA	NA
Toluene	NE	1 2 UJ	57 J	6 7 J	13 U	21 U
Extractables (ug/kg)						
Benzaldehyde	NE	3800 U	11000 U	3800 U	420 U	78 J
Miscellaneous Extractables (ug/kg)						
Unknown Compounds/#	NE				1400 J/7	5300 J/9
9-Hexadecanoic Acid	NE				220 NJ	
Hexadecanoic Acid	NE				230 NJ	350 NJ
Phytol	NE				120 NJ	
Butyl Hexadecanoate	NE				100 NJ	
Phenanthrene, 2,4,5,7-Tetram	NE				320 NJ	440 NJ
Octadecanoic Acid, Butyl Est	NE				100 NJ	
2-Phenanthrenol, 4B,5,6,7,8,	NE					240 NJ
Ethanol, 2-(Tetradecyloxy)-	NE				250 NJ	

NOTES:

Sediment Screening Value: EPA Region 4 Ecological Risk Assessment Bulletins, Supplement to RAGS sediment screening values, updated November 2001

ug/kg: micrograms per kilogram

Blank spaces indicate the miscellaneous compound was not detected in subject sample

NE: An EPA SSV has not been established for this constituent

NA: Analyte was not identified in SESD validated data or electronic data. Analyte was presumably not analyzed for this sample

U: Material was analyzed for but not detected The number is the minimum quantitation limit

N: Presumptive evidence of presence of material

J: Estimated value

Table 5-7
Tin Products/Red Bank Creek
Segment II - Sediment Sampling Results - CLP Organic Data
Lexington County, South Carolina

BVSPC Sample ID	Sediment Screening Value	TP-SD-10	TP-SD-10 (Duplicate)	TP-SD-49	TP-SD-53	TP-SD-53 (Duplicate)	TP-SD-76	TP-SD-81
Collection Depth		0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
Volatile Organics (ug/kg)								
Acetone	NE	60	100	32	13 UJ	12 UJ	140	18 U
Methyl Ethyl Ketone	NE	43 U	46 U	29 U	2.5 UJ	2.5 UJ	49	18 U
Extractables (ug/kg)								
Benzaldehyde	NE	170 J	290 J	120 J	4500 U	3900 U	340 J	180 J
Benzo(a)anthracene	330	920 U	970 U	610 U	4500 U	3900 U	360 J	610 U
Benzo(a)pyrene	330	920 U	970 U	610 U	4500 U	3900 U	200 J	610 U
Benzo(b)fluoranthene	NE	920 U	970 UJ	610 UJ	4500 U	3900 U	470 J	610 UJ
Benzo(k)fluoranthene	NE	920 U	970 UJ	610 UJ	4500 U	3900 U	180 J	610 UJ
Bis(2-ethylhexyl)phthalate	182	920 J	970 U	610 U	4500 U	3900 U	1100 U	610 U
Caprolactam	NE	210 J	270 J	610 U	4500 U	3900 U	1100 U	610 U
Chrysene	330	920 U	970 U	610 U	4500 U	3900 U	390 J	610 U
Fluoranthene	330	920 U	970 U	610 U	4500 U	3900 U	840 J	610 U
Indeno(1,2,3-cd)pyrene	NE	920 UJ	970 U	610 U	4500 U	3900 U	140 J	610 U
Phenanthrene	330	920 U	970 U	610 U	4500 U	3900 U	490 J	610 U
Pyrene	330	920 U	970 U	610 U	4500 U	3900 U	730 J	610 U
Misceallaneous Extractables (ug/kg)								
Unknown Compounds/#	NE	11000 J/9	15000 J/11	3000 J/7			6100 J/7	5600 J/7
Stannane, Tetrabutyl-	NE						1900 NJ	
Phenol, 2,5-Dimethoxy-4- (2-P	NE						260 NJ	
Tetradecanoic Acid	NE						330 NJ	
Unknown Organic Acid	NE			130 NJ			310 NJ	
2-Pentadecanone, 6,10,14-Tri	NE						240 NJ	
9-Hexadecenoic Acid	NE			210 NJ			2000 NJ	
Hexadecanoic Acid	NE		220 NJ	400 NJ			1700 NJ	
Heptadecane, 9-Octyl	NE						11000 NJ	
2-Phenanthrenol, 4B,5,6,7,8,	NE			310 NJ				
1-Nonadecene	NE			1700 NJ				
Phenanthrene, 2,4,5,7-Tetram	NE	950 NJ	2400 NJ					4000 NJ
1-Heneicosyl Formate	NE	2900 NJ						

59 0035

Table 5-7 (Continued)
Tin Products/Red Bank Creek
Segment II - Sediment Sampling Results - CLP Organic Data
Lexington County, South Carolina

BVSPC Sample ID	Sediment Screening Value	TP-SD-10	TP-SD-10 (Duplicate)	TP-SD-49	TP-SD-53	TP-SD-53 (Duplicate)	TP-SD-76	TP-SD-81
Collection Depth		**0-2"**	**0-2"**	**0-2"**	**0-2"**	**0-2"**	**0-2"**	**0-2"**
Miscellaneous Extractables (ug/kg) (Continued)								
Benzoic Acid	NE		240 NJ					140 NJ
Estra-1,3,5,7,9-Pentaen-17-O	NE		420 NJ					
17-Pentatriacontene	NE		2400 NJ					
1-Methyl-4-(1-Methylethyl)-C	NE							130 NJ
5-Octadecene,(E)-	NE							1100 NJ

NOTES:

Sediment Screening Value: EPA Region 4 Ecological Risk Assessment Bulletins, Supplement to RAGS sediment screening values, updated November 2001

ug/kg: micrograms per kilogram

Blank spaces indicate the miscellaneous compound was not detected in subject sample

NE: An EPA SSV has not been established for this constituent

J: Estimated value

U: Material was analyzed for but not detected The number is the minimum quantitation limit

N: Presumptive evidence of presence of material

Shading indicates concentration exceeds sediment screening value

Table 5-8
Tin Products/Red Bank Creek
Segment IV - Sediment Sampling Results - CLP Organic Data
Lexington County, South Carolina

BVSPC Sample ID	Sediment Screening Value	TP-SD-92	TP-SD-95
Collection Depth		**0-2"**	**0-2"**
Extractables (ug/kg)			
Benzaldehyde	NE	7300 U	160 J
Phenol	NE	7300 U	100 J
Misceallaneous Extractables (ug/kg)			
Unknown Compounds/#	NE		3700 J/10
Hexadecanoic Acid	NE		280 NJ
Phenanthrene, 2,4,5,7-Tetram	NE		510 NJ
Ethanol, 2-(Tetradecyloxy)-	NE		2100 NJ

NOTES:

Sediment Screening Value — EPA Region 4 Ecological Risk Assessment Bulletins, Supplement to RAGS sediment screening values, updated November 2001.

Blank spaces indicate the miscellaneous compound was not detected in subject sample.

ug/kg — micrograms per kilogram

NE — An EPA SSV has not been established for this constituent.

J — Estimated value.

N — Presumptive evidence of presence of material.

Table 5-9
Tin Products/Red Bank Creek
Segment V - Sediment Sampling Results - CLP Organic Data
Lexington County, South Carolina

BVSPC Sample ID	Sediment Screening Value	TP-SD-106
Collection Depth		0-2"
Volatile Organics (ug/kg)		
Acetone	NE	33
Methyl Ethyl Ketone	NE	16
Extractables (ug/kg)		
Benzaldehyde	NE	76 J
Misceallaneous Extractables (ug/kg)		
Unknown Compounds/#	NE	680 J/3
Bicyclo [3.1.1] Heptan-2-One,	NE	210 NJ
9-Hexadecenoic Acid	NE	120 NJ
Hexadecanoic Acid	NE	250 NJ
2-Phenanthrenol, 4B,5,6,7,8,	NE	140 NJ
Octadecanal	NE	210 NJ

NOTES:

Sediment Screening Value EPA Region 4 Ecological Risk Assessment Bulletins, Supplement to RAGS sediment screening values, updated November 2001

ug/kg micrograms per kilogram

NE An EPA SSV has not been established for this constituent

J Estimated value

N Presumptive evidence of presence of material

59 0038

Table 5-10
Tin Products/Red Bank Creek
Segment I - Sediment Sampling Results - CLP Inorganic Data
Lexington County, South Carolina

BVSPC Sample ID	Sediment Screening Value	TP-SD-25 (Background)	TP-SD-70 (Background)	Average Background*	2X Average Background*	TP-SD-21	TP-SD-107	TP-SD-108
Collection Depth		0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
Metals (mg/kg)								
Aluminum	NE	3700	140	1920	3840	780	430 J	NA
Barium	NE	43	1 4	22 2	44.4	6.7	431 J	NA
Calcium	NE	720	52	386	772	220	92	NA
Chromium	52.3	5.2	0.39	2.795	5.59	11	0.89	NA
Iron	NE	3700 J	190 J	3890	7780	1600 J	500	NA
Lead	30.2	7.3	0.78 J	4.04	8.08	2.7	2.4	NA
Manganese	NE	43	4.3	23.65	47.3	[illegible]	2 8 U	NA
Potassium	NE	91 J	6 6 U	6.6	13.2	41	47	NA
Sodium	NE	660 U	230 U	230	460	270 U	180	NA
Vanadium	NE	9.2 U	0.44 U	0.44	0.88	2.6 U	12	NA
Zinc	124	5.9	0.23 U	0.23	0.46	[illegible]	38	NA

NOTES:

Sediment Screening Value EPA Region 4 Ecological Risk Assessment Bulletins, Supplement to RAGS sediment screening values, updated November 2001

mg/kg milligrams per kilogram

NE An EPA SSV has not been established for this constituent.

NA Not analyzed.

* Average background was calculated based on results from samples TP-SD-70 and TP-SD-25 and is defined as follows

For two detects, the average background is an average of the two concentrations

For two non-detects, the average background is the lower of the sample quantitation limits (SQLs)

For a detect and a non-detect, the average background is reported as the SQL of the non-detect sample

U Material was analyzed for but not detected. The number is the minimum quantitation limit.

J Estimated value

Shading indicates concentration exceeds 2X average background or sediment screening value

5 9 0039

Table 5-11
Tin Products/Red Bank Creek
Segment II - Sediment Sampling Results - CLP Inorganic Data
Lexington County, South Carolina

BVSPC Sample ID	Sediment Screening Value	2X Average Background*	TP-SD-10	TP-SD-10 (Duplicate)	TP-SD-49	TP-SD-53	TP-SD-53 (Duplicate)	TP-SD-76	TP-SD-81
Collection Depth		0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
Metals (mg/kg)									
Aluminum	NE	3840	8700 J	10000 J	7600 J	450	540	8400 J	4100 J
Barium	NE	44.4	27	31	53	3.8	4.5	100	24
Beryllium	NE	0.18	0.63	0.72	0.54	0.10 U	0.10 U	0.53	0.22
Cadmium	1	0.14	0.18 U	0.24	0.25	0.08 U	0.08 U	0.35	0.15 U
Calcium	NE	772	300	300	600	58	44	1600	270
Chromium	52.3	5.59	8.2	9.6	9.3	0.98	1.2	9.8	5.9
Cobalt	NE	0.24	0.65 U	0.74 U	1.6	0.26 U	0.16 U	4.4	1.4
Iron	NE	7780	610	770	3100	720 J	820 J	10000	1500
Lead	30.2	8.08	9.8	12	13	1.5	1.1 J	22	8.6
Magnesium	NE	19.6	120	130	160	37 U	23 U	390	91
Manganese	NE	47.3	15	16	110	11	16	340	42
Nickel	15.9	0.32	1.9	1.8 U	2.6	0.18 U	0.25 U	4.4	0.86
Potassium	NE	13.2	180	220	200	17	16	440	160
Sodium	NE	460	300	310	400	250 U	210 U	480	350
Vanadium	NE	0.88	6.9	8.1	9.1	1.3 U	1.6 U	15	6.2
Zinc	124	0.46	4	5.9	19	3.6	2	35	9

NOTES:

Sediment Screening Value — EPA Region 4 Ecological Risk Assessment Bulletins, Supplement to RAGS sediment screening values, updated November 2001.
mg/kg — milligrams per kilogram
NE — An EPA SSV has not been established for this constituent.
* — Average background was calculated based on results from samples TP-SD-70 and TP-SD-25; refer to Table 5-10 for a detailed explanation of derivation.
J — Estimated value.
Shading indicates concentration exceeds 2X average background or sediment screening value.

Table 5-12 Tin Products/Red Bank Creek Segment IV - Sediment Sampling Results - CLP Inorganic Data Lexington County, South Carolina				
BVSPC Sample ID	**Sediment Screening Value**	**2X Average Background***	**TP-SD-92**	**TP-SD-95**
Collection Depth		**0-2"**	**0-2"**	**0-2"**
Metals (mg/kg)				
Aluminum	NE	3840	4400	6400 J
Barium	NE	44.4	37	30
Calcium	NE	772	360	270
Chromium	52.3	5.59	5.4	9.2
Cobalt	NE	0.24	1.5 U	0.66
Iron	NE	7780	2200 J	1400
Lead	30.2	8.08	26	83
Magnesium	NE	19.6	150 U	110
Manganese	NE	47.3	130	30
Potassium	NE	13.2	96	170
Sodium	NE	460	390 U	210
Vanadium	NE	0 88	7.7 U	6.6
Zinc	124	0.46	13	68

NOTES:

Sediment Screening Value	EPA Region 4 Ecological Risk Assessment Bulletins, Supplement to RAGS Sediment Screening values, updated November 2001
mg/kg	milligrams per kilogram
NE	An EPA SSV has not been established for this constituent
*	Average background was calculated based on results from samples TP-SD-70 and TP-SD-25, refer to Table 5-10 for a detailed explanation of derivation
J	Estimated value
	Shading indicates concentration exceeds 2X average background or sediment screening value

59 0041

Table 5-13
Tin Products/Red Bank Creek
Segment V - Sediment Sampling Results - CLP Inorganic Data
Lexington County, South Carolina

BVSPC Sample ID	Sediment Screening Value	2X Average Background*	TP-SD-106
Collection Depth			**0-2"**
Metals (mg/kg)			
Aluminum	NE	3840	4100 J
Barium	NE	44 4	22
Beryllium	NE	0 18	0 26
Calcium	NE	772	240
Chromium	52.3	5.59	6.9
Cobalt	NE	0.24	1.1
Iron	NE	7720	3400
Lead	30 2	8 08	65
Magnesium	NE	19.6	510
Manganese	NE	47.3	40
Potassium	NE	13.2	400
Sodium	NE	460	210
Vanadium	NE	0 88	11
Zinc	124	0.46	14

NOTES:

Sediment Screening Value — EPA Region 4 Ecological Risk Assessment Bulletins, Supplement to RAGS Sediment Screening values, updated November 2001

ug/kg — micrograms per kilogram

mg/kg — milligrams per kilogram

NE — An EPA SSV has not been established for this constituent

* — Average background was calculated based on results from samples TP-SD-70 and TP-SD-25, refer to Table 5-10 for a detailed explanation of derivation

J — Estimated value

Shading indicates concentration exceeds 2X average background or sediment screening value

5 9 0042

Table 5-14
Tin Products/Red Bank Creek
Segment I - Sediment Sampling Results - Organotin Data
Lexington County, South Carolina

BVSPC Sample ID	Ecological PRG**	TP-SD-109 (Background)	TP-SD-25 (Background)	TP-SD-70 (Background)	Average Background*	2X Average Background*	TP-SD-18	TP-SD-21	TP-SD-72	TP-SD-107	TP-SD-108
Collection Depth		0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
Organotin Compounds (ug/kg)											
Monobutyltin	772	0.37 U	0.66 U	0.31 U	0.31	0.62	0.30 U	3.5	34	0.32 U	0.45 U
Dibutyltin	772	0.74 U	1.3 U	0.62 U	0.62	1.24	2.8 J	10 J	67 J	0.63 U	0.89 U
Tributyltin	772	0.74 U	1.3 U	0.62 U	0.62	1.24	6.1 J	21 J	64 J	0.63 U	0.89 U
Tetrabutyltin	772	0.74 UJ	1.3 UJ	0.62 UJ	0.62	1.24	3.1 J	28 J	110 J	0.63 UJ	0.89 UJ
Miscellaneous Organotin Compounds (ug/kg)											
Trioctyltin	772	74 UJ	130 UJ	62 UJ	62 UJ	124	60 UJ	78 UJ	18 J	63 UJ	89 UJ
Tetraoctyltin	772	74 UJ	130 UJ	62 UJ	62 UJ	124	60 UJ	78 UJ	29 J	63 UJ	89 UJ
Total Organotins	ND	ND	ND	ND	ND	ND	12 J	62.5 J	322 J	ND	ND
Elemental Tin											
Tin (ug/kg)	NA	NA	700	NA	NA	NA	NA	1,900	NA	NA	NA

NOTES:

ug/kg micrograms per kilogram

* Average background was calculated based on results from samples TP-SD-109, TP-SD-70, and TP-SD-25 and is defined as the lowest of the SQLs

** The Ecological Preliminary Remediation Goal (PRG) (772 ug/kg) is the most conservative in a range calculated in the BERA using conservative assumptions. Concentrations exceeding this value do not necessarily indicate ecological risks are present; rather, the screening value is intended to demonstrate the absence of ecological risks throughout the majority of the site.

ND The total organotin concentration could not be calculated since all compounds were below SQLs.

NA Not Analyzed

U Material was analyzed for but not detected. The number is the minimum quantitation limit.

J Estimated value.

Table 5-15
Tin Products/Red Bank Creek
Segment II - Sediment Sampling Results - Organotin Data
Lexington County, South Carolina

BVSPC Sample ID	Ecological RG**	2X Average Background*	TP-SD-10	TP-SD-10 (Duplicate)	TP-SD-12		TP-SD-13	TP-SD-49	
Collection Depth		0-2"	0-2"	0-2"	0-2"	2-4"	0-2"	0-2"	2-4"
Organotin Compounds (ug/kg)									
Monobutyltin	772	0.62	0.76 UJ	0.70 U	2	0.33 U	0.30 UR	8.0 J	0.48 U
Dıbutyltın	772	1.24	1.5 U	1.4 U	10 J	0.67 U	6.6 J	18 J	0.96 U
Tributyltın	772	1 24	1.5 U	1 4 U	27 J	0 67 U	9.6 J	39 J	0.96 U
Tetrabutyltın	772	1 24	4.4 J	5.5 J	33 J	0 67 UJ	13 J	107 J	0 06 UJ
Miscellaneous Organotin Compounds (ug/kg)									
Trioctyltin	772	124	150 UJ	190 UJ	85 UJ	67 UJ	60 UJ	120 UJ	96 UJ
Tetraoctyltin	772	124	150 UJ	190 UJ	85 UJ	67 UJ	60 UJ	120 UR	96 UR
Total Organotins	772		4 4 J	5.5 J	72 J	ND	29.2 J	172 J	ND
Elemental Tin									
Tin (ug/kg)	NE	NA	NA	NA	NA	NA	NA	NA	NA

BVSPC Sample ID	Ecological RG**	2X Average Background*	TP-SD-51	TP-SD-53***	TP-SD-53 (Duplicate)	TP-SD-73**	TP-SD-75		TP-SD-76
Collection Depth		0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	2-4"	0-2"
Organotin Compounds (ug/kg)									
Monobutyltın	772	0.62	7 7	1.282	5.085	460	320	12	27 J
Dıbutyltın	772	1.24	15 J	41 1	19.33	500 J	350 J	270 J	120 J
Trıbutyltın	772	1.24	19 J	9 9	27 1	1200 J	14000 J	1900 J	130 J
Tetrabutyltın	772	1 24	81 J	5.933	16.17	4100 J	24000 J	940 J	670 J
Miscellaneous Organotin Compounds (ug/kg)									
Trıoctyltın	772	124	100 UJ	59 UJ	29 5	410 J	1700 J	160 J	160 UJ
Tetraoctyltin	772	124	100 UJ	59 UJ	22.33	920 J	4000 J	310 J	160 UR
Total Organotins	772		122 7 J	58.215	119 515	7,590 J	44,370 J	3,592 J	947 J
Elemental Tin									
Tin (ug/kg)	NE	NA	NA	1,400	1,000	80,000	NA	NA	NA

59 0044

Table 5-15 (Continued)
Tin Products/Red Bank Creek
Segment II - Sediment Sampling Results - Organotin Data
Lexington County, South Carolina

BVSPC Sample ID	Ecological PRG**	2X Average Background*	TP-SD-79	TP-SD-81		TP-SD-83		TP-SD-85	
Collection Depth		0-2"	0-2"	0-2"	2-4"	0-2"	2-4"	0-2"	2-4"
Organotin Compounds (ug/kg)									
Monobutyltin	772	0.37 U	3.2	0.40 U	2.9 J	13 J	0.53 U	6.7	0.50 U
Dibutyltin	772	0.74 U	10 J	3.7 J	8.3 J	22 J	1 1 U	12 J	1 0 U
Tributyltin	772	0 74 U	22 J	9 1 J	9 4 J	31 J	2.6 J	13 J	1 0 U
Tetrabutyltin	772	0 74 UJ	30 J	3 5 J	3 6 J	163 J	2 4 J	46 J	1 0 U
Miscellaneous Organotin Compounds (ug/kg)									
Trioctyltin	772	124	100 UJ	81 UJ	85 UJ	140 UJ	110 UJ	130 UJ	100 UJ
Tetraoctyltin	772	124	100 UJ	81 UR	85 UR	140 UR	110 UR	130 UJ	100 UJ
Total Organotins	772		65.2 J	16.3 J	24.2 J	229 J	5 J	77.7 J	ND
Elemental Tin									
Tin (ug/kg)	NE	NA	NA	NA	NA	NA	NA	NA	NA

NOTES:

ug/kg micrograms per kilogram

ND The total organotin concentration could not be calculated since all compounds were below SQLs

* Average background was calculated based on results from samples TP-SD-109, TP-SD-70, and TP-SD-25, refer to Table 5-14 for a detailed explanation of derivation

** The Ecological Preliminary Remediation Goal (PRG) (772 ug/kg) is the most conservative in a range calculated in the BERA using conservative assumptions Concentrations exceeding this value do not necessarily indicate ecological risks are present, rather, the screening value is intended to demonstrate the absence of ecological risks throughout the majority of the site

*** Three sets of analytical results were reported for TP-SD-53 and TP-SD-53 (Duplicate) The average of the three samples was derived as follows

For three detects, the concentrations were averaged

For three non-detects, the lowest SQL was reported

For a combination of detects and non-detects, an average was calculated based on detected concentrations and one-half SQLs

NA Not Analyzed

U Material was analyzed for but not detected. The number is the minimum quantitation limit.

J Estimated value

Shading indicated value exceeds the ecological remediation goal

Table 5-16
Tin Products/Red Bank Creek
Segment III - Sediment Sampling Results - Organotin Data
Lexington County, South Carolina

BVSPC Sample ID	Ecological PRG**	2X Average Background*	TP-SD-17		TP-SD-90
Collection Depth		**0-2**	**0-2**	**2-4**	**0-2**
Organotin Compounds (ug/kg)					
Monobutyltin	772	0.62	16 J	5.5 J	0.30 U
Dibutyltin	772	1.24	43 J	18 J	4 J
Tributyltin	772	1.24	38 J	28 J	14 J
Tetrabutyltin	772	1.24	13 J	6.5 J	0.60 UJ
Miscellaneous Organotin Compounds (ug/kg)					
Trioctyltin	772	124	78 UJ	79 UJ	60 UJ
Tetraoctyltin	772	124	78 UR	79 UR	60 UR
Total Organotins	772		110 J	58 J	18 J
Elemental Tin					
Tin (ug/kg)	NA	NA	NA	NA	NA

NOTES:

ug/kg micrograms per kilogram

-- Not detected

* Average background was calculated based on results from samples TP-SD-109, TP-SD-70, and TP-SD-25; refer to Table 5-14 for a detailed explanation of derivation.

** The Ecological Preliminary Remediation Goal (PRG) (772 ug/kg) is the most conservative in a range calculated in the BERA using conservative assumptions. Concentrations exceeding this value do not necessarily indicate ecological risks are present; rather, the screening value is intended to demonstrate the absence of ecological risks throughout the majority of the site

NA Not Analyzed

U Material was analyzed for but not detected The number is the minimum quantitation limit.

J Estimated value

59 0046

Table 5-17
Tin Products/Red Bank Creek
Segment IV - Sediment Sampling Results - Organotin Data
Lexington County, South Carolina

BVSPC Sample ID	Ecological PRG**	2X Average Background*	TP-SD-8	TP-SD-36		TP-SD-92	TP-SD-93	
Collection Depth		0-2"	0-2"	0-2"	2-4"	0-2"	0-2"	2-4"
Organotin Compounds (ug/kg)								
Monobutyltin	772	0 62	0 52 U	0 50 U	0.40 U	3.6	0 45 U	0 35 U
Dibutyltin	772	1.24	3.1 J	1.0 U	0.80 U	18 J	2.5 J	0.70 U
Tributyltin	772	1.24	5.9 J	1.0 U	0.80 U	39 J	6.2 J	0 70 U
Tetrabutyltin	772	1.24	1.0 UJ	1.0 UJ	0.80 UJ	14 J	0.89 UJ	0.70 UJ
Miscellaneous Organotin Compounds (ug/kg)								
Trioctyltin	772	124	100 UJ	100 UJ	80 UJ	88 UJ	89 UJ	70 UJ
Tetraoctyltin	772	124	100 UJ	100 UR	80 UR	88 UJ	89 UR	70 UR
Total Organotins	772		9 J	ND	ND	74.6 J	8.7 J	ND
Elemental Tin								
Tin (ug/kg)	NA	NA	760	NA	NA	NA	NA	NA

BVSPC Sample ID	Ecological PRG**	2X Average Background*	TP-SD-94		TP-SD-95	TP-SD-96	TP-SD-100	
Collection Depth		0-2"	0-2"	2-4"	0-2"	0-2"	0-2"	2-4"
Organotin Compounds (ug/kg)								
Monobutyltin	772	0.62	0.89 U	0.42 U	0.43 U	0.36 U	0.78 U	0.55 U
Dibutyltin	772	1.24	1.80 U	0.85 U	0.86 U	0.71 U	1.6 U	1.1 U
Tributyltin	772	1.24	1.80 U	0.85 U	0.86 U	0.71 U	1.6 U	1.1 U
Tetrabutyltin	772	1.24	1.80 UR	0.85 UJ	0.86 UJ	0.71 UJ	1.6 UJ	1.1 UJ
Miscellaneous Organotin Compounds (ug/kg)								
Trioctyltin	772	124	180 UJ	85 UJ	71 UJ	71 UJ	160 UJ	110 UJ
Tetraoctyltin	772	124	180 UR	85 UR	71 UR	71 UR	160 UR	110 UR
Total Organotins	772		ND	ND	ND	ND	ND	ND
Elemental Tin								
Tin (ug/kg)	NA	NA	NA	NA	NA	NA	NA	NA

NOTES:

ug/kg micrograms per kilogram

-- Not detected

ND The total organotin concentration could not be calculated since all compounds were below SQLs

* Average background was calculated based on results from samples TP-SD-109, TP-SD-70, and TP-SD-25, refer to Table 5-14 for a detailed explanation of derivation

** The Ecological Preliminary Remediation Goal (PRG) (772 ug/kg) is the most conservative in a range calculated in the BERA using conservative assumptions Concentrations exceeding this value do not necessarily indicate ecological risks are present, rather, the screening value is intended to demonstrate the absence of ecological risks throughout the majority of the site

NA Not Analyzed

U Material was analyzed for but not detected The number is the minimum quantitation limit

J Estimated value

59 0047

Table 5-18
Tin Products/Red Bank Creek
Segment V - Sediment Sampling Results - Organotin Data
Lexington County, South Carolina

BVSPC Sample ID	Ecological PRG**	2X Average Background*	TP-SD-3	TP-SD-3 (Duplicate)	TP-SD-4	TP-SD-4 (Duplicate)	TP-SD-7	TP-SD-103	TP-SD-106
Collection Depth		0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
Organotin Compounds (ug/kg)									
Monobutyltin	772	0.62	9.9 J	11 J	0.57 UJ	8.3	20 J	2.9 J	6.8 J
Dibutyltin	772	1.24	19 J	21 J	73 J	38 J	38 J	16 J	9.8 J
Tributyltin	772	1.24	22 J	24 J	150 J	58 J	38 J	15 J	6.6 J
Tetrabutyltin	772	1.24	1.2 UJ	1.3 UJ	7.3 J	3.1 J	4.4 J	1.1 UJ	0.91 UJ
Miscellaneous Organotin Compounds (ug/kg)									
Trioctyltin	772	124	120 UJ	130 UJ	110 UJ	109 UJ	94 UJ	110 UJ	91 UJ
Tetraoctyltin	772	124	120 UR	130 UR	110 UJ	109 UJ	94 UR	110 UR	91 UR
Total Organotins			50.9 J	56 J	230.3 J	107.4 J	100.4 J	33.9 J	23.2 J
Elemental Tin									
Tin (ug/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA

NOTES:

ug/kg micrograms per kilogram

– Not detected.

* Average background was calculated based on results from samples TP-SD-109, TP-SD-70, and TP-SD-25; refer to Table 5-14 for a detailed explanation of derivation.

** The Ecological Preliminary Remediation Goal (PRG) (772 ug/kg) is the most conservative in a range calculated in the BERA using conservative assumptions. Concentrations exceeding this value do not necessarily indicate ecological risks are present; rather, the screening value is intended to demonstrate the absence of ecological risks throughout the majority of the site.

NA Not Analyzed

U Material was analyzed for but not detected. The number is the minimum quantitation limit.

J Estimated value.

Table 5-20
Tin Products/Red Bank Creek
Surface Water Sampling Results - CLP OrganicsData
Lexington County, South Carolina

BVSPC Sample ID	Surface Water Screening Value	TP-SW-25 (Background)	TP-SW-70 (Background)	TP-SW-21	TP-SW-107	TP-SW-108	TP-SW-49	TP-SW-53	TP-SW-53 (Duplicate)
Stream Segment		I	I	I	I	I	II	II	II
Volatile Organics (ug/L)									
Acetone	NE	10	10 U	10 U	10 UJ	13 J	10 U	11	10 U
Miscellaneous Extractables (ug/L)									
Unknown Organic Acid	NE		5 NJ			3 NJ		7 NJ	8 NJ
Unknown Compound/#	NE	10 J/2	2 J/1	7 J/2	10 J/2	7 J/1	15 J/3	3 J/1	4 J/1
Butyl Tetradecanoate (Myrist)	NE		4 NJ						
Octadecanoic Acid, Butyl Est	NE	5 NJ			5 NJ	6 NJ		5 NJ	6 NJ
Docosanoic Acid	NE			4 NJ					

NOTES:

Surface Water Screening Value — Drinking Water Standards and Health Advisories, Maximum Contaminant Levels (MCLs), EPA 822-B-00-001, Summer 2000 In the absence of a MCL, the EPA Region 4 Ecological Risk Assessment Bulletins, Supplement to RAGS (updated November 2001), Freshwater Surface Water Screening Values are used

ug/L — micrograms per liter

NE — An MCL or EPA Freshwater Surface Water Screening Value has not been established

Blank spaces indicate the miscellaneous compound was not detected in subject sample

-- — Not detected

U — Material was analyzed for but not detected The number is the minimum quantitation limit

J — Estimated value

N — Presumptive evidence of presence of material

Table 5-21
Tin Products/Red Bank Creek
Surface Water Sampling Results - CLP Inorganic Data
Lexington County, South Carolina

BVSPC Sample ID	Surface Water Screening Value	TP-SW-25 (Background)	TP-SW-70 (Background)	Average Background***	2X Average Background***	TP-SW-21	TP-SW-107
Stream Segment		I	I			I	I
Metals (ug/L)							
Aluminum	50 to 200*	280	340	310	620	330	220
Barium	2000	17	19	18	36	17	13
Calcium	NE	860	1000	930	1860	990	980
Iron	300*	670	760	715	1430	660	310
Lead	15 TT/1.32**	3.4	2.0 U	2	4	3.3 J	2.7 U
Magnesium	NE	530	550	540	1080	490	320
Manganese	50*	15	36	25.5	51	16	7.1 U
Zinc	5000*	0.80 U	0.80 U	0.80	1.6	21	14

BVSPC Sample ID	Surface Water Screening Value	Average Background***	2X Average Background***	TP-SW-108	TP-SW-49	TP-SW-53	TP-SW-53 (Duplicate)
Stream Segment				I	II	II	II
Metals (ug/L)							
Aluminum	50 to 200*	310	620	170 U	220	240	280
Barium	2000	18	36	15	17	18	19
Calcium	NE	930	1860	660	1200	1200	1200
Iron	300*	715	1430	1300	1000	1100	1100
Lead	15 TT/1.32**	2	4	1.5 U	3.4 J	3.1 J	1.6
Magnesium	NE	540	1080	430	570	560	580
Manganese	50*	25.5	51	29	17	24	21
Zinc	5000*	0.80	1.6	0.80 U	0.80 U	16	0.80 U

NOTES:

Surface Water Screening Value: Drinking Water Standards and Health Advisories, Maximum Contaminant Levels (MCLs), EPA 822-B-00-001, Summer 2000 In the absence of a MCL, the EPA Region 4 Ecological Risk Assessment Bulletins, Supplement to RAGS (updated November 2001), Freshwater Surface Water Screening Values are used

ug/L: micrograms per liter

NE: An MCL or EPA Freshwater Surface Water Screening Value has not been established

--: Not detected

*: Value is a secondary MCL

**: Value is a Freshwater Surface Water Screening Value

***: Average background was calculated based on results from samples TP-SD-70 and TP-SD-25 and is defined as follows

For two detects, the average background is an average of the two concentrations

For two non-detects, the average background is the lower of the SQLs

For a detect and a non-detect, the average background is reported as the SQL of the non-detect sample

TT: Action level

U: Material was analyzed for but not detected The number is the minimum quantitation limit

J: Estimated value

Shading indicates concentration exceeds 2X background or surface water screening value

590050

Table 5-22
Tin Products/Red Bank Creek
Surface Water Sampling Results - Organotin Data
Lexington County, South Carolina

BVSPC Sample ID	Surface Water Health Based RG**	TP-SW-25 (Background)	TP-SW-70 (Background*)	TP-SW-21	TP-SW-107	TP-SW-108	TP-SW-49	TP-SW-53	TP-SW-53 (Duplicate)
Stream Segment		I	I	I	I	I	II	II	II
Organotin Compounds (ug/L)									
Monobutyltin	11	0.003 UR	0.003 UR	0.003 UR	0.003 UR	0.003 UR	0.055 J	0.071 J	0.003 UR
Dibutyltin	11	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.11	0.11	0.044
Tributyltin	11	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.17	0.23	0.1
Tetrabutyltin	11	0.005 UJ	0.005 UJ	0.005 UJ	0.005 UJ	0.005 UJ	0.01 UJ	0.005 UJ	0.005 UJ
Miscellaneous Organotin Compounds (ug/l)									
Trioctyltin	11	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	1.0 UJ	0.50 UJ	0.50 UJ
Tetraoctyltin	11	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	1.0 UJ	0.50 UJ	0.50 UJ
Total Organotins		ND	ND	ND	ND	ND	0.335 J	0.411 J	0.144
Tin (ug/L)	NE	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.81	0.57

BVSPC Sample ID	Surface Water Health Based RG**	TP-SW-25 (Background)	TP-SW-70 (Background*)	TP-SW-76	TP-SW-83	TP-SW-95	TP-SW-96	TP-SW-103	TP-SW-7
Stream Segment		I	I	II	II	IV	IV	V	V
Organotin Compounds (ug/L)									
Monobutyltin	11	0.003 UR	0.003 UR	0.035 J	0.029 J	0.027 J	0.015 J	0.003 UR	0.003 UR
Dibutyltin	11	0.005 U	0.005 U	0.057	0.044	0.026	0.018	0.005 U	0.005 U
Tributyltin	11	0.005 U	0.005 U	0.26	0.13	0.047	0.031	0.005 U	0.005 U
Tetrabutyltin	11	0.005 UJ	0.005 UJ	0.073 J	0.005 UJ	0.005 UJ	0.005 UJ	0.005 UJ	0.005 UJ
Miscellaneous Organotin Compounds (ug/L)									
Trioctyltin	11	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ
Tetraoctyltin	11	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ
Total Organotins		ND	ND	0.425 J	0.203 J	0.1 J	0.064 J	ND	ND
Tin (ug/L)	NE	0.5 U	NA	NA	NA	NA	0.5 U	NA	NA

NOTES:

- ug/L micrograms per liter
- NE A PRG has not been established for this constituent.
- ND The total organotin concentration could not be calculated since all compounds were below SQLs
- * Supplemental background sample collected in this medium
- ** The surface water health based RG provided by EPA is 11 ppb for all organotin compounds
- U Material was analyzed for but not detected. The number is the minimum quantitation limit.
- J Estimated value
- N Presumptive evidence of presence of material
- R QC indicates that data is unusable

TABLE 7.1.RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 2**
Receptor Population:	**Visitor (Swimmer)**
Receptor Age:	**Adolescent**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Monobutyl Tin	2.0E-004	mg/L	2.0E-004	mg/L	M	2.7E-004	L/kg-day	3.0E-004	mg/kg-day			1.8E-004
	Tributyl Tin	5.6E-004	mg/L	5.6E-004	mg/L	M	2.7E-004	L/kg-day	3 0E-004	mg/kg-day			5.0E-004
	(Total)												6.8E-004
Dermal	Monobutyl Tin	2.0E-004	mg/L	2 0E-004	mg/L	M	1.2E-003	L/kg-day	1.5E-004	mg/kg-day			1.5E-003
	Tributyl Tin	5.6E-004	mg/L	5.6E-004	mg/L	M	1.2E-003	L/kg-day	1.5E-004	mg/kg-day			4.3E-003
	(Total)												5.8E-003
									Total Hazard Index Across All Exposure Routes/Pathways				0.007

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.2 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 4

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 4**
Receptor Population:	**Visitor (Swimmer)**
Receptor Age:	**Adolescent**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Dibutyl Tin	2.6E-005	mg/L	2.6E-005	mg/L	M	2.7E-004	L/kg-day	3.0E-004	mg/kg-day			2.3E-005
	Monobutyl Tin	2.7E-005	mg/L	2.7E-005	mg/L	M	2.7E-004	L/kg-day	3.0E-004	mg/kg-day			2.4E-005
	Tributyl Tin	4.7E-005	mg/L	4.7E-005	mg/L	M	2.7E-004	L/kg-day	3.0E-004	mg/kg-day			4.2E-005
	(Total)												9.0E-005
Dermal	Dibutyl Tin	2.6E-005	mg/L	2.6E-005	mg/L	M	1.2E-003	L/kg-day	1.5E-004	mg/kg-day			2.0E-004
	Monobutyl Tin	2.7E-005	mg/L	2.7E-005	mg/L	M	1.2E-003	L/kg-day	1.5E-004	mg/kg-day			2.1E-004
	Tributyl Tin	4.7E-005	mg/L	4.7E-005	mg/L	M	1.2E-003	L/kg-day	1.5E-004	mg/kg-day			3.6E-004
	(Total)												7.7E-004
												Total Hazard Index Across All Exposure Routes/Pathways	0.0009

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

59 0053

TABLE 7.3.RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 5

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 5**
Receptor Population:	**Visitor (Wading)**
Receptor Age:	**Adolescent**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Dibutyl Tin	3.0E-004	mg/L	3.0E-004	mg/L	M	2.7E-005	L/kg-day	3E-004	mg/kg-day			2.7E-005
	Tetrabutyl Tin	5.4E-004	mg/L	5 4E-004	mg/L	M	2.7E-005	L/kg-day	3E-004	mg/kg-day			4.9E-005
	Tributyl Tin	1.1E-003	mg/L	1.1E-003	mg/L	M	2.7E-005	L/kg-day	3E-004	mg/kg-day			9.9E-005
	(Total)												1.7E-004
Dermal	Dibutyl Tin	3.0E-004	mg/L	3.0E-004	mg/L	M	2.9E-004	L/kg-day	1.5E-004	mg/kg-day			5.8E-004
	Tetrabutyl Tin	5.4E-004	mg/L	5.4E-004	mg/L	M	2.9E-004	L/kg-day	1.5E-004	mg/kg-day			1.0E-003
	Tributyl Tin	1.1E-003	mg/L	1.1E-003	mg/L	M	2.9E-004	L/kg-day	1.5E-004	mg/kg-day			2.1E-003
	(Total)												3.7E-003
Total Hazard Index Across All Exposure Routes/Pathways													0.004

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

(2) Specify if subchronic.

TABLE 7.4.RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium.	**Surface Soil/Dry Sediment**
Exposure Medium:	**Surface Soil/Dry Sediment**
Exposure Point:	**Segment 2**
Receptor Population:	**Resident**
Receptor Age:	**Child**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Aluminum	9 4E+003	mg/kg	9 4E+003	mg/kg	M	1 8E-007	kg/kg-day	1E+000	mg/kg-day			1 7E-003
	(Total)												1 7E-003
Dermal	Aluminum	9 4E+003	mg/kg	9 4E+003	mg/kg	M	3 2E-008	kg/kg-day	1E-001	mg/kg-day			3 0E-003
	(Total)												3 0E-003
									Total Hazard Index Across All Exposure Routes/Pathways				0 005

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation

(2) Specify if subchronic

59 0055

TABLE 7.5.RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	Current/Future
Medium:	Water
Exposure Medium:	Surface Water
Exposure Point:	Segment 2
Receptor Population:	Resident (Swimmer)
Receptor Age:	Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Monobutyl Tin	2.0E-004	mg/L	2 0E-004	mg/L	M	8.2E-004	L/kg-day	3.0E-004	mg/kg-day			5.5E-004
	Tributyl Tin	5.6E-004	mg/L	5.6E-004	mg/L	M	8.2E-004	L/kg-day	3.0E-004	mg/kg-day			1.5E-003
	(Total)												2.1E-003
Dermal	Monobutyl Tin	2 0E-004	mg/L	2.0E-004	mg/L	M	1.9E-003	L/kg-day	1.5E-004	mg/kg-day			2.5E-003
	Tributyl Tin	5.6E-004	mg/L	5.6E-004	mg/L	M	1.9E-003	L/kg-day	1.5E-004	mg/kg-day			7.1E-003
	(Total)												9.6E-003
												Total Hazard Index Across All Exposure Routes/Pathways	0.01

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

5 9 0056

TABLE 7.6.RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 4

Scenario Timeframe:	Current/Future
Medium:	Water
Exposure Medium:	Surface Water
Exposure Point:	Segment 4
Receptor Population:	Resident (Swimmer)
Receptor Age:	Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Dibutyl Tin	2.6E-005	mg/L	2.6E-005	mg/L	M	8.2E-004	L/kg-day	3.0E-004	mg/kg-day			7.1E-005
	Monobutyl Tin	2.7E-005	mg/L	2.7E-005	mg/L	M	8.2E-004	L/kg-day	3.0E-004	mg/kg-day			7.4E-005
	Tributyl Tin	4.7E-005	mg/L	4.7E-005	mg/L	M	8.2E-004	L/kg-day	3.0E-004	mg/kg-day			1.3E-004
	(Total)												2.7E-004
Dermal	Dibutyl Tin	2.6E-005	mg/L	2.6E-005	mg/L	M	1.9E-003	L/kg-day	1.5E-004	mg/kg-day			3.3E-004
	Monobutyl Tin	2.7E-005	mg/L	2.7E-005	mg/L	M	1.9E-003	L/kg-day	1.5E-004	mg/kg-day			3.4E-004
	Tributyl Tin	4.7E-005	mg/L	4.7E-005	mg/L	M	1.9E-003	L/kg-day	1.5E-004	mg/kg-day			6.0E-004
	(Total)												1.3E-003
												Total Hazard Index Across All Exposure Routes/Pathways	0.002

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

(2) Specify if subchronic.

5 9 0057

TABLE 7.7.RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 5

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 5**
Receptor Population:	**Resident (Wading)**
Receptor Age:	**Child**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Dibutyl Tin	3.0E-004	mg/L	3.0E-004	mg/L	M	8.2E-005	L/kg-day	3 0E-004	mg/kg-day			8 2E-005
	Tetrabutyl Tin	5.4E-004	mg/L	5.4E-004	mg/L	M	8.2E-005	L/kg-day	3.0E-004	mg/kg-day			1.5E-004
	Tributyl Tin	1.1E-003	mg/L	1.1E-003	mg/L	M	8.2E-005	L/kg-day	3.0E-004	mg/kg-day			3.0E-004
	(Total)												5.3E-004
Dermal	Dibutyl Tin	3.0E-004	mg/L	3.0E-004	mg/L	M	5.0E-004	L/kg-day	1.5E-004	mg/kg-day			1.0E-003
	Tetrabutyl Tin	5 4E-004	mg/L	5.4E-004	mg/L	M	5.0E-004	L/kg-day	1.5E-004	mg/kg-day			1.8E-003
	Tributyl Tin	1.1E-003	mg/L	1.1E-003	mg/L	M	5.0E-004	L/kg-day	1.5E-004	mg/kg-day			3.7E-003
	(Total)												6.5E-003
												Total Hazard Index Across All Exposure Routes/Pathways	0.007

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

(2) Specify if subchronic

5 9 0058

TABLE 7.8.RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Surface Soil/Dry Sediment**
Exposure Medium:	**Surface Soil/Dry Sediment**
Exposure Point:	**Segment 2**
Receptor Population:	**Resident**
Receptor Age:	**Adult**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Aluminum	9.4E+003	mg/kg	9.4E+003	mg/kg	M	1.6E-006	kg/kg-day	1E+000	mg/kg-day			1.5E-002
	(Total)												1.5E-002
Dermal	Aluminum	9.4E+003	mg/kg	9.4E+003	mg/kg	M	8.8E-009	kg/kg-day	1E-001	mg/kg-day			8.2E-004
	(Total)												8.2E-004
												Total Hazard Index Across All Exposure Routes/Pathways	0.02

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

(2) Specify if subchronic

TABLE 7.9 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 2**
Receptor Population:	**Resident (Swimmer)**
Receptor Age:	**Adult**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Monobutyl Tin	2.0E-004	mg/L	2.0E-004	mg/L	M	1.8E-004	L/kg-day	3.0E-004	mg/kg-day			1.2E-004
	Tributyl Tin	5.6E-004	mg/L	5.6E-004	mg/L	M	1.8E-004	L/kg-day	3.0E-004	mg/kg-day			3.3E-004
	(Total)												4.5E-004
Dermal	Monobutyl Tin	2.0E-004	mg/L	2.0E-004	mg/L	M	1.3E-003	L/kg-day	1.5E-004	mg/kg-day			1.7E-003
	Tributyl Tin	5.6E-004	mg/L	5.6E-004	mg/L	M	1.3E-003	L/kg-day	1.5E-004	mg/kg-day			4.9E-003
	(Total)												6.6E-003
	Total Hazard Index Across All Exposure Routes/Pathways												0.007

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

(2) Specify if subchronic.

TABLE 7.10.RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 4

Scenario Timeframe:	Current/Future
Medium:	Water
Exposure Medium:	Surface Water
Exposure Point:	Segment 4
Receptor Population:	Resident (Swimmer)
Receptor Age:	Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Dibutyl Tin	2.6E-005	mg/L	2.6E-005	mg/L	M	1.8E-004	L/kg-day	3E-004	mg/kg-day			1.5E-005
	Monobutyl Tin	2.7E-005	mg/L	2.7E-005	mg/L	M	1.8E-004	L/kg-day	3E-004	mg/kg-day			1.6E-005
	Tributyl Tin	4.7E-005	mg/L	4.7E-005	mg/L	M	1.8E-004	L/kg-day	3E-004	mg/kg-day			2.8E-005
	(Total)												5.9E-005
Dermal	Dibutyl Tin	2.6E-005	mg/L	2.6E-005	mg/L	M	1.3E-003	L/kg-day	1.5E-004	mg/kg-day			2.3E-004
	Monobutyl Tin	2.7E-005	mg/L	2.7E-005	mg/L	M	1.3E-003	L/kg-day	1.5E-004	mg/kg-day			2.3E-004
	Tributyl Tin	4.7E-005	mg/L	4.7E-005	mg/L	M	1.3E-003	L/kg-day	1.5E-004	mg/kg-day			4.1E-004
	(Total)												8.7E-004
												Total Hazard Index Across All Exposure Routes/Pathways	0.0009

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.11.RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 5

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 5**
Receptor Population:	**Resident (Wading)**
Receptor Age:	**Adult**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Dibutyl Tin	3.0E-004	mg/L	3.0E-004	mg/L	M	1.8E-005	L/kg-day	3.0E-004	mg/kg-day			1.8E-005
	Tetrabutyl Tin	5.4E-004	mg/L	5.4E-004	mg/L	M	1.8E-005	L/kg-day	3.0E-004	mg/kg-day			3.2E-005
	Tributyl Tin	1.1E-003	mg/L	1.1E-003	mg/L	M	1.8E-005	L/kg-day	3.0E-004	mg/kg-day			6.5E-005
	(Total)												1.1E-004
Dermal	Dibutyl Tin	3.0E-004	mg/L	3.0E-004	mg/L	M	2.6E-004	L/kg-day	1.5E-004	mg/kg-day			5.2E-004
	Tetrabutyl Tin	5.4E-004	mg/L	5.4E-004	mg/L	M	2.6E-004	L/kg-day	1.5E-004	mg/kg-day			9.4E-004
	Tributyl Tin	1.1E-003	mg/L	1.1E-003	mg/L	M	2.6E-004	L/kg-day	1.5E-004	mg/kg-day			1.9E-003
	(Total)												3.4E-003
												Total Hazard Index Across All Exposure Routes/Pathways	0.003

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.12.RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Fish**
Exposure Point:	**Crystal Lake (Segment 2)**
Receptor Population:	**Recreational Fisher**
Receptor Age:	**Adult**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference oncentration	Reference oncentration Units	Hazard Quotient
Ingestion	Butyl Tin - TEQ	8.95E-001	mg/L	8.95E-001	mg/L	M	3.6E-004	L/kg-day	3.0E-004	mg/kg-day			1.1E+000
	(Total)												1.1E+000
												Total Hazard Index Across All Exposure Routes/Pathways	1.1

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

59 0063

TABLE 7.13.RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Sediment**
Exposure Medium:	**Ducks (via Benthic Invertebrates)**
Exposure Point:	**Segment 2**
Receptor Population:	**Hunter**
Receptor Age:	**Adult**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Tributyltin (Total)	1.0E+001	mg/kg	1.0E+001	mg/kg	M	4.4E-004	mg/kg-day	3E-004	mg/kg-day			1.5E+001
	(Total)												1.5E+001
												Total Hazard Index Across All Exposure Routes/Pathways	15

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

5 9 0064

TABLE 7.14.RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Sediment**
Exposure Medium:	**Ducks (via Benthic Invertebrates)**
Exposure Point.	**Segment 2**
Receptor Population:	**Hunter**
Receptor Age:	**Adult**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Tributyltin (Total)	1 0E+001	mg/kg	1 0E+001	mg/kg	M	2 86E-005	mg/kg-day	3E-004	mg/kg-day			9 9E-001
	(Total)												9 9E-001
												Total Hazard Index Across All Exposure Routes/Pathways	0 99

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation
(2) Specify if subchronic

TABLE 8.1.RME
CALCULATION OFCANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 2**
Receptor Population:	**Visitor (Swimmer)**
Receptor Age:	**Adolescent**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Monobutyl Tin	2 0E-004	mg/L	2 0E-004	mg/L	M	3.9E-005	L/kg-day	--	mg/kg-day			--
	Tributyl Tin	5 6E-004	mg/L	5.6E-004	mg/L	M	3.9E-005	L/kg-day	--	mg/kg-day			--
	(Total)												--
Dermal	Monobutyl Tin	2.0E-004	mg/L	2 0E-004	mg/L	M	1.6E-004	L/kg-day	--	mg/kg-day			--
	Tributyl Tin	5.6E-004	mg/L	5.6E-004	mg/L	M	1.6E-004	L/kg-day	--	mg/kg-day			--
	(Total)												--
													--

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation

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TABLE 8.2.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 4

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 4**
Receptor Population:	**Visitor (Swimmer)**
Receptor Age:	**Adolescent**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Dibutyl Tin	2.6E-005	mg/L	2.6E-005	mg/L	M	3.9E-005	L/kg-day	–	mg/kg-day			–
	Monobutyl Tin	2.7E-005	mg/L	2.7E-005	mg/L	M	3.9E-005	L/kg-day	–	mg/kg-day			–
	Tributyl Tin	4.7E-005	mg/L	4 7E-005	mg/L	M	3.9E-005	L/kg-day	–	mg/kg-day			–
	(Total)												–
Dermal	Dibutyl Tin	2.6E-005	mg/L	2.6E-005	mg/L	M	1.6E-004	L/kg-day	–	mg/kg-day			–
	Monobutyl Tin	2.7E-005	mg/L	2.7E-005	mg/L	M	1.6E-004	L/kg-day	–	mg/kg-day			–
	Tributyl Tin	4.7E-005	mg/L	4.7E-005	mg/L	M	1.6E-004	L/kg-day	–	mg/kg-day			–
	(Total)												–
													–

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

5 9 0067

TABLE 8.3.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 5

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 5**
Receptor Population:	**Visitor (Wading)**
Receptor Age:	**Adolescent**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Dibutyl Tin	3.0E-004	mg/L	3.0E-004	mg/L	M	3.9E-006	L/kg-day	--	mg/kg-day			--
	Tetrabutyl Tin	5.4E-004	mg/L	5.4E-004	mg/L	M	3.9E-006	L/kg-day	--	mg/kg-day			--
	Tributyl Tin	1.1E-003	mg/L	1.1E-003	mg/L	M	3.9E-006	L/kg-day	--	mg/kg-day			--
	(Total)												--
Dermal	Dibutyl Tin	3.0E-004	mg/L	3.0E-004	mg/L	M	4.2E-005	L/kg-day	--	mg/kg-day			--
	Tetrabutyl Tin	5.4E-004	mg/L	5.4E-004	mg/L	M	4.2E-005	L/kg-day	--	mg/kg-day			--
	Tributyl Tin	1.1E-003	mg/L	1.1E-003	mg/L	M	4.2E-005	L/kg-day	--	mg/kg-day			--
	(Total)												--
													--

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

590068

TABLE 8.4.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Surface Soil/Dry Sediment**
Exposure Medium:	**Surface Soil/Dry Sediment**
Exposure Point:	**Segment 2**
Receptor Population:	**Resident**
Receptor Age:	**Child**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Slope Factor (2)	Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Aluminum	9.4E+003	mg/kg	9.4E+003	mg/kg	M	–	kg/kg-day	–	mg/kg-day			–
	(Total)												–
Dermal	Aluminum	9.4E+003	mg/kg	9.4E+003	mg/kg	M	–	kg/kg-day	–	mg/kg-day			–
	(Total)												–
													–

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

(2) Specify if subchronic.

TABLE 8.5.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 2**
Receptor Population:	**Resident (Swimmer)**
Receptor Age:	**Child**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Monobutyl Tin	2.0E-004	mg/L	2.0E-004	mg/L	M	7.0E-005	L/kg-day	–	mg/kg-day			–
	Tributyl Tin	5.6E-004	mg/L	5.6E-004	mg/L	M	7.0E-005	L/kg-day	–	mg/kg-day			–
	(Total)												–
Dermal	Monobutyl Tin	2.0E-004	mg/L	2.0E-004	mg/L	M	1.6E-004	L/kg-day	–	mg/kg-day			–
	Tributyl Tin	5.6E-004	mg/L	5.6E-004	mg/L	M	1.6E-004	L/kg-day	–	mg/kg-day			–
	(Total)												–
													–

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

59 0070

TABLE 8.6.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 4

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 4**
Receptor Population:	**Resident (Swimmer)**
Receptor Age:	**Child**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Dibutyl Tin	2.6E-005	mg/L	2.6E-005	mg/L	M	7.0E-005	L/kg-day	--	mg/kg-day			--
	Monobutyl Tin	2.7E-005	mg/L	2.7E-005	mg/L	M	7.0E-005	L/kg-day	--	mg/kg-day			--
	Tributyl Tin	4.7E-005	mg/L	4.7E-005	mg/L	M	7.0E-005	L/kg-day	--	mg/kg-day			--
	(Total)												--
Dermal	Dibutyl Tin	2.6E-005	mg/L	2.6E-005	mg/L	M	1.6E-004	L/kg-day	--	mg/kg-day			--
	Monobutyl Tin	2.7E-005	mg/L	2.7E-005	mg/L	M	1.6E-004	L/kg-day	--	mg/kg-day			--
	Tributyl Tin	4.7E-005	mg/L	4.7E-005	mg/L	M	1.6E-004	L/kg-day	--	mg/kg-day			--
	(Total)												--
													--

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

59 0071

TABLE 8.7.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 5

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 5**
Receptor Population:	**Resident (Wading)**
Receptor Age:	**Child**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Dibutyl Tin	3.0E-004	mg/L	3.0E-004	mg/L	M	7.0E-006	L/kg-day	--	mg/kg-day			--
	Tetrabutyl Tin	5.4E-004	mg/L	5.4E-004	mg/L	M	7.0E-006	L/kg-day	--	mg/kg-day			--
	Tributyl Tin	1.1E-003	mg/L	1.1E-003	mg/L	M	7.0E-006	L/kg-day	--	mg/kg-day			--
	(Total)												--
Dermal	Dibutyl Tin	3.0E-004	mg/L	3.0E-004	mg/L	M	4.2E-005	L/kg-day	--	mg/kg-day			--
	Tetrabutyl Tin	5.4E-004	mg/L	5.4E-004	mg/L	M	4.2E-005	L/kg-day	--	mg/kg-day			--
	Tributyl Tin	1.1E-003	mg/L	1.1E-003	mg/L	M	4.2E-005	L/kg-day	--	mg/kg-day			--
	(Total)												--
													--

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.8.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Surface Soil/Dry Sediment**
Exposure Medium:	**Surface Soil/Dry Sediment**
Exposure Point:	**Segment 2**
Receptor Population:	**Resident**
Receptor Age:	**Adult**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Slope Factor (2)	Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Aluminum	9 4E+003	mg/kg	9 4E+003	mg/kg	M	–	kg/kg-day	–	mg/kg-day			–
	(Total)												–
Dermal	Aluminum	9 4E+003	mg/kg	9 4E+003	mg/kg	M	–	kg/kg-day	–	mg/kg-day			–
	(Total)												–
													–

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation

(2) Specify if subchronic

5 9 0073

TABLE 8.9.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 2**
Receptor Population:	**Resident (Swimmer)**
Receptor Age:	**Adult**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Monobutyl Tin	2 0E-004	mg/L	2 0E-004	mg/L	M	6 0E-005	L/kg-day	–	mg/kg-day			–
	Tributyl Tin	5 6E-004	mg/L	5 6E-004	mg/L	M	6 0E-005	L/kg-day	–	mg/kg-day			–
	(Total)												–
Dermal	Monobutyl Tin	2 0E-004	mg/L	2 0E-004	mg/L	M	4 5E-004	L/kg-day	–	mg/kg-day			–
	Tributyl Tin	5 6E-004	mg/L	5 6E-004	mg/L	M	4 5E-004	L/kg-day	–	mg/kg-day			–
	(Total)												–
													–

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation

5 9 0074

TABLE 8.10.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 4

Scenario Timeframe:	Current/Future
Medium:	Water
Exposure Medium:	Surface Water
Exposure Point:	Segment 4
Receptor Population:	Resident (Swimmer)
Receptor Age:	Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Dibutyl Tin	2.6E-005	mg/L	2.6E-005	mg/L	M	6.0E-005	L/kg-day	--	mg/kg-day			--
	Monobutyl Tin	2.7E-005	mg/L	2.7E-005	mg/L	M	6.0E-005	L/kg-day	--	mg/kg-day			--
	Tributyl Tin	4.7E-005	mg/L	4.7E-005	mg/L	M	6.0E-005	L/kg-day	--	mg/kg-day			--
	(Total)												--
Dermal	Dibutyl Tin	2.6E-005	mg/L	2.6E-005	mg/L	M	4.5E-004	L/kg-day	--	mg/kg-day			--
	Monobutyl Tin	2.7E-005	mg/L	2.7E-005	mg/L	M	4.5E-004	L/kg-day	--	mg/kg-day			--
	Tributyl Tin	4.7E-005	mg/L	4.7E-005	mg/L	M	4.5E-004	L/kg-day	--	mg/kg-day			--
	(Total)												--
													--

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.11.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 5

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Surface Water**
Exposure Point:	**Segment 5**
Receptor Population:	**Resident (Wading)**
Receptor Age:	**Adult**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Dibutyl Tin	3.0E-004	mg/L	3.0E-004	mg/L	M	6.0E-006	L/kg-day	–	mg/kg-day			–
	Tetrabutyl Tin	5.4E-004	mg/L	5.4E-004	mg/L	M	6.0E-006	L/kg-day	–	mg/kg-day			–
	Tributyl Tin	1.1E-003	mg/L	1.1E-003	mg/L	M	6.0E-006	L/kg-day	–	mg/kg-day			–
	(Total)												–
Dermal	Dibutyl Tin	3.0E-004	mg/L	3.0E-004	mg/L	M	9.0E-005	L/kg-day	–	mg/kg-day			–
	Tetrabutyl Tin	5.4E-004	mg/L	5.4E-004	mg/L	M	9.0E-005	L/kg-day	–	mg/kg-day			–
	Tributyl Tin	1.1E-003	mg/L	1.1E-003	mg/L	M	9.0E-005	L/kg-day	–	mg/kg-day			–
	(Total)												–
													–

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

59 0076

TABLE 8.12.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS

Scenario Timeframe:	**Current/Future**
Medium:	**Water**
Exposure Medium:	**Fish**
Exposure Point:	**Crystal Lake (Segment 2)**
Receptor Population:	**Recreational Fisher**
Receptor Age:	**Adult**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Butyl Tin - TEQ	8.95E-001	mg/L	3.0E-004	mg/L	M	1.5E-004	L/kg-day	--	mg/kg-day			--
	(Total)												--
													--

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.13.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Sediment**
Exposure Medium:	**Ducks (via Benthic Invertebrates)**
Exposure Point:	**Segment 2**
Receptor Population:	**Hunter**
Receptor Age:	**Adult**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Tributyl Tin (Total)	1.0E+001	mg/kg	1 0E+001	mg/kg	M	1.9E-004	mg/kg-day	–	mg/kg-day			–
	(Total)												–
													–

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

5 9 0078

TABLE 8.14.RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
TIN PRODUCTS SEGMENT 2

Scenario Timeframe:	**Current/Future**
Medium:	**Sediment**
Exposure Medium:	**Ducks (via Benthic Invertebrates)**
Exposure Point:	**Segment 2**
Receptor Population:	**Hunter**
Receptor Age:	**Adult**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Reference Concentration	Reference Concentration Units	Cancer Risk
Ingestion	Tributyl Tin (Total)	1.0E+001	mg/kg	1.0E+001	mg/kg	M	2.1E-004	mg/kg-day	–	mg/kg-day			--
	(Total)												--
													–

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

59 0079

APPENDIX B
STATE CONCURRENCE LETTER

DHEC
PROMOTE PROTECT PROSPER
2600 Bull Street
Columbia, SC 29201-1708

5 9 0081

September 18, 2003

Jimmy Palmer, Jr.
Regional Administrator
EPA Region IV
61 Forsyth Street, 11th Floor
Atlanta, Georgia 30303-8960

RE: Tin Products Superfund Site – Record of Decision
Lexington County, SC

Dear Mr. Palmer:

The South Carolina Department of Health and Environmental Control (Department) concurs with the referenced Record of Decision (ROD) with the following conditions: (1) we be provided the opportunity to review and approve the Remedial Design plan for future monitoring; and (2) the Tin Products plant site be further investigated during the Remedial Design phase. After careful review and consideration of data generated during the Remedial Investigation and additional data gathered since, the Department finds that the following concerns remain:

1) For a number of reasons, the Department did not approve the Remedial Investigation and Risk Assessment (RI/RA) that preceded this ROD. Detailed comments regarding the Department's concerns on the RI/RA can be found in our comment letter dated August 28, 2003.

2) A fundamental basis of EPA's decision to issue this ROD is the determination by EPA that natural degradation of organo-tin compounds has resulted in no specific need for additional assessment of the site or evaluation of additional remedial alternatives. The Department's position is that current data supports a no-action decision only with additional monitoring over time to determine whether organo-tin compounds are breaking down sufficiently to be protective of human health and the environment.

3) The Department has had ongoing conversations and provided additional data to EPA regarding the Tin Products plant site. Our concern is that the source of contamination has not been fully addressed.

In concurring with this ROD conditioned upon the review and approval by the Department of the Remedial Design plan for future monitoring, the Department does not waive any right or authority it may have under federal or state law, and reserves any right or authority it may have to require corrective action in accordance with the South Carolina Pollution Control Act. These rights include, but are not limited to, the right to ensure that all necessary permits are obtained and that all clean-up goals and criteria are met, and the right to take separate action in the event clean-up goals and criteria are not met. Nothing in this concurrence shall preclude the Department from exercising any administrative, legal or equitable remedies available to require additional response actions in the event that: (1) previously unknown or undetected conditions arise at the site, or (2) the Department receives additional information not consistent with the premises relied upon in concurring conditionally with the selected alternative; or (3) the implementation of the remedial alternative selected in the ROD is not protective of public health and the environment.

The Department appreciates the opportunity to comment on this ROD. Please do not hesitate to contact me at (803) 896-8940 should you wish to further discuss this matter.

Sincerely,

R. Lewis Shaw

R. Lewis Shaw, P.E.
Deputy Commissioner
Environmental Quality Control

cc: Hartsill Truesdale, Chief, BLWM
Keith Lindler, BLWM

APPENDIX C
RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY
TIN PRODUCTS RED BANK CREEK SITE

INTRODUCTION

This responsiveness summary is provided to summarize community comments and concerns received during the public comment period for the Tin Products - Red Bank Creek site, and EPA's responses to those comments and concerns. All comments summarized in this document have been considered in EPA's final decision for this site.

Public interest at this site is relatively high. Both the kick off meeting and the proposed plan public meeting were well attended with many comments and questions offered by the public. Additionally, four written responses were submitted to EPA during the public comment period. EPA provides the following responses to the written comments. Oral comments made during the public meeting follow the written comments below.

SUMMARY OF WRITTEN COMMENTS AND RESPONSES

1. Mr. Clayton Macaulay, writing on behalf of Dr. and Mrs. Gray Macaulay, requested that EPA provide a statement indicating that Red Bank Creek and Crystal Lake are suitable for human activity. This request was made to assist the Macaulays in having their property insurance restored.

   Response: Based on the results of the human health risk assessment, the risk values for the Tin Products Red Bank Creek site are below EPA's level of concern for protection of human health. Generally speaking, this site would not pose any greater risk to humans than any other similar water body under reasonable exposure scenarios (i.e. swimming, wading, fishing, or hunting). Following EPA's signing of the ROD for this site, a letter will be sent to the Macaulays which reiterates the conclusions of the risk assessment.

2. Mr. Bill Irwin expressed his concern over the WWTP discharge pipe located within his back yard. He states that the plug is holding contaminated liquid in the pipe and that the liquid can leak out and contaminate the adjacent soils and groundwater. Mr. Irwin is also concerned that rain water is infiltrating the pipe and then migrating back into the adjacent soils and groundwater. He also requested testing of the general areas after heavy rains.

   Response: EPA's investigation of the WWTP discharge pipe did reveal that the sediment within the WWTP discharge pipe was contaminated with organotins, and that shallow groundwater samples collected adjacent to the WWTP discharge pipe also contained measurable levels of organotins, but the soil samples did not contain organotins. Because the sediment within the WWTP discharge pipe could continue to disperse organotins into the environment, EPA's emergency response personnel plan to remove the sediment and liquid from within the discharge pipe.

3. Mr. Tim Houghtaling writes to complement EPA for the investigative work on the fate of organotins, and to criticize EPA for not following up on other issues of significance to Mr. Houghtaling. His comments and EPA responses are summarized as follows:

Comment 1: During the public meeting, EPA did not state if the creek water is safe for children to swim.

Response: EPA did specifically state that the creeks are safe for swimming. Verification of this statement can be viewed within the public meeting transcript (page 47, line 22, and again on page 49, line 4).

Comment 2: Why did it take three years for the community to hear the news that the contaminants are degrading faster than the 7 ½ year half life.

Response: The possibility that the organotin concentrations at this site could degrade at faster rates was mentioned during the kickoff meeting, but it took some time to gather site specific evidence for establishing what the actual degradation rates were at this site. Multiple sampling stations had to be added and then sampled over time to evaluate the degradation process. EPA also choose to wait until the in-lab degradation test performed by the USGS was completed before presenting all of the lines of evidence to the public. The information was then presented to the public as expeditiously as possible.

Comment 3: EPA has disregarded the need to determine the causes of the release from the WWTP, both procedural and political, and has not found a way to prevent recurrences. Who is responsible for overseeing waste water treatment plant (WWTP) operations? What were the Standard Operating Procedures for the WWTP? Who is investigating the procedural failures of the WWTP, and does any documentation of such an investigation exists?

Response: The Two Notch Road WWTP is operated by Lexington County Joint Water and Sewer Authority, who maintains the SOP for plant operations. The South Carolina DHEC's Bureau of Water ~~Division~~ has the responsibility for regulating the operations of the WWTP. Documentation of the release incident can be obtained by contacting their office. Because EPA has delegated this responsibility to the state, our agency maintains limited oversight of the administration of this program. Information on EPA's oversight of this program can be obtained through EPA's Water Management Division, 61 Forsyth Street, Atlanta, GA 30303.

Comment 4: EPA had authority to monitor poisonous chemicals and that EPA failed to do this. Why was such a failure not investigated?

Response: At the time of the release, organotins were not listed as a hazardous substance, therefore no direct monitoring was performed. However, the handling of organotins at the

Tin Products site was managed indirectly through a pretreatment permit issued to Tin Products by Lexington County. This permit stated that no organics were to be disposed into the sewer system. Tin Products chose to ignore their permit restriction and discharged organotions into the sewer system.

In response to this release the State of South Carolina created legislation on May 24, 2002, which classified organotins as a hazardous waste. This legislation increased the level of regulation for organotins and further restricted the manner in which organotins are handled.

Comment 5: EPA plans to monitor the site by having property owners catch fish and submit the fish for analysis.

Response: For data quality purposes, the collection of aquatic species will be performed by trained field technicians operating under the guidelines established in EPA's Ecological Assessment Standard Operating Procedures and Quality Assurance Manual.

Comment 6: Why is EPA not collaborating with University biologists to monitor the return of wildlife?

EPA often works with other educational groups which would include universities. While our agency would welcome such a collaborative effort, there is no particular reason to actively seek out additional support from the university for this project.

4. Mr David Hargett of the Pinnacle Consulting Group in Greenville, South Carolina, writes to provide comments on the conceptual approach to the RI, the work performed and presented in the RI report, and the Feasibility Study.

Comment 1: Conceptual approach to the RI - definition of the site should be expanded so that the investigation could be expanded to include other areas: the WWTP discharge pipe and Muddy Springs Branch, the WWTP, the sewer pipe leading from the Tin Products plant to the WWTP, and the Old Barnwell WWTP which temporarily received waste rerouted from the Two Notch Road WWTP.

Response: Remedial Investigations are performed on sites where there is reasonable evidence of a contaminant source area, a viable exposure pathway, and receptors for these pathways. The RI focused on the only area which had all three components: a source area (14 miles of contaminated sediment and surface water), viable exposure pathways (drinking water intake, recreational use of surface water) and receptors (city of Cayce, swimmers, fishers, hunters). The other areas mentioned do not have these components and would not warrant further investigation by EPA.

EPA did sample the sediments within Muddy Springs Branch during the RI and the results revealed non-detectable levels of organotins (TP-SD-107 and TP-SD-108). Additionally the concentration of total organotins in the pond samples collected by Pinnacle Consulting in May 2000 (17.4 ug/kg for sample IP-A and 21.4 ug/kg for sample IP-B) were significantly below the 772 ug/kg PRG ecological screening value or the 18,000 ug/kg human health screening value used by EPA during the remedial investigation. These results would not suggest the presence of any significant source of organotins in Muddy Springs Branch.

The investigation of the sediment, soil, and groundwater surrounding the WWTP discharge pipe did reveal levels of organotins in the sediment within the pipe (35,120 ug/kg for TP-SD-111), but non-detectable concentrations in the soils samples at locations less that three feet from the pipe. One of the groundwater samples had a total organotin concentration of 11.97 ug/L (TP-GP-01) which was slightly above the screening value of 11 ug/L used for this site. Another groundwater sample contained monobutyltin at 0.32 ug/L. The remaining groundwater sample had non-detectable levels of organotin as did the surface water sample collected from the adjacent spring. The results suggest a limited area of contamination exists outside this section of the WWTP discharge pipe. Furthermore the sediment within the pipe is intermittent, varying in thickness between 0-3 inches, and does not exist at all in some section of the pipe. These findings do not warrant further investigation. A removal action for the sediment within this pipe is a practical approach and it is the only action EPA plans to pursue.

Comment 2: There is a crucial need to expand the study with regards to distribution and mobility of contaminants. Variations in mineral-organic sediment medium as it relates to distribution and mobility of contaminants should be evaluated, and additional data points should be added to the field investigation. There is a concern that the phase I data suggest a "slug" of contaminated that may be migrating downstream. Furthermore a comparison of the phase I data against the phase II data show increase in total butyltins, therefore Mr. Hargett does not concur with EPAs conclusion that sequential degradation is occurring between phase I and phase II. Additionally, Mr. Hargett urges EPA to thoroughly integrate all the data sets (i.e. SCDHEC and LCJMWC reports) in order to enhance the management of the site. Mr. Hargett concludes that EPAs interpretation of rapidly degrading organotin concentrations may be overly optimistic.

Response: The existing data sets were more than adequate for characterizing the extent of contamination and evaluating the potential risk posed by this site. EPA has collected data for this site spanning a 25 month time period, beginning in March 2000 following the news of the fish kill and ending with the April 2002 sampling event. Our agency has also incorporated all the known data sets from other parties (i.e. SC DHEC, LCJWSC, and USGS) pertinent to the site characterization into the decision process. While volume of data alone would not necessarily ensure adequate characterization, the interpretation of the data is crucial for characterization and that is where several points should be discussed.

The first point is that the data sets were adequate for investigating the release to surface water and that the data does not demonstrate a level of risk justifying a clean up action. Risk assessment results demonstrated no toxicity for test organisms using the most contaminated sediments available at the time of testing, and that the benthic macroinvertebrate community continues to recover in the creeks and lakes. Some of Mr. Hargett's suggestions would be appropriate to pursue if the risk values warranted a cleanup action, but that is not the case for this site.

The second point is that EPA did not nor would not compare the Phase I data to the Phase II data for the purpose of evaluating concentration trends over time. Our agency only discussed the relative extent of contamination as it existed between the 0-2 inch layer (Phase I) in 2001 versus a deeper sediment grab sample (Phase II) in 2002. It would have been erroneous to compare these two sampling events for the purpose of evaluating concentration trends over time. These two data sets do not contradict the case for degradation as proposed in Mr. Hargett's comments, nor do they definitively support the conclusion that contaminants are migrating downstream as suggested later in his comments.

The third point to consider is that any conclusion derived from one or more data sets should hold true, or at lease not be contradicted by any of the other data sets. An interpretation of the data sets over time does not support the case for significant contaminant migration. If the contaminants were migrating downstream, then some of the downstream sampling stations which were sampled over time would have to have shown an increase in concentration at some point. This was not the case because every one of the stations which were subjected to multiple sampling events demonstrated decreasing concentrations over time. Furthermore, the "single event" sampling stations located downstream of the historically "hot" stations did not show evidence of receiving levels of organotins commensurate with the levels that would be expected if sediments from the higher contaminated areas were migrating down stream. An independent study of organotin degradation rates by USGS provides further evidence that site sediments are capable of degrading organotins.

Comment 3: The selection of a "No Action" alternative without a thorough review of other alternatives is unacceptable, and that the data trends in the RI report support the need for reviewing other cleanup alternatives. The nature and extent of the contamination associated with the WWTP discharge pipe should be thoroughly characterized.

Response: The need for evaluating other alternatives was unnecessary because the human health and ecological risk values did not justify any response action. Therefore assessing other alternatives would have been unwarranted.

The results of soil, sediment, surface water and groundwater samples taken near the WWTP discharge pipe did not show contaminant levels that would justify a remedial action. Contaminated sediment within the WWTP discharge pipe will remain primarily concentrated within the pipe, depending upon the integrity of the pipe. Because the pipe could quickly release organotin contaminated sediment into the environment during a catastrophic event (i.e. plug is removed, or pipe is breached), a removal action is planned for the sediment within the pipe.

SUMMARY OF ORAL COMMENTS AND RESPONSES

The following section represents a condensed summary of oral comments made during the proposed plan public meeting. Some of the written comments presented in the preceding section were also expressed verbally during the public meeting. For the sake of brevity, those comments were not reiterated in this section.

1. Regulatory oversight: Several members of the community voiced their concern that no controls were in place to prevent this release, and that a similar release could happen again. Operation of WWTPs are performed by the County, and regulated by the State. From a regulatory perspective, the permit issued by Lexington County to Tin Products specifically banned the discharge of any organic material into their discharge line. Furthermore any industry which generates a waste has the responsibility of characterizing the waste so that safe disposal options are chosen.

   Tin Products acted in direct violation of their permit, and with disregard for their obligation to characterize this waste prior to disposal. Ultimately they were punished for their actions. The State of South Carolina has since passed additional regulations which further restrict the way that organotins are managed. The new regulations should make the illegal discharge of organotins less likely in the future. However, any law can be broken if an individual chooses to do so.

2. Likelihood of previous releases: During the RI, public meeting and community interviews, several comments were made suggesting that there were multiple releases, rather than a single release of contaminants from the Tin Products plant. Based on the information that we do know, there is no need to assess the validity of these accusations. If multiple releases of organotins did occur over time, then the contaminants would have also been subject to degradation.

3. Recreational use of lakes and creeks: Several residents wanted to know if the creeks and lakes were safe for swimming. Based on the results of the human health risk assessment, the lakes and creeks are safe for swimming and other recreational purposes typically associated with similar surface water bodies. In assessing the risk for this site EPA took a conservative approach. Specifically the total butyltin concentrations were compared against the standard established for tributyl tin oxide. This approach would tend to overestimate the risk.

4. Groundwater contamination: One property owner raised the concern about the limited investigation performed on the WWTP discharge pipe. EPAs investigation of the WWTP pipe focused on a 1000 foot section of the pipe. The rationale for choosing this section of the

pipe was that it contained standing liquids and was also close to a private well. The results indicated low levels of contamination present in two of the three groundwater samples collected adjacent to the pipe. None of the subsurface soil samples had detectable concentrations of organotins. No organotins were present in the adjacent spring, the private well, or the sediment samples taken from Muddy Springs Branch. These results do not suggest wide spread contamination in the areas adjacent to the WWTP discharge pipe.

5. Concern over sediment redeposition: Concern was expressed over the migration of contaminated sediment along the creeks and lakes, based on empirical observations of sediment redeposition. Stream beds do tend to be dynamic and undergo scouring and redeposition on a continual basis. The degree to which this happens and the concern over its effects are amplified when contaminated sediments are involved. From a qualitative perspective, the historical sampling data for this site show evidence of stability rather than migration. For example, the initial stations showing "hot" sediments (SD-21, SD-18, SD-10, SD-49, SD-51, SD-53) have all decreased in concentration over time while none of the corresponding downstream stations have increased. If sediments were migrating to a large degree, then some of these downstream stations should have demonstrated increasing concentrations over time.

6. Residual sediment contamination: Initial information provided by other sources, primarily the news media, stated that contamination could remain in the streams and lakes for seven years or longer. Therefore, EPAs suggestion that organotins are rapidly degrading was met with some skepticism. To address these concerns, EPA acknowledged that the research literature on organotins state that degradation does occur and that degradation rates vary considerably based on site specific conditions. This possibility was mentioned during the kick off meeting. During the proposed plan public meeting, three lines of evidence were presented in support of degradation. The three lines of evidence consisted of 1) decreasing levels of total organotin concentrations over time for all sampling stations, 2) presence of degradation products (tetrabutyltin, tributyltin, dibutyltin, monobutyltin, tin) for these sampling stations, and 3) USGS degradation study. The USGS degradation study concluded that organotins were degrading in site sediments samples, observed within the controlled environment of the laboratory, at a rate similar to the degradation rates observed in the field.

APPENDIX D
SAMPLING RESULTS MEMORANDUM

BLACK & VEATCH SPECIAL PROJECTS CORP.

TECHNICAL MEMORANDUM

To: Terry Tanner, Remedial Project Manager, EPA Region 4

From: John W. Jenkins, Black & Veatch Special Projects Corp.

RE: Trip Report from RI/FS Additional Sampling Activities
Tin Products/Red Bank Creek Site, Lexington County, South Carolina

Date: November 7, 2002

Introduction

Black & Veatch Special Projects Corp. (Black & Veatch), under a U.S. Environmental Protection Agency (EPA) Region 4 Response Action Contract (RAC), has been tasked to complete the remedial investigation (RI) report and perform the feasibility study (FS) for EPA Region 4 at the Tin Products/Red Bank Creek Site, Lexington County, South Carolina. All Black & Veatch activities conducted during the RI/FS are performed under EPA Contract 68-W-99-043, Work Assignment 035-RICO-A43F. Initial RI sampling activities were performed during May and June 2001. After the initial RI sampling, a potable well sampling effort by EPA Science and Ecosystem Support Division (SESD) in September 2001 was conducted in the Tin Products Site area. Results from this SESD sampling event indicated that groundwater may have been impacted. As a result, Black & Veatch was tasked with additional sampling that included groundwater from private wells, Geoprobe™ wells, surface water, subsurface soil (from Geoprobe™ locations), and sediment from the wastewater treatment plant (WWTP) discharge pipe. This additional sampling effort was performed in June 2002. The purpose of this memorandum is to summarize the efforts and subsequent laboratory results from the additional sampling effort.

Objective, Scope, Rationale

The objective of the additional sampling was to evaluate a WWTP discharge pipe located on residential property as a possible source of groundwater contamination, and to determine the presence or absence of organotin in four local private wells and one local spring. Results of this effort will be included as an appendix in the Tin Products/Red Bank Creek RI report.

Additional RI sampling activities were conducted as a result of a September 2001 potable well sampling effort performed by the SESD in the vicinity of the Tin Products facility. Analyses of one sample collected from a potable well during the September 2001 investigation (well located on the property at 346 Muddy Springs Road) indicated the presence of monobutyl tin at an estimated concentration of 0.29 micrograms per liter (ug/L). For consistency with other samples collected in the RI, the sample designation for the

SESD sample TP-003 is referred to as TP-PW-03 in text and tables of this document. The well was resampled in early 2002 and analyses did not detect organotin compounds above quantitation limits. The results of the SESD investigation are presented in a November 26, 2001, memorandum (EPA, 2001).

The purpose of this investigation was to collect analytical samples in the vicinity of private well TP-PW-03 and in the Tin Products organotin release area to assess the impact (if any) on the local groundwater.

The scope of the additional sampling effort included:

- The installation of three temporary (Geoprobe™) wells, including the collection of one subsurface soil sample and one groundwater sample from each well (TP-PW-003, TP-PW-005, TP-PW-007).
- The collection of groundwater samples from four potable wells (TP-PW-003, TP-PW-005, TP-PW-007, and TP-PW-008).
- The collection of one surface water sample from a spring near private well TP-PW-003.
- The collection of two sediment samples from the WWTP discharge pipe.
- The collection of PVC pipe that was once part of the pump system in TP-PW-003.

The majority of the samples were collected in the immediate vicinity of the well (TP-PW-003) that indicated the presence of organotin in the September 2001 sampling event. Figure 1 illustrates the location of samples collected near the TP-PW-003 well, and Figure 2 illustrates the locations of two potable well samples (TP-PW-005 and TP-PW-007). Figure 3 illustrates the location of one potable well sample (TP-PW-008). Groundwater and surface water samples were analyzed for the following organotin compounds: monobutyl tin, dibutyl tin, tributyl tin, tetrabutyl tin, methyl tin, dimethyl tin, trimethyl tin, and trioctyltin.

The field investigation was conducted jointly by Black & Veatch and SESD. All sampling activities were conducted in accordance with the EPA *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual* (EISOPQAM), Environmental Services Division, May 1996, Revised 1997 (EPA, 1997), the Field Sampling Plan (FSP) (Black & Veatch, 2001a), the Quality Assurance Project Plan (QAPP) (Black & Veatch, 2001b), and the Health and Safety Plan (HASP) (Black & Veatch, 2001c). Investigation-derived waste (IDW) (decontamination water, soil cuttings, and personal protective equipment [PPE]) was drummed, labeled, and staged onsite in a designated area and were disposed the week of October 28, 2002, after validation of analytical data.

Sample Results Summary

Groundwater collected from potable wells and temporary Geoprobe™ wells were sampled for organotin compounds only. Table 1 presents organotin results from all water samples collected (groundwater and surface water). In summary, none of the samples collected from potable wells or the surface water sample contained organotin compounds; however, two of the three groundwater samples collected from Geoprobe™ temporary wells indicated the presence of organotin compounds.

Table 2 presents subsurface soil samples collected from Geoprobe™ locations and sediment samples collected from the WWTP discharge pipe. None of the subsurface soil samples collected from the Geoprobe™ locations indicated the presence of organotin compounds. Analyses of both sediment samples (TP-SD-110 and TP-SD-111) indicate the presence of organotin compounds, primarily butyltins. Table

2 also provides analytical results of the sample of PVC pipe that was collected to determine if the PVC pipe in the well (TP-PW-003) at 346 Muddy Springs Road may have contributed to the organotin detects in groundwater collected from that well in the September 2001 SESD groundwater investigation. No organotin compounds were detected from the PVC pipe sample. Tables 3 provides CLP metal analysis results from the two sediment samples collected from the WWTP discharge pipe. Several metals were detected; however, none were detected at levels exceeding the EPA Region 9 PRGs for residential soil (EPA, 2000).

The two sediment samples were also analyzed for organic compounds and pesticides and PCBs. Results from these analyses did not detect any organic compounds or pesticides; however, several miscellaneous compounds were detected. These miscellaneous compounds are included in the analytical data in Appendix A.

Conclusions

Analyses of groundwater from potable wells surface water from the spring collected during the May/June additional sampling effort do not indicate the presence of organotin compounds. None of the organotin analysis of subsurface soil samples collected from Geoprobe™ locations indicate the presence of organotin compounds; however, several organotin compounds were detected in groundwater collected from two of the three Geoprobe™ temporary wells. Sediment samples collected from the WWTP discharge pipe indicate the presence of several organotin compounds. Sediment from the WWTP discharge pipe is a potential organotin source to local groundwater since fluid within the pipe is also in contact with sediments and could potentially be released to the environment. The likelihood of this is largely dependent upon the integrity of the WWTP discharge pipe and associated pipe joints as well as the quantity of fluid within the WWTP discharge pipe.

References

Black & Veatch, 2001a. Black & Veatch Special Projects Corp., Sampling and Analysis Plan, Volume 2 - Field Sampling Plan, Tin Products/Red Bank Creek Site, Lexington County, South Carolina, May 18, 2001.

Black & Veatch, 2001b. Black & Veatch Special Projects Corp., Sampling and Analysis Plan, Volume 1 - Quality Assurance Project Plan, Tin Products/Red Bank Creek Site, Lexington County, South Carolina, May 18, 2001.

Black & Veatch, 2001c. Black & Veatch Special Projects Corp., Site and Task-Specific Health and Safety Plan, Tin Products/Red Bank Creek Site, Lexington County, South Carolina, May 25, 2001.

Black & Veatch 2002. Black & Veatch Special Projects Corp., Technical Memorandum, Revision 1, for Addendum Sampling at Tin Products/Red Bank Creek Site, Lexington County, South Carolina, June 7, 2002.

EPA, 1997. U.S. Environmental Protection Agency, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual* (EISOPQAM), Environmental Services Division, May 1996, Revised 1997.

EPA, 2001. U.S. Environmental Protection Agency, Region 4, Science and Ecosystem Support Division, Memorandum, November 26, 2001. Subject: Sampling results from Tin Products/Red Bank Creek Site, Lexington, SC, SESD Project No. 01-1160 & 01-1161.

Table 1
Tin Products/Red Bank Creek
Supplimental Sampling 2002 - Groundwater and Surface Water Locations
Lexington County, South Carolina

BVSPC Sample ID	TP-GP-01	TP-GP-02	TP-GP-03	TP-PW-003	TP-PW-005	TP-PW-905 (Duplicate)	TP-PW-007	TP-PW-008	TP-SW-112
Date Collected	06/12/2002	06/11/2002	06/12/2002	06/11/2002	06/11/2002	06/11/2002	06/11/2002	06/11/2002	06/12/2002
	Geoprobe Samples			Potable (private) Well Samples					Surface Water Sample
Organotin Compounds (ug/L)									
Monobutyltin	2.4	0.12 U	0.32 J	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
Dibutyltin	1.7	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
Tributyltin	2.3	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U
Tetrabutyltin	0.08 U	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U	0.080 UJ	0.080 UJ	0.080 UJ
Methyl tin	2.8	0.01 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Dimethyl tin	0.37 J	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Trimethyl tin	0.10 UR	0.10 UR	0.10 UR	0.10 UR	0.10 UR	0.10 UR	0.10 UR	0.10 UR	0.10 UR
Trioctyltin	2.4	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U

NOTES:

ug/L micrograms per liter.

-- Not detected.

Shading indicates evidence an organotin compound was detected above the minimum quantitation limit.

U Material was analyzed for but not detected. The number is the minimum quantitation limit.

J Estimated value.

R QC indicates that data is unusable.

5 9 0094

Table 2
Tin Products/Red Bank Creek
Supplimental Sampling 2002 - Geoprobe Subsurface Soil Samples, Sediment Samples, and Pipe Sample
Lexington County, South Carolina

BVSPC Sample ID	TP-SB-01	TP-SB-901 (Duplicate)	TP-SB-02	TP-SB-03	TP-SD-110	TP-SD-111	TP-PVC-01 Pipe Sample
Date collected	06/12/2002	06/12/2002	06/12/2002	06/12/2002	06/12/2002	06/12/2002	06/12/2002
Organotin Compounds (ug/kg)							
Monobutyltin	3.6 U	3.4 U	3.6 U	4.7 U	1600	4500	0.42 U
Dibutyltin	3.6 U	3.4 U	3.6 U	4.7 U	140	1300	0.55 U
Tributyltin	4.1 U	3.9 U	4.0 U	5.4 U	2200	12000	0.63 U
Tetrabutyltin	2.4 UJ	2.2 UJ	2.3 UJ	3.1 UJ	1100 J	17000 J	0.72 U
Methyl tin	3.0 U	2.8 U	3.0 U	3.9 U	3.2 U	320	NA
Dimethyl tin	3.0 U	2.8 U	3.0 U	3.9 U	3.2 U	3.5 U	NA
Trimethyl tin	3.0 UR	2.8 UR	3.0 UR	3.9 UR	3.2 UR	3.5 UR	NA
Trioctyltin	8.5 UJ	8.1 UJ	8.4 UJ	11 UJ	160 J	1100 J	NA

NOTES:

ug/kg micrograms per kilogram.

-- Not detected.

Shading indicates evidence an organotin compound was detected above the minimum quantitation limit.

U Material was analyzed for but not detected. The number is the minimum quantitation limit.

J Estimated value.

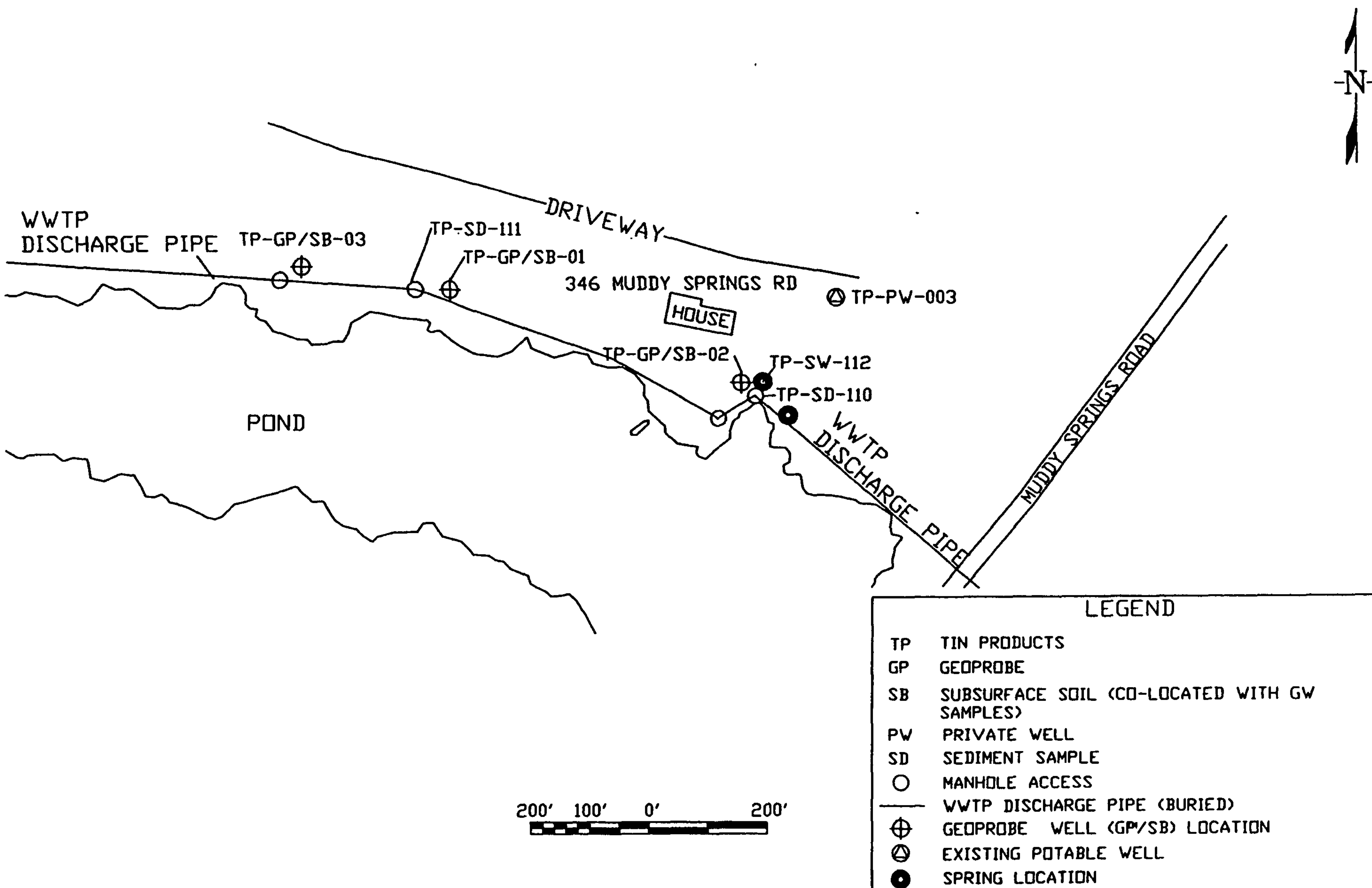
R QC indicates that data is unusable.

Tab.
Tin Products/Red Bank Creek
Supplimental Sampling 2002 - Sediment Organics and Inorganics
Lexington County, South Carolina

BVSPC Sample ID	Sediment Screening Value	TP-SD-110	TP-SD-111
Date Collected		06/12/2002	06/12/2002
Volatile Organics (ug/kg)			
Trichlorofluoromethane	NE	4 J	NA
Miscellaneous Extractables (ug/kg)			
Unknown Compounds / #	NE	7200 J / 24	46000 J / 23
Stannane, tetrabutyl-	NE	1700 JN	
Stannane, tetrabutyl-(3 isomers)	NE		28000 JN
Unknown stannanes / #	NE		1200 J / 2
Trichothec-9-en-8-one,4-(ac)	NE		9600 JN
Unknown Steroid	NE		3400 JN
Inorganic Analyses (mg/kg)			
Aluminum	NE	5600	2600
Barium	NE	14	11
Calcium	NE	3800	1500
Chromium	52.3	7.1	4.3
Cobalt	NE	0.22	0.27 R
Copper	18.7	7.9	7.8
Iron	NE	6300	4500
Lead	30.2	4.0 J	3.5 J
Manganese	NE	23	28
Nickel	15.9	2.7	1.9
Potassium	NE	180 U	210
Sodium	NE	48	61
Vanadium	NE	8.1	6.2
Zinc	124	11	12

NOTES:

Sediment Screening Value	EPA Region 4 Ecological Risk Assessment Bulletins, Supplement to RAGS; updated December 2000.
NE	An EPA SSV has not been established for this constituent.
ug/kg	micrograms per kilogram.
mg/kg	miligrams per kilogram.
NA	Not Analyzed
J	Estimated value.
N	Presumptive evidence of presence of material.
R	QC indicates that data is unusable.



SAMPLE LOCATION MAP (MAY & JUNE 2002)
TIN PRODUCTS SITE
LEXINGTON COUNTY, SC

FIGURE 1

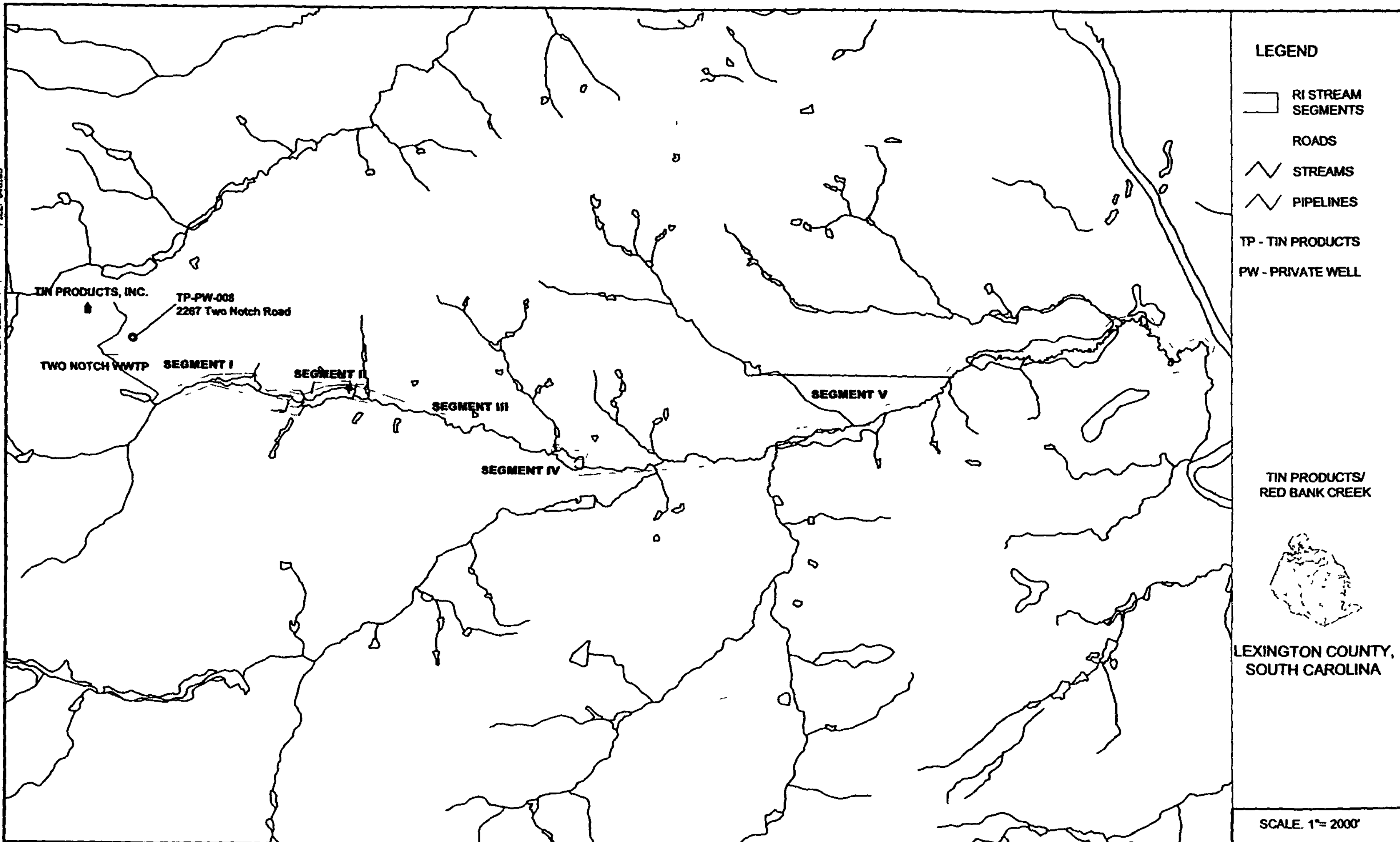
TIN PRODUCTS/RED BANK CREEK
LEXINGTON COUNTY, SOUTH CAROLINA

SEGMENT II - SAMPLE LOCATION MAP (MAY & JUNE 2002)

FIGURE 2

5 9 0098

CAD DWG NO: MAP 1.DWG
DATE: 02/07/02 ACM
PLOT SCALE: 1=1
ORIGINAL DWG SIZE
17 x 11
FILE: 048135
MOST RECENT REVISION
REVISION DATE: 03-12-02
DRAFTERS INITIALS ACM



TIN PRODUCTS/RED BANK CREEK
LEXINGTON COUNTY, SOUTH CAROLINA

SITE LOCATION MAP (MAY & JUNE 2002)

FIGURE
3

5 9 0099

APPENDIX E
TRIP REPORT FOR ADDITIONAL SAMPLING

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 4, SCIENCE and ECOSYSTEM SUPPORT DIVISION
ATHENS, GA 30605-2720

NOV 2 6 2001

4-SESD-EIB

MEMORANDUM

SUBJECT: Sampling results from Tin Products/Red Bank Creek Site
Lexington, SC
SESD Project No. 01-1160 & 01-1161

FROM: Brian Striggow, Environmental Protection Specialist
Superfund and Air Section
Enforcement and Investigations Branch

THRU: Jim Mcguire, Acting Chief
Superfund and Air Section
Enforcement and Investigations Branch

TO: Terry Tanner
North Site Management Branch
Waste Management Division

On Sept 25 and 26, 2001, SESD personnel conducted sampling of potable wells in the vicinity of the Tin Products facility near Lexington, South Carolina. The purpose of this expedition was to collect analytical samples of potable wells in the vicinity of an organotin release to assess the impact on the local drinking water aquifer. Several water samples were analyzed for additional compounds to determine if contamination from releases of other compounds may have occurred.

The attached Figure 1-Well Locations displays the locations of each well in relation to Red Bank Creek and the point of initial release. The attached Table 1-Tin Products/Red Bank Creek Sample Designations indicates the sample designations, owners and addresses, GIS coordinates, and the analyses performed on each sample.

All samples were collected and handled in accordance with the US-EPA, Region 4, SESD, Environmental Investigation Standard Operating Procedures and Quality Assurance Manual, May 1, 1996. Each well was purged from a point as close to the wellhead as possible until turbidity, pH, conductivity, and temperature had stabilized.

The six wells sampled were analyzed for the following organotin compounds: monobutyl tin, dibutyl tin, tributyl tin, and tetrabutyl tin. The complete results are displayed in Table 2-Organotin Analysis Results. The only organotin compound detected was monobutyl tin at an estimated concentration of 0.29ug/l in well TP-3. This well was on the property of Mr. Bill Irwin at 346 Muddy Springs Rd.

The three wells designated TP-1, TP-3, and TP-5 were analyzed for metals, extractable organics, and volatile organics in addition to the organotin analyses. No volatile or extractable organic compounds were detected in any of the three wells. There were several metal concentrations exceeding detection limits. Table 3-Detected Metals, lists the metals detected and the analytical results. Safe Drinking Water Act primary and secondary Maximum Contaminant Levels (MCLs) are included in the table for reference. None of the three samples contained metals concentrations exceeding a primary or secondary MCL. Lead was detected in all three wells at levels below the MCL but above the very conservative Maximum Contaminant Level Goal (MCLG) of 0ug/l. Of the three wells, only the TP-3 well was thought to have soldered copper piping upstream of the sample point.

Copies of the complete analytical results for the volatile organic, extractable organic and metals analyses are attached. If you have any questions about this work, please contact me at (706) 355-8619 or at email *striggow.brian@epamail.epa.gov*

Figure 1
Well Locations

590102

Table 1. Tin Products/Red Bank Creek Sample Designations

Sample Designation	Description / Address	Coordinates (WGS84)	Analyses: Organotins	Metals Scan	Volatiles Scan	Extractables Scan
TP-001	Mr. Elton Wilson residence (803)-359-4658 2120 Two Notch Rd Lexington, SC 29072	81°16'00"W 33°56'36"N	X	X	X	X
TP-002	Mark Irwin residence (803)-359-6963 348 Muddy Springs Rd Lexington, SC 29072	81°16'11"W 33°55'52"N	*X			
TP-003	Bill Irwin residence (803)-359-6737 346 Muddy Springs Rd Lexington, SC 29072	81°16'03"W 33°55'44"N	X	X	X	X
TP-004	Ronnie Hall residence (803)-791-1020 521 Muddy Springs Rd Lexington, SC 29073	81°16'06"W 33°55'32"N	X			
TP-005	Carolyn Steele (803)- 152 Wilson Rd Lexington, SC 29073	81°14'03"W 33°55'59"N	X	X	X	X
TP-006	C.M. Caldwell (803)-359-6550 660 Whippoorwill Lexington, SC 29073	81°16'43"W 33°55'54"N	X			
TP-TB1	VOA trip blank				X	
TP-PB1	Preservative blank			X		
	Containers:		(1) 1 liter glass	(1) 1liter poly	(3) 40ml	(1) 4 liter glass
	*Matrix Spike&dup:		(2) 1 liter glass			
	Preservative:		Ice	HNO3, ice	HCl, Ice	Ice

Table 2. Organotin Analysis Results

COMPOUND	units	TP1	TP2	TP3	TP4	TP5	TP6
MONOBUTYL TIN	UG/L	0.03 U	0.03 U	0.29 J	0.03 U	0.03 U	0.03 U
DIBUTYL TIN	UG/L	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
TRIBUTYL TIN	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
TETRABUTYL TIN	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U

Data Qualifiers
J-Estimated value.
U-Material was analyzed for but not detected.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 4, SCIENCE and ECOSYSTEM SUPPORT DIVISION
ATHENS, GA 30605-2720

4-SESD-EIB

SEP 2 1 2001

MEMORANDUM

SUBJECT: Sampling at Tin Products/Red Bank Creek Site, Lexington, SC
SESD Project No. 01-1160 & 01-1161

FROM: Brian Striggow, Environmental Protection Specialist
Superfund and Air Section

THRU: Jim Mcguire, Chief
Superfund and Air Section

TO: Terry Tanner
Waste Management Division

During the week of Sept 24, 2001, SESD personnel will perform sampling of potable wells in the vicinity of the Tin Products facility near Lexington, South Carolina. The purpose of this expedition is to collect analytical samples of potable wells in the vicinity of an organotin release to assess the impact on the local drinking water aquifer. Water samples from nearest the release will be analyzed for additional compounds to determine if contamination from any additional releases has occurred. The following description of work is in lieu of a formal work plan.

Project Leader Brian Striggow and an ESAT contract support sampler will travel to Lexington, South Carolina on September 25. Sampling will begin on the afternoon of September 25 and will likely be completed the morning of September 26. The organotin samples will be shipped from the field from either West Columbia, SC or Augusta, GA on September 26. Samples for other analyses will either be shipped from the field or brought back to the SESD laboratory. The attached Table 1, Tin Products/Red Bank Creek Sample Designations, indicates the locations to be sampled and the analyses to be performed for each location.

Purging and sampling will be done from a tap as close to the well as possible. Each potable well will be purged until physical parameters (pH, conductivity, temperature) have stabilized. Samples will be collected and handled in accordance with the <u>US-EPA, Region 4, SESD, Environmental Investigation Standard Operating Procedures and Quality Assurance Manual, May 1, 1996</u>.

No Investigation Derived Waste (IDW) is expected to be generated. Purge water from the potable wells will be discharged to ground surface in the vicinity of the wells.

If you have any questions about this work, please contact me at (706) 355-8619 or at email *striggow.brian@epamail.epa.gov*

Table 3. Detected Metals

		Sample Locations			Reference Values		
		TP-1	TP-3	TP-5	MCL	MCLG	Secondary MCL
BARIUM	UG/L	6.5	84	90 A	2000 UG/L	2000 UG/L	
CALCIUM	MG/L	U	4.6	1.3 A			
COPPER	UG/L	U	U	12 A	1300 UG/L	1300 UG/L	1000 UG/L
LEAD	UG/L	0.81	2.6	3.7 A	15 UG/L	0 UG/L	
MAGNESIUM	MG/L	U	1.2	0.64 A			
MANGANESE	UG/L	U	20	24 A			50 UG/L
POTASSIUM	MG/L	U	U	2 A			
SODIUM	MG/L	U	5.3	7.6 A			
STRONTIUM	UG/L	U	45	20 A			
ZINC	UG/L	U	600	U			5000 UG/L

Data Qualifiers

A-Average value
U-Material was analyzed for but not detected.

Table 1. Tin Products/Red Bank Creek Sample Designations

Sample Designation	Description	Organotins	Metals Scan	Volatiles Scan	Extractables Scan
TP-001	Mr. Elton Wilson residence (803)-359-4658 2120 Two Notch Rd Lexington, SC 29072	X	X	X	X
TP-002	Mark Irwin residence (803)-359-6963 348 Muddy Springs Rd Lexington, SC 29072	X	X	X	X
TP-003	Bill Irwin residence (803)-359-6737 346 Muddy Springs Rd Lexington, SC 29072	X			
TP-004	Ronnie Hall residence (803)-791-1020 521 Muddy Springs Rd Lexington, SC 29073	X			
TP-005		X	X	X	X
TP-006		X			
TP-TB1	VOA trip blank			X	
TP-PB1	Preservative blank		X		
	Containers:	(1) 1 liter glass	(1) 1liter poly	(3) 40ml*	(1) 4 liter glass
	Matrix Spike&dup (if used):	(2) 1 liter glass	(1) 1liter poly	(2) 40ml	(1) 4 liter glass
	Preservative:	Ice	HNO3, ice	HCl, Ice	Ice

* (2) containers for CLP.