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EPA Superfund
Record of Decision:

BROWN WOOD PRESERVING
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LIVE OAK, FL
04/08/1988

"AT LEAST ONE ALTERNATIVE FOR EACH OF THE FOLLOWING MUST, AT A MINIMUM, BE EVALUATED WITHIN THE REQUIREMENTS OF THE FEASIBILITY STUDY GUIDANCE AND PRESENTED TO THE DECISION MAKER:

(A) ALTERNATIVES FOR TREATMENT OR DISPOSAL AT AN OFFSITE FACILITY APPROVED BY EPA (INCLUDING RCRA, TSCA, CWA, CAA, MPRSA, AND SDWA APPROVED FACILITIES), AS APPROPRIATE;

(B) ALTERNATIVES WHICH ATTAIN APPLICABLE AND RELEVANT FEDERAL PUBLIC HEALTH OR ENVIRONMENTAL STANDARDS;

(C) AS APPROPRIATE, ALTERNATIVES WHICH EXCEED APPLICABLE AND RELEVANT PUBLIC HEALTH OR ENVIRONMENTAL STANDARDS;

(D) ALTERNATIVES WHICH DO NOT ATTAIN APPLICABLE OR RELEVANT PUBLIC HEALTH OR ENVIRONMENTAL STANDARDS BUT WILL REDUCE THE LIKELIHOOD OF PRESENT OR FUTURE THREAT FROM THE HAZARDOUS SUBSTANCES. THIS MUST INCLUDE AN ALTERNATIVE WHICH CLOSELY APPROACHES THE LEVEL OF PROTECTION PROVIDED BY THE APPLICABLE OR RELEVANT STANDARDS AND MEETS CERCLA'S OBJECTIVE OF ADEQUATELY PROTECTING PUBLIC HEALTH, WELFARE AND ENVIRONMENT.

(E) A NO-ACTION ALTERNATIVE.".

2. ALTERNATIVE SCREENING PROCESS

THE PURPOSE OF THE INITIAL SCREENING PROCESS IS TO IDENTIFY, DEVELOP, AND INCORPORATE COMPLEMENTARY MITIGATING TECHNOLOGIES INTO SITE-SPECIFIC ALTERNATIVES. THE NATIONAL OIL AND HAZARDOUS SUBSTANCES CONTINGENCY PLAN (NCP) SECTION 300.68(G)(H) OUTLINES THE PROCESS FOR DEVELOPING AND SCREENING REMEDIAL ALTERNATIVES. THE NCP STATES "A LIMITED NUMBER OF ALTERNATIVES SHOULD BE DEVELOPED FOR EITHER SOURCE CONTROL OR OFFSITE REMEDIAL ACTION (OR BOTH) DEPENDING UPON THE TYPE OF RESPONSE THAT HAS BEEN IDENTIFIED.". FURTHERMORE, "THE ALTERNATIVES DEVELOPED UNDER CFR 300.68(G), DEVELOPMENT OF ALTERNATIVES, WILL BE SUBJECTED TO AN INITIAL SCREENING TO NARROW THE LIST OF POTENTIAL REMEDIAL ACTIONS FOR FURTHER DETAILED ANALYSIS.". THREE BROAD CRITERIA SHOULD BE USED IN THE INITIAL SCREENING OF ALTERNATIVES: 1) COST; 2) EFFECTS OF THE ALTERNATIVES; AND 3) ACCEPTABLE ENGINEERING PRACTICE. IN ACCORDANCE WITH CFR 300.68(G) AND (H) AND U.S. EPA GUIDANCE ON FEASIBILITY STUDIES UNDER CERCLA, THE INITIAL SCREENING PROCESS OF REMEDIAL ACTION TECHNOLOGIES WAS DIVIDED INTO SIX (6) STEPS:

- IDENTIFICATION OF REMEDIAL ACTION TECHNOLOGIES BASED UPON GENERAL RESPONSE ACTIONS;
- DEVELOPMENT OF TECHNOLOGICAL FEASIBILITY CRITERIA AND SCREENING (ACCEPTABLE ENGINEERING PRACTICE);
- DEVELOPMENT OF REMEDIAL ACTION ALTERNATIVES;
- DEVELOPMENT OF ENVIRONMENTAL AND PUBLIC HEALTH CRITERIA AND SCREENING (ACCEPTABLE ENGINEERING PRACTICE);
- OTHER CRITERIA SCREENING; AND
- COST ESTIMATING AND SCREENING.

THE TECHNOLOGIES/ALTERNATIVES REMAINING AFTER THE INITIAL SCREENING PROCESS WERE SUBJECTED TO A DETAILED EVALUATION.

3. ALTERNATIVE TECHNOLOGIES

SEVERAL ALTERNATIVE TECHNOLOGIES WERE STUDIED FOR POSSIBLE UTILIZATION AS A REMEDY. THE SEVEN (7) TECHNOLOGIES CONSIDERED WERE: IN-SITU CONTAINMENT, SOURCE REMOVAL, WATER TREATMENT, BIOLOGICAL TREATMENT, THERMAL TREATMENT, SOLVENT EXTRACTION, AND DISPOSAL. THESE SEVEN (7) TECHNOLOGIES WERE FURTHER SPECIFIED INTO TWENTY-FOUR (24) SEPARATE SPECIFIC TECHNOLOGICAL ALTERNATIVES.

A. IN-SITU CONTAINMENT TECHNOLOGIES WERE ELIMINATED FROM CONSIDERATION BECAUSE OF THE RISK OF A PARTIAL SINKHOLE COLLAPSE IN THE LAGOON AND BECAUSE THE METHOD WOULD RESULT IN NO REDUCTION IN THE TOXICITY OR VOLUME OF THE CONTAMINANTS.

B. SEVERAL SOURCE REMOVAL TECHNOLOGIES WERE EVALUATED. THE TECHNOLOGIES EVALUATED IN THIS CATEGORY APPLY TO SLUDGE AND HEAVILY CONTAMINATED SOILS FOUND IN THE LAGOON, THE DISCHARGE DITCH AND THE PLANT AREA. INCLUDED IN THIS CATEGORY ARE INFLOW CONTROL, WATER REMOVAL, AND SHALLOW EXCAVATION. THERE WERE NO SIGNIFICANT IMPEDIMENTS TO IMPLEMENTING THESE TECHNOLOGIES AT THE SITE. SOURCE REMOVAL WILL BE A

NECESSARY COMPONENT OF MOST OF THE REMEDIAL ACTION ALTERNATIVES EVALUATED.

C. THE WATER TREATMENT TECHNOLOGIES EVALUATED ARE APPLICABLE TO CONTAMINATED WATER REMOVED FROM THE LAGOON AS PART OF THE SOURCE REMOVAL ACTION. TECHNOLOGIES CONSIDERED INCLUDED: SPRAY IRRIGATION, EVAPORATION, TREATMENT AND DISCHARGE TO A SURFACE STREAM, AND PRETREATMENT AND DISCHARGE TO THE MUNICIPAL SEWER. THE LAST OPTION IS CONSIDERED THE MOST FEASIBLE OPTION FROM A TECHNICAL, ECONOMIC AND ADMINISTRATIVE PERSPECTIVE.

D. BIOLOGICAL TREATMENT TECHNOLOGIES CONSIDERED INCLUDED: IN-SITU TREATMENT, BIOLOGICAL BATCH REACTORS AND LAND TREATMENT. IN-SITU TREATMENT IS TECHNICALLY FEASIBLE FOR LOW LEVEL CONTAMINATED SOIL. HOWEVER, THE MAJORITY OF THE WASTES REQUIRING TREATMENT ARE HIGHLY CONTAMINATED SLUDGES. THEREFORE, IN-SITU TREATMENT OF HIGHLY CONTAMINATED SLUDGES WAS EXCLUDED. BIOLOGICAL BATCH REACTORS ARE POTENTIALLY FEASIBLE FOR PRETREATMENT OF THE HIGHLY CONTAMINATED SLUDGES. THE RESIDUES FROM THIS PROCESS WOULD STILL REQUIRE FINAL TREATMENT AND DISPOSAL. LAND TREATMENT OF LOW-LEVEL WASTES IS CONSIDERED FEASIBLE AND WAS RETAINED AS AN ALTERNATIVE TECHNOLOGY.

E. THERMAL TREATMENT TECHNOLOGIES INCLUDED: EXAMINATION OF THE HUBER SYSTEM, THE SHIRCO INCINERATOR, THE MOBILE ROTARY KILN, THE MOBILE CIRCULATING FLUIDIZED BED, THE COMMERCIAL INCINERATOR, AND THE INDUSTRIAL KILN. THESE TECHNOLOGIES ARE APPLICABLE TO THE SLUDGES AND THE CONTAMINATED SOILS. TECHNOLOGIES EVALUATED INCLUDED BOTH MOBILE INCINERATORS (FOR ON-SITE WASTE INCINERATION) AND STATIONARY, OFF-SITE COMMERCIAL INCINERATION FACILITIES. THE SHIRCO SYSTEM IS CONSIDERED THE MOST TECHNICALLY FEASIBLE OPTION. THIS SYSTEM WILL BE EVALUATED FURTHER IN THE REVIEW OF THE REMEDIAL ACTION ALTERNATIVES. SEVERAL INDUSTRIAL KILNS AND COMMERCIAL INCINERATORS ARE TECHNICALLY FEASIBLE. OF THESE OPTIONS, THE MARINE SHALE INDUSTRIAL KILN IN LOUISIANA IS CONSIDERED THE MOST ECONOMICALLY VIABLE AND WAS RETAINED FOR FURTHER EVALUATION.

F. THREE SOLVENT EXTRACTION PROCESSES WERE CONSIDERED: THE B.E.S.T. PROCESS, THE CRITICAL FLUID EXTRACTION SYSTEM, AND THE PCB SOIL DECONTAMINATION PROCESS. THESE TECHNOLOGIES ARE APPLICABLE TO LOW-LEVEL SLUDGES AS WELL AS HIGHLY CONTAMINATED SLUDGES. THERE IS A LACK OF OPERATING HISTORY WITH THESE TECHNOLOGIES. THE MOST ADVANCED SYSTEM FOR WHICH THERE IS A COMMERCIALLY AVAILABLE UNIT IS THE B.E.S.T. PROCESS. HOWEVER, THIS ALTERNATIVE WAS ELIMINATED DUE TO (1) THE EXTENSIVE RESEARCH AND DEVELOPMENT WORK WHICH WOULD BE REQUIRED, (2) THE EXTENSIVE UTILITY REQUIREMENTS FOR THE UNIT, (3) THE NEED TO FIND A USE FOR THE OILS RECOVERED FROM THE PROCESS, AND (4) THE UNCERTAIN REGULATORY STATUS OF THE SYSTEM.

G. TWO (2) DISPOSAL ALTERNATIVES WERE EXAMINED: (1) ON-SITE VAULTING AND (2) DISPOSAL AT OFF-SITE COMMERCIAL FACILITIES. PERMANENT ON-SITE VAULTING WAS ELIMINATED DUE TO RCRA LAND DISPOSAL REGULATIONS, THE SITE'S LOCATION IN KARST TERRAIN, AND FLORIDA'S BAN ON THE SITING OF HAZARDOUS WASTE LANDFILLS WITHIN THE STATE. DISPOSAL AT OFF-SITE COMMERCIAL FACILITIES WAS RETAINED FOR FURTHER EVALUATION.

4. SUMMARY OF ALTERNATIVES EVALUATIONS

AS DESCRIBED IN TABLE 2.0 AND ABOVE, SEVEN (7) GENERAL CLEANUP TECHNOLOGIES FURTHER DIVIDED INTO TWENTY-FOUR (24) REMEDIAL ALTERNATIVES WERE INITIALLY SCREENED WITH THE INTENT TO REDUCE THE NUMBER OF ALTERNATIVES TO BE EVALUATED IN DETAIL. THIS INITIAL SCREENING PROCESS INVOLVED THE USE OF SEVERAL CRITERIA: 1) TECHNICAL FEASIBILITY; 2) PUBLIC HEALTH EFFECTS; 3) ENVIRONMENTAL EFFECTS; 4) ATTAINMENT OF THE LEGALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS OF OTHER FEDERAL AND STATE PUBLIC HEALTH OR ENVIRONMENTAL LAWS, OR PROVIDES THE GROUNDS FOR INVOKING ONE OF THE SIX WAIVERS PROVIDED FOR IN SARA; 5) SITE-SPECIFIC APPLICATION; AND 6) COST.

SECTION 121 (B)(1) AND (B)(2) OF CERCLA/SARA SAYS:

(1) REMEDIAL ACTIONS IN WHICH TREATMENT WHICH PERMANENTLY AND SIGNIFICANTLY REDUCES THE VOLUME, TOXICITY OR MOBILITY OF THE HAZARDOUS SUBSTANCES, POLLUTANTS, AND CONTAMINANTS IS A PRINCIPAL ELEMENT, ARE TO BE PREFERRED OVER REMEDIAL ACTIONS NOT INVOLVING SUCH TREATMENT. THE OFFSITE TRANSPORT AND DISPOSAL OF HAZARDOUS SUBSTANCES OR CONTAMINATED MATERIALS WITHOUT SUCH TREATMENT SHOULD BE THE LEAST FAVORED ALTERNATIVE REMEDIAL ACTION WHERE PRACTICABLE TREATMENT TECHNOLOGIES ARE AVAILABLE. THE PRESIDENT SHALL CONDUCT AN ASSESSMENT OR PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES THAT, IN WHOLE OR IN PART, WILL RESULT IN A PERMANENT AND SIGNIFICANT DECREASE IN THE TOXICITY, MOBILITY, OR VOLUME OF THE HAZARDOUS SUBSTANCE, POLLUTANT, OR CONTAMINANT. IN MAKING SUCH ASSESSMENT, THE PRESIDENT SHALL SPECIFICALLY ADDRESS THE LONG-TERM EFFECTIVENESS OF VARIOUS ALTERNATIVES. IN ASSESSING ALTERNATIVE REMEDIAL ACTIONS, THE PRESIDENT SHALL, AT A MINIMUM, TAKE INTO ACCOUNT:

(A) THE LONG-TERM UNCERTAINTIES ASSOCIATED WITH LAND DISPOSAL;
(B) THE GOALS, OBJECTIVES, AND REQUIREMENTS OF THE SOLID WASTE DISPOSAL ACT;
(C) THE PERSISTENCE, TOXICITY, MOBILITY, AND PROPENSITY TO BIOACCUMULATE OF SUCH HAZARDOUS SUBSTANCES AND THEIR CONSTITUENTS;
(D) SHORT- AND LONG-TERM POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM HUMAN EXPOSURE;
(E) LONG-TERM MAINTENANCE COSTS;
(F) THE POTENTIAL FOR FUTURE REMEDIAL ACTION COSTS IF THE ALTERNATIVE REMEDIAL ACTION IN QUESTION WOULD FAIL; AND
(G) THE POTENTIAL THREAT TO HUMAN HEALTH AND THE ENVIRONMENT ASSOCIATED WITH EXCAVATION, TRANSPORTATION, AND REDISPOSAL, OR CONTAINMENT.

THE PRESIDENT SHALL SELECT A REMEDIAL ACTION THAT IS PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT, THAT IS COST-EFFECTIVE, AND THAT UTILIZES PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE. IF THE PRESIDENT SELECTS A REMEDIAL ACTION NOT APPROPRIATE FOR A PREFERENCE UNDER THIS SUBSECTION, THE PRESIDENT SHALL PUBLISH AN EXPLANATION AS TO WHY A REMEDIAL ACTION INVOLVING SUCH REDUCTIONS WAS NOT SELECTED.

(2) THE PRESIDENT MAY SELECT AN ALTERNATIVE REMEDIAL ACTION MEETING THE OBJECTIVES OF THIS SUBSECTION WHETHER OR NOT SUCH ACTION HAS BEEN ACHIEVED IN PRACTICE AT ANY OTHER FACILITY OR SITE THAT HAS SIMILAR CHARACTERISTICS. IN MAKING SUCH A SELECTION, THE PRESIDENT MAY TAKE INTO ACCOUNT THE DEGREE OF SUPPORT FOR SUCH REMEDIAL ACTION BY PARTIES INTERESTED IN SUCH SITE.

OF THE TWENTY-FOUR (24) SPECIFIC ALTERNATIVES, FOURTEEN (14) WERE ELIMINATED IN THE INITIAL SCREENING. THE REMAINING TEN (10) WERE MERGED INTO SEVEN (7) AND THE SEVEN (7) SPECIFIC ALTERNATIVES WERE SUBJECTED TO DETAILED SCREENING PROCEDURES (TABLE 2.0 DESCRIBES THE RESULTS OF THE PROCESS.). A MORE DETAILED EVALUATION OF THE SEVEN (7) SPECIFIC ALTERNATIVES FOLLOWS.

A. NO-ACTION

THE NO-ACTION ALTERNATIVE IMPLIES LEAVING THE SITE IN ITS PRESENT CONDITION WITHOUT DISTURBING THE CONTAMINATED MATERIALS. THIS ALTERNATIVE HAS THE ADVANTAGE THAT BOTH THE SHORT-TERM AND THE LONG-TERM RISKS OF EXPOSURE ARE NOT IMPACTED FROM THEIR PRESENT LEVELS. THE RISK OF SPREAD OF CONTAMINATED MATERIALS IS NOT INCREASED. A PART OF THE NO-ACTION ALTERNATIVE MAY BE CONTINUED MONITORING OF THE GROUNDWATER ALLOWING IDENTIFICATION OF ANY CHANGES IN SITE CONDITIONS OR THE MIGRATION OF CONTAMINATED MATERIALS OFF-SITE. SHOULD CHANGES BE DISCOVERED WHICH INCREASE THE RISKS ASSOCIATED WITH THIS SITE, THIS ALTERNATIVE COULD BE REASSESSED AND, IF NECESSARY, ALTERNATIVE ACTIONS COULD BE TAKEN.

B. ON-SITE INCINERATION

THIS ALTERNATIVE INCLUDES EXCAVATION OF ALL CONTAMINATED MATERIALS AT THE SITE FOLLOWED BY ON-SITE INCINERATION. THE STEPS REQUIRED FOR THIS ALTERNATIVE INCLUDE:

1. SITE PREPARATION INCLUDING MOBILIZATION AND ESTABLISHMENT OF ON-SITE SUPPORT FACILITIES;

2. INFLOW CONTROL INCLUDING CONSTRUCTION OF ENGINEERED BERMS AND DRAINAGE DITCHES;

3. WATER REMOVAL FROM THE LAGOON TO SITE STORAGE TANKS AND OTHER WATER DISPOSAL SYSTEM;

4. DISCHARGE TO THE POTW OF WATER FROM SITE STORAGE TANKS AND OTHER WATER DISPOSAL SYSTEMS AFTER TREATMENT, IF NECESSARY;

5. EXCAVATION OF LAGOON SLUDGES AND CONTAMINATED SOILS AND SHORT HAUL TO INCINERATOR STAGING AREA;

6. INCINERATION BY USE OF THE SHIRCO INCINERATOR ON-SITE;

7. SITE RESTORATION INCLUDING REGRADING TO ESTABLISH ENGINEERED DRAINAGE PATTERNS AND APPROPRIATE REVEGETATION.

INSTITUTIONAL REQUIREMENTS FOR THIS ALTERNATIVE INCLUDE OBTAINING LOCAL APPROVALS FOR DISCHARGE TO THE POTW AND COMPLETING A PILOT TEST BURN TO DEMONSTRATE THE APPLICABILITY OF THE TECHNOLOGY IN MEETING RCRA AND STATE AIR QUALITY PERFORMANCE STANDARDS.

THE IMPACTS OF THIS ALTERNATIVE INCLUDE ELEVATED RISKS FOR SHORT-TERM EXPOSURE TO CONSTRUCTION WORKERS AND PROCESS EMPLOYEES. THE IMPACTS OF THESE RISKS CAN BE REDUCED, AS DISCUSSED ABOVE, BY IMPLEMENTATION OF A SITE-SPECIFIC HEALTH AND SAFETY PLAN. THERE IS NO LONG-TERM RISK ASSOCIATED WITH ANY CONTAMINATED MATERIALS AS THEY WOULD BE DETOXIFIED ON-SITE AND DELISTABLE.

PRIOR TO IMPLEMENTATION OF THIS ALTERNATIVE, A PILOT TEST BURN WOULD BE REQUIRED TO PROVE THE VIABILITY OF THE TREATMENT TECHNOLOGY AND TO DEFINE SYSTEM OPERATING PARAMETERS. BASED UPON THE RESULTS OF THE PILOT TEST, BURN PERFORMANCE OBJECTIVES WOULD BE ESTABLISHED. ONCE THESE STEPS ARE COMPLETED, THE ALTERNATIVE COULD BE IMPLEMENTED RELATIVELY QUICKLY.

THE TIME TO ACCOMPLISH THE ON-SITE INCINERATION ALTERNATIVE IS AN ESTIMATED MINIMUM OF SEVEN (7) MONTHS.

NO LONG-TERM OPERATION, MAINTENANCE, AND MONITORING REQUIREMENTS OTHER THAN CONTINUED GROUNDWATER MONITORING ARE ASSOCIATED WITH THIS ALTERNATIVE.

C. LAND TREATMENT

THIS ALTERNATIVE ASSUMES THAT ALL THE CONTAMINATED MATERIALS AT THE SITE ARE EXCAVATED AND LAND-TREATED IN THE FORMER RAILROAD TIE STORAGE AREA. PRIOR TO IMPLEMENTATION OF THIS ALTERNATIVE, AN ON-SITE PILOT SCALE DEMONSTRATION WOULD BE NECESSARY USING THE ACTUAL WASTE AND SITE SOILS. FOLLOWING THIS DEMONSTRATION, A DETAILED ENGINEERING DESIGN FOR THE FACILITY WOULD BE PREPARED. THE DEMONSTRATION TEST WOULD TAKE APPROXIMATELY SIX MONTHS TO ONE YEAR TO COMPLETE. AN ADDITIONAL SIX MONTHS WOULD BE NECESSARY TO PREPARE A TREATMENT DEMONSTRATION WORK PLAN ON THE FRONT END AND A DETAILED DESIGN ON THE BACK END.

IMPLEMENTATION OF THIS ALTERNATIVE WOULD INVOLVE THE FOLLOWING STEPS:

1. SITE PREPARATION INCLUDING MOBILIZATION, ESTABLISHMENT OF ON-SITE SUPPORT FACILITIES, AND CONSTRUCTION OF THE LAND TREATMENT AREA (WHICH WOULD INCLUDE GRADING, BERM AND DITCH CONSTRUCTION AND CONSTRUCTION OF A SITE PERIMETER FENCE AND ROAD);

2. INFLOW CONTROL;

3. LAGOON WATER REMOVAL, TREATMENT (IF NECESSARY), AND DISPOSAL;

4. EXCAVATION AND WASTE SPREADING ACCORDING TO THE DESIGN PLAN AND SCHEDULE;

5. SOIL INCORPORATION AND CULTIVATION USING A ROTOTILLER DEVICE;

6. SOIL TREATMENT FOR AT LEAST ONE YEAR;

7. CLOSURE, INCLUDING PROVIDING A VEGETATIVE COVER AND POST-CLOSURE CARE (INCLUDING GROUNDWATER, SOIL, AND SOIL PORE WATER MONITORING) FOR UP TO THIRTY (30) YEARS UNLESS THE ZONE OF INCORPORATION COULD BE DELISTED.

THE INITIAL EXCAVATION AND WASTE APPLICATION PERIOD COULD OCCUR WITHIN THREE MONTHS OF INITIATING SITE ACTIVITIES. THE TREATMENT PERIOD WOULD EXTEND FOR ONE TO TWO YEARS.

THE PRIMARY INSTITUTIONAL REQUIREMENT FOR THIS ALTERNATIVE INVOLVES COMPLETING AN EXTENSIVE DEMONSTRATION TEST WHICH WOULD SIMULATE FULL-SCALE OPERATING CONDITIONS.

D. OFF-SITE INCINERATION

THIS ALTERNATIVE INCLUDES EXCAVATION OF ALL CONTAMINATED MATERIALS AT THE SITE AND TRANSPORTATION TO AN INDUSTRIAL PROCESS KILN, WHERE THE MATERIALS WOULD BE PROCESSED INTO CONSTRUCTION AGGREGATE. THE STEPS REQUIRED WITH THIS ALTERNATIVE INCLUDE:

1. SITE PREPARATION INCLUDING MOBILIZATION AND ESTABLISHMENT OF ON-SITE SUPPORT FACILITIES;

2. INFLOW CONTROL;

3. LAGOON WATER REMOVAL, TREATMENT (IF NECESSARY), AND DISPOSAL;

4. EXCAVATION OF LAGOON SLUDGES AND CONTAMINATED SOILS, STABILIZATION OF AT LEAST A PORTION OF THE LAGOON SLUDGE;

5. TRANSPORTATION OF EXCAVATED MATERIALS TO AN INDUSTRIAL PROCESS KILN WHERE THEY WOULD BE PROCESSED BY INCINERATION INTO ASPHALT AGGREGATE; AND

6. SITE RESTORATION.

ALL TRANSPORTATION LOADS MUST BE MANIFESTED AND CARRIED BY LICENSED HAZARDOUS WASTE HAULERS. PERMITS FOR THE INDUSTRIAL PROCESS KILN WOULD BE VERIFIED PRIOR TO INITIATING THE PROCESS. HOWEVER, THE RESPONSIBILITY FOR OBTAINING AND MAINTAINING THE NECESSARY PERMITS FOR THE INCINERATOR IS THAT OF THE OWNER/OPERATOR.

THE IMPACTS OF THIS ALTERNATIVE INCLUDE ELEVATED RISKS FOR SHORT-TERM EXPOSURE TO SITE WORKERS. IN ADDITION, THERE IS SOME RISK TO THE GENERAL POPULATION ASSOCIATED WITH TRANSPORTATION OF THE MATERIALS. THERE IS NO LONG-TERM RISK ASSOCIATED WITH ANY CONTAMINATED MATERIALS AS THEY WOULD BE DETOXIFIED AND DELISTED.

IT IS ESTIMATED THAT THIS ALTERNATIVE WOULD TAKE AT LEAST SEVEN (7) MONTHS TO IMPLEMENT COMPLETELY. NO LONG-TERM OPERATION AND MAINTENANCE REQUIREMENTS EXCEPT GROUNDWATER MONITORING ARE ASSOCIATED WITH THIS ALTERNATIVE.

E. TREATMENT AND OFF-SITE DISPOSAL

IMPLEMENTATION OF THIS TECHNOLOGY AS A REMEDIAL ACTION ALTERNATIVE WOULD REQUIRE THE FOLLOWING STEPS:

1. SITE PREPARATION;

2. INFLOW CONTROL;

3. LAGOON WATER REMOVAL, TREATMENT (IF NECESSARY), AND DISPOSAL;

4. EXCAVATION, TREATMENT (IF NECESSARY) BY A MECHANICAL OR POZZOLANIC STABILIZATION PROCESS OF LAGOON SLUDGES AND CONTAMINATED SOILS;

5. DISPOSAL OF TREATED AND UNTREATED MATERIALS AT AN EPA-APPROVED DISPOSAL SITE; AND

6. SITE RESTORATION.

INSTITUTIONAL CONSIDERATIONS FOR THIS ALTERNATIVE INCLUDE OBTAINING APPROVAL FROM LOCAL AGENCIES FOR DISCHARGE TO THE LOCAL POTW. THE PERMANENT STATUS OF THE DISPOSAL SITE MUST BE VERIFIED AND COMMERCIAL DISPOSERS MUST ACCEPT THESE CONTAMINATED MATERIALS. THE LICENSES OF THE HAZARDOUS WASTE TRANSPORTER MUST BE VERIFIED AND WASTE MANIFESTS PREPARED PRIOR TO SHIPMENT.

FOR THIS ALTERNATIVE THERE ARE ELEVATED RISKS FOR SHORT-TERM EXPOSURE MAINLY TO SITE WORKERS. THERE IS ALSO A SHORT-TERM RISK TO THE GENERAL POPULATION ASSOCIATED WITH HAULING OF THE CONTAMINATED MATERIALS. AT LEAST FOUR (4) MONTHS WOULD BE REQUIRED TO COMPLETE THE EXCAVATION, REMOVAL, AND RESTORATION ALTERNATIVE.

THIS ALTERNATIVE WOULD REMOVE ALL CONTAMINATED MATERIALS FROM THE SITE, SO NO LONG-TERM OPERATION AND MAINTENANCE REQUIREMENTS EXCEPT GROUNDWATER MONITORING WOULD BE INCURRED.

F. TREATMENT AND DISPOSAL OF SLUDGES AND LAND TREATMENT OF SOILS

THIS ALTERNATIVE ASSUMES THAT THE SLUDGES ARE TREATED ON-SITE USING EITHER MECHANICAL TREATMENT OR STABILIZATION AND DISPOSED OFF-SITE; AND THE CONTAMINATED SOILS ARE LAND-TREATED ON-SITE. THIS ALTERNATIVE IS A COMBINATION OF THE LAND TREATMENT AND OFF-SITE DISPOSAL ALTERNATIVES. IT OFFERS MORE FLEXIBILITY THAN EITHER ALTERNATIVE AS THE MOST HIGHLY CONTAMINATED SLUDGES ARE IMMEDIATELY REMOVED FROM THE SITE. THE SOILS OF LOW-LEVEL CONTAMINATION ARE TEMPORARILY STORED WHILE A TREATMENT DEMONSTRATION IS COMPLETED.

THE BASIC STEPS OF THIS ALTERNATIVE ARE:

1. SITE PREPARATION;
2. INFLOW CONTROL;
3. LAGOON WATER REMOVAL, TREATMENT (IF NECESSARY), AND DISPOSAL;
4. SLUDGE EXCAVATION, TREATMENT (WHERE NECESSARY), AND REMOVAL TO AN EPA-APPROVED DISPOSAL FACILITY;
5. SOIL EXCAVATION AND STORAGE IN SEVERAL LINED AND TEMPORARILY CAPPED CELLS;
6. LAND TREATMENT AREA CONSTRUCTION ON-SITE ON APPROXIMATELY FOURTEEN (14) ACRES;
7. SOIL SPREADING OVER LAND TREATMENT AREA;
8. SOIL INCORPORATION WITH NUTRIENTS, ETC.;
9. TREATMENT; AND
10. CLOSURE.

INSTITUTIONAL CONSIDERATIONS FOR THIS ALTERNATIVE INCLUDE OBTAINING APPROVAL FROM LOCAL AGENCIES FOR DISCHARGE TO THE POTW AND COMPLETING A LAND TREATMENT DEMONSTRATION.

ASSUMING A ONE-YEAR PERIOD FOR THE DEMONSTRATION AND DESIGN PHASE, THE TREATMENT COULD BEGIN WITHIN ONE YEAR OF INITIATING SLUDGE REMOVAL ACTIVITIES. AS THE APPLICATION WOULD OCCUR IN A SINGLE BATCH PROCESS, THE ENTIRE WASTE APPLICATION COULD BE COMPLETED WITHIN ONE MONTH AND THE TREATMENT PERIOD WOULD LAST APPROXIMATELY TWO (2) YEARS.

POST-CLOSURE ACTIVITIES COULD LAST FOR THIRTY (30) YEARS.

G. BIOLOGICAL TREATMENT OF SLUDGES AND LAND TREATMENT

THIS ALTERNATIVE ASSUMES THAT THE SLUDGES ARE PRETREATED BIOLOGICALLY USING SEQUENCED BATCH REACTORS FOLLOWED BY LAND TREATMENT OF THE BIOSLUDGE AND CONTAMINATED SOILS. THIS ALTERNATIVE WOULD SIGNIFICANTLY REDUCE THE ORGANIC CONTENT OF THE SLUDGES THEREBY DECREASING LAND AREA REQUIREMENTS FOR THE LAND TREATMENT ALTERNATIVE.

THE PRETREATMENT PROCESS WOULD USE THREE (3) POLYETHYLENE LINED REACTORS, EACH APPROXIMATELY 250,000 GALLONS IN CAPACITY AND EQUIPPED WITH THREE (3) 25-HORSEPOWER AGITATOR/AERATOR UNITS. THE SYSTEM WOULD BE OPERATED IN THE PLUG FLOW MODE WITH AN AVERAGE SOLIDS RESIDENCE TIME OF SEVEN (7) DAYS/REACTOR. THE RESULTING SOLIDS FROM THIS PROCESS WOULD BE HAULED TO THE LAND TREATMENT AREA FOR FINAL TREATMENT. VENDORS OF THIS TECHNOLOGY SUGGEST THAT UP TO 90% REDUCTIONS IN TOTAL CREOSOTE CONSTITUENTS WOULD BE PRODUCED BY THIS PROCESS.

THIS ALTERNATIVE WOULD TAKE A MINIMUM OF NINE (9) MONTHS TO COMPLETE. IT WOULD REQUIRE COMPLETION OF A LAND TREATMENT DEMONSTRATION AND LABORATORY TREATABILITY STUDIES TO DETERMINE THE FINAL DESIGN PARAMETERS FOR THE SLUDGE BIOLOGICAL PRETREATMENT PROCESS. THE BASIC STEPS AND SCHEDULE IDENTIFIED IN THE LAND TREATMENT ALTERNATIVE APPLY TO THIS ALTERNATIVE AS WELL EXCEPT THAT THE LAND AREA REQUIREMENTS FOR THE PRETREATED SLUDGES DECREASE TO ABOUT SIX (6) ACRES.

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F. SELECTED REMEDY DESCRIPTION AND RATIONALE FOR SELECTION

1. EXTENT OF REMOVAL ACTIVITY

AN EPA-APPROVED REMOVAL OCCURRED IN DECEMBER 1987 THROUGH MARCH 1988. THIS REMOVAL WAS UNDERTAKEN BY AMAX/BROWN IN ACCORDANCE WITH AN ADMINISTRATIVE CONSENT ORDER COMPLETED IN JANUARY 1988. THE REMOVAL INCLUDED:

A. MOBILIZATION, INCLUDING ESTABLISHMENT OF A SITE OFFICE AND ON-SITE SAFETY ZONES;
B. REMOVAL OF LAGOON WATER TO ALLOW EXCAVATION OF SLUDGES;
C. EXCAVATION, TREATMENT, AND DISPOSAL OF APPROXIMATELY 15,000 TONS OF CREOSOTE CONTAMINATED LAGOON SLUDGE AND SOIL AT THE CHEMICAL WASTE MANAGEMENT, INC. (CWM) SECURE LANDFILL NEAR EMELLE, ALABAMA;
D. TREATMENT OF APPROXIMATELY 200,000 GALLONS OF LAGOON WATER REMOVED AS PART OF THE LAGOON EXCAVATION;
E. EXTENSIVE SAMPLING AND ANALYSES OF SOIL AND WATER AT APPROPRIATE LOCATIONS AND TIMES; AND
F. DISMANTLING, DECONTAMINATION, AND DISPOSAL OF THE OLD WOOD PRESERVING PLANT IN AN EPA-APPROVED MANNER.

MORE DETAILED INFORMATION ON THE REMOVAL IS CONTAINED IN ATTACHMENT A ("LIVE OAK INTERIM REMOVAL" MEMORANDUM, JOHN RYAN, FEBRUARY 11, 1988).

2. SELECTED REMEDY

THE SELECTED REMEDY EMBODIES THE REMAINING WORK NECESSARY TO COMPLETE THE REMEDIATION OF THE SITE AFTER CONSIDERING THE WORK ACCOMPLISHED BY THE REMOVAL ACTIVITIES IN DECEMBER 1987 THROUGH MARCH 1988.

THE RECOMMENDED ALTERNATIVE IS BASICALLY ALTERNATIVE F.: TREATMENT AND DISPOSAL OF SLUDGES AND LAND TREATMENT OF SOILS.

HOWEVER, THERE ARE FOUR MODIFICATIONS TO ALTERNATIVE F.: (1) IF THE LAND TREATMENT (BIODEGRADATION) DOES NOT ATTAIN THE DESIRED CLEANUP LEVELS FOR THE APPROPRIATE ORGANIC CONTAMINANTS WITHIN THE TIME ALLOWED, THEN AN ALTERNATIVE MEANS OF DEALING WITH THE CONTAMINATED SOILS, SUCH AS REMOVAL, INCINERATION, SOLIDIFICATION, OR VITRIFICATION, WILL BE DETERMINED BY EPA AT THAT TIME; (2) GROUND WATER MONITORING WILL CONTINUE FOR FIVE YEARS; (3) CONTAMINATED SOILS EXCEEDING CERTAIN HIGHER CONTAMINANT LEVELS MAY BE STABILIZED AND REMOVED TO AN EPA-APPROVED HAZARDOUS WASTE FACILITY (EMELLE, ALABAMA OR PINEWOOD, SOUTH CAROLINA); AND (4) CONTAMINATED SOILS EXCEEDING CERTAIN LOWER CONTAMINANT LEVELS WILL BE BIODEGRADED IN AN ONSITE EXCAVATED AREA THAT HAS BEEN LINED.

THE REMEDY IS CONSISTENT WITH 40 CFR PART 300.68 (J) IN THAT THE ABOVE-MODIFIED ALTERNATIVE F. IS TECHNICALLY FEASIBLE, ALLEVIATES ALL EXISTING AND POTENTIAL HEALTH EFFECTS, PRESENTS NO NEW PUBLIC HEALTH HAZARDS AND SUBSTANTIALLY REDUCES THE THREAT TO THE SURFACE AND GROUND WATER AND THE GENERAL ENVIRONMENT.

PREFERENCE IS GIVEN TO THIS OPTION BECAUSE OF TECHNICAL FEASIBILITY, COST, SITE-SPECIFIC PERMANENCE, AND THE EXISTENCE OF LAND DISPOSAL RESTRICTION VARIANCES WHICH ALLOW ITS IMPLEMENTATION WITHIN CERTAIN ADVANTAGEOUS TIME FRAMES. MODIFICATION OF THE PROCESSES INVOLVED IN THIS OPTION MAY BE REQUIRED IN ORDER TO SATISFY DESIGN REQUIREMENTS AND SITE CONDITIONS.

CREOSOTE, THE WOOD PRESERVATIVE, CONSISTS OF APPROXIMATELY TWO HUNDRED (200) DIFFERENT COMPOUNDS. THE BELOW-MENTIONED COMPOUNDS ARE SIX (6) OF THOSE TWO HUNDRED. THESE COMPOUNDS WERE SELECTED AS INDICATORS BECAUSE THE EPA WEIGHT-OF-EVIDENCE SYSTEM INDICATES THAT THEY ARE "POSSIBLE" OR "PROBABLE" HUMAN CARCINOGENS.

BENZO (A) ANTHRACENE
BENZO (A) PYRENE
BENZO (B) FLUORANTHENE
CHRYSENE
DIBENZO (A,H) ANTHRACENE
INDENO (1,2,3,C,D) PYRENE

NOTE: FLUORANTHENE AND PENTACHLOROPHENOL WERE ALSO CONSIDERED.

THE SELECTION OF INDICATOR PARAMETERS IS BASED UPON NUMEROUS PREVIOUS PRIORITY POLLUTANT ANALYSES CONDUCTED DURING THE REMEDIAL INVESTIGATION PHASE. ALTHOUGH OTHER TYPES OF CONTAMINANTS WERE PRESENT ONSITE, THESE COMPOUNDS ARE AMONG THE MOST COMMON AND POTENTIALLY THE MOST CARCINOGENIC FOUND AT THE BROWN WOOD SITE.

CLEANUP STANDARDS WERE BASED UPON THE RESULTS OF A RISK ASSESSMENT WHICH FOCUSED ON ATTAINING AT LEAST A 1 X 10-6 RISK WITH REGARD TO INGESTION OF CONTAMINATED SOIL BY A CHILD. CLEANUP STANDARDS WERE DESCRIBED BY MEANS OF THE TOTAL CONCENTRATION OF THE SIX INDICATOR PARAMETERS.

A DETAILED COST DEVELOPMENT AND ANALYSIS OF SELECTED REMEDIAL ALTERNATIVES WAS DONE PRIOR TO THE REMOVAL ACTIVITY (PRIOR TO DECEMBER 1987) TO ASSURE THAT THE MOST COST-EFFECTIVE REMEDIAL ACTION WAS CHOSEN FOR THE BROWN WOOD SITE. COST ESTIMATES FOLLOWED THE PROCEDURES SPECIFIED IN 40 CFR 300.68 (8)(2)(B), GUIDANCE ON FEASIBILITY STUDIES UNDER CERCLA, AND THE REMEDIAL ACTION COSTING PROCEDURES MANUAL.

TWENTY-FOUR (24) SPECIFIC REMEDIAL ACTION ALTERNATIVES UNDERWENT THE EVALUATION PROCESS. FOURTEEN (14) WERE ELIMINATED ON THE BASIS OF SITE-SPECIFIC APPLICATION, TECHNICAL FEASIBILITY, PUBLIC HEALTH AND WELFARE, AND ENVIRONMENTAL EVALUATIONS. THE TEN (10) REMAINING WERE MERGED INTO SEVEN (7). A DETAILED COST ANALYSIS WAS PERFORMED FOR EACH OF THE REMAINING SEVEN (7) ALTERNATIVES. THESE ALTERNATIVES ARE LISTED IN TABLE 7.0.

THE FINAL REMEDY CONSISTS OF THREE (3) MAJOR TASKS.

A. SITE PREPARATION WHICH WILL INCLUDE THE FOLLOWING ACTIVITIES:

1) CLEARING, GRUBBING, AND GRADING THE PROPOSED BIOLOGICAL TREATMENT AREA, WHERE NECESSARY;
2) INSTALLING A DRAINAGE SWALE IN THE APPROPRIATE LOCATION(S);
3) INSTALLING A PERIMETER FENCE AROUND THE LAND TREATMENT AREA; AND INSTALLING SIGNS ON THE PERIMETER FENCE WARNING AGAINST EXPOSURE TO HAZARDOUS MATERIAL.

B. CONSTRUCTION OF THE TREATMENT SYSTEM FOR BIODEGRADATION WHICH WILL INCLUDE THE FOLLOWING TASKS:

1) SITE GRADING;
2) INSTALLING A LINER THROUGHOUT THE TREATMENT AREA;
3) INSTALLING A DRAINAGE SYSTEM ON TOP OF THE LINER AND UNDERNEATH THE SOILS TO BE TREATED;
4) INSTALLING A SPRAY IRRIGATION SYSTEM WITHIN THE LAND TREATMENT AREAS;
5) CONSTRUCTING A STOCKPILE/HOLDING AREA FOR THE SOILS TO BE TREATED;
6) INSTALLING A WATER AERATION SYSTEM WITHIN THE LAND TREATMENT AREA;
7) HOOKING UP UTILITIES; AND
8) SPREADING CONTAMINATED SOIL AND CONSOLIDATING THE STOCKPILE.

C. OPERATION AND MAINTENANCE

1) TILLING, IRRIGATION, AND FERTILIZATION OF THE LAND TREATMENT AREA;
2) MAINTENANCE OF THE WATER/LEACHATE TREATMENT SYSTEM;
3) MONITORING OF THE LAND AND WATER TREATMENT SYSTEMS;
4) SEMI-ANNUAL MONITORING OF THE GROUND WATER QUALITY FOR FIVE (5) YEARS AFTER COMPLETION OF CONSTRUCTION ACTIVITIES; REVIEW OF SITE'S CONDITION AFTER FIVE (5) YEARS (SEE SECTION 121(C), CERCLA/SARA.); AND
5) MAINTENANCE OF SECURITY FENCES AND WARNING SIGNS.

3. CLEANUP STANDARDS

THE CLEANUP STANDARDS FOR THE SELECTED REMEDY ARE BASED UPON THE RISK ASSESSMENT AND ADDENDA AND WERE FINALIZED BY EPA AFTER DISCUSSIONS WITH THE FDER AND AMAX/BROWN. THESE STANDARDS ARE DESCRIBABLE BY REFERRING TO ONE FACTOR: THE TOTAL CONCENTRATION OF CARCINOGENIC CREOSOTE CONSTITUENTS (INDICATORS).

A. STANDARDS FOR SOILS TREATED IN THE OLD LAGOON AND NEW LAND TREATMENT AREA:

WITHIN TWO (2) YEARS FROM ITS INITIAL SEEDING THE LAND TREATMENT PROCESS MUST REDUCE THE CONCENTRATION OF TOTAL CARCINOGENIC INDICATOR CHEMICALS TO 100 PARTS PER MILLION (PPM) THROUGHOUT THE VOLUME OF THE MATERIAL TREATED. THIS LEVEL FOR TOTAL CARCINOGENIC INDICATOR CHEMICALS CORRESPONDS TO AN APPROXIMATE 1 X 10-6 SOIL INGESTION RISK LEVEL. UPON SUCCESSFUL COMPLETION OF THE BIOREMEDIATION IN THE LAND TREATMENT AREA, THE LAND TREATMENT AREA SHALL BE REVEGETATED.

B. STANDARDS FOR THE PLANT AREA, THE WOOD STORAGE AREA AND OTHER SITE AREAS:

UPON COMPLETION OF THE REMEDIAL ACTIVITIES IN THE PLANT AREA, THE WOOD STORAGE AREA, AND ANY OTHER SITE AREAS, THE SOILS MUST CONTAIN NO MORE THAN A 100 PPM TOTAL FOR THE CARCINOGENIC INDICATOR CHEMICALS.

4. RATIONALE FOR SELECTION OF FINAL REMEDY

THE REMOVAL DESCRIBED IN F.1. ABOVE, ACCORDING TO ENGINEERING CALCULATIONS, CAUSED THE MAJORITY OF THE CONTAMINATION (I.E., THE CONTAMINATED SLUDGES AND SOILS IN AND AROUND THE LAGOON) TO BE PROPERLY DISPOSED OF AT THE CWM FACILITY IN EMELLE, ALABAMA, OR IN PINEWOOD, SOUTH CAROLINA. THE SELECTED REMEDY DESCRIBED IN F.2. ABOVE COMPRISES THE MAJOR ACTIVITIES NECESSARY TO COMPLETE REMEDIATION OF THE SITE IN A TECHNICALLY FEASIBLE AND COST-EFFECTIVE MANNER CONSISTENT WITH CERCLA/SARA, THE NCP, AND APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARAR'S).

WITH REGARD TO EPA'S DECISION TO ENTER INTO AN ADMINISTRATIVE CONSENT ORDER WITH AMAX/BROWN FOR THE REMOVAL DESCRIBED IN F.1. ABOVE, SECTIONS 104(A)(2) INDICATES THAT ANY REMOVAL ACTION UNDERTAKEN BY EITHER THE PRESIDENT (EPA) OR BY POTENTIALLY RESPONSIBLE PARTIES WITH THE PRESIDENT'S (EPA'S) APPROVAL SHOULD "CONTRIBUTE TO THE EFFICIENT PERFORMANCE OF ANY LONG TERM REMEDIAL ACTION" WITH RESPECT TO THE RELEASE OR THREATENED RELEASE CONCERNED. SECTION 122(E)(6) INDICATES THAT ONCE A REMEDIAL INVESTIGATION AND FEASIBILITY STUDY HAS BEEN INITIATED "NO POTENTIALLY RESPONSIBLE PARTY MAY UNDERTAKE ANY REMEDIAL ACTION AT THE FACILITY UNLESS SUCH REMEDIAL ACTION HAS BEEN AUTHORIZED BY THE PRESIDENT" (E.G., EPA AUTHORIZES ACTIVITY BY MEANS OF A CONSENT ORDER).

THE REMOVAL ACTIVITIES NOT ONLY ELIMINATED THE MAJOR SOURCE OF CONTAMINATION AND SET THE STAGE FOR THE FINAL SITE REMEDIATION ACTIVITIES, BUT CONTRIBUTED TO THE ACCELERATION OF THE SITE ALONG THE SUPERFUND ENFORCEMENT PROCESS TRACK. THE FINAL REMEDY CONSISTS OF THOSE REMAINING ACTIVITIES WHICH WILL BRING THE SITE INTO COMPLIANCE WITH THOSE CLEANUP STANDARDS DESCRIBED IN THE RISK/HEALTH ASSESSMENT AND ADDENDA (SEE ATTACHMENT B) AND APPROVED BY BOTH EPA AND THE STATE OF FLORIDA.

THE SELECTED REMEDY IS A COMBINATION OF TWO GENERAL SOURCE CONTROL REMEDIAL ACTIONS AS DEFINED IN 40 CFR 300.68(E)(2). THESE TWO MEASURES ARE: 1) REMOVAL TO THE CWM FACILITY IN EMELLE, ALABAMA, OR IN PINEWOOD, SOUTH CAROLINA, OF THE MOST SEVERELY CONTAMINATED SOILS/SLUDGES; AND 2) ONSITE BIODEGRADATION OF THE LESS SEVERELY CONTAMINATED SOILS TO ACHIEVE THE CLEANUP LEVELS INDICATED IN THE RISK/HEALTH ASSESSMENT. IN CASE NUMBER ONE, THE GOVERNING REGULATORY FACTOR HAS BEEN THE RCRA LAND DISPOSAL RESTRICTION (LDR) PHASE-IN. THE LDR PHASE-IN SCHEDULE HAS ALLOWED THE REMOVAL OF CREOSOTE CONTAMINATED SLUDGES AND SOILS THUS ELIMINATING POTENTIAL ONSITE CONTAMINATION BY TRANSPORTING THE HAZARDOUS SUBSTANCES TO A SECURE HAZARDOUS WASTE LANDFILL AT A DIFFERENT LOCATION. IN CASE NUMBER TWO, AN ALTERNATIVE AND INNOVATIVE TECHNOLOGY, BIODEGRADATION, IS TO BE USED ON LESS SEVERELY CONTAMINATED SOILS TO "POLISH" THOSE SOILS TO ACCEPTABLE LEVELS OF CLEANLINESS. EPA'S OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE (OSWER), THE OFFICE OF TECHNOLOGY ASSESSMENT (OTA), AND THE OFFICE OF RESEARCH DEVELOPMENT (ORD) HAVE, IN RESPONSE TO CERCLA/SARA, RECOGNIZED THAT OUR ABILITY TO CHARACTERIZE OR ASSESS THE EXTENT OF CONTAMINATION, THE CHEMICAL AND PHYSICAL CHARACTER OF THE CONTAMINANTS, OR THE STRESSES IMPOSED BY THE

CONTAMINANTS ON COMPLEX ECOSYSTEMS IS LIMITED, AND NEW, INNOVATIVE TECHNOLOGIES ARE NEEDED. THE BROWN WOOD PRESERVING SITE NOW PROVIDES EPA WITH AN EXCELLENT OPPORTUNITY TO UTILIZE AND RE-ASSESS BIODEGRADATION IN A CONTROLLED SITUATION IN EPA'S REGION IV. THE SELECTED REMEDY DICTATES THAT THE BIOREMEDIATION WILL OCCUR IN A LIMITED AREA WHICH IS DESIGNED WITH INTERIOR DRAINAGE AND SPRAY IRRIGATION SYSTEMS. THE LAND TREATMENT AREA WILL ALSO HAVE A PERIMETER SECURITY FENCE AND AN EXTERIOR DRAINAGE SYSTEM.

#RS

III. RESPONSIVENESS SUMMARY

A. BACKGROUND ON COMMUNITY INVOLVEMENT

HISTORICALLY, COMMUNITY CONCERN REGARDING THE BROWN WOOD PRESERVING SITE HAS BEEN LOW, ACCORDING TO EPA, THE FDER, LOCAL OFFICIALS, AND THE LOCAL NEWS MEDIA. THERE HAVE BEEN NO RECORDED COMPLAINTS FROM THE LOCAL RESIDENTS. ON THE CONTRARY, THE COMMUNITY SEEMS GENUINELY GLAD THAT EPA AND THE FDER HAVE ACTED RAPIDLY TO CLEAN UP THE SITE.

B. SUMMARY OF PUBLIC COMMENTS AND AGENCY RESPONSES

THERE WERE NO COMMENTS FROM THE PUBLIC DURING OR AFTER THE PUBLIC COMMENT PERIOD. AN ARTICLE INDICATING THE TIME AND PLACE FOR THE PUBLIC MEETING WAS PLACED IN THE SUWANNEE DEMOCRAT NEWSPAPER MORE THAN TWO WEEKS PRIOR TO THE ACTUAL MEETING DATE. FEW PEOPLE ATTENDED THE PUBLIC MEETING AND THERE WERE ONLY THREE OR FOUR GENERAL QUESTIONS WHICH HAD NO BEARING ON THE SELECTED REMEDY. ADDITIONALLY, THE ADMINISTRATIVE RECORD REQUIRED UNDER SECTION 113 OF CERCLA/SARA WAS PLACED IN THE SITE REPOSITORY GIVEN BELOW ON SEPTEMBER 29, 1987:

SUWANNEE RIVER REGIONAL LIBRARY
ATTN: MS. FAYE ROBERTS
REFERENCE LIBRARIAN
207 PINE ST.
LIVE OAK, FLORIDA 32060
(904) 362-2317.

SELF-ADDRESSED AND STAMPED ENVELOPES WERE LEFT WITH THE ADMINISTRATIVE RECORD. THE FIRST DRAFT OF THE RECORD-OF-DECISION AND AN INSTRUCTION SHEET FOR COMMENTERS WAS ALSO DEPOSITED WITH THE OTHER RECORDS. HOWEVER, THE EPA REGIONAL PROJECT MANAGER RECEIVED NO MAIL OR TELEPHONE CALLS FROM THE COMMUNITY REGARDING EITHER THE PROPOSED REMEDY OR THE ACTUAL ONSITE ACTIVITIES.

THE AGENCY HAS RESPONDED TO THE LOW LEVEL OF INTEREST BY PERIODICALLY SPEAKING WITH NEWSPAPER REPORTERS WHO ARE WITH THE SUWANNEE DEMOCRAT. NEWSPAPER ARTICLES FOLLOWED THESE TELEPHONE AND IN-PERSON DISCUSSIONS WITH THE REPORTERS.

C. EXPLANATIONS OF DIFFERENCES BETWEEN PROPOSED PLAN AND THE SELECTED REMEDY

THE PROPOSED PLAN IN THE FEASIBILITY STUDY IS GENERALLY THE SAME AS THE SELECTED REMEDY IN THE RECORD-OF-DECISION. THERE ARE BASICALLY FIVE DIFFERENCES IN THE TWO: (1) THE REMOVAL OF LAGOON SLUDGES HAS ALREADY OCCURRED; (2) THE GRUBBING OF THE MAJORITY OF THE LAND TREATMENT AREA HAS ALREADY OCCURRED; (3) WATERS PUMPED FROM THE LAGOON PRIOR TO THE EXCAVATION OF THE SLUDGES HAVE ALREADY BEEN TREATED AND PROPERLY DISPOSED OF; (4) THE LAND TREATMENT AREA WILL BE LINED; AND (5) THE CLEANUP STANDARDS WITH REGARD TO THE ORIGINAL RISK ASSESSMENT WERE CHANGED.

D. COMMUNITY RELATIONS CONDUCTED AT THE SITE PRIOR TO AND DURING THE PUBLIC COMMENT PERIOD

FROM 1984 THROUGH 1987 EPA, FDER, AND AMAX/BROWN REPRESENTATIVES MAINTAINED CONTACT WITH LIVE OAK CITY OFFICIALS WHILE UNDERTAKING THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY. NUMEROUS NEWSPAPER ARTICLES APPEARED IN THE LOCAL SUWANNEE DEMOCRAT DESCRIBING THE ONSITE ACTIVITIES. SEVERAL CITY COUNCIL MEETINGS WERE ATTENDED AND THE COMMUNITY WAS MADE AWARE OF EPA, FDER, AND PRP ACTIVITIES.

THE ADMINISTRATIVE RECORD WAS INSTALLED IN THE SITE REPOSITORY IN SEPTEMBER, 1987, AND THROUGH THE SUWANNEE DEMOCRAT THE COMMUNITY WAS MADE AWARE OF THE PROGRESS MADE TOWARDS THE CLEANUP. IN NOVEMBER THROUGH THE MIDDLE OF DECEMBER, 1987, THE PUBLIC COMMENT PERIOD OCCURRED. IN DECEMBER THE PUBLIC MEETING OCCURRED. THERE WERE NO PUBLIC COMMENTS FORTHCOMING FROM THE COMMUNITY. ONLY COMMENTS OF A SPECIFIC TECHNICAL NATURE WERE RECEIVED FROM THE PRPS' CONTRACTOR.

#TMA
TABLES, MEMORANDA, ATTACHMENTS

ATTACHMENT A

MEMORANDUM ON THE EXTENT OF REMOVAL ACTIVITY
WHICH OCCURRED DECEMBER 1987 THROUGH FEBRUARY 1988

RETEC
REMEDIATION
TECHNOLOGIES INC

MEMO TO: DISTRIBUTION
FROM: J. RYAN
DATE: FEBRUARY 11, 1988

RE: LIVE OAK INTERIM REMOVAL

INTRODUCTION

THIS MEMORANDUM SUMMARIZES ACTIVITIES COMPLETED AT THE LIVE OAK SITE AS PART OF INTERIM REMOVAL ACTIVITIES DURING THE PERIOD DECEMBER, 1987 THROUGH THE PRESENT. THESE ACTIVITIES HAVE INCLUDED:

- MOBILIZATION,
- REMOVAL OF LAGOON WATER TO ALLOW EXCAVATION OF SLUDGES,
- EXCAVATION, TREATMENT AND DISPOSAL OF SLUDGES AND CONTAMINATED SOIL AT THE CWM SECURE LANDFILL, EMELLE, AL, AND
- TREATMENT OF THE LAGOON WATER REMOVED AS PART OF EXCAVATION.

EXTENSIVE SAMPLING AND ANALYSES OF SOIL AND WATER WERE COMPLETED DURING THESE ACTIVITIES.

MOBILIZATION

MOBILIZATION OCCURRED THE FIRST WEEK IN DECEMBER. AN OFFICE TRAILER AND DECONTAMINATION TRAILER WERE BROUGHT TO THE SITE AS WELL AS THE NECESSARY EXCAVATION AND PUMPING EQUIPMENT. A HEALTH AND SAFETY PLAN WAS REVIEWED WITH THE SITE WORKERS AND THE SITE SEPARATED INTO "CLEAN" AND "CONTAMINATED" ZONES FOR TRUCK STAGING AND DECONTAMINATION PURPOSES.

DIVERSION DITCHES WERE EXCAVATED AROUND THE PERIMETER OF THE LAGOON TO DIVERT RUN ON TO THE NORTH. THE LOCATION OF THESE DITCHES ARE SHOWN ON FIGURE 1. A SEDIMENTATION TRAP WAS INSTALLED IN THE DIVERSION DITCHES CONSISTING OF A SERIES OF HAY BALES PLACED ACROSS THE DITCH.

REMOVAL OF LAGOON WATER

STANDING WATER WAS PUMPED FROM THE LAGOON USING A VACUUM TRUCK. THIS WATER WAS STORED IN FOUR FORMER PRODUCT STORAGE TANKS ON SITE WITH AN ESTIMATED CAPACITY OF 250,000 GALLONS. ONCE ALL STANDING WATER WAS REMOVED, A SERIES OF TRENCHES WERE EXCAVATED IN THE LOW PART OF THE LAGOON TO CONTINUE DEWATERING THE LAGOON WHILE EXCAVATION WAS ONGOING. THE VACUUM TRUCK CONTINUED TO REMOVE THE FREE LIQUIDS WHILE THE EXCAVATION WAS UNDERWAY.

EXCAVATION, TREATMENT AND DISPOSAL

THE LAGOON SLUDGES WERE TREATED WITH KILN DUST IN PLACE BY MIXING THE DUST WITH THE SLUDGE USING POWER SHOVELS. WHEN A PORTION OF THE LAGOON WAS STABILIZED, IT WAS EXCAVATED AND STAGED ON THE SIDES OF THE LAGOON FOR SUBSEQUENT LOADING ONTO THE TRANSPORT VEHICLES.

SAMPLING OF THE UPPER FOUR FEET OF SOIL WAS CONDUCTED IN THE LAGOON BY EXCAVATING TEST PITS WITH A TRACKHOE AND COLLECTING SAMPLES FROM THE PIT WALLS. ONLY SOIL WAS SAMPLED (NO SLUDGE) TO IDENTIFY THE DEPTH OF CONTAMINATION THAT EXCEEDED 1000 PPM OF TOTAL CREOSOTE SUBSTANCES (TCS). FIGURE 1 SHOWS THE LOCATION OF THE SAMPLING POINTS AND THE ATTACHED TABLES SUMMARIZE THE ANALYTICAL RESULTS. THESE RESULTS ARE PRIOR TO SLUDGE EXCAVATION. IN GENERAL, NO CONTAMINATED SOIL WAS FOUND ON THE WESTERN END OF THE LAGOON WHEREAS THE EASTERN END HAD SIGNIFICANT CONTAMINATION.

TABLE 1 PRESENTS A DAILY LOG OF MATERIAL, TRANSPORTED TO EMELLE. A TOTAL OF 15,000 TONS OF CONTAMINATED MATERIAL WAS HAULED FROM THE SITE BETWEEN DECEMBER AND THE END OF JANUARY. THIS TOTAL INCLUDES OVER 6000 TONS OF SLUDGES WHICH EXCEEDED 100,000 PPM TCS. THE REMAINDER WAS HIGHLY CONTAMINATED SOILS GREATER THAN 5,000 PPM TCS.

LOW LEVEL CONTAMINATED SAND AND SOME OF THE UNDERLYING CLAYS WERE ALSO EXCAVATED. THESE SOILS ARE CURRENTLY STOCKPILED AROUND THE EASTERN END OF THE LAGOON. IT IS ESTIMATED THAT THESE SOILS REPRESENT APPROXIMATELY 10,000 TONS OF MATERIALS. TABLE 3 PRESENTS DATA FROM VARIOUS SAMPLES COLLECTED FROM THE LAGOON AND THE STOCKPILED SOILS WHICH REPRESENT THE AVERAGE COMPOSITION OF THESE STOCKPILED SOILS. THE CONCENTRATION OF TCS RANGES FROM LESS THAN 1000 PPM TO 5000 PPM WITH AN AVERAGE AROUND 3000 PPM. CARCINOGENIC PAH RANGE FROM 100 TO 200 PPM. IT IS THIS STOCKPILED MATERIAL WHICH WILL BE TREATED BIOLOGICALLY.

APPROXIMATELY ONE FOOT OF NATIVE CLAYS WERE BACKFILLED IN THE LAGOON AND COMPACTED IN PLACE TO PROVIDE A CONTOURED SURFACE. THE LOWEST PART OF THE LAGOON IS NOW APPROXIMATELY 10 FEET LOWER THAN ITS ORIGINAL SURFACE. STANDING WATER COVERS THE BOTTOM TO A DEPTH OF APPROXIMATELY TWO FEET.

THIS WATER IS RUN OFF AND HAS AN OILY SHEEN. FIGURE 1 SHOWS THE CURRENT ELEVATIONS OF THE BOTTOM OF THE LAGOON.

TREATMENT OF WATER

THE WATER WHICH WAS REMOVED FROM THE LAGOON TO FACILITATE EXCAVATION WAS STORED IN FOUR TANKS IN THE PROCESS AREA. IN ADDITION, APPROXIMATELY 70,000 GALLONS OF WATER WERE PUMPED OUT OF THE RETORT PIT. APPROXIMATELY 200,000 GALLONS OF WATER WERE PUMPED INTO THESE TANKS. TABLE 4 PRESENTS ANALYSES OF THE WATER PRIOR TO TREATMENT.

THE INITIAL ATTEMPT TO TREAT THE WATER INDICATED THAT THE WATER WOULD CLOG THE FILTERS DUE TO A STRONG EMULSION. SUBSEQUENTLY A FLOCCULATION STEP WAS ADDED TO BREAK THE EMULSION. THE CURRENT TREATMENT SYSTEM CONSISTS OF FLOCCULATION, FOLLOWED BY SAND FILTRATION FOLLOWED BY A MICRON FILTER FOLLOWED BY CARBON ADSORPTION. THE TREATED EFFLUENT IS THEN DISCHARGED TO A SERIES OF FOUR TEMPORARY STORAGE TANKS, (20,000 GALLONS CAPACITY PER TANK) FOR SAMPLING PURPOSES. THE STORED EFFLUENT IS THEN SPRAY IRRIGATED OVER A THREE ACRE AREA ON-SITE LOCATED TO THE WEST OF THE PLANT.

THE INITIAL 40,000 GALLONS TREATED WERE SAMPLED FOR VOLATILES, SEMI-VOLATILES AND COPPER CHROMIUM AND ARSENIC. RESULTS OF THIS SAMPLING ARE NOTED BELOW AND THE COMPLETE LABORATORY RESULTS ARE PRESENTED AS TABLE 5.

	TANK #1	TANK #2
2 BUTANOL	39 PPB	ND
PHENANTHRENE	5 PPB	ND
FLUORANTHENE	5 PPB	ND
PYRENE	3 PPB	ND
ARSENIC	LT 5 PPB	LT 5 PPB
COPPER	3 PPB	3 PPB
CHROMIUM	13 PPB	6 PPB.

THESE RESULTS WERE TRANSMITTED VERBALLY TO DR. WALKER OF THE FDER ON MONDAY, FEBRUARY 1, 1988 AND MS. DANNER, OF U.S. EPA, ON TUESDAY, FEBRUARY 2. BOTH INDIVIDUALS GAVE PERMISSION TO SPRAY IRRIGATE THE WATER. MS. DANNER ALSO REQUESTED THAT WE CONTINUE TO SAMPLE EACH TANK FOR PAH AND REPORT THE RESULTS PRIOR TO SPRAYING. TANKS 1, 3, AND 4 WERE SUBSEQUENTLY ANALYZED FOR PAH COMPOUNDS AND THESE RESULTS WERE VERBALLY TRANSMITTED TO DR. WALKER ON MONDAY, FEBRUARY 8. ALL THE PAH COMPOUNDS WERE BELOW DETECTION LEVELS OF TWO PARTS PER BILLION IN TANKS 3 AND 4. TANK 1 HAD DETECTABLE QUANTITIES OF CERTAIN PAH COMPOUNDS.

FLUORANTHENE WAS DETECTED AT 40 PARTS PER BILLION AND PYRENE WAS DETECTED AT 29 PARTS PER BILLION. THE REMAINING COMPOUNDS WERE LESS THAN 20 PARTS PER BILLION. DR. WALKER GAVE VERBAL APPROVAL TO SPRAY IRRIGATE THE WATER ON TUESDAY. TO DATE, 100,000 GALLONS OF WATER HAVE BEEN SPRAY IRRIGATED. TREATMENT OF THE WATER WILL CONTINUE UNTIL THE CONTENTS OF THE TANKS ARE EMPTIED. IT IS THEN PROPOSED TO PROCEED WITH THE DISMANTLING OF THE PLANT AS DESCRIBED IN THE ATTACHED MEMORANDUM CONCERNING A CONCEPTUAL PLAN FOR THE FINAL REMEDY.

ATTACHMENT B
RISK ASSESSMENT AND ADDENDA

RISK ASSESSMENT TO ACCOMPANY
THE FEASIBILITY STUDY OF
THE LIVE OAK SUPERFUND SITE,
LIVE OAK, FLORIDA

PREPARED FOR:
AMAX, INC.
GOLDEN, CO
THE JAMES GRAHAM
BROWN FOUNDATION
LOUISVILLE, KY
AUGUST 1987

EXECUTIVE SUMMARY

INTRODUCTION

THE FOLLOWING REPORT IS A HEALTH BASELINE RISK ASSESSMENT OF THE LIVE OAK SUPERFUND SITE IN LIVE OAK, SUWANNEE COUNTY, FLORIDA. THE REPORT FOLLOWS THE GUIDELINES OUTLINED IN THE SUPERFUND PUBLIC HEALTH ASSESSMENT MANUAL (EPA 540/1-86/060) AND IS INTENDED TO ACCOMPANY THE FEASIBILITY STUDY REPORT FOR THE SITE DEVELOPED BY REMEDIATION TECHNOLOGIES INCORPORATED. A SUMMARY OF THE HISTORY OF THE SITE AND ITS USE AS A WOOD PRESERVING FACILITY IS PRESENTED IN THE FEASIBILITY STUDY REPORT AS WELL AS THE REMEDIAL INVESTIGATION REPORT, PREPARED BY FISHBECK, THOMPSON, CARR AND HUBER AND ENVIRONMENTAL ENGINEERING AND MANAGEMENT, LIMITED.

SELECTION OF INDICATOR CHEMICALS

SAMPLING OF MEDIA FOR CHEMICAL ANALYSIS HAS BEEN CARRIED OUT BY A LARGE NUMBER OF AGENCIES AND CONTRACTORS. THE CHRONOLOGY OF SAMPLING, WHICH OCCURRED BETWEEN 1982 AND 1986 IS PRESENTED IN TABLE 2-1 OF THE FOLLOWING REPORT. MOST ANALYSIS WAS DONE WITH A FOCUS ON CONSTITUENTS TYPICALLY USED AT WOOD PRESERVING SITES. CREOSOTE CONSTITUENTS AND A SMALL AMOUNT OF PENTACHLOROPHENOL WERE FOUND TO BE PRESENT IN SOIL, SEDIMENT, AND SURFACE WATER AT THE SITE. CERTAIN LOW MOLECULAR WEIGHT FRACTIONS OF CREOSOTE WERE ALSO FOUND IN GROUND WATER. NO METALS WERE FOUND AT THE SITE. BASED ON THESE FINDINGS, CREOSOTE CONSTITUENTS AND PENTACHLOROPHENOL WERE SELECTED AS INDICATOR CHEMICALS FOR DETAILED HEALTH RISK ASSESSMENT AT THE SITE. THE CREOSOTE CONSTITUENTS WERE EVALUATED AS A WHOLE FOR THEIR POTENTIAL TO PRODUCE ACUTE, NON-CARCINOGENIC EFFECTS ON SKIN. ADDITIONALLY, SIX HIGH MOLECULAR WEIGHT COMPONENTS OF CREOSOTE WERE EVALUATED FOR POTENTIAL TO PRODUCE A CARCINOGENIC RESPONSE (BENZO(A)ANTHRACENE, BENZO(A)PYRENE, BENZO(B)FLUORANTHENE, CHRYSENE, DIBENZO(A,H)ANTHRACENE, AND INDENO (1,2,3,C,D)PYRENE). THESE COMPOUNDS WERE SELECTED BECAUSE THE U.S. EPA WEIGHT-OF-EVIDENCE SYSTEM INDICATES THEY ARE "POSSIBLE" OR "PROBABLE" HUMAN CARCINOGENS. ANOTHER CREOSOTE CONSTITUENT, FLUORANTHENE, WAS SELECTED FOR EVALUATION BECAUSE IT IS PRESENT IN SIGNIFICANT AMOUNTS AT MANY OF THE CONTAMINATED AREAS OF THE SITE, AND BECAUSE OF THE EXISTENCE OF AN AMBIENT WATER QUALITY CRITERION FOR THIS COMPOUND. PENTACHLOROPHENOL WAS EVALUATED FOR ITS POTENTIAL TO PRODUCE ACUTE, NON-CARCINOGENIC EFFECTS ON SKIN AND ALSO FOR ITS POTENTIAL TO PRODUCE SYSTEMIC TOXIC EFFECTS.

EXPOSURE ASSESSMENT

AT ANY SITE, HUMANS MAY BE EXPOSED TO CONTAMINANTS IN AIR, WATER, OR SOLID MEDIA SUCH AS SOIL AND SEDIMENTS. THEY MAY INGEST, INHALE, OR ABSORB A COMPOUND. IN CERTAIN CASES, SKIN CONTACT WITHOUT ABSORPTION INTO THE SYSTEM MAY BE CONSIDERED AN EXPOSURE. CONSIDERATION OF THE LOCATION OF THE SITE, ITS ACCESSIBILITY, AND REGIONAL HYDROGEOLOGY INDICATED THAT THE PERTINENT ROUTES OF POTENTIAL EXPOSURE FOR THE LIVE OAK SITE WERE INGESTION OF DRINKING WATER FROM THE FLORIDAN AQUIFER IF IT WERE TO BECOME CONTAMINATED, AND ACUTE DERMAL CONTACT WITH OR INGESTION OF CONSTITUENTS IN SURFACE SOILS BY TRESPASSERS OR VISITORS TO THE SITE.

CONCENTRATIONS OF INDICATOR CHEMICALS USED IN THE RISK ASSESSMENT WERE DETERMINED FROM ANALYTIC RESULTS OR ESTIMATED WITH THE AID OF MATHEMATICAL MODELS. THE MODELS USED FOR DETERMINING POTENTIAL IMPACT ON GROUND WATER WERE A LEACHING MODEL DEVELOPED BY EPA (THE ORGANIC LEACHING MODEL), AN ANALYTICAL ONE-DIMENSIONAL UNSATURATED ZONE MODEL, AND AN ANALYTICAL SATURATED ZONE MODEL (THE HORIZONTAL PLANE SOURCE MODEL). THE MODELS ARE DESCRIBED IN DETAIL IN APPENDIX A OF THIS REPORT. THE PAH INPUTS FOR THE MODEL WERE OBTAINED FROM DATA ON SEDIMENTS AND SOILS IN THE LAGOON AREA, SAMPLED BY THE EPA AND P.E. LAMOREAUX ON JUNE 20-24, 1983. DATA FROM THE LAGOON WERE USED BECAUSE THIS IS THE AREA WITH THE LARGEST WASTE LOAD AND THE MOST LIKELY PLACE FOR GROUND WATER CONTAMINATION TO OCCUR. THE EXPOSURE POINT CHOSEN

FOR THE DRINKING WATER RISK ASSESSMENT WAS THE NEAREST DOWNGRADIENT OFFSITE WELL (WELL NUMBER 15 ON SHEET 10 OF THE REMEDIAL INVESTIGATION REPORT). FOR THE DIRECT CONTACT AND SOIL INGESTION ASSESSMENTS, ON-SITE SURFACE SOIL AND SEDIMENTS NOT NORMALLY COVERED BY WATER WERE CONSIDERED.

METHODS USED TO ASSESS RISK

RISK ASSESSMENT WAS CARRIED OUT USING TWO METHODS:

- THE ANALYTICAL AND PREDICTED CONCENTRATIONS WERE COMPARED TO RELEVANT STANDARDS AND CRITERIA; AND
- POTENTIAL INTAKE OF INDICATOR CHEMICALS USING EXPOSURE SCENARIOS IN WHICH INDIVIDUALS WERE ASSUMED TO DRINK WATER FROM POTENTIALLY-AFFECTED WELLS OR INADVERTENTLY INGEST SURFACE SOILS AND SEDIMENTS WHILE VISITING THE SITE (THE LATTER SCENARIO IS ASSUMED TO BE RELEVANT TO CHILDREN WHO SOIL THEIR HANDS AND PUT THEM IN THEIR MOUTH). POTENTIAL INTAKES OF NON-CARCINOGENIC INDICATOR CHEMICALS (PCP AND FLUORANTHENE) WERE COMPARED TO "ACCEPTABLE INTAKES" DEVELOPED BY THE EPA. POTENTIAL INTAKES OF THE CARCINOGENIC PAH WERE USED TO CALCULATE CANCER RISKS USING "POTENCY FACTORS" DEVELOPED BY THE EPA. FOR DERMAL CONTACT, CONCENTRATIONS IN THE SOIL WERE COMPARED TO APPARENT MINIMAL-EFFECTS LEVELS DETERMINED FROM THE LITERATURE.

COMPARISON OF INDICATOR CHEMICAL CONCENTRATIONS TO STANDARDS AND CRITERIA

COMPARISON OF MEASURED OR PREDICTED CONCENTRATIONS OF INDICATOR CHEMICALS IN OFF-SITE WELL WATER TO AMBIENT WATER QUALITY CRITERIA (THE ONLY CRITERIA THAT APPEAR TO BE RELEVANT FOR THE LIVE OAK SITE) INDICATE THAT NO IMPACT FROM PENTACHLOROPHENOL OR FLUORANTHENE IS EXPECTED. THE AMBIENT WATER QUALITY CRITERIA FOR CARCINOGENIC PAH GIVES A RANGE OF VALUES FOR VARIOUS RISKS OF CANCER. THE SUMMED CONCENTRATION OF THE CARCINOGENIC PAH PREDICTED TO BE IN THE NEAREST OFF-SITE WELL IS LESS THAN THE CONCENTRATION ASSOCIATED WITH A CANCER RISK OF 1 CHANCE IN 1,000,000.

ESTIMATION OF CARCINOGENIC RISK

THE POTENCY FACTOR FOR CARCINOGENIC PAH IS BASED ON OBSERVATIONS OF CARCINOGENIC ACTIONS OF A SINGLE COMPOUND, BENZO(A)PYRENE. AS THIS IS AMONG THE MOST CARCINOGENIC PAH, USING A POTENCY FACTOR BASED ON BENZO(A)PYRENE FOR ALL CARCINOGENIC PAH IS CONSERVATIVE. THE FACTOR IS 0.0115/MICROGRAM/KILOGRAM BODY WEIGHT DAY. THIS VALUE INDICATES THAT AN INDIVIDUAL TAKING IN ONE MICROGRAM OF CARCINOGENIC PAH PER KILOGRAM OF BODY WEIGHT EVERY DAY FOR LIFE WOULD HAVE A CANCER RISK OF .0115 (I.E., SLIGHTLY MORE THAN ONE CHANCE IN ONE HUNDRED) IN EXCESS OF "BACKGROUND" RISK.

USING THE FACTOR WITH THE PREDICTED INTAKE OF CARCINOGENIC PAH THAT COULD OCCUR AS A RESULT OF LIFETIME INGESTION OF WATER IN THE NEAREST DOWNGRADIENT WELL IF CONTAMINATION WERE TO OCCUR INDICATES THAT THE UPPER LIMIT CANCER RISK FROM THIS ACTIVITY IS SLIGHTLY LESS THAN 1 CHANCE IN 1,000,000. THIS LOW RISK IS OFTEN CONSIDERED "VIRTUALLY SAFE.".

USING THE FACTOR WITH PREDICTED INTAKE FROM A LESS LIKELY EXPOSURE SCENARIO, THE ASSUMPTION THAT CHILDREN COULD INFREQUENTLY VISIT THE SITE AND INGEST SOILS AND SEDIMENTS CONTAMINATED WITH PAH, INDICATES THAT AN UPPER-BOUND CANCER RISK OF EIGHTY EIGHT CHANCES IN ONE HUNDRED THOUSAND.

COMPARISON OF PREDICTED INTAKES TO ACCEPTABLE INTAKES OF NON-CARCINOGENS

ACCEPTABLE INTAKES FOR PENTACHLOROPHENOL AND FLUORANTHENE ARE 30 MICROGRAMS/KILOGRAM BODY WEIGHT DAY, AND 6.12 MICROGRAMS/KILOGRAM BODY WEIGHT DAY, RESPECTIVELY. THESE VALUES WERE DEVELOPED BY THE EPA UNDER THE ASSUMPTION THAT THESE SUBSTANCES, AS NON-CARCINOGENS, HAVE A "THRESHOLD" FOR THEIR TOXIC EFFECTS. THAT IS, THERE IS A DOSE BELOW WHICH VIRTUALLY NO RISK OF A TOXIC RESPONSE EXISTS. THE ACCEPTABLE INTAKES ARE ASSUMED TO BE BELOW THE THRESHOLD DOSE FOR PENTACHLOROPHENOL AND FLUORANTHENE. NO ESTIMATED INTAKE FOR PENTACHLOROPHENOL OR FLUORANTHENE USING ANY EXPOSURE SCENARIO, WAS IN EXCESS OF THE ACCEPTABLE INTAKES DEVELOPED BY THE EPA.

A NO-EFFECT LEVEL FOR THE DERMAL EFFECT OF CREOSOTE AND PENTACHLOROPHENOL WAS DETERMINED BY EXTRAPOLATING FROM REPORTS IN THE LITERATURE ON THE PHOTOSENSITIZATION EFFECTS OF CREOSOTE CONSTITUENTS AND THE DERMAL IRRITATION PRODUCED BY PENTACHLOROPHENOL. IT WAS DETERMINED THAT CONCENTRATIONS OF CREOSOTE OR PENTACHLOROPHENOL IN EXCESS OF 1000 PPM MIGHT PRODUCE ACUTE DERMAL EFFECTS. INSPECTION OF ANALYTICAL RESULTS INDICATE THAT SOME SURFACE SOILS AND SEDIMENTS THAT ARE NOT CONTINUOUSLY COVERED WITH WATER HAVE CONCENTRATIONS OF CREOSOTE AND PENTACHLOROPHENOL ABOVE 1000 PPM. THUS, SOME RISK OF TRANSIENT DERMAL EFFECT MAY EXIST FOR THE CURRENT CONDITION OF THE SITE.

DEVELOPMENT OF PERFORMANCE GOALS

FOR SOURCE CONTROL REMEDIAL ALTERNATIVES, THE SUPERFUND PUBLIC HEALTH EVALUATION MANUAL SUGGESTS THAT AN ANALYSIS TO DETERMINE "ACCEPTABLE" LEVELS OF RESIDUAL CONTAMINATION BE PERFORMED. NO EVALUATION WAS DEEMED NECESSARY FOR PENTACHLOROPHENOL OR FLUORANTHENE BECAUSE THE BASELINE ASSESSMENT INDICATED NO PRESENT OR FUTURE HEALTH IMPACTS OF THE COMPOUND. THE LOW LEVEL OF POTENTIAL CARCINOGENIC RISK FROM DRINKING WATER FROM OFF-SITE ALSO PRECLUDED THE NECESSITY OF PERFORMANCE GOALS BASED ON THIS LIMITED HEALTH IMPACT. THE MOST LIKELY HEALTH IMPACT FOR THE LIVE OAK SITE IS THE POTENTIAL FOR NON-CARCINOGENIC ACUTE DERMAL EFFECTS FROM CREOSOTE AND PENTACHLOROPHENOL. THUS, PERFORMANCE GOALS OF NO MORE THAN 1000 PPM CREOSOTE OR PENTACHLOROPHENOL IN SOILS OR SEDIMENTS IS RECOMMENDED. IF ALL MEDIA CONTAINING PENTACHLOROPHENOL OR CREOSOTE IN EXCESS OF THESE CONCENTRATIONS IS REMOVED, IT HAS THE SECONDARY EFFECT OF DECREASING THE POTENTIAL CANCER RISK PRODUCED BY INADVERTENT INGESTION OF SOILS AND SEDIMENTS. USING THE EXPOSURE SCENARIO DEVELOPED IN THE BASELINE RISK ASSESSMENT, THE MEAN CONCENTRATION OF CARCINOGENIC PAH CALCULATED TO REMAIN FOLLOWING REMOVAL OF CREOSOTE COMPOUNDS IN EXCESS OF 1000 PPM, THE CANCER RISK FROM INGESTION OF SOILS IS CALCULATED TO BE SLIGHTLY GREATER THAN ONE CHANCE IN 1,000,000.

1. INTRODUCTION

THE FOLLOWING REPORT IS PROVIDED TO SUPPORT THE FEASIBILITY STUDY OF THE BROWN WOOD PRESERVING SITE IN LIVE OAK, FLORIDA PREPARED BY REMEDIATION TECHNOLOGIES FOR AMAX, INC. AND THE JAMES GRAHAM BROWN FOUNDATION, INC. IT IS A BASELINE HEALTH RISK EVALUATION, AND DOCUMENTATION OF THE METHOD USED FOR DEVELOPING PERFORMANCE GOALS BASED ON HUMAN HEALTH CONSIDERATIONS. THE FORMAT FOLLOWS THE GUIDANCE PROVIDED IN THE SUPERFUND PUBLIC HEALTH EVALUATION MANUAL (EPA, 1986).

THE BASELINE EVALUATION IS A HEALTH RISK ASSESSMENT OF THE CURRENT CONDITION OF THE SITE AND, AS SUCH, REPRESENTS A SCREENING OF THE "NO-ACTION ALTERNATIVE.". IT INDICATES IF A REMEDIAL ACTION IS NEEDED AND HOW QUICKLY STEPS MUST BE TAKEN. THE METHODOLOGY DEVELOPED IN THE BASELINE ASSESSMENT ALSO PROVIDES THE FRAMEWORK FOR DEVELOPING PERFORMANCE GOALS USED FOR SCREENING REMEDIAL ALTERNATIVES.

THE REMEDIAL ALTERNATIVES (OTHER THAN "NO ACTION") THAT HAVE BEEN SELECTED FOR SCREENING FOR THE LIVE OAK SITE ARE SOURCE CONTROL MEASURES. EPA GUIDANCE (EPA, 1986) SUGGESTS THAT SUCH ALTERNATIVES MUST BE SCREENED FOR THEIR ABILITY TO FULFILL REQUIREMENTS OF THE NATIONAL CONTINGENCY PLAN AND BEST ENGINEERING JUDGMENT. HOWEVER, AS SUGGESTED IN THE SUPERFUND PUBLIC HEALTH EVALUATION MANUAL, HEALTH-BASED CRITERIA CAN BE USEFUL IN DERIVING ACCEPTABLE RESIDUAL LEVELS OF CONSTITUENTS IN SOILS (PERFORMANCE GOALS). PERFORMANCE GOALS WILL BE CALCULATED TO PROVIDE PUBLIC HEALTH PROTECTION AT THE EXPOSURE POINTS IDENTIFIED IN THE BASELINE ASSESSMENT. SPECIFICALLY, PERFORMANCE GOALS WILL BE SET WHICH WOULD ENSURE EXPOSURE BELOW THE ACCEPTABLE INTAKE FOR CHRONIC EXPOSURE (AIC) FOR NON-CARCINOGENIC TOXIC CONSTITUENTS AND PROVIDE FOR LOW RISK FROM CARCINOGENIC SUBSTANCES. THESE VALUES PROVIDE AN OBJECTIVE, HEALTH-BASED CRITERIA FOR DETERMINING THE RELATIVE EFFECTIVENESS OF REMEDIAL ALTERNATIVES.

TO THE EXTENT POSSIBLE, AN ANALYSIS OF THE SHORT TERM HEALTH RISKS ASSOCIATED WITH THE REMEDIAL ACTIONS WILL BE PROVIDED. UNDER EPA HEALTH ASSESSMENT GUIDANCE (EPA, 1986) THIS ANALYSIS IS INTENDED TO PROVIDE GUIDANCE FOR THE HEALTH AND SAFETY PLAN ACCOMPANYING THE CHOSEN ACTION.

2. BASELINE ASSESSMENT

THE FORMAT OF THIS BASELINE ASSESSMENT FOLLOWS THE 4-STEP METHODOLOGY RECOMMENDED BY THE EPA (49 FR 46304, NOVEMBER 23, 1984; 50 FR 1170, JANUARY 9, 1985, AND EPA, 1986). IT SHOULD BE NOTED THAT THE TERMINOLOGY USED IN THE FEDERAL REGISTER AND THE SUPERFUND PUBLIC HEALTH EVALUATION MANUAL (SPHEM) IS DIFFERENT. ALTHOUGH THE DIFFERENCES ARE ONLY SEMANTIC, READERS MAY BE FAMILIAR WITH ONLY ONE TERMINOLOGY. TO AVOID CONFUSION, THE TERMS AND A SHORT DESCRIPTION OF THE METHODS INVOLVED WITH EACH STEP ARE PROVIDED HERE.

STEP 1: SELECTION OF INDICATOR CHEMICALS IN THE SUPERFUND PUBLIC HEALTH EVALUATION MANUAL IS COMPARABLE TO THE HAZARD IDENTIFICATION IN THE FEDERAL REGISTER. THE ASSESSMENT REVIEWS THE CONTAMINANTS FOUND IN VARIOUS MEDIA. INDICATOR CHEMICALS ARE THEN CHOSEN BASED ON CONCENTRATION, DISTRIBUTION, TOXICITY AND CONSISTENCY OF DETECTION.

STEPS 2 AND 3: ESTIMATION OF EXPOSURE POINT CONCENTRATIONS AND ESTIMATION OF CHEMICAL INTAKES ARE COMPARABLE TO THE EXPOSURE ASSESSMENT MENTIONED IN THE FEDERAL REGISTER. THE SECTION REVIEWS THE POTENTIAL EXPOSURE PATHWAYS, COMPARES RELEVANT STANDARDS AND CRITERIA TO CONCENTRATIONS AT EXPOSURE POINTS AND CALCULATES EXPECTED DOSES FROM PLAUSIBLE EXPOSURE SCENARIOS.

STEP 4: TOXICITY ASSESSMENT IS COMPARABLE TO DOSE-RESPONSE ASSESSMENT. THE SECTION PRESENTS A TOXICITY PROFILE AND DEVELOPS A DOSE RESPONSE RELATIONSHIP FOR EACH INDICATOR CHEMICAL. THE GENERAL SOURCE FOR THIS INFORMATION IS THE SUPPORTING LITERATURE FOR THE STANDARDS AND CRITERIA FOR THE CONSTITUENTS (EVEN IF A STANDARD OR CRITERION IS NOT PERTINENT TO THE EXPOSURE SITUATION, THE TOXICITY LITERATURE IS OFTEN USEFUL). UPDATED INFORMATION WILL ALSO BE ANALYZED.

STEP 5: RISK CHARACTERIZATION IS TITLED THE SAME IN THE FEDERAL REGISTER AND THE SPHEM. IN THIS SECTION EXPECTED DOSES ARE COMPARED TO THE DOSE RESPONSE ESTIMATION IN ORDER TO QUANTITATE RISK FOR THE SITE SPECIFIC CONDITIONS.

THE ASSESSMENT OF CONDITIONS AT THE LIVE OAK SITE IS BASED ON FIELD OBSERVATIONS AS PRESENTED IN THE REMEDIAL INVESTIGATION (RI) PERFORMED BY FISHBECK, THOMPSON, CARR, AND HUBER, AND ENVIRONMENTAL ENGINEERING AND MANAGEMENT LTD. ANALYTICAL DATA ON A VARIETY OF SAMPLES TAKEN BY SEVERAL ORGANIZATIONS (FLORIDA DER (FDER), EPA, P.E. LAMOREAUX AND ASSOCIATES (PELA), LAW ENGINEERING AND TESTING CO. (LETCO), AS WELL AS ENVIRONMENTAL ENGINEERING AND MANAGEMENT LTD. (EEM)) BETWEEN 1982 AND 1987 WERE ASSESSED. TABLE 2-1 PRESENTS THE CHRONOLOGY OF SAMPLING.

2.1 SELECTION OF INDICATOR CHEMICALS

ALL OF THE SAMPLING ROUNDS AT THE LIVE OAK SITE HAVE BEEN FOCUSED ON CONSTITUENTS POTENTIALLY PRESENT, GIVEN THE LAST USE OF THE PROPERTY AS A WOOD PRESERVING OPERATION. CREOSOTE IS THE PRINCIPAL PRESERVATIVE REPORTED TO HAVE BEEN USED AT THE SITE DURING OPERATIONS BY BROWN AND AMAX. PENTACHLOROPHENOL AND ARSENIC-METAL COMPLEXES (E.G., CHROMATED COPPER ARSENATE, CHROMATED ZINC CHLORIDE) ARE ALSO COMMON WOOD PRESERVING COMPOUNDS. ALTHOUGH NOT REPORTED TO HAVE BEEN USED BY BROWN OR AMAX, THEY HAVE BEEN ADDRESSED IN SAMPLE ANALYSIS. THE REASONS FOR SELECTION OR REJECTION OF A COMPOUND AS AN INDICATOR CHEMICAL IS DETAILED BELOW AND THE FINAL LIST OF CHOSEN CONSTITUENTS IS GIVEN IN TABLE 2-2.

2.1.1 CREOSOTE CONSTITUENTS

CREOSOTE IS DEFINED BY ITS PHYSICAL PROPERTIES (SELECTED SPECIFICALLY TO MAKE THE MATERIAL SUITABLE FOR WOOD PRESERVATION) RATHER THAN ITS CHEMICAL COMPOSITION. AS A COMPLEX MIXTURE, THE TOXICITY OF CREOSOTE MAY VARY WITH EACH LOT. CREOSOTE IS A MIXTURE OF AROMATIC COMPOUNDS, INCLUDING:

- LIGHT AROMATIC COMPOUNDS, INCLUDING BENZENE, NAPHTHALENE AND SUBSTITUTED ARYL STRUCTURES SUCH AS XYLENES AND TOLUENE. THESE CONSTITUENTS ARE PRESENT AT LOW LEVELS BECAUSE THEIR BOILING POINTS ARE LOWER THAN THE CREOSOTE FRACTIONATION TEMPERATURE RANGE.

- PHENOL AND SUBSTITUTED PHENOLS (E.G., CRESOLS).

- POLYNUCLEAR AROMATIC HYDROCARBONS (PAH).

BENZENE AND SUBSTITUTED BENZENES HAVE BEEN DETECTED ONCE, BY THE FDER IN 1982. AT THAT TIME, THEY WERE FOUND TO BE PRESENT IN SURFACE WATER OF A SHALLOW HOLE DUG IN THE DRAINAGE DITCH ON SITE, BUT NOT IN FOUR GROUND WATER WELLS OFF SITE. THE FDER AND EPA (IN SUMMER OF 1982 AND FEBRUARY OF 1983, RESPECTIVELY) DID NOT FIND NAPHTHALENE, PHENOL OR PAH IN PRIVATE GROUND WATER WELLS OFFSITE (NO CONSTITUENTS WERE FOUND IN THE PRIVATE WELL SAMPLED BY EEM IN 1987), NOR WERE THEY FOUND IN GROUND WATER MONITORING WELL SAMPLES DURING THE 1985 SAMPLING ROUNDS BY EEM. NO PHENOL WAS FOUND BY EEM IN 1986 SAMPLING OF GROUND WATER, WHILE VERY LOW CONCENTRATIONS OF NAPHTHALENE AND LOW MOLECULAR PAHS (ACENAPHTHENE, DIBENZOFURAN, FLUORENE, PHENANTHRENE AND ANTHRACENE) WERE REPORTED IN TWO ON-SITE MONITORING WELLS IN 1986 AND 1987.

PHENOL, NAPHTHALENE, AND PAH WERE DETECTED IN SURFACE WATER ON SITE BY FDER AND EPA (DATES MENTIONED ABOVE), BUT ANALYSES BY PELA IN JUNE OF 1983 WERE NEGATIVE.

PHENOL WAS NOT DETECTED TO A SIGNIFICANT EXTENT IN SOILS ANALYSIS DURING THE REMEDIAL INVESTIGATION, AND WAS CALCULATED TO BE PRESENT IN AIR TO THE EXTENT OF ABOUT 0.5 PPB (EPA-FIT STUDY NO. Z0830202, 1983), A CONCENTRATION WHICH IS FOUR ORDERS OF MAGNITUDE BELOW THE NIOSH EXPOSURE LIMIT (NIOSH, 1985). THUS, PHENOL HAS BEEN ELIMINATED FROM FURTHER CONSIDERATION IN THE BASELINE RISK ASSESSMENT DUE TO ITS LIMITED PRESENCE AT THE SITE. SOIL ANALYSES DONE DURING THE REMEDIAL INVESTIGATION INDICATE THAT NAPHTHALENE, METHYLNAPHTHALENE, AND CERTAIN PAH ARE PRESENT IN SOILS IN SPECIFIC AREAS AT THE SITE. HOWEVER, NAPHTHALENE AND METHYLNAPHTHALENE HAVE FAIRLY LOW ACUTE TOXICITY (LETHAL DOSE IN HUMANS IS 2-15 G, SANDMEYER, 1981) AND THEIR CHRONIC TOXICITY IS INADEQUATELY STUDIED. THEREFORE, THE NAPHTHALENES WERE NOT ASSESSED FURTHER. PAH WITH AN ADEQUATE TOXICOLOGY BASE WERE SELECTED AS INDICATOR CHEMICALS.

THE TOXIC EFFECT OF PRIMARY CONCERN FOR PAH IS CARCINOGENICITY. THE U.S. EPA HAS DEVELOPED A "WEIGHT-OF-EVIDENCE" SYSTEM TO CLASSIFY THE DATA THAT IS SUGGESTIVE OF HUMAN CARCINOGENIC ACTIVITY OF INDIVIDUAL PAH COMPOUNDS. THE WEIGHT OF EVIDENCE CATEGORIES ARE:

1) A - HUMAN CARCINOGEN. DEMONSTRATED HUMAN CARCINOGENIC ACTIVITY.

2) B-1 - PROBABLE HUMAN CARCINOGEN. SUGGESTED BY LIMITED STUDIES IN HUMANS.

3) B-2 - PROBABLE HUMAN CARCINOGEN. SUGGESTED BY LIFETIME STUDIES IN ANIMALS.

4) C - POSSIBLE HUMAN CARCINOGEN. SUGGESTED BY LIMITED STUDIES IN ANIMALS.

5) D - NO DATA, OR NO DEMONSTRATED CARCINOGENIC ACTIVITY.

THERE ARE NO A OR B-1 LEVEL CARCINOGENS AMONG THE PAH DETECTED AT THE LIVE OAK SITE. SIX PAH COMPOUNDS FOUND AT THE SITE HAVE EPA RATINGS OF "PROBABLE" (B-2) TO "POSSIBLE" (C) HUMAN CARCINOGENS (EPA, 1986) AND HAVE BEEN CHOSEN FOR DETAILED RISK ANALYSIS IN THE PRESENT ASSESSMENT. THEY ARE LISTED IN TABLE 2-2.

ADDITIONALLY, A NON-CARCINOGENIC PAH, FLUORANTHENE, HAS BEEN SELECTED BECAUSE THERE IS ADEQUATE DOSE-RESPONSE DATA TO ASSESS THE TOXICITY OF THIS COMPOUND (EPA, 1980A).

AS WILL BE DETAILED BELOW, AN ACUTE DERMAL TOXIC EFFECT OF PAH MAY ALSO BE IMPORTANT AT THE LIVE OAK SITE (AN ACUTE EFFECT IS ONE WHICH MAY OCCUR AFTER A SINGLE INSTANCE OF CONTACT WITH THE CHEMICAL, AND GENERALLY HAPPENS WITHIN HOURS TO DAYS AFTER EXPOSURE). ALL PAH WILL PRODUCE SUN SENSITIVITY TO VARYING DEGREES. IT IS NEITHER POSSIBLE OR NECESSARY TO DETERMINE THE DERMAL TOXICITY RISK OF EACH PAH. RATHER A VALUE INTENDED TO PROTECT AGAINST PHOTOSENSITIVITY WILL BE DEVELOPED FOR TOTAL PAH. EVEN THE PAH WHICH HAVE BEEN ELIMINATED FROM ASSESSMENT FOR SYSTEMIC TOXICITY WILL BE INCLUDED IN THIS VALUE.

2.1.2 PENTACHLOROPHENOL

PENTACHLOROPHENOL HAS BEEN DETECTED IN SURFACE WATER BUT NOT IN GROUND WATER SAMPLES FROM THE ON-SITE OR OFFSITE MONITORING WELLS. THE COMPOUND APPEARS TO BE LESS WIDELY DISTRIBUTED IN SOILS THAN CREOSOTE CONSTITUENTS. HOWEVER THERE ARE CONCENTRATIONS IN THE SEDIMENTS THAT COULD CONCEIVABLY POSE A RISK THROUGH DIRECT HUMAN CONTACT OR AS A SOURCE FOR FUTURE GROUND WATER CONTAMINATION. THUS, PENTACHLOROPHENOL WILL BE INCLUDED AS AN INDICATOR CHEMICAL IN THE QUANTITATIVE RISK ASSESSMENT.

2.1.3 METAL-ARSENIC COMPLEXES

THERE ARE NO REPORTS OF THE USE OF METAL-ARSENIC PRESERVATIVE AT THE LIVE OAK SITE AND ANALYTIC DATA DOES NOT INDICATE CONTAMINATION WITH THESE COMPOUNDS. THE EPA (IN FEBRUARY OF 1983) DETECTED COPPER IN ONLY ONE OFF-SITE WELL AT 30 PPB, A VALUE WELL BELOW THE AMBIENT WATER QUALITY CRITERIA (1 PPM, EPA, 1980D) OR PROPOSED RECOMMENDED MAXIMUM CONTAMINATION LEVEL (1.3 PPM, FR 50 46968, NOVEMBER 13, 1985). ZINC WAS FOUND IN ALL WELLS SAMPLED (AT CONCENTRATIONS OF 0.04 TO 1.3 PPM) BUT ADVERSE HEALTH EFFECTS FROM THIS COMPOUND HAVE NEVER BEEN IDENTIFIED (FR 50 46981, NOVEMBER 13, 1985). PELA DETECTED ZINC AND COPPER IN THE LOW PPB RANGE (LEVELS CONSISTENT WITH NATURAL OCCURRENCE, BOND & STRAUB, 1973) IN LAGOON WATER SAMPLES IN JUNE OF 1983. AT THIS TIME THEY FOUND NO ARSENIC OR CHROMIUM. THE LIMITED DISTRIBUTION OF METALS AND ARSENIC SUPPORTS THE CLAIM THAT METAL-ARSENIC PRESERVATIVES WERE NOT USED AT THE LIVE OAK SITE. IT IS THEREFORE NOT NECESSARY TO INCLUDE THESE COMPOUNDS AMONG THE INDICATOR CHEMICALS.

2.1.4 SUMMARY

SELECTED INDICATOR CHEMICALS ARE LISTED IN TABLE 2-2.

2.2 EXPOSURE ASSESSMENT

THE LIVE OAK SITE IS LOCATED WEST OF THE CITY OF LIVE OAK, SUWANNEE COUNTY, FLORIDA, A TOWN OF 6700 PEOPLE (1980 POPULATION, BUREAU OF THE CENSUS, 1983) IN THE NORTH CENTRAL PORTION OF THE STATE. THERE ARE PRIVATE WATER SUPPLY WELLS IN ALL DIRECTIONS FROM THE SITE. THE AREA SURROUNDING THE SITE IS RURAL. A DEFUNCT SAWMILL OPERATION AND A CONSTRUCTION COMPANY ARE LOCATED TO THE WEST AND EAST OF THE SITE, RESPECTIVELY, BUT THERE ARE NO PERMANENT RESIDENTS AT THESE LOCATIONS. THE NEAREST PERMANENT RESIDENTS ARE LOCATED IN A TRAILER COURT NORTH OF THE SITE, AND IN NEW HOUSES TO THE SOUTH. THE SITE IS POSTED WITH NO TRESPASSING SIGNS AND LOCKED CABLE GATES HAVE BEEN INSTALLED ACROSS ROADWAYS. THE PROPERTY IS PARTIALLY FENCED AND, WHILE THE PRESENCE OF UNAUTHORIZED PERSONS ON SITE WAS DOCUMENTED IN THE REMEDIAL INVESTIGATION, THIS IS A RARE OCCURRENCE DUE TO THE GATES.

2.2.1 EXPOSURE PATHWAYS

AT ANY SITE, HUMANS MAY POTENTIALLY BE EXPOSED TO CONTAMINANTS IN AIR, WATER, OR SOLID MEDIA (SOILS, SEDIMENTS OR SLUDGES); DIRECTLY, OR VIA THE FOOD CHAIN. THE ROUTE OF INTAKE MAY BE BY INGESTION, INHALATION, OR DERMAL ABSORPTION. DERMAL CONTACT EVEN WITHOUT ABSORPTION MAY ALSO BE PERTINENT FOR THE INDICATOR CHEMICALS SELECTED AT THE PRESENT SITE.

AIR

EXPOSURE TO CONTAMINANTS IN AIR IS NOT A LIKELY EXPOSURE PATHWAY FOR THE LIVE OAK SITE. THE VOLATILITY OF THE INDICATOR CHEMICALS IS GENERALLY LOW, AND THE NATURE OF THE WASTE PRECLUDES SUBSTANTIAL ENTRAINMENT. FINALLY, A MAJORITY OF THE LOCAL POPULATION LIVES AT DISTANCES FROM THE SITE THAT MAKE AIR DISPERSION AND DILUTION SIGNIFICANT FACTORS IN DIMINISHING EXPOSURE BY THIS PATHWAY.

WATER

A SIGNIFICANT POTENTIAL EXPOSURE PATHWAY OFF SITE IS INGESTION OF WATER IF THE FLORIDAN AQUIFER WERE TO BECOME CONTAMINATED AS A RESULT OF LEACHING FROM THE SITE. THIS PATHWAY WILL RECEIVE SUBSTANTIAL ANALYSIS IN THE FOLLOWING SECTIONS.

A PATHWAY FOR DIRECT CONTACT WITH MEDIA ONSITE, WHICH WOULD INCLUDE SURFACE WATER IS DEVELOPED BELOW, IN THE SECTION ON SOLID MEDIA.

SOLID MEDIA (SOILS, SEDIMENTS, SLUDGES)

A SECOND PATHWAY THAT MAY BE SIGNIFICANT FOR A SUBSET OF THE POPULATION IS THE EXPOSURE TO CONTAMINANTS BY DIRECT CONTACT WITH MATERIALS (SEDIMENTS, SOILS AND LAGOON WATER) WHILE ON SITE. AS THE ONLY AUTHORIZED INDIVIDUALS ON THE PROPERTY WOULD BE REPRESENTATIVES OF THE PRPS OR AGENCIES WHO ARE AWARE OF APPROPRIATE PROTECTIVE MEASURES FOR THE LOCATION, THE POTENTIALLY AT-RISK POPULATION WOULD BE LIMITED TO TRESPASSERS.

FOOD CHAIN

FOOD CHAIN EXPOSURE VIA PLANT CROPS IS AN UNLIKELY PATHWAY AS SURFACE RUN OFF FROM THE SITE IS CAPTURED BY THE LAGOON OR A SWAMPY AREA TO THE WEST. THE CROPS NEARBY HAVE NOT REQUIRED IRRIGATION (FTCH, 1987, PG. 92). WILDLIFE SPECIES WHICH MAY INHABIT THE SITE, AND MAY BE HUNTED INCLUDE RACCOON, OPPOSSUM, AND BOBWHITE. HOWEVER, PAH AND PENTACHLOROPHENOL DO NOT TEND TO ACCUMULATE APPRECIABLY IN TERRESTRIAL ANIMALS, PROBABLY BECAUSE THE COMPOUNDS ARE EXTENSIVELY METABOLIZED AND ELIMINATED (EPA, 1980B). THUS, FOOD CHAIN EXPOSURE IS ELIMINATED AS A MAJOR PATHWAY FOR EXPOSURE.

2.2.2 EXPOSURE POINT CONCENTRATIONS

THE ANALYSIS OF PLAUSIBLE EXPOSURE PATHWAYS PRESENTED ABOVE INDICATES THAT HUMANS MAY POTENTIALLY BE EXPOSED TO INDICATOR CHEMICALS BY DRINKING WATER OR MAKING DIRECT CONTACT WITH MATERIALS ON THE PROPERTY. THE FOLLOWING SECTION DETERMINES WHAT CONCENTRATIONS OF INDICATOR CHEMICALS MAY EXIST AT THESE EXPOSURE POINTS NOW OR IN THE FUTURE. THE DATA WILL BE UTILIZED TO DETERMINE POTENTIAL HUMAN HEALTH IMPACTS BY COMPARING THE VALUES TO RELEVANT STANDARDS AND CRITERIA (SEE SECTION 2.2.3) AND USING THE DATA FOR CALCULATING HUMAN INTAKES AND APPLYING DOSE-RESPONSE RELATIONS (SEE SECTION 2.3). THE EXPOSURE POINT CONCENTRATIONS DEVELOPED BELOW ARE PRESENTED IN TABLE 2-3.

DRINKING WATER PATHWAY

THE EPA REPORTED NO DETECTION OF "EXTRACTABLE ORGANICS" IN PRIVATE WELLS DURING SAMPLING IN FEBRUARY OF 1983. THE NEW PRIVATE WELL, SAMPLED BY EEM IN JANUARY, 1987 HAD NO DETECTABLE CREOSOTE CONSTITUENTS. THE REMEDIAL INVESTIGATION REPORT INDICATED NO INDICATOR PARAMETERS IN GROUND WATER SAMPLES TAKEN IN 1985 FROM MONITORING WELLS AT DETECTION LIMITS OF 20 PPB FOR CARCINOGENIC PAH COMPOUNDS AND 110 PPB FOR PENTACHLOROPHENOL. IN OCTOBER 1986, FLUORANTHENE AND OTHER LOW MOLECULAR WEIGHT PAH (ACENAPHTHENE, DIBENZOFURAN, FLUORENE, PHENANTHRENE, AND ANTHRACENE) WERE DETECTED IN WELLS MW-4 AND MW-8. RESAMPLING IN JANUARY, 1987 INDICATED AGAIN THAT LOW MOLECULAR WEIGHT PAH WERE PRESENT IN MW-4 AND MW-8, ALTHOUGH THE COMPOUNDS WERE DETECTED IN LOWER CONCENTRATIONS THAN THE PREVIOUS SAMPLING ROUND.

IN ORDER TO DETERMINE WHAT FUTURE IMPACTS MIGHT OCCUR AS A RESULT OF CONSTITUENTS AT THE LIVE OAK SITE, A LEACHATE AND GROUND-WATER TRANSPORT MODELING EFFORT WAS UNDERTAKEN. THE METHODS AND RESULTS ARE DETAILED IN AN APPENDIX TO THIS REPORT.

THE PAH CONCENTRATION INPUTS FOR THE MODEL WERE OBTAINED FROM DATA ON THE SEDIMENTS AND SOILS IN THE LAGOON AREA (PELA AND EPA SAMPLING OF JUNE 20-24, 1983) BECAUSE THIS IS THE AREA OF THE LARGEST WASTE LOAD AND THE MOST LIKELY PLACE FOR GROUND WATER CONTAMINATION TO OCCUR. INADEQUATE DATA WERE AVAILABLE TO MODEL POSSIBLE LEACHING OF PENTACHLOROPHENOL, SO THIS VALUE IS NOT REPORTED.

THE MODEL UTILIZED FOR DETERMINING THE POTENTIAL MAGNITUDE OF LEACHING FROM THE LAGOON MATERIAL (THE EPA ORGANIC LEACHING MODEL, OR OLM), PROVED VALID ONLY FOR SOILS BENEATH THE SLUDGE LAYER IN THE LAGOON. FOR SLUDGE CONTAMINANTS, THE MODEL CONSISTENTLY PREDICTED LEACHATE CONCENTRATIONS IN EXCESS OF THE SOLUBILITY LIMITS OF THE CARCINOGENIC PAH. THUS, THE SOLUBILITY LIMITS WERE USED AS A SLUDGE SOURCE TERM FOR TRANSPORT MODELS. TRANSPORT IN THE UNSATURATED ZONE WAS CALCULATED BY A ONE-DIMENSIONAL ANALYTICAL MODEL. THIS MODEL PROVIDED MASS FLUXES AS A SOURCE TERM TO THE SATURATED ZONE MODEL (THE HPS MODEL), WHICH WAS DEVELOPED BY ERT. THESE MODELS (DESCRIBED IN DETAIL IN APPENDIX A) WERE UTILIZED TO PREDICT POTENTIAL DRINKING WATER IMPACT OF THE LAGOON IN ITS PRESENT CONDITION.

THE PRIMARY POINT OF IMPACT CHOSEN WAS THE NEAREST DOWNGRADIENT WELL FROM THE SOURCE. THIS IS WELL NUMBER 15 ON SHEET 10 IN THE REMEDIAL INVESTIGATION REPORT, WHICH IS APPROXIMATELY 1600 FEET FROM THE SOURCE. ALTHOUGH AN ACTUAL WELL WAS CHOSEN, THE MODELS MAKE THE ASSUMPTION THAT THE POINT IS DIRECTLY DOWN GRADIENT. THUS, THE VALUES PREDICTED FROM THE MODELS WILL BE GENERALLY VALID FOR 1600 FEET DOWN GRADIENT, REGARDLESS OF DIRECTION OF GROUND WATER FLOW. ADDITIONALLY, SOLUTIONS TO THE TRANSPORT MODELS WERE CALCULATED USING MW-8 AS AN EXPOSURE POINT. THIS ACTIVITY SERVED A DUAL PURPOSE. AS SOME MATERIALS WERE DETECTED IN MW-8 DURING THE 1986 SAMPLING ROUND, IT WAS POSSIBLE TO COMPARE MODEL OUTPUT TO ACTUAL DATA IN ORDER TO ENSURE THAT THE MODEL WAS CONSERVATIVE (THE ONLY INDICATOR CHEMICAL FOUND IN THIS WELL

WAS FLUORANTHENE; TRANSPORT OF AN ADDITIONAL LOW MOLECULAR WEIGHT PAH, PHENANTHRENE, WAS MODELED TO PROVIDE AN ADDITIONAL COMPARISON TO ANALYTICAL DATA). ADDITIONALLY, MW-8 IS ONLY A FEW FEET FROM THE LAGOON, THE AREA OF HIGHEST WASTE LOAD AND POTENTIAL FOR LEACHING TO GROUND WATER. IT THEREFORE MAY SERVE AS A POINT FOR MAKING CONSERVATIVE, POSSIBLY "WORST-CASE", PREDICTIONS OF POTENTIAL GROUND WATER CONTAMINATION. PREDICTED CONCENTRATIONS ARE GIVEN IN TABLE 2-3.

DIRECT CONTACT PATHWAY

OF CONCERN FOR DIRECT CONTACT ARE THOSE SOILS, SEDIMENTS AND SURFACE WATERS TO WHICH PROJECT PERSONNEL OR TRESPASSERS MAY HAVE ACCESS. FOR THE ANALYSIS, ALL SURFACE WATER, THE DITCH SEDIMENTS, AND SURFACE SOILS WERE CONSIDERED TO BE ACCESSIBLE. THE HIGHEST VALUE AND THE MEAN CONCENTRATION OF THE INDICATOR CHEMICALS IN EACH OF THE ACCESSIBLE MEDIA IS GIVEN IN TABLE 2-3.

2.2.3 COMPARISON OF EXPOSURE POINT CONCENTRATIONS TO STANDARDS AND CRITERIA

DRINKING WATER PATHWAY

THERE ARE FEW CRITERIA AND NO STANDARDS WHICH ARE RELEVANT TO AND APPLICABLE TO THE EXPOSURE PATHWAYS AT THE LIVE OAK SITE. THE AMBIENT WATER QUALITY CRITERIA (AWQC), WHICH WERE INTENDED FOR USE WITH SURFACE WATER, MAY BE USED TO PREDICT HEALTH RISK FROM DRINKING WATER. THESE CRITERIA ARE INTENDED TO MINIMIZE HEALTH RISK FROM INGESTION OF WATER AS WELL AS INGESTION OF AQUATIC SPECIES WHOSE FLESH MAY CONTAIN CONTAMINANTS PARTITIONED FROM THE WATER. BY ELIMINATING THE ALLOWANCE FOR INGESTION OF AQUATIC BIOTA, AWQC VALUES MAY BE APPLIED TO AQUIFER WATER, WHERE ONLY THE DRINKING EXPOSURE OCCURS. THE ADJUSTED AWQC, TAKEN FROM THE SUPERFUND PUBLIC HEALTH EVALUATION MANUAL (PAGES 61-64) ARE GIVEN IN TABLE 2-4.

AN AWQC FOR A LOW MOLECULAR WEIGHT PAH, ACENAPHTHENE, IS ALSO GIVEN IN TABLE 2-4. THIS IS THE ONLY NON-INDICATOR CHEMICAL DETECTED IN THE ON-SITE WELLS FOR WHICH AN AWQC EXISTS. THE AWQC FOR ACENAPHTHENE IS NOT DESIGNED FOR PROTECTION OF HEALTH (THERE IS LITTLE DATA ON THE HEALTH EFFECTS OF ACENAPHTHENE, WHICH IS WHY IT WAS NOT CHOSEN AS AN INDICATOR CHEMICAL). RATHER IT IS AN "ORGANOLEPTIC" LIMIT, INDICATING A CONCENTRATION AT WHICH WATER MIGHT BE IMPACTED RELATIVE TO TASTE OR SMELL.

THE ONLY OTHER RELEVANT VALUE IS A PROPOSED MAXIMUM CONTAMINANT LEVEL GOAL FOR PENTACHLOROPHENOL UNDER THE SAFE DRINKING WATER ACT, WHICH IS ALSO GIVEN IN TABLE 2-4.

CHEMICAL ANALYSIS OF SAMPLES FROM PRIVATE WELLS (EPA SAMPLING OF FEBRUARY, 1983) REVEALED NO INDICATOR CHEMICALS. THIS WOULD INDICATE THAT THE POTENTIAL HUMAN HEALTH IMPACT OF INDICATOR CHEMICALS EITHER ON-SITE OR OFF-SITE, VIA THE DRINKING WATER PATHWAY IS LOW. HOWEVER, THE EPA DATA IS DIFFICULT TO INTERPRET BECAUSE DETECTION LIMITS WERE NOT PROVIDED. FURTHER, THE AWQC FOR CARCINOGENIC PAH IS AN EXTREMELY SMALL CONCENTRATION AND ANALYTIC METHODS WITH DETECTION LIMITS IN THE RANGE OF THE CRITERION ARE NOT PRACTICALLY FEASIBLE. THUS, THE DETECTION LIMITS FOR CARCINOGENIC PAH REPORTED IN THE REMEDIAL INVESTIGATION ARE ABOVE THE AWQC. IT IS THEREFORE NOT POSSIBLE TO USE THE METHOD OF COMPARISON TO CRITERIA TO DETERMINE THE EXTENT OF PUBLIC HEALTH IMPACT OF CARCINOGENIC PAH USING EITHER THE EPA OR THE REMEDIAL INVESTIGATION DATA. IF IT IS ASSUMED THAT THE EPA ACHIEVED DETECTION LIMITS COMPARABLE TO THOSE REPORTED FOR ANALYSES IN THE RI FOR FLUORANTHENE, PENTACHLOROPHENOL, AND ACENAPHTHENE (20 PPB, 100 PPB, AND 20 PPB, RESPECTIVELY), NO IMPACT ON HUMAN HEALTH OR WELFARE WOULD BE EXPECTED, BASED ON THE METHOD OF COMPARISON TO CRITERIA.

IN THE REMEDIAL INVESTIGATION STUDY, FLUORANTHENE WAS ESTIMATED TO BE PRESENT IN WELL MW-8 AT A CONCENTRATION OF 2 PPB IN OCTOBER, 1986 AND 11 PPB IN JANUARY, 1987; AND PENTACHLOROPHENOL WAS NOT DETECTED (DETECTION LIMITS, 100 PPB OCTOBER, 1986). THESE CONCENTRATION VALUES ARE SUBSTANTIALLY BELOW THE AWQC LISTED IN TABLE 2-4. PROVIDED THAT THE MONITORING WELLS PROVIDE A GENERALIZED PICTURE OF GROUND WATER QUALITY AT THE BROWN WOOD TREATING SITE, NO IMPACT ON PUBLIC HEALTH IS INDICATED BY THE METHOD OF COMPARISON TO CRITERIA FOR THESE INDICATOR CHEMICALS. THE OCTOBER, 1986 SAMPLING INDICATED 45 PPB ACENAPHTHENE IS PRESENT IN MW-8. THIS DOES NOT INDICATE ANY HEALTH IMPACT, BUT DOES SUGGEST THE POSSIBILITY THAT THE ODOR OR TASTE QUALITY OF WATER COULD BE IMPACTED AT THIS "WORST-CASE" LOCATION.

DATA FROM THE GROUND WATER MODELING STUDY PREDICT HIGHER CONCENTRATIONS OF FLUORANTHENE AND PHENANTHRENE IN MW-8 THAN HAVE BEEN DETECTED. THE DIFFERENCE IN VALUES MAY BE DUE TO CONSERVATISM OF THE MODEL. THEREFORE, THE PREDICTED CONCENTRATIONS APPEAR TO BE CONSERVATIVE VALUES FOR ESTIMATING THE CURRENT IMPACT OF INDICATOR CHEMICALS POTENTIALLY LEACHING TO GROUND WATER. MODEL OUTPUT FOR TOTAL CARCINOGENIC PAH AND FLUORANTHENE AT THE 1600-FOOT WELL ARE 0.0003 AND 0.1 PPB, RESPECTIVELY (PENTACHLOROPHENOL VALUES COULD NOT BE CALCULATED). CONCENTRATIONS PREDICTED FOR ON SITE LOCATION, MW-8 ARE 0.006 PPB AND 3 PPB FOR CARCINOGENIC PAH AND FLUORANTHENE, RESPECTIVELY. THE CARCINOGENIC PAH VALUES IN EACH OF THESE LOCATIONS ARE BELOW THE CONCENTRATIONS SET IN AMBIENT WATER QUALITY CRITERIA DOCUMENTS AS VALUES WHERE CARCINOGENIC RISK WOULD BE RELATIVELY LOW. THE PREDICTED FLUORANTHENE CONCENTRATION AT THE OFF-SITE AND ON-SITE WELL LOCATIONS ARE SUBSTANTIALLY BELOW THE CRITERION. THUS, BY THE METHOD OF

COMPARISON OF MODELING RESULTS TO CRITERIA, IMPACT OF THE INDICATOR CHEMICALS FROM THE SITE APPEARS VERY LOW.

DIRECT CONTACT PATHWAY

STANDARDS OR CRITERIA FOR ALLOWABLE CONCENTRATIONS IN SOILS, SEDIMENTS, OR LAGOON WATER ARE NOT AVAILABLE. THE SIGNIFICANCE OF CONTAMINATION IN THESE MEDIA HAVE BEEN ASSESSED USING STANDARD RISK ANALYSIS PROCEDURES.

2.2.4 ESTIMATION OF CHEMICAL INTAKES

CHEMICAL INTAKES HAVE BEEN CALCULATED WITH THE AID OF EXPOSURE SCENARIOS RELEVANT TO THE PATHWAYS IDENTIFIED ABOVE. PLAUSIBLE MECHANISMS BY WHICH INTAKE MAY OCCUR HAS BEEN OUTLINED AND AN ESTIMATE OF THE MAGNITUDE OF THE INTAKE HAS BEEN CALCULATED FROM STANDARD VALUES FOR HUMAN ACTIVITIES LEADING TO THE EXPOSURE (E.G., VOLUME OF DAILY FLUID INTAKE). INTAKE VALUES HAVE BEEN CONVERTED TO UNITS OF MICROGRAMS OF INDICATOR CHEMICAL PER KILOGRAM OF BODY WEIGHT PER DAY, TO MAKE THEM COMPATIBLE WITH THE DOSE-RESPONSE RELATIONS DEVELOPED IN THE SUBSEQUENT SECTION.

DRINKING WATER PATHWAY

MOST OF THE POPULATION OF LIVE OAK CONSUMES WATER FROM WELLS IN THE FLORIDAN AQUIFER. ALTHOUGH THE GENERAL FLOW OF GROUND WATER IN THE AREA OF THE SITE IS AWAY FROM POPULATED AREAS, THE POSSIBILITY HAS BEEN CONSIDERED THAT EXPOSURE TO CONSTITUENTS COULD OCCUR IF GROUND WATER WERE CONTAMINATED BY MATERIALS FROM THE LIVE OAK SITE. TO CALCULATE THE MAGNITUDE OF EXPOSURE (IN MICROGRAMS OF CONSTITUENT PER KILOGRAM BODY WEIGHT PER DAY) ONE MULTIPLIES THE AMOUNT OF DRINKING WATER CONSUMED DAILY (ASSUMED TO BE 2 LITERS PER DAY IN ADULTS AND 1 LITER PER DAY IN CHILDREN, EPA, 1986) BY THE CONCENTRATION OF INDICATOR CHEMICALS PREDICTED AT THE EXPOSURE POINT AND CORRECTS FOR BODY WEIGHT (ASSUMED TO BE 10 KG FOR SMALL CHILDREN AND 70 KG FOR ADULTS):

WATER INGESTION, DAILY DOSE (UG/KG DAY) = (CW X WC) / BW

WHERE,

CW = CONCENTRATION OF CONSTITUENT IN WATER (UG/L)
WC = WATER CONSUMPTION (1 L/DAY FOR CHILDREN; 2L/DAY FOR ADULTS)
BW = BODY WEIGHT (10 KG FOR CHILDREN, 70 KG FOR ADULTS).

NO INDICATOR CHEMICALS HAVE BEEN DETECTED IN GROUND WATER AT THE OFF-SITE EXPOSURE POINTS. FOR THE ON-SITE LOCATION, ONLY FLUORANTHENE WAS DETECTED IN ANALYTICAL SAMPLES. THUS, ONLY MODEL PREDICTIONS FOR CARCINOGENIC PAH (AS SHOWN IN TABLE 2-3) WERE USED. IN THE CASE OF FLUORANTHENE, MODEL PREDICTIONS WERE USED FOR THE OFF-SITE LOCATION, AND BOTH ANALYTIC RESULTS AND MODEL PREDICTIONS WERE USED FOR ON-SITE ASSESSMENT. THIS IS EQUIVALENT TO ASSESSING THE HEALTH RISK NOW AND IN THE FUTURE, GIVEN THE TIME PROJECTION OF THE TRANSPORT MODEL. BECAUSE NEITHER ANALYTIC DATA NOR MODEL PREDICTION DATA WERE AVAILABLE FOR PENTACHLOROPHENOL, THE INTAKE (DAILY DOSE) EQUATION WAS APPLIED TO THE DETECTION LIMITS OF THE RI STUDY. THE VALUES REPRESENT A "WORST CASE" FOR INTAKE BECAUSE THE ACTUAL CONCENTRATIONS ARE BELOW THE DETECTION LIMIT, IF THEY ARE PRESENT AT ALL. FOR THE OFF-SITE LOCATION, THE INTAKE PREDICTION IS EVEN MORE CONSERVATIVE, BECAUSE DILUTION OF PENTACHLOROPHENOL WOULD OCCUR BETWEEN THE ENTRY POINT INTO THE AQUIFER AT THE SITE AND ULTIMATE EXPOSURE POINTS.

BOTH CHILD AND ADULT INTAKE VALUES WERE CALCULATED FOR PENTACHLOROPHENOL AND FLUORANTHENE, BECAUSE IT IS PRESUMED THAT TOXICITY COULD APPEAR AFTER A RELATIVELY SHORT PERIOD OF EXPOSURE. IN CONTRAST, THE VALUE THAT MUST BE APPLIED TO DOSE RESPONSE RELATIONS FOR CARCINOGENIC TOXICANTS IS A LIFETIME DAILY DOSE. BECAUSE MOST OF A LIFETIME IS LIVED AS AN ADULT, ONLY AN ADULT INTAKE WAS CALCULATED FOR CARCINOGENIC PAH. THE CALCULATED VALUES ARE PRESENTED IN TABLE 2-5.

DIRECT CONTACT PATHWAY

BECAUSE THE SITE IS NOT COMPLETELY SECURED, IT IS POSSIBLE THAT PEOPLE MIGHT TRESPASS AND MAKE DIRECT CONTACT WITH CONTAMINATED MEDIA ONSITE. THERE ARE TWO ASPECTS TO SUCH AN EXPOSURE. PEOPLE MIGHT EXPERIENCE A SYSTEMIC EXPOSURE AS THE RESULT OF INADVERTENT INGESTION OF MATERIALS CLINGING TO HANDS OR ARTICLES WHICH MAY BE PLACED IN THE MOUTH. CONTAMINATED SOILS AND DITCH AND LAGOON SEDIMENTS (THOSE NOT COVERED CONTINUALLY BY WATER) ARE THE MEDIA OF CONCERN FOR THIS SCENARIO. PEOPLE MIGHT ALSO EXPERIENCE A DERMAL EFFECT AS A RESULT OF CONTACT WITH CONTAMINATED MATERIALS. SOILS, SEDIMENTS AND SURFACE WATER ARE ALL OF CONCERN FOR THIS SCENARIO.

INGESTION OF MATERIALS IS NORMALLY CONSIDERED TO BE OF CONCERN FOR CHILDREN ONLY. IT HAS RECENTLY BEEN SUGGESTED THAT A CHILD BETWEEN THE AGES OF TWO AND SIX YEARS MAY BE ASSUMED TO INGEST 55 MG OF SOIL

PER DAY WHILE OUTDOORS (CLAUSIUS, ET AL. 1987). THE QUESTION FOR A RURAL SITE SUCH AS THE LIVE OAK PROPERTY IS WHETHER CHILDREN OF THIS AGE WOULD EVER REACH THE SITE AND, IF SO, HOW OFTEN. IT IS UNLIKELY THAT FREQUENT VISITS BY THIS AGE GROUP WOULD OCCUR IN THE PRESENT CONDITION OF THE SITE. FOR THE PURPOSES OF QUANTITATION, INTAKE PREDICTIONS WILL BE MADE FOR CHILDREN VISITING THE SITE ONCE MONTHLY FROM AGE TWO THROUGH SIX YEARS. THIS SEEMS CONSERVATIVE, GIVEN THE DISTANCE OF THE SITE FROM RESIDENCES. THE LIMITED ACCESS TO THE PROPERTY, AND THE FACT THAT THE SITE IS NOT ON THE ROUTE TO A SCHOOL, PLAYGROUND OR OTHER DESTINATION ATTRACTIVE TO CHILDREN. UNKNOWN FUTURE USES OF THE PROPERTY, UNLESS OTHERWISE RESTRICTED, MIGHT INCLUDE MORE FREQUENT PRESENCE OF CHILDREN. NOTICE THAT BECAUSE A LIFETIME AVERAGE DAILY DOSE IS REQUIRED FOR ASCERTAINING CHRONIC RISKS OF CARCINOGENIC PAH, AN ADJUSTMENT MUST BE MADE FOR THE PROPORTION OF A 70 YEAR LIFETIME IN WHICH EXPOSURE OCCURS. THIS CORRECTION IS NOT APPLIED FOR FLUORANTHENE OR PENTACHLOROPHENOL, WHERE TOXICITY MAY BE EXPRESSED AFTER SHORTER PERIODS OF DOSING. CHILDREN IN THIS AGE GROUP ARE ASSUMED TO HAVE AN AVERAGE BODY WEIGHT OF 17 KG (EPA, 1986). EXPRESSED MATHEMATICALLY THE INTAKE WOULD BE:

SOIL INGESTION DAILY INTAKE (UG/KG DAY) = ((CS X SC) / BW) X F X D

WHERE,

CS = CONSTITUENT CONCENTRATION IN SOIL (UG/KG)
SC = SOIL CONSUMPTION (0.000055 KG/DAY)
BW = BODY WEIGHT (17 KG)
F = FREQUENCY OF EXPOSURE (1 DAY/30 DAYS)
D = DURATION OF EXPOSURE (USED FOR CARCINOGENS ONLY, TO OBTAIN A LIFETIME AVERAGE DAILY INTAKE: 5 YEARS/70 YEARS).

THIS FORMULA HAS BEEN APPLIED TO THE MEAN SOIL CONCENTRATION DATA TO MODEL THE POTENTIAL IMPACT OF AN INDIVIDUAL TAKING A "RANDOM WALK" AROUND THE SITE AND PICKING UP CONTAMINATED MATERIALS FROM SEVERAL PLACES. THE RESULTS ARE PRESENTED IN TABLE 2-5.

A MORE PLAUSIBLE SCENARIO FOR HEALTH IMPACTS FROM DIRECT CONTACT WITH CONTAMINATED MATERIAL AT THE LIVE OAK SITE IS TOXIC EFFECTS ON THE SKIN. THIS SCENARIO IS MORE PLAUSIBLE BECAUSE IT WOULD AFFECT ADULTS AS WELL AS CHILDREN, AND CHILDREN ARE LESS LIKELY TO BE ON SITE. FURTHER, THIS IS AN ACUTE EFFECT OF THE INDICATOR CHEMICALS. THUS, IT IS NOT A FUNCTION OF FREQUENCY OF CONTACT. IT IS NOT REALLY NECESSARY TO CALCULATE AN "INTAKE" FOR THIS TYPE OF TOPICAL EFFECT. IN SECTION 2.3.4 CONCENTRATIONS OF PAH (TOTAL) AND PENTACHLOROPHENOL THAT MIGHT BE ASSOCIATED WITH DERMAL EFFECTS ARE DEVELOPED.

2.3 TOXICITY ASSESSMENT

2.3.1 CARCINOGENIC PAH

PAH ARE FORMED AS A RESULT OF ELEVATED TEMPERATURE PROCESSES SUCH AS FIRES, PETROLEUM-SYNTHETIC MECHANISMS IN THE DEEP SUBSURFACE, AND ANTHROPOGENIC ACTIVITIES SUCH AS OPERATION OF INTERNAL COMBUSTION ENGINES AND INCINERATION OR OTHER COMBUSTION OF REFUSE, FOREST, AND AGRICULTURAL PRODUCTS. THE LARGEST CONTRIBUTION OF PAH TO THE ENVIRONMENT ARE THE MAN-MADE COMBUSTION SOURCES MENTIONED ABOVE. PAH ARE NOT GENERALLY INTENTIONALLY SYNTHESIZED, BUT ARE OBTAINED BY REFINING NATURAL MATERIALS FOR USE AS FUELS, LUBRICANTS, PRESERVATIVES AND STARTING MATERIALS FOR PETROCHEMICAL MANUFACTURE.

ONLY CERTAIN PAH HAVE BEEN IDENTIFIED AS HAVING THE POTENTIAL TO CAUSE CANCER. SUCH CARCINOGENIC PAH GENERALLY TEND TO BE HIGH IN MOLECULAR WEIGHT, HAVE AT LEAST 3 AROMATIC RINGS (USUALLY MORE), HAVE LOW WATER SOLUBILITY, ARE EASILY ABSORBED BY HUMANS, AND HAVE VERY LOW ACUTE TOXICITY. PAH HAVE NOT BEEN UNEQUIVOCALLY DEMONSTRATED TO BE CARCINOGENIC IN HUMANS. HOWEVER, BY EXTRAPOLATION FROM HEALTH EFFECTS IN INDIVIDUALS WHO SMOKE, AND FROM ANIMAL DATA ON CERTAIN PAH COMPOUNDS THERE IS REASON TO BELIEVE THAT SOME PAH ARE CARCINOGENIC IN HUMANS. THE U.S. EPA "WEIGHT-OF-EVIDENCE" SYSTEM TO CLASSIFY CARCINOGEN DATA HAS BEEN DESCRIBED PREVIOUSLY (SECTION 2.1.1). THERE ARE NO A OR B-1 LEVEL CARCINOGENS AMONG THE PAH DETECTED AT THE LIVE OAK SITE. SIX PAH COMPOUNDS FOUND AT SITE HAVE EPA RATINGS OF "PROBABLE" (B-2) TO "POSSIBLE" (C) HUMAN CARCINOGENS (EPA, 1986) AND HAVE BEEN CHOSEN FOR DETAILED RISK ANALYSIS IN THE PRESENT ASSESSMENT.

IN DETERMINING ONE SET OF CRITERIA, THE AWQC, EPA (1980A) USED ANIMAL DOSE-RESPONSE DATA FOR BENZO(A)PYRENE TO ESTABLISH A CRITERION FOR ALL CARCINOGENIC PAH (SUMMED QUANTITIES). THIS APPROACH IS VERY CONSERVATIVE, BECAUSE THE CARCINOGENIC POTENCY OF BENZO(A)PYRENE IS PROBABLY GREATER THAN OTHER PAH. THE APPROACH IS ALSO AN OVERSIMPLIFICATION BECAUSE THE POTENCY OF AN INDIVIDUAL PAH MAY CHANGE ACCORDING TO THE ROUTE OF EXPOSURE AND THE PRESENCE OF OTHER COMPOUNDS IN THE EXPOSURE MIXTURE. APPLYING DOSE-RESPONSE DATA FROM BENZO(A)PYRENE TO OTHER PAH IS, NONETHELESS, THE ONLY METHOD CURRENTLY MORE AVAILABLE.

STUDIES ON CHEMICAL CARCINOGENESIS SUGGEST THAT, FOR SOME COMPOUNDS, NO THRESHOLD FOR THE EFFECT EXISTS. THAT IS, CERTAIN CARCINOGENS, EVEN IN EXTREMELY SMALL DOSES, WILL POSE SOME RISK OF CANCER. THIS ASSUMPTION IS INCORPORATED INTO THE CANCER DOSE-RESPONSE ASSESSMENT FOR PAH. NEAL AND RIGDON (1967) GAVE MICE FEED CONTAINING BETWEEN 1 AND 250 MILLIGRAMS PER KILOGRAM (PPM) BENZO(A)PYRENE AND FOUND THAT MORE TREATED ANIMALS DEVELOPED STOMACH TUMORS THAN THE CONTROL GROUP. THE INCREASED TUMOR INCIDENCE WAS DOSE DEPENDENT. AFTER ADJUSTING THE DOSES TO CORRECT FOR PRESUMED DIFFERENCES IN MOUSE VERSUS HUMAN METABOLISM, THIS DATA WAS USED BY THE EPA CARCINOGEN ASSESSMENT GROUP IN A COMPUTER PROGRAM WHICH CALCULATES THE UPPER 95 PERCENT CONFIDENCE INTERVAL ON THE SLOPE OF A DOSE RESPONSE LINE FITTED TO AN EQUATION MODELING THE ASSUMED NO THRESHOLD, MULTISTAGE MECHANISM OF CHEMICAL CARCINOGENESIS. THE VALUE, CALLED A "POTENCY SLOPE," IS 0.0115 PER MICROGRAM PER KILOGRAM BODY WEIGHT PER DAY FOR INGESTION EXPOSURES TO BENZO(A)PYRENE. THE POTENCY SLOPE INDICATED THAT AN INDIVIDUAL CONSUMING 1 MICROGRAM BENZO(A)PYRENE PER KILOGRAM BODY WEIGHT, DAILY, FOR LIFE, MIGHT HAVE A RISK OF CONTRACTING CANCER OF ABOUT 1 CHANCE IN 100 OVER THAT OF THE NON-EXPOSED INDIVIDUAL (NOTE THAT THIS IS AN UPPER BOUND ON THE ESTIMATE, THE ACTUAL RISK IS MORE LIKELY TO BE LOWER). BECAUSE THE DOSE-RESPONSE RELATION IS PRESUMED TO BE LINEAR, MULTIPLYING THE PREDICTED LIFETIME DAILY INTAKE OF CARCINOGENIC PAH BY THE POTENCY SLOPE WILL GIVE AN UPPER BOUND ESTIMATE OF EXCESS CANCER RISK FROM EXPOSURE TO CONSTITUENTS AT THE LIVE OAK SITE (BY THE ROUTES PREVIOUSLY OUTLINED).

2.3.2 FLUORANTHENE

FLUORANTHENE IS AMONG THE PAH COMPOUNDS WHICH HAS BEEN DEMONSTRATED TO LACK CARCINOGENIC ACTIVITY BOTH IN SKIN PAINTING TESTS AND BY SUBCUTANEOUS INJECTION. FLUORANTHENE HAS ALSO BEEN SHOWN TO LACK MUTAGENIC ACTIVITY IN THE AMES TEST (MUTAGENIC ACTIVITY IS OFTEN RELATED TO CARCINOGENICITY). THUS, RISK ANALYSIS FOR FLUORANTHENE WILL BE CONDUCTED ON OTHER POTENTIAL TOXICITIES.

THE ACUTE TOXICITY OF FLUORANTHENE APPEARS TO BE LOW (LD50 IN RATS 2G/KG; SMYTH, ET AL. 1962 AS QUOTED IN EPA, 1980A). THE AWQC FOR FLUORANTHENE (EPA, 1980A) WAS CALCULATED ON THE BASIS OF AN EXTREMELY LIMITED STUDY BY HOFFMAN, ET AL. (1978). IT IS QUESTIONABLE WHETHER THE DATA ARE TRULY SUFFICIENT TO ESTABLISH A CRITERION. THE DATA ARE APPLIED TO THIS RISK ANALYSIS WITH SKEPTICISM. HOFFMAN, ET AL. APPLIED 50 MICROLITERS OF A 1% SOLUTION OF FLUORANTHENE TO THE BACKS OF MICE 3 TIMES WEEKLY FOR ONE YEAR AND SAW NO MORTALITY IN THE ANIMALS (FOR UP TO 15 MONTHS). IF ONE PRESUMES THAT THE ENTIRE AMOUNT OF FLUORANTHENE WAS ABSORBED AND THAT THE AVERAGE WEIGHT OF A MOUSE IS 35 G, ONE MAY CALCULATE A "NO-EFFECT LEVEL" OF 6.12 MG/KG BODY WEIGHT. PRESUMABLY THIS TYPE OF TOXIC EFFECT HAS A THRESHOLD. THAT IS, THERE EXISTS A DOSE BELOW WHICH NO INDIVIDUAL WILL RESPOND WITH A TOXIC EFFECT. IT IS COMMON PRACTICE TO APPLY A "SAFETY FACTOR" TO AN EXPERIMENTALLY DETERMINED NO-EFFECT LEVEL TO PROVIDE REASONABLE CERTAINTY THAT A SUB-THRESHOLD FOR TOXIC EFFECTS IS OBTAINED. OFTEN THE NO EFFECT LEVEL IS DIVIDED BY 10 TO ALLOW FOR POSSIBLE DIFFERENCES IN SENSITIVITY BETWEEN MAN AND ANIMALS AND ANOTHER FACTOR OF 10 TO CORRECT FOR POSSIBLE DIFFERENCES IN SENSITIVITY AMONG HUMANS. IN THE CASE OF FLUORANTHENE, AN ADDITIONAL 10 FOLD SAFETY FACTOR WAS APPLIED BY THE EPA DUE TO THE SMALL AMOUNT OF DATA AVAILABLE IN THE STUDY. THUS, THE CORRECTED NO EFFECT LEVEL, CALLED AN "ACCEPTABLE DAILY INTAKE" (ADI) FOR FLUORANTHENE WAS DETERMINED TO BE 6.12 UG/KG DAY. EPA CALCULATIONS OF FLUORANTHENE BURDENS FROM OTHER SOURCES (.016 MG/MAN DAY FROM DIET AND .0001 MG/MAN DAY FROM THE AIR) DO NOT APPRECIABLY CHANGE THIS VALUE. THE SPHEM GIVES NO ACCEPTABLE INTAKE VALUE FOR FLUORANTHENE. THUS, THE ADI DEVELOPED IN THE AWQC WILL BE USED FOR ASSESSING RISK FROM FLUORANTHENE AT THE LIVE OAK SITE. APPLYING THE THRESHOLD CONCEPT, IF THE EXPOSURE IS BELOW THE ADI, NO RISK WOULD BE EXPECTED. IF EXPOSURE IS ABOVE THE ADI RISK MAY BE PRESENT. THIS RISK IS NOT QUANTIFIABLE, BUT IT MAY BE QUALITATIVELY STATED THAT THE GREATER THE EXCEEDANCE OF THE ADI, THE MORE LIKELY IT IS THAT A TOXIC EFFECT WILL BE SEEN.

2.3.3 PENTACHLOROPHENOL (PCP)

THE SOLE USE OF PCP IS AS AN ANTIMICROBIAL PRESERVATIVE OF WOOD PRODUCTS. PCP IS WELL ABSORBED BY THE DERMAL, INHALATION, AND INGESTION ROUTES OF EXPOSURE. ACUTE TOXIC EPISODES IN HUMANS HAVE BEEN REPORTED AFTER DERMAL AND INHALATION EXPOSURES (EPA, 1985B). THE ACUTE TOXIC EFFECTS OF SWEATING, FEVER, AND RAPID HEART RATE ARE PROBABLY RELATED TO THE ABILITY OF PCP TO INTERRUPT ENERGY METABOLISM. OTHER ACUTE TOXIC EFFECTS OF PCP ARE RELATED TO THE IRRITATIVE PROPERTIES OF THE COMPOUND AND INCLUDE REDDENING AND PAINFUL SENSATIONS OF SKIN IMMERSED IN THE COMPOUND, IRRITATION OF THE THROAT AFTER DRINKING CONTAMINATED WATER (12.5 MILLIGRAMS PER LITER), AND CONGESTION OF EYES AND NASAL PASSAGES. EFFECTS REPORTED IN HUMANS WITH POSSIBLE CHRONIC EXPOSURE TO PCP MAY INCLUDE LIVER, KIDNEY, BONE MARROW DAMAGE, AND INFECTIONS WHICH MAY BE RELATED TO POOR IMMUNE FUNCTION.

TO ESTABLISH A DOSE-RESPONSE RELATIONSHIP FOR THE SYSTEMIC EFFECTS OF PCP, THE EPA HAS RELIED ON A STUDY CONDUCTED BY SCHWETZ, ET AL. (1978), WHICH REPORTS ON CHRONIC TOXIC EFFECTS AND THE REPRODUCTIVE ABILITY OF RATS. SCHWETZ, ET AL. NOTED THAT IN THE REPRODUCTIVE STUDY WHEN ANIMALS WERE FED 0, 3 OR 30 MILLIGRAMS PER KILOGRAM BODY WEIGHT (PPM) PER DAY OF PCP PRIOR TO AND DURING THE GESTATION PERIOD, ANIMALS IN THE HIGHEST DOSE GROUP ONLY HAD A LOWER PERCENTAGE OF LIVE BIRTHS THAN CONTROLS. EACH DOSE GROUP CONTAINED 10 MALES AND 20 FEMALES. THE OFFSPRING OF THE HIGH DOSE MOTHERS WERE LOWER IN WEIGHT AND SURVIVED LESS OFTEN THAN UNTREATED ANIMALS. THIS WOULD MAKE THE LOWER DOSE (3 MILLIGRAMS PER KILOGRAM

(PPM) PER DAY) A "NO EFFECT" LEVEL.

THE TWO YEAR CHRONIC STUDY CONTAINED 5 DIFFERENT DOSE LEVELS (0, 1, 3, 10, 30 MILLIGRAMS PCP PER KILOGRAM PER DAY). EACH DOSE GROUP CONTAINED 25 SETS OF EACH SEX WITH 2 ADDITIONAL RATS PER GROUP MAINTAINED FOR TISSUE SPECIMENS USED FOR CHEMICAL ANALYSIS. THE NO-OBSERVABLE-ADVERSE-EFFECT-LEVEL (NOAEL) FOR PCP, BASED ON CHRONIC TOXICITY, WAS 10 MILLIGRAMS PER KILOGRAM PER DAY AMONG MALES AND 3 MILLIGRAMS PER KILOGRAM PER DAY AMONG FEMALES.

THE EPA HAD USED THE STANDARD PRACTICE OF APPLYING A 100 FOLD SAFETY FACTOR TO THE NOAEL DOSE TO ARRIVE AT AN ACCEPTABLE INTAKE, SUBCHRONIC (AIS) OF 0.03 MILLIGRAMS PER KILOGRAM BODY WEIGHT PER DAY. NO FURTHER UNCERTAINTY FACTORS WERE APPLIED TO THE AIS TO DERIVE THE ACCEPTABLE DAILY INTAKE, CHRONIC (AIC): IT IS ALSO 0.03 MILLIGRAMS PER KILOGRAM BODY WEIGHT PER DAY. PRESUMABLY TOXIC EFFECTS SUCH AS THOSE OBSERVED IN THE PCP EXPERIMENTS HERE HAVE A THRESHOLD. THAT IS, THERE EXISTS A DOSE BELOW WHICH NO INDIVIDUAL WILL RESPOND WITH A TOXIC EFFECT. THE PURPOSE OF THE SAFETY FACTOR (WHICH IS A FACTOR OF 10 TO ALLOW FOR POSSIBLE DIFFERENCES IN SENSITIVITY BETWEEN MAN AND ANIMALS AND ANOTHER FACTOR OF 10 TO CORRECT FOR POSSIBLE DIFFERENCES IN SENSITIVITY AMONG HUMANS) IS TO PROVIDE REASONABLE CERTAINTY THAT THE AIC WILL BE BELOW THE THRESHOLD FOR TOXIC EFFECTS. THE AIC DERIVED BY THE EPA WILL BE USED FOR THE PRESENT ASSESSMENT OF PCP IMPACT AT THE SITE. IF PREDICTED INTAKE IS BELOW THIS VALUE, NO RISK OF TOXIC EFFECT IS EXPECTED. IF INTAKE IS GREATER THAN THE AIC, A TOXIC EFFECT MAY OCCUR. THE LARGER THE INTAKE VALUE IS OVER THE AIC, THE GREATER LIKELIHOOD OF A TOXIC EFFECT.

2.3.4 NONCARCINOGENIC DERMAL TOXICITY OF INDICATOR CHEMICALS

THE VALUES PRESENTED ABOVE ARE DERIVED FROM STUDIES OF THE SYSTEMIC TOXICITY OF INDICATOR CHEMICALS. AS HAS BEEN SUGGESTED IN PREVIOUS SECTIONS OF THIS REPORT, IT IS POSSIBLE THAT THE MOST LIKELY EXPOSURE FOR PERSONS ON SITE AT THE LIVE OAK SITE MAY BE BRIEF DERMAL CONTACT WITH CONTAMINATED SOILS. SUCH AN EXPOSURE MIGHT NOT RESULT IN SIGNIFICANT SYSTEMIC ABSORPTION OF COMPOUNDS OR MIGHT NOT BE OF SUFFICIENT FREQUENCY FOR A CHRONIC SYSTEMIC EFFECT TO OCCUR. HOWEVER, IT COULD RESULT IN DERMAL IRRITATION OR OTHER EFFECTS. SOME SUGGESTED CONCENTRATION VALUES, THAT MAY RESULT IN THESE EFFECTS, ARE DERIVED FROM THE DATA PRESENTED BELOW.

CREOSOTE CONSTITUENTS

A NUMBER OF PAPERS HAVE NOTED THAT VARIOUS PAH COMPOUNDS, WHEN APPLIED TO HUMAN SKIN, WILL PRODUCE AN ENHANCED SUNBURN REACTION ON EXPOSURE TO ULTRAVIOLET LIGHT. THE PHOTOTOXICITY EFFECT IS USUALLY REVERSIBLE, BUT COULD CAUSE TRANSIENT PROBLEMS FOR WORKERS OR TRESPASSERS AT THE SITE. IN 1980, AN EXCHANGE OF CORRESPONDENCE BETWEEN URBANEK AND WALTER IN THE JOURNAL OF THE AMERICAN ACADEMY OF DERMATOLOGY INDICATED THAT 0.25 PERCENT ANTHRACENE DISSOLVED IN PETROLEUM DID NOT PRODUCE PHOTOTOXICITY BUT DID CAUSE A STINGING SENSATION AND TRANSIENT HIVE-LIKE REACTION IN A SMALL NUMBER OF PATIENTS WHILE 0.1 PERCENT SOLUTION WAS WITHOUT ANY TOXIC EFFECT. FOR THE PURPOSE OF THE CURRENT ASSESSMENT, 0.1 PERCENT (1,000 PPM) WILL BE CONSIDERED A NO-EFFECT LEVEL FOR ALL PAH. THIS VALUE MAY BE OVERLY CONSERVATIVE IN THAT THE AVAILABILITY OF PAH ADSORBED TO SOIL PARTICLES MAY NOT BE AS GREAT AS THAT IN A HOMOGENEOUS SOLUTION IN MEDICINAL PREPARATIONS. THE VALUE MAY BE A POOR ESTIMATE TOXICITY IN THAT PAH OTHER THAN ANTHRACENE ARE PRESENT IN SOIL AT THE LIVE OAK SITE. THE OTHER PAH HAVE NOT BEEN STUDIED, BUT MAY BE MORE OR LESS PHOTOREACTIVE THAN ANTHRACENE ALONE. IT IS NOTABLE, HOWEVER, THAT A 1 PERCENT (10,000 PPM) COAL TAR SOLUTION WAS ONLY MINIMALLY EFFECTIVE IN PRODUCING A PHOTOTOXIC REACTION (TANNENBAUM, 1975). THIS PREPARATION WOULD BE EXPECTED TO CONTAIN A VARIETY OF PAH COMPOUNDS.

PENTACHLOROPHENOL

DEICHMAN, ET AL (1942) REPORTED ON THE EFFECTS OF PCP ADMINISTERED DERMALLY IN ANIMALS. IN THIS STUDY, APPLICATION OF 10 ML OF 1 PERCENT PCP IN MINERAL OIL (10,000 PPM) FOR 4 HOURS WAS WITHOUT LOCAL DERMAL EFFECT IN 21 DAYS OF DOSING. SOLUTIONS OF 5-10 PERCENT GAVE POSITIVE OR NEGATIVE DERMAL RESULTS DEPENDING ON THE VOLUME OF MATERIAL APPLIED AND THE VEHICLE IN WHICH THE PCP WAS DISSOLVED. USING A 10 FOLD SAFETY FACTOR FOR ANIMAL TO HUMAN EXTRAPOLATION ON THE 10,000 MILLIGRAMS PER KILOGRAM (PPM) NO EFFECT LEVEL FOR DERMAL IRRITATION WOULD INDICATE AN ACCEPTABLE CONCENTRATION FOR PROTECTION FROM THIS EFFECT WOULD BE 1,000 MILLIGRAMS PER KILOGRAM (PPM). THIS VALUE MAY BE OVERLY CONSERVATIVE IN THAT THE AVAILABILITY OF PCP ADSORBED TO A SOIL OR SLUDGE PARTICLE MAY NOT BE AS GREAT AS THAT IN A HOMOGENEOUS SOLUTION IN ORGANIC SOLVENTS.

2.4 RISK CHARACTERIZATION

TABLE 2-6 PRESENTS NUMERICAL ESTIMATES OF CARCINOGENIC RISK AND OTHER TOXIC EFFECTS FOR THE SCENARIOS DEVELOPED IN THIS REPORT.

IT IS NOT POSSIBLE TO CALCULATE A DRINKING WATER CANCER RISK FROM ACTUAL DATA BECAUSE OF THE LACK OF DETECTION LIMIT INFORMATION FOR THE SAMPLING ROUND ON PRIVATE WELLS. THE MODELING EFFORT FOR THE POTENTIAL FUTURE CONDITION OF THE AQUIFER IF NO ACTION IS TAKEN AT THE SITE INDICATES THAT A CANCER RISK OF SLIGHTLY LESS THAN 1 CHANCE IN 10,000,000 COULD BE INCURRED BY DRINKING WATER FROM THE AQUIFER IF LEACHING OCCURS. FOR THE ONSITE WATER LOCATION, THE RISK IS APPROXIMATELY 2 CHANCES IN 1,000,000. IT SHOULD BE POINTED OUT THAT THIS RISK ESTIMATE IS AN UPPER BOUND FOR THE FOLLOWING REASONS:

- THE POTENCY SLOPE VALUE USED TO ESTIMATE RISK IS THE 95% UPPER CONFIDENCE BOUND ON THE DOSE RESPONSE RELATION. THUS, THE ACTUAL RISK IS LIKELY TO BE LOWER.

- THE CONCENTRATIONS ARE PREDICTED FOR THE CLOSEST EXISTING OFF SITE WELL AND A MONITORING WELL EXTREMELY CLOSE TO A POTENTIAL SOURCE OF CONTAMINATION.

CANCER RISKS FROM DIRECT CONTACT (INGESTION) WITH CONTAMINATED SOILS ONSITE ARE GREATER IN MAGNITUDE THAN THE DRINKING WATER SCENARIO AT SLIGHTLY LESS THAN 1 CHANCE IN 10,000, BUT ALSO LESS LIKELY TO OCCUR. THE LOCATION AND CHARACTERISTICS OF THE SITE PRECLUDE REGULAR VISITS BY SMALL CHILDREN. ALTHOUGH THIS SCENARIO DOES NOT REPRESENT A PROBABLE SITUATION FOR EVALUATING THE CURRENT IMPACT OF THE SITE, IT SHOULD BE CONSIDERED WHEN PLANNING FUTURE USES OF THE PROPERTY.

NO EXPOSURE SCENARIO REVEALED A HEALTH IMPACT FROM FLUORANTHENE. ALL PREDICTED INTAKES WERE LESS THAN THE ADI, INDICATING VIRTUALLY NO RISK OF A TOXIC EFFECT FROM THIS COMPOUND.

GROUND WATER ANALYSIS INDICATED PENTACHLOROPHENOL WAS UNDETECTABLE AT A LIMIT OF ABOUT 100 PPB. EVEN IF PENTACHLOROPHENOL WERE PRESENT AT THE LEVEL OF DETECTION, NO HEALTH RISK WOULD BE EXPECTED AS INGESTION OF THIS LEVEL PENTACHLOROPHENOL WOULD PROVIDE A DOSE THAT IS STILL BELOW THE ACCEPTABLE DAILY INTAKE.

A POSSIBLE RISK NOT QUANTIFIED IN THE TABLES IS THE POTENTIAL FOR DERMAL EFFECTS FROM DIRECT CONTACT WITH SURFACE MATERIALS ON SITE. AS WITH OTHER SCENARIOS, IT IS DIFFICULT TO QUANTIFY THE LIKELIHOOD THAT AN INDIVIDUAL WOULD BE ON SITE AND MAKE CONTACT WITH CONTAMINATED SOILS, SEDIMENTS OR SURFACE WATER. HOWEVER, BECAUSE DERMAL TOXICITY IS AN ACUTE EFFECT, REQUIRING ONLY A SINGLE VISIT TO THE SITE, ONE WOULD INTUITIVELY RATE THIS AS A MORE LIKELY SCENARIO THAN THOSE WHICH REQUIRE REGULAR PRESENCE ON THE PROPERTY. IN THE TOXICITY ASSESSMENT SECTION IT WAS CONSERVATIVELY ESTIMATED THAT 1,000 PPM OF TOTAL PAH COULD CAUSE PHOTOSENSITIZATION AND 1,000 PPM PENTACHLOROPHENOL MIGHT CAUSE DERMAL IRRITATION. THERE ARE SURFACE SEDIMENT AND SOIL LOCATIONS WHERE THESE VALUES ARE EXCEEDED. HOWEVER, SURFACE WATER CONCENTRATIONS ARE SUBSTANTIALLY BELOW THIS CONCENTRATION. THUS, DERMAL EFFECTS FROM CONTACT WITH SOLID MEDIA SEEM PLAUSIBLE, BUT SURFACE WATER DOES NOT PRESENT THIS HAZARD.

3. DEVELOPMENT OF PERFORMANCE GOALS

IN COMPLIANCE WITH THE SUPERFUND PUBLIC HEALTH EVALUATION MANUAL GUIDANCE ON SOURCE CONTROL REMEDIAL ALTERNATIVES, AN ANALYSIS DETERMINING "ACCEPTABLE" RESIDUAL LEVELS OF CHEMICALS IS PRESENTED HERE.

NO EVALUATION OF FLUORANTHENE AND PENTACHLOROPHENOL WERE DONE AS THE BASELINE ASSESSMENT INDICATED NO PRESENT OR FUTURE HEALTH IMPACTS OF THE COMPOUNDS. THE LOW LEVEL OF CARCINOGENIC RISK FOR THE DRINKING WATER SCENARIO ALSO PRECLUDED THE NECESSITY OF PERFORMANCE GOALS BASED ON THIS LIMITED HEALTH IMPACT.

IT WAS DETERMINED IN CHAPTER 2 THAT THE MOST LIKELY HEALTH RISK OF THE LIVE OAK SITE WAS THE POTENTIAL FOR NON-CARCINOGENIC, ACUTE DERMAL EFFECTS PRODUCED BY DIRECT CONTACT WITH PAH AND PCP IN SURFACE SOILS AND SEDIMENTS. THUS, A CONCENTRATION LIMIT SHOULD BE PUT ON PAH AND PCP IN SOILS WITH WHICH PEOPLE MIGHT MAKE DIRECT CONTACT. TOTAL PAH SHOULD NOT EXCEED 1000 PPM IN SURFACE SOILS IN ORDER TO AVOID POSSIBLE PHOTOTOXIC REACTIONS. PENTACHLOROPHENOL SHOULD NOT EXCEED 1000 PPM TO AVOID DERMAL IRRITATION. AS DETAILED IN THE FEASIBILITY STUDY REPORT, THE PREFERRED REMEDIAL ALTERNATIVE HAS BEEN DESIGNED TO MEET THIS PERFORMANCE GOAL. ALL MATERIALS IN THE LAGOON, DITCH, AND SOIL CONTAINING CONCENTRATIONS IN EXCESS OF 1000 PPM PAH OR PCP WILL BE REMOVED.

A CALCULATION MAY ALSO BE MADE FOR THE RISK REDUCTION ACHIEVED BY THE PREFERRED ALTERNATIVE FOR THE SOIL INGESTION SCENARIO, ALTHOUGH IT IS A LESS LIKELY EXPOSURE, GIVEN THE CURRENT USE OF THE SITE. IN SECTION 2.4, THE CANCER RISK ASSOCIATED WITH THE MEAN CONCENTRATION OF SURFACE SOIL AT THE SITE WAS ESTIMATED FOR A SCENARIO IN WHICH CHILDREN INGESTED SOIL AT THE SITE ONCE A MONTH FOR 5 YEARS. BECAUSE THE RISK ESTIMATE WAS RELATED TO SOIL CONCENTRATION IN A LINEAR MANNER, THE RISK REDUCTION ASSOCIATED WITH THE DECREASED AVERAGE SOIL CONCENTRATION AT THE SITE MAY BE EASILY CALCULATED USING THE EQUATION DEVELOPED ON PAGE 2-22 AND THE POTENCY SLOPE (0.0115/MG/KG DAY). IF ONE REMEDIATED SOIL CONTAINING GREATER THAN 1000 PPM CREOSOTE SUBSTANCES IN ORDER TO LIMIT THE RISK OF TRANSIENT DERMAL EFFECTS, THE AVERAGE ACROSS THE SITE OF CARCINOGENIC PAH CONCENTRATIONS REMAINING IN THE SOIL WOULD BE APPROXIMATELY

14 PPM. THIS VALUE WAS CALCULATED BY SUBSTITUTING THE CONCENTRATION OF CARCINOGENIC PAH IN THE NEXT STRATA SAMPLED (IF AVAILABLE) FOR EACH SAMPLING POINT WHERE VALUES OF PAH OR PCP WERE IN EXCESS OF 1000 PPM. THE CALCULATIONS ARE PRESENTED IN APPENDIX B.

AS SHOWN IN TABLE 3-1, 14 PPM OF CARCINOGENIC PAH WOULD BE ASSOCIATED WITH A SUBSTANTIALLY REDUCED CANCER RISK DUE TO INGESTION OF SOIL; 1.2 CHANCES IN 1,000,000.

4. SHORT-TERM RISKS OF REMEDIAL ALTERNATIVES

OTHER THAN THE NO ACTION ALTERNATIVE, THE REMEDIAL ACTIONS CHOSEN FOR SCREENING FOR THE LIVE OAK SITE ARE SOURCE CONTROL MEASURES. THE ALTERNATIVES ARE OFF-SITE DISPOSAL, OFF-SITE INCINERATION, ON-SITE INCINERATION, SOLVENT WASHING TECHNIQUES, AND COMBINATIONS OF THESE TECHNIQUES. SHORT-TERM HEALTH RISKS FROM THESE ACTIVITIES ARE DISCUSSED IN A QUALITATIVE MANNER BELOW.

4.1 DERMAL TOXICITY

THE POSSIBILITY THAT INDIVIDUALS MIGHT MAKE CONTACT WITH MATERIALS AT THE SITE HAS BEEN COVERED IN THE BASELINE ASSESSMENT. IT WAS STATED THAT SITE ACCESS WAS DIFFICULT AND IT WAS UNLIKELY THAT INDIVIDUALS WOULD BE PRESENT AT THE SITE WITH ANY FREQUENCY. WHEN REMEDIAL MEASURES ARE IMPLEMENTED, THE NUMBER AND FREQUENCY OF PERSONNEL ON THE SITE WILL INCREASE. THIS MAY INCREASE THE SHORT-TERM RISK DUE TO DIRECT CONTACT WITH CONTAMINATED MATERIALS. HOWEVER, IT SHOULD BE RECOGNIZED THAT AN APPROVED HEALTH AND SAFETY PLAN WILL BE IMPLEMENTED. THAT PLAN WILL PROVIDE FOR MINIMIZING PROLONGED CONTACT WITH MEDIA CONTAINING MORE THAN 1000 PPM PENTACHLOROPHENOL OR 1000 PPM CREOSOTE SUBSTANCES AND FREQUENT CLEANSING OF UNPROTECTED SKIN.

4.2 TRANSPORTATION RISKS

OFF-SITE REMEDIAL ACTIVITIES INVOLVING TRANSPORTATION (E.G., OFF-SITE DISPOSAL, OFF-SITE INCINERATION, TRANSPORTATION OF RECOVERED MATERIAL) MAY BE ASSOCIATED WITH VEHICULAR ACCIDENTS. IF VEHICLES INVOLVED IN THE REMEDIAL ACTION ARE SUBJECT TO THE SAME RISKS AS FLORIDA MOTORISTS IN GENERAL, STATISTICS WOULD INDICATE THAT 3.3 TRAFFIC DEATHS WILL OCCUR FOR EVERY 100,000,000 MILES DRIVEN (LAND, ET AL., 1985). THE MILEAGE ESTIMATED FROM REMEDIAL ACTIONS (MAXIMUM, ABOUT 350,000 MILES) WOULD BE ASSOCIATED WITH A POPULATION RISK OF ACCIDENTAL DEATH OF ABOUT 1 CHANCE IN 100 (N.B. THIS IS A POPULATION RISK WHICH CANNOT BE COMPARED TO THE INDIVIDUAL RISKS DERIVED FOR CARCINOGENS PREVIOUSLY - IF A COMPARISON IS PERTINENT, THE TRANSPORTATION RISK WOULD BE ROUGHLY EQUIVALENT TO THE POPULATION CANCER RISK OF THE CITY OF LIVE OAK (6700 RESIDENTS) IF THE AVERAGE INDIVIDUAL RISK WAS 2 IN 1,000,000).

A SECOND ASPECT OF VEHICLE ACCIDENT RISK IS THE HUMAN HEALTH IMPACT OF DISPERSION OF CONTAMINATED MATERIALS. A CONTINGENCY PLAN WILL ADDRESS THIS POSSIBILITY IF OFF-SITE REMEDIAL ACTIONS ARE CHOSEN.

4.3 AIR EMISSIONS

IF INCINERATION ALTERNATIVES ARE CHOSEN, THERE IS A POSSIBILITY THAT EMISSIONS FROM THIS TECHNOLOGY COULD HAVE A HEALTH IMPACT. ADEQUATE REMEDIATION DESIGN IS REQUIRED TO MINIMIZE THIS RISK.

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MEMO TO: DISTRIBUTION
FROM: J. RYAN
DATE: FEBRUARY 17, 1988

RE: ACTION LEVELS FOR THE LIVE OAK SITE

INTRODUCTION

THIS MEMORANDUM DISCUSSES ACTION LEVELS FOR FINAL REMEDIATION OF THE LIVE OAK SITE. THE DOCUMENT HAS BEEN PREPARED BASED ON DISCUSSIONS WITH EPA AND FDER PERSONNEL AND ADDITIONAL WORK ON THE RISK ASSESSMENT REPORT FOR THE SITE. INCLUDED IN THIS EVALUATION ARE CONSIDERATIONS RELATED TO: (A) THE EXISTING SITE CONDITIONS FOLLOWING THE INTERIM ACTION AND (B) THE PROPOSED BIOLOGICAL TREATMENT OF THE CONTAMINATED SOILS REMAINING AFTER THE INTERIM REMOVAL ACTION.

IN PREPARING THE ACTION LEVELS THE FOLLOWING ITEMS WERE EVALUATED:

- CRITERIA FOR SOIL CONCENTRATIONS OF CARCINOGENIC PAH,
- BACKGROUND CONCENTRATIONS OF CARCINOGENIC PAH,
- THE PROPOSED REMEDY,
- LEACHATE CONCENTRATIONS ASSOCIATED WITH RESIDUALS,
- AVERAGE SITE CONCENTRATIONS OF CARCINOGENIC PAH,
- THE FUTURE DEVELOPMENT OF THE SITE,
- APPROPRIATE RISK LEVELS,
- EXTENT AND COST EFFECTIVENESS OF REMOVAL, AND
- THE RISK ASSOCIATED WITH INGESTION OF SURFICIAL CONTAMINATED SOILS.

SOIL CRITERIA

ALTHOUGH NO STANDARDS HAVE BEEN SET FOR CLEAN UP LEVELS ASSOCIATED WITH PAH CONTAMINATED SOIL, VARIOUS GUIDELINES AND SITE SPECIFIC ACTIONS CAN BE USED TO PROVIDE A PERSPECTIVE ON SOIL ACTION LEVELS. THE MOST SIGNIFICANT STUDY IS BY THE CENTER FOR DISEASE CONTROL IN ATLANTA WHICH BUILDS ON PREVIOUS WORK COMPLETED WITH DIOXINS.

THE CENTERS FOR DISEASE CONTROL'S AGENCY OF TOXIC SUBSTANCES DISEASE REGISTRY (ATSDR) HAS EVALUATED THE CARCINOGENIC STATUS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH) RELATIVE TO 2,3,7,8 TETRACHLORODIBENZO-P-DIOXIN, AN EXTREMELY POTENT ANIMAL CARCINOGEN (3). ATSDR HAS SUGGESTED 100 PPM FOR PAH IN SOIL AS A SAFE LEVEL.

AS STATED BY DR. STEPHEN MARGOLIS OF THE ATSDR:

> "IN A PUBLISHED ARTICLE (4), THE CENTERS FOR DISEASE CONTROL (CDC) DERIVED AN ACTION LEVEL AT WHICH TO LIMIT HUMAN EXPOSURE FOR 2,3,7,8-TETRACHLORO-DIBENZO-P-DIOXIN (2,3,7,8-TCDD), CONTAMINATED RESIDENTIAL SOIL. THIS DERIVED VALUE WAS BASED UPON EXTRAPOLATIONS FROM ANIMAL TOXICITY EXPERIMENTS (INCLUDING CARCINOGENICITY AND REPRODUCTIVE EFFECTS) TO POSSIBLE HUMAN HEALTH EFFECTS IN ORDER TO ESTIMATE A REASONABLE LEVEL OF RISK FOR 2,3,7,8-TCDD. A 10-6 EXCESS LIFETIME RISK WAS USED IN THE DEVELOPMENT OF THIS TCDD SOIL LEVEL.
>
> THE ENVIRONMENTAL PROTECTION AGENCY'S CARCINOGEN ASSESSMENT GROUP HAS DERIVED A RELATIVE POTENCY INDEX FOR MORE THAN 50 CHEMICALS (5). THE ORDER OF MAGNITUDE POTENCY INDEX FOR 2,3,7,8-TCDD IS EIGHT, WHILE THAT FOR BENZO(A)PYRENE IS ONLY THREE. THUS, 2,3,7,8-TCDD IS CONSIDERED TO BE FIVE ORDERS OF MAGNITUDE MORE POTENT AS A CARCINOGEN THAN BENZO(A)PYRENE. USING ONLY THIS ORDER OF MAGNITUDE DIFFERENCE IN POTENCY BETWEEN THE TWO CHEMICALS AND THE CDC-DERIVED RESIDENTIAL SOIL ACTION LEVEL, GIVES 100,000 PPB OF BENZO(A)PYRENE EQUIVALENT TO 1 PPB OF 2,3,7,8-TCDD IN SOIL.".

THIS COMPARISON USED BENZO(A)PYRENE AS THE REPRESENTATIVE PAH. IT MUST BE RECALLED THAT BENZO(A)PYRENE IS THE MOST POTENT OF ALL PAH COMPOUNDS STUDIED. THEREFORE, THIS MODEL IS CONSIDERED TO BE A CONSERVATIVE MODEL WHEN APPLIED TO THE OTHER SUSPECTED CARCINOGENS.

AN ADDITIONAL MEASURE OF CONSERVATISM IS ADDED TO THE ATSDR MODEL BY OVERESTIMATING THE INGESTION OF CONTAMINATED SOIL. AGAIN, AS STATED BY DR. MARGOLIS,

> "IN THE MODEL USED TO DERIVE THE 2,3,7,8-TCDD SOIL VALUE, THE ASSUMPTION CONCERNING THE AMOUNT OF SOIL INGESTED HAS BEEN SHOWN TO BE HIGH. A RECENT PUBLISHED STUDY BY CDC HAS SHOWN THE AMOUNT OF SOIL INGESTED BY CHILDREN OF THE SOIL-EATING AGE RANGES FROM 0.1 TO 1 GRAM PER DAY (S. BINDER PERSONNEL COMMUNICATION). THUS, THE MODEL ESTIMATE FOR SOIL INGESTION DURING THE PERIOD OF MINIMUM HYGIENE IS EXCESSIVE BY AT LEAST AN ORDER OF MAGNITUDE. SINCE THE OTHER SOIL INGESTION RATES IN THE MODEL ARE ALSO ESTIMATES, THERE IS A GOOD LIKELIHOOD THAT THEY ARE ALSO IN ERROR, POSSIBLY BY MORE THAN AN ORDER OF MAGNITUDE. THUS, THE MODEL VERY LIKELY OVERESTIMATES THE TOTAL LIFETIME SOIL INGESTION EXPOSURE BY AT LEAST ONE ORDER OF MAGNITUDE.".

BECAUSE OF THE CONSERVATIVE NATURE OF THE RECOMMENDED CDC ACTION LEVELS, USEPA REGION VI AND REGION VII HAVE USED THE 100 PPM AS ACTION LEVELS FOR CARCINOGENS AT PAH CONTAMINATED SITES.

BACKGROUND CONCENTRATIONS

THE REMEDIAL INVESTIGATION INCLUDED SAMPLING OF BACKGROUND AREAS WHERE PAH COMPOUNDS MAY HAVE BEEN USED OR OCCUR NATURALLY. ONE AREA WAS A SWAMP AND THE OTHER WAS ABANDONED RAILROAD TRACKS. CONCENTRATIONS OF CARCINOGENIC PAH AT THE ABANDONED RAILROAD TRACKS WERE IN EXCESS OF 16 PPM AND IN THE SWAMP WERE 0.8 PPM.

PROPOSED REMEDY

THE PROPOSED REMEDY IS DESCRIBED IN THE ATTACHED MEMORANDUM ENTITLED "CONCEPTUAL PLAN FOR FINAL SITE REMEDIATION". THE REMEDY INVOLVES: (A) PLANT DEMOLITION, (B) REMOVAL AND OFF SITE DISPOSAL OF HARDENED CREOSOTE SLUDGES FROM THE PLANT AREA, (C) EXCAVATION OF CONTAMINATED SOILS FROM THE PLANT AREA, (D) BIOLOGICAL TREATMENT OF CONTAMINATED SOILS WITHIN OR ADJACENT TO THE FORMER LAGOON AND (E) SITE SECURITY AND MONITORING.

IT SHOULD BE NOTED THAT THE MAJORITY OF SITE CONTAMINATION HAS BEEN REMOVED AS PART OF THE INTERIM REMOVAL ACTION. OVER 15,000 TONS OF SLUDGES AND CONTAMINATED SOILS WERE REMOVED FROM THE LAGOON. (SEE MEMO ON INTERIM REMOVAL ACTION.). AN ADDITIONAL 1500 TONS OF HARDENED CREOSOTE WILL BE REMOVED FROM THE PLANT SITE AND DISPOSED AT CWM'S FACILITY IN EMELLE, ALABAMA, AS PART OF THE PROPOSED REMEDY. AN ESTIMATED 10,000 TONS OF SOIL CONTAINING GREATER THAN 1000 PPM TOTAL CREOSOTE SUBSTANCES WILL BE TREATED ON-SITE BIOLOGICALLY. THE TREATMENT GOAL FOR THESE SOILS IS 100 PPM CARCINOGENIC PAH. BASED ON MODELING AND EXPERIENCE WITH BIOLOGICAL TREATMENT OF SIMILAR MATERIALS IT IS ESTIMATED THAT THE TREATMENT PROCESS WILL TAKE LESS THAN TWO YEARS.

THE COST EFFECTIVENESS OF THE PROPOSED PLAN CAN BE CONTRASTED TO THE COST EFFECTIVENESS OF REMOVING SOILS CONTAINING LESS THAN 100 PPM CARCINOGENIC PAH BY COMPARING THE OVERALL MASS OF TCS REMOVED (OR TREATED). APPROXIMATELY 6,000 TONS OF SLUDGE AND 9000 TONS OF HIGHLY CONTAMINATED SOIL WERE REMOVED AS PART OF THE INTERIM REMOVAL. IT IS ESTIMATED THAT ANOTHER 1500 TONS OF HARDENED CREOSOTE WILL BE REMOVED FROM THE PLANT AREA AND DISPOSED OF AT EMELLE AND 10,000 TONS OF MODERATELY CONTAMINATED SOIL WILL BE TREATED AS PART OF THE FINAL REMEDIAL ACTION. THE SLUDGE AND HARDENED CREOSOTE ARE ESTIMATED TO HAVE AN AVERAGE CONCENTRATION IN EXCESS OF 100,000 PPM TOTAL CREOSOTE SUBSTANCES (TCS). THE HIGHLY CONTAMINATED SOIL IS ESTIMATED TO BE IN EXCESS OF 10,000 PPM TCS AND THE MODERATELY CONTAMINATED SOIL IS ESTIMATED TO HAVE TCS CONCENTRATIONS RANGING FROM 1000 TO 5,000 PPM TCS.

SURFICIAL SOIL WHICH IS GREATER THAN 100 PPM TCS AND LESS THAN 1000 PPM TCS WAS NOT IDENTIFIED IN THE R.I. SURFICIAL SOIL WHICH EXCEEDS 10 PPM TCS AND IS LESS THAN 100 PPM TCS IS ESTIMATED AT APPROXIMATELY 7500 TONS. SURFICIAL SOIL WHICH EXCEEDS ONE PPM TCS BUT IS LESS THAN 1,000 PPM TCS IS ESTIMATED AT 31,750 TONS.

TABLE 1 COMPARES THE MASS OF TCS WHICH WILL HAVE BEEN REMOVED AND THE MASS OF TCS WHICH WILL BE TREATED TO THE MASS PRESENT IN THE SURFICIAL SOIL WHICH IS IN EXCESS OF ONE PPM IN THE SURFICIAL SOILS. THE COST OF REMOVING OR TREATING THESE MATERIALS IS EXPRESSED ON THE BASIS OF $/POUND OF TCS. IT CAN BE SEEN THAT THE INCREMENTAL COST OF REMOVING THE SURFICIAL SOILS IS TWO ORDERS OF MAGNITUDE GREATER DESPITE THE FACT THAT THESE MATERIALS REPRESENT LESS THAN 0.03 PERCENT OF THE TOTAL CREOSOTE SUBSTANCES.

LEACHATE MIGRATION

THIS PATHWAY WAS EVALUATED IN DETAIL IN THE EXISTING RISK ASSESSMENT REPORT AND WAS CONCLUDED TO REPRESENT AN ACCEPTABLE RISK UNDER THE EXISTING CONDITIONS IN THE LAGOON. THIS PATHWAY IS REVISITED, HOWEVER, TO EVALUATE THE IMPACT OF THE TREATMENT DRAINAGE RETURNING TO THE POND. THE RITZE MODEL WAS USED TO EVALUATE THE CONCENTRATIONS OF CARCINOGENIC PAH IN THE SOIL PORE WATER WHICH WOULD BE RECYCLED THROUGH THE TREATMENT POND. THE MODELING RESULTS INDICATE THAT THIS WATER SHOULD BE BELOW DETECTION LIMITS OF ONE PPB FOR INDIVIDUAL PAH COMPOUNDS.

THESE RESULTS ARE REASONABLE IN LIGHT OF REPORTED SEDIMENT/WATER PARTITION COEFFICIENTS FOR THESE COMPOUNDS. TABLES 2A AND 2B PRESENT THE RANGE OF THESE PARTITION COEFFICIENTS. IN GENERAL, LOG KOC RANGE FROM 5.29 TO 7.34. THE ACTUAL WATER CONCENTRATION WILL BE A FUNCTION OF THE SOIL ORGANIC CARBON CONTENT AND THE CONCENTRATION OF THE INDIVIDUAL COMPOUND. USING AN ORGANIC CARBON CONTENT OF 0.5 TO ONE PERCENT AND AN INITIAL CONCENTRATION OF 20 PPM, THE ESTIMATED WATER CONCENTRATION WOULD RANGE FROM 21 TO LT 0.5 PPB.

THESE RESULTS HAVE ALSO BEEN SHOWN IN TCLP TESTING OF THE CONTAMINATED SOIL AND SLUDGES. THESE RESULTS ARE SHOWN ON TABLE 3 AND ARE EXPRESSED AS THE TOTAL CONCENTRATION AND THE TCLP (WATER SOLUBLE) EXTRACT.

AVERAGE SITE CONCENTRATIONS

THE EXPOSURE ASSESSMENTS RELATED TO SOIL INGESTION CONSIDER A LONG TERM SITE EXPOSURE RATHER THAN A SHORT TERM EXPOSURE RELATED TO A SPECIFIC AREA ON THE SITE. ANY DEVELOPMENT OF THE SITE FOR EITHER INDUSTRIAL OR RESIDENTIAL PURPOSES WOULD REQUIRE EXTENSIVE EARTHWORK. IT IS APPROPRIATE, THEREFORE, TO CONSIDER A COMPOSITE SITE CONCENTRATION OF CARCINOGENIC PAH. THIS COMPOSITE IS BASED ON AN AVERAGE CONCENTRATION ACROSS THE SITE TO A DEPTH OF TWO FEET.

THE AVERAGE CONCENTRATIONS HAVE BEEN CALCULATED BASED ON THE CONDITIONS WHICH WILL EXIST AFTER THE CONTAMINATED SOIL FROM THE PLANT AREA HAVE BEEN REMOVED AND ASSUMES THE RESIDUALS IN THE FORMER LAGOON HAVE BEEN TREATED TO A LEVEL LESS THAN 100 PPM CARCINOGENIC PAH.

FIGURE 1 SHOWS THE AREAS USED IN THESE CALCULATIONS. THE FORMER WOOD STORAGE AREA IS APPROXIMATELY 520,000 SQUARE FEET IN SIZE. THE PLANT AREA IS APPROXIMATELY 240,000 SQUARE FEET IN SIZE AND THE FORMER LAGOON AREA (AND FUTURE TREATMENT AREA) IS APPROXIMATELY 240,000 SQUARE FEET IN SIZE. THE OVERALL SITE AREA IS ABOUT 2,100,000 SQUARE FEET IN SIZE.

AVERAGE CONCENTRATIONS OVER THE PLANT AREA AND THE WOOD STORAGE AREA WERE CALCULATED USING EXISTING SURFICIAL DATA (0-12 INCHES) EXCLUDING HIGHLY CONTAMINATED SAMPLES FROM THE PLANT AREA WHICH WILL BE REMOVED AS PART OF THE FINAL REMEDIAL ACTION. CONCENTRATIONS FROM 12 TO 24 INCHES WERE ESTIMATED USING 50 PERCENT OF THE CONCENTRATION FROM SIX TO 12 INCHES. IF THE CONCENTRATION MEASURED AT SIX TO 12 INCHES WAS LESS THAN 1.3 PPM THEN THE CONCENTRATION AT 12 TO 24 INCHES WAS ASSUMED TO BE BDL. FIGURE 1 SHOWS THE LOCATION OF THE SAMPLING POINTS AND TABLE 4 PRESENTS THE MEASURED CONCENTRATIONS AND THE ESTIMATED COMPOSITE AVERAGE.

CONCENTRATIONS IN THE PROPOSED TREATMENT AREA WERE ASSUMED TO BE 100 PPM IN THE UPPER 12 INCHES AND 10 PPM AT 12 TO 24 INCHES BASED ON MODELING RESULTS. (SEE THE MEMORANDUM "CONCEPTUAL PLAN FOR FINAL SITE REMEDIATION"). THE COMPOSITE CONCENTRATIONS FOR THE THREE AREAS IS 16 PPM AND FOR THE OVERALL SITE IS 7.6 PPM FOR CARCINOGENIC PAH.

SITE DEVELOPMENT

MOST OF THE SOIL CRITERIA REVOLVE AROUND THE ISSUE OF THE FUTURE USE OF THE SITE. THE PRP'S ARE PURSUING INSTITUTIONAL CONTROLS WHICH WOULD PRECLUDE THE USE OF THE SITE AS A RESIDENTIAL DEVELOPMENT. THE ACTION LEVELS, THEREFORE CONSIDER BOTH UNRESTRICTED RESIDENTIAL DEVELOPMENT AND RESTRICTED SITE ACCESS (SUCH AS AN INDUSTRIAL PARK OR PRESERVE LAND).

THE SITE IN ITS CURRENT CONDITION IS HEAVILY VEGETATED WITH LESS THAN FIVE PERCENT OF THE SITE AREA HAVING LITTLE OR NO GROUND COVER. THE PROBABILITY OF EXTENSIVE RESIDENTIAL DEVELOPMENT ON THE PROPERTY IS EXTREMELY LOW GIVEN THE DEMOGRAPHICS OF THE AREA. HOWEVER, IF DEVELOPMENT WERE TO OCCUR, EXTENSIVE EARTH MOVING WOULD BE REQUIRED TO PROVIDE UTILITIES, ROADS AND LANDSCAPING.

INSTITUTIONAL CONTROLS THAT WOULD LIMIT RESIDENTIAL DEVELOPMENT COULD INCLUDE A NOTICE IN THE PROPERTY DEED OR A RESTRICTIVE COVENANT. A PROPOSED RESTRICTIVE COVENANT IS INCLUDED AS ATTACHMENT A TO THIS MEMO. HOWEVER, AMAX AND THE BROWN FOUNDATION ARE NOT IN A POSITION AT THIS TIME TO GUARANTEE RESTRICTED USE OF THE SITE UNTIL THE CURRENT PROPERTY OWNERS/LIENHOLDERS GIVE THEIR PERMISSION TO THIS ARRANGEMENT. AMAX AND THE BROWN FOUNDATION ARE PREPARED TO MAKE THE APPROPRIATE CONTACTS TO RESTRICT THE FUTURE USE OF THE SITE UPON CONCEPTUAL APPROVAL BY USEPA AND FDER. VARIOUS SITE DEVELOPMENT SCENARIOS WERE CONSIDERED IN DEVELOPING THIS MEMORANDUM. THESE INCLUDE:

SCENARIO 1: INDUSTRIAL ADULT

THIS SCENARIO CONSIDERS AN ADULT WHO INADVERTENTLY INGESTS 5.0 MG OF SOIL FROM THE SITE ONCE EVERY 30 DAYS ALL YEAR FOR 35 YEARS DURING ADULTHOOD (AGES 25 TO 60 YEARS). THIS ADULT HAS AN AVERAGE WEIGHT OF 70 KG DURING THE EXPOSURE AND HAS A LIFE EXPECTANCY OF 70 YEARS.

SCENARIO 2: NEIGHBORHOOD CHILD

THIS SCENARIO CONSIDERS A CHILD WHO INADVERTENTLY INGESTS 50.0 MG OF SOIL FROM THE SITE ONCE EVERY 30 DAYS ALL YEAR FOR FIVE YEARS DURING CHILDHOOD (AGES 6 TO 11 YEARS). THIS CHILD HAS AN AVERAGE WEIGHT OF 30 KG DURING THE EXPOSURE PERIOD AND HAS A LIFE EXPECTANCY OF 70 YEARS.

SCENARIO 3: RESIDENTIAL PERSON

THIS SCENARIO CONSIDERS A PERSON WHO LIVES ON THE PROPERTY AND HAS A LIFE EXPECTANCY OF 70 YEARS. FOR THE FIVE-YEAR PERIOD FROM AGES ONE TO SIX YEARS, THIS PERSON INADVERTENTLY INGESTS 100.0 MG OF SOIL FROM THE SITE EVERY THIRD DAY AND HAS AN AVERAGE WEIGHT OF 15 KG DURING THE PERIOD OF EXPOSURE. FOR THE FIVE-YEAR PERIOD FROM AGES SIX TO 11 YEARS, THIS PERSON INADVERTENTLY INGESTS 50.0 MG OF SOIL FROM THE SITE EVERY THIRD DAY AND HAS AN AVERAGE WEIGHT OF 30 KG DURING THE PERIOD OF EXPOSURE. FOR THE 59-YEAR PERIOD FROM AGES 11 TO 70 YEARS, THIS PERSON INADVERTENTLY INGESTS 5.0 MG OF SOIL FROM THE SITE EVERY THIRD DAY AND HAS AN AVERAGE WEIGHT OF 70 KG DURING THE PERIOD OF EXPOSURE.

THE WEIGHT AND SOIL INGESTION FACTORS ARE BASED ON RECENTLY PUBLISHED DATA (12,13). NO SPECIFIC CRITERIA ARE AVAILABLE IN TERMS OF THE FREQUENCY OF EXPOSURE. DUE TO THE RELATIVE INACCESSIBILITY OF THE SITE AND THE IMPROVED HYGIENE OF ADULTS, THE FREQUENCY OF EXPOSURE FOR THE NEIGHBORHOOD AND INDUSTRIAL SETTING IS REASONABLE. THIS FREQUENCY IS INCREASED BY AN ORDER OF MAGNITUDE (10 TIMES A MONTH) FOR THE RESIDENTIAL SETTING. THIS ALSO IS REASONABLE IN LIGHT OF THE CONSERVATIVE LIFETIME (0-70 YEARS) WHICH THE ASSESSMENT SPANS, AND CONSIDERATIONS RELATED TO:

- INCLEMENT WEATHER
- CLOSE SUPERVISION OF YOUNG CHILDREN, AND
- TIME SPENT AWAY FROM THE HOME (AT SCHOOL, WORK, ETC.).

SUMMARY: LIMITED EXPOSURE CURRENTLY EXISTS DUE TO CONTACT WITH EXPOSED SURFACE SOIL. THE PROBABILITY OF RESIDENTIAL DEVELOPMENT IS EXTREMELY LOW IN THE FORESEEABLE FUTURE. INSTITUTIONAL CONTROLS RESTRICTING ACCESS ARE FEASIBLE.

RISK LEVELS

A MAJOR CONSIDERATION IN ESTABLISHING ACTION LEVELS IS THE APPROPRIATE LEVEL OF RISK. CERCLA GUIDANCE RECOMMENDS RISK LEVELS WHICH RANGE BETWEEN 10-4 TO 10-7. GENERALLY, A LEVEL OF 10-5 TO 10-6 IS CONSIDERED APPROPRIATE FOR PROTECTION OF HUMAN HEALTH. THE LOWER RISK (10-6) IS APPROPRIATE IN INSTANCES WHERE THE SITE CONDITIONS REPRESENT A SUBSTANTIAL AND IMMEDIATE THREAT TO HUMAN HEALTH AND THE ENVIRONMENT. THE 10-5 RISK IS APPROPRIATE FOR SITUATIONS SUCH AS LIVE OAK WHERE THE PROBABILITY OF RISK IS LOW AND IS DRIVEN BY CONSERVATIVE MODELING ASSUMPTIONS AND FUTURE LAND USE CONSIDERATIONS.

SOIL INGESTION

THE RISK ASSESSMENT REPORT PROVIDED AN ESTIMATE OF RISK FOR THE SITE BASED ON A NUMBER OF HIGHLY CONSERVATIVE ASSUMPTIONS AND CONCLUDED THAT THE BASELINE RISK ASSOCIATED WITH THE CURRENT CONDITIONS (ASSUMING WASTE REMOVAL TO 1000 PPM OF TOTAL CREOSOTE CONSTITUENTS) WAS ACCEPTABLE. THIS ASSESSMENT IS REVISITED TO EVALUATE RISK THE ASSOCIATED WITH BOTH INDUSTRIAL AND RESIDENTIAL DEVELOPMENT. IMPORTANT ASSUMPTIONS MADE IN THIS ASSESSMENT INCLUDE:

THE POTENCY OF FACTOR FOR BENZO(A)PYRENE: THE "SUPERFUND PUBLIC HEALTH EVALUATION MANUAL", (1) CONSERVATIVELY ESTIMATES A CANCER POTENCY FACTOR (CPF) FOR BENZO(A)PYRENE OF 11.5 (MG/KG/DAY)-1. ICF CLEMENTS (THE SAME CONTRACTOR WHICH PREPARED THE ABOVE GUIDANCE MANUAL) HAS COMPLETED A RECENT EVALUATION OF EXISTING DATA AND THE APPLICATION OF A BIOLOGICALLY BASED DOSE RESPONSE TO EVALUATE THE POTENCY OF BENZO(A)PYRENE; (2) THIS EVALUATION HAS ESTABLISHED THE POTENCY OF BENZO(A)PYRENE AS 5.74 (MG/KG/DAY)-1. THIS ASSESSMENT IS PROVIDED AS ATTACHMENT B TO THIS MEMORANDUM.

THE RELATIVE POTENCY OF THE SUSPECTED CARCINOGENS: THE EXISTING SITE DATABASE WAS REVIEWED TO EVALUATE THE RELATIVE RATIOS OF THE CARCINOGENIC PAH. THE DATA BASE INCLUDED THE SOIL DATA ON THE PLANT AREA AND FORMER WOOD STORAGE AREA SUMMARIZED IN TABLE 4. THE DATA BASE INDICATES THE AVERAGE RELATIVE PROPORTIONS OF THE CARCINOGENIC PAH ARE:

COMPOUND	RELATIVE % OF TOTAL CARCINOGENS	CPF (MG/KG/DAY)-1
BENZO(A)PYRENE	11.54%	5.74
BENZO(A)ANTHRACENE	8.71%	0.8323
BENZO(B)FLUORANTHENE	49.43%	0.8036
CHRYSENE	18.52%	0.0253
DIBENZO(A,H)ANTHRACENE	3.56%	6.3714
INDENO(1,2,3-CD)PYRENE	8.23%	1.3317.

SHOWN ABOVE IS THE CANCER POTENCY FACTOR CALCULATED BY ICF CLEMENS FOR THE OTHER CARCINOGENS. THE RELATIVE DISTRIBUTION OF THE CARCINOGENS AND THEIR CANCER POTENCY FACTOR WAS USED IN MODELING RISKS ASSOCIATED WITH SOIL INGESTION. THE CUMULATIVE CANCER POTENCY FACTOR BASED ON THE RELATIVE DISTRIBUTION OF THE CARCINOGENS IS 1.4713.

MATRIX/AVAILABILITY EFFECTS: THE BIOACCUMULATION OF THE PAH COMPOUNDS IS STRONGLY RELATED TO THE SOIL MATRIX CONTAINING THE COMPOUNDS. LOW LEVELS OF COMPOUNDS SORBED ONTO SOIL CANNOT BE READILY ACCUMULATED BY THE BODY. A MATRIX FACTOR OF 0.3 IS USED IN THIS ASSESSMENT AND IS CONSISTENT WITH THE VALUE USED BY THE CDC IN EVALUATING ACTION LEVELS FOR DIOXIN CONTAMINATED SOIL.

DEGRADATION FACTORS: A HALF-LIFE OF 0.5 YEARS WAS USED TO MODEL THE PHOTOCHEMICAL AND BIOLOGICAL DEGRADATION OF THE CARCINOGENS. ATTACHMENT C PRESENTS A DATABASE WHICH SHOWS THESE CARCINOGENS GENERALLY HAVE HALF LIVES LESS THAN 0.5 YEARS. FIGURE 1 PRESENTS THE MAXIMUM RANGE ASSOCIATED WITH THE 95 PERCENT CONFIDENCE INTERVAL FOR THE ATTACHED DATA BASE. THE HALF YEAR ASSUMPTION IS THE MAXIMUM VALUE FOR ANY OF THE CARCINOGENIC COMPOUNDS EVALUATED.

RELATIVE RISK

THE RELATIVE RISK ASSOCIATED WITH THE RESIDUALS REMAINING ON THE PLANT SITE AFTER COMPLETION OF THE PROPOSED REMEDY WAS CALCULATED FOR EACH OF THE RELEVANT AREAS AS WELL AS FOR THE SITE AS A WHOLE. TABLE 5 PRESENTS THE AVERAGE CONCENTRATION ASSOCIATED WITH EACH AREA (WEIGHT AVERAGED OVER TWO FEET) AND THE ASSOCIATED RISK LEVEL WITH VARIOUS EXPOSURE SCENARIOS. THE TABLE SHOWS THAT THE RISKS ASSOCIATED WITH THE PROPOSED REMEDY RANGE FROM 10-7 TO 10-10 FOR THE OVERALL SITE. THIS RISK IS BASED ON THE COMPLETION OF THE PROPOSED REMEDY WHICH INCLUDES TREATING THE CONTAMINATED SOILS DOWN TO A LEVEL OF 100 PPM TOTAL CARCINOGENS. ATTACHMENT D PROVIDES THE EQUATIONS USED IN THESE CALCULATIONS.

SUMMARY

THIS REVIEW HAS EVALUATED A VARIETY OF CONSIDERATIONS WHICH AFFECT SOIL ACTION LEVELS FOR THE LIVE OAK SITE. THE ACTION LEVELS HAVE CONSIDERED BOTH AVERAGE SITE CONCENTRATIONS AS WELL AS MAXIMUM CONCENTRATIONS FOR INDIVIDUAL AREAS.

THE PROPOSED MAXIMUM CONCENTRATIONS FOR SURFICIAL SOILS IN ANY GIVEN AREA IS 100 PPM OF CARCINOGENIC PAH. THIS VALUE IS BASED ON WORK COMPLETED BY THE CENTER FOR DISEASE CONTROL ON THE RELATIVE POTENCY OF PAH CARCINOGENS AS COMPARED TO 2,3,7,8-TCDD. THIS VALUE HAS BEEN USED AS AN ACTION LEVEL AT OTHER PAH CONTAMINATED SITES.

UNDER THE PROPOSED ACTION LEVELS, THE MAXIMUM CONCENTRATION CRITERIA WOULD BE APPLIED TO THE TREATMENT AREA. THE REMAINDER OF SURFICIAL SOILS ON THE SITE ARE WELL BELOW THE PROPOSED MAXIMUM CRITERIA. THE RISK LEVELS ON A SITE AVERAGE BASIS FOLLOWING TREATMENT TO 100 PPM WOULD BE 10-7 FOR AN UNRESTRICTED DEVELOPMENT SCENARIO AND 10-9 FOR A RESTRICTED DEVELOPMENT SCENARIO. THEREFORE, NO FURTHER ACTION IS NECESSARY FOR SITE SOILS BELOW 100 PPM CARCINOGENIC PAH. IT SHOULD BE NOTED THAT THE UNRESTRICTED DEVELOPMENT SCENARIO ASSUMES THAT HOUSES ARE CONSTRUCTED ON THE SITE IMMEDIATELY AFTER THE COMPLETION OF THE PROPOSED REMEDY AND THAT INDIVIDUALS LIVE ON THE SITE FROM BIRTH TO AGE 70. GIVEN THE DEMOGRAPHICS OF THE AREA, THIS SCENARIO IS HIGHLY UNLIKELY. EVEN SO, THE ASSOCIATED RISK LEVELS ARE 10-7 WHICH DEMONSTRATES THE PROPOSED REMEDY IS HIGHLY PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT.

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ATLANTA, GA 30365

DEAR DR. WALKER AND MR. DEANGELO:

AT A MEETING I HAD WITH DR. WALKER ON MARCH 15, 1988, DR. WALKER REQUESTED THAT WE EXPLICITLY STATE THE ASSUMPTIONS USED IN MODELING SOIL INGESTION RISKS PRESENTED IN MY MEMORANDUM TITLED "ACTION LEVELS FOR THE LIVE OAK SITE", DATED FEBRUARY 17, 1988. THE FOLLOWING ASSUMPTIONS WERE USED IN DEVELOPING THE RISK FACTORS PRESENTED IN TABLE 5 OF THAT MEMORANDUM:

CARCINOGENIC POTENCY FACTOR	1.4713 (MG/KG/DAY)-1
AVERAGE SOIL CONCENTRATION AT TIME 0	55 PPM AND 7.6 PPM RESPECTIVELY FOR THE THE TREATMENT AREA AND THE SITE AREA BASED ON A COMPOSITE OF THE UPPER TWO FEET OF SOIL
MATRIX FACTOR FOR SOIL INGESTION	0.3
FREQUENCY OF INGESTION	ONCE EVERY THREE DAYS
DEGRADATION HALF-LIFE	0.5 YEARS
AMOUNT OF SOIL INGESTED/EVENT	100 MG FOR AGES 0-5, 50 MG FOR AGES 6-11 AND 5 MG FOR AGES 11-70.

THE BASIS FOR THESE ASSUMPTIONS WERE IDENTIFIED IN THE MEMORANDUM. DR. WALKER REQUESTED THAT WE ALSO MODEL THE RESIDENTIAL EXPOSURE RISKS USING THE FOLLOWING ASSUMPTIONS:

AMOUNT OF SOIL INGESTED/EVENT	100 MG FOR AGES 0-11 AND 25 MG FOR AGES 11-70
DEGRADATION HALF-LIFE	0.5 YEARS, 1 YEAR AND 1.5 YEARS.

THESE RESULTS ARE PRESENTED IN TABLE 1. CHANGING THE AMOUNT OF SOIL INGESTED FROM AGES 6-70 DOES NOT CHANGE THE RESULTS ORIGINALLY PRESENTED IN TABLE 5. INCREASING THE HALF-LIFE INCREASES THE RISK ONLY MARGINALLY AND IS STILL WITHIN 10-6 FOR THE TREATMENT AREA AND 10-7 FOR THE SITE AREA. THIS SENSITIVITY ANALYSIS DEMONSTRATES THAT A TREATMENT GOAL OF 100 PPM OF CARCINOGENIC PAH IS PROTECTIVE OF HUMAN HEALTH AND IS AN APPROPRIATE CRITERIA FOR THE SITE.

IT SHOULD BE NOTED THAT THE RISK LEVELS PRESENTED IN TABLE 1 ARE FOR UNRESTRICTED SITE DEVELOPMENT AND FOR SURFICIAL SOILS. THEREFORE, THE REQUIREMENTS IN THE ROD WHICH PERTAIN TO: (A) DEED RESTRICTIONS AND (B) SOIL COVER ON THE TREATMENT AREA ARE NOT NECESSARY COMPONENTS OF THE FINAL REMEDY.

I TRUST THE ABOVE INFORMATION SATISFACTORILY ADDRESSES YOUR QUESTION REGARDING THE PROPOSED ACTION LEVELS. SHOULD YOU REQUIRE ANY FURTHER CLARIFICATION PLEASE DO NOT HESITATE TO GIVE ME A CALL.

SINCERELY,

JOHN RYAN
PRINCIPAL

JR:CT.

RETEC
REMEDIATION
TECHNOLOGIES INC

MARCH 28, 1988

DR. RUSSELL WALKER
FLORIDA DER
2600 BLAIR STONE ROAD
TALLAHASSEE, FL 32399-2400

DEAR RUSS:

PURSUANT TO YOUR REQUEST, I HAVE CALCULATED THE EFFECTS OF CHANGING THE HALF-LIFE ON THE RISK LEVELS ASSOCIATED WITH SOIL INGESTION PREVIOUSLY PRESENTED IN MY MEMORANDUM DATED FEBRUARY 17, 1988. ASSUMING HALF-LIFE VALUES OF 5, 10, AND 20 YEARS, THE RESULTANT RISK LEVELS FOR UNRESTRICTED RESIDENTIAL USE OF THE SITE ARE:

RISK LEVEL

HALF LIFE (YEARS)	TREATMENT AREA	SITE AREA
5	3.7 X 10-6	5.2 X 10-7
10	4.2 X 10-6	6.4 X 10-7
20	5.2 X 10-6	7.2 X 10-7.

ALL OTHER ASSUMPTIONS USED IN CALCULATING THE RISK LEVELS ARE THE SAME AS THOSE PRESENTED IN MY MEMORANDUM DATED FEBRUARY 17, AND FURTHER CLARIFIED IN MY LETTER DATED MARCH 23, 1988. AS WE PREVIOUSLY DISCUSSED, IT IS RETEC'S POSITION THAT A HALF-LIFE OF 0.5 YEARS IS AN APPROPRIATE VALUE TO USE IN THIS EVALUATION.

THIS EVALUATION AND THE PREVIOUS DATA SUBMITTED INDICATE THAT THE RISKS ASSOCIATED WITH AN ACTION LEVEL OF 100 PPM CARCINOGENIC PAH FOR SURFICIAL SOILS IS WITHIN THE 10-6 RANGE FOR THE TREATMENT AREA AND 10-7 FOR THE OVERALL SITE AS PREVIOUSLY REPORTED. IT SHOULD BE NOTED THAT THESE RISKS ARE BASED ON THE EXTREMELY CONSERVATIVE ASSUMPTION THAT THE SITE WOULD BE USED FOR UNRESTRICTED RESIDENTIAL DEVELOPMENT AND THAT SUCH DEVELOPMENT WOULD OCCUR IMMEDIATELY AFTER TREATMENT OF THE CONTAMINATED SOILS IS COMPLETED. THE PROPOSED ACTION LEVELS ARE CONSERVATIVELY LOW AND ARE PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT.

PLEASE LET ME KNOW IF YOU HAVE ANY ADDITIONAL QUESTIONS.

BEST REGARDS,

JOHN RYAN
PRINCIPAL

JR:CT

CC: T. DEANGELO
K. BURKE
K. PAULSEN
S. HUGENBERG
J. RODES.

BIOREMEDIATION OF CONTAMINATION BY HEAVY ORGANICS AT A WOOD PRESERVING PLANT SITE

RONALD J. LINKENHEIL
REMEDIATION TECHNOLOGIES, INC.
FORT COLLINS, COLORADO

THOMAS J. PATNODE
GLACIER PARK COMPANY
SEATTLE, WASHINGTON

ABSTRACT

ON-SITE TREATMENT WAS CHOSEN AS THE CLOSURE ALTERNATIVE FOR A CREOSOTE IMPOUNDMENT AT A SUPERFUND SITE IN MINNESOTA. THIS ALTERNATIVE WAS IDENTIFIED IN THE FEASIBILITY STUDY AS THE MOST COST EFFECTIVE SOURCE CONTROL MEASURE FOR THE SITE. THE EFFECTIVENESS OF USING LAND TREATMENT TECHNOLOGY TO DETOXIFY CONTAMINATED SOILS AT THE SITE WAS DEMONSTRATED IN PILOT SCALE STUDIES. RESULTS OF THESE STUDIES WERE USED TO DEVELOP DESIGN CRITERIA FOR A FULL SCALE TREATMENT FACILITY.

A LINED 3-ACRE TREATMENT FACILITY WAS CONSTRUCTED IN 1985 TO TREAT 10,000 C.Y. OF CONTAMINATED SOILS AND SLUDGES FROM THE CREOSOTE IMPOUNDMENT. THE FACILITY HAS BEEN SUCCESSFULLY OPERATED BY RETEC SINCE 1986 ACHIEVING GREATER THAN 90 PERCENT REDUCTION OF POLYNUCLEAR AROMATIC HYDROCARBONS (PNAS) DURING THE FIRST YEAR OF OPERATION. THIS PAPER SUMMARIZES RESULTS FROM THE FIRST YEAR OF TREATMENT AND DEMONSTRATES THE EFFECTIVENESS OF THE FULL SCALE SYSTEM. ASPECTS OF CONSTRUCTION AND START-UP OF THE FULL SCALE FACILITY ARE ALSO REVIEWED.

INTRODUCTION

WASTEWATERS FROM A CREOSOTE WOOD PRESERVING OPERATION HAVE BEEN SENT TO A SHALLOW, UNLINED SURFACE IMPOUNDMENT FOR DISPOSAL SINCE THE 1930'S. THE DISCHARGE OF WASTEWATER TO THE DISPOSAL POND GENERATED A SLUDGE WHICH IS A LISTED HAZARDOUS WASTE UNDER THE RESOURCE CONSERVATION AND RECOVERY ACT (RCRA). DUE TO GROUNDWATER CONTAMINATION OF THE SHALLOW AQUIFER AT THE SITE BY PNAS, THE STATE OF MINNESOTA NOMINATED THE SITE FOR LISTING ON THE SUPERFUND NATIONAL PRIORITIES LIST IN 1982. SINCE 1982 NUMEROUS REMEDIAL INVESTIGATION ACTIVITIES HAVE BEEN UNDERTAKEN TO DETERMINE THE NATURE AND EXTENT OF CONTAMINATION AT THE SITE. BASED ON THE RESULTS OF THESE STUDIES AND EXTENSIVE NEGOTIATIONS, THE MINNESOTA POLLUTION CONTROL AGENCY (MPCA), THE U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA), AND THE OWNER OF THE FACILITY SIGNED A CONSENT ORDER IN MARCH 1985 SPECIFYING ACTIONS TO BE TAKEN AT THE SITE.

IN GENERAL TERMS, THE REMEDIAL ACTIONS SELECTED BY THE MPCA AND EPA INVOLVE A COMBINATION OF OFF-SITE CONTROL MEASURES AND SOURCE CONTROL MEASURES. THE OFF-SITE CONTROLS INVOLVE A SERIES OF GRADIENT CONTROL WELLS TO CAPTURE CONTAMINATED GROUND WATER. THE SOURCE CONTROL MEASURES INCLUDE ON-SITE BIOLOGICAL TREATMENT OF THE SLUDGES AND CONTAMINATED SOILS AND CAPPING OF RESIDUAL CONTAMINANTS LOCATED AT DEPTHS GREATER THAN 5 FEET. COSTS FOR ON-SITE TREATMENT AND CAPPING WERE ESTIMATED TO BE $59/T0N.

PILOT SCALE STUDIES

BEFORE THE ON-SITE TREATMENT ALTERNATIVE WAS IMPLEMENTED, BENCH SCALE AND PILOT SCALE STUDIES WERE CONDUCTED TO DEFINE OPERATING AND DESIGN PARAMETERS FOR THE FULL SCALE FACILITY. SEVERAL PERFORMANCE, OPERATING, AND DESIGN PARAMETERS WERE EVALUATED IN THE LAND TREATMENT STUDIES. THESE INCLUDED:

- SOIL CHARACTERISTICS;
- CLIMATE;
- TREATMENT SUPPLEMENTS;
- REDUCTION OF GROSS ORGANICS AND PAH COMPOUNDS;
- TOXICITY REDUCTION;
- EFFECT OF INITIAL LOADING RATE;
- EFFECT OF REAPPLICATION;

THREE DIFFERENT LOADING RATES WERE EVALUATED IN THE TEST PLOT STUDIES: 2 PERCENT, 5 PERCENT, AND 10 PERCENT BE HYDROCARBONS. THE SOILS USED IN THE PILOT STUDY CONSISTED OF A FINE SAND WHICH WAS COLLECTED FROM THE UPPER 2 FEET OF THE RCRA IMPOUNDMENT. THE SOIL WAS CONTAMINATED WITH CREOSOTE CONSTITUENTS CONSISTING PRIMARILY OF PNA COMPOUNDS. TOTAL PNAS IN THE SOIL RANGED FROM 1000 TO 10,000 PPM, AND BE HYDROCARBONS IN THE CONTAMINATED SOIL RANGED FROM APPROXIMATELY 2 TO 10 PERCENT BY WEIGHT.

BECAUSE THE NATURAL SOILS ARE FINE SANDS AND EXTREMELY PERMEABLE, IT WAS DECIDED THAT THE FULL SCALE SYSTEM WOULD INCLUDE A LINER AND LEACHATE COLLECTION SYSTEM TO PREVENT POSSIBLE LEACHATE BREAK THROUGH.

TO SIMULATE THE PROPOSED FULL SCALE CONDITIONS, THE PILOT STUDIES CONSISTED OF FIVE LINED, 50 FOOT SQUARE TEST PLOTS WITH LEACHATE COLLECTION. THE STUDIES WERE DESIGNED TO MAINTAIN SOIL CONDITIONS WHICH PROMOTE THE DEGRADATION OF HYDROCARBONS. THESE CONDITIONS INCLUDED:

- MAINTAIN A PH OF 6.0 TO 7.0 IN THE SOIL TREATMENT ZONE;

- MAINTAIN SOIL CARBON TO NITROGEN RATIOS BETWEEN 50:1 AND 25:1; AND

- MAINTAIN SOIL MOISTURE NEAR FIELD CAPACITY.

HYDROCARBON LOSSES IN THE TEST PLOTS WERE MEASURED USING BENZENE AS THE EXTRACTION SOLVENT. THE ANALYSIS OF BE HYDROCARBONS PROVIDES A GENERAL PARAMETER WHICH IS WELL SUITED TO WASTES CONTAINING HIGH MOLECULAR WEIGHT AROMATICS SUCH AS CREOSOTE WASTES. REDUCTIONS OF BE HYDROCARBONS WERE FAIRLY SIMILAR BETWEEN ALL THE FIELD PLOTS. AVERAGE REMOVALS FOR ALL FIELD PLOTS OVER FOUR MONTHS WERE APPROXIMATELY 40% WITH A CORRESPONDING FIRST ORDER KINETIC CONSTANT (K) OF 0.004/DAY.

THE REDUCTION OF PNA CONSTITUENTS WAS MONITORED BY MEASURING DECREASES IN 16 PNA COMPOUNDS. THE FOLLOWING COMPOUNDS WERE MONITORED IN THE TEST PLOTS:

2 RINGS	3 RINGS	4, 5, AND 6 RINGS
NAPHTHALENE	FLUORENE	FLUORANTHENE
ACENAPHTHYLENE	PHENANTHRENE	PYRENE
ACENAPHTHENE	ANTHRACENE	BENZO(A)ANTHRACENE
		CHRYSENE
		BENZO(J)FLUORANTHENE
		BENZO(K)FLUORANTHENE
		BENZO(A)PYRENE
		DIBENZO(A,H)ANTHRACENE
		BENZO(G,H,I)PERYLENE
		INDENO(1,2,3,C,D)PYRENE.

GREATER THAN 62 PERCENT REMOVALS OF PAHS WERE ACHIEVED IN ALL THE TEST PLOTS AND LABORATORY REACTORS OVER A FOUR MONTH PERIOD. PAH REMOVALS FOR EACH RING CLASS ARE SHOWN BELOW:

- 2 RING PAH: 80-90 PERCENT
- 3 RING PAH: 82-93 PERCENT
- 4+ RING PAH: 21-60 PERCENT
- TOTAL PAH: 62-80 PERCENT.

TABLE 1 SUMMARIZES FIRST ORDER RATE CONSTANTS AND HALF-LIFE DATA FOR BE HYDROCARBONS AND PNA COMPOUNDS FOR THE 5 AND 10 PERCENT BE HYDROCARBON TEST PLOTS. WITH THE EXCEPTION OF THE 4 AND 5 RING PNAS, THE TABLE SHOWS THAT THE KINETIC VALUES ARE APPROXIMATELY EQUAL FOR THE 5 AND 10 PERCENT LOADING RATES. IN THE CASE OF THE 4 AND 5-RING COMPOUNDS, THE 5 PERCENT LOADING RATE RESULTED IN HIGHER KINETIC RATES FOR THESE COMPOUNDS AS COMPARED TO THE 10 PERCENT LOADING RATE. THIS DIFFERENCE MAY HAVE BEEN DUE TO MORE 2-RING AND 3-RING COMPOUNDS BEING AVAILABLE TO SOIL BACTERIA AT THE 10 PERCENT LOADING RATE. THESE COMPOUNDS MAY BE PREFERENTIALLY DEGRADED BY SOIL BACTERIA.

OPERATING AND DESIGN CRITERIA

THE PILOT SCALE STUDIES WERE SUCCESSFUL IN DEVELOPING OPERATING AND DESIGN CRITERIA FOR A FULL SCALE SYSTEM. THESE CRITERIA ARE SUMMARIZED BELOW:

- TREATMENT PERIOD CAN BE EXTENDED THROUGH OCTOBER
- SOIL MOISTURE SHOULD BE MAINTAINED NEAR FIELD CAPACITY
- SOIL PH SHOULD BE MAINTAINED BETWEEN 6.0 AND 7.0
- SOIL CARBON:NITROGEN RATIOS SHOULD BE MAINTAINED BETWEEN 25:1 AND 50:1
- FERTILIZER APPLICATIONS SHOULD BE COMPLETED IN SMALL FREQUENT DOSES
- INITIAL BENZENE EXTRACTABLE HYDROCARBON CONTENTS OF 5 TO 10% ARE FEASIBLE
- WASTE REAPPLICATION SHOULD OCCUR AFTER INITIAL SOIL CONCENTRATIONS HAVE BEEN EFFECTIVELY DEGRADED
- WASTE REAPPLICATION RATES OF 2 TO 3 LB OF BENZENE EXTRACTABLE PER CUBIC FOOT OF SOIL PER 3 DEGRADATION MONTHS CAN BE EFFECTIVELY DEGRADED.

THE STUDIES SUGGEST THAT ALL THE LOADING RATES TESTED ARE FEASIBLE. FIRST ORDER RATE CONSTANTS WERE FAIRLY SIMILAR BETWEEN ALL THE TEST PLOTS ALTHOUGH THE INTERMEDIATE LOADING RATE (5% BENZENE EXTRACTABLE

HYDROCARBONS) MAY DEMONSTRATE A SLIGHTLY HIGHER REMOVAL OF HIGH MOLECULAR WEIGHT PAH COMPOUNDS. THE HIGHER LOADING RATES, HOWEVER, SHOWED THE GREATEST MASS REMOVALS. THE SELECTION OF AN INITIAL LOADING RATE SHOULD BALANCE ADDITIONAL LAND AREA REQUIREMENTS AGAINST TIME REQUIREMENTS FOR COMPLETING THE TREATMENT PROCESS. MODERATE LOADING RATES (5%) WILL RESULT IN A FASTER DETOXIFICATION WHEREAS HIGHER LOADING RATES WILL DECREASE LAND AREA REQUIREMENTS.

CONSTRUCTION AND START-UP OF FULL SCALE SYSTEM

CONSTRUCTION OF THE FULL SCALE SYSTEM INVOLVED PREPARATION OF A TREATMENT AREA WITHIN THE CONFINES OF THE EXISTING RCRA IMPOUNDMENT (FIGURE 1). THE TREATMENT AREA WAS CONSTRUCTED ON TOP OF THE IMPOUNDMENT TO AVOID PERMITTING A NEW RCRA FACILITY. IF THE FACILITY WAS LOCATED OUTSIDE THE IMPOUNDMENT, THEN A PART B PERMIT WOULD HAVE TO BE OBTAINED BEFORE THE TREATMENT FACILITY COULD BE CONSTRUCTED. BY LOCATING THE TREATMENT AREA WITHIN THE CONFINES OF THE IMPOUNDMENT, THE TREATMENT SYSTEM WAS CONSIDERED PART OF CLOSURE OF THE IMPOUNDMENT. THIS ENABLED US TO FAST TRACK THE CLEAN-UP AND AVOID THE DELAYS ASSOCIATED WITH PERMITTING A NEW RCRA UNIT.

THE PRINCIPAL CONSTRUCTION ACTIVITIES AT THE SITE INVOLVED:

- PREPARATION OF A LINED WASTE PILE FOR TEMPORARY STORAGE OF THE SLUDGE AND CONTAMINATED SOIL.

- REMOVAL OF ALL STANDING WATER IN THE IMPOUNDMENT.

- EXCAVATION AND SEGREGATION OF THE SLUDGES FOR SUBSEQUENT FREE OIL RECOVERY.

- EXCAVATION OF APPROXIMATELY 3-5 FEET OF "VISIBLY" CONTAMINATED SOIL FROM THE IMPOUNDMENT AND SUBSEQUENT STORAGE IN THE LINED WASTE PILE.

- STABILIZATION OF THE BOTTOM OF THE IMPOUNDMENT AS A BASE FOR THE TREATMENT AREA.

- CONSTRUCTION OF THE TREATMENT AREA INCLUDING INSTALLATION OF A 100 ML HDPE LINER, A LEACHATE COLLECTION SYSTEM AND 4 FEET OF CLEAN BACKFILL.

- INSTALLATION OF A SUMP FOR COLLECTION OF THE STORMWATER AND LEACHATE.

- INSTALLATION OF A CENTER PIVOT IRRIGATION SYSTEM.

AS PREVIOUSLY DISCUSSED, A LINED TREATMENT AREA WAS CONSTRUCTED BECAUSE THE NATURAL SOILS AT THE SITE ARE HIGHLY PERMEABLE. A CAP ALSO WAS NEEDED FOR THE RESIDUAL CONTAMINANTS LEFT IN PLACE BELOW THE LINER. THEREFORE, THE TREATMENT AREA LINER SERVES TWO FUNCTIONS AT THE SITE. THE FIRST FUNCTION IS TO PROVIDE A BARRIER TO LEACHATE FROM THE TREATMENT AREA. THE SECOND FUNCTION IS TO PROVIDE A CAP OVER THE RESIDUAL CONTAMINANTS THAT WERE LEFT IN PLACE.

THE TREATMENT AREA WAS CONSTRUCTED ON TOP OF THE EXISTING WASTE WATER DISPOSAL POND AFTER ALL CONTAMINATED MATERIALS WERE REMOVED. THE SURFACE AREA FOR TREATMENT IS APPROXIMATELY 125,000 SQUARE FEET. CONTAINMENT BERMS WITH 3 TO 1 SLOPES ENCLOSE THE TREATMENT AREA AND PREVENT SURFACE RUN OFF FROM LEAVING THE SITE.

THE TREATMENT AREA IS LINED WITH A 100 MIL HDPE MEMBRANE (FIGURE 2). THE BASE OF THE LINER SLOPES 0.5 PERCENT TO THE SOUTH AND WEST. A SUMP WITH A 50,000 GALLON CAPACITY IS LOCATED IN THE SOUTHWEST CORNER OF THE TREATMENT AREA. A LAYER OF SILTY SAND BALLAST 18 INCHES THICK WAS PLACED ON TOP OF THE TREATMENT AREA LINER. A 6 INCH GRAVEL LAYER WAS PLACED ON TOP OF THE BALLAST. THIS LAYER SERVES AS A LEACHATE COLLECTION SYSTEM AND AS A MARKING LAYER FOR LAND TREATMENT OPERATIONS.

THE LEACHATE COLLECTION SYSTEM INCLUDES 2 FOOT WIDE LEACHATE COLLECTION DRAINS AT 100 FOOT CENTERS (FIGURE 2). THE DRAINS ARE FILLED WITH GRAVEL AND PERFORATED PIPE TO CARRY LEACHATE FROM THE COLLECTION SYSTEM TO THE SUMP. THE DRAINS WERE WRAPPED IN FILTER FABRIC TO PREVENT CLOGGING. TWO FEET OF UNCONTAMINATED SAND WAS PLACED ABOVE THE LEACHATE COLLECTION SYSTEM. THIS LAYER OF SAND SERVES AS AN INITIAL MIXING LAYER FOR THE CONTAMINATED SOILS AND IS THE TREATMENT ZONE FOR THE FULL SCALE SYSTEM.

WATER IN THE LEACHATE COLLECTION SUMP IS DISCHARGED BY GRAVITY FLOW TO A MANHOLE AND IS AUTOMATICALLY PUMPED VIA A LIFT STATION TO A 117,000 GALLON STORAGE TANK. WATER IN THE STORAGE TANK IS RECYCLED BACK TO THE TREATMENT AREA VIA A SPRAY IRRIGATION SYSTEM. WATER IN EXCESS OF IRRIGATION REQUIREMENTS IS DISCHARGED TO THE MUNICIPAL WASTEWATER TREATMENT PLANT.

CONSTRUCTION OF THE WASTE PILE AND TREATMENT AREA WAS COMPLETED IN OCTOBER 1985. IN LATE APRIL 1986, A CENTER PIVOT IRRIGATION SYSTEM WAS INSTALLED AND 120 TONS OF MANURE WERE SPREAD IN THE TREATMENT AREA.

MANURE LOADING RATES WERE BASED ON ACHIEVING A CARBON:NITROGEN RATIO OF 50:1. IN ADDITION TO NITROGEN, THE MANURE PROVIDES ORGANIC MATTER WHICH ENHANCES ABSORPTION OF THE HAZARDOUS WASTE CONSTITUENTS.

IN MAY 1986, A 3 INCH LIFT OF CONTAMINATED SOIL WAS APPLIED TO THE TREATMENT AREA. THE TARGET LOADING RATE FOR START-UP WAS A BE HYDROCARBON CONCENTRATION OF 5 PERCENT. THE SOIL WAS MIXED (ROTOTILLED) WITH 3 INCHES OF NATIVE SOIL TO ACHIEVE A TREATMENT DEPTH OF 6 INCHES. THIS APPLICATION INVOLVED APPROXIMATELY 1200 CUBIC YARDS OF SLUDGE AND CONTAMINATED SOIL. TABLE 2 SUMMARIZES START-UP DATA FOR THE FULL SCALE FACILITY.

THE TREATMENT AREA IS IRRIGATED ALMOST DAILY DUE TO DRY WEATHER DURING THE SUMMER MONTHS. IRRIGATION NEEDS ARE DETERMINED FROM SOIL TENSIOMETER READINGS, SOIL MOISTURE ANALYSES, AND PRECIPITATION AND EVAPORATION RECORDS. TYPICAL IRRIGATION RATES RANGE FROM 1/4 INCH TO 3/8 INCH PER APPLICATION. THIS APPLICATION RATE KEEPS THE SOILS IN THE CULTIVATION ZONE MOIST WITHOUT SATURATING SOILS IN THE LOWER TREATMENT ZONE. MAINTAINING SOIL MOISTURE NEAR FIELD CAPACITY WAS DETERMINED TO BE A KEY OPERATING PARAMETER IN THE PILOT SCALE STUDIES.

PERFORMANCE OF THE FULL SCALE FACILITY

BENZENE EXTRACTABLE (BE) HYDROCARBONS AND 16 POLYNUCLEAR AROMATIC (PNA) COMPOUNDS ARE BEING MONITORED TO EVALUATE THE PERFORMANCE OF THE FACILITY. FIGURE 3 SHOWS THE BE HYDROCARBON CONCENTRATIONS MEASURED IN THE ZONE OF INCORPORATION (ZOI) DURING THE FIRST YEAR OF TREATMENT. BE HYDROCARBON CONCENTRATIONS DECREASED APPROXIMATELY 60 PERCENT OVER THE FIRST YEAR OF OPERATION. MOST OF THE DECREASE OCCURRED DURING THE FIRST 120 DAYS (MAY THROUGH SEPTEMBER). LITTLE DECREASE IN BE HYDROCARBON CONCENTRATIONS WAS OBSERVED DURING THE FALL AND WINTER MONTHS.

FIGURES 4 AND 5 SHOW PNA CONCENTRATIONS MEASURED IN THE TREATMENT FACILITY DURING THE FIRST YEAR OF TREATMENT. FIGURE 4 SUMMARIZES DATA FOR 2-RING AND 3-RING PNAS. FIGURE 5 SUMMARIZES DATA FOR THE 4-RING AND 5-RING COMPOUNDS. GREATER THAN 95 PERCENT REDUCTIONS IN CONCENTRATION WERE OBTAINED FOR THE 2 AND 3 RING PNAS. GREATER THAN 70 PERCENT OF THE 4-RING AND 5-RING PNA COMPOUNDS WERE DEGRADED DURING THE FIRST YEAR OF OPERATION.

WITH THE EXCEPTION OF ANTHRACENE, ALL THE 2-RING AND 3-RING COMPOUNDS WERE DEGRADED BELOW OR NEAR DETECTION LIMITS AFTER 90 DAYS OF TREATMENT. GREATER THAN 92 PERCENT OF THE ANTHRACENE PRESENT IN THE WASTE WAS DEGRADED DURING THE FIRST 90 DAYS OF TREATMENT. SIMILARLY, MOST OF THE 4 AND 5 RING REMOVALS OCCURRED DURING THE FIRST 90 DAYS OF TREATMENT. THIS WAS EXPECTED BECAUSE THE WARMEST WEATHER OCCURRED DURING THIS PERIOD.

TABLE 3 SHOWS AVERAGE PNA REMOVALS MEASURED IN THE PILOT SCALE STUDIES AND COMPARES THEM WITH THE FULL SCALE REMOVAL EFFICIENCIES. FULL SCALE REMOVAL EFFICIENCIES WERE HIGHER THAN TEST PLOT REMOVAL EFFICIENCIES FOR EVERY PNA RING CLASS AND BE HYDROCARBONS. HOWEVER, IT MUST BE NOTED THAT THE FULL SCALE FACILITY OPERATED FOR 360 DAYS COMPARED TO ONLY 126 DAYS FOR THE TEST PLOT UNITS. TABLE 3 ALSO PRESENTS AVERAGE HALF-LIFE DATA FOR BOTH THE TEST PLOTS AND THE FULL SCALE UNIT. FULL SCALE HALF-LIVES WERE CONSISTENTLY IN THE LOW END OF THE RANGE OF HALF-LIVES REPORTED FOR THE TEST PLOT UNITS.

IN SUMMARY, THE RATE AND AMOUNT OF PNA DEGRADATION IS PROPORTIONAL TO THE NUMBER OF RINGS CONTAINED BY THE PNA COMPOUNDS (FIGURE 6). THE 2-RING AND 3-RING PNAS DEGRADED MOST RAPIDLY. THE 4-RING AND 5-RING PNAS DEGRADED AT SLOWER RATES, HOWEVER, THESE COMPOUNDS ARE STRONGLY ADSORBED TO SOILS AND ARE IMMOBILIZED IN THE TREATMENT ZONE OF THE FACILITY. TABLE 4 SUMMARIZES WATER QUALITY DATA FOR THE LEACHATE COLLECTION SYSTEM OF THE FACILITY. ONLY ACENAPHTHENE AND FLUORANTHENE WERE DETECTED IN THE DRAIN TILE WATER SAMPLES. CONCENTRATIONS FOR THESE TWO COMPOUNDS WERE NEAR ANALYTICAL DETECTION LIMITS.

CONCLUSION

THE DATA DEVELOPED DURING THIS PROJECT HAS SHOWN THAT ON-SITE TREATMENT OF CREOSOTE CONTAMINATED SOILS IS FEASIBLE. BASED ON THE DATA DEVELOPED IN PILOT SCALE STUDIES, A CONSERVATIVE DESIGN FOR A FULL SCALE SYSTEM WAS DEVELOPED AND CONSTRUCTED. THE FULL SCALE UNIT HAS MATCHED OR SURPASSED THE PERFORMANCE OF THE PILOT SCALE UNIT IN DEGRADING CREOSOTE ORGANICS. THE ADVANTAGES OF ON-SITE TREATMENT ARE THAT IT REDUCES THE SOURCE OF CONTAMINANTS AT THE SITE IN A VERY COST EFFECTIVE MANNER. IN ADDITION, IT SATISFIES THE DEVELOPING PHILOSOPHICAL APPROACH THAT EPA HAS TO ON-SITE REMEDIES AND IT REDUCES THE LIABILITY OF THE OWNER/OPERATOR DUE TO OFF-SITE DISPOSAL.

ATTACHMENT D

LETTER FROM DOI RE NATURAL RESOURCES SURVEY

UNITED STATE DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY

ER-84/552 JUL 20, 1984

MR. GENE LUCERO, DIRECTOR
OFFICE OF WASTE PROGRAMS ENFORCEMENT
ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DEAR MR. LUCERO:

PURSUANT TO YOUR REQUEST WE HAVE CONDUCTED A PRELIMINARY NATURAL RESOURCES SURVEY AT THE BROWN WOOD PRESERVING SITE, LIVE OAK, SUWANNEE COUNTY, FLORIDA, TO DETERMINE WHETHER ANY NATURAL RESOURCES UNDER THE TRUSTEESHIP OF THE SECRETARY OF THE INTERIOR HAVE BEEN, ARE BEING, OR HAVE THE POTENTIAL TO BE AFFECTED BY RELEASES OF HAZARDOUS SUBSTANCES AT THE SITE.

OUR SURVEY REVEALED THAT THERE ARE NO LANDS, MINERALS, WATERS, OR INDIAN RESOURCES UNDER INTERIOR'S TRUSTEESHIP IN THE VICINITY OF THE SITE.

ALTHOUGH CERTAIN FISH AND WILDLIFE, INCLUDING ENDANGERED SPECIES, UNDER OUR TRUSTEESHIP INHABIT THE VICINITY, THERE IS NO EVIDENCE OF DAMAGES TO THESE RESOURCES AT THE SITE ITSELF. MOREOVER, THE PROBABILITY OF OFF-SITE DAMAGES IS REMOTE.

ACCORDINGLY WE WOULD BE WILLING TO GRANT A RELEASE FROM CLAIMS FOR DAMAGES TO NATURAL RESOURCES UNDER THE TRUSTEESHIP OF THE SECRETARY OF THE INTERIOR IN REGARD TO RELEASES OF HAZARDOUS SUBSTANCES AT THE BROWN WOOD PRESERVING SITE.

SINCERELY,

BRUCE BLANCHARD, DIRECTOR
ENVIRONMENTAL PROJECT REVIEW

CC: JANET FARELLA.

ATTACHMENT E

TRANSCRIPTION RE THE PUBLIC MEETING ON OCTOBER 9, 1987

MINUTES OF THE PUBLIC MEETING

DATE: DECEMBER 09, 1987

LOCATION: LIVE OAK CITY HALL, LIVE OAK, FLORIDA

TIME: 2 TO 5 PM

SUBJECT: THE PROPOSED REMEDY FOR THE BROWN WOOD PRESERVING NATIONAL PRIORITIES LIST SITE, LIVE OAK, SUWANNEE COUNTY, FLORIDA

NOTE: TRANSCRIBED FROM CASSETTE TAPE BY TONY DEANGELO, 12/16/87

DEANGELO: THIS IS THE PUBLIC MEETING FOR THE BROWN WOOD SUPERFUND SITE WHICH IS LOCATED OVER ON SAWMILL AND GOLDKIST. IF YOU HAVE NOT SIGNED IN, PLEASE DO SO SO THAT WE HAVE A READING ON WHO ATTENDED THE MEETING.

FIRST, I'D LIKE TO INTRODUCE THE REGULATORY PEOPLE HERE. MY NAME IS TONY DEANGELO. I'M AN ENGINEER AND THE SUPERFUND PROJECT MANAGER AND WORK OUT OF THE EPA REGIONAL OFFICE IN ATLANTA. THIS GENTLEMAN (POINTS TO HIS RIGHT) IS MIKE HENDERSON. HE WORKS FOR THE OFFICE OF CONGRESSIONAL AND EXTERNAL AFFAIRS AT THE REGIONAL OFFICE IN ATLANTA. HE'S OUR PR MAN. THIS GENTLEMAN HERE (POINTS TO HIS LEFT) IS CHARLES ROOKS. HE'S THE ATTORNEY WHO WORKS OUT OF THE REGIONAL OFFICE AND IS ASSIGNED TO THIS CASE.

THIS GENTLEMAN IS JOHN RYAN FROM RETECH. HE IS A CONSULTANT FOR AMAX AND THE BROWN FOUNDATION.

ALSO, WE HAVE CINDY HILTY, A SUPERVISOR FROM THE FDER IN TALLAHASSEE. RUSS WALKER, PHD, WHO'S THE STATE PROJECT MANAGER WHO WORKS ON THE SITE. THE OTHER GENTLEMAN HERE I DON'T KNOW. IF HE WOULD INTRODUCE HIMSELF, . . .

JOE RODES: I'M JOE RODES.

DEANGELO: THE PURPOSE OF THIS MEETING IS TO PRESENT OUR PROPOSED REMEDY FOR THE SITE AND TO SOLICIT ANY COMMENTS FROM ANYBODY AND HOW OUR PROPOSED REMEDY MIGHT BE MODIFIED. IF ANYONE HERE HAS NOT BEEN DOWN TO THE LIBRARY, I ENCOURAGE YOU TO GO DOWN TO LIBRARY AND AT LEAST BROWSE THROUGH THE DOCUMENTS DOWN THERE. UNDER SECTION 113 OF THE LAW, THE SUPERFUND LAW, THERE'S WHAT WE CALL AN ADMINISTRATIVE RECORD PLACED IN THAT REPOSITORY DOWN THERE. FROM TIME TO TIME NEW DOCUMENTS WILL BE SENT DOWN TO THE REPOSITORY, . . .

AT THIS TIME I WOULD LIKE TO PRESENT A BRIEF DESCRIPTION OF THE SUPERFUND PROCESS SO THAT YOU CAN GET A GENERAL IDEA OF HOW THE SUPERFUND PROCESS WORKS AND WHERE WE ARE IN THE PROCESS. THE INITIAL STEP IN THE PROCESS IS THE LOCATION AND IDENTIFICATION AND GRADING OF A LARGE NUMBER OF SITES NATIONWIDE AS REGARDS THEIR POTENTIAL OR PROBABILITY TO CAUSE HAZARD OR TO BE HAZARDOUS TO THE PUBLIC HEALTH, WELFARE AND THE ENVIRONMENT. WE HAVE A SYSTEM WHEREBY WE DO PRELIMINARY ASSESSMENTS AND SITE INVESTIGATIONS AND STATE GRANTS ARE GIVEN FOR THAT PURPOSE. OUT OF THIS LARGE NUMBER OF SITES, ABOUT OVER 20,000 AT THIS TIME IN THE NATION, WE CULL THOSE WHICH HAVE A VERY HIGH PRIORITY. THESE ARE SUBJECTED TO THE HAZARD RANKING SYSTEM SCORING, A SCORE BETWEEN 0 AND 100. IT GOES THROUGH A VERY DETAILED VERIFICATION PROCESS IN WASHINGTON; AND FROM THERE THE SITES ARE VERIFIED TO HAVE THAT HAZARD AND ARE PLACED ON THE NATIONAL PRIORITY LIST. BROWN WOOD IS ONE OF THOSE SITES THAT WAS PLACED ON THE LIST. AT THIS TIME THERE ARE ABOUT 1,000 SITES NATIONWIDE ON THE NATIONAL PRIORITY LIST. BROWN WOOD RANKS APPROXIMATELY IN THE MIDDLE OR PERHAPS A LITTLE BELOW MIDDLE ON THE LIST. FROM THIS LARGE NUMBER OF SITES THAT WE GET FROM CULLING DOWN, WE GET THOSE SITES THAT WE FOCUS A LOT OF ATTENTION ON . . .

THEY ARE TREATED IN A VERY SPECIAL MANNER. THERE'S A PROCESS WHEREBY WE DO WHAT WE CALL A REMEDIAL INVESTIGATION/FEASIBILITY STUDY WHICH IS ESSENTIALLY A STUDY WHICH DEFINES THE NATURE AND EXTENT OF THE CONTAMINATION AND THEN COMES UP WITH ALTERNATIVES FOR CLEANUP. FROM THERE WE GO TO WHAT WE CALL A DECISION DOCUMENT OR THE RECORD OF DECISION. AT THAT TIME EPA'S COMMENTS AND THE PUBLIC'S COMMENTS AND THE POTENTIALLY RESPONSIBLE PARTIES' COMMENTS ARE CONCENTRATED AND WE COME UP WITH A REMEDY WHICH IS APPROVED BY EPA. FROM THERE WE GO INTO WHAT WE CALL THE REMEDIAL DESIGN/REMEDIAL ACTION STAGE WHERE WE DESIGN THE ACTUAL REMEDY AND THEN THE REMEDIAL ACTION STAGE WHERE WE DESIGN THE ACTUAL REMEDY AND THEN THE REMEDIAL ACTION CARRIES IT OUT. AFTER THAT THE SITE IS ONCE AGAIN SUBJECTED TO AN INVESTIGATION, MAINLY OF FILES, AND WE COME UP WITH A DELETION REPORT. THAT IS SUBMITTED TO HEADQUARTERS AND THEN FINALLY, HOPEFULLY, THE SITE IS DELETED FROM THE NATIONAL PRIORITY LIST AND IS DEEMED TO BE SAFE. WHERE

BROWN WOOD IS AT THE MOMENT IS: WE HAVE A REMEDIAL INVESTIGATION/FEASIBILITY STUDY DONE. AND A RECORD-OF-DECISION HOPEFULLY WILL BE SIGNED BY THE END OF THIS MONTH (DECEMBER) AND AT THAT TIME WE WILL BEGIN NEGOTIATING WITH THE POTENTIALLY RESPONSIBLE PARTIES, AMAX AND THE BROWN FOUNDATION AND ANY OTHER POTENTIALLY RESPONSIBLE PARTIES WE CAN BRING TO BEAR; AND SEE IF THEY WANT TO IMPLEMENT THE REMEDIAL DESIGN/REMEDIAL ACTION. YOU MIGHT ASK WHY IS THIS PRESENT REMOVAL ACTIVITY GOING ON OUT THERE . . .

BEING UNDERTAKEN UNDER SECTION 122(E)(6) OF THE SUPERFUND LAW WHICH INDICATES THAT THIS TYPE OF ACTIVITY CAN GO ON IF AUTHORIZED BY THE PRESIDENT. THE ACTIVITY IS IN CONCERT WITH THE PRESENT PROPOSED DRAFT REMEDY AND ISN'T DEEMED TO BE HAZARDOUS OR CAUSING ANY KIND OF ENDANGERMENT TO THE PUBLIC. UNLESS ANYONE HAS ANY QUESTIONS ABOUT THIS, WHAT I'VE SAID ALREADY, I'LL . . .

OF COURSE MOST OF THE PEOPLE HERE UNDERSTAND THE BASIC HISTORY OF THE SITE. IT WAS A WOOD PRESERVING . . .

IT BASICALLY OPERATED FOR 30 YEARS FROM 1948 THROUGH 1978. THE PRESERVATIVES USED WERE CREOSOTE AND PENTACHLOROPHENOL, THE ACRONYM FOR THAT IS PCP. THERE ARE SEVERAL AREAS WHERE THE CREOSOTE AND THE PCP HAVE CONTAMINATED THE SURFACE SOILS; AND THERE IS A LAGOON OUT THERE WHICH HAS CREOSOTE SLUDGES IN IT. AS FAR AS WE KNOW AT THIS TIME THERE'S NO SIGNIFICANT GROUNDWATER CONTAMINATION. CHIEFLY DUE TO THE PROBABLE EXISTENCE OF A LAYER OF CLAY UNDERNEATH THE SLUDGE IN THE LAGOON AND ALSO BECAUSE THERE ARE A GREAT MANY CHANNELS UNDER THE SITE WHICH ALLOW THE GROUNDWATER TO MOVE RATHER RAPIDLY. SINCE THE LAST RELEASE OVER 10 YEARS AGO . . . MOST OF THE CONTAMINATION . . .

EPA'S PROPOSED REMEDY FOR THE SITE CONSISTS OF SEVERAL PARTS. NUMBER 1: WE PROPOSE THAT THE SLUDGES IN THE LAGOON AND ANY OTHER SLUDGES THAT WE FIND BE REMOVED AND PRETREATED OR TREATED AND BE TAKEN TO A FACILITY AT EMELLE, ALABAMA, OR PINEWOOD, SOUTH CAROLINA. TWO: WE PROPOSE THAT A TEST DEMONSTRATION USING ONE OR TWO CELLS USING CONTAMINATED SURFACE SOIL . . .

THREE: WE ALSO PROPOSE THAT

FOUR: . . .

I BELIEVE THAT PRETTY WELL DESCRIBES WHAT THE EPA PROPOSES; SO I'D LIKE TO OPEN IT UP . . . TO QUESTIONS OR COMMENTS.

(NO QUESTIONS OR COMMENTS FORTHCOMING.).

OKAY.

I THINK THAT THE PRESENT REMOVAL ACTION IS PROBABLY VERY APPROPRIATE AT THIS TIME. THERE ARE SEVERAL REASONS FOR THAT. FRANKLY, WE AT THE REGIONAL OFFICE HAVE RECEIVED SOME FLAK FOR AUTHORIZING THIS ACTIVITY. HOWEVER, THERE ARE OVERLAPS OF WINDOW OF OPPORTUNITY THAT WE CAN TAKE ADVANTAGE OF AT THE PRESENT TIME, THE CHIEF ONE IS THE DRY SEASON IN THIS PART OF THE SOUTH. IT WILL COST A GREAT DEAL MORE IF WE OPERATE IN THE WET SEASON AND IT WILL PRESENT GREATER PROBLEMS . . .

NUMBER TWO, THERE IS A DIFFICULT REGULATORY SITUATION AT THE PRESENT TIME. UNDER THE RESOURCE CONSERVATION AND RECOVERY ACT, AND AMENDMENTS TO THAT LAW, OR ADDITIONS TO THAT, THERE IS A GRADUAL LAND BAN GOING INTO EFFECT WHEREBY ONLY CERTAIN WASTES CAN BE TAKEN FROM THESE SITES AND SENT TO HAZARDOUS WASTE FACILITIES. IT'S A GRADUAL PHASE-IN. THERE HAVE BEEN VARIANCES GIVEN SO THAT CERTAIN WASTES GO IN AT CERTAIN TIME PERIODS. THIS TYPE OF WASTE HERE, CREOSOTE WASTES, . . . CAN GO IN ONLY FOR A VERY SHORT PERIOD OF TIME. WHEN THAT WINDOW CLOSES, GIVEN THE PRESENT SITUATION, THEN IT CAN NO LONGER BE DONE. I WAS TOLD BY HEADQUARTERS WITHIN THE LAST COUPLE OF DAYS THAT VIRTUALLY ALL THIS TYPE OF WASTE WILL EVENTUALLY HAVE TO BE INCINERATED ON-SITE OR OFF-SITE. THE TYPE OF LAND DISPOSAL WHEREBY EXCAVATION AND REMOVAL WAS ACCOMPLISHED WILL BE A THING OF THE PAST . . .

ARE THERE ANY QUESTIONS? (PAUSE) ANY QUESTIONS?

CINDY HILTY: WITH REGARD TO THE LAND BAN, WHAT DOES IT SAY EXACTLY? RCRA FACILITIES WILL NO LONGER BE ALLOWED TO ACCEPT CREOSOTE WASTES . . . WHAT DOES IT EXACTLY COVER?

TONY DEANGELO: I GAVE . . . DOCUMENTS TO RUSS (WALKER).

WHAT YOU WILL FIND IS THAT IT BECOMES DIFFICULT TO KNOW WHAT TO DO WITH THE WASTES GIVEN THE LEAD TIMES THAT YOU HAVE. IT'S GOING TO BECOME DIFFICULT TO PLAN AHEAD GIVEN THESE VARYING WINDOWS OF OPPORTUNITY.

CHUCK ROOKS: LET ME JUST CLARIFY THAT: WHEN TONY SAID THAT THERE WAS SOME FLAK ON CONDUCTING THE REMOVAL OPERATION. NOBODY IS QUESTIONING THE ENVIRONMENTAL SAFETY OR ANYTHING LIKE THAT. IT WAS SIMPLY

A MATTER OF HOW IT WAS HANDLED AT THE REGIONAL OFFICE AND IT DOESN'T PRESENT ANY KIND OF ENVIRONMENTAL HARM . . . WE THINK THAT THE . . . IS APPROPRIATE AND EVERYONE AGREES WITH THAT.

DENNIS PRICE (FDER LOCAL LIAISON):

TONY DEANGELO: DOES ANYONE HAVE ANY QUESTIONS ABOUT THE ENFORCEMENT PROCESS? EXACTLY HOW THINGS ARE GOING TO OPERATE AFTER THE RECORD-OF-DECISION IS SIGNED.

SOMEONE: I'M SURE WE DO.

TONY DEANGELO: WELL, ALL RIGHT, I WANT TO SAY A FEW WORDS ABOUT THAT. THERE ARE TWO SIDES TO THE SUPERFUND PROCESS IN TERMS OF NOT ONLY IMMEDIATE REMOVALS, CHEMICAL SPILLS AND THAT KIND OF STUFF, BUT ALSO IN TERMS OF REMEDIAL OR LONG-TERM ACTIVITY AT SITES LIKE BROWN WOOD. THE ONE SIDE IS WHAT WE CALL THE FUND LEAD SITE. IN THAT AREA EPA PEOPLE ACT IN CONCERT WITH EPA CONTRACTORS TO ACCOMPLISH SUCH ACTIVITIES. ON THE OTHER SIDE WE HAVE THE ENFORCEMENT AREA. THAT IS WHERE EPA TECHNICAL PEOPLE AND LEGAL PERSONNEL GET TOGETHER AND MEET WITH PEOPLE WE FEEL ARE POTENTIALLY RESPONSIBLE UNDER THE LAW FOR WHAT'S OCCURRED AT THE SITE AND TRY TO WORK OUT AGREEMENTS TO ACCOMPLISH CLEANUPS . . . IT'S GENERALLY A MORE LABORIOUS PROCESS.

IN THE CASE OF BROWN WOOD, IF WE HAD NOT DONE ANYTHING, NOT AUTHORIZED ANY ACTIVITY WITHIN THE LAST COUPLE OF MONTHS, IN OTHER WORDS, IF THAT REMOVAL HAD NOT BEEN DONE, THEN IT WOULD PROBABLY BE AT LEAST ONE WHOLE YEAR BEFORE ANYONE WOULD BE OUT ON THE SITE AGAIN DOING ANY KIND OF CLEANUP WORK. UNDER THE NEW LAW WE HAVE TO GO THROUGH A CONSENT DECREE PROCESS. A CONSENT DECREE IS AN AGREEMENT BETWEEN THE POTENTIALLY RESPONSIBLE PARTIES AND EPA WHEREIN THE POTENTIALLY RESPONSIBLE PARTIES AGREE TO DO CERTAIN WORK WITHIN CERTAIN TIME FRAMES. THAT DECREE IS PASSED ON BY A JUDGE IN A FEDERAL DISTRICT COURT. THE DECREE IS NOT PRESENTED BY A REGIONAL ATTORNEY, BUT BY THE DEPARTMENT OF JUSTICE. SO YOU CAN SEE THAT THE MECHANISMS ARE SET UP SO THAT IT'S PROBABLY GOING TO TAKE QUITE A BIT LONGER IN ORDER TO COME TO AN AGREEMENT TO ACTUALLY DO THE ACTUAL CLEANUP.

I WOULD APPRECIATE ANY QUESTIONS --

I'M WILLING TO TAKE A SHOT . . . (UNINTELLIGIBLE.).

CINDY HILTY: (SHE SAYS SOMETHING ABOUT LOOKING FORWARD TO SEEING SOMETHING FROM RETECH.). (UNINTELLIGIBLE.).

TONY DEANGELO: DO YOU HAVE ANY? OKAY, IF THERE'S NO OTHER QUESTIONS WE WILL STAY AROUND AWHILE TO ANSWER ANY QUESTIONS YOU MIGHT HAVE. I APPRECIATE Y'ALL COMING AND I LOOK FORWARD TO SEEING YOU IN THE FUTURE. THANK YOU.

TABLE 1.0

SUMMARY OF SITE INVESTIGATIONS

COMPANY/AGENCY	DATE	ACTIVITIES
FLORIDA DER	JULY 2, 1982	PRIVATE WELL SAMPLING/SITE INSPECTION
NUS CORPORATION	FEBRUARY 9, 1983	PRIVATE WELL, SURFACE WATER AND SOIL SAMPLING
EPA EMERGENCY RESPONSE TEAM	JUNE 1983	SURFACE SOIL/WASTE SAMPLING (1)
LETCO	SEPTEMBER 1983	SOIL BORINGS/GROUND WATER/SURFACE WATER SAMPLING
LETCO	NOVEMBER 1984	PRELIMINARY SITE INVESTIGATION REPORT (2)
FTC&H/EEM	MARCH 1986	DRAFT RI REPORT (3)
RETEC	AUGUST 1986	LAGOON TEST PITS/TCLP ANALYSES
FTC&H/EEM	MARCH, 1987	FINAL RI REPORT (4)
ERT	JULY 1987	RISK ASSESSMENT (5)

(1) P.E. LAMOREAUX AND ASSOCIATES INC. "A HYDROGEOLOGIC EVALUATION OF THE IMPACT OF PAST WASTE DISPOSAL OPERATIONS AT AN ABANDONED WOOD PRESERVING PLANT IN LIVE OAK, FLORIDA AND RECOMMENDATIONS FOR REMEDIAL ACTION". NOVEMBER 15, 1983

(2) LAW ENGINEERING AND TESTING COMPANY "FINAL REPORT OF INVESTIGATION FOR THE BROWN WOOD PRESERVING SITE, LIVE OAK, FLORIDA". NOVEMBER 20, 1984

(3) FTC&H AND ENVIRONMENTAL ENGINEERING MANAGEMENT "REPORT ON THE REMEDIAL INVESTIGATION, BROWN WOOD PRESERVING SITE, LIVE OAK, FLORIDA". (FIRST DRAFT) MARCH 6, 1986

(4) FTC&H AND ENVIRONMENTAL ENGINEERING MANAGEMENT "REPORT ON THE REMEDIAL INVESTIGATION, BROWN WOOD PRESERVING SITE, LIVE OAK, FLORIDA". (FINAL)

(5) ERT "RISK ASSESSMENT TO ACCOMPANY THE FEASIBILITY STUDY OF THE LIVE OAK SUPERFUND SITE, LIVE OAK, FLORIDA". JULY 1987.

TABLE 2.0

SUMMARY OF TECHNOLOGY SCREENING

TECHNOLOGY	APPLICABLE
CONTAINMENT TECHNOLOGIES	
- IN-SITU SOLIDIFICATION	NO
- VERTICAL SEEPAGE CUTOFFS	NO
- HORIZONTAL BARRIERS	NO
SOURCE REMOVAL	
- WATER INFLOW CONTROL	YES
- WATER REMOVAL	YES
- EXCAVATION	YES
WATER TREATMENT TECHNOLOGIES	
- PRETREATMENT AND MUNICIPAL DISCHARGE	YES
- TREATMENT AND SURFACE WATER DISCHARGE	NO
- EVAPORATION	NO
- SPRAY IRRIGATION	YES
BIOLOGICAL TREATMENT TECHNOLOGIES	
- LAND TREATMENT	YES
- BATCH REACTORS	YES (1)
- IN-SITU TREATMENT	NO (2)
THERMAL TREATMENT TECHNOLOGIES	
- HUBER SYSTEM	NO
- SHIRCO	YES
- MOBILE ROTARY KILN	NO
- MOBILE CIRCULATING FLUIDIZED BED	NO
- COMMERCIAL INCINERATOR	NO
- INDUSTRIAL KILN	YES
SOLVENT EXTRACTION	
- B.E.S.T. PROCESS	NO
- CRITICAL FLUID EXTRACTION SYSTEM	NO
- PCB SOIL DECONTAMINATION PROCESS	NO
DISPOSAL	
- ON-SITE VAULT	NO
- OFF-SITE COMMERCIAL FACILITIES	YES

(1) ONLY FOR SLUDGES
(2) APPLICABLE TO LOW LEVEL CONTAMINATED SOILS.

TABLE 3.0

ESTIMATED VOLUMES
OF
CONTAMINATED MATERIALS

(PRIOR TO REMOVAL WHICH OCCURRED DEC. '87 - FEB. '88 UNDER EPA APPROVAL)

LOCATION	MATERIAL	AREA (FT 2)	DEPTH (FT)	VOLUME (YD 3)
PLANT AREA	SOIL	40600 (1)	0.5 (3)	750-1100
DITCH	SLUDGE	3000 (1)	3.5 (4)	400-600
LAGOON	SLUDGE	106938 (2)	0-4.0 (4)	3000
LAGOON SOIL	SOIL	106938 (2)	0-3 (5)	1000-6500

NOTES:

(1) AREA CALCULATED FROM "RESIDUE AREA", FISHBECK-THOMPSON CARR & HUBER, INC. "AMAX/BROWN WOOD PRESERVING SITE HYDROLOGIC STUDY", SHEET 10, PROJECT NO. F 84816A

(2) LAW ENGINEERING TESTING CO., "FINAL REPORT OF INVESTIGATION FOR THE BROWN WOOD PRESERVING SITE, JOB NO. GE4271, DATED NOVEMBER 1984

(3) ASSUMED AVERAGE DEPTH BASED ON ANALYTICAL RESULTS SAMPLE NUMBERS SL-055, 058, 061, 062, 067, 300-323, 400, 401

(4) ASSUMED DEPTH BASED ON TEST HOLE 12 BY ARDAMAN AND ASSOCIATES, 1985, AND TEST PIT 3 BY ERT, 1985

(5) SEE TEXT FOR ASSUMPTIONS.

TABLE 5.0

CHRONOLOGY OF ENVIRONMENTAL SAMPLING

LIVE OAK, FLORIDA

	DATE	SAMPLED	N	FOR
FDER	SUMMER/82	SURFACE AND GROUND WATER (PRIVATE WELLS)	4	"PURGEABLE ORGANICS"
EPA	2/8/83	AIR		
EPA	2/8/83	GROUND WATER (PRIVATE WELLS)	7	METALS
EPA	2/9/83	SURFACE WATER	3	CREO. CONSTITUENTS, PCP
EPA	2/83	SEDIMENT (DITCH AND LAGOON)	2	CREO. CONSTITUENTS, PCP
EPA/PELA	6/83	BORINGS		CREO. CONSTITUENTS, PCP
PELA	6/24/83	SURFACE WATER	3	CREO. CONSTITUENTS, PCP
LETCO	9/83	BORINGS	7	CREO. CONSTITUENTS, PCP
EEM	9/84	SURFACE SOIL (PLANT AREA)	7	CREO. CONSTITUENTS, PCP
EEM	1/85	BORINGS (DITCH AND PLANT)	10	CREO. CONSTITUENTS, PCP
EEM	8/85	SURFACE SOIL (PLANT)	26	CREO. CONSTITUENTS, PCP
EEM	8/85	SURFACE SOIL (WOOD STORAGE)	16	CREO. CONSTITUENTS, PCP
EEM	9/85	GROUND WATER (MONITORING WELLS)	5	CREO. CONSTITUENTS, PCP
EEM	10/86	GROUND WATER (MONITORING WELL)	7	CREO. CONSTITUENTS, PCP
EEM	1/87	GROUND WATER (MONITORING WELL AND PRIVATE WELL)	3	CREO. CONSTITUENTS

* CREO. CONSTITUENTS = PHENOL, DIBENZOFURAN AND PAH ASSOCIATED WITH CREOSOTE

* PCP = PENTACHLOROPHENOL.

TABLE 6.0

INDICATOR CHEMICALS

COMPOUND	WEIGHT OF EVIDENCE (A)	SOLUBILITY (B)	LOG KOW (C)
BENZO (A) ANTHRACENE	B2	14	5.61
BENZO (B) FLUORANTHENE	B2	0.8	6.06
BENZO (A) PYRENE	B2	3.8	6.06
CHRYSENE	B2	2	5.61
DIBENZO (A,H) ANTHRACENE	B2	0.5	6.77
INDENO (1,2,3,CD) PYRENE	C	0.2	
FLUORANTHENE	NOT RANKED	260	4.90
PENTACHLOROPHENOL	D	14000	5.01

(A) EPA (1986). THERE ARE ONLY A LIMITED NUMBER OF CHEMICAL COMPOUNDS THAT HAVE BEEN DEMONSTRATED UNEQUIVOCALLY TO BE HUMAN CARCINOGENS; HOWEVER, EXPERIMENTAL AND EPIDEMIOLOGIC DATA ARE AVAILABLE THAT ARE SUGGESTIVE OF THE CARCINOGENIC ACTIVITY OF CERTAIN COMPOUNDS. THE EPA "WEIGHT-OF-EVIDENCE" SYSTEM FOR RANKING FROM A TO D (IN DECREASING ORDER) THE LEVEL OF CERTAINTY THAT A COMPOUND IS A HUMAN CARCINOGEN IS EXPLAINED IN THE TEXT. THERE ARE NO A OR B-1 LEVEL CARCINOGENS PRESENT AT THE LIVE OAK SITE. CERTAIN PAH COMPOUNDS PRESENT AT THE SITE HAVE BEEN RATED AT B-2 OR C-LEVEL POTENTIAL CARCINOGENS. TO OBTAIN AN APPROPRIATELY CONSERVATIVE RISK ASSESSMENT THE ASSUMPTION IS MADE THAT COMPOUNDS ARE HUMAN CARCINOGENS, EVEN IF THERE IS LIMITED CERTAINTY THAT THIS EFFECT IS REAL. AS SUCH, POTENTIAL CARCINOGENS DOWN TO LEVEL C WEIGHT OF EVIDENCE HAVE BEEN SELECTED. (EPA, 1986)

(B) SOLUBILITY (IN PPB), AT 25 DEGREES C. DATA FOR PAH FROM CRAUN AND MIDDLETON, 1984, DATA FOR PENTACHLOROPHENOL FROM EPA, 1980C.

(C) LOG OCTANOL/WATER COEFFICIENT. DATA FOR PAH FROM EPA, 1980B. DATA FOR PENTACHLOROPHENOL EPA, 1980C.

(ATTACHMENT)

TABLE 1

TRANSPORTATION LOG SUMMARY
LIVE OAK, FLORIDA

DATE	NET TONS
12-15	304.11
12-16	602.13
12-17	473.45
12-18	698.73
12-19	517.13
12-20	322.61
1-4	1097.25
1-5	1233.27
1-6	1298.27
1-7	494.38
1-8	437.00
1-9	324.97
1-10	1318.33
1-11	1623.51
1-12	619.50
1-13	527.30
1-14	291.33
1-15	136.10
1-18	167.18
1-19	643.39
1-20	430.67
1-21	639.79
1-22	595.72
1-23	238.92
1-26	22.51
TOTAL	15057.55.

(ATTACHMENT)

TABLE 2

PAH CONCENTRATIONS IN LAGOON SOIL

COMPOUND	SAMPLE, CONCENTRATIONS IN UG/G (PPM)					
	2-3A	2-3B	2-3C	3-5A	3-5B	3-5C
NAPHTHALENE	160	0.96	0	20	0	0
2-METHYL NAPHTHALENE	120	0	0	0	0	0
ACENAPHTHYLENE	0	0	0	0	0	0
ACENAPHTHENE	100	1	0	0	0	0
FLUORINE	89	0	0	0	0	0
PHENANTHRENE	180	0	0	0	0	0
ANTHRACENE	0	0	0	0	0	0
FLUORANTHENE	150	0	0	0	0	0
PYRENE	110	0	0	0	0	0
BENZO(A)ANTHRACENE	14	0	0	0	0	0
CHRYSENE	0	0	0	0	0	0
BENZO(B)FLUORANTHENE	3	0	0	0	0	0
BENZO(K)FLUORANTHENE	0	0	0	0	0	0
BENZO(A)PYRENE	0	0	0	0	0	0
INDENO(1,2,3-CD) PYRENE	0	0	0	0	0	0
DIBENZO(A,H)ANTHRACENE	0	0	0	0	0	0
BENZO(GHI)PERYLEN	0	0	0	0	0	0
TOTAL PAH	926	1.96	0	20	0	0
CARCINOGENIC PAH	17	0	0	0	0	0

(ATTACHMENT)

TABLE 2

PAH CONCENTRATIONS IN LAGOON SOIL

COMPOUND	SAMPLE, CONCENTRATIONS IN UG/G (PPM) 4-6A	4-6B	5-3A	5-3B	6-1A	6-1B
NAPHTHALENE	130	130	0	0.6	0	0
2-METHYL NAPHTHALENE	44	120	0	0	0	0
ACENAPHTHYLENE	0	0	0	0	0	0
ACENAPHTHENE	18	140	0	0	0	0
FLUORINE	25	110	0	0	0	0
PHENANTHRENE	36	180	6.7	6.8	0	0
ANTHRACENE	0	0	0	0	0	0
FLUORANTHENE	9	120	3	3.5	0	0
PYRENE	9	100	0	1.5	0	0
BENZO(A)ANTHRACENE	0	13	0	0	0	0
CHRYSENE	0	0	0	0	0	0
BENZO(B)FLUORANTHENE	0	0	0	0	0	0
BENZO(K)FLUORANTHENE	0	0	0	0	0	0
BENZO(A)PYRENE	0	0	0	0	0	0
INDENO(1,2,3-CD) PYRENE	0	0	0	0	0	0
DIBENZO(A,H)ANTHRACENE	0	0	0	0	0	0
BENZO(GHI)PERYLEN	0	0	0	0	0	0
TOTAL PAH	271	913	9.7	12.4	0	0
CARCINOGENIC PAH	0	13	0	0	0	0

(ATTACHMENT)

TABLE 2

PAH CONCENTRATIONS IN LAGOON SOIL

COMPOUND	SAMPLE, CONCENTRATIONS IN UG/G (PPM) 6-2A	6-2B	6-3A	6-3B	7-1A	7-1B
NAPHTHALENE	0	0	0	0	0	0
2-METHYL NAPHTHALENE	0	0	0	0	0	0
ACENAPHTHYLENE	0	0	0	0	0	0
ACENAPHTHENE	0	0	0	0	0	0
FLUORINE	0	0	0	0	0	0
PHENANTHRENE	0	0	0	0	0	0
ANTHRACENE	0	0	0	0	0	0
FLUORANTHENE	0	0	0	0	0	0
PYRENE	0	0	0	0	0	0
BENZO(A)ANTHRACENE	0	0	0	0	0	0
CHRYSENE	0	0	0	0	0	0
BENZO(B)FLUORANTHENE	0	0	0	0	0	0
BENZO(K)FLUORANTHENE	0	0	0	0	0	0
BENZO(A)PYRENE	0	0	0	0	0	0
INDENO(1,2,3-CD) PYRENE	0	0	0	0	0	0
DIBENZO(A,H)ANTHRACENE	0	0	0	0	0	0
BENZO(GHI)PERYLEN	0	0	0	0	0	0
TOTAL PAH	0	0	0	0	0	0
CARCINOGENIC PAH	0	0	0	0	0	0

(ATTACHMENT)

TABLE 2

PAH CONCENTRATIONS IN LAGOON SOIL

COMPOUND	SAMPLE, CONCENTRATIONS IN UG/G (PPM) 7-2A	7-2B	7-3A	7-3B
NAPHTHALENE	0	0	0	0
2-METHYL NAPHTHALENE	0	0	0	0
ACENAPHTHYLENE	0	0	0	0
ACENAPHTHENE	0	0	0	0
FLUORINE	0	0	0	0
PHENANTHRENE	0	0	0	0
ANTHRACENE	0	0	0	0
FLUORANTHENE	0	0	0	0
PYRENE	0	0	0	0
BENZO(A)ANTHRACENE	0	0	0	0
CHRYSENE	0	0	0	0
BENZO(B)FLUORANTHENE	0	0	0	0
BENZO(K)FLUORANTHENE	0	0	0	0
BENZO(A)PYRENE	0	0	0	0
INDENO(1,2,3-CD) PYRENE	0	0	0	0
DIBENZO(A,H)ANTHRACENE	0	0	0	0
BENZO(GHI)PERYLEN	0	0	0	0
TOTAL PAH	0	0	0	0
CARCINOGENIC PAH	0	0	0	0

(ATTACHMENT)

TABLE 2

PAH CONCENTRATIONS IN LAGOON SOIL

COMPOUND	SAMPLE, CONCENTRATIONS IN UG/G (PPM) 2-1A	2-1B	2-2A	2-2B	3-1A	3-1B
NAPHTHALENE	46	2700	1000	90	860	500
2-METHYL NAPHTHALENE	23	1800	470	64	350	470
ACENAPHTHYLENE	0	0	0	0	0	0
ACENAPHTHENE	72	1100	580	62	330	250
FLUORINE	17	1600	560	110	340	380
PHENANTHRENE	13	1500	1200	64	530	340
ANTHRACENE	0	280	31	0	22	0
FLUORANTHENE	4.6	940	940	86	440	320
PYRENE	1.9	680	660	61	320	140
BENZO(A)ANTHRACENE	0	150	150	0	55	0
CHRYSENE	0	150	187	24	44	90
BENZO(B)FLUORANTHENE	0	46	64	0	26	11
BENZO(K)FLUORANTHENE	0	0	0	0	0	0
BENZO(A)PYRENE	0	75	41	0	12	0
INDENO(1,2,3-CD) PYRENE	0	0	0	0	0	0
DIBENZO(A,H)ANTHRACENE	0	0	0	0	0	0
BENZO(GHI)PERYLEN	0	0	0	0	0	0
TOTAL PAH	177.5	11021	5883	561	3329	2501
CARCINOGENIC PAH	0	421	442	24	137	101

(ATTACHMENT)

TABLE 2

PAH CONCENTRATIONS IN LAGOON SOIL

COMPOUND	SAMPLE, CONCENTRATIONS IN UG/G (PPM) 5-1A	5-1B
NAPHTHALENE	15	0
2-METHYL NAPHTHALENE	0	0
ACENAPHTHYLENE	0	0
ACENAPHTHENE	0	0
FLUORINE	5.3	0
PHENANTHRENE	4.6	3.6
ANTHRACENE	0	0
FLUORANTHENE	0	0
PYRENE	0	0
BENZO(A)ANTHRACENE	0	0
CHRYSENE	0	0
BENZO(B)FLUORANTHENE	0	0
BENZO(K)FLUORANTHENE	0	0
BENZO(A)PYRENE	0	0
INDENO(1,2,3-CD) PYRENE	0	0
DIBENZO(A,H)ANTHRACENE	0	0
BENZO(GHI)PERYLEN	0	0
TOTAL PAH	24.9	3.6
CARCINOGENIC PAH	0	0.

(ATTACHMENT)

TABLE 4

ANALYTICAL RESULTS:
LAGOON (OR POND) WATER BEFORE TREATMENT

COMPOUND	SAMPLE CONCENTRATIONS IN UG/L (PPB)	
	INFLUENT #1	INFLUENT #2
NAPHTHALENE	20500	560
2-METHYL NAPHTHALENE	2700	180
ACENAPHTHYLENE	LT 5	LT 5
ACENAPHTHENE	5100	920
FLUORINE	4600	1200
PHENANTHRENE	10600	9300
ANTHRACENE	LT 5	LT 5
FLUORANTHENE	3800	4800
PYRENE	2100	4000
BENZO(A)ANTHRACENE	320	400
CHRYSENE	370	720
BENZO(K)FLUORANTHENE	56	40
BENZO(B)FLUORANTHENE	210	360
BENZO(A)PYRENE	400	480
DIBENZO(A,H)ANTHRACENE	LT 5	LT 5
INDENO(1,2,-CD)PYRENE	LT 5	LT 5
BENZO(G,H,I)PERYLENE	LT 5	LT 5
PENTACHLOROPHENOL	2100	LT 1000
SURROGATES		
% RECOV. FLUOROBIPHENYL	34	52
% RECOV. TRIBROMOPHENOL	120	110
% RECOV. TERPHENYL-D14	55	98.

(ATTACHMENT)

LAUCKS
TESTING LABORATORIES, INC.

CERTIFICATE

CLIENT: REMEDIATION TECHNOLOGY, INC.
19219 WEST VALLEY HWY., SUITE M103
KENT, WA 98032
ATTN: JOHN RYAN

LABORATORY NO. 8028

DATE: FEB. 2, 1988
PROJ. NO. C86-006-910

REPORT ON: WATER

SAMPLE
IDENTIFICATION: SUBMITTED 01/29/88 AND IDENTIFIED AS SHOWN:

1) WATER #1 01/28/88 16:15
2) WATER #2 01/28/88 16:30

TESTS PERFORMED
AND RESULTS:

PARTS PER MILLION (MG/L)

	1	2
ARSENIC	LT 0.005	LT 0.005
COPPER	0.003	0.003
CHROMIUM	0.013	0.006

SAMPLES WERE ANALYZED IN ACCORDANCE WITH TEST METHODS FOR EVALUATING SOLID WASTE, (SW-846), U.S.E.P.A., 1982, METHOD 8270 (SEMI-VOLATILE EXTRACTABLES).

EXTRACTABLES (BY GC/MS)

PARTS PER BILLION (UG/L)

	1	2	LAB BLANK
PHENOL	LT 2.	LT 2.	LT 2.
* ANILINE	LT 10.	LT 10.	LT 10.
BIS(2-CHLOROETHYL)ETHER	LT 2.	LT 2.	LT 2.
2-CHLOROPHENOL	LT 2.	LT 2.	LT 2.
1,3-DICHLOROBENZENE	LT 2.	LT 2.	LT 2.

REMEDIATION TECHNOLOGY, INC. LABORATORY NO. 8028

PARTS PER BILLION (UG/L)

	1	2	LAB BLANK
1,4-DICHLOROBENZENE	LT 2.	LT 2.	LT 2.
* BENZYL ALCOHOL	LT 2.	LT 2.	LT 2.
1,2-DICHLOROBENZENE	LT 2.	LT 2.	LT 2.
* 2-METHYLPHENOL	LT 2.	LT 2.	LT 2.
BIS(2-CHLOROISOPROPYL)ETHER	LT 2.	LT 2.	LT 2.
* 4-METHYLPHENOL	LT 2.	LT 2.	LT 2.
N-NITROSO-DI-N-PROPYLAMINE	LT 2.	LT 2.	LT 2.
HEXACHLOROETHANE	LT 4.	LT 4.	LT 4.
NITROBENZENE	LT 2.	LT 2.	LT 2.
ISOPHORONE	LT 2.	LT 2.	LT 2.
2-NITROPHENOL	LT 2.	LT 2.	LT 2.
2,4-DIMETHYLPHENOL	LT 2.	LT 2.	LT 2.
* BENZOIC ACID	LT 50.	LT 50.	LT 50.
BIS(2-CHLOROETHOXY)METHANE	LT 2.	LT 2.	LT 2.
2,4-DICHLOROPHENOL	LT 4.	LT 4.	LT 4.
1,2,4-TRICHLOROBENZENE	LT 2.	LT 2.	LT 2.
NAPHTHALENE	LT 4.	LT 4.	LT 4.
* 4-CHLOROANILINE	LT 2.	LT 2.	LT 2.
HEXACHLOROBUTADIENE	LT 2.	LT 2.	LT 2.
4-CHLORO-3-METHYLPHENOL	LT 4.	LT 4.	LT 4.
* 2-METHYLNAPHTHALENE	LT 2.	LT 2.	LT 2.
HEXACHLOROCYCLOPENTADIENE	LT 4.	LT 4.	LT 4.
2,4,6-TRICHLOROPHENOL	LT 4.	LT 4.	LT 4.
* 2,4,5-TRICHLOROPHENOL	LT 4.	LT 4.	LT 4.
2-CHLORONAPHTHALENE	LT 2.	LT 2.	LT 2.
* 2-NITROANILINE	LT 4.	LT 4.	LT 4.
DIMETHYL PHTHALATE	LT 2.	LT 2.	LT 2.
ACENAPHTHYLENE	LT 2.	LT 2.	LT 2.
* 3-NITROANILINE	LT 10.	LT 10.	LT 10.
ACENAPHTHENE	LT 2.	LT 2.	LT 2.
2,4-DINITROPHENOL	LT 20.	LT 20.	LT 20.

REMEDIATION TECHNOLOGY, INC. LABORATORY NO. 8028

PARTS PER BILLION (UG/L)

	1	2	LAB BLANK
4-NITROPHENOL	LT 20.	LT 20.	LT 20.
* DIBENZOFURAN	LT 2.	LT 2.	LT 2.
2,4-DINITROTOLUENE	LT 4.	LT 4.	LT 4.
2,6-DINITROTOLUENE	LT 2.	LT 2.	LT 2.
DIETHYL PHTHALATE	LT 2.	LT 2.	LT 2.
4-CHLOROPHENYL-PHENYLETHER	LT 2.	LT 2.	LT 2.
FLUORENE	LT 2.	LT 2.	LT 2.
* 4-NITROANILINE	LT 4.	LT 4.	LT 4.
4,6-DINITRO-2-METHYLPHENOL	LT 20.	LT 20.	LT 20.
N-NITROSODIPHENYLAMINE	LT 2.	LT 2.	LT 2.
1,2-DIPHENYLHYDRAZINE	LT 4.	LT 4.	LT 4.
4-BROMOPHENYL-PHENYLETHER	LT 4.	LT 4.	LT 4.
HEXACHLOROBENZENE	LT 2.	LT 2.	LT 2.
PENTACHLOROPHENOL	LT 20.	LT 20.	LT 20.
PHENANTHRENE	5.	LT 2.	LT 2.
ANTHRACENE	LT 2.	LT 2.	LT 2.
DI-N-BUTYL PHTHALATE	LT 2.	LT 2.	LT 2.
FLUORANTHENE	5.	LT 2.	LT 2.
PYRENE	3.	LT 2.	LT 2.
BENZIDINE	LT 50.	LT 50.	LT 50.
BUTYLBENZYLPHTHALATE	LT 2.	LT 2.	LT 2.
3,3'-DICHLOROBENZIDINE	LT 20.	LT 20.	LT 20.
BENZO(A)ANTHRACENE	LT 2.	LT 2.	LT 2.
BIS(2-ETHYLHEXYL)PHTHALATE	LT 2.	LT 2.	LT 2.
CHRYSENE	LT 2.	LT 2.	LT 2.
DI-N-OCTYL PHTHALATE	LT 2.	LT 2.	LT 2.
BENZO(B)FLUORANTHENE	LT 4.	LT 4.	LT 4.
BENZO(K)FLUORANTHENE	LT 4.	LT 4.	LT 4.
BENZO(A)PYRENE	LT 4.	LT 4.	LT 4.
INDENO(1,2,3-CD)PYRENE	LT 4.	LT 4.	LT 4.
DIBENZO(A,H)ANTHRACENE	LT 4.	LT 4.	LT 4.
BENZO(G,H,I)PERYLENE	LT 4.	LT 4.	LT 4.

REMEDIATION TECHNOLOGY, INC. LABORATORY NO. 8028

SAMPLES WERE ANALYZED IN ACCORDANCE WITH TEST METHODS FOR EVALUATING SOLID WASTE (SW-846), U.S.E.P.A., 1982, METHOD 8240 (VOLATILE ORGANICS).

VOLATILE ORGANICS (BY GC/MS)

PARTS PER BILLION (UG/L)

	1	2	LAB BLANK
CHLOROMETHANE	LT 1.	LT 1.	LT 1.
BROMOMETHANE	LT 1.	LT 1.	LT 1.
VINYL CHLORIDE	LT 1.	LT 1.	LT 1.
CHLOROETHANE	LT 3.	LT 3.	LT 3.
METHYLENE CHLORIDE	LT 1.	LT 1.	LT 1.
* ACETONE	LT 5.	LT 5.	LT 5.
* CARBON DISULFIDE	LT 1.	LT 1.	LT 1.
1,1-DICHLOROETHENE	LT 1.	LT 1.	LT 1.
1,1-DICHLOROETHANE	LT 1.	LT 1.	LT 1.
TRANS-1,2-DICHLOROETHYLENE	LT 1.	LT 1.	LT 1.
CIS-1,2-DICHLOROETHENE	LT 1.	LT 1.	LT 1.
TOTAL-1,2-DICHLOROETHENE	LT 1.	LT 1.	LT 1.
CHLOROFORM	LT 1.	LT 1.	LT 1.
* 2-BUTANONE	39.	LT 3.	LT 3.
1,2-DICHLOROETHANE	LT 1.	LT 1.	LT 1.
1,1,1-TRICHLOROETHANE	LT 1.	LT 1.	LT 1.
CARBON TETRACHLORIDE	LT 1.	LT 1.	LT 1.
* VINYL ACETATE	LT 1.	LT 1.	LT 1.
BROMODICHLOROMETHANE	LT 1.	LT 1.	LT 1.
1,2-DICHLOROPROPANE	LT 1.	LT 1.	LT 1.
TRICHLOROETHENE	LT 1.	LT 1.	LT 1.
BENZENE	LT 1.	LT 1.	LT 1.
CHLORODIBROMOMETHANE	LT 3.	LT 3.	LT 3.
1,1,2-TRICHLOROETHANE	LT 1.	LT 1.	LT 1.
BROMOFORM	LT 1.	LT 1.	LT 1.

REMEDIATION TECHNOLOGY, INC. LABORATORY NO. 8028

PARTS PER BILLION (UG/L)

	1	2	LAB BLANK
* 4-METHYL-2-PENTANONE	LT 3.	LT 3.	LT 3.
* 2-HEXANONE	LT 3.	LT 3.	LT 3.
1,1,2,2-TETRACHLOROETHANE	LT 3.	LT 3.	LT 3.
TETRACHLOROETHENE	LT 1.	LT 1.	LT 1.
TOLUENE	LT 1.	LT 1.	LT 1.
CHLOROBENZENE	LT 3.	LT 3.	LT 3.
TRANS-1,3-DICHLOROPROPENE	LT 3.	LT 3.	LT 3.
ETHYLBENZENE	LT 1.	LT 1.	LT 1.
CIS-1,3-DICHLOROPROPENE	LT 3.	LT 3.	LT 3.
* STYRENE	LT 1.	LT 1.	LT 1.
* TOTAL XYLENES	LT 1.	LT 1.	LT 1.

KEY

* = ADDITIONAL COMPOUNDS FROM THE EPA'S HAZARDOUS SUBSTANCES LIST
LT = "LESS THAN"

RESPECTFULLY SUBMITTED,

LAUCKS TESTING LABORATORIES, INC.

J. M. OWENS

JMO:EMT.

(ATTACHMENT)

TABLE 2-1

CHRONOLOGY OF ENVIRONMENTAL SAMPLING

LIVE OAK, FLORIDA

	DATE	SAMPLED	N	FOR
FDER	SUMMER/82	SURFACE AND GROUND WATER (PRIVATE WELLS)	4	"PURGEABLE ORGANICS"
EPA	2/8/83	AIR		
EPA	2/8/83	GROUND WATER (PRIVATE WELLS)	7	METALS
EPA	2/9/83	SURFACE WATER	3	CREO. CONSTITUENTS, PCP
EPA	2/83	SEDIMENT (DITCH AND LAGOON)	2	CREO. CONSTITUENTS, PCP
EPA/PELA	6/83	BORINGS		CREO. CONSTITUENTS, PCP
PELA	6/24/83	SURFACE WATER	3	CREO. CONSTITUENTS, PCP
LETCO	9/83	BORINGS	7	CREO. CONSTITUENTS, PCP
EEM	9/84	SURFACE SOIL (PLANT AREA)	7	CREO. CONSTITUENTS, PCP
EEM	1/85	BORINGS (DITCH AND PLANT)	10	CREO. CONSTITUENTS, PCP
EEM	8/85	SURFACE SOIL (PLANT)	26	CREO. CONSTITUENTS, PCP
EEM	8/85	SURFACE SOIL (WOOD STORAGE)	16	CREO. CONSTITUENTS, PCP
EEM	9/85	GROUND WATER (MONITORING WELLS)	5	CREO. CONSTITUENTS, PCP
EEM	10/86	GROUND WATER (MONITORING WELL)	7	CREO. CONSTITUENTS, PCP
EEM	1/87	GROUND WATER (MONITORING WELL AND PRIVATE WELL)	3	CREO. CONSTITUENTS

* CREO. CONSTITUENTS = PHENOL, DIBENZOFURAN AND PAH ASSOCIATED WITH CREOSOTE

* PCP = PENTACHLOROPHENOL.

(ATTACHMENT)

TABLE 2-2

INDICATOR CHEMICALS

COMPOUND	WEIGHT OF EVIDENCE (A)	SOLUBILITY (B)	LOG KOW (C)
BENZO (A) ANTHRACENE	B2	14	5.61
BENZO (B) FLUORANTHENE	B2	0.8	6.06
BENZO (A) PYRENE	B2	3.8	6.06
CHRYSENE	B2	2	5.61
DIBENZO (A,H) ANTHRACENE	B2	0.5	6.77
INDENO (1,2,3,CD) PYRENE	C	0.2	
FLUORANTHENE	NOT RANKED	260	4.90
PENTACHLOROPHENOL	D	14000	5.01

(A) EPA (1986). THERE ARE ONLY A LIMITED NUMBER OF CHEMICAL COMPOUNDS THAT HAVE BEEN DEMONSTRATED UNEQUIVOCALLY TO BE HUMAN CARCINOGENS; HOWEVER, EXPERIMENTAL AND EPIDEMIOLOGIC DATA ARE AVAILABLE THAT ARE SUGGESTIVE OF THE CARCINOGENIC ACTIVITY OF CERTAIN COMPOUNDS. THE EPA "WEIGHT-OF-EVIDENCE" SYSTEM FOR RANKING FROM A TO D (IN DECREASING ORDER) THE LEVEL OF CERTAINTY THAT A COMPOUND IS A HUMAN CARCINOGEN IS EXPLAINED IN THE TEXT. THERE ARE NO A OR B-1 LEVEL CARCINOGENS PRESENT AT THE LIVE OAK SITE. CERTAIN PAH COMPOUNDS PRESENT AT THE SITE HAVE BEEN RATED AT B-2 OR C-LEVEL POTENTIAL CARCINOGENS. TO OBTAIN AN APPROPRIATELY CONSERVATIVE RISK ASSESSMENT THE ASSUMPTION IS MADE THAT COMPOUNDS ARE HUMAN CARCINOGENS, EVEN IF THERE IS LIMITED CERTAINTY THAT THIS EFFECT IS REAL. AS SUCH, POTENTIAL CARCINOGENS DOWN TO LEVEL C WEIGHT OF EVIDENCE HAVE BEEN SELECTED. (EPA, 1986)

(B) SOLUBILITY (IN PPB), AT 25 DEGREES C. DATA FOR PAH FROM CRAUN AND MIDDLETON, 1984, DATA FOR PENTACHLOROPHENOL FROM EPA, 1980C

(C) LOG OCTANOL/WATER COEFFICIENT. DATA FOR PAH FROM EPA, 1980B. DATA FOR PENTACHLOROPHENOL EPA, 1980C.

(ATTACHMENT)

TABLE 2-3

CONCENTRATION OF INDICATOR CHEMICALS (A)

AT EXPOSURE POINTS

LIVE OAK, FLORIDA

DRINKING WATER PATHWAY

	ANALYTICAL DATA (PPB)		MODEL (PPB)	
INDICATOR	AT MW-8	PRIVATE WELLS	AT MW-8	1600 FT WELL
CARCINOGENIC PAH	(20) (B)	D	.006	.0003
ACENAPHTHENE	45/40	D		
FLUORANTHENE	2/2 (C)	D	3	.1
PENTACHLOROPHENOL	(100) (B)	D		
PHENANTHRENE	8/11 (C)	D	31	1

(A) ALL CONCENTRATIONS GIVEN IN PPB (MICROGRAMS PER LITER). ANALYTIC DATA FOR MW-8 IS FROM OCTOBER 1986 SAMPLING, REPORTED IN THE RI; PRIVATE WELL DATA IS FROM EPA, 1983 SAMPLING INFORMATION; ACENAPHTHENE AND PHENANTHRENE CONCENTRATIONS ARE GIVEN IN ADDITION TO INDICATOR CHEMICALS; ACENAPHTHENE WAS CONSIDERED BECAUSE IT HAS AN "ORGANOLEPTIC" AWQC; PHENANTHRENE CONCENTRATIONS WERE USED TO CHECK THE TRANSPORT MODEL VALUES VERSUS ANALYTIC DATA

(B) NOT DETECTED BY EEM IN LATEST 1986 SAMPLING ROUND. VALUE GIVEN IN PARENTHESES IS DETECTION LIMIT REPORTED BY LABORATORY

(C) RESULTS OF SAMPLING IN OCTOBER, 1986 AND JANUARY, 1987, RESPECTIVELY. THESE VALUES WERE ESTIMATED BY THE LABORATORY. THE NORMAL DETECTION LIMITS ARE AFFECTED BY THE MATRIX, BUT GENERALLY ARE ABOUT 20 PPB

(D) NOT DETECTED BY EPA, 1983, NO DETECTION LIMITS GIVEN

(ATTACHMENT)

TABLE 2-3 (CONTINUED)

DIRECT CONTACT PATHWAY

INDICATOR	SURFACE WATER (A) DITCH	LAGOON	SURFACE SOILS AND (B) ACCESSIBLE SEDIMENTS
TOTAL PAH	329 PPB	76 PPB	12,357 PPM
CARCINOGENIC PAH	14 PPB	14 PPB	992 PPM
FLUORANTHENE	69 PPB	25 PPB	2,141 PPM
PENTACHLOROPHENOL	94 PPB	53 PPB	5,363 PPM

(A) DATA FROM SAMPLING ROUND BY NUS FROM DITCH AND LAGOON (1 EACH) FEBRUARY 9, 1983, EXCEPT PENTACHLOROPHENOL IN LAGOON, WHICH IS MEAN OF SAMPLING RESULTS FROM FEBRUARY 9, 1983 AND JUNE 24, 1983

(B) MEAN CONCENTRATION OF 37 SAMPLES OF SURFACE SOIL AND DITCH SEDIMENTS, AS SHOWN IN APPENDIX B.

(ATTACHMENT)

TABLE 2-4

STANDARDS AND CRITERIA FOR INDICATOR CHEMICALS

COMPOUND	AMBIENT WATER QUALITY CRITERIA (A)	RECOMMENDED MAXIMUM CONTAMINANT LEVEL (B)
CARCINOGENIC PAH	0.031 PPB (C)	
ACENAPHTHENE	20 PPB (D)	
FLUORANTHENE	188 PPB	
PENTACHLOROPHENOL	1010 PPB	200 PPB

(A) AWQC HAS BEEN ADJUSTED FOR INGESTION OF WATER ONLY. ALL VALUES GIVEN IN UNITS OF PPB (MICROGRAMS PER LITER)

(B) THE VALUE IS A PROPOSED RMCL (50 FR 47002, NOVEMBER 13, 1985)

(C) EPA HAS CALCULATED CANCER RISKS FOR VARIOUS CONCENTRATIONS. THE VALUE FOR A 1 CHANCE IN 100,000 RISK IS GIVEN HERE

(D) THE ACTUAL AWQC FOR ACENAPHTHENE IS INDICATIVE ONLY OF AN "ORGANOLEPTIC" LEVEL AT WHICH SOME IMPACT ON WATER TASTE OR SMELL MIGHT BE AFFECTED. NO HEALTH IMPACT IS EXPECTED AT THIS LEVEL.

(ATTACHMENT)

TABLE 2-5

PREDICTED INTAKES OF INDICATOR CHEMICALS

DRINKING WATER PATHWAY

LIVE OAK, FLORIDA

ON-SITE (UG/KG DAY) (A,B)

COMPOUND	CHILD INTAKE	ADULT INTAKE
CARCINOGENIC PAH	-------	0.0002
FLUORANTHENE	0.2 - 0.3	0.6 - 0.09
PENTACHLOROPHENOL	LT 10	LT 2.86

OFF-SITE (UG/KG DAY) (B,C)

COMPOUND	CHILD INTAKE	ADULT INTAKE
CARCINOGENIC PAH	-------	0.0000086
FLUORANTHENE	0.01	0.0029
PENTACHLOROPHENOL	LT 10	LT 2.86

(A) FOR PREDICTED OR MEASURED CONCENTRATIONS IN MW-8. ANALYSES WERE BELOW DETECTION LIMITS FOR PAH AND PENTACHLOROPHENOL. VALUES HAVE BEEN CALCULATED FROM MODEL PREDICTIONS FOR PAH AND DETECTION LIMITS FOR PENTACHLOROPHENOL, THE LATTER IS NOTED AS BEING "LESS THAN (LT)" THE INTAKE PREDICTED FROM CONTAMINATION AT THE DETECTION LIMIT; RANGE OF VALUES CALCULATED FOR FLUORANTHENE ARE FROM DETECTED CONCENTRATION TO CONCENTRATION PREDICTED BY THE MODEL. ALL VALUES IN UNITS OF MICROGRAMS INDICATOR CHEMICAL PER KILOGRAM BODY WEIGHT PER DAY (UG/KG DAY)

(B) BECAUSE TOXIC EFFECTS FOR CARCINOGENIC PAH REQUIRE LIFETIME DOSING, NO CHILD'S DOSE WAS CALCULATED

(C) FOR PREDICTED CONCENTRATIONS AT THE 1600 FOOT WELL. MODEL PREDICTIONS USED FOR CARCINOGENIC PAH AND FLUORANTHENE. DETECTION LIMIT USED FOR PENTACHLOROPHENOL. ALL VALUES IN UNITS OF MICROGRAMS INDICATOR CHEMICAL PER KILOGRAM BODY WEIGHT PER DAY

(ATTACHMENT)

TABLE 2-5 (CONTINUED)

PREDICTED INTAKES OF INDICATOR CHEMICALS

DIRECT CONTACT PATHWAY (A)

LIVE OAK, FLORIDA

	UG/KG DAY
CARCINOGENIC PAH	0.0076
FLUORANTHENE	0.58
PENTACHLOROPHENOL	0.23

(A) INTAKE OF MATERIALS BY CHILDREN VISITING THE SITE ONCE MONTHLY AND CONSUMING 55 MG SOIL PER VISIT FOR FIVE YEARS. ALL VALUES IN UNITS OF MICROGRAMS CONSTITUENT PER KILOGRAM BODY WEIGHT PER DAY (UG/KG DAY). VALUES ARE LIFETIME AVERAGE DAILY DOSES FOR CARCINOGENIC PAH AND AVERAGE DAILY DOSES FOR FLUORANTHENE AND PENTACHLOROPHENOL.

(ATTACHMENT)

TABLE 2-6

HEALTH RISKS FROM INDICATOR CHEMICALS

FOR PRESENT CONDITION OF SITE

LIVE OAK, FLORIDA

CARCINOGENIC PAH (A)

SOURCE	RISK
INGESTION OF DRINKING WATER	
ON SITE	2.3 CHANCES IN 1,000,000
OFF SITE	9.9 CHANCES IN 100,000,000
INGESTION OF PAH IN SURFACE SOILS	8.8 CHANCES IN 100,000

(A) CALCULATED FOR THE SUM OF CARCINOGENIC PAH, ASSUMING ALL HAVE EQUIVALENT POTENCY AS BENZO(A)PYRENE (POTENCY SLOPE = .0115/UG/KG DAY)

(ATTACHMENT)

TABLE 2-6 (CONTINUED)

HEALTH RISKS FROM INDICATOR CHEMICALS

FOR PRESENT CONDITION OF SITE

LIVE OAK, FLORIDA

HEALTH IMPACTS OF FLUORANTHENE

SOURCE	PREDICTED INTAKE/ADI (A)	
INGESTION OF DRINKING WATER	CHILD	ADULT
ON SITE	0.03 - 0.05	0.01 - 0.015
OFF SITE	0.002	0.0005
INGESTION OF FLUORANTHENE IN SURFACE SOILS	0.09	

(A) A VALUE OF LESS THAN ONE INDICATES INTAKE IS BELOW ADI (6.12 UG/KG DAY) AND VIRTUALLY NO RISK IS LIKELY. VALUES ABOVE ONE INDICATE POSSIBLE RISK OF TOXIC EFFECT

(ATTACHMENT)

TABLE 2-6 (CONTINUED)

HEALTH RISKS FROM INDICATOR CHEMICALS

FOR PRESENT CONDITION OF SITE

LIVE OAK, FLORIDA

HEALTH IMPACTS OF PENTACHLOROPHENOL

SOURCE	PREDICTED INTAKE/ADI (A)	
INGESTION OF DRINKING WATER	CHILD	ADULT
ON SITE	LT .33	LT 0.1
OFF SITE	LT .33	LT 0.1
INGESTION OF PENTACHLOROPHENOL IN SURFACE SOILS	0.008	

(A) A VALUE OF LESS THAN ONE INDICATES INTAKE IS BELOW ADI (30 UG/KG DAY) AND VIRTUALLY NO RISK IS LIKELY. VALUES ABOVE ONE INDICATE POSSIBLE RISK OF TOXIC EFFECT.

(ATTACHMENT)

TABLE 3-1

COMPARISON OF HEALTH RISKS

BEFORE AND AFTER

PREFERRED REMEDIAL ALTERNATIVE

LIVE OAK, FLORIDA

	PAH (A)		PCP (B)		FLUORANTHENE (B)	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
ACUTE DIRECT CONTACT	POSSIBLE	UNLIKELY	POSSIBLE	UNLIKELY	INCLUDED IN TOTAL PAH	
SOIL INGESTION	8.8	0.12	0.008	NC (C)	0.09	NC (C)
DRINKING WATER, OFF-SITE	0.099	NC (C)	LT 0.1-LT 0.33	NC (C)	0.002-0.0005	NC (C)
DRINKING WATER, ON-SITE	0.23	NC (C)	LT 0.1-LT 0.33	NC (C)	0.03-0.015	NC (C)

(A) PAH RISK IS CALCULATED AS CANCER RISK PER 100,000 CHANCES, EXCEPT IN THE CASE OF ACUTE DIRECT CONTACT, WHERE THE LIKELIHOOD OF DERMAL PHOTOSENSITIZATION IS ESTIMATED QUALITATIVELY

(B) PCP AND FLUORANTHENE RISK IS CALCULATED AS THE PROPORTION OF THE AIC REPRESENTED BY THE ESTIMATED INTAKE EXCEPT IN THE CASE OF ACUTE DIRECT CONTACT, WHERE THE LIKELIHOOD OF DERMAL IRRITATION IS ESTIMATED QUALITATIVELY. AS NOTED, FLUORANTHENE IS AMONG THE TOTAL PAH ASSUMED TO HAVE PHOTOSENSITIZING PROPERTIES AND IS INCLUDED UNDER THE PAH CATEGORY

(C) WHERE SMALL RISK WAS ESTIMATED FOR THE CURRENT CONDITION OF THE SITE, RISK VALUES FOR THE REMEDIATED SITE WERE NOT CALCULATED (NC).

(ATTACHMENT)

TABLE A-1

OLM MODEL PREDICTIONS AND SOLUBILITY VALUES

FOR CARCINOGENIC PAH COMPOUNDS AND FLUORANTHENE

(ALL VALUES IN PPM)

COMPOUND	SLUDGE CONC IN WASTE	SLUDGE OLM PREDICTION	SOIL CONC IN WASTE	SOIL OLM PREDICTION	SOLUBILITY
CARCINOGENIC PAH					
BENZO(A)ANTHRACENE/ BENZO(A)PYRENE	510	0.025	15.4	0.0023	0.0089 (A)
BENZO(B)FLUORANTHENE	770	0.013	10.6	0.00073	0.0008
CHRYSENE	14360	0.137	317	0.010	0.002
DIBENZO(A,H)ANTHRACENE	560	0.0090	13.8	0.00073	0.0005
INDENO(1,2,3CD)PYRENE	256	0.0038	6.7	0.00032	0.0002
FLUORANTHENE	9100	0.62	200	0.046	0.26

(A) THE MEAN SOLUBILITY LIMIT OF THE 2 COMPOUNDS WERE USED IN THE MODEL.

(ATTACHMENT)

TABLE A-2

RETARDATION FACTORS AND MASS FLUXES

FOR CARCINOGENIC PAH COMPOUNDS,
FLUORANTHENE AND PHENANTHRENE

CONSTITUENT	RETARDATION FACTOR	MASS FLUX (GM/YR)
BENZA(A)PYRENE/BENZO(A)ANTHRACENE	2.1 X 10-4	0.012
BENZO(B)FLUORANTHENE	4.1 X 10-3	0.005
CHRYSENE	1.5 X 10-3	0.037
DIBENZO(A,H)ANTHRACENE	2.5 X 10-4	0.0005
INDENO(1,2,3-CD)PYRENE	1.2 X 10-4	0.0005
FLUORANTHENE	2.8 X 10-2	25.0
PHENANTHRENE	1.0 X 10-2	261.0.

(ATTACHMENT)

TABLE A-3

HPS MODEL PREDICTIONS OF CONCENTRATIONS

OF CARCINOGENIC PAH, FLUORANTHENE AND PHENANTHRENE

AT COMPLIANCE WELL

CONSTITUENT	HPS PREDICTED CONC AT MW-8 (MG/L)	HPS PREDICTED CONC AT RECEPTOR WELL (MG/L)	HIGHEST MEASURED CONC AT MW-8 (MG/L)
BENZO(A)PYRENE/BENZO(A)ANTHRACENE	.1 X 10-5	.6 X 10-7	LT .020
BENZO(B)FLUORANTHENE	.6 X 10-6	.2 X 10-7	LT .020
CHRYSENE	.4 X 10-5	.2 X 10-6	LT .020
DIBENZO(A,H)ANTHRACENE	.6 X 10-7	.2 X 10-8	LT .020
INDENO(1,2,3-CD)PYRENE	.6 X 10-7	.2 X 10-8	LT .020
FLUORANTHENE	.003	.0001	.002
PHENANTHRENE	.031	.001	.008.

(ATTACHMENT)

TABLE B-1

DATA USED FOR DETERMINING

SURFACE SOIL CONCENTRATIONS

LIVE OAK, FLA

SOURCE	NO	CARCINOGENIC PAH	TOTAL CREOSOTE CONSTITUENTS	PCP	FLUORANTHENE
EPA, FEB. 1983	TAB. 1-4	17500	221300	3000	29000
LETCO, SEPT. 1983	A-1	15	32.8	830	3.7
(0-1 FT DEPTH)	A-2	0	0	6.1	
	A-3	12.7	43.8	158500	9.6
	A-4	13.9	44.8	985	13.7
	A-5	8.4	23.7		5.1
	A-6	269	1005.3	9550	150
	A-7	29.5	51.3	169.5	7.9
REMEDIAL	5(005)	594	1615	0	490
INVESTIGATION	8(027)	0	16300	0	7700
TEST HOLES IN	9(034)	3800	37990	0	7300
VICINITY OF LAGOON	10(040)	680	5345	0	2300
(0-1 FT, ABOVE	11(046)	166	253.8	0	9.3
WATER ONLY)	12(051)	11600	146389	0	26000
	13(055)	900	16770	20000	3300
	14(062)	918	2713	0	770
REMEDIAL	300	17.88	32.658	10	0.16
INVESTIGATION	302	0.919	1.328	0	0.011
INDIVIDUAL SOIL	304	15.79	23.724	0	4.7
SAMPLES IN FORMER	306	4.82	8.06	0	0.026
PLANT AREA	308	1.18	2.268	0	0.029
(0-0.5 FT DEPTH)	310	0.072	0.0824	0	0.095
	312	1.51	2.934	0	0
	314	19.36	30.736	0	0.35
	316	18.11	33.02	0	3.8
	318	10.7	18.09	0	0
	320	6.77	21.465	0	0
	322	2.02	3.3982	0	0.17
	400	0.503	0.706	0	0
REMEDIAL	AREA 1	17.7	31.2	0	5.1
INVESTIGATION	AREA 2	11.4	20.09	0	3.1
COMPOSITE SAMPLE	AREA 3	0.058	0.1515	0	0.036
OF SOIL IN WOOD	AREA 4	3.41	6.426	0	1.2
STORAGE AREA	AREA 5	2.91	4.22	0.5	0.58
(0-0.5 FT DEPTH)	AREA 6	54.4	77.7	0	5.5
	AREA 7	2.5	4.786	0	0.8
	AREA 8	1.53	3.38	0	0.73
	MAX	17500	221300	158500	29000
	MEAN	995	12168	5363	2141
	SD	3375	42539	26135	6415
	SEM	555	6993	4356	1069.

(ATTACHMENT)

TABLE B-2

MEAN INDICATOR CHEMICAL CONCENTRATIONS

WHEN TOTAL CREOSOTE SUBSTANCES ABOVE 1000 PPM ARE REMEDIATED

LIVE OAK, FLA

SOURCE	NO	CARCINOGENIC PAH	TOTAL CREOSOTE SUBSTANCES	PCP	FLUORANTHENE
LETCO, SEPT, 1983 (0-1 FT, EXCEPT AS NOTED)	A-1	15	32.8	830	3.7
	A-2	0	0	6.1	
	A-3	0	0	14.90	0
	A-4	13.9	44.8	985	13.7
	A-5	8.4	23.7		5.1
	A-6	24.1	70.6	805	10.4
	A-7	29.5	51.3	169.5	
RI, LAGOON (0-1 FT, EXCEPT AS NOTED)	5 (007, 3-5 FT)	0	0.34	0	0.15
	8 (029, 3-5 FT)	10.8	105.4	0	23.0
	9 (036, 3-5 FT)	0	5.09	0	.76
	10 (042, 3-5 FT)	0.15	13.11	0	.34
	11 (046)	166	253.8	0	9.3
	12 (054, 5-7 FT)	8.63	166.5	0	23
	13 (058B, 5-7 FT)	6.65	157.2	0	24
RI, PLANT AREA (0-0.5 FT DEPTH)	300	17.88	32.658	10	0.16
	302	0.919	1.328	0	0.011
	304	15.79	23.724	0	4.7
	306	4.82	8.06	0	0.026
	308	1.18	2.268	0	0.029
	310	0.072	0.0824	0	0.095
	312	1.51	2.934	0	0
	314	19.36	30.736	0	0.35
	316	18.11	33.02	0	3.8
	318	10.7	18.09	0	0
	320	6.77	21.465	0	0
	322	2.02	3.3982	0	0.17
	400	0.503	0.706	0	0
RI, WOOD STORAGE AREA (0-0.5 FT DEPTH)	AREA 1	17.7	31.2	0	5.1
	AREA 2	11.4	20.09	0	3.1
	AREA 3	0.058	0.1515	0	0.036
	AREA 4	3.41	6.426	0	1.2
	AREA 5	2.91	4.22	0.5	0.58
	AREA 6	54.4	77.7	0	5.5
	AREA 7	2.5	4.786	0	0.8
	AREA 8	1.53	3.38	0	0.73
	MAX	166	254	985	24
	MEAN	14	36	83	4
	SD	29	56	252	7
	SEM	5	10	44	1.

(ATTACHMENT)

TABLE 2B

RANGE OF VALUES LEACHATE WATER CONCENTRATIONS

COMPOUND	KOC (1)		WATER CONCENTRATION (UG/L) (2) 0.5% ORGANIC CARBON		1.0% ORGANIC CARBON	
	LOWER	UPPER	UPPER	LOWER	UPPER	LOWER
BENZO(A)ANTHRACENE	194984	1862087	21	2	10	1
CHRYSENE	194984	295121	21	14	10	7
BENZO(B)FLUORANTHENE	229087	1778279	17	2	9	1
BENZO(K)FLUORANTHENE	426580	3311311	9	1	5	1
BENZO(A)PYRENE	524807	4466836	8	1	4	0
DIBENZO(A,H)ANTHRACENE	446684	3090295	9	1	4	1
INDENO(1,2,3-CD)PYRENE	2818383	21877616	1	0	1	0

(1) FROM TABLE 2A
(2) CALCULATED USING A CONSTITUENT CONCENTRATION OF 20 PPM.

(ATTACHMENT)

TABLE 4
AVERAGE CONCENTRATIONS OF
CARCINOGENIC PAH (PPM)

WOOD STORAGE AREA

SAMPLE NUMBER	0-6 INCHES	6-12 INCHES	12-24 INCHES
1.00	11.40	0.23	BDL
2.00	11.40	0.23	BDL
3.00	11.40	0.23	BDL
4.00	11.40	0.23	BDL
5.00	2.90	0.06	BDL
6.00	2.90	0.06	BDL
7.00	2.90	0.06	BDL
8.00	2.90	0.06	BDL
9.00	2.80	0.70	BDL
10.00	2.80	0.70	BDL
11.00	2.80	0.70	BDL
12.00	2.80	0.70	BDL
13.00	3.40	1.30	BDL
14.00	3.40	1.30	BDL
15.00	3.40	1.30	BDL
16.00	3.40	1.30	BDL
17.00	1.50	0.15	BDL
18.00	1.50	0.15	BDL
19.00	1.50	0.15	BDL
20.00	1.50	0.15	BDL
21.00	62.00	6.40	3.20
22.00	62.00	6.40	3.20
23.00	62.00	6.40	3.20
24.00	62.00	6.40	3.20
25.00	17.70	7.10	3.60
26.00	17.70	7.10	3.60
27.00	17.70	7.10	3.60
28.00	17.70	7.10	3.60
29.00	0.06	BDL	BDL
30.00	0.06	BDL	BDL
31.00	0.06	BDL	BDL
32.00	0.06	BDL	BDL
AVG	12.72	1.99	0.85
COMPOSITE AVG (OVER 2 FEET)		4.10	

PLANT AREA

33.00	17.20	0.73	BDL
34.00	0.92	BDL	BDL
35.00	15.80	6.60	3.30
36.00	4.80	0.62	BDL
37.00	1.20	0.04	BDL
38.00	0.07	0.05	BDL
39.00	1.50	0.02	BDL
40.00	19.40	0.30	BDL
41.00	18.10	11.40	5.70
42.00	10.70	0.06	BDL
43.00	6.70	0.02	BDL
44.00	1.60	2.10	1.00
45.00	0.50	BDL	BDL
AVG	7.58	1.69	0.77
COMPOSITE AVG (OVER 2 FEET).		2.70	

(ATTACHMENT)

TABLE 5

LIFETIME RISK ASSOCIATED WITH VARIOUS AREAS OF THE SITE AFTER TREATMENT OF CONTAMINATED SOILS TO 100 PPM TOTAL PAH CARCINOGENS

RISK LEVELS UNDER VARIOUS SCENARIOS

LOCATION	RESIDENTIAL (B)	INDUSTRIAL	NEIGHBORHOOD CHILD
WOOD STORAGE AREA	7.7 X 10-8	8.2 X 10-11	1.9 X 10-9
PLANT AREA	5.0 X 10-8	5.4 X 10-11	1.3 X 10-9
TREATMENT AREA	1.0 X 10-6	1.1 X 10-9	2.6 X 10-8
SITE AREA (A)	1.4 X 10-7	1.5 X 10-10	3.6 X 10-9

A) WEIGHTED AVERAGE OF WOOD STORAGE AREA, PLANT AREA, TREATMENT AREA AND THE OVERALL SITE

B) NOTE: THE RESIDENTIAL SCENARIO ASSUMES THAT HOUSES ARE CONSTRUCTED ON THE SITE IMMEDIATELY AFTER TREATMENT IS COMPLETED AND THAT A PERSON SPENDS HIS ENTIRE LIFE ON THIS SITE (FROM BIRTH TO 70 YEARS); THIS SCENARIO IS EXTREMELY CONSERVATIVE AND HIGHLY UNLIKELY GIVEN THE DEMOGRAPHICS OF THE AREA.

(ATTACHMENT)

TABLE 1

LIFETIME SOIL INGESTION RISKS
ASSOCIATED WITH UNRESTRICTED RESIDENTIAL DEVELOPMENT
AFTER TREATMENT OF CONTAMINATED SOILS
TO 100 PPM TOTAL PAH CARCINOGENS (A)

HALF LIFE (YEARS)	SOIL INGESTION/EVENT (MG/EVENT)	RISK LEVEL TREATMENT AREA	SITE AREA (B)
0.5	100 MG FOR AGES 0-5, 50 MG FOR AGES 6-11 AND 5 MG FOR AGES 12-70	1.0 X 10-6	1.4 X 10-7
0.5	100 MG FOR AGES 0-11, 25 MG FOR AGES 12-70	1.0 X 10-6	1.4 X 10-7
1.0	100 MG FOR AGES 0-11, 25 MG FOR AGES 12-70	1.5 X 10-6	2.1 X 10-7
1.5	100 MG FOR AGES 0-11, 25 MG FOR AGES 12-70	2.0 X 10-6	2.8 X 10-7

A) NOTE: THE RESIDENTIAL SCENARIO ASSUMES THAT HOUSES ARE CONSTRUCTED ON THE SITE IMMEDIATELY AFTER TREATMENT IS COMPLETED AND THAT A PERSON SPENDS HIS ENTIRE LIFE ON THIS SITE (FROM BIRTH TO 70 YEARS); THIS SCENARIO IS EXTREMELY CONSERVATIVE AND HIGHLY UNLIKELY GIVEN THE DEMOGRAPHICS OF THE AREA

B) WEIGHTED AVERAGE OF WOOD STORAGE AREA, PLANT AREA, TREATMENT AREA AND THE OVERALL SITE.

(ATTACHMENT)

TABLE 1
COMPARISON OF PILOT SCALE KINETIC DATA
AT TWO INITIAL LOADING RATES

	FIRST ORDER RATE CONSTANT (DAY-1)		HALF-LIFE (DAYS)	
	5% PLOT	10% PLOT	5% PLOT	10% PLOT
BENZENE EXTRACTABLE	0.003	0.003	231	231
2-RING PAH	0.023	0.023	30	30
3-RING PAH	0.016	0.016	43	43
4-RING PAH	0.004	0.001	173	693
TOTAL PNAS	0.009	0.008	77	87.

(ATTACHMENT)

TABLE 2
SUMMARY OF START-UP DATA (5/23/86)

PARAMETER	AVERAGE
BENZENE EXTRACTABLES, %	53000
TOC, PPM	29710
TKN, PPM	1367
AMMONIA, PPM	2.37
TOTAL PHOSPHORUS, PPM	522
TOTAL POTASSIUM, PPM	502
PH	7.66
POLYNUCLEAR AROMATIC HYDROCARBONS (PAH), PPM;	
NAPHTHALENE	1148
ACENAPHTHYLENE	21
ACENAPHTHENE	1082
TOTAL 2-RING PAH	2251
FLUORINE	1885
PHENANTHRENE	4190
ANTHRACENE	3483
TOTAL 3-RING PAH	9558
FLUORANTHENE	1575
PYRENE	958
BENZO(A)ANTHRACENE AND CHRYSENE	837
TOTAL 4-RING PAH	3370
BENZOFLUORANTHENES	368
BENZOPYRENES	294
INDENO(123CD)PYRENE	111
DIBENZO(AH)ANTHRACENE	100
BENZO(GHI)PERYLENE	106
TOTAL 5-RING PAH'S	979
TOTAL PAH'S	16159.

TABLE 3
COMPARISON OF FULL SCALE AND TEST PLOT REMOVALS

	AVE. PERCENT REMOVAL		AVE. HALF-LIFE (DAYS)	
PARAMETER	FULL SCALE (1)	TEST PLOTS (2)	FULL SCALE	TEST PLOTS
2-RING PAHS	95	93 - 95	LT 45	29 - 33
3-RING PAHS	95	83 - 85	45	46 - 49
4-AND 5-RING PAHS	72	32 - 60	115	95 - 226
TOTAL PAHS	90	65 - 76	65	61 - 83
BE HYDROCARBONS	60	35 - 56	150	106 - 202

(1) REMOVAL EFFICIENCY CALCULATED AFTER 193 DAYS OF TREATMENT
(2) REMOVAL EFFICIENCY CALCULATED AFTER 126 DAYS OF TREATMENT.

(ATTACHMENT)

TABLE 4
DRAIN TILE WATER QUALITY

	CONCENTRATION, PPB		
COMPOUND	JUNE 1986	AUGUST 1986	OCTOBER 1986
NAPHTHALENE	LT 1	LT 1	LT 1
1-METHYLNAPHTHALENE	LT 1	LT 1	LT 1
2-METHYLNAPHTHALENE	LT 1	LT 1	LT 1
ACENAPHTHYLENE	LT 1	LT 1	LT 1
ACENAPHTHENE	LT 1	3.7	2.7
FLUORINE	LT 1	LT 1	LT 1
PHENANTHRENE	LT 1	LT 1	LT 1
ANTHRACENE	LT 1	LT 1	LT 1
FLUORANTHENE	LT 1	2.1	1.4
PYRENE	LT 1	LT 1	LT 1
BENZO(A)ANTHRACENE	LT 1	LT 1	LT 1
CHRYSENE	LT 1	LT 1	LT 1
BENZOFLUORANTHENES	LT 5	LT 1	LT 1
BENZOPYRENES	LT 5	LT 1	LT 1
INDENO(123CD)PYRENE	LT 5	LT 1	LT 1
DIBENZO(AH)ANTHRACENE	LT 5	LT 1	LT 1
BENZO(GHI)PERYLENE	LT 5	LT 1	LT 1.