APPENDIX 4-D

CLOSURE AND POST-CLOSURE CARE PLANS FOR THE CHROMIUM HYDROXIDE SAND DRYING BEDS AND CERTIFICATION

Georgia Department of Natural Resources
205 Butler Street, S.E., Suite 1252, Atlanta, Georgia 30334
Joe D. Tanner, Commissioner
Harold F. Reheis, Director
Environmental Protection Division

LFH

OCT 4 1991

September 30, 1991

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Leo F. Harlan, Sr.
Technical Director
William L. Bonnell Company, Inc.
Post Office Box 428
Newnan, Georgia 30264

Re: Approval of Closure Plan
GAD 003273224

Dear Mr. Harlan:

The Georgia Environmental Protection Division (EPD) revised the closure plan submitted by William L. Bonnell Company, Inc. (Bonnell) for the Chromium Hydroxide (CrOH) sand drying beds. EPD announced its intent to approve the revised closure plan in a public notice issued on August 22, 1991 and on September 24, 1991, a 30-day comment period associated with the public notice expired. In addition, a public hearing was held at the Newnan-Coweta Library on September 17, 1991. The Division did not receive any written comments, nor did anyone attend the public hearing to make a statement regarding the content of the closure plan.

Bonnell is hereby notified that the closure plan is approved. Please begin implementation of closure activities within 30 days after receipt of this letter.

Sincerely,

Bill Mundy

Bill Mundy
Unit Coordinator
Hazardous Waste Management Program

BM:sec\Bonnell.clo

File: Wm. L. Bonnell (R)

THE WILLIAM L BONNELL COMPANY, INC.
NEWNAN, GEORGIA FACILITY
EPA I.D. NO. GAD003273224

CLOSURE AND POST-CLOSURE PLAN
FOR THE CHROMIUM HYDROXIDE SLUDGE SAND DRYING BED

JULY 31, 1990
REVISED - OCTOBER 24, 1990
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TABLE OF CONTENTS

Page No.

I CLOSURE PLAN 1

I-1 INTRODUCTION 1

I-1a Production Processes 1
I-1b Wastewater Treatment and Sludge Handling Operations 2

I-2 CLOSURE OBJECTIVES PERFORMANCE STANDARD 5
I-3 PARTIAL CLOSURE AND FINAL ACTIVITIES 5
I-4 MAXIMUM WASTE INVENTORY 5
I-5 SCHEDULE OF CLOSURE AND CERTIFICATION 6
I-6 CLOSURE ACTIVITIES .... ~~6~~ 7

I-6a Detailed Design and Bidding 7
I-6b Piping and Associated Equipment Removal 7
I-6c CrOH Sludge Sand Drying Bed Area Cover .... ~~7~~ 8
I-6d Design Considerations 10
I-6e Extensions for Closure Plan .... ~~12~~ 14
I-6f Ground-Water Monitoring .... ~~13~~ 14

I-7 DECONTAMINATION OF EQUIPMENT .... ~~13~~ 14

II POST-CLOSURE PLAN .... ~~14~~ 16

II-1 POST-CLOSURE ACTIVITIES .... ~~14~~ 16

II-1a Inspection Plan .... ~~15~~ 17
II-1b Ground-Water Monitoring .... ~~15~~ 17
II-1c Maintenance Activities .... ~~16~~ 17
II-1d Demonstration of Security at the Site .... ~~17~~ 19

III NOTICE IN DEED AND NOTICE TO LAND AUTHORITY .... ~~17~~ 20

IV CLOSURE COST ESTIMATE .... ~~18~~ 21

V POST-CLOSURE COST ESTIMATE .... ~~19~~ 22

TABLE OF CONTENTS (cont.)

Page No.

VI FINANCIAL ASSURANCE FOR CLOSURE/POST-CLOSURE AND LIABILITY COVERAGE .... ~~19~~ 23

VII FINANCIAL ASSURANCE MECHANISM FOR SUDDEN/NON-SUDDEN ACCIDENTAL OCCURRENCES .... ~~19~~ 24

REFERENCE .... ~~20~~ 25

LIST OF TABLES

1 List of Materials Introduced in the Chemical Conversion Coating Process and Wastewater Treatment Facility
2 List of Materials Introduced in the Anodizing Process and Wastewater Treatment Facility
3 HELP Model-Default Unvegetated, Uncompacted Soil Characteristics
4 Post-Closure Inspection Checklist for CrOH Sludge Sand Drying Bed Area
5 Cost Estimate for Closure of CrOH Sludge Sand Drying Bed Area
6 Cost Estimate for Post-Closure Care of CrOH Sludge Sand Drying Bed Area

LIST OF FIGURES

1 Chemical Conversion Coating Process Flow Diagram
2 Anodizing Process Flow Diagram
3 Site Plan
4 CrOH Sludge Sand Drying Bed Area Closure Schedule
5 CrOH Sludge Sand Drying Bed Area Typical Cover Schematic
6 CrOH Sludge Sand Drying Bed Area Conceptual Cover
7 Decontamination Water Collection System
8 Bonnell Perimeter Fence Quarterly Inspection Log

LIST OF APPENDICES

A Laboratory Data and Material Safety Data Sheets
B Report of Clean-up Activities Conducted March and April, 1990
C Letter to Myles Morse
D HELP Model Input and Output
E Manufacturers Literature
F Boring Logs for Wells BN-GW-2S and BN-GW-2D
G Ditch Sizing Calculations
H CrOH Sludge Sand Drying Bed Area Soil Loss Calculation
I Ground-Water Monitoring Program
J Financial Assurance for Closure/Post-Closure and Liability Coverage

I CLOSURE PLAN

I-1 INTRODUCTION

This plan is submitted in accordance with the requirements of the Georgia Hazardous Waste Management Rule (Georgia Rule) 391-3-11-.10 (40 CFR 265.110 through 265.120 and 265.310). This plan identifies steps necessary to close the chromium hydroxide (CrOH) sludge sand drying bed area located at the William L Bonnell Company, Inc. (Bonnell) plant in Newnan, Georgia (EPA I.D. No. GAD003273224).

I-1a Production Processes

William L Bonnell Company, Inc. operates an aluminum extrusion and finishing facility that uses ingot and recycled scrap aluminum to produce aluminum extrusions for the construction industry and other uses. These extrusions are finished in one of two separate processes: a) a chemical conversion coating operation that uses a solution of chromic and phosphoric acids to prepare the extrusions for painting, or b) an anodizing line that uses a sulfuric acid solution to treat the extrusions. Material Safety Data Sheets for the materials used in these processes are provided in Appendix A. The chemical conversion coating process operations, their wastewater treatment facilities ("WWTFs"), and their sludge handling facilities are discussed below.

I-1a(1) Chemical Conversion Coating Process

The chemical conversion coating process, shown schematically in Figure 1, creates a film of chromium oxide on the aluminum and prepares the metal for painting. Table 1 is a list of materials introduced to the chemical conversion coating process and wastewater treatment facility. Aluminum extrusions are hung on an overhead conveyor which first moves through a spray chamber where the extrusions are sprayed with an alkaline cleaner and rinsed with clear water. Extrusions are then sprayed with a phosphoric acid/chromic acid solution. These then go through two water rinses and a drying oven. Wastewaters for the chemical conversion coating process flow to the chemical conversion process wastewater treatment facility which is discussed below in Section I-1b.

I-1a(2) Anodizing Process

Figure 2 is a schematic flow diagram for the anodizing process. Table 2 is a list of materials introduced to the anodizing process and wastewater treatment facility. The anodizing process creates an exterior layer of clear aluminum oxide over the aluminum extrusion to provide a corrosion resistent, hard surface of various colors. The aluminum extrusion is first dipped in a cleaning bath containing either a mild alkaline cleaner or mild (less than 5 percent) phosphoric acid solution. The extrusion is rinsed with water and placed in an etching bath containing an aqueous solution of sodium hydroxide. Next, the extrusion is rinsed and placed in a dilute sulfuric acid bath containing hydrogen peroxide. It is rinsed again and placed in an electrically charged bath of sulfuric acid, and is rinsed again. The extrusions can then be colored by depositing dyes or tin into the anodic coating pores. The coating is then sealed with hot water or a nickel acetate solution. The extrusion is then rinsed with clear water to complete the anodizing process. Wastewaters for the anodizing process flow to the anodizing process wastewater treatment facility which is discussed below in Section I-1b.

I-1b Wastewater Treatment and Sludge Handling Operations

The Bonnell facility operates two separate wastewater treatment systems. One wastewater treatment facility (WWTF) handles wastewater from the chemical conversion coating (CCC) operation that produces a sludge defined in Georgia Rule 391-3-11.07 (40 CFR 261.31) as F019 (wastewater treatment sludges from chemical conversion coating of aluminum). F019 wastes are listed as hazardous wastes on the basis that they may contain hexavalent chromium and/or cyanide (complexed).

The other WWTF handles wastewater from the sulfuric acid anodizing of aluminum and produces a sludge that is not a listed hazardous waste. Details of the wastewater treatment systems for each of these processes are presented in the following sections.

I-1b(1) Chemical Conversion Coating WWTF and Sludge Handling

Treatment of wastewater generated from the (CCC) process begins with wastewater discharge into one of two lined concrete treatment basins. These basins, along with the discharge location (Point A), are shown on Figure 3. Sulfuric acid and sodium bisulfite are added to the treatment basins and mixed in a batch process to ensure complete mixing and reduction of any hexavalent chromium to trivalent chromium. Samples are then collected and analyzed for hexavalent chromium. If no hexavalent chromium is detected, lime is added to raise the pH to approximately 8.3. A small amount of polymer is added in order to promote flocculation of metals and solids. The wastewater is then discharged to the CCC clarifier (Point B on Figure 3).

Until September 1989, the liquid effluent (F019) from the CCC clarifier was discharged to the settling pond (Point C on Figure 3). Supernatant (F019) from the settling pond then discharged to the polishing pond (Point G on Figure 3). In September 1989, at the suggestion of the Georgia EPD personnel, Bonnell rerouted the CCC clarifier liquid effluent directly to the National Pollutant Discharge Elimination System (NPDES) permitted (Permit No. GA0000507) outfall (Point D on Figure 3).

As discussed previously, chromium hydroxide (CrOH) sludge (F019) is also produced in the CCC clarifier. Prior to November 1989, this sludge (F019) was dewatered in the CrOH sand drying beds (Point E on Figure 3). The dewatered sludge (F019) was periodically removed and placed in an on-site CrOH sludge (F019) disposal area (Point F on Figure 3). Laboratory data for sludge (F019) samples collected from the CrOH sand drying beds are included as Appendix A.

Until September 1989, the filtrate (F019) from the CrOH sand drying beds was discharged into the settling pond. In November 1989, a filter press was installed (Point H on Figure 3) to handle the CCC clarifier sludge (F019) and use of the CrOH sand drying beds was

discontinued. Since then, sludge (F019) from the CCC filter press has been collected in roll-off containers for disposal at a permitted hazardous waste landfill in Emelle, Alabama operated by Chemical Waste Management, Inc. The filtrate (F019) from the CCC sludge filter press is routed back to the CCC clarifier tank and from there to the NPDES-permitted outfall. Thus, filtrate (F019) and supernate (F019) from the CCC system is no longer routed to the settling pond. However, the sludge currently in the settling pond is F019. Therefore, any sludge deposited on the AlOH sand drying beds from the settling pond is F019. The filtrate from the AlOH sand drying beds which returns to the settling pond is also F019.
In March and April, 1990, the CrOH sludge sand drying beds and associated drainage piping were removed. The F019 sludge and chromium contaminated soils in and around the CrOH sludge sand drying beds were excavated and transported to the Chemical Waste Management disposal facility in Emelle, Alabama. Gravel was placed into the excavation to a point above the ground water. A perforated corrugated metal stand pipe was also installed to allow for possible future ground-water recovery. The area was then backfilled with on-site soil. A summary of the clean-up activities is presented in Appendix B.

I-1b(2) Anodizing Process WWTF and Sludge Handling

Treatment of wastewater generated from the anodizing process flow begins with wastewater discharge into a treatment basin (Point I on Figure 3) where acid, lime, or spent sodium hydroxide is added to treat and neutralize the anodizing solution. Wastewater from this basin flows to the settling pond (Point C on Figure 3), which then discharges to the polishing pond (Point G on Figure 3). The overflow from the polishing pond discharges to the NPDES permitted outfall.

In the settling pond, an aluminum hydroxide (AlOH) sludge is produced from solids that settle out of the solution. Sludge (F019) that collects in the settling pond is dredged and pumped onto the AlOH sand drying beds (Point J on Figure 3) for dewatering. Filtrate (F019) from these sand drying beds is piped back to the settling pond.

The AlOH sludge (F019) from the sand drying beds is moved to the AlOH sludge-soil mixture area (Point K on Figure 3), where it is mixed with soil. The AlOH sludge-soil mixture area is permitted by the state of Georgia as an Industrial Waste Landfill under Permit No. 038-003D(L), which permit does not allow the disposal of hazardous waste including but not limited to F019.

I-2 CLOSURE OBJECTIVES PERFORMANCE STANDARD

This closure plan is designed so that the CrOH sludge sand drying bed area will require only minimal maintenance or controls, potential threats to human health and the environment will be minimized, and escape of hazardous waste to the ground, ground water, surface waters, or the atmosphere will be controlled, minimized, or eliminated in accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.111). To accomplish this, the closure plan consists of removal and disposal of the anodizing water discharge piping located in the CrOH sludge sand drying bed area, installation of a cap over the area, construction of run-on control ditches, removal and appropriate disposal of contaminated materials generated during the cleaning of the site, and the decontamination of the equipment. The following sections discuss in detail the approach Bonnell will take to satisfy the closure performance standard in accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.112(b)), as discussed on Page 7.

I-3 PARTIAL CLOSURE AND FINAL ACTIVITIES

The partial closure plan describes the activities that will be performed to close the CrOH sludge sand drying bed area. Closure of the other hazardous waste management units will be addressed in separate closure plans.

I-4 MAXIMUM WASTE INVENTORY

As discussed in Section I-1, the F019 sludge (with listing constituents hexavalent chromium and cyanide (complexed)) along with most of the surrounding chromium contaminated soil was removed in March and April, 1990 and later disposed of in June, 1990. A report of these clean-up activities is included as Appendix B. It should be noted that chromium is the only F019 constituent present in the sludge (F019) and surrounding soil. The chemicals used at the Bonnell facility do not contain any, nor does the process generate any, cyanides as verified by previous tests performed on sludge samples. The results of these tests were provided to the U.S. EPA by letter dated December 5, 1980 to Mr. Myles Morse, Hazardous and Industrial Waste Division (WH-565), Waste Characterization Branch. A copy of the letter is included as Appendix C.

From 1970 to December 1989, the CrOH sludge sand drying beds received chromium hydroxide sludge (F019) from the adjacent clarifier. The sludge (F019) production is estimated at 1,680 pounds per day, or 252 tons per year based on a 300 day per year operating schedule. In accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.112(b)(3)), Bonnell estimates that a total of approximately 4,788 tons of sludge (F019) was produced over the 19-year period.

I-5 SCHEDULE OF CLOSURE AND CERTIFICATION

The CrOH sludge sand drying bed area is scheduled to be closed within 2~~8~~6 weeks after closure begins. In accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.112(b)(6)), a schedule for each closure activity has been provided as Figure 4 . As indicated on the schedule, completion of closure is not expected to extend beyond 180 days following Georgia EPD approval of the closure plan. This schedule is in compliance with Georgia Rule 391-3-11-.10 (40 CFR 265.113(b)). The Georgia EPD Director will be notified by Bonnell before beginning final closure of the CrOH sludge sand drying bed area.

The certification of closure will be submitted via registered mail to the Georgia EPD Director within 60 days after completion of closure in accordance with the approved closure plan as per Georgia Rule 391-3-11-.10 (40 CFR 265.115). This certification will be signed by both Bonnell and an independent registered professional engineer. Documentation supporting the engineer's certification will be available to Georgia EPD upon request and will be maintained until Bonnell is released from financial assurance requirements. A survey plat containing the information required by Georgia Rule 391-3-11-.10 (40 CFR 265.116) will also be submitted to the local land use authority and the Georgia EPD as part of the certification of closure. Bonnell will maintain an on-site copy of the approved closure plan and all revisions to the plan until the certification of closure completeness has been submitted and accepted by the Georgia EPD.

I-6 CLOSURE ACTIVITIES

During closure of the CrOH sludge sand drying bed area, access control devices (fences, gates, etc.) will be maintained to prevent unauthorized access by non-Bonnell employees or their subcontractors. Closure of the CrOH sludge sand drying bed area will consist of placing a low permeability cap over the area and providing run-on control. The cover design was modeled using the U.S. EPA Hydrologic Evaluation of Landfill Performance (HELP) program. A copy of the HELP model input and output is included as Appendix D. Details of closure activities are provided in the following sections of this plan.

I-6a Detailed Design and Bidding

Upon final approval of the closure plan by Georgia EPD, preparation of detailed plans and specifications will be initiated. Completion of these documents will allow Bonnell to obtain competitive bids for construction of the CrOH sludge sand drying bed area cover system. The closure activities will be initiated within 30 days of issuance of the construction contract.

I-6b Piping and Associated Equipment Removal

Currently, wastewater from the anodizing line flows into treatment basins where it is neutralized with either lime or sulfuric acid. Wastewater from these basins then flows through 12-inch diameter below-grade corrugated metal piping to the settling pond. This piping, and associated manholes, is located outside the west perimeter of the removed CrOH sand drying beds. As part of these closure activities, the piping will be removed and new piping will be installed routing flow around the cap.

In addition, the corrugated metal stand pipe which exists in the CrOH sludge sand drying bed area will be cut off below ground surface and filled with cement grout prior to placing the cover. After removal, all piping and manhole components will be bulk-loaded and shipped to an Interim Status or approved facility for disposal as hazardous waste (e.g. Chemical Waste Management, Inc. landfill at Emelle, Alabama).

I-6c CrOH Sludge Sand Drying Bed Area Cover

The CrOH sludge sand drying bed area cover will consist of several layers. The cover layers from top to bottom consist of 2 feet of a vegetative soil, a geofabric, geonet drainage layer, a geofabric, a 40-mil high density polyethylene (HDPE) liner, and a clayey soil subgrade. A schematic of the cover is shown on Figure 5. A plan view of the cover system is shown on Figure 6.

Prior to placement of the HDPE membrane the surface of the CrOH sludge sand drying bed area will be prepared. The subgrade preparation will include removal of material (e.g. rocks, and sticks,) that could damage the membrane along with placement of a subgrade soil layer. The soil will be compacted to a density equal to or greater than 92 percent of the material's maximum dry density according the Standard Proctor Compaction Test (ASTM D-698). The approximate 6-inch subgrade soil layer will be composed of soil with a Unified Soil Classification of CL including a compacted hydraulic conductivity on the order of 3.2×10^{-6}.

The barrier portion of the cover will consist of a 40-mil HDPE membrane that will meet or exceed the U.S. EPA recommend design of 1 x 10 $^{-7}$ cm/sec for a barrier system. HDPE has been shown to have a permeability of 4.5 x 10 $^{-10}$ cm/sec. Boring logs for monitoring wells, BN-GW-2S and BN-GW-2D, installed approximately 5 feet east of the removed CrOH sludge sand drying beds show the lithology from 0 to 15 feet to be a sandy clay (Unified Soil Classification - SC). The removed sand beds were approximately 8 feet deep. The typical permeability of SC ranges from 1 x 10 $^{-6}$cm/sec to 1 x 10 $^{-5}$cm/sec (Peck, Hanson and Thornburn, 1973). Hence, the final sand bed cover will have a permeability less than the natural subsoils present as per Georgia Rule 391-3-11-.10 (40 CFR 265.310(a)(5)). Manufacturers' literature summarizing physical properties of HDPE are included in Appendix E and the above well boring logs are included in Appendix F.

The membrane portion of the cover will be overlain by a filter fabric. The filter fabric will increase friction and minimize slippage between the drainage layer and the underlying barrier layer.

The geofabric layer will be overlain by a drainage layer consisting of a geonet having a coefficient of permeability equal to or greater than 1 x 10 $^{-2}$ cm/sec. This layer will be utilized as the lateral drainage medium within the cover. A filter fabric will be placed over the geonet to reduce the potential of silt entering and clogging the drainage layer. The geonet will convey infiltration from the vegetative soil layer to drainage collection pipes, as shown on Figure 5. The collection pipes will be located along the two downgradient sides of the capped area. At the southernmost corner of the cap, the collected drainage will flow by gravity and discharge to an existing ditch.

The upper filter fabric will be overlain by 24 inches of soil with a Unified Soil Classification of SM or an equivalent soil capable of supporting vegetation. The lower 18 inches will be compacted to at least 92 percent of the material's maximum dry density (ASTM D-698). The upper six inches will be disked in preparation for seeding. Following grading, the vegetative layer will be fertilized and seeded to minimize erosion.

In order to confirm that the subgrade and lower 18 inches of vegetative soil meet the compaction requirements, field density tests will be performed using method ASTM D-2937, Density of Soil in Place by the Drive-Cylinder Method. At least one test will be made for each six-inch lift and for each 1000 square feet or 20 cubic yards of vegetative or subgrade soil placed. Soil not meeting density requirements will be scarified, re-compacted and re-tested.

In addition to construction of the cover system, run-on control ditches will be constructed along the northern boundary of the CrOH sludge sand drying bed area. These ditches will be sized to convey run-on to the cover generated by the 24-hour, 25-year storm as determined by U.S. Weather Bureau Technical Paper No. 40. The approximate location of the ditches is shown on Figure 6. Copies of the ditch sizing calculations are included in Appendix G.

I-6d Design Considerations

a. <u>Erosion Potential</u>

Analysis of the final grading of the cover shows that an erosion of 0.32 tons per acre could occur per year. This value is small enough to be considered insignificant. The soil loss calculation considered a maximum cover slope of 8 percent and indicates that significant erosion should not occur. A copy of this calculation is included in Appendix H.

b. <u>Drainage</u>

Storm water run-on will be controlled by the construction of ditches designed to contain the water volume resulting from a 24-hour, 25-year storm.

The run-off will be controlled through maintenance of the grassed condition of the cover surface. The grassed cover sloped approximately 8 percent will minimize the potential for excessive erosion and soil loss due to major storm events that may occur. Run-off from this area will drain to the settling pond as it does currently. Since run-on will be diverted away from the cover, the volume of run-off that drains from the cover to the settling pond will be less after closure than what occurred prior to closure.

c. <u>Geosynthetic Materials</u>

Geosynthetic materials used in the cover construction include a 40-mil HDPE membrane, geonet, and filter fabric. The membrane, as required in a RCRA cover, will be placed over the subgrade soil layer to reduce the potential for infiltration into the closed CrOH sludge sand drying bed area. The filter fabric will separate the geonet from the vegetative layer, prohibiting the finer soil particles in the vegetative layer from clogging the drainage layer. A second filter fabric will separate the membrane from the geonet to reduce the potential for slippage between the layers.

d. <u>Leak Detection and Leachate Collection Systems</u>

Since the CrOH sludge sand drying bed area is part of an interim status facility, leak detection, and leachate collection systems are not required. Thus, there is no clay liner or synthetic liner system to serve as a barrier or to collect and remove leachate from the CrOH sludge sand drying bed area. The cover system has been designed to restrict percolation into the underlying soil in accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.310(a)(1)).

e. Prevention of Airborne Contaminant Release

As discussed previously, the main constituent of concern is chromium (see Appendix C). The CrOH sludge sand drying beds, chromium hydroxide sludge (F019), and all connected drainage piping have been removed. On-site soils were used as backfill and therefore, airborne contaminant release is unlikely.

f. Other Considerations

As discussed in Section I-6, the cover system has been modelled using the U.S. EPA HELP computer program. This program is used to predict the movement of surface water (from precipitation) throughout the cover system. The model considers run-off, evapotranspiration and lateral drainage as the mechanism for reducing the amount of percolation that penetrates the cover and moves into the waste. The model also predicts that for all rainfall events including peak rainfall events, no vertical percolation into the waste is expected to occur.

The climatological conditions for the Bonnell facility in Newnan, Georgia were characterized by using synthetically generated rainfall, temperature and solar radiation data for Atlanta, Georgia for a 20-year period. Appendix D presents the HELP model input and output for the cover system to be used for CrOH sludge sand drying bed area.

Input values for the various soil physics parameters were selected from the default data base contained within the HELP model, as shown on Table 3. Fine sandy loam (No. 7, Unified Soil Classification - SM) values were used to describe layer 1, the vegetative soil layer. Although the specific characteristics of the vegetative soil layer have little effect on the amount of percolation through the unit cover, soil actually used in the construction of the cap will meet the parameters used in the HELP model. The purpose of the vegetative soil layer is to support vegetation and to provide a medium for evapotranspiration.

The input parameters that describe layer 2, the lateral drainage layer, were recommended by the author/developer of the HELP model, Dr. Paul Schroeder of the Waterways Experiment Station, U.S. Army Corps of Engineers, Vicksburg, Mississippi. Drainage net meeting the parameters in the HELP model will be used to construct the cap.

Clay loam (No. 11, Unified Soil Classification - CL) values were used to describe layer 3, barrier soil liner with flexible membrane, a compacted layer. When compaction is specified such as in layer 3, the soil characteristics are automatically adjusted as follows: (1) the saturated hydraulic conductivity is reduced by a factor of 20, (2) the porosity is reduced by 25 percent, (3) the field capacity is reduced by 25 percent of the difference between uncompacted field capacity and wilting point and (4) the evaporation coefficient is assigned the minimum value of 3.3. Layer 3 contains a HDPE membrane which the model assumes is impermeable except for possible leaks. Therefore, a leakage fraction of 0.0001, as recommended by Dr. Paul Schroeder assuming installation with good QA/QC procedures, was entered to characterize the potential leaks in the HDPE membrane.

HELP model input values such as the maximum leaf area index (2.00) and evaporative zone depth (22.00 inches) are default values for fair grass in Atlanta, Georgia.

I-6e Extensions for Closure Plan

As previously indicated, the proposed schedule for closure of the CrOH sludge sand drying bed area is based on a 180-day construction period. If, due to encountering unforeseen conditions during closure, additional time is necessary to complete closure, the Georgia EPD will be notified within 30 days prior to expiration of the 180-day period in accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.113(c)(2)) and an extension to the schedule to reflect the additional time required will be requested under Georgia Rule 391-3-11-.10 (40 CFR 265.113(b)(1)).

I-6f Ground-Water Monitoring

During closure of the CrOH sludge sand drying bed area, the compliance monitoring program described in the RCRA Part B Permit Application for Post-Closure Care dated October 1990 (which is being revised in accordance with the March 8, 1991 NOD letter) will be maintained. For completeness of this closure plan, a copy of Section E-7 "Description of Compliance Monitoring Program" and E-5 "General Monitoring Program Requirements" from the permit application along with selected tables, figures and appendices referenced in these sections have been included as Appendix I.

I-7 DECONTAMINATION OF EQUIPMENT

Equipment, including earth-moving and transport vehicles, that has been in contact with hazardous wastes during this closure of the CrOH sludge sand drying bed area will be decontaminated, as per Georgia Rule 391-3-11-.10 (40 CFR 265.112(b)(4) and 265.114). The decontamination will be completed by triple rinsing using a low-volume pressure water wash and visual determination that all soil has been removed.

A decontamination station, shown on Figure 7, will be constructed at the location shown on Figure 6. This station will contain the rinse water used in cleaning equipment. At the end of closure activities, the station will be pressure washed. The rinse water will be pumped to the head of the chemical conversion coating process wastewater treatment system for treatment and disposal through the NPDES-permitted outfall. Material that cannot be easily decontaminated (e.g. protective clothing) will be bulk-loaded and shipped to an Interim Status or approved facility for disposal as hazardous waste.

A Safety Plan will be developed prior to initiating closure activities. This plan will be prepared and followed so that individuals participating in the closure are knowledgeable of potential dangers and take specific safety precautions. Only qualified personnel will participate in the closure activities.

CrOH SDB

II POST-CLOSURE PLAN

II-1 POST-CLOSURE ACTIVITIES

This Post-Closure Plan describes in general, the activities that will be performed to monitor the CrOH sludge sand drying bed area throughout the 30-year post-closure period in accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.117-119 and 265.310). Property use during post-closure care will be restricted in accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.117(c)). The 30-year post-closure period may be shortened or extended by the Georgia EPD under Georgia Rule 391-3-11-.10 (40 CFR 265.117(a)(2)).

The post-closure certification will be submitted via registered mail to the Georgia EPD Director within 60 days after completion of post-closure care period in accordance with the approved post-closure plan as per Georgia Rule 391-3-11-.10 (40 CFR 265.120). This certification will be signed by both Bonnell and an independent registered professional engineer. Documentation supporting the engineer's certification will be available to Georgia EPD upon request and will be maintained until Bonnell is released from financial assurance requirements.

During plant operation, the Technical Director of Bonnell will be responsible for retaining and updating the on-site copy of the post-closure plan. In accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.118(c)(3)), the following representative can be contacted concerning the post-closure activities of the facilities at the plant:

Mr. Leo F. Harlan, Sr.
Technical Director
William L Bonnell Company, Inc.
25 Bonnell Street
Newnan, Georgia 30263

mailing address: P.O. Box 428
Newnan, Georgia 30264

phone number: (404) 253-2020

II-1a Inspection Plan

The closed CrOH sludge sand drying bed area will be monitored and maintained throughout the post-closure period by regular inspections and ground-water monitoring as per Georgia Rule 391-3-11-.10 (40 CFR 265.118(c)(1) and (2)). Inspection items include:

- cover and surrounding area
- ground-water monitoring wells
- run-on diversion ditches
- permanent benchmarks

Inspections will be made by Bonnell personnel trained for such purposes, on a quarterly basis and after major storm events to ascertain the condition of the cover and surrounding area. This inspection schedule is intended to insure proper monitoring of the closed unit. An inspection checklist has been included as Table 4. The purpose of this checklist is to assist the inspector in noticing particular items during the facility inspections including ground cover maintenance. The following sections describe the general procedures which will be followed during the post-closure care period.

Inspection and monitoring will continue for the 30-year post-closure period or until Bonnell receives approval from the Georgia EPD to discontinue the program. Inspection records will be kept at the Bonnell facility for a period of 5 years after the end of the post-closure care period.

II-1b Ground-Water Monitoring

Ground-water monitoring activities will be performed as described in Section I-6f. The monitoring system, along with the sampling and analysis plan procedures, will be continued for the 30-year post-closure period or until Bonnell receives notification from the Georgia EPD of approval to discontinue monitoring.

II-1c Maintenance Activities

This section addresses maintenance of the closed CrOH sludge sand drying bed area as per Georgia Rule 391-3-11-.10 (40 CFR 265.310(b)) in the following areas:

1. Maintenance and Repair of the Final Cover

   The cover will be inspected quarterly throughout the post-closure care period. Inspections will include checks for consistency of the soil cover, erosion, stability of the lower embankment, settlement, condition of the vegetation, and any other element of the system which may adversely affect the performance of the cover.

2. Run-on/off Control System

   The run-on ditches and diversion structures will be inspected quarterly and after all major storm events to check for proper flow capacity and discharge. Ditches will be repaired and/or seeded as necessary to maintain grass cover.

3. Ground-Water Monitoring System

   Ground-water monitoring wells will be inspected quarterly to verify that accessible parts of the wells including the outer casing and cap, lock, apron, inner casing and cap, measuring point, and well identification number are maintained.

4. Security Control Devices

   All access to the closed CrOH sludge sand drying bed area will be controlled by fences surrounding the Bonnell site. These fences will be repaired or replaced as necessary. The fence will be inspected quarterly. An inspection log for the perimeter fence is included as Figure 8.

5. Vegetative Cover

   The surficial cover and perimeter run-on diversion ditch will be grassed. Fertilizer and seed will be applied as needed to assure continuous grass cover as a deterrent to erosion. Fertilizer will be applied a minimum of once a year.

Post-closure care will include mowing the grass of the CrOH sludge sand drying bed area at least four times per year. Clippings will be left in place to provide nutrients and organic matter and to promote erosion control.

Also during post-closure, supplemental water will be applied as needed during dry weather to maintain the vegetative cover and help control wind erosion. Irrigation will be scheduled based on observations made during field inspections.

During post-closure care, Bonnell will inspect the grass cover quarterly and after major rainfall events. Inspections will be logged, and reports will be retained by Bonnell. The inspections will check for erosion, vegetative distress due to insect infestation or drought, or other factors which may adversely affect the vegetative cover.

6. Additional Considerations

The cover drainage system will be checked during inspections to assure that no ponding of water occurs on the surface of the cover.

II-1d Demonstration of Security at the Site

The plant site is monitored by security guards 24 hours per day, 365 days per year. Signs will be posted that read "DANGER - UNAUTHORIZED PERSONNEL KEEP OUT." The monitoring wells have been provided with locks to maintain the security of the individual wells.

III NOTICE IN DEED AND NOTICE TO LAND AUTHORITY

In conjunction with the closure certification, Bonnell will submit to the local zoning authority and to the Director of Georgia EPD, a survey plat indicating the location and dimensions of the closed CrOH sludge sand drying bed area. This plat will be prepared and certified by a professional land surveyor. The plat will be filed with the local zoning authority and will contain a note, prominently displayed, which states the owner's obligation to restrict disturbance of the unit as specified in Georgia Rule 391-3-11-.10 (40 CFR 265.116).

Within 60 days after certification of closure, Bonnell will record a notation on the deed to the property as per Georgia Rule 391-3-11-.10 (40 CFR 265.119(b)(1)). The notation on the deed to the property will include: (1) that the CrOH sludge sand drying bed area has been used to manage hazardous wastes, (2) that its use is restricted under Georgia Rule 391-3-11-.10 (40 CFR 265 Subpart G regulations, 265.117(c)), (3) that a survey plat and record of the type, location and quantity of the wastes which have been stored there as required under Georgia Rule 391-3-11-.10 (40 CFR 265.116 and 265.119(a)), respectively, has been filed with the local zoning authority and with the Georgia EPD. Bonnell will submit a certification of notice that the notation specified in 40 CFR 265.119(b)(1) has been recorded in accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.119(b)(2)) to the Director of Georgia EPD.

IV CLOSURE COST ESTIMATE

The closure cost information presented is submitted in accordance with requirements of Georgia Rule 391-3-11-.10 (40 CFR 265.142 and 265.143).

An estimated $83,077 (cost estimate in 1991 dollars) will be needed to close the CrOH sludge sand drying bed area. The closure costs for the area are presented by activity in Table 5. Total costs were calculated by adding 10% for contingencies and 5% for Bonnell's administration of the project.

These closure cost estimates will be kept on file by Bonnell. Until closure is completed, this estimate will be adjusted annually for inflation within 30 days after close of Bonnell's fiscal year in accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.142(b)). Whenever a change in the closure plan affects the cost of closure, the cost estimate will be adjusted within 30 days after the revision to the closure plan in accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.142(c)).

V POST-CLOSURE COST ESTIMATE

The post-closure cost information presented is submitted in accordance with requirements of Georgia Rule 391-3-11-.10 (40 CFR 265.144). An estimated $8,780 (cost estimate in 1991 dollars) will be needed for post-closure inspections and maintenance procedures over the 30 year post-closure period. The post-closure costs are presented by activity in Table 6.

This post-closure cost estimate will be kept on file by Bonnell. The cost estimate will be adjusted for inflation annually within 30 days after the close of Bonnell's fiscal year in accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.144(b). Whenever a change in the post-closure plan affects the cost of post closure, the cost estimate will be adjusted within 30 days after the revision to the post-closure plan in accordance with Georgia Rule 391-3-11-.10 (40 CFR 265.144(c)).

VI FINANCIAL ASSURANCE FOR CLOSURE/POST-CLOSURE AND LIABILITY COVERAGE

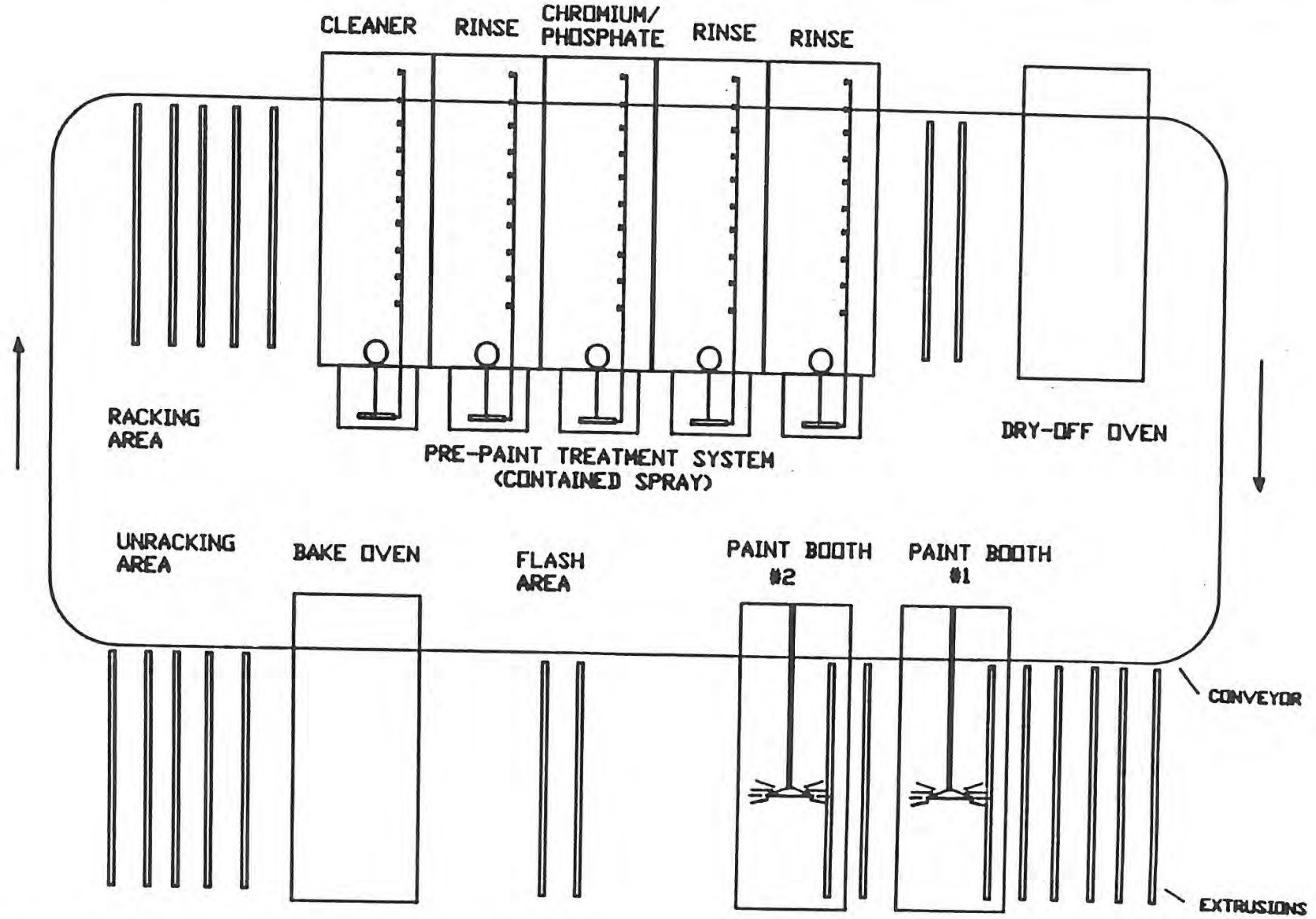
Bonnell has selected the "corporate guarantee" as the method for demonstrating financial responsibility for closure, post-closure care, and liability coverage for specified hazardous waste treatment, storage, and disposal units at Bonnell's Newnan, Georgia facility. Bonnell's guarantor is its corporate parent, Tredegar Industries, Inc. ("Tredegar"), a Virginia corporation. Because Tredegar is Bonnell's direct parent, Tredegar can satisfy the requirements of Georgia Rule 391-3-11-.05 (40 CFR 265.143(e)(10), 265.145(e)(11), and 265.147(g)). The documentation required to demonstrate financial assurance for closure and post-closure is included in Appendix J.

VII FINANCIAL ASSURANCE MECHANISM FOR SUDDEN/NON-SUDDEN ACCIDENTAL OCCURRENCES

The documentation required to demonstrate financial assurance under Georgia Rule 391-3-11-.05 (40 CFR 265.147), for sudden and non-sudden accidental occurrences, is included in Appendix J. The documentation reflects liability coverage in the amount of $4 million per occurrence and an $8 million annual aggregate.

REFERENCE

Peck, R.B., W.E. Hanson and T.H. Thornburn. 1973. Foundation Engineering, Second Edition. John Wiley & Sons, Inc., New York.



SOURCE: DELISTING PETITION FOR THE WILLIAM L BONNEL COMPANY

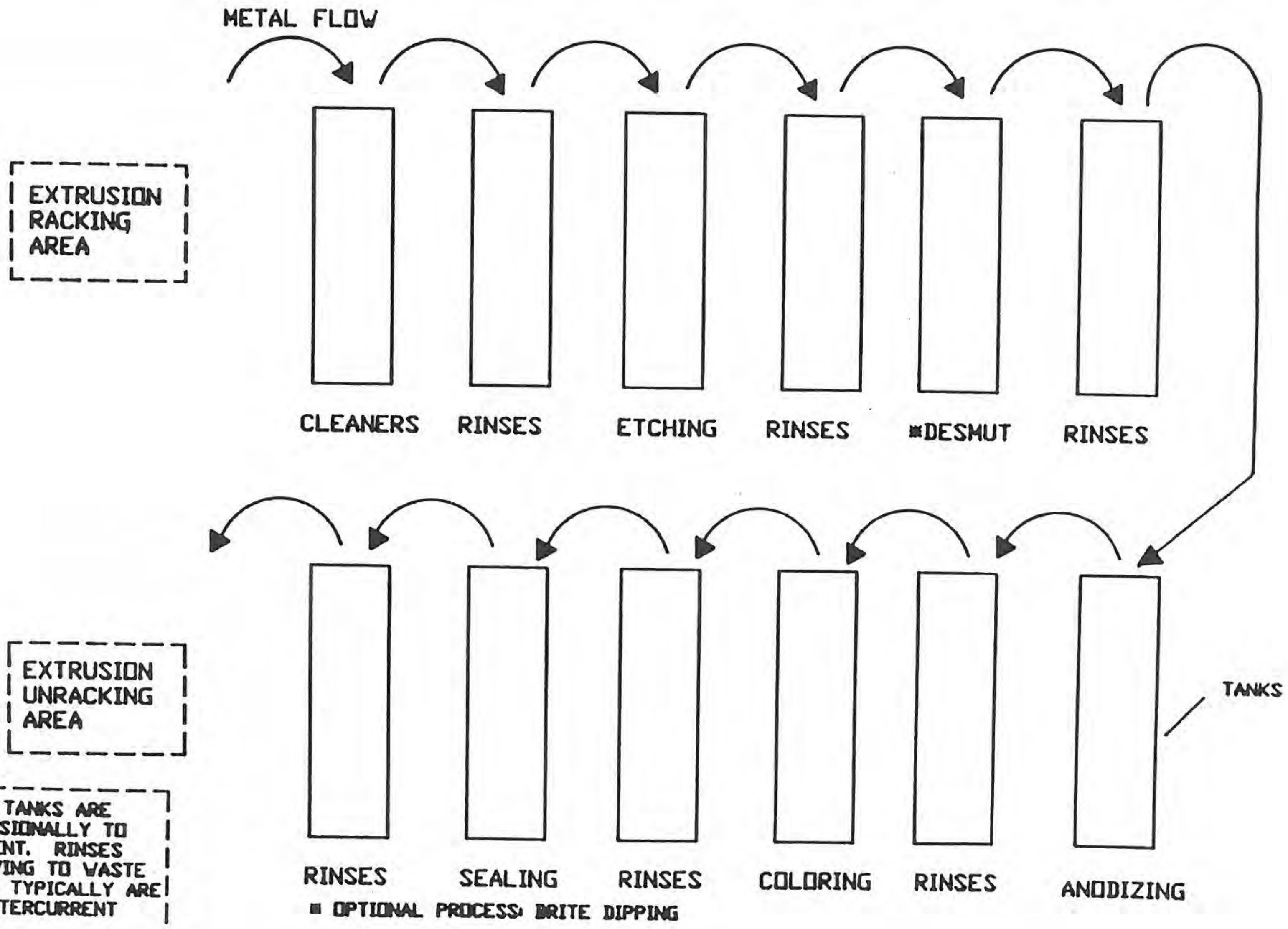
WILLIAM L BONNELL COMPANY
NEWNAN, GEORGIA

LAW ENVIRONMENTAL, INC.

CHEMICAL CONVERSION COATING
PROCESS FLOW DIAGRAM

JOB NO. 55-0649

FIGURE 1



NOTE: PROCESS TANKS ARE DECANTED OCCASIONALLY TO WASTE TREATMENT. RINSES ARE FREE FLOWING TO WASTE TREATMENT AND TYPICALLY ARE A SET OF COUNTERCURRENT RINSE TANKS.

SOURCE: DELISTING PETITION FOR THE WILLIAM L BONNEL COMPANY

WILLIAM L BONNEL COMPANY
NEWNAN, GEORGIA

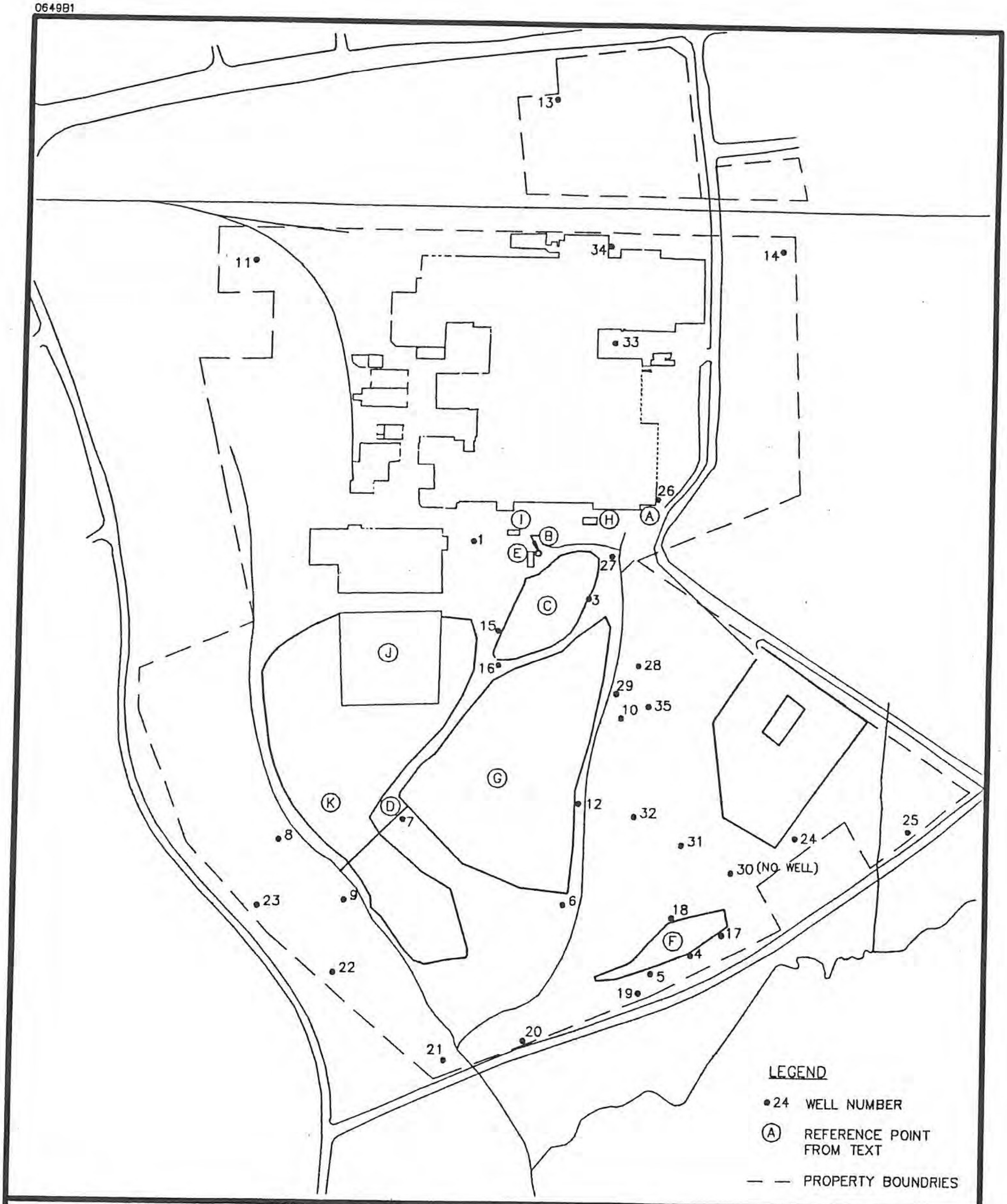
LAW ENVIRONMENTAL, INC.

ANODIZING PROCESS
FLOW DIAGRAM

JOB NO. 55-0649

FIGURE 2

0649B1



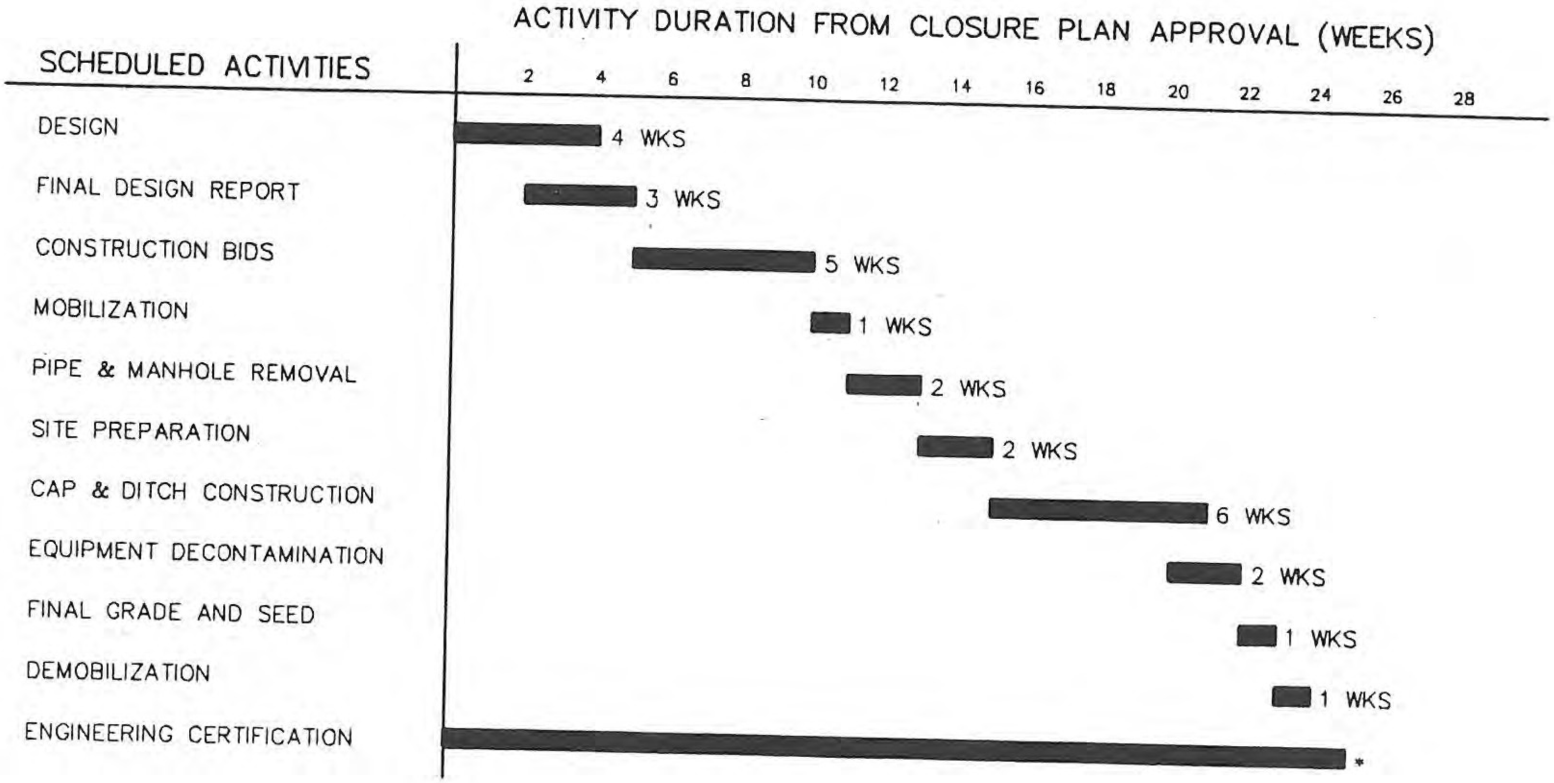
WILLIAM L BONNELL COMPANY
NEWNAN, GEORGIA

LAW ENVIRONMENTAL, INC.

SITE PLAN

JOB NO. 55-0649

FIGURE 3



LEGEND

▬ PROJECTED TIME LINE

* CERTIFICATION TO BE SUBMITTED WITHIN 60 DAYS AFTER CLOSURE COMPLETION

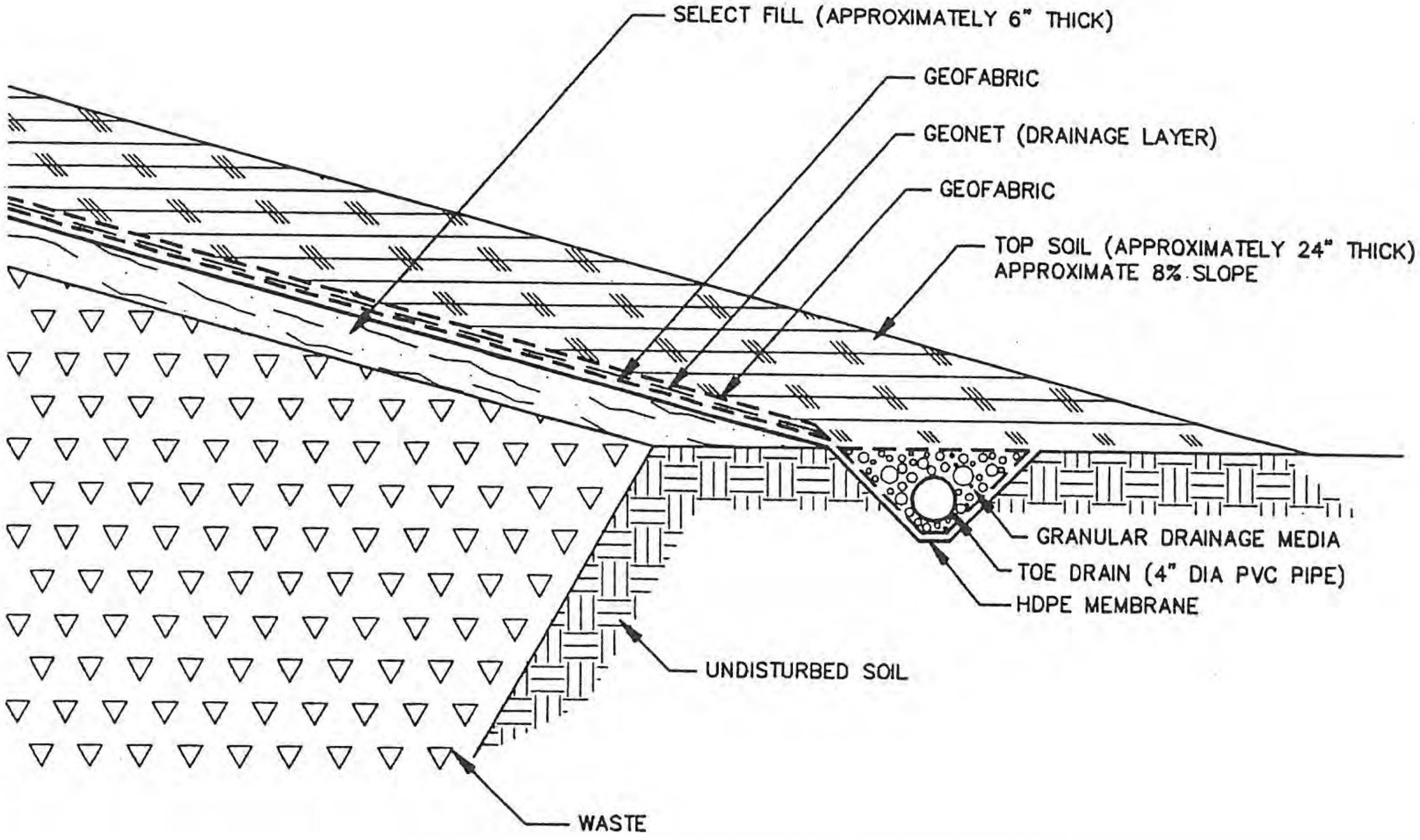
WILLIAM L BONNELL COMPANY, INC.
NEWNAN, GEORGIA

LAW ENVIRONMENTAL, INC.

CrOH SLUDGE
SAND DRYING BED AREA
CLOSURE SCHEDULE

JOB NO. 55-0649

FIGURE 4



WILLIAM L BONNELL COMPANY, INC.
NEWNAN, GEORGIA

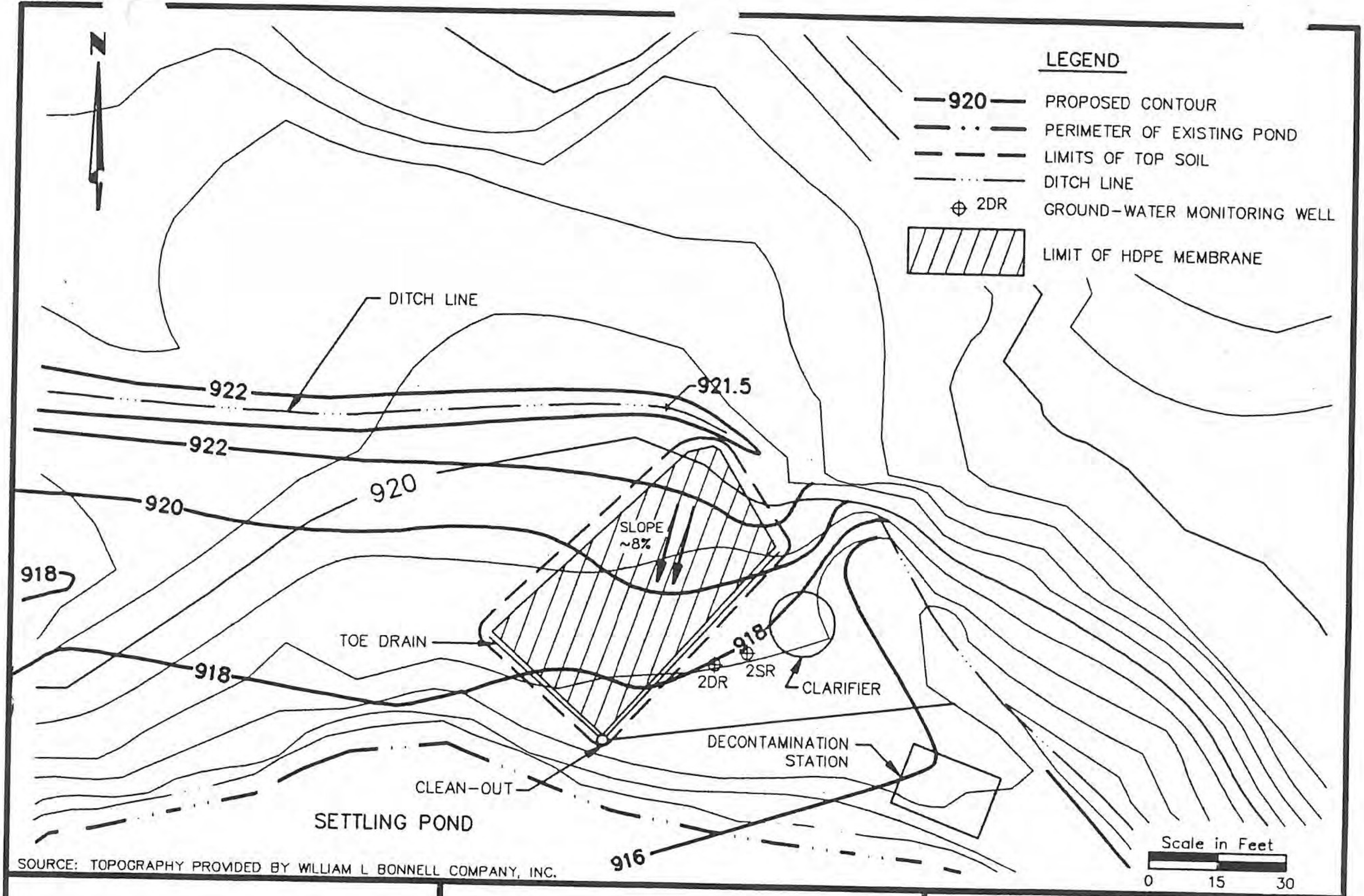
LAW ENVIRONMENTAL, INC.

CrOH SLUDGE
SAND DRYING BED AREA
TYPICAL COVER SCHEMATIC

JOB NO. 55-0649

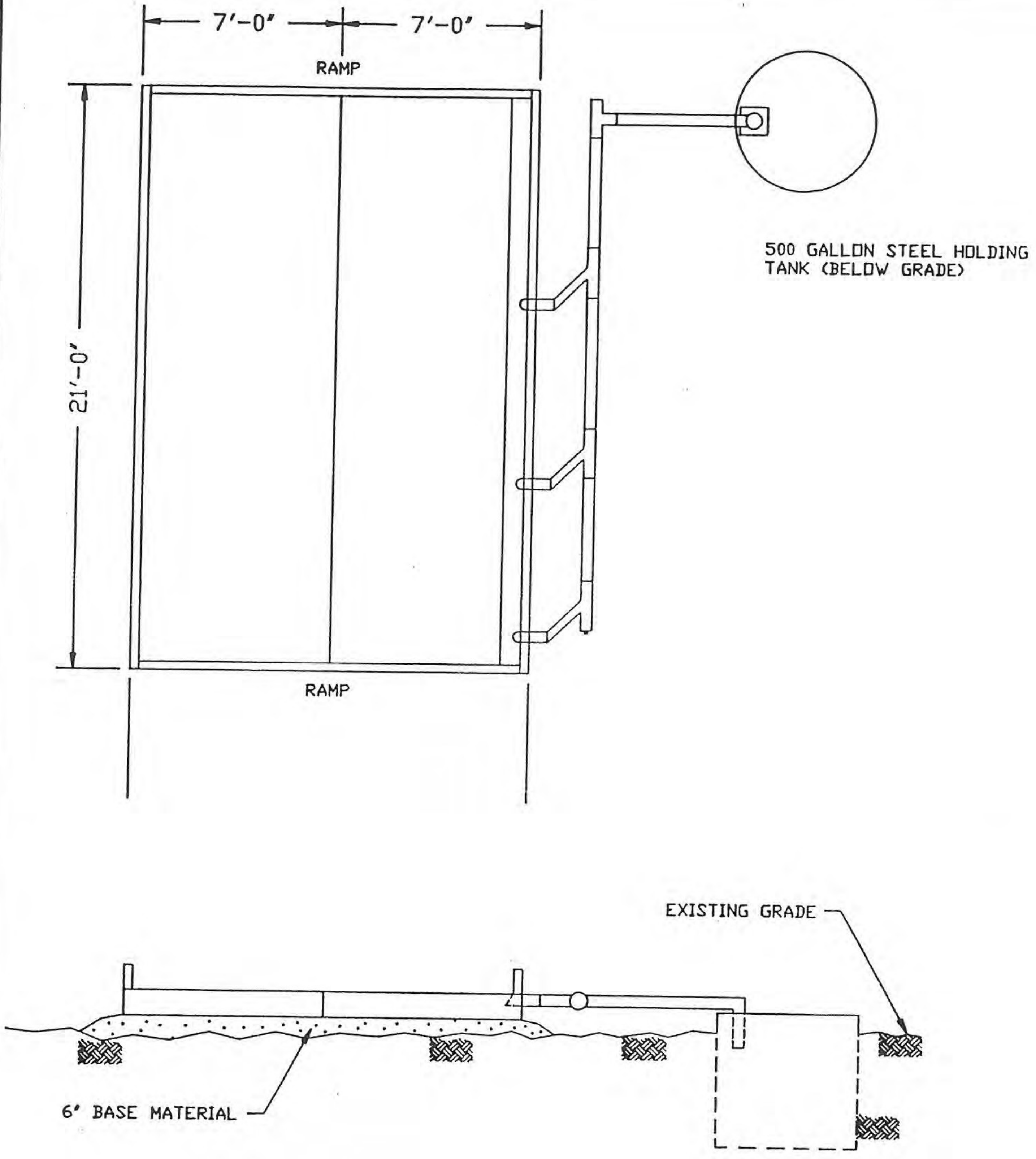
FIGURE 5

1130sh



SOURCE: TOPOGRAPHY PROVIDED BY WILLIAM L BONNELL COMPANY, INC.

WILLIAM L BONNELL COMPANY, INC. NEWNAN, GEORGIA	LAW ENVIRONMENTAL, INC.	CrOH SLUDGE SAND DRYING BED AREA CONCEPTUAL COVER JOB NO. 55-0649 FIGURE 6



SOURCE: REVISED CLOSURE PLAN CHROMIUM HYDROXIDE SLUDGE
SAND DRYING BEDS BY ATEC ENVIRONMENTAL DATED MARCH 7, 1990

SCALE: 1'=5'

WILLIAM L BONNELL COMPANY NEWNAN, GEORGIA		DECONTAMINATION WATER COLLECTION SYSYEM FIGURE 7

EXHIBIT 8

BONNELL PERIMETER FENCE

QUARTERLY INSPECTION LOG

INSPECTION DATE AND TIME: ______________________________

INSPECTOR'S NAME: ______________________________

DESCRIBE LOCATION AND TYPE OF DEFICIENCIES (Breaks, Collapse, Erosion, Excessive Rust):

____

____

____

DESCRIBE REPAIRS MADE TO CORRECT DEFICIENCIES AND INDICATE DATE OF REPAIRS:

____

____

____

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TABLE 1

LIST OF MATERIALS INTRODUCED IN THE CHEMICAL CONVERSION COATING PROCESS AND WASTEWATER TREATMENT FACILITY

WILLIAM L BONNELL COMPANY, INC.

NEWNAN, GEORGIA

PROCESS:

Aluminum
Chromic acid
Hydrofluoric acid
Isopropyl alcohol
Phosphoric acid
Sodium hydroxide

WWTF:

Lime
Polymer
Sodium bisulfite
Sulfuric acid
Phosphoric acid

TABLE 2

LIST OF MATERIALS INTRODUCED IN THE ANODIZING PROCESS AND WASTEWATER TREATMENT FACILITY
WILLIAM L BONNELL COMPANY, INC.
NEWNAN, GEORGIA

PROCESS:

- Aluminum
- Hydrogen peroxide
- Nickel acetate
- Nitric acid
- Phosphoric acid
- Sodium hydroxide
- Sulfuric acid
- Water

WWTF:

- Lime
- Polymer
- Spent sodium hydroxide
- Spent sulfuric acid
- Sodium hydroxide

TABLE 3
HELP MODEL-DEFAULT UNVEGETATED, UNCOMPACTED SOIL CHARACTERISTICS

HELP	SOIL CLASSIFICATIONS		POROSITY (VOL/VOL)	FIELD CAPACITY (VOL/VOL)	WILTING POINT (VOL/VOL)	SAT. HYD. CONDUCTIVITY (CM/SEC)
	USDA	USCS				
1	CoS	GS	0.417	0.045	0.018	1.0E - 02
2	S	SW	0.437	0.062	0.024	5.8E - 03
3	FS	SM	0.457	0.083	0.033	3.1E - 03
4	LS	SM	0.437	0.105	0.047	1.7E - 03
5	LFS	SM	0.457	0.131	0.058	1.0E - 03
6	SL	SM	0.453	0.190	0.085	7.2E - 04
7	FSL	SM	0.473	0.222	0.104	5.2E - 04
8	L	ML	0.463	0.232	0.116	3.7E - 04
9	SiL	ML	0.501	0.284	0.135	1.9E - 04
10	SCL	SC	0.398	0.244	0.136	1.2E - 04
11	CL	CL	0.464	0.310	0.187	6.4E - 05
12	SiCL	CL	0.471	0.342	0.210	4.2E - 05
13	SC	CH	0.430	0.321	0.221	3.3E - 05
14	SiC	CH	0.479	0.371	0.251	2.5E - 05
15	C	CH	0.475	0.378	0.265	1.7E - 05
16	Liner Soil		0.430	0.366	0.280	1.0E - 07
17	Liner Soil		0.400	0.356	0.290	1.0E - 08
18	Mun. Waste		0.520	0.294	0.140	2.0E - 04
19		USER SPECIFIED SOIL CHARACTERISTICS				
20		USER SPECIFIED SOIL CHARACTERISTICS				

TABLE 4

POST-CLOSURE INSPECTION CHECKLIST
FOR CrOH SLUDGE SAND DRYING BED AREA
WILLIAM L BONNELL COMPANY, INC.
NEWNAN, GEORGIA

Date Inspected/Time ______________________________

Reasons for Inspection
(routine/rainfall data) ______________________________

Erosion (yes/no) ______________________________

Ample Vegetative Ground-Cover (yes/no) ______________________________

Woody Plant Infiltration (yes/no) ______________________________

Security Barrier Intact (yes/no) ______________________________

Drainage Ditches checked (yes/no) ______________________________

Ground-water Monitoring Wells checked (yes/no)
- Locks
- Structure Integrity
- Identification
- Survey Benchmark ______________________________

Comments
____

Date/Type of Corrective Action ______________________________

Name of Inspector ______________________________
(Signature)

Name of Person responsible for Corrective Action or Further Investigation ______________________________
(Signature)

The purpose of this checklist is to assist the inspector in noticing particular item during the facility inspections. These inspections are to occur on a routine basis and also are to be conducted following any heavy rainfall or any natural disaster.

The inspector is encouraged to make general observations in the "Comments" section regarding conditions found during inspections. Comments such as condition of vegetation, weather, repair, etc. should be noted. Any necessary corrective action or further investigation must be noted in the "Comments" section. Finally, the inspector is responsible for obtaining the description of the corrective action or further investigation for entry in the "Date/Type of Corrective Action or Further Investigation" section and for obtaining the signature of the person responsible for the corrective action or further investigation.

TABLE 5
COST ESTIMATE FOR CLOSURE OF CrOH SAND DRY BED AREA

WILLIAM L BONNELL COMPANY, INC.
NEWNAN, GEORGIA

ITEM	QUANTITY	UNIT COSTS	COST **
1. DESIGN			
a. Professional Engineer	40 hours	$100.00 per hour	$4,000
b. Design Engineer	100 hours	$60.00 per hour	$6,000
c. Drafter	50 hours	$40.00 per hour	$2,000
2. SITE PREPARATION			
a. Mobilization/Demobilization	Lump Sum	$1,000.00	$1,000
b. Cover Preparation	200 c.y.	$6.00 per c.y.	$1,200
c. Pipe and Manhole Removal	Lump Sum	$5,000.00	$5,000
3. CONSTRUCTION *			
a. Cap Construction			
1. Fill Material (2 ft. topsoil)	200 c.y.	$6.00 per c.y.	$1,200
2. Geofabric	532 s.y.	$1.62 per s.y.	$862
3. Geonet	266 s.y.	$3.15 per s.y.	$838
4. HDPE Membrane	266 s.y.	$31.05 per s.y.	$8,259
c. Ditch Construction	Lump Sum	$1,000.00	$1,000
4. EQUIPMENT DECONTAMINATION	40 hours	$10.00 per hour	$400
5. FINAL GRADE AND SEED	266 s.y.	$1.70 per s.y.	$452
6. CONTRACTOR SUPERVISION			
a. Labor	300 hours	$50.00 per hour	$15,000
b. Expenses	60 days	$25.00 per day	$1,500
7. ENGINEERING INSPECTION AND CERTIFICATION			
a. Professional Engineer	100 hours	$100.00 per hour	$10,000
b. Technician	300 hours	$40.00 per hour	$12,000
c. Clerical	10 hours	$33.00 per hour	$330
d. Expenses, Travel and Per Diem	40 days	$30.00 per day	$1,200
	SUB-TOTAL		$72,241
	CONTINGENCY (10%)		$7,224
	ADMINISTRATION (5%)		$3,612
	TOTAL COST		$83,077

* Includes labor cost

** 1991 dollars

TABLE 6
COST ESTIMATE FOR POST-CLOSURE CARE OF CrOH SAND DRYING BED AREA

WILLIAM L BONNELL COMPANY, INC.
NEWNAN, GEORGIA

ITEM	QUANTITY	UNIT COSTS	COST **
1. SITE INSPECTION (4 times/year)			
a. Technician	16 hours	$40.00 per hour	$640
2. MOWING AND FERTILIZING *			
a. Mowing (4 times/year)	0.52 acres	$30.00 per acre	$16
b. Fertilizing	0.13 acres	$350.00 per acre	$46
3. ROUTINE EROSION REPAIR *			
a. Soil excavating, hauling, spreading and compaction	0.5 c.y.	$10.00 per c.y.	$5
b. Seeding	40 s.f.	$0.08 per s.f.	$3
4. GROUND-WATER QUALITY MONITORING			
Sampling and Analysis, per year	4 wells	$650.00 per well	***
		SUB-TOTAL	$710
		CONTINGENCY (10%)	$71
		ADMINISTRATION (5%)	$36
		TOTAL COST PER YEAR	$817
		POST-CLOSURE COST (30 years) ****	$8,780

* Includes labor cost

** 1991 dollars

*** Costs for ground-water quality monitoring of the CrOH Sand Drying Bed Area are included in the Polishing Pond Post-Closure Cost Estimate.

**** Calculated as follows:

$$P = A \frac{[(i + 1)^n - 1]}{i(i + 1)^n}$$

where P - present worth
A - total cost per year
i - Federal Discount Rate of 8.5%
n - number of compounding periods

APPENDIX A

Laboratory Data and
Material Safety Data Sheets

EXHIBIT C-2

RESULTS OF ANALYSES OF BONNELL F019 WASTE
1980-1983

1980

03/06/80	0.50 ppm Extraction Procedure Chromium
08/14/80	0.25 ppm Extraction Procedure Chromium
12/02/80	< 0.1 ppm Total Cyanide

1983

CONCENTRATION (ppm)

Constituent	Sample 1 09/26/83	Sample 2 10/08/83	Sample 3 10/10/83	Sample 4 10/17/83	EP Results
Arsenic	< 6	< 6	< 6	< 6	< 0.5
Barium	34	30	21	14	< 0.1
Cadmium	< 1	< 1	< 1	< 1	< 0.1
Chromium	4,100	4,000	3,000	3,500	0.3
Lead	2	< 3	< 3	< 3	< 0.1
Mercury	2	< 1	< 1	< 1	0.1
Selenium	< 6	< 6	< 6	< 6	< 0.3
Silver	< 1	< 1	< 1	< 1	0.4
Nickel	30	3	2	6	0.1
Oil & Grease	1800	1200	1600	2300	N/A

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EXHIBIT C-3

RESULTS OF ANALYESES OF BONNELL F019 WASTE

1986-1988

1986

Total Mercury (Hg) (mg/kg)	< 0.02
Water Soluble Fluoride (F) (mg/kg)	80
Total Solids @ 105°F	11.6%

1988

	Total Solids	Total Cr	Cr^{+6}
05/02/88	10.9%	8350 ppm	< 0.02 ppm
05/10/88	35.1%	7130 ppm	< 0.02 ppm

GM67B

Ethyl Aluminum Group

MATERIAL SAFETY DATA SHE

Emergency Phone 504-344-7147

25.0.2

PRODUCT IDENTIFICATION

TRADE NAME: ALUMINUM EXTRUSIONS
May be painted or anodized. May contain polyvinyl chloride or polyurethane as cavity fillers.

These products do not in and of themselves constitute a hazardous material under OSHA regulations. The products do contain alloying elements that have been determined by OSHA to be hazardous. However, these elements can only be released by certain manufacturing procedures such as welding, brazing, burning, grinding, etc.

INGREDIENTS

BASE METAL	CAS. NO.	% COMPOSITION BY WEIGHT	EXPOSURE LIMIT
Aluminum	7429-90-5	90 - 99	10 mg/M^3 as metal dust and oxide; 5 mg/M^3 as welding fume (ACGIH).

ALLOYING ELEMENT	CAS. NO.	% COMPOSITION BY WEIGHT	EXPOSURE LIMIT
Magnesium	1309-48-4	0.1 - 1.5	10 mg/M^3 TWA$_8$ as fume (ACGIH). 15 mg/M^3 TWA$_8$ as fume (OSHA).
Silicon	7440-21-3	0.2 - 1.0	10 mg/M^3 TWA$_8$ as total dust (ACGIH).

02/25/86
Continued

ALLOYING ELEMENT	CAS. NO.	% COMPOSITION BY WEIGHT	EXPOSURE LIMIT
Chromium	7440-47-3	0.005 - 0.2	0.5 mg/M^3 TWA_8 (ACGIH). 1.0 mg/M^3 TWA_8 (OSHA).
Zinc	1314-13-2	0.01 - 5.0	5.0 mg/M^3 as fume (OSHA/ ACGIH).

PHYSICAL DATA

APPEARANCE: Solids, varying shapes.

MELTING POINT: 593 - 704°C/1100 - 1300°F.

VAPOR PRESSURE: Not applicable.

SOLUBILITY IN WATER: Not applicable.

SPECIFIC GRAVITY: 2.5 - 2.9

FIRE AND EXPLOSION HAZARDS

FLASH POINT: Not applicable.

FLAMMABLE LIMITS: Not applicable.

EXTINGUISHING MEDIA: This product is nonflammable in its massive form. For fires involving fines or chips, use dry sand or Class D extinguishing agents. <u>DO NOT</u> use water or halogenated extinguishing agents.

HAZARDOUS THERMAL DECOMPOSITION PRODUCTS: Extrusions which are painted and/or contain polyvinyl chloride or polyurethane inserts may evolve the following compounds when exposed to high heat or fire: oxides of carbon and nitrogen, traces of hydrogen chloride from polyvinyl chloride inserts and traces of hydrogen cyanide from polyurethane inserts.

SPECIAL FIRE FIGHTING PROCEDURES:
DO NOT use water or halogenated extinguishing agents.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
None known.

REACTIVITY DATA

STABILITY: Stable.

MATERIALS TO AVOID: May be incompatible with acids, bases and oxidizers.

HAZARDOUS POLYMERIZATION:
Will not occur.

HEALTH HAZARDS

Ozone may be emitted as a by-product during welding or plasma arc cutting. Exposure to ozone may produce irritation to eyes, nose and throat. Prolonged exposure may result in nausea, headache, and pulmonary edema.

Aluminum: Aluminum dust can cause pulmonary fibrosis. Asthma can be caused by aluminum soldering.

Chromium: Can cause skin and eye irritation. Dust may be irritating to the respiratory tract. Hexavalent chromium has been shown to cause nasal perforation and carcinogenicity in laboratory animals. Certain chromium compounds are on the NTP list of carcinogens.

Magnesium: Inhalation of the oxide can cause metal fume fever. Exposure of abraded skin surfaces can cause inflamation. Overexposure to fumes may cause irritation to the eyes and respiratory tract. No chronic effects of overexposure are known.

Silicon: Considered a nuisance dust by ACGIH. No chronic effects of overexposure are known.

Zinc: Inhalation of the oxide can cause metal fume fever. Symptoms from ingestion include stomach cramps, nausea, vomiting, diarrhea and fever. No chronic effects of overexposure are known.

Continued

NOTE: If exposures for aluminum fume, dust, and oxides are kept below the permissible exposure limit the alloy components should not present any significant health risk.

EMERGENCY FIRST AID PROCEDURES

INHALATION:	If inhaled, remove to fresh air.
EYE CONTACT:	Immediately flush eyes with water for at least 15 minutes.
SKIN CONTACT:	Wash exposed area with soap and water.
INGESTION:	Not expected to be a route of exposure.

EXPOSURE CONTROL INFORMATION

EXPOSURE LIMITS:	See Ingredients section.
EYE PROTECTION:	Safety glasses with side shields or goggles when cutting extrusions. If extrusions are welded, use standard welding protective eyewear.
PROTECTIVE GLOVES:	Use gloves appropriate for the type of processing activity.
RESPIRATORY PROTECTION:	None needed under normal processing conditions. NIOSH approved dust/fume respirator when grinding, welding, brazing, or burning.
LOCAL EXHAUST VENTILATION:	Not needed under normal processing conditions. Local exhaust ventilation is recommended for grinding, welding, brazing, burning.
MECHANICAL VENTILATION:	Recommended.
OTHER:	Other protective equipment as needed according to the nature of the processing activity.

ENVIRONMENTAL PROTECTION

SPILLS OR LEAKS: Not applicable.

DISPOSAL METHODS: Used or unused product should be tested as necessary to determine hazard status and disposal requirements under federal, state, or local laws and regulations.

STORAGE REQUIREMENTS: No special storage required.

ADDITIONAL PRECAUTIONS OR COMMENTS

If aluminum extrusions are remelted, make certain no water or moisture is present in cavaties or on external surfaces. Entrapped moisture or the presence of strong oxidizers could cause an explosion.

REVISED: 02/25/86 (Original) SUPERSEDES: NEW
T&IH File Code: TX 02555-XX-7
MSDS prepared by: Toxicology and Industrial Hygiene Department
Ethyl Corporation
FOR ADDITIONAL NONEMERGENCY MSDS INFORMATION, CONTACT:
TOXICOLOGY AND INDUSTRIAL HYGIENE DEPARTMENT
ETHYL CORPORATION
451 FLORIDA ST.
BATON ROUGE, LA 70801
(504) 388-7717

THIS MATERIAL SAFETY DATA SHEET CONTAINS AT LEAST THE INFORMATION REQUIRED BY THE FEDERAL OSHA HAZARD COMMUNICATION RULE, 29 CFR 1910.1200(g)(2).

MATERIAL SAFETY DATA SHEET

NOVAMAX TECHNOLOGIES (U.S.) INC.
1615 Johnson Road N.W.
Atlanta, Georgia 30318

Phone:
INQUIRY---(404) 799-1292
EMERGENCY-(800) 366-6682

HAZARD RATINGS		
HEALTH	3	0=Least 1=Slight
FLAMMABILITY	0	2=Moderate 3=High
REACTIVITY	2	4=Extreme

IDENTITY: (As used on label and list)

SC-34
SPRAY ALKALINE ALUMINUM CLEANER

SECTION I

MANUFACTURER'S NAME: NOVAMAX TECHNOLOGIES (U.S.) INC.
ADDRESS: 1615 Johnson Road N.W.
Atlanta, Georgia 30318
EMERGENCY PHONE NUMBER: (800) 366-6682
PHONE NUMBER FOR INFORMATION: (404) 799-1292
TE PREPARED: May 22, 1989
ME OF PREPARER: Virgil Zipperer

SECTION II HAZARDOUS INGREDIENTS/INFORMATION

HAZARDOUS COMPONENTS		OSHA PEL	ACGIH TLV	OTHER NIOSH
SODIUM HYDROXIDE	CAS# 1310-73-2	2mg/m3	2mg/m3 Ceil. 15-min.	2mg/m3 Ceil.

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point______________220 F
Vapor Pressure (mm Hg)____16
Vapor Density (Air=1)___1.4
Specific Gravity (H2O=1)_________1.514
Melting Point__________________50 F
Evaporation Rate
(Butyl Acetate=1)_______________20.0
Solubility in Water: Complete.
Appearance and odor: Hazy, off white, viscous liquid with mild amine odor.

SECTION IV- FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used):_NONE Flammable Limits___N/A_ LEL_N/A__ UEL _N/A
Extinguishing Media: N/A
Special Fire Fighting Procedures: This product is corrosive to skin, eyes and mucous membranes. Firefighters should wear full protective clothing and face shield to prevent contact with solutions.
Unusual Fire and Explosion Hazards: Solutions of this product react with aluminum and magnesium to produce hydrogen gas which is explosive.

NOVAMAX TECHNOLOGIES (U.S.) INC.
1616 Johnson Road N.W.
Atlanta, Georgia 30318

****

SECTION V- REACTIVITY DATA

****

Stability: Stable

Incompatibility (Materials to Avoid): Do not mix with acids, reducing agents, aluminum, zinc or tin.

Hazardous Decomposition or Byproducts: Heat and/or hydrogen.

Hazardous Polymerization: Will Not Occur.

****

SECTION VI- HEALTH HAZARD DATA

****

Route(s) of Entry:

Inhalation? Mists are corrosive.

Skin? Solutions and mists are corrosive.

Ingestion? Solutions are corrosive.

Health Hazards (Acute and Chronic): Corrosive to skin, eyes and mucous membranes.

Carcinogenicity:

NTP? Not on list.

IARC Monographs? Not on list.

OSHA Regulated? Refer to SECTION II for PEL and TLV values.

Signs and Symptoms of Exposure:

INHALATION- Irritation of respiratory system with possible difficulty in breathing.

INGESTION- Small amounts may cause gastric pain, diarrhea and vomiting.

SKIN CONTACT-Irritation, inflammation, pain.

Medical Conditions Generally Aggravated by Exposure: Unknown

Emergency and First Aid Procedures:

INGESTION-Administer citrus juices or

ata Sheet

IV FIRE AND EXPLOSION DATA

FLASH POINT (TEST METHOD) None

AUTOIGNITION TEMPERATURE None

FLAMMABLE LIMITS IN AIR, % BY VOL. None

LOWER

UPPER

EXTINGUISHING MEDIA Water, dry chemical, foam

SPECIAL FIRE FIGHTING PROCEDURES
Strong oxidizer self contained breathing apparatus and full protective clothing.

UNUSUAL FIRE AND EXPLOSION HAZARD
Strong oxidizer do not mix with organic materials.

V HEALTH HAZARD INFORMATION

HEALTH HAZARD DATA

ROUTES OF EXPOSURE

INHALATION Redness, irritaiton, may cause perforation of nasal septum

SKIN CONTACT Redness, irritation, chrome sores

SKIN ABSORPTION Redness, irritation, chrome sores

EYE CONTACT Causes severe damage and blindness very rapidly

INGESTION Results in severe damage to mucous membranes and deep tissues can result in death

EFFECTS OF OVEREXPOSURE
ACUTE OVEREXPOSURE redness, blistering, blindness, stopped breathing death

CHRONIC OVEREXPOSURE Liver damage, lung damage

EMERGENCY AND FIRST AID PROCEDURES
EYES. Immediately flush with large amounts of water for 15 minutes, lifting upper and lower lids. get medical attention

SKIN Immediately flush exposed area with water for 15 minutes. get medical attention. Remove contaminated clothing. Launder clothing before reuse.

INHALATION If affected remove to fresh air. If breathing impaired give oxygen. If breathing stopped give artifical respiration. Keep person warm. get medical attention.

INGESTION. Do not induce vomiting. Vomiting will further damage the throat. Dilute by giving water. Give milk of magnesia. Keep warm and quiet.Get medical attention.

NOTES TO PHYSICIAN

VI REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY

Stable

INCOMPATIBILITY

Organic material, bases

HAZARDOUS DECOMPOSITION PRODUCTS

Chromic gas, hydrofluoric gas

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION

none

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

Collect in absorbent material haul to hazardous landfill.

NEUTRALIZING CHEMICALS

Alkalies, soda ash, caustic

WASTE DISPOSAL METHOD

Treat chrome and remove from solution.
Collect sludge and haul to landfill - dispose of water.

VIII INDUSTRIAL HYGIENE CONTROL MEASURES

VENTILATION REQUIREMENTS

Provide sufficient air movement to take care of fumes.

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY (SPECIFY IN DETAIL)

If adequate ventilation none necessary

EYE

Splash goggles, face shield, safety glasses.

GLOVES

Rubber gloves

OTHER CLOTHING AND EQUIPMENT

Rubber gloves, apron, boots

IX SPECIAL PRECAUTIONS

PRECAUTIONARY STATEMENTS

Corrosive, oxidizer poisionous

For Industrial Use Only

OTHER HANDLING AND STORAGE REQUIREMENTS

Do not store with alkalies

Do not allow to contact organics

DEPARTMENT OF TRANSPORTATION INFORMATION
PROPER SHIPPING NAME:
HAZARD CLASS:
I.D. NO.:
HAZARD SUBSTANCE:

PREPARED BY

DATE [illegible]

Paint. ✓

SPECIALTY CHEMICALS & SERVICES, INC.

MATERIAL SAFETY DATA SHEET

(APPROVED BY THE U. S. DEPARTMENT OF LABOR AS FORM APPROVED OMB NO. 44-R1387)

Information on this form is furnished solely for the purpose of compliance with the Occupational Safety and Health Act of 1970 and shall not be used for any other purpose. Use or dissemination of all or any part of this information for any other purpose may result in a violation of law or constitute grounds for legal action.

SECTION I

MANUFACTURER'S NAME: SPECIALTY CHEMICALS & SERVICES, INC.

EMERGENCY TELEPHONE NO.: 525-1518

ADDRESS (Number, Street, City, State, and ZIP Code): 89 Mangum St. S.W., Atlanta, Ga. 30313

CHEMICAL NAME AND SYNONYMS: SC-278, chromate acidulated rinse

TRADE NAME AND SYNONYMS:

CHEMICAL FAMILY: acid solution

FORMULA:

SECTION II HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Chromic Acid	30	0.1 mg
Phosphoric Acid	22	1.0 mg

SECTION III PHYSICAL DATA

BOILING POINT (°F.)	no data	SPECIFIC GRAVITY (H_2O=1)	1.445
VAPOR PRESSURE (mm Hg.)	no data	PERCENT VOLATILE BY VOLUME (%)	48
VAPOR DENSITY (AIR=1)	no data	EVAPORATION RATE (_____=1)	no data
SOLUBILITY IN WATER	complete		

APPEARANCE AND ODOR: Slight acidic odor. Reddish brown liquid

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method Used): N.A.

FLAMMABLE LIMITS: N.A. | Lel | Uel

EXTINGUISHING MEDIA: N.A.

SPECIAL FIRE FIGHTING PROCEDURES: N.A.

UNUSUAL FIRE AND EXPLOSION HAZARDS: N.A.

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE NXAX.5 Mil/Cu Centimeter=Chromic Acid

1.0 " " " =Phosphoric acid

EFFECTS OF OVEREXPOSURE Will cause skin and eye damage.

EMERGENCY AND FIRST AID PROCEDURES
Eye & skin contact: flush 15 minutes with water. If irritation per seek medical aid. Ingestion: do not induce vomiting. Take large amounts of aluminum hydroxide or milk of magnesia. Follow with milk or white of eggs. Consult physician.

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID N.A.
	STABLE	X	

INCOMPATABILITY (Materials to avoid) Organic materials

HAZARDOUS DECOMPOSITION PRODUCTS N.A.

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID N.A.
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Small amounts, flush to drain. Large amounts should be absorbed in light soda ash and placed in adequate landfilliarea.

WASTE DISPOSAL METHOD Consult local authorities.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specific type) N.A.

VENTILATION	LOCAL EXHAUST	N.A.	SPECIAL	N.A.
	MECHANICAL (General)	N.A.	OTHER	NA.

PROTECTIVE GLOVES rubber

EYE PROTECTION glasses with side shields

OTHER PROTECTIVE EQUIPMENT face shield & rubber apron.

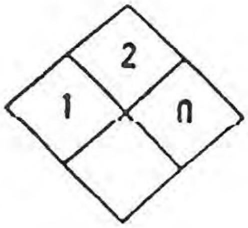
SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Avoid skin and eye contact.

OTHER PRECAUTIONS

AMCHEM PRODUCTS, INC.
DIVISION OF HENKEL CORPORATION
300 BROOKSIDE AVENUE
AMBLER, PA 19002

AMCHEM



MATERIAL SAFETY DATA SHEET

WILLIAM L BONNELL COMPANY, INC
25 BONNELL STREET
NEWNAN, GA 30263

CUSTOMER # 32560001

PRODUCT TRADE NAME	RINSE AID
DOT PROPER SHIPPING NAME	Not Regulated
DOT HAZARD CLASSIFICATION	None
TECHNICAL CONTACT (NAME)	Charles Gruszka
TELEPHONE NUMBER	(215) 628-1364
EMERGENCY NUMBER	(215) 628-1000

1 HAZARDOUS INGREDIENTS

MATERIAL	CAS NO.	CONTENTS (% WT/WT)	HAZARD	TLV
Isopropanol	67-63-0	5-10	Flammable	980mg/M³

2 PHYSICAL DATA

APPEARANCE	Clear colorless liquid
SOLUBILITY IN WATER	Complete
ODOR, @ 60 °F.	Solvent
SPECIFIC GRAVITY @ 60 °F.	0.97-0.99
pH of CONCENTRATE	N/A
BOILING POINT, °F.	>212
OTHER:	N/A

3 FIRE & EXPLOSION DATA

FLASH POINT	>120°F
TEST METHOD	TCC
EXTINGUISHING MEDIA	Carbon dioxide, foam, or vaporizing liquid

UNUSUAL FIRE OR EXPLOSION HAZARDS

None

SPECIAL FIRE FIGHTING PROCEDURES

None

PERSONAL PROTECTION

VENTILATION REQUIREMENTS

GENERAL AREA EXHAUST ☒

LOCAL EXHAUST ☐

NO EXHAUST NECESSARY ☐

PERSONAL PROTECTIVE EQUIPMENT

EYE PROTECTION	Safety goggles
SKIN PROTECTION	Rubber gloves
RESPIRATORY PROTECTION	Fume mask - NIOSH approved
OTHER REQUIRED EQUIPMENT	None

9 SPECIAL PRECAUTIONS & STORAGE

Store in a cool place.

PREPARED BY Charles Gruszka

DATE 10/23/86

TITLE Senior Chemist

4 REACTIVITY DATA

STABLE ☒

UNSTABLE ☐

CONDITIONS TO AVOID

INCOMPATIBLE MATERIALS

Strong oxidants

HAZARDOUS POLYMERIZATION

WILL OCCUR ☐

WILL NOT OCCUR ☒

CONDITIONS TO AVOID

HAZARDOUS DECOMPOSITION PRODUCTS

Oxides of carbon

5 HEALTH HAZARD DATA

Skin:	May irritate.
Eyes:	May irritate.
Ingestion:	May irritate mucous membranes.
Inhalation:	May irritate mucous membranes if prolonged.

6 FIRST AID RECOMMENDATIONS

Skin:	Wash with soap and water and rinse thoroughly.
Eyes:	Flush immediately with copious amounts of water for at least 15 minutes. Call a doctor.
Ingestion:	Dilute by drinking several glasses of water or milk. Call a doctor. Do not induce vomiting unless directed by a doctor.
Inhalation:	Remove from contaminated area to fresh air.

7 SPILL PROCEDURES & WASTE DISPOSAL

SPILL PROCEDURES

Transfer any excess to a clean mild steel container. Soak up remaining residue with absorbent material.

WASTE TREATMENT

Either incinerate or put in a landfill with approval of regulatory agency.

APPENDIX B

Report of Clean-up Activities Conducted March and April, 1990

TERRY D. SNELL AND ASSOCIATES
1111 VALERIE WOODS DRIVE
STONE MOUNTAIN, GEORGIA 30083
404/294-8335

December 20, 1990
Revised January 5, 1991
Revised July 26, 1991

Leo Harlan
Technical Director
William L Bonnell Company, Inc.
25 Bonnell Street
Newnan, GA 30263

Re: Closure Activities
Chromium Hydroxide Sand Drying Beds

Dear Leo

The purpose of this brief report is to document the closure activities for the chromium hydroxide sand drying beds (CrOH sand drying beds) during March, April, and June, 1990 performed by Bonnell and Four Seasons Industrial Services, Inc. (Four Seasons), and directed by Terry Snell. The closure activities were an attempt to achieve clean closure of the CrOH sand drying beds unit (CrOH SDB Unit) in accordance with the Partial Closure Plan dated March 7, 1990, (submitted to EPD on March 7, 1990). This report will also respond to the comment in Bill Mundy's letters to you dated November 5, 1990, and June 26, 1991, in reference to the Notices of Deficiencies for the Revised [Partial] Closure Plan for the CrOH Sand Drying Beds dated July 31, 1990, (submitted to EPD on July 31, 1990) and the revision dated December 1990 (submitted to EPD on December 20, 1990). The referenced NODs requested a more detailed description of the closure activities.

The location of the CrOH SDB Unit is shown on Figure 1. Under the Partial Closure Plan, Bonnell was to "remove and decontaminate all waste residues, contaminated containment system components (liners, etc.), contaminated subsoils, and structures and equipment contaminated with wastes and leachate, and manage them as hazardous wastes" from the CrOH SDB Unit in accordance with 40 CFR 265.228.

Under the March 7, 1990, Partial Closure Plan, materials removed from the CrOH SDB Unit were to be stockpiled on-site prior to disposal at Chemical Waste Management's permitted landfill at Emelle, Alabama. The location of the stockpile is also shown on Figure 1. The stockpile area was prepared by Bonnell prior to the arrival of Four Seasons. The area was bermed and three layers of polyethylene sheeting were placed on the ground and over the berms.

In addition, Bonnell constructed and placed the decontamination station shown on Figure 1 near the CrOH SDB Unit. The decontamination station was used during closure activities to decontaminate equipment necessary for the closure operations prior to removing it from the site. Personnel decontamination was also performed at the decontamination station.

Four Seasons mobilized to the site on March 18. On March 19, a project meeting was held at the site to discuss the project's site health and safety plan and to ensure that all parties understood their role in the closure activities.

Four Seasons began the operation by placing three layers of polyethylene sheeting on the ground in a working area large enough for a dump truck to operate. The polyethylene sheeting also covered the area between the CrOH SDB Unit, the decontamination station, and the stockpile area. Four Seasons then began removing the sand from the CrOH SDB Unit and placing it and other materials from the CrOH SDB Unit (i.e., concrete and piping) into the bed of a dump truck. The bed of the dump truck and the side of the dump truck were protected with polyethylene sheeting to prevent their contamination. Polyethylene sheeting was also wrapped around the tires of the dump trucks during loading to prevent soils from the CrOH SDB Unit from contacting them.

The dump truck was used to transport the contaminated materials from the CrOH SDB Unit to the stockpile area across the three layers of polyethylene sheeting to prevent contamination of the ground between the CrOH SDB Unit and the stockpile area. Four Seasons continued the operation by demolishing the concrete structure and moving the concrete debris and piping associated with the CrOH SDB Unit to the stockpile area. All soil was removed from under the CrOH SDB Unit to below groundwater. The excavation ranged from approximately 6 feet to 15 feet in depth due to surface topography, with a relatively flat bottom. The areal extent of the excavation is shown on Figure 2.

Soil samples were then collected from the areas shown on Figure 3 for analysis. The result of the analyses are summarized in Table 1. The certified laboratory reports are included as Attachment A.

Soil samples were collected using a spatula. The following decontamination procedures were specified for the spatula:

1. scrubbing between samples with tap water and laboratory grade detergent,
2. rinsing once with deionized water,

3. rinsing once with reagent grade isopropanol, and
4. rinsing three times with deionized water.

The samples were placed in clean glass jars supplied by Analytical Services, Inc. (ASI). All samples were labeled, numbered, and placed on ice for preservation and transportation to ASI. The soil samples were then tested for total chromium using EPA method 6010.

After the results of these laboratory analyses were received, additional soil was removed from the area which expanded the excavation to the area shown on Figure 4 and a second set of soil samples was collected as shown on Figure 5 and summarized in Table 2. The certified laboratory reports are included as Attachment B. Only total chromium values were used to determine whether or not additional soil removal was performed.

In addition, a visible lens of soil that had a turquoise green color was observed at the southeastern end of the excavation. The areal extent of the turquoise green material is shown on Figure 6. All of the turquoise green colored lens was excavated and placed in the stockpile area with the other hazardous materials. Analyses of samples taken from the lens material are summarized in Table 3. The certified laboratory reports are included as Attachment C along with a description of the test for hexavalent chromium (method 7196).

When the contaminated soils, concrete, and piping were taken to the stockpile area, they were dumped onto the polyethylene sheeting and spread by a small backhoe. The operation was conducted such that the backhoe worked on a layer of soil and did not contact the polyethylene sheeting directly. This prevented any direct contact between the CrOH SDB Unit materials and the soils under the stockpile. Concrete and other debris were placed on top of several layers of CrOH SDB Unit soil so that they had no contact with the polyethylene sheeting.

The material removed from the CrOH SDB Unit consisted of contaminated soils, concrete, and piping, from the unit itself. In addition, uncontaminated surface soils from areas outside the CrOH SDB Unit were removed to allow excavation of piping as shown on Figure 2. These soils from outside the unit were stockpiled separately from the contaminated soils.

The stockpiled contaminated soil, sand, concrete, and piping were covered with layers of polyethylene sheeting which was secured in place. Four Seasons then demobilized until June 17, 1990.

On June 19, Four Seasons began loading the stockpiled contaminated material into trucks. The trucks beds were lined with polyethylene sheeting, and the sides of the truck beds were protected with polyethylene sheeting in the same manner as the dump truck. The trucks were owned and operated by Chemical Waste Management, Inc., a permitted hazardous wastes transporter. Each truck was washed at the decontamination station prior to leaving the immediate project control area. The trucks were weighed at Bonnell's security gate prior to leaving the facility. All the contaminated material from the CrOH SDB Unit, which included sand, soil, concrete debris, and pipe debris, was transported to Emelle, Alabama and disposed of in the Chemical Waste Management permitted landfill.

In discussions with Mark Smith of EPD, it was determined that it would be wise to remove a layer of soil below the liner and dispose of that soil with the CrOH SDB Unit materials. Therefore, one foot of soil below the polyethylene liner for the stockpile was removed and shipped to Emelle. A total of 1,231.35 tons of soils and debris were transported to Emelle, Alabama and disposed of in the Chemical Waste Management permitted landfill.

Four Seasons then began backfilling the excavation pit. The backfilling operations were as follows:

1. A 24-inch corrugated metal stand pipe was first placed in the excavation to facilitate installation of groundwater recovery equipment in anticipation of groundwater remediation, if required. The standpipe's location is shown on Figure 7. Gravel was then placed in the excavation pit around the standpipe up to approximately 2 feet above the groundwater and compacted with the backhoe. The total volume of gravel was approximately 150 cubic yards.

2. Backfill soils obtained from an area on Bonnell property remote from the CrOH SDB Unit was then placed in the excavation pit. Approximately 400 cubic yards of these soils were placed in the excavation in six-inch lifts and compacted with the backhoe.

3. Approximately 50 cubic yards of soils previously removed from areas outside of the CrOH SDB Unit were placed into the excavation pit in six-inch lifts and compacted with the backhoe. Summary results of laboratory analyses of samples of these soils are included in Table 4. The certified laboratory reports are included as Attachment D. The samples collected from these soils are designated

"Soil Pile #3" on laboratory report No. 21769[1]. The total chromium in the 50 cubic yards averaged 133 mg/kg, which was less than the 152 mg/kg level in soils left in the ground (i.e., never removed from the ground) at sample point 32A shown on Figure 5. Backfilling of the excavation pit with the soils from outside the CrOH SDB Unit was discussed in a June 5, 1990, meeting between Bonnell representatives and Mark Smith and Kathy Methier of EPD. In the meeting, EPD requested that Bonnell proceed with transportation and disposal of the stockpiled materials. Bonnell agreed to dispose of the contaminated material, and EPD agreed that the soils from outside the CrOH SDB Unit could be placed into the excavation pit providing these soils had total chromium levels less than the total chromium levels of soils that were left in (i.e., never removed from) the excavation pit. From a technical point of view, since these soils did not come from the CrOH SDB Unit and were not F019 material, placing these soils into the pit could not be a violation of the Georgia Hazardous Waste Management Act, including the Land Ban Restrictions (which did not come into effect for F019 materials until August 8, 1990). In addition, sample S-41 had a total chromium content of 1970 mg/kg, and an EP toxicity level of 0.51 mg/l. Since the soils from outside the CrOH SDB Unit which were placed in the excavation pit had total chromium levels that averaged only 133 mg/kg (which were less than the S-41 level), an EP toxicity level less than 5.2 mg/l would be expected. Therefore, treatment standards would have been met.

4. Approximately 200 cubic yards of additional backfill soils were placed over the area in six-inch lifts and compacted with the backhoe.

The area was then staked to mark the extent of the excavation and backfill. Additional area was included within the staked area in order to be conservative. This area is shown on Figure 7, and is larger than the final excavation limits shown on Figure 4. Therefore, the HDPE cap will cover even more area than the final excavation limits.

---

[1] It should be noted that the laboratory report designates both samples as "Soil grab from covered waste pile, samples 6/14/90". Soil pile #2 was soil removed from areas designated as the unit. Soil pile #3, however, was from areas outside the unit and should not have been designated as a waste pile.

In conclusion, the activities under the March 7, 1990 Partial Closure Plan described in this report conformed to 40 CFR 265.112(b)(4). Soils that remain on-site (i.e., in the unit) will be capped according to the closure performance standards included in Section 1.2 of the Revised Closure Plan dated July 26, 1991. Therefore, waste residues were not decontaminated during the activities under the March 7, 1990 Partial Closure Plan. No equipment or structures were left in the CrOH SDB Unit.

The decontamination station referred to in this report was constructed for decontamination of mobile construction equipment used during the partial closure activities. There was no other equipment to be decontaminated. The decontamination procedure used for construction equipment was a triple rinse to remove all visible contamination. This procedure is described in the NIOSH/OSHA/USCG/EPA document entitled "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" (October 1985). The mobile construction equipment was visually inspected to ensure that all soil had been removed. All rinsewaters were collected and pumped to the head of the chemical conversion coating wastewater treatment system for treatment and disposal in the NPDES permitted outfall.

Personnel wore protective clothing during closure activities. All protective clothing was collected at the decontamination station. Clothing that could be decontaminated (i.e., boots) were decontaminated using the same triple rinse method described in the referenced manual. Clothing that could not be decontaminated (i.e., tyvek suits) were disposed of with the materials shipped to Emelle, Alabama.

There was no decontamination of "...waste residues and contaminated containment systems components, equipment structures, [or] soil..." as discussed in 40 CFR265.112(b)(4) during the partial closure activities. Initial efforts were directed toward removing all contaminated soils with a goal of clean closure. All "contaminated containment systems components" and "equipment structures" (i.e., concrete and piping) were taken to Chemical Waste Management's permitted landfill at Emelle, Alabama, for disposal. Since no decontamination was attempted or performed for closure purposes, no decontamination closure performance standard was applicable.

If you have any questions, please contact me.

Sincerely

Terry D. Snell

Terry D. Snell, P.E.

cc: Kevin Finto
Loren McCune

FIGURES

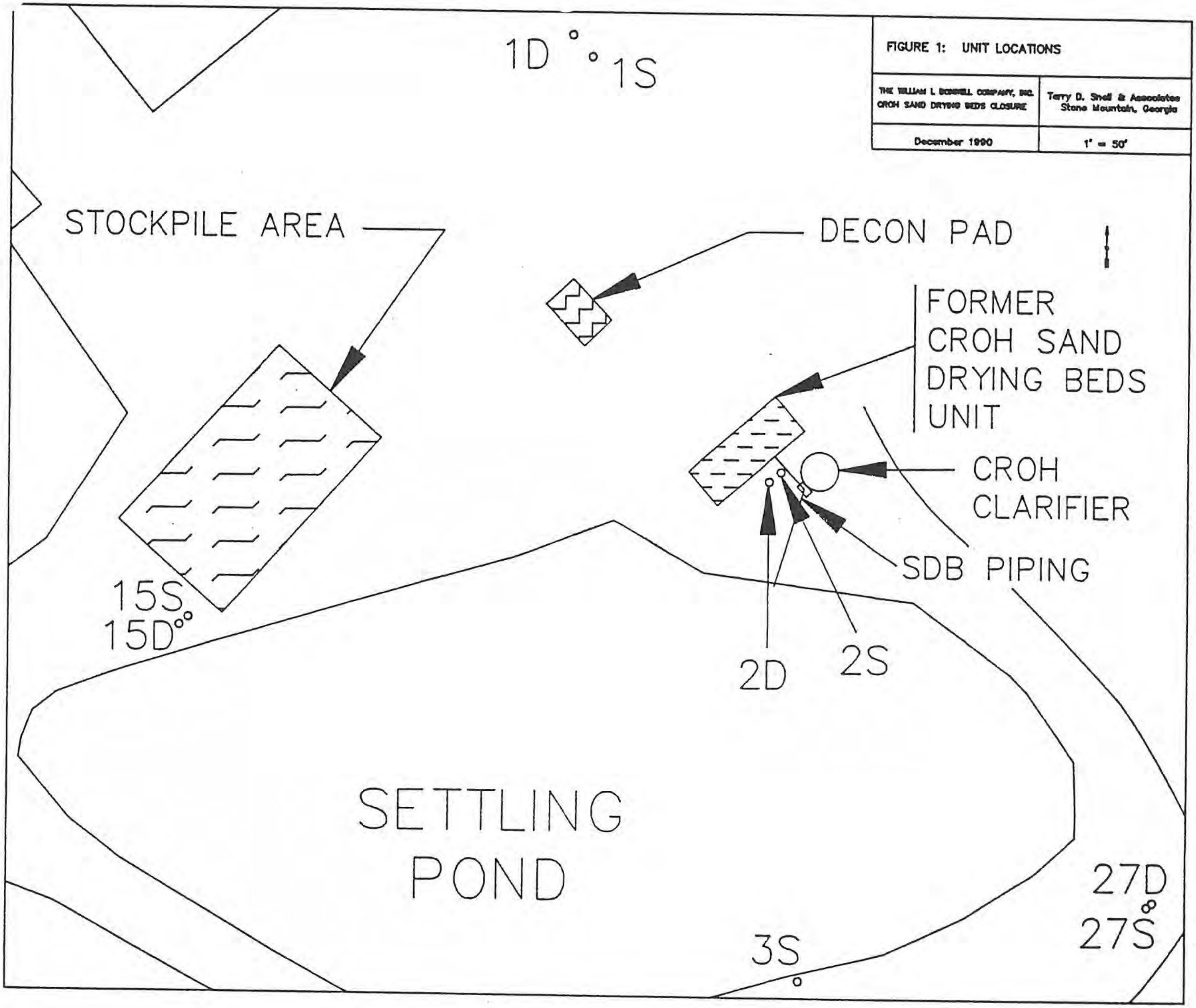


FIGURE 1: UNIT LOCATIONS

THE WILLIAM L. BONNELL COMPANY, INC.
CROH SAND DRYING BEDS CLOSURE

Terry D. Snell & Associates
Stone Mountain, Georgia

December 1990

1" = 50'

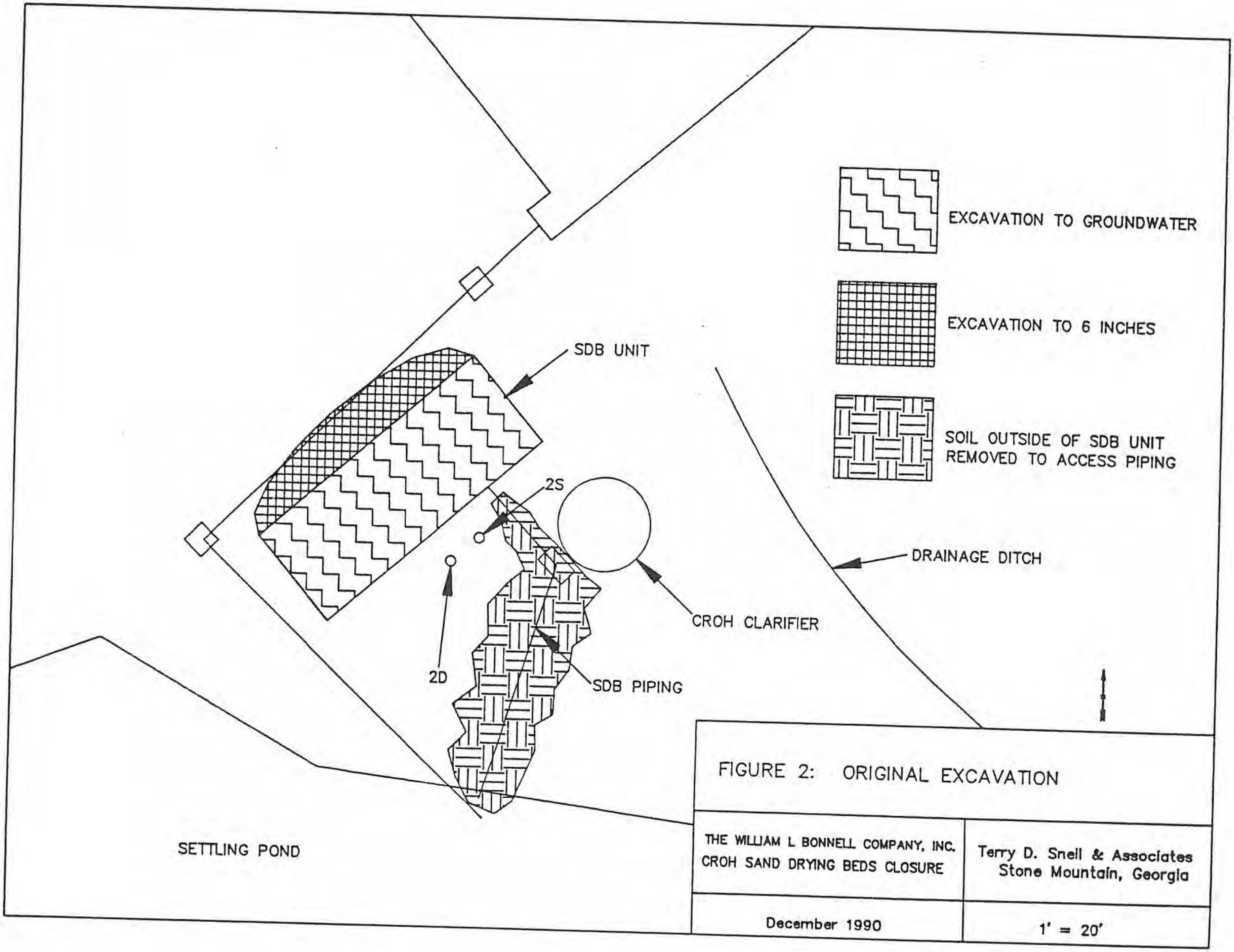


FIGURE 2: ORIGINAL EXCAVATION

THE WILLIAM L BONNELL COMPANY, INC. CROH SAND DRYING BEDS CLOSURE	Terry D. Snell & Associates Stone Mountain, Georgia
December 1990	1' = 20'

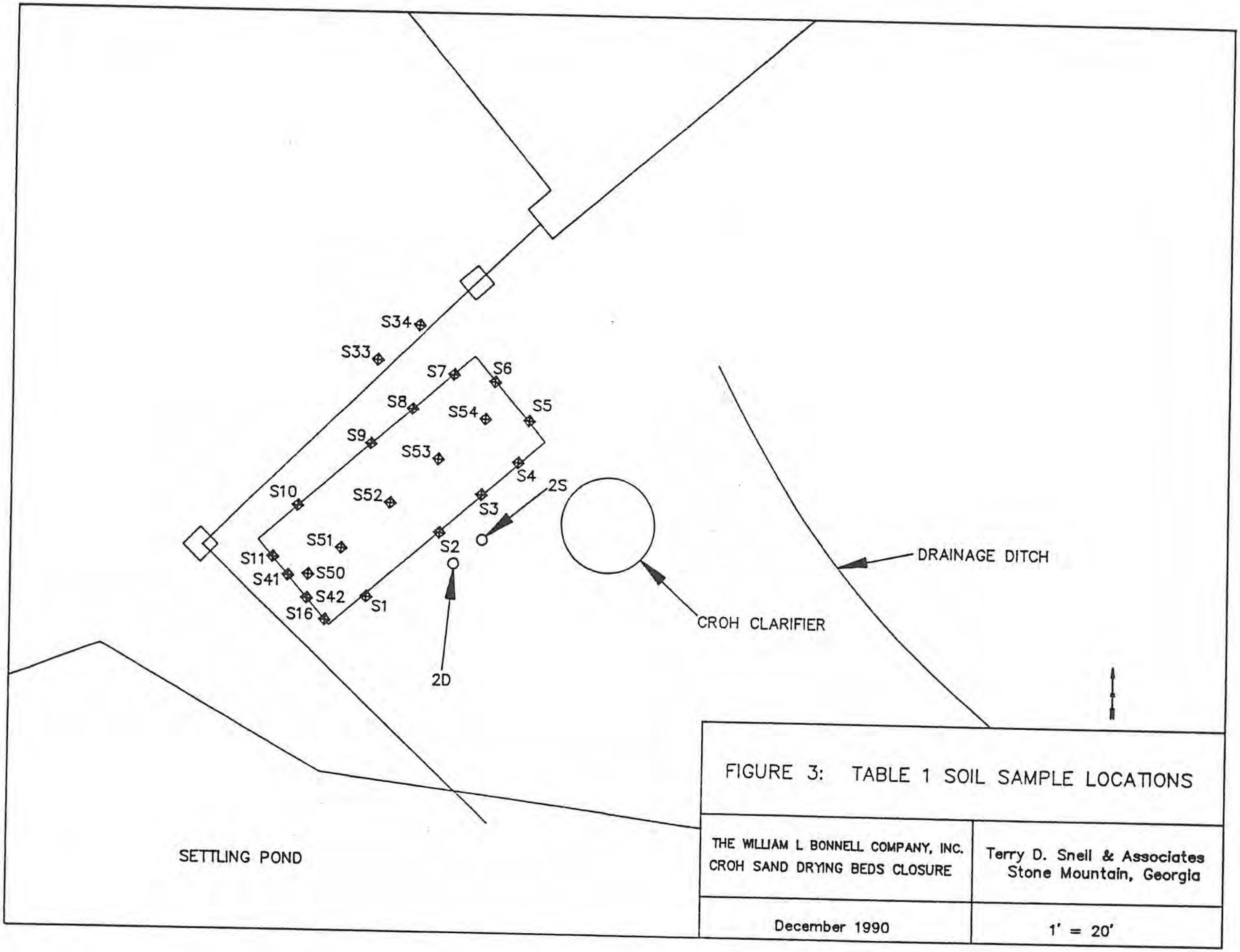


FIGURE 3: TABLE 1 SOIL SAMPLE LOCATIONS

THE WILLIAM L BONNELL COMPANY, INC.
CROH SAND DRYING BEDS CLOSURE

Terry D. Snell & Associates
Stone Mountain, Georgia

December 1990

1' = 20'

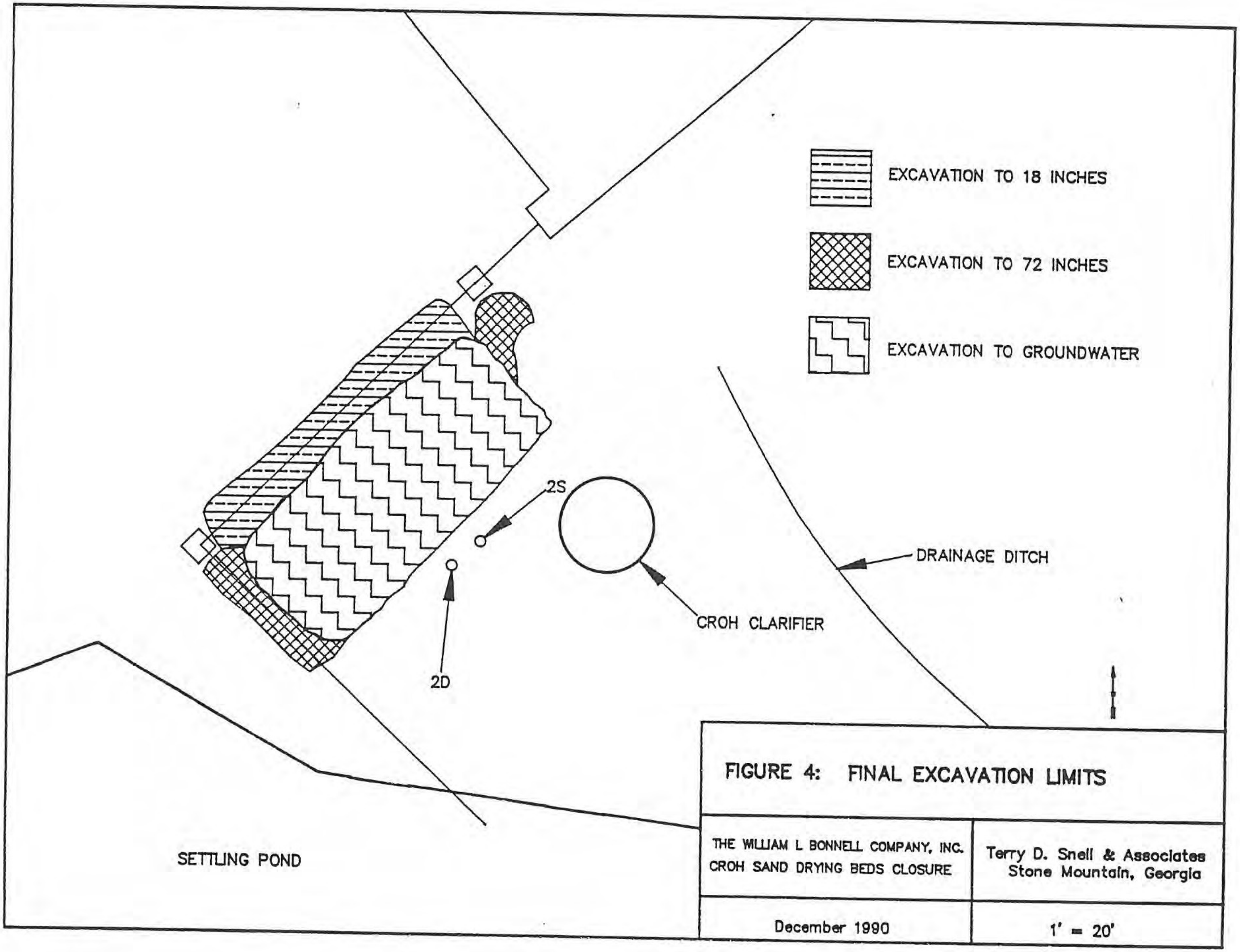


FIGURE 4: FINAL EXCAVATION LIMITS

THE WILLIAM L BONNELL COMPANY, INC.
CROH SAND DRYING BEDS CLOSURE

Terry D. Snell & Associates
Stone Mountain, Georgia

December 1990

1' = 20'

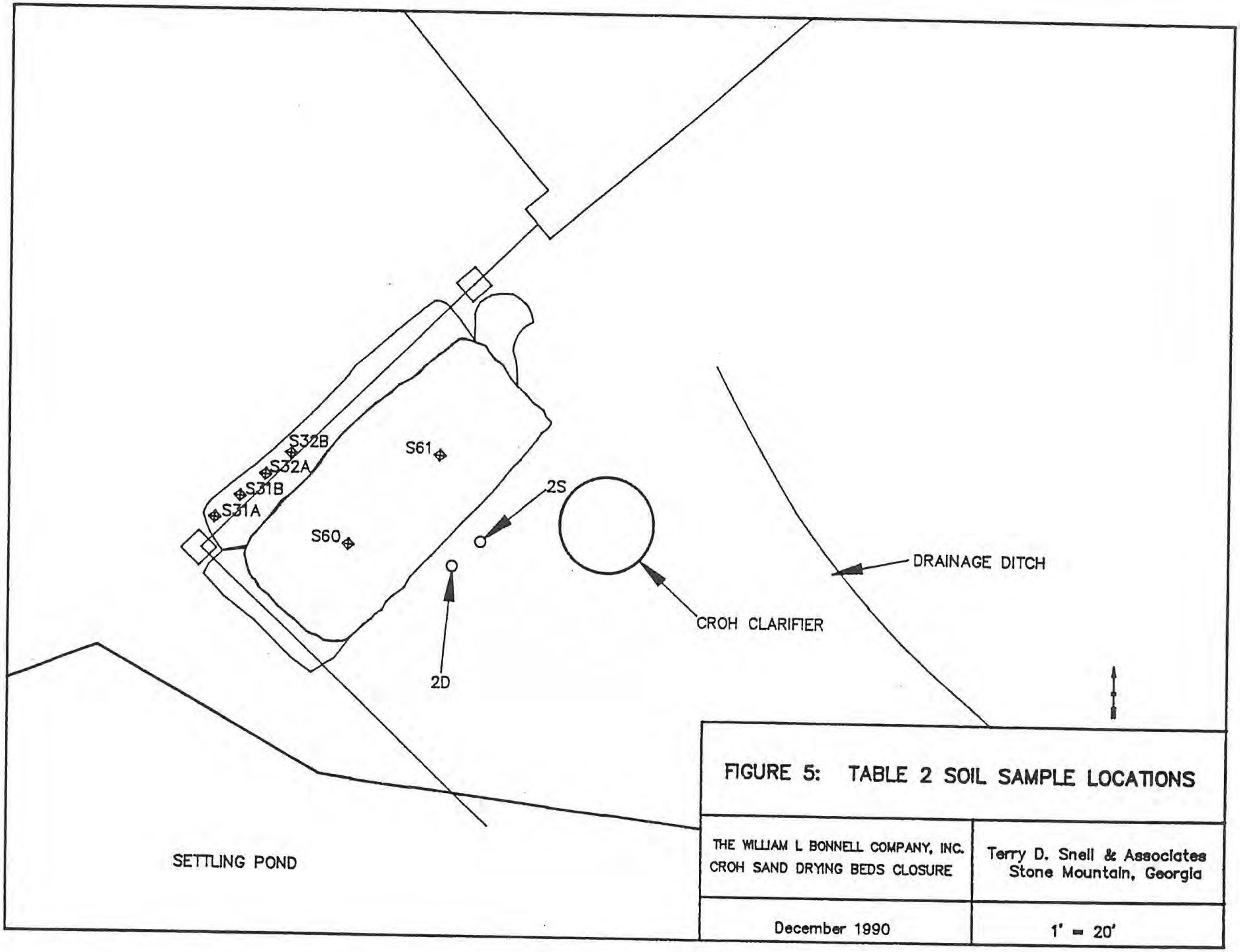


FIGURE 5: TABLE 2 SOIL SAMPLE LOCATIONS

THE WILLIAM L BONNELL COMPANY, INC.
CROH SAND DRYING BEDS CLOSURE

Terry D. Snell & Associates
Stone Mountain, Georgia

December 1990

1' = 20'

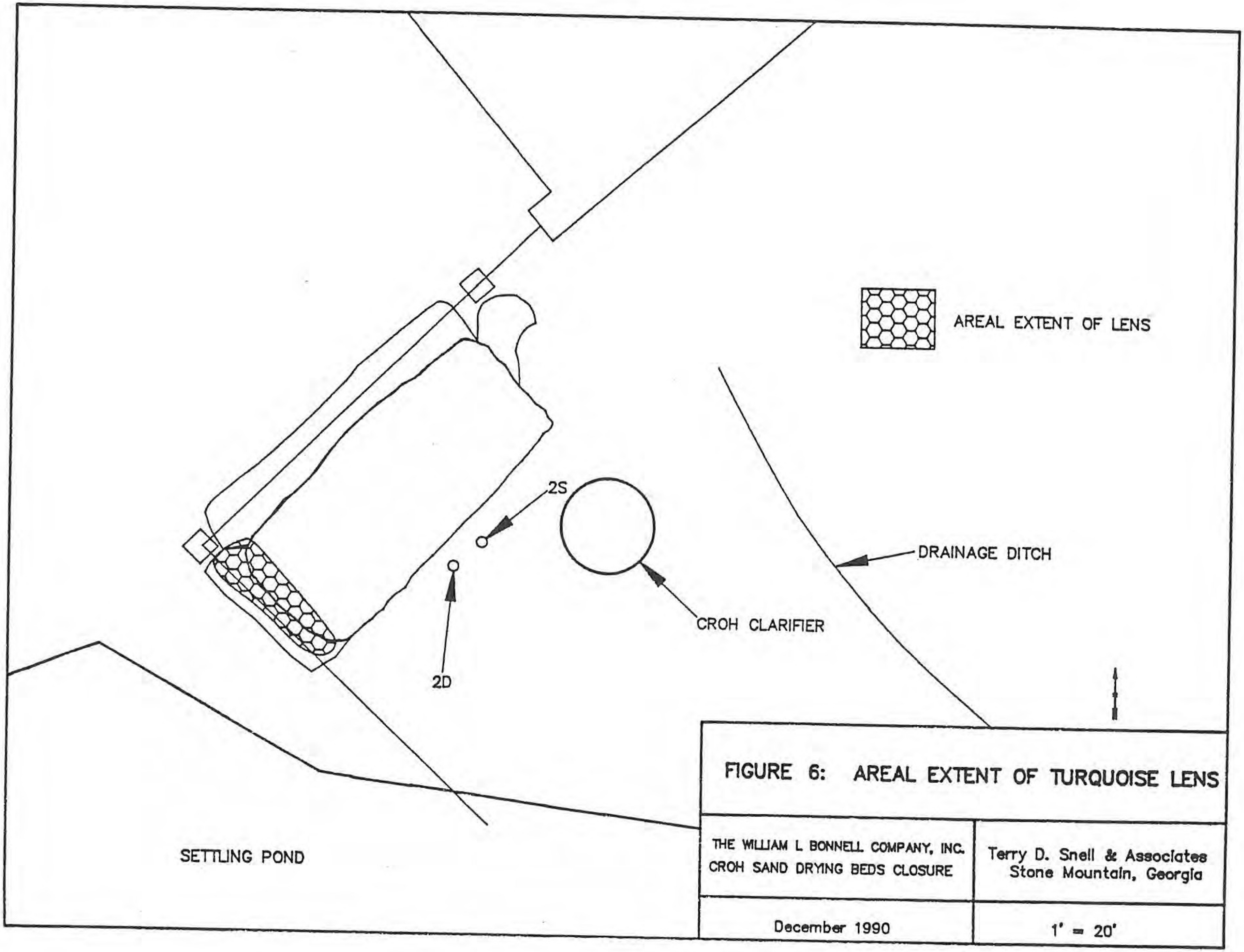


FIGURE 6: AREAL EXTENT OF TURQUOISE LENS

THE WILLIAM L BONNELL COMPANY, INC.
CROH SAND DRYING BEDS CLOSURE

Terry D. Snell & Associates
Stone Mountain, Georgia

December 1990

1' = 20'

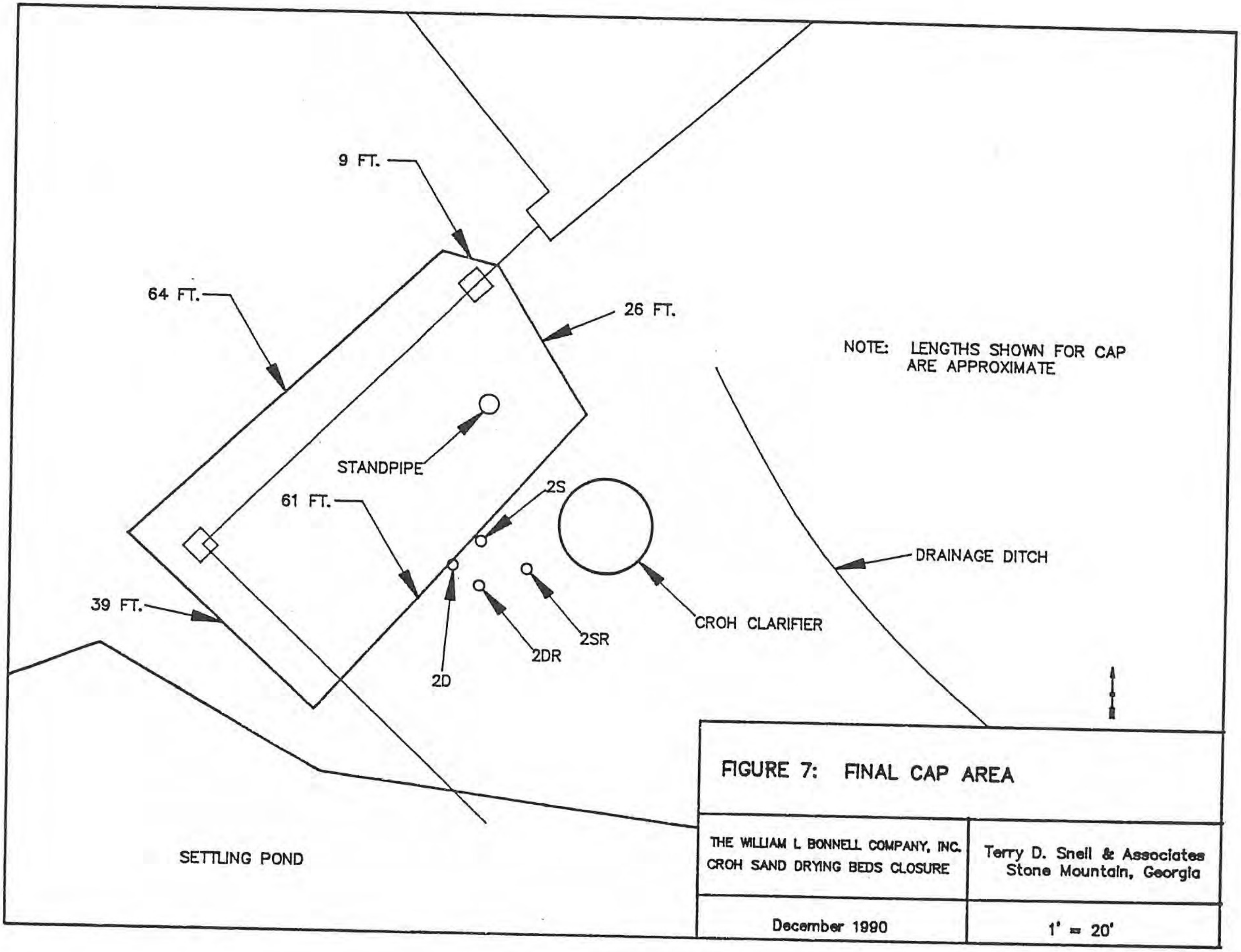


FIGURE 7: FINAL CAP AREA

THE WILLIAM L BONNELL COMPANY, INC.
CROH SAND DRYING BEDS CLOSURE

Terry D. Snell & Associates
Stone Mountain, Georgia

December 1990

1' = 20'

TABLES

TABLE 1: SUMMARY OF SOIL SAMPLE RESULTS ORIGINAL EXCAVATION PIT[1].

SAMPLE NUMBER	SAMPLE LOCATION	CONCENTRATION OF TOTAL CHROMIUM
S-1	Sidewall	41 ppb
S-2	Sidewall	46 ppb
S-3	Sidewall	43 ppb
S-4	Sidewall	22 ppb
S-5	Sidewall	18 ppb
S-6	Sidewall	27 ppb
S-7	Sidewall	77 ppb
S-8	Sidewall	34 ppb
S-9	Sidewall	56 ppb
S-10	Sidewall	43 ppb
S-11	Sidewall	27 ppb
S-16	Sidewall	31 ppb
S-31	Bottom	191 ppb
S-32	Bottom	73 ppb
S-33	Bottom	28 ppb
S-34	Bottom	28 ppb
S-50	Bottom	31 ppb
S-51	Bottom	68 ppb
S-52	Bottom	36 ppb
S-53	Bottom	50 ppb
S-54	Bottom	44 ppb

---

1. From Analytical Services Laboratory Reports # 20398, dated March 30, 1990, and 20421, dated March 30, 1990 (See Attachment A).

TABLE 2: SUMMARY OF SOIL SAMPLE RESULTS AFTER ADDITIONAL SOIL REMOVAL[1.]

SAMPLE NUMBER	SAMPLE LOCATION	CONCENTRATION OF TOTAL CHROMIUM
S-60	Bottom	32.7 ppb
S-61	Bottom	35.9 ppb
S-31A	Bottom	63.3 ppb
S-31B	Bottom	91.6 ppb
S-32A	Bottom	152 ppb
S-32B	Bottom	146 ppb

---

1. From Analytical Services Laboratory Report # 20441, dated April 4, 1990 (See Attachment B).

TABLE 3: SUMMARY OF SOIL SAMPLE RESULTS LENS MATERIAL

SAMPLE NUMBER	TOTAL CHROMIUM	TRIVALENT CHROMIUM	HEXAVALENT CHROMIUM	EP TOXICITY
ZB-1[1]	6430 ppb	6430 ppb	BDL	N/A
ZB-2[1]	3000 ppb	3000 ppb	BDL	N/A
ZB-3[1]	5470 ppb	5470 ppb	BDL	N/A
ZB-4[1]	8210 ppb	8210 ppb	BDL	N/A
S-41[2]	1970 ppb	N/A	N/A	0.51 mg/l

---

1. From Analytical Services Laboratory Report # 20647, dated April 12, 1990 (See Attachment C).

2. From Analytical Services Laboratory Report # 20398, dated March 30, 1990 (See Attachment A).

TABLE 4: SUMMARY OF SOIL SAMPLE RESULTS BACKFILL SOILS[1]

SAMPLE NUMBER	CONCENTRATION OF TOTAL CHROMIUM
A	129 ppb
B	137 ppb

---

[1] From Analytical Services Laboratory Report # 20398, dated March 30, 1990 (See Attachment D).

ATTACHMENT A

SOIL REMOVAL FROM UNIT

CERTIFIED LABORATORY REPORTS

ASI ANALYTICAL SERVICES, INC.
ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE • ATLANTA, GEORGIA 30309 • (404) 892-8144
FAX (404) 892-2740 • Federal I.D. # 58-1625655

LABORATORY REPORT

William L. Bonnell, Co. Inc.
P.O. Box 428
Newnan, GA 30264

March 30, 1990

Attention: Mr. Leo Harland, Sr.

Report No. 20398

Sample: Soil, Grab, William L. Bonnell, sampled by Terry Snell/ Mark Potts, 3/26/90

RESULTS

Sample	Total Chromium (Cr)(mg/kg)(EPA 6010)
S-41	1970
S-1	41
S-2	46
S-3	43
S-4	22
S-5	18
S-6	27
S-7	77
S-8	34
S-9	56
S-10	43
S-11	27
S-16	31
S-42	35
S-17	34
S-18	13
S-19	45
S-20	179
S-22	67
S-23	106
S-24	88
S-25	28
S-26	85
S-27	41
S-28	74
S-29	62
S-30	39
S-31	191
S-32	73
S-33	28
S-34	28
Detection Limit	2

Respectfully submitted,
By:

cc: Janet Hart/Terry Snell
3-93000

ASI ANALYTICAL SERVICES, INC.
ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE • ATLANTA, GEORGIA 30309 • (404) 892-8144
FAX (404) 892-2740 • Federal I.D. # 58-1625655

LABORATORY REPORT

William L. Bonnell Co., Inc.
P.O. Box 428
Newnan, GA 30264

March 30, 1990

Attention: Mr. Gary L. Mitchell

Report No. 20421

Sample: Soil, Grab, William L. Bonnell, 3/27/90

RESULTS

Sample	Total Chromium (Cr) (mg/kg) (EPA 6010)
S-50	31
S-51	68
S-52	36
S-53	50
S-54	44
Detection Limit	2

Respectfully submitted,

By:

cc: Mr. Terry Snell

3-15000

ASI
ANALYTICAL SERVICES, INC
ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE • ATLANTA, GEORGIA 30309 • (404) 892-8144
FAX (404) 892-2740 • Federal I.D. # 58-1625655

LABORATORY REPORT

William L. Bonnell Co., Inc.
P.O. Box 428
Newnan, GA 30264

April 4, 1990

Attention: Mr. Gary L. Mitchell

Report No. 20398-1AT

Sample: Soil S-41, Grab, William L. Bonnell, sampled by Terry Snell/ Mark Potts AEM, 3/26/90

RESULTS

The material was extracted and analyzed according to the procedures contained in the Code of Federal Regulations, Title 40, part 261 (40 CFR 261). The analysis of the extract is as follows:

	Result	Detecti Limit
Chromium (Cr)(mg/l)............................	0.51	0.04

Respectfully submitted,

By: T. Denise Lund

cc: Mr. Terry Snell
AEM

3-13000

ATTACHMENT B

SECOND ROUND SOIL REMOVAL

CERTIFIED LABORATORY REPORTS

ASI ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE • ATLANTA, GEORGIA 30309 • (404) 892-8144
FAX (404) 892-2740 • Federal I.D. # 58-1625655

LABORATORY REPORT

William L. Bonnell Co., Inc.
P.O. Box 428
Newnan, GA 30264

April 4, 1990

P. O. No. NP21740

Report No. 20441

Attention: Mr. Gary L. Mitchell

Sample: Soil samples, sampled by AEM, 3/28/90

RESULTS

	Total Chromium (Cr) (mg/kg)(EPA 6010)
S-60	32.7
S-61	35.9
S-31A	63.3
S-31B	91.6
S-32A	152
S-32B	146
Detection Limit	1

Respectfully submitted,

By:

cc: Mr. Terry Snell
AEM

RECEIVED
4-10-90

3-15000

A Unit of American Analytical Services, Inc.

ATTACHMENT C

TURQUOISE LENS MATERIAL

CERTIFIED LABORATORY REPORTS AND

HEXAVALENT CHROMIUM METHODOLOGY

Bonnell 90-74
DATA

ASI ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE • ATLANTA, GEORGIA 30309 • (404) 892-8144
FAX (404) 892-2740 • Federal I.D. # 58-1625655

LABORATORY REPORT

William L. Bonnell Co., Inc.
P.O. Box 428
Newnan, GA 30264

April 12, 1990

Attention: Mr. Gary L. Mitchell

Report No. 20647

Sample: Soil sample, SDB Closure Project #90-74-05, 4/10/90, sampled by AEM

RESULTS

	Total Chromium (Cr) (mg/kg) (EPA 6010)	Trivalent Chromium (Cr^{+3}) (mg/kg) (difference)	Hexavalent Chromium (Cr^{+6}) (mg/kg) (EPA 7196)
ZB-1 4:00..........	6430	6430	BDL
ZB-2 4:30..........	3000	3000	BDL
ZB-3 4:30..........	5470	5470	BDL
ZB-4 4:30..........	8210	8210	BDL
Detection Limit	0.2	0.2	0.2

BDL = Below Detection Limit

Respectfully submitted,

By:

cc: Terry Snell/AEM
Janet Hart/AEM

3-24000

ASI **ANALYTICAL SERVICES, INC.**

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

July 18, 1991

Terry Snell & Associates
1111 Valerie Woods Dr.
Stone Mountain, GA 30083

Dear Mr. Snell:

SOLUBLE HEXAVALENT CHROME IN SOILS

Hexavalent Chromium (Cr^{+6}) was analyzed by EPA Method 7196 (SW-846, 1986) after leaching the soil with a 5% HNO_3 solution. A weighed amount of soil was placed in an acid-rinsed plastic container. A known volume of ~5% HNO_3 was added to the container and the sample extracted by rotating end-over-end for approximately one hour. The sample was then filtered and the leachate analyzed by the stated colorimetric method. The results represent the soluble hexavalent chromium in the sample.

Please note that there is no method for hexavalent chromium in soil in the current edition of SW-846 (1986).

Respectfully submitted,

By: Victor E. Bendeck, Jr.

ATTACHMENT D

STOCKPILE SOILS FROM OUTSIDE THE CrOH SAND DRYING BEDS UNIT

CERTIFIED LABORATORY REPORTS

ASI ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE • ATLANTA, GEORGIA 30309 • (404) 892-8144
FAX (404) 892-2740 • Federal I.D. # 58-1625655

LABORATORY REPORT

William L. Bonnell Co., Inc.
P.O. Box 428
Newnan, GA 30264

June 18, 1990

Attention: Mr. Gary L. Mitchell

Report No. 21769

Sample: Soil grab from covered waste pile, sampled 6/14/90, received 6/15/90

RESULTS

	Total Chromium (Cr) (mg/kg) (EPA 6010)
Soil Pile #2	
A.	269
B.	135
Soil Pile #3	
C.	129
D.	137
Detection Limit	0.1

Respectfully submitted,

By: Denise S. Tier

3-12000

APPENDIX C

Letter to Myles Morse

ATTACHMENT C

ETHYL CORPORATION

December 5, 1980

PLEASE ADDRESS REPLY
TO: P. O. BOX 341
BATON ROUGE, LA. 70821

CERTIFIED MAIL

Mr. Myles Morse
Environmental Protection Agency
Hazardous and Industrial Waste Division (WH-565)
Waste Characterization Branch
401 M Street SW
Washington, D. C. 20460

Dear Mr. Morse:

Re: Petition for Temporary Exclusion and Proposed Rulemaking

This letter is written in response to your questions and comments concerning Ethyl Corporation's November 10, 1980, Petition. We appreciate your quick response and consideration of the Petition. Answers to your questions are itemized below.

Principal Products

The principal products produced at all four Ethyl Aluminum Division plants are aluminum extrusions of various forms, sizes, and finishes. Depending on customer requirements, the extrusions may be anodized, conversion coated, or painted, or a combination of these processes can be utilized to produce a desired surface finish. These extrusions have end uses primarily in the building materials trade. Capitol Products Corporation also uses some of its own extrusions for use in patio door and window assemblies.

Description of Operation

All four facilities paint some of the extrusions prior to use or sale. The aluminum extrusion is first cleaned and conversion coated to prepare the metal surface for painting. This process is shown as Figure 1 (attached). Table 1 lists overflow rates, sizes, pH and hexavalent chromium contents of the various tanks used at the Carthage, Tennessee, Bonnell facility for conversion coating. The Newnan, Georgia, Bonnell and the two Capitol Products facilities utilize a similar 5-stage pre-treatment process although tank sizes and overflow rates vary.

Chromium bearing wastewater originates from Stages 4 and 5 as shown in Figure 1. Stage 4, a cold water rinse, has a continuous overflow containing a maximum of about 125 ppm Cr^{+6}. Stage 5, an acidic rinse, does not overflow but must be drained and recharged on a weekly basis. This solution contains a maximum of about 75 ppm Cr^{+6}. Although overflow quantities and tank sizes vary, this same process is used at each of the four Aluminum Division Plants. All facilities have waste water treatment using SO_2 to reduce to chrome to trivalent and lime to precipitate it. The Bonnell Plants have batch processes while the Capitol plants employ a continuous process.

At the Bonnell facilities, two reaction tanks, each having a minimum capacity equal to eight hours of waste flow, are provided and are used alternately. When a reaction tank has been filled, sulfuric acid is added to lower the pH to about 2.0. Sulfur dioxide is then added to reduce the hexavalent chromium to the trivalent state. The contents of the reaction tanks are agitated to insure thorough mixing. After the reduction is complete, lime is added to raise the pH to about 8.0 and precipitate the trivalent chromium. Chemical dosages are controlled by pH measurements and by analytical techniques. Also, a distinct color change is evident upon complete reduction. The precipitates are removed by sedimentation and the accumulated sludge is dewatered via a vacuum filter and hauled away for land disposal. A process flow diagram is attached as Figure 2.

At the Capitol Products facilities, a proprietary continuous reduction-neutralization process is utilized. This process uses a four-stage tank for reduction, reaction, recycle, and neutralization. The reduction is controlled automatically by pH and oxidation-reduction potential (ORP) instruments. Sulfuric acid is added to the hexavalent chromium continuing wastewater to lower the pH to 2.5 to 3.0. Sulfur dioxide is then added, controlled by the ORP instrument. Water overflows the first stage and enters the second stage which is sized so as to ensure ample residence time for completion of the reduction reaction. Water then enters the third or recycle stage where filtrate from the vacuum filter is re-introduced to the system. Finally water overflows to the fourth, or neutralization stage, where lime is added to bring the pH to 8.0-8.5. Water exits the fourth stage and goes to a thickener where flocculants are added to enhance settling of the chromium hydroxide sludge. The sludge is pumped from the thickener to a rotary vacuum filter for dewatering and hauled away for disposal. A process flow diagram is attached as Figure 3.

Hazardous Constituents

Chemical conversion coating sludges are listed as hazardous wastes on the basis that they contain significant amounts of hexavalent chromium and cyanide complexes. Ethyl Corporation has completed tests on sludges from all four Aluminum Division facilities, and the results are discussed below.

calcium fluorophosphate, aluminum hydroxide and chromium hydroxide. The chromium content of the sludge is about 3 wt % dry basis and 1% wet basis.

Estimated sludge volumes generated at each plant are as follows:

	Wet Basis	
	Estimated lbs/month	Approximate cu yd/mo
Bonnell, Newnan, GA	90,000	45
Bonnell, Carthage, TN	36,000	18
Capitol, Harrisburg, PA	43,000	22
Capitol, Kentland, IN	20,000	10

Disposal Sites

Proposed disposal sites are as follows:

Hexavalent Chromium

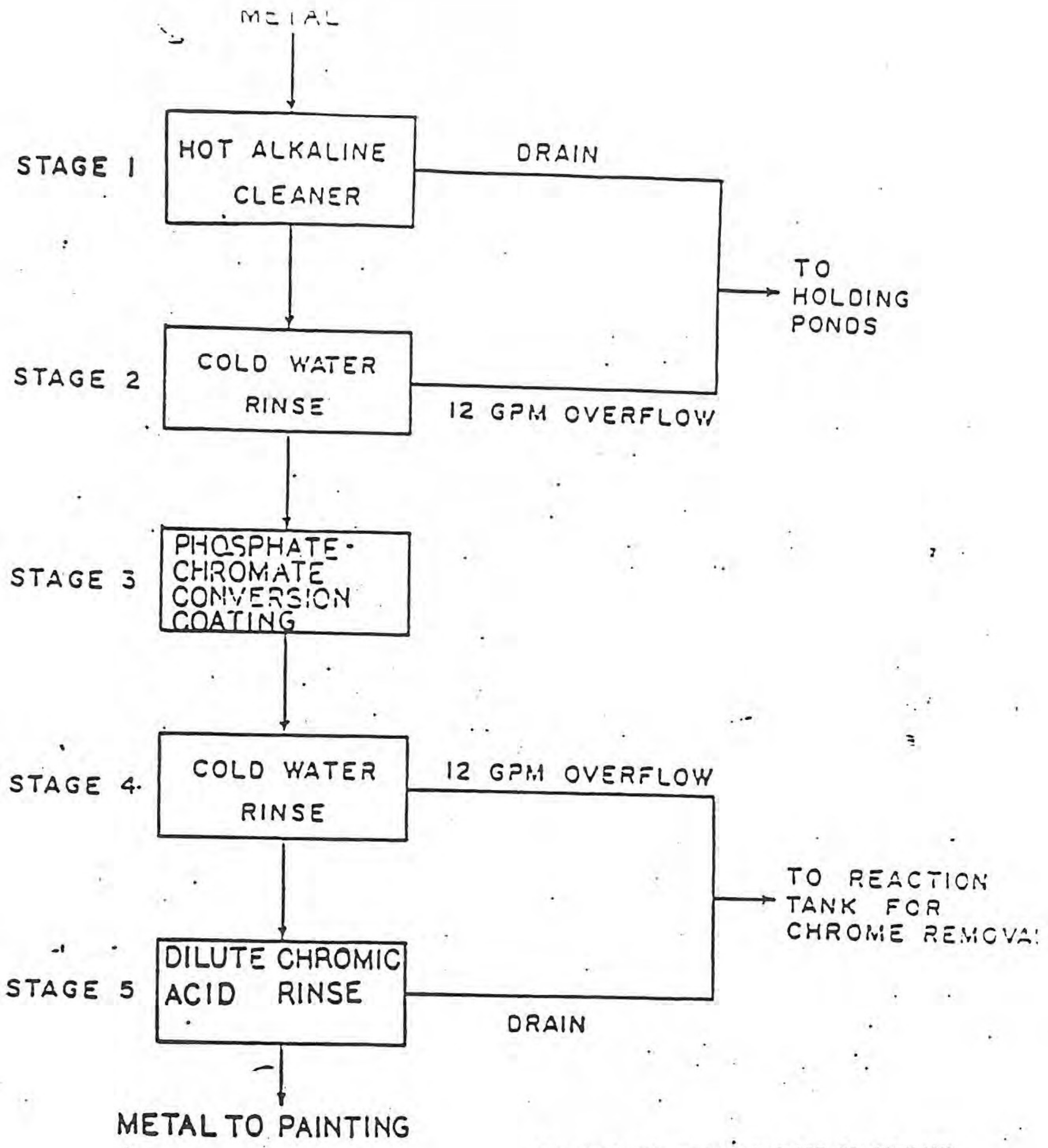
We have performed the EPA EP Toxicity test for chromium on samples from each plant. Test results were as follows:

Facility	Date of Test	Total Chromium in Extract
William L. Bonnell, Newnan,. GA	3/6/80	0.50 ppm
William L. Bonnell, Newnan, GA	8/14/80	0.25 ppm
William L. Bonnell, Carthage, TN	8/28/80	0.70 ppm
Capitol Products Corp., Kentland, IN	10/2/80	0.26 ppm
Capitol Products Corp., Harrisburg, PA	8/20/80	0.20 ppm

Since the total chromium in the extract is very low, this demonstrates that there is little or no hexavalent chromium present in the sludges.

Cyanide Content

[illegible] used in the conversion coating contain no cyanides



CONFIDENTIAL TREATMENT FOR OTHER THAN
EMISSION DATA IN ACCORDANCE WITH THE
PURPOSES OF SECTION 1905 OF TITLE 18
OF THE UNITED STATES CODE IS REQUESTED.

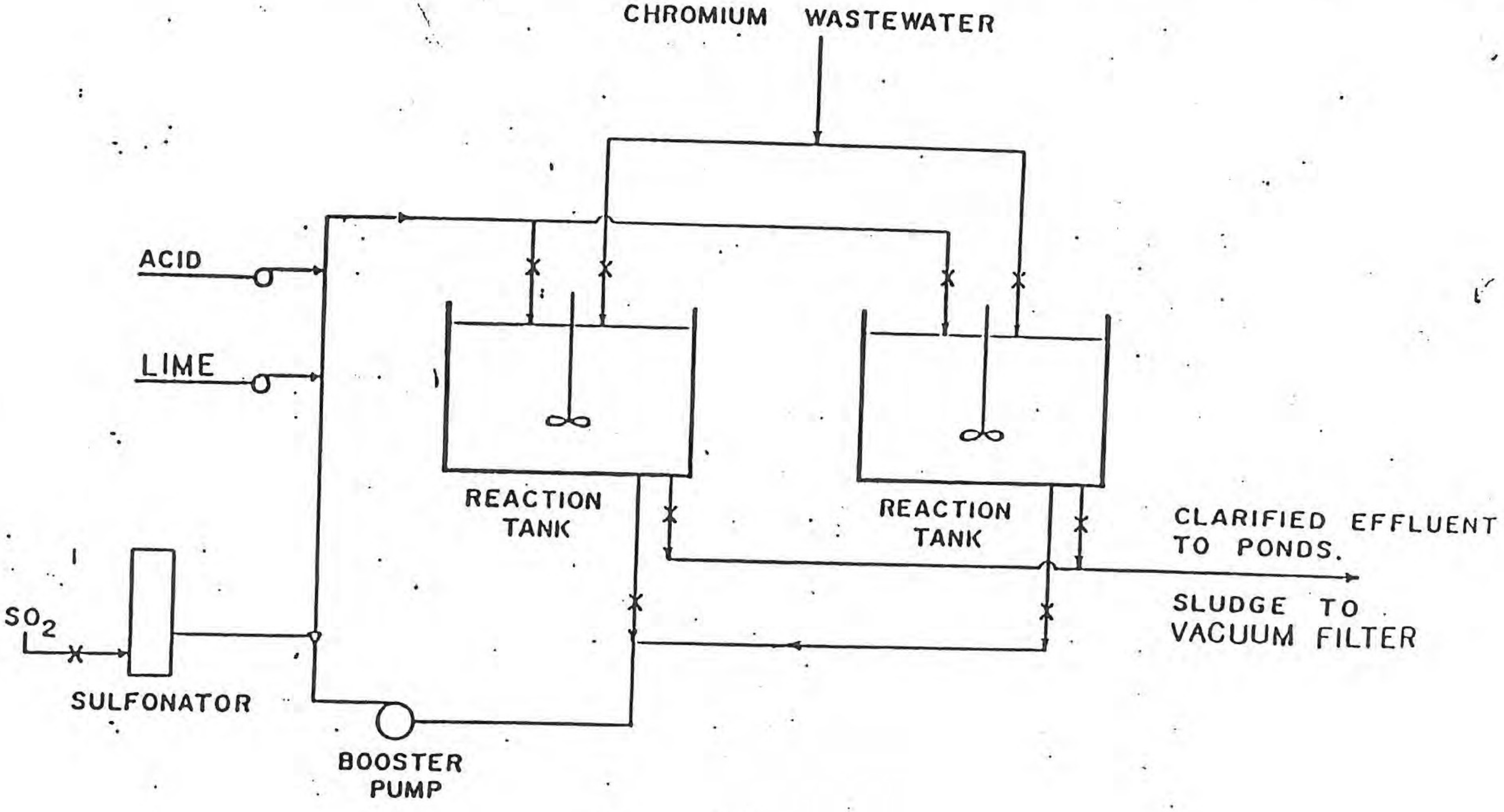
FIG, 1 - FIVE-STAGE PRE-PAINT TREATMENT PROCESS

TABLE 1

FIVE-STAGE PRE-PAINT TREATMENT PROCESS

Stage	Overflow gpm	Capacity of tank gal	Dumping Interval	pH	Chromium mg/l
1	0	2100	2 weeks	9.5-10.5	0
2	12	1000		8.0- 9.0	0
3	0	2100	Never	1.5- 2.5	2500
4	12	1000		3.5- 4.0	100±25
5	0	1000	Weekly	3.5	90±25

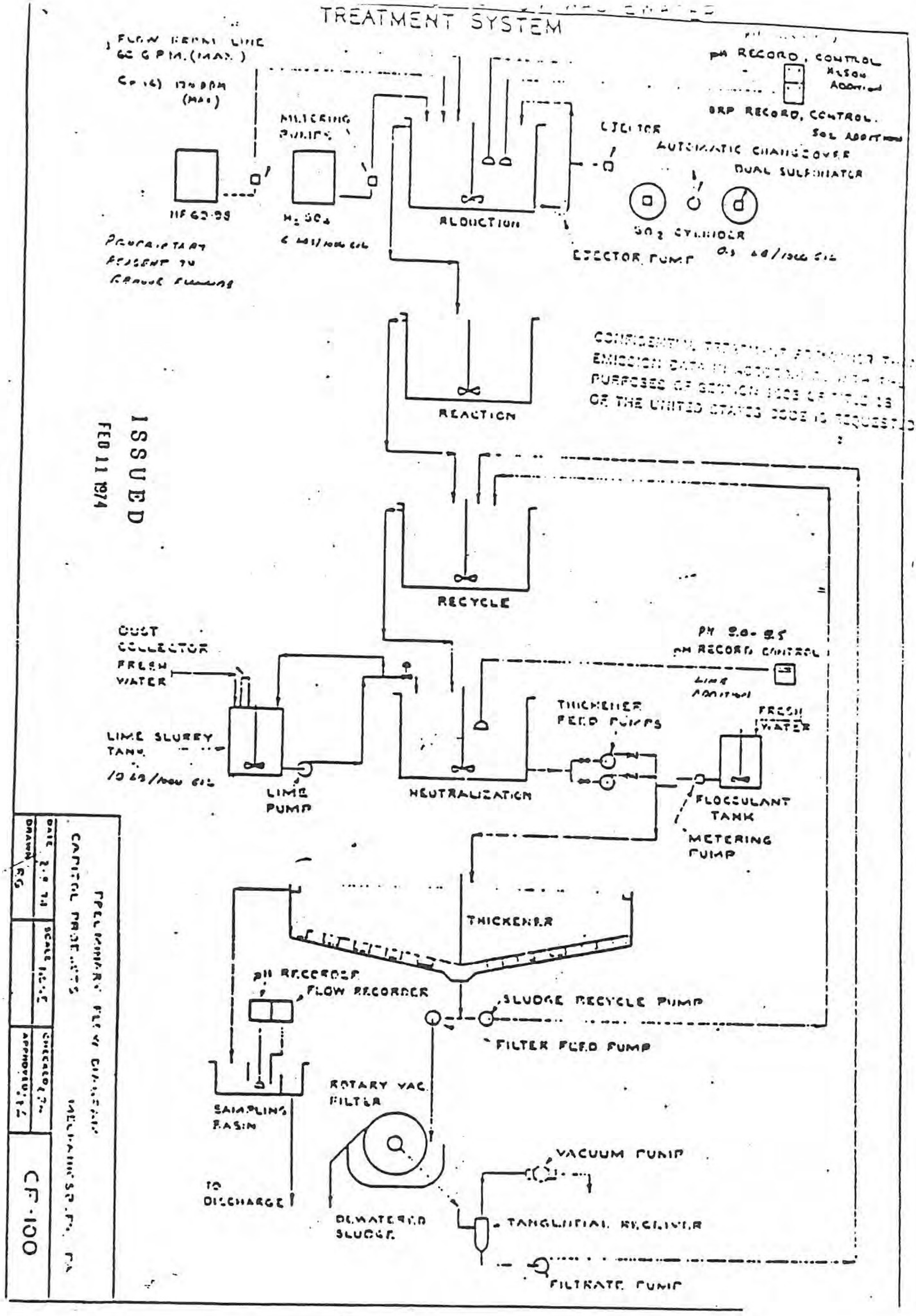
CONFIDENTIAL TREATMENT FOR OTHER THAN
EMISSION DATA IN ACCORDANCE WITH THE
PURPOSES OF SECTION 1905 OF TITLE 18
OF THE UNITED STATES CODE IS REQUESTED.



CONFIDENTIAL TREATMENT FOR OTHER THAN EMISSION DATA IN ACCORDANCE WITH THE PURPOSES OF SECTION 1905 OF TITLE 18 OF THE UNITED STATES CODE IS REQUESTED.

FIG. 2 BONNELL CHROMIUM WASTEWATER TREATMENT SYSTEM

TREATMENT SYSTEM



CONFIDENTIAL TREATMENT FOR OTHER THAN EMISSION DATA IN ACCORDANCE WITH THE PURPOSES OF SECTION 1905 OF TITLE 18 OF THE UNITED STATES CODE IS REQUESTED.

ISSUED
FEB 11 1974

PRELIMINARY FLOW DIAGRAM
CAPITOL PRODUCTS
MECHANICSBURG, PA
DATE 2-8-74
DRAWN E.G.
SCALE NONE
CHECKED
APPROVED
CF-100

Attachment 1

Raw Materials Used in the Manufacturing Process

0041 Capitol Products Corporation, Harrisburg, PA

Multi-Stage Pre-Paint Treatment Process

Chemical Trade Name

Buzz Kleen No. 734
Buzz Bond No. 1047
Buzz Bond No. 1407

Four-Stage Wastewater Treatment Process

Chemical Trade Name

Sulfur Dioxide
Hydro-fax Reagent 98
Sulfuric Acid
Calcium Hydrated Lime
Hydro-fax Flocculent 190

Data sheets for each chemical are included in this section.

CONFIDENTIAL TREATMENT FOR OTHER THAN
EMISSION DATA IN ACCORDANCE WITH THE
PURPOSES OF SECTION 1905 OF TITLE 18
OF THE UNITED STATES CODE IS REQUESTED.

APPENDIX D

HELP Model Input and Output

EXHIBIT 1

HELP MODEL INPUT DATA
FOR CLOSURE OF CROH SANDBEDS

STEP	INFORMATION REQUESTED AND RESPONSE
1.1	SELECT INPUT OPERATION 1 TO ENTER, EDIT OR REVIEW CLIMATOLOGICAL DATA. 1
1.2	SELECT TYPE OF RAINFALL DATA INPUT: 3 TO SYNTHETICALLY GENERATE RAINFALL DATA.
4.2	ENTER NAME OF STATE OF INTEREST. GEORGIA
4.3	ENTER NAME OF CITY OF INTEREST. ATLANTA
4.4	ENTER NUMBER OF YEARS OF DATA TO BE GENERATED. 20
7.3	DO YOU WANT TO ENTER THE NORMAL MEAN MONTHLY TEMPERATURE DATA FOR YOUR LOCATION? NO
	THE LATITUDE BEING USED FOR SOLAR RADIATION DATA GENERATION IS 33.65. (ATLANTA GEORGIA)
7.7	DO YOU WANT TO CORRECT THIS VALUE FOR YOUR SITE? NO
4.5	DO YOU WISH TO IMPROVE THE GENERATED RAINFALL DATA BY ENTERING THE NORMAL MEAN MONTHLY RAINFALL FOR YOUR EXACT LOCATION? NO

4.9 ENTER THE MAXIMUM LEAF AREA INDEX.

2.0 FOR FAIR GRASS.

4.11 ENTER THE EVAPORATIVE ZONE DEPTH IN INCHES.

22 IN. FOR FAIR GRASS.

GROWING SEASON SELECTED FOR ATLANTA GEORGIA STARTS ON DAY 92 AND ENDS ON DAY 312.

4.12 DO YOU WANT TO ENTER A NEW GROWING SEASON?

NO

1.3 SELECT TYPE OF SOIL AND DESIGN DATA INPUT:

1 TO USE DEFAULT SOIL CHARACTERISTICS.

5.1 ENTER A 3-LINE TITLE. FOR EXAMPLE: ENTER PROJECT TITLE ON LINE 1, ENTER LOCATION OF DISPOSAL SITE ON LINE 2, AND ENTER TODAY'S DATE ON LINE 3.

SANDBED DEFAULT SOILS 12/90
BONNELL
07/25/91

5.2 DO YOU WANT THE PROGRAM TO INITIALIZE THE SOIL WATER CONTENT FOR EACH LAYER? IF YOU ANSWER NO, YOU WILL BE ASKED TO ENTER THE SOIL WATER CONTENT FOR EACH LAYER.

YES

5.3 ENTER THE NUMBER OF LAYERS IN YOUR DESIGN. YOU MAY USE UP TO 12 LAYERS AND UP TO 4 BARRIER SOIL LINERS.

3

THE LAYERS ARE NUMBERED SUCH THAT
SOIL LAYER 1 IS THE TOP LAYER AND
SOIL LAYER 3 IS THE BOTTOM LAYER.

5.5 ENTER THICKNESS OF SOIL LAYER 1 IN INCHES.

24

5.6 ENTER THE LAYER TYPE FOR LAYER 1.

1 FOR A VERTICAL PERCOLATION LAYER.

5.8 DO YOU WANT A LIST OF DEFAULT SOIL TYPES AND CHARACTERISTICS? ENTER YES OR NO.

NO

5.9 ENTER SOIL TEXTURE OF SOIL LAYER 1.

7

5.14 IS SOIL LAYER 1 COMPACTED?

NO

5.5 ENTER THICKNESS OF SOIL LAYER 2 IN INCHES.

0.22

5.6 ENTER THE LAYER TYPE FOR LAYER 2.

2

5.9 ENTER SOIL TEXTURE OF SOIL LAYER 2.

19

5.10 ENTER THE WILTING POINT OF THE LAYER IN VOL/VOL.

0.02

5.11 ENTER THE FIELD CAPACITY OF THE LAYER IN VOL/VOL.

0.05

5.12 ENTER THE POROSITY OF THE LAYER IN VOL/VOL.

0.82

5.13 ENTER THE HYDRAULIC CONDUCTIVITY OF THE LAYER IN CM/SEC.

18

5.5 ENTER THE THICKNESS OF SOIL LAYER 3 IN INCHES.

6

5.6 ENTER THE LAYER TYPE FOR LAYER 3.

4

5.7 WHAT FRACTION OF THE AREA OF THE SOIL LINER DRAINS FROM LEAKS IN THE FLEXIBLE MEMBRANE OR WHAT FRACTION OF THE DAILY POTENTIAL PERCOLATION THROUGH THE BARRIER SOIL LINER IS ABLE TO OCCUR ON ANY DAY?

0.0001

5.9 ENTER SOIL TEXTURE OF SOIL LAYER 3.

11

5.14 IS SOIL LAYER 3 COMPACTED?

YES

5.17 SELECT THE TYPE OF VEGETATIVE COVER.

3 FOR FAIR GRASS

5.18 DO YOU WANT TO ENTER A RUNOFF CURVE NUMBER TO OVERRIDE THE DEFAULT VALUE?

NO

5.20 IS THE LANDFILL OPEN OR ACTIVE (UNCOVERED)?

NO

10.1 ENTER THE TOTAL AREA OF THE SURFACE, IN SQUARE FEET.

2395

10.2 ENTER THE SLOPE AT THE BASE OF SOIL LAYER 2, IN PERCENT.

8

```
10.3     ENTER THE MAXIMUM DRAINAGE DISTANCE HORIZONTALLY TO THE
         COLLECTOR, IN FEET.

                 70

1.1      SELECT INPUT OPERATION:

                 5 TO STOP THE PROGRAM


help
```

```
***********************************************************************
***********************************************************************

 WILLIAM L BONNELL
 SAND BED COVER
 DECEMBER 13, 1990

***********************************************************************
***********************************************************************


                              FAIR GRASS

                               LAYER  1
                               --------

                   VERTICAL PERCOLATION LAYER
  THICKNESS                                  =      24.00 INCHES
  POROSITY                                   =       0.4730 VOL/VOL
  FIELD CAPACITY                             =       0.2217 VOL/VOL
  WILTING POINT                              =       0.1043 VOL/VOL
  INITIAL SOIL WATER CONTENT                 =       0.2217 VOL/VOL
  SATURATED HYDRAULIC CONDUCTIVITY           =       0.001560000004 CM/SEC


                               LAYER  2
                               --------

                     LATERAL DRAINAGE LAYER
  THICKNESS                                  =       0.22 INCHES
  POROSITY                                   =       0.8200 VOL/VOL
  FIELD CAPACITY                             =       0.0500 VOL/VOL
  WILTING POINT                              =       0.0200 VOL/VOL
  INITIAL SOIL WATER CONTENT                 =       0.0500 VOL/VOL
  SATURATED HYDRAULIC CONDUCTIVITY           =      18.000000000000 CM/SEC
  SLOPE                                      =       8.00 PERCENT
  DRAINAGE LENGTH                            =      70.0 FEET


                               LAYER  3
                               --------

         BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER
 THICKNESS                                   =       6.00 INCHES
```

```
          POROSITY                                    =        0.3949 VOL/VOL
          FIELD CAPACITY                              =        0.2797 VOL/VOL
          WILTING POINT                               =        0.1875 VOL/VOL
          INITIAL SOIL WATER CONTENT                  =        0.3949 VOL/VOL
          SATURATED HYDRAULIC CONDUCTIVITY            =        0.000003200000 CM/SEC
          LINER LEAKAGE FRACTION                      =        0.00010000


                             GENERAL SIMULATION DATA
                             -----------------------

         SCS RUNOFF CURVE NUMBER                     =          74.26
         TOTAL AREA OF COVER                         =        2395. SQ FT
         EVAPORATIVE ZONE DEPTH                      =          22.00 INCHES
         UPPER LIMIT VEG. STORAGE                    =        10.4060 INCHES
         INITIAL VEG. STORAGE                        =         5.6194 INCHES
         INITIAL SNOW WATER CONTENT                  =         0.0000 INCHES
         INITIAL TOTAL WATER STORAGE IN
           SOIL AND WASTE LAYERS                     =         7.7012 INCHES

                 SOIL WATER CONTENT INITIALIZED BY PROGRAM.


                              CLIMATOLOGICAL DATA
                              -------------------

        SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
        SOLAR RADIATION FOR      ATLANTA                 GEORGIA

        MAXIMUM LEAF AREA INDEX                       = 2.00
        START OF GROWING SEASON (JULIAN DATE)         =   92
        END OF GROWING SEASON (JULIAN DATE)           =  312

             NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

      JAN/JUL      FEB/AUG      MAR/SEP      APR/OCT      MAY/NOV      JUN/DEC
      -------      -------      -------      -------      -------      -------

       41.90        44.90        52.50        61.80        69.30        75.80
       78.60        78.20        73.00        62.20        52.00        44.50

*******************************************************************************

                       MONTHLY TOTALS FOR YEAR     1
-------------------------------------------------------------------------------

                            JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                            ------- ------- ------- ------- ------- -------

PRECIPITATION (INCHES)        1.58    4.92    4.01    2.58    2.91    4.87
                              6.40    3.70    4.77    1.41    5.27    6.41
```

```
 RUNOFF (INCHES)                 0.000    0.000    0.000    0.000    0.000    0.000
                                 0.015    0.000    0.013    0.000    0.000    0.057

 EVAPOTRANSPIRATION              1.898    2.380    4.011    2.832    3.394    4.965
     (INCHES)                    5.450    5.299    2.942    2.993    2.111    1.790

 LATERAL DRAINAGE FROM           0.8688   0.1524   2.8159   0.2689   0.0941   0.0287
   LAYER  2 (INCHES)             0.0151   0.0099   0.0071   0.0059   0.0047   4.4123

 PERCOLATION FROM                0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
   LAYER  3 (INCHES)             0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

-------------------------------------------------------------------------------
                       MONTHLY SUMMARIES FOR DAILY HEADS
-------------------------------------------------------------------------------

 AVG. DAILY HEAD ON               0.00     0.00     0.02     0.00     0.00     0.00
   LAYER  3 (INCHES)              0.00     0.00     0.00     0.00     0.00     0.07

 STD. DEV. OF DAILY HEAD          0.00     0.00     0.01     0.00     0.00     0.00
   ON LAYER  3 (INCHES)           0.00     0.00     0.00     0.00     0.00     0.21
*******************************************************************************

*******************************************************************************
                      ANNUAL TOTALS FOR YEAR    1
-------------------------------------------------------------------------------
                                       (INCHES)      (CU. FT.)     PERCENT
                                       --------      ---------     -------
 PRECIPITATION                          48.83           9746.      100.00

 RUNOFF                                  0.085            17.        0.17

 EVAPOTRANSPIRATION                     40.064          7996.       82.05

 LATERAL DRAINAGE FROM LAYER  2          8.6837         1733.       17.78

 PERCOLATION FROM LAYER  3               0.0002            0.        0.00

 CHANGE IN WATER STORAGE                -0.003            -1.       -0.01

 SOIL WATER AT START OF YEAR             8.58           1712.

 SOIL WATER AT END OF YEAR               8.57           1711.

 SNOW WATER AT START OF YEAR             0.00              0.

 SNOW WATER AT END OF YEAR               0.00              0.

 ANNUAL WATER BUDGET BALANCE             0.00              0.        0.00
*******************************************************************************
```

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*******************************************************************************

                    MONTHLY TOTALS FOR YEAR    2
-------------------------------------------------------------------------------

                          JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                          ------- ------- ------- ------- ------- -------

 PRECIPITATION (INCHES)    0.95    2.49    5.11    8.72    5.90    4.13
                           5.25    0.88    3.39    2.03    4.87    5.11

 RUNOFF (INCHES)          0.000   0.000   0.129   0.123   0.081   0.000
                          0.000   0.000   0.000   0.000   0.002   0.011

 EVAPOTRANSPIRATION       1.984   2.318   3.261   5.479   6.560   3.113
    (INCHES)              6.320   1.300   2.936   2.060   1.363   1.467

 LATERAL DRAINAGE FROM    0.8799  0.1616  0.6077  1.5820  2.9462  0.0693
   LAYER  2 (INCHES)      0.0214  0.0124  0.0084  0.0067  0.3909  3.1408

 PERCOLATION FROM         0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
   LAYER  3 (INCHES)      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

-------------------------------------------------------------------------------
                  MONTHLY SUMMARIES FOR DAILY HEADS
-------------------------------------------------------------------------------


 AVG. DAILY HEAD ON         0.00    0.00    0.00    0.01    0.02    0.00
   LAYER  3 (INCHES)        0.00    0.00    0.00    0.00    0.00    0.02

 STD. DEV. OF DAILY HEAD    0.00    0.00    0.00    0.02    0.03    0.00
   ON LAYER  3 (INCHES)     0.00    0.00    0.00    0.00    0.00    0.03
*******************************************************************************


*******************************************************************************

                    ANNUAL TOTALS FOR YEAR    2
-------------------------------------------------------------------------------
                                        (INCHES)     (CU. FT.)     PERCENT
                                        --------     ---------     -------
 PRECIPITATION                           48.83           9746.      100.00

 RUNOFF                                   0.345            69.        0.71

 EVAPOTRANSPIRATION                      38.161          7616.       78.15

 \TERAL DRAINAGE FROM LAYER  2            9.8274         1961.       20.13

 PERCOLATION FROM LAYER  3                0.0002            0.        0.00

 CHANGE IN WATER STORAGE                  0.497            99.        1.02
```

```
   SOIL WATER AT START OF YEAR            8.57        1711.

   SOIL WATER AT END OF YEAR              9.07        1810.

   SNOW WATER AT START OF YEAR            0.00           0.

   SNOW WATER AT END OF YEAR              0.00           0.

   ANNUAL WATER BUDGET BALANCE            0.00           0.      0.00
*******************************************************************************




*******************************************************************************

                      MONTHLY TOTALS FOR YEAR     3
-------------------------------------------------------------------------------

                         JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                         ------- ------- ------- ------- ------- -------

 PRECIPITATION (INCHES)    4.23    3.00    6.22    2.17    5.49    3.06
                           4.29    3.29    1.53    3.71    5.64    4.38

 RUNOFF (INCHES)          0.025   0.000   0.000   0.000   0.000   0.000
                          0.000   0.000   0.000   0.016   0.000   0.000

 EVAPOTRANSPIRATION       2.129   2.352   3.805   3.281   3.909   5.329
     (INCHES)             4.364   3.217   1.959   2.110   1.940   1.995

 LATERAL DRAINAGE FROM   2.5438  0.7062  2.3250  1.0981  0.1613  0.0542
   LAYER  2 (INCHES)     0.0224  0.0128  0.0086  0.0068  0.9463  3.1687

 PERCOLATION FROM        0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
   LAYER  3 (INCHES)     0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

-------------------------------------------------------------------------------
                      MONTHLY SUMMARIES FOR DAILY HEADS
-------------------------------------------------------------------------------

 AVG. DAILY HEAD ON         0.04    0.00    0.01    0.01    0.00    0.00
   LAYER  3 (INCHES)        0.00    0.00    0.00    0.00    0.01    0.02

 STD. DEV. OF DAILY HEAD    0.18    0.00    0.02    0.00    0.00    0.00
   ON LAYER  3 (INCHES)     0.00    0.00    0.00    0.00    0.02    0.01
*******************************************************************************


*******************************************************************************

                      ANNUAL TOTALS FOR YEAR     3
-------------------------------------------------------------------------------
```

```
                                             (INCHES)      (CU. FT.)     PERCENT
                                             --------      ---------     -------
     PRECIPITATION                             47.01           9382.      100.00

     RUNOFF                                     0.041             8.        0.09

     EVAPOTRANSPIRATION                        36.391          7263.       77.41

     LATERAL DRAINAGE FROM LAYER  2            11.0542         2206.       23.51

     PERCOLATION FROM LAYER  3                  0.0002            0.        0.00

     CHANGE IN WATER STORAGE                   -0.476           -95.       -1.01

     SOIL WATER AT START OF YEAR                9.07           1810.

     SOIL WATER AT END OF YEAR                  8.59           1715.

     SNOW WATER AT START OF YEAR                0.00              0.

     SNOW WATER AT END OF YEAR                  0.00              0.

     ANNUAL WATER BUDGET BALANCE                0.00              0.        0.00

***********************************************************************




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                         MONTHLY TOTALS FOR YEAR    4
-----------------------------------------------------------------------

                           JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                           ------- ------- ------- ------- ------- -------
  PRECIPITATION (INCHES)     4.11    2.17    3.72    2.74    4.06    5.38
                             2.34    0.62    0.95    2.87    0.40    7.09

  RUNOFF (INCHES)           0.000   0.000   0.000   0.000   0.000   0.000
                            0.000   0.000   0.000   0.069   0.000   0.020

  EVAPOTRANSPIRATION        2.147   2.758   3.350   2.908   4.696   5.762
      (INCHES)              2.654   0.620   0.279   2.872   0.473   1.628

  LATERAL DRAINAGE FROM    1.9818  1.0563  0.4057  0.2116  0.0858  0.0254
    LAYER  2 (INCHES)      0.0141  0.0095  0.0069  0.0087  0.0248  1.8383

  PERCOLATION FROM         0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
    LAYER  3 (INCHES)      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

     ------------------------------------------------------------------
                       MONTHLY SUMMARIES FOR DAILY HEADS
-----------------------------------------------------------------------
```

```
AVG. DAILY HEAD ON          0.01    0.01    0.00    0.00    0.00    0.00
  LAYER  3 (INCHES)         0.00    0.00    0.00    0.00    0.00    0.01

TD. DEV. OF DAILY HEAD      0.00    0.00    0.00    0.00    0.00    0.00
 ON LAYER  3 (INCHES)       0.00    0.00    0.00    0.00    0.00    0.03

*******************************************************************************


*******************************************************************************

                  ANNUAL TOTALS FOR YEAR    4
-------------------------------------------------------------------------------
                                        (INCHES)     (CU. FT.)    PERCENT
                                        --------     ---------    -------
  PRECIPITATION                          36.45          7275.     100.00

  RUNOFF                                  0.088           18.       0.24

  EVAPOTRANSPIRATION                     30.147         6017.      82.71

  LATERAL DRAINAGE FROM LAYER  2          5.6690        1131.      15.55

  PERCOLATION FROM LAYER  3               0.0002           0.       0.00

  CHANGE IN WATER STORAGE                 0.546          109.       1.50

  SOIL WATER AT START OF YEAR             8.59          1715.

  SOIL WATER AT END OF YEAR               9.14          1824.

  SNOW WATER AT START OF YEAR             0.00             0.

  SNOW WATER AT END OF YEAR               0.00             0.

  ANNUAL WATER BUDGET BALANCE             0.00             0.       0.00

*******************************************************************************


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                  MONTHLY TOTALS FOR YEAR    5
-------------------------------------------------------------------------------

                          JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                          ------- ------- ------- ------- ------- -------

PRECIPITATION (INCHES)      1.62    1.70    5.75    1.92    2.05    2.83
                            4.60    1.86    4.39    3.24    1.39    8.04

NOFF (INCHES)              0.000   0.000   0.000   0.000   0.000   0.000
                           0.000   0.000   0.000   0.000   0.000   0.020

EVAPOTRANSPIRATION         2.216   1.888   3.890   2.892   1.952   3.627
```

```
      (INCHES)            4.232    2.228    4.390    1.851    1.528    1.521

   LATERAL DRAINAGE FROM  1.2691   0.2496   0.1767   1.6394   0.1129   0.0249
     LAYER  2 (INCHES)    0.0140   0.0094   0.0069   0.0057   0.0045   3.4843

   PERCOLATION FROM       0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
     LAYER  3 (INCHES)    0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

-------------------------------------------------------------------------------
                     MONTHLY SUMMARIES FOR DAILY HEADS
-------------------------------------------------------------------------------

   AVG. DAILY HEAD ON       0.01     0.00     0.00     0.01     0.00     0.00
     LAYER  3 (INCHES)      0.00     0.00     0.00     0.00     0.00     0.02

   STD. DEV. OF DAILY HEAD  0.01     0.00     0.00     0.02     0.00     0.00
     ON LAYER  3 (INCHES)   0.00     0.00     0.00     0.00     0.00     0.04
*******************************************************************************

*******************************************************************************
                      ANNUAL TOTALS FOR YEAR   5
-------------------------------------------------------------------------------
                                       (INCHES)      (CU. FT.)     PERCENT
                                       --------      ---------     -------
   PRECIPITATION                        39.39           7862.      100.00

   RUNOFF                                0.021             4.        0.05

   EVAPOTRANSPIRATION                   32.214          6429.       81.78

   LATERAL DRAINAGE FROM LAYER  2        6.9974         1397.       17.76

   PERCOLATION FROM LAYER  3             0.0002            0.        0.00

   CHANGE IN WATER STORAGE               0.157            31.        0.40

   SOIL WATER AT START OF YEAR           9.14           1824.

   SOIL WATER AT END OF YEAR             8.66           1728.

   SNOW WATER AT START OF YEAR           0.00              0.

   SNOW WATER AT END OF YEAR             0.64            128.

   ANNUAL WATER BUDGET BALANCE           0.00              0.        0.00
*******************************************************************************


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```

```
                      MONTHLY TOTALS FOR YEAR    6
---------------------------------------------------------------------------

                           JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                           ------- ------- ------- ------- ------- -------

 PRECIPITATION (INCHES)     5.81    4.27    3.68    3.50    8.20    2.44
                            5.49    2.13    3.22    1.03    5.59    7.10

 RUNOFF (INCHES)            0.083   0.000   0.000   0.000   0.005   0.000
                            0.000   0.000   0.000   0.000   0.000   0.226

 EVAPOTRANSPIRATION         2.009   1.869   3.918   3.334   6.136   5.051
     (INCHES)               5.301   2.319   0.809   2.338   2.110   1.855

 LATERAL DRAINAGE FROM      2.6721  4.6005  1.6334  0.1891  0.4590  0.1397
   LAYER  2 (INCHES)        0.0266  0.0141  0.0092  0.0072  0.0055  6.0142

 PERCOLATION FROM           0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
   LAYER  3 (INCHES)        0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

---------------------------------------------------------------------------
                    MONTHLY SUMMARIES FOR DAILY HEADS
---------------------------------------------------------------------------


 AVG. DAILY HEAD ON          0.02    0.06    0.01    0.00    0.00    0.00
   LAYER  3 (INCHES)         0.00    0.00    0.00    0.00    0.00    0.14

 STD. DEV. OF DAILY HEAD     0.01    0.18    0.01    0.00    0.00    0.00
   ON LAYER  3 (INCHES)      0.00    0.00    0.00    0.00    0.00    0.39
***************************************************************************


***************************************************************************
                      ANNUAL TOTALS FOR YEAR    6
---------------------------------------------------------------------------
                                         (INCHES)    (CU. FT.)    PERCENT
                                         --------    ---------    -------
 PRECIPITATION                            52.46        10470.     100.00

 RUNOFF                                    0.315          63.       0.60

 EVAPOTRANSPIRATION                       37.047        7394.      70.62

 LATERAL DRAINAGE FROM LAYER  2           15.7706       3148.      30.06

 PERCOLATION FROM LAYER  3                 0.0002          0.       0.00

 CHANGE IN WATER STORAGE                  -0.673        -134.      -1.28

 SOIL WATER AT START OF YEAR               8.66         1728.

 SOIL WATER AT END OF YEAR                 8.63         1721.
```

```
  SNOW WATER AT START OF YEAR             0.64          128.

  SNOW WATER AT END OF YEAR               0.00            0.

  \NNUAL WATER BUDGET BALANCE             0.00            0.        0.00
*******************************************************************************




*******************************************************************************

                    MONTHLY TOTALS FOR YEAR     7
-------------------------------------------------------------------------------

                          JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                          ------- ------- ------- ------- ------- -------

 PRECIPITATION (INCHES)     5.96    8.64    4.58    1.34    6.39    5.10
                            5.48    2.48    3.85    3.20    2.62    6.59

 RUNOFF (INCHES)            0.004   0.021   0.010   0.000   0.183   0.000
                            0.075   0.000   0.000   0.000   0.000   0.003

 EVAPOTRANSPIRATION         1.735   2.069   3.818   2.901   4.237   7.939
      (INCHES)              5.469   2.651   2.303   3.175   2.290   1.589

   ERAL DRAINAGE FROM       2.7590  7.9007  1.0435  0.4556  0.1149  0.0845
  LAYER  2 (INCHES)         0.0408  0.0174  0.0106  0.0082  0.0205  2.0749

 PERCOLATION FROM           0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  LAYER  3 (INCHES)         0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

-------------------------------------------------------------------------------
                    MONTHLY SUMMARIES FOR DAILY HEADS
-------------------------------------------------------------------------------

 AVG. DAILY HEAD ON          0.02    0.08    0.01    0.00    0.00    0.00
   LAYER  3 (INCHES)         0.00    0.00    0.00    0.00    0.00    0.01

 STD. DEV. OF DAILY HEAD     0.03    0.11    0.00    0.00    0.00    0.00
   ON LAYER  3 (INCHES)      0.00    0.00    0.00    0.00    0.00    0.04
*******************************************************************************


*******************************************************************************

                    ANNUAL TOTALS FOR YEAR     7
-------------------------------------------------------------------------------
                                      (INCHES)     (CU. FT.)     PERCENT
                                      --------     ---------     -------
 PRECIPITATION                          56.23         11223.      100.00
```

APPENDIX E

Manufacturers Literature

LAW ENVIRONMENTAL, INC.
a professional engineering and
earth science consulting firm

JOB NO. ______ SHEET ______ OF ______
JOB NAME William L Bonnell
BY SBM DATE 12/5/90
CHECKED BY DAP DATE 12/6/90

Moisture Vapor Transmission (MVT) for the

GUNDLE 40-mil HDPE = $\frac{0.04\ g}{m^2 \cdot day}$

$$\frac{0.04 g}{\cancel{m^2} \cdot \cancel{day}} \times \frac{1 \cancel{m^2}}{100^2 cm^2} \times \frac{1 \cancel{day}}{24 \cancel{hr}} \times \frac{1 \cancel{hr}}{3600\ sec} = \frac{4.63 \times 10^{-11} g}{cm^2 - sec}$$

MVT ÷ Density of water (1g/cm³) = 40-mil HDPE permeability

$$\frac{4.63 \times 10^{-11} \cancel{g}}{cm^2 - sec} \times \frac{cm^3}{1 \cancel{g}} = \underline{\underline{4.63 \times 10^{-11} cm/sec}}$$

LAW ENVIRONMENTAL, INC.
a professional engineering and
earth science consulting firm

[illegible]

[illegible] – [illegible] HDPE ([illegible])

[illegible] (WVT) = $\frac{[illegible]}{[illegible]}$

[illegible] (1g/cm³) = [illegible]

$\frac{[illegible]}{[illegible]} \times \frac{[illegible]}{24\,hr} \times \frac{1\,hr}{3600\,sec} \times \frac{[illegible]}{(2.54)^2\,cm^2} \div \frac{1g}{cm^3}$ ([illegible]) $= \underline{\underline{4.48 \times 10^{-10}\ cm/sec}}$

APPENDIX F

Boring Logs for Wells BN-GW-2S and BN-GW-2D

TEST BORING RECORD

Page 1 of 1

BN-GW-02S

ELEV.	DEPTH (FEET)	DESCRIPTION			PENETRATION RESISTANCE (BLOWS PER FOOT) 0 10 20 40 60 80 100
		Red, soft, SANDY CLAY, some mica, no foliation (weathered quartz-mica schist), dry (SC) HNU < background			
	5		1	5	
		Dark brown SANDY CLAY, some medium to coarse sand, some mica, good foliation (weathered quartz-mica schist), dry (SC) HNU < background			
	10		2	10	
			▽		
	15	BORING TERMINATED AT 13.5 FT.	3	20	

REMARKS:

Groundwater noted on rods at 12 feet below land surface

BORING NUMBER: BN-GW-02S
DATE DRILLED: 9/20/89
PROJECT NUMBER: 32-97182

ATEC Associates, Inc.

TEST BORING RECORD

Page 1 of 1

BN-GW-02D

ELEV.	DEPTH (FEET)	DESCRIPTION		PENETRATION RESISTANCE (BLOWS PER FOOT) 0 10 20 40 60 80 100
		Black and white soft SANDY CLAY, some mica, slight foliation, (weathered quartz-mica schist), dry (SC) HNU < background		
	5		1	15
		Black, grey, white, firm SANDY CLAY, some mica, good foliation(weathered quartz-mica schist), dry (SC) HNU < background		
	10		2	16
			▽	
	15		3	18
		No samples collected below 15 feet		
	20			
	25			
	30			
	35			
	40	BORING TERMINATED AT 39.5 FT		

REMARKS:

Groundwater encountered at a depth of 12 feet below land surface on rods.

BORING NUMBER: BN-GW-02D
DATE DRILLED: 9/20 & 9/21/89
PROJECT NUMBER: 32-97182

ATEC Associates, Inc.

APPENDIX G

Ditch Sizing Calculations

RUN-OFF CALCULATIONS AND DITCH DESIGN

Prior to sizing the ditches, peak discharge rates were calculated using the SCS method outlined in "Urban Hydrology for Small Watersheds." Parameters used to determine discharge rates are as follows:

- Precipitation (inches) for a peak storm event (P) - Precipitation was determined for the 25-year, 24-hour storm.
- Acreage of the watershed (A)
- SCS curve number (CN) - CN is an indication of the amount of precipitation that is expected to run off the watershed.
- Flow length and slope of watershed - These parameters are used to calculate the time of concentration (T_c), the time it takes for run-off to travel from the hydraulically most distant part of the watershed to the point of reference.

The peak flow for the chosen storm event is determined for each reference point using this information.

The ditches, as designed in this appendix, were sized using Manning's Equation. Parameters used in Manning's Equation are as follows: discharge (Q) in cubic feet per second, flow area (A) in square feet, hydraulic radius (R) in feet, channel slope (S) in feet per feet and channel roughness coefficient (n). Q was taken as the design flow determined by the run-off calculations.

Solving Manning's equation for an unknown ditch size is an iterative process. The ditch size (bottom width (b), flow depth (d) and side slopes (z:1)), slope, and lining material was assumed, providing the A, R, S, and Manning's "n" parameters. With this information, Q was determined, and the calculated Q was compared to the design Q. The assumed values were adjusted as required until the calculated Q equaled the design Q. The velocity is then checked to ensure that it does not exceed the maximum allowable velocity for the lining material.

Many different variations of ditch size, slope, and lining could be used to achieve the same Q. The designer uses engineering judgement to produce a design that meets the flow requirements and is constructable and economical.

The ditches, A, B, C, and D, refer to the ditches within each drainage basin area and are shown on a map comprising the final page of this appendix.

RUN-OFF CALCULATIONS AND DITCH DESIGN

WILLIAM L BONNELL COMPANY, INC.
NEWNAN, GEORGIA
Project No. 55-0649.32

By Jennifer Miller
Date 7-10-91

Checked by Desire Preison
Date 7-10-91

RUN-OFF CALCULATIONS

References:

1. "Urban Hydrology for Small Watersheds," Technical Release #55, U.S. Soil Conservation Service, Jan. 1075.
2. "Soil and Water Conservation Engineering," Third Edition, 1981.
3. Final Grading Plan

Design Storm: 25-year, 24-hour; Rainfall(P) = 6.75 in.

Drainage Areas: A - drainage area, acres

Discharge Point	A
A	1.66
B	2.27
C	3.60
D	2.44

Run-off Volumes:
CN - SCS curve number
S - Potential abstraction, inches
Qr - Accumulated run-off, inches
P - Accumulated rainfall, inches

Soil is Cecil-Madison series (U.S.D.A. Soil Survey, Coweta Co., GA)
Soil Group B (Georgia DOT Erosion and Sediment Control Manual)
Therefore, use curve number(CN) 58 (Attached sheet)

$S = (1000/CN) - 10$ $S =$ 7.241 in.

$Qr = (P-0.2S)^2/(P+0.8S)$ $Qr =$ 2.241 in.

Times of Concentration:
L = length of travel (ft)
dh = change in height (ft)
S = average slope
V = velocity (ft/s)
Tc = L/V (hr)

Area	Overland			In Channel			Tc
	L	S	V	L	S	V	
A	220	0.07	1.70	365	0.014	3.1	0.07
B	370	0.04	1.40	140	0.043	3.7	0.08
C	520	0.04	1.30	185	0.011	3.5	0.13
D	510	0.04	1.40	320	0.019	3.8	0.12

RUN-OFF CALCULATIONS AND DITCH DESIGN

WILLIAM L BONNELL COMPANY, INC.
NEWNAN, GEORGIA
Project No. 55-0649.32

By: ennifer Miller
Date 7-10-91

Checked by Cecily Pierson
Date 7-10-91

RUN-OFF CALCULATIONS (cont'd)

Peak Run-off:

Q(peak) = q*A*Qr
q - from Fig. 5-2, Ref. 1; (csm/in)
A - drainage area; (sq. mi.)
Qr - run-off volume (in)
Q(peak) = q * A(ac)/640 acres per sq mi * Qr

Discharge Point	Tc	q	A (ac)	Qr	Q(peak)
A	0.07	1000	1.66	2.24	5.81
B	0.09	1000	2.27	2.24	7.93
C	0.13	930	3.60	2.24	11.72
D *	0.12	940	2.44	2.24	8.04

* - Cumulative discharge at D is B+C+D = 27.69 cfs

DITCH CALCULATIONS

Assumptions:

Use Manning's Equation - $Q = 1.49*A*R^{(2/3)}*S^{(1/2)}/n$
n(grass) = 0.030

Definitions:

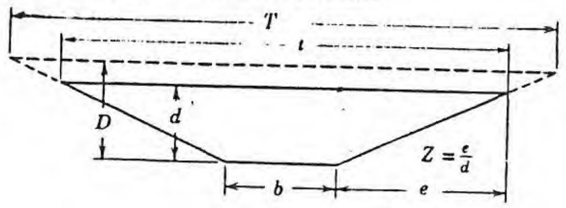
Q - flow rate, cu.ft/s
A - area of flow, sq.ft.
R - hydraulic radius, ft
n - roughness coefficient
z:1 - channel side slope
V - channel velocity (Q/A), ft/s
d - depth of flow, ft
b - bottom width of trapezoidal channel, ft
(if b=0, channel is V-shaped)
s - slope of channel, ft/ft

Discharge Point	Q	b	d	s	n	z	A	V
A	5.81	2	0.59	0.013	0.030	2.0	1.88	3.10
B	7.93	2	0.65	0.017	0.030	2.0	2.13	3.72
C	11.72	2	0.88	0.011	0.030	2.0	3.32	3.53
D	27.69	10	0.64	0.013	0.030	2.0	7.20	3.85

Ditches as designed are adequate:
z=2, b=2, d=2 (A,B and C)
z=2, b=10, d=2 (D)

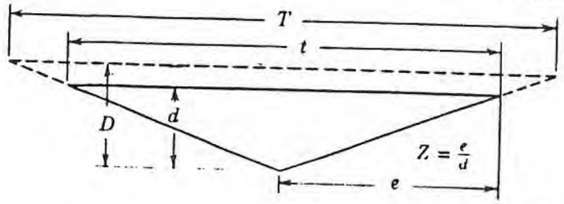
All ditches are grass-lined.

Note: Freeboard = $D-d$ for all sections



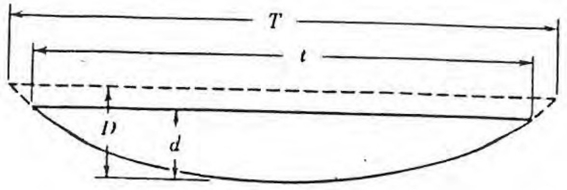
Cross-Sectional Area a	Wetted Perimeter, p	Hydraulic Radius $R=\frac{a}{p}$	Top Width
$bd + Zd^2$	$b + 2d\sqrt{Z^2+1}$	$\frac{bd + Zd^2}{b + 2d\sqrt{Z^2+1}}$	$t = b + 2dZ$ $T = b + 2DZ$

Trapezoidal cross section



Zd^2	$2d\sqrt{Z^2+1}$	$\frac{Zd}{2\sqrt{Z^2+1}}$ or $\frac{d}{2}$ approx.	$t = 2dZ$ $T = \frac{D}{d}t$

Triangular cross section



$\frac{2}{3}td$	$t + \frac{8d^2}{3t}$	$\frac{t^2d}{1.5t^2 + 4d^2}$ or $\frac{2d}{3}$ approx.	$t = \frac{a}{0.67d}$ $T = t\left(\frac{D}{d}\right)^{1/2}$

Parabolic cross section

Fig. 7.1. Channel cross section, wetted perimeter, hydraulic radius, and top width formulas.

APPENDIX B

Manning Velocity Formula

Table B.1 Roughness Coefficient *n* for Manning Formula

Line No.	Type and Description of Conduits	n *Values*^{a}		
		Min.	*Design*	*Max.*
	Channels. Lined			
1	Asphaltic concrete, machine placed		0.014	
2	Asphalt, exposed prefabricated		0.015	
3	Concrete	0.012	0.015	0.018
4	Concrete, rubble	0.017		0.030
5	Metal, smooth (flumes)	0.011		0.015
6	Metal, corrugated	0.021	0.024	0.026
7	Plastic	0.012		0.014
8	Shotcrete	0.016		0.017
9	Wood, planed (flumes)	0.010	0.012	0.015
10	Wood, unplaned (flumes)	0.011	0.013	0.015
	Channels, Earth			
11	Earth bottom, rubble sides	0.028	0.032	0.035
	Drainage ditches, large, no vegetation			
12	(*a*) <0.8 m, hydraulic radius	0.040		0.045
13	(*b*) 0.8–1.2 m, hydraulic radius	0.035		0.040
14	(*c*) 1.2–1.5 m, hydraulic radius	0.030		0.035
15	(*d*) >1.5 m, hydraulic radius	0.025		0.030
16	Small drainage ditches	0.035	0.040	0.040
17	Stony bed, weeds on bank	0.025	0.035	0.040
18	Straight and uniform	0.017	0.0225	0.025
19	Winding, sluggish	0.0225	0.025	0.030
	Channels, Vegetated (grassed waterways) (See Chapter 7)			
	Dense, uniform stands of green vegetation more than 250 mm long			
20	(*a*) Bermuda grass	0.04		0.20
21	(*b*) Kudzu	0.07		0.23
22	(*c*) Lespedeza, common	0.047		0.095
	Dense, uniform stands of green vegetation cut to a length less than 60 mm			

(Table B.1, Soil and Water Conservation Engineering, Third Edition, 1981)

Table B.1 Roughness Coefficient *n* for Manning Formula

Line No.	*Type and Description of Conduits*	n *Values*[a]		
		Min.	*Design*	*Max.*
23	(*a*) Bermuda grass, short	0.034		0.11
24	(*b*) Kudzu	0.045		0.16
25	(*c*) Lespedeza	0.023		0.05
26	Sorghum, 1-m rows	0.04		0.15
27	Wheat, mature poor	0.08		0.15
	Natural Streams			
28	(*a*) Clean, straight bank, full stage, no rifts or deep pools	0.025		0.033
29	(*b*) Same as (*a*) but some weeds and stones	0.030		0.040
30	(*c*) Winding, some pools and shoals, clean	0.035		0.050
31	(*d*) Same as (*c*), lower stages, more ineffective slopes and sections	0.040		0.055
32	(*e*) Same as (*c*), some weeds and stones	0.033		0.045
33	(*f*) Same as (*d*), stony sections	0.045		0.060
34	(*g*) sluggish river reaches, rather weedy or with very deep pools	0.050		0.080
35	(*h*) Very weedy reaches	0.075		0.150
	Pipe			
36	Asbestos cement		0.009	
37	Cast iron, coated or uncoated	0.011	0.013	0.015
38	Clay or concrete drain tile (102-305 mm dia.)	0.011	0.013	0.020
39	Concrete or clay vitrified sewer pipe	0.01	0.014	0.017
40	Corrugated plastic tubing	0.014	0.016	0.018
41	Metal, corrugated, ring	0.021	0.025	0.026
42	Metal, corrugated, helical	0.013	0.015	
43	Steel, riveted and spiral	0.013	0.016	0.017
44	Wood stave	0.010	0.013	
45	Wrought iron, black	0.012		0.015
46	Wrought iron, galv.	0.013	0.016	0.017

[a] Selected from numerous sources.

(Table B.1, Soil and Water Conservation Engineering, Third Edition, 1981)

Table 7.2 Permissible Velocities for Vegetated Channels

	Permissible Velocity For Erosion Resistant Soils (m/s) (fps)		
	% Slope in Channel		
Cover	*0–5*	*5–10*	*Over 10*
Bermuda grass	2.4 (8)[a]	2.1 (7)[a]	1.8 (6)[a]
Blue grama Buffalo grass Kentucky bluegrass Smooth brome Tall fescue	2.1 (7)[a]	1.8 (6)[a]	1.5 (5)[a]
Annual crops for temporary protection Alfalfa Crabgrass Kudzu Lespedeza sericea Weeping lovegrass	1.1 (3.5)[b]	NR[c]	NR
Grass mixture	1.5 (5)[b]	1.2 (4)[b]	NR

[a] Moderately resistant soils reduce velocities 0.3 m/s (1 fps). Easily eroded soils reduce velocities 0.6 m/s (2 fps).

[b] Easily eroded soils reduce velocities 0.3 m/s (1 fps).

[c] Not recommended.

Source: Modified from Ree (1949).

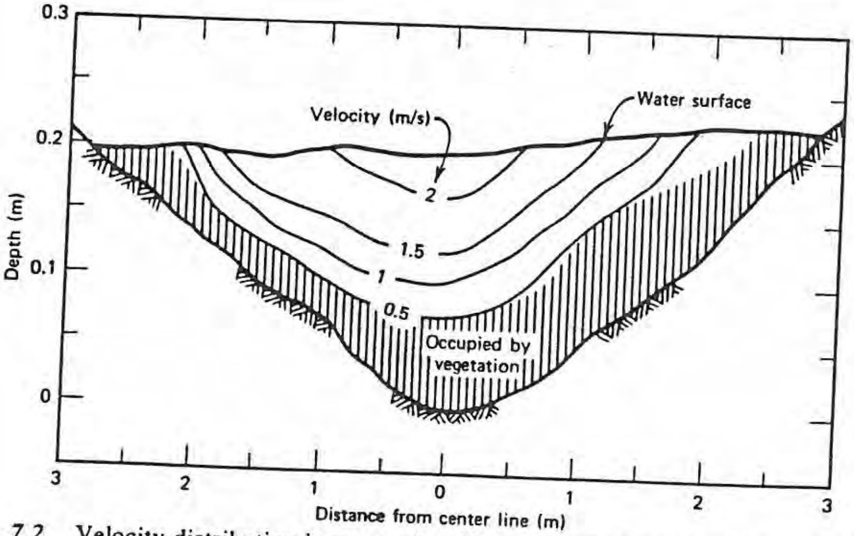


Fig. 7.2. Velocity distribution in a grass-lined channel. (Redrawn from Ree, 1949.)

Table 2-2.--Runoff curve numbers for selected agricultural, suburban, and urban land use. (Antecedent moisture condition II, and $I_a = 0.2S$)

LAND USE DESCRIPTION	HYDROLOGIC SOIL GROUP			
	A	B	C	D
Cultivated land[1]: without conservation treatment	72	81	88	91
: with conservation treatment	62	71	78	81
Pasture or range land: poor condition	68	79	86	89
good condition	39	61	74	80
Meadow: good condition	30	58	71	78
Wood or Forest land: thin stand, poor cover, no mulch	45	66	77	83
good cover[2]	25	55	70	77
Open Spaces, lawns, parks, golf courses, cemeteries, etc.				
good condition: grass cover on 75% or more of the area	39	61	74	80
fair condition: grass cover on 50% to 75% of the area	49	69	79	84
Commercial and business areas (85% impervious)	89	92	94	95
Industrial districts (72% impervious).	81	88	91	93
Residential:[3]				
Average lot size — Average % Impervious[4]				
1/8 acre or less — 65	77	85	90	92
1/4 acre — 38	61	75	83	87
1/3 acre — 30	57	72	81	86
1/2 acre — 25	54	70	80	85
1 acre — 20	51	68	79	84
Paved parking lots, roofs, driveways, etc.[5]	98	98	98	98
Streets and roads:				
paved with curbs and storm sewers[5]	98	98	98	98
gravel	76	85	89	91
dirt	72	82	87	89

[1] For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, Aug. 1972.

[2] Good cover is protected from grazing and litter and brush cover soil.

[3] Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

[4] The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

[5] In some warmer climates of the country a curve number of 95 may be used.

then computed by dividing the total overland flow length by the average velocity.

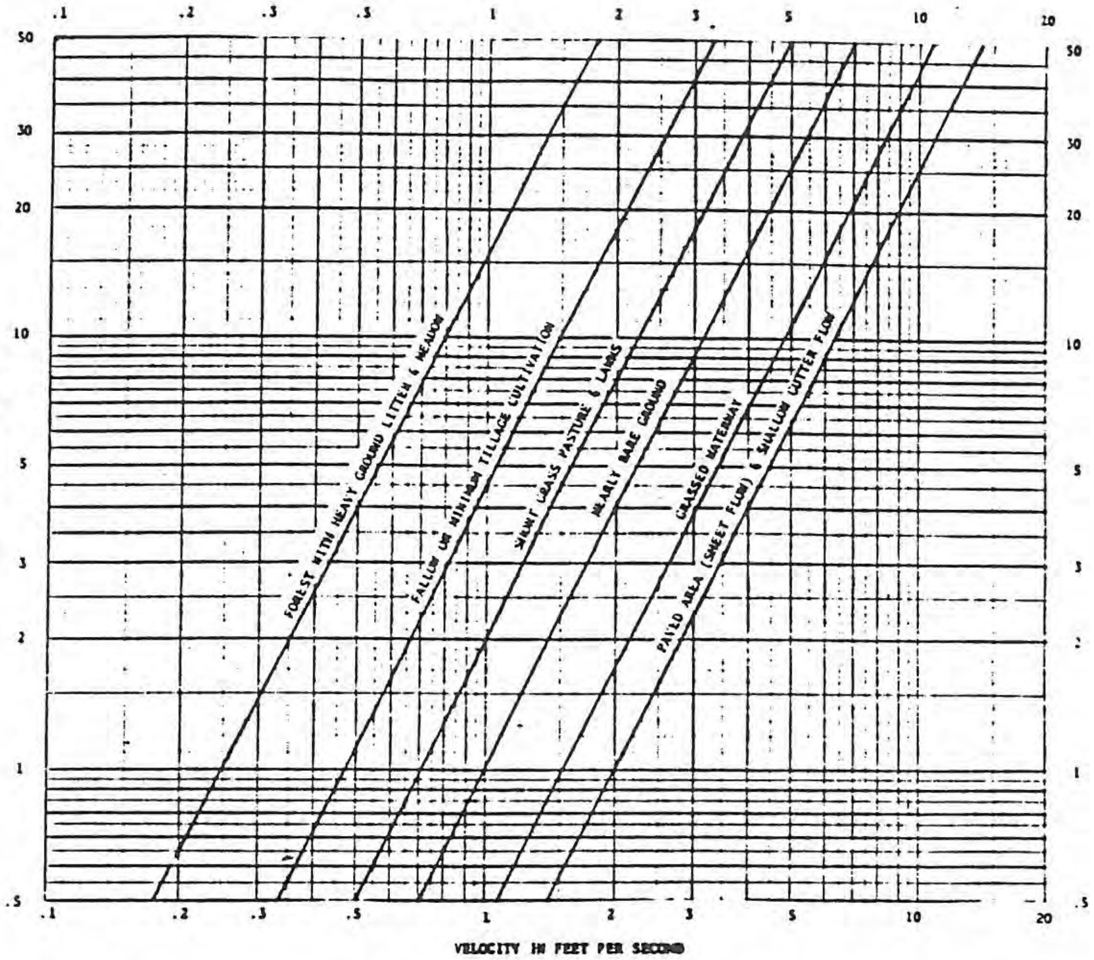


Figure 3-1.--Average velocities for estimating travel time for overland flow.

Storm sewer or road gutter flow
Travel time through the storm sewer or road gutter system to the main open channel is the sum of travel times in each individual component of the system between the uppermost inlet and the outlet. In most cases average velocities can be used without a significant loss of accuracy. During major storm events, the sewer system may be fully taxed and additional overland flow may occur, generally at a significantly lower velocity than the flow in the storm sewers. By using average conduit sizes and an average slope (excluding any vertical drops in the system), the average velocity can be estimated using Manning's formula.

Since the hydraulic radius of a pipe flowing half full is the same as when flowing full, the respective velocities are equal. Travel time may

Graphical Method of Determining Peak Discharge

The curve of T_c vs. peak discharge in csm per inch of runoff shown in figure 5-2 was developed from table 5-3 for zero T_t. It can be used for a watershed where the runoff can be represented by one curve number, i.e., the land use, soils, and cover are similar and are distributed uniformly throughout the watershed. This procedure is limited to peak discharge determination (hydrograph not required) for a watershed where valley routing is not required. The peak discharge can be calculated from figure 5-2 using T_c in hours, runoff in inches from a 24-hour rainfall, and drainage area in square miles.

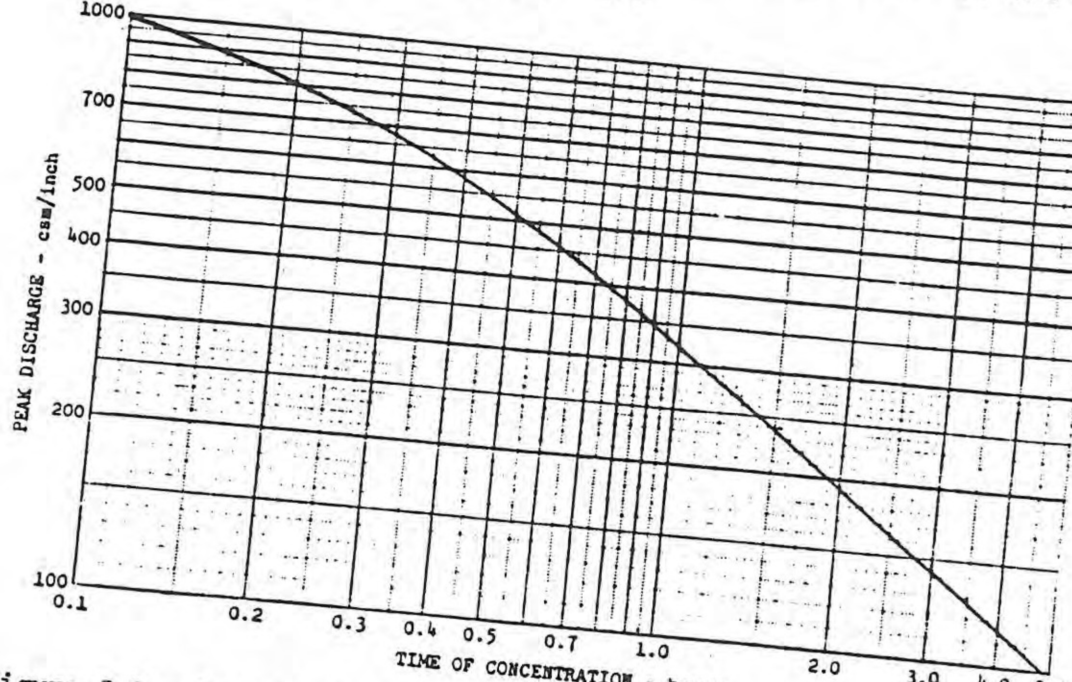


Figure 5-2.—Peak discharge in csm per inch of runoff versus time of concentration (T_c) for 24-hour, type-II storm distribution.

Example 5-2

A developer wishes to install a planned unit development in the uppermost part of a watershed. An ordinance in the township requires that a planned unit development not increase the 100-year-frequency flood flow at the downstream end of the development. The following basic data have been determined for present and future conditions:

Drainage area = 960 acres (1.5 mi^2)

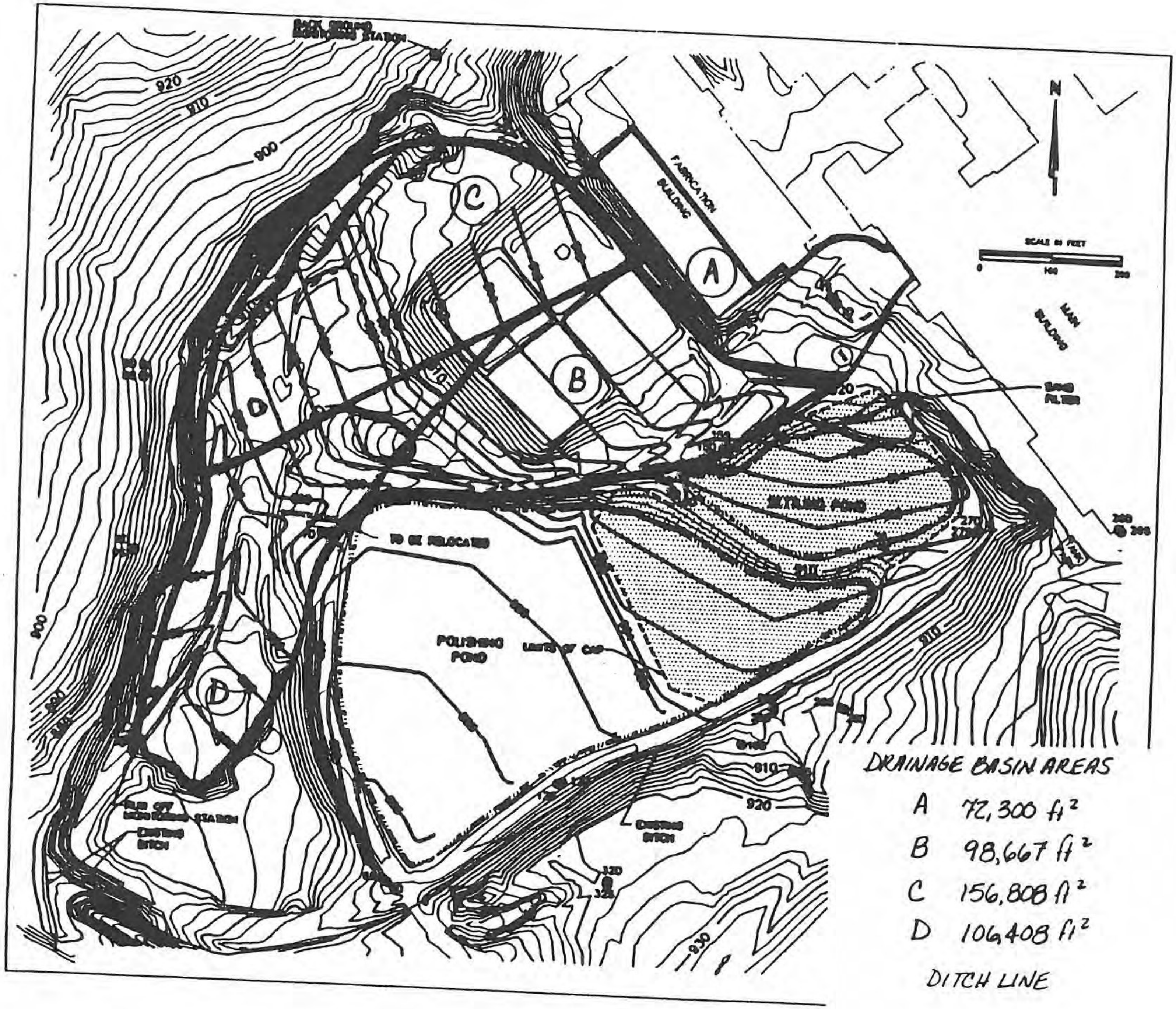
CN (present) = 80

CN (future) = 85

T_c (present) = 0.9 hr

T_c (future) = 0.6 hr

P_{24} (24-hour, 100-year frequency rainfall) = 6.0 in.



DRAINAGE BASIN AREAS

A 72,300 ft²
B 98,667 ft²
C 156,808 ft²
D 106,408 ft²

DITCH LINE

APPENDIX G

Ditch Sizing Calculations

RUN-OFF CALCULATIONS AND DITCH DESIGN

Prior to sizing the ditches, peak discharge rates were calculated using the SCS method outlined in "Urban Hydrology for Small Watersheds." Parameters used to determine discharge rates are as follows:

- Precipitation (inches) for a peak storm event (P) - Precipitation was determined for the 25-year, 24-hour storm.
- Acreage of the watershed (A)
- SCS curve number (CN) - CN is an indication of the amount of precipitation that is expected to run off the watershed.
- Flow length and slope of watershed - These parameters are used to calculate the time of concentration (T_c), the time it takes for run-off to travel from the hydraulically most distant part of the watershed to the point of reference.

The peak flow for the chosen storm event is determined for each reference point using this information.

The ditches, as designed in this appendix, were sized using Manning's Equation. Parameters used in Manning's Equation are as follows: discharge (Q) in cubic feet per second, flow area (A) in square feet, hydraulic radius (R) in feet, channel slope (S) in feet per feet and channel roughness coefficient (n). Q was taken as the design flow determined by the run-off calculations.

Solving Manning's equation for an unknown ditch size is an iterative process. The ditch size (bottom width (b), flow depth (d) and side slopes (z:1)), slope, and lining material was assumed, providing the A, R, S, and Manning's "n" parameters. With this information, Q was determined, and the calculated Q was compared to the design Q. The assumed values were adjusted as required until the calculated Q equaled the design Q. The velocity is then checked to ensure that it does not exceed the maximum allowable velocity for the lining material.

Many different variations of ditch size, slope, and lining could be used to achieve the same Q. The designer uses engineering judgement to produce a design that meets the flow requirements and is constructable and economical.

The ditches, A, B, C, and D, refer to the ditches within each drainage basin area and are shown on a map comprising the final page of this appendix.

RUN-OFF CALCULATIONS AND DITCH DESIGN

WILLIAM L BONNELL COMPANY, INC.
NEWNAN, GEORGIA
Project No. 55-0649.32

By Jennifer Miller
Date 7-10-91

Checked by Desiré Preison
Date 7-10-91

RUN-OFF CALCULATIONS

References:

1. "Urban Hydrology for Small Watersheds," Technical Release #55, U.S. Soil Conservation Service, Jan. 1075.
2. "Soil and Water Conservation Engineering," Third Edition, 1981.
3. Final Grading Plan

Design Storm: 25-year, 24-hour; Rainfall(P) = 6.75 in.

Drainage Areas: A - drainage area, acres

Discharge Point	A
A	1.66
B	2.27
C	3.60
D	2.44

Run-off Volumes:
CN - SCS curve number
S - Potential abstraction, inches
Qr - Accumulated run-off, inches
P - Accumulated rainfall, inches

Soil is Cecil-Madison series (U.S.D.A. Soil Survey, Coweta Co., GA)
Soil Group B (Georgia DOT Erosion and Sediment Control Manual)
Therefore, use curve number(CN) 58 (Attached sheet)

$S = (1000/CN) - 10$ $S =$ 7.241 in.

$Qr = (P-0.2S)^2/(P+0.8S)$ $Qr =$ 2.241 in.

Times of Concentration:
L = length of travel (ft)
dh = change in height (ft)
S = average slope
V = velocity (ft/s)
Tc = L/V (hr)

Area	Overland			In Channel			Tc
	L	S	V	L	S	V	
A	220	0.07	1.70	365	0.014	3.1	0.07
B	370	0.04	1.40	140	0.043	3.7	0.08
C	520	0.04	1.30	185	0.011	3.5	0.13
D	510	0.04	1.40	320	0.019	3.8	0.12

RUN-OFF CALCULATIONS AND DITCH DESIGN

WILLIAM L BONNELL COMPANY, INC.
NEWNAN, GEORGIA
Project No. 55-0649.32

By: Jennifer Miller
Date 7-10-91

Checked by Cesiy Preisor
Date 7-10-91

RUN-OFF CALCULATIONS (cont'd)

Peak Run-off:

Q(peak) = q*A*Qr
q - from Fig. 5-2, Ref. 1; (csm/in)
A - drainage area; (sq. mi.)
Qr - run-off volume (in)
Q(peak) = q * A(ac)/640 acres per sq mi * Qr

Discharge Point	Tc	q	A (ac)	Qr	Q(peak)
A	0.07	1000	1.66	2.24	5.81
B	0.09	1000	2.27	2.24	7.93
C	0.13	930	3.60	2.24	11.72
D *	0.12	940	2.44	2.24	8.04

* - Cumulative discharge at D is B+C+D = 27.69 cfs

DITCH CALCULATIONS

Assumptions:

Use Manning's Equation - $Q = 1.49*A*R^{(2/3)}*S^{(1/2)}/n$
n(grass) = 0.030

Definitions:

Q - flow rate, cu.ft/s
A - area of flow, sq.ft.
R - hydraulic radius, ft
n - roughness coefficient
z:1 - channel side slope
V - channel velocity (Q/A), ft/s
d - depth of flow, ft
b - bottom width of trapezoidal channel, ft
(if b=0, channel is V-shaped)
s - slope of channel, ft/ft

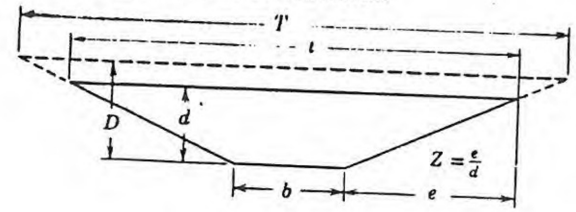
Discharge Point	Q	b	d	s	n	z	A	V
A	5.81	2	0.59	0.013	0.030	2.0	1.88	3.10
B	7.93	2	0.65	0.017	0.030	2.0	2.13	3.72
C	11.72	2	0.88	0.011	0.030	2.0	3.32	3.53
D	27.69	10	0.64	0.013	0.030	2.0	7.20	3.85

Ditches as designed are adequate:

z=2, b=2, d=2 (A,B and C)
z=2, b=10, d=2 (D)

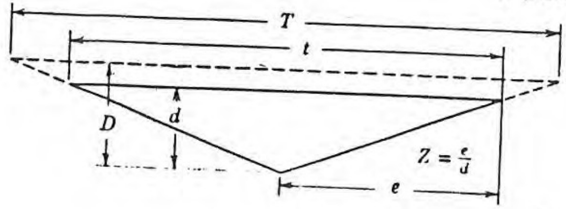
All ditches are grass-lined.

Note: Freeboard = $D-d$ for all sections



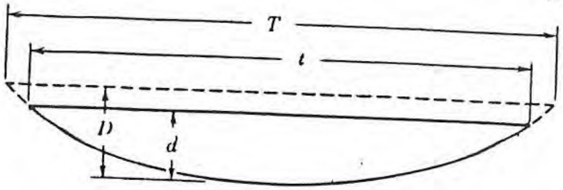
Cross-Sectional Area a	Wetted Perimeter, p	Hydraulic Radius $R = \frac{a}{p}$	Top Width
$bd + Zd^2$	$b + 2d\sqrt{Z^2+1}$	$\frac{bd + Zd^2}{b + 2d\sqrt{Z^2+1}}$	$t = b + 2dZ$ $T = b + 2DZ$

Trapezoidal cross section



Zd^2	$2d\sqrt{Z^2+1}$	$\frac{Zd}{2\sqrt{Z^2+1}}$ or $\frac{d}{2}$ approx.	$t = 2dZ$ $T = \frac{D}{d}t$

Triangular cross section



$\frac{2}{3}td$	$t + \frac{8d^2}{3t}$	$\frac{t^2d}{1.5t^2 + 4d^2}$ or $\frac{2d}{3}$ approx.	$t = \frac{a}{0.67d}$ $T = t\left(\frac{D}{d}\right)^{\frac{1}{2}}$

Parabolic cross section

Fig. 7.1. **Channel cross section, wetted perimeter, hydraulic radius, and top width formulas.**

(Figure 7.1 Soil and Water Conservation Engineering [illegible]

APPENDIX B

Manning Velocity Formula

Table B.1 Roughness Coefficient *n* for Manning Formula

Line No.	*Type and Description of Conduits*	n *Values*[a]		
		Min.	*Design*	*Max.*
	Channels. Lined			
1	Asphaltic concrete, machine placed		0.014	
2	Asphalt, exposed prefabricated		0.015	
3	Concrete	0.012	0.015	0.018
4	Concrete, rubble	0.017		0.030
5	Metal, smooth (flumes)	0.011		0.015
6	Metal, corrugated	0.021	0.024	0.026
7	Plastic	0.012		0.014
8	Shotcrete	0.016		0.017
9	Wood, planed (flumes)	0.010	0.012	0.015
10	Wood, unplaned (flumes)	0.011	0.013	0.015
	Channels. Earth			
11	Earth bottom, rubble sides	0.028	0.032	0.035
	Drainage ditches, large, no vegetation			
12	(*a*) <0.8 m, hydraulic radius	0.040		0.045
13	(*b*) 0.8–1.2 m, hydraulic radius	0.035		0.040
14	(*c*) 1.2–1.5 m, hydraulic radius	0.030		0.035
15	(*d*) >1.5 m, hydraulic radius	0.025		0.030
16	Small drainage ditches	0.035	0.040	0.040
17	Stony bed, weeds on bank	0.025	0.035	0.040
18	Straight and uniform	0.017	0.0225	0.025
19	Winding, sluggish	0.0225	0.025	0.030
	Channels, Vegetated (grassed waterways) (See Chapter 7)			
	Dense, uniform stands of green vegetation more than 250 mm long			
20	(*a*) Bermuda grass	0.04		0.20
21	(*b*) Kudzu	0.07		0.23
22	(*c*) Lespedeza, common	0.047		0.095
	Dense, uniform stands of green vegetation cut to a length less than 60 mm			

(Table B.1, Soil and Water Conservation Engineering, Third Edition, 1981)

Table B.1 Roughness Coefficient *n* for Manning Formula

Line No.	*Type and Description of Conduits*	n *Values*[a]		
		Min.	*Design*	*Max.*
23	(*a*) Bermuda grass, short	0.034		0.11
24	(*b*) Kudzu	0.045		0.16
25	(*c*) Lespedeza	0.023		0.05
26	Sorghum, 1-m rows	0.04		0.15
27	Wheat, mature poor	0.08		0.15
	Natural Streams			
28	(*a*) Clean, straight bank, full stage, no rifts or deep pools	0.025		0.033
29	(*b*) Same as (*a*) but some weeds and stones	0.030		0.040
30	(*c*) Winding, some pools and shoals, clean	0.035		0.050
31	(*d*) Same as (*c*), lower stages, more ineffective slopes and sections	0.040		0.055
32	(*e*) Same as (*c*), some weeds and stones	0.033		0.045
33	(*f*) Same as (*d*), stony sections	0.045		0.060
34	(*g*) sluggish river reaches, rather weedy or with very deep pools	0.050		0.080
35	(*h*) Very weedy reaches	0.075		0.150
	Pipe			
36	Asbestos cement		0.009	
37	Cast iron, coated or uncoated	0.011	0.013	0.015
38	Clay or concrete drain tile (102-305 mm dia.)	0.011	0.013	0.020
39	Concrete or clay vitrified sewer pipe	0.01	0.014	0.017
40	Corrugated plastic tubing	0.014	0.016	0.018
41	Metal, corrugated, ring	0.021	0.025	0.026
42	Metal, corrugated, helical	0.013	0.015	
43	Steel, riveted and spiral	0.013	0.016	0.017
44	Wood stave	0.010	0.013	
45	Wrought iron, black	0.012		0.015
46	Wrought iron, galv.	0.013	0.016	0.017

[a] Selected from numerous sources.

(Table B.1, Soil and Water Conservation Engineering, Third Edition, 1981)

Table 7.2 Permissible Velocities for Vegetated Channels

	Permissible Velocity For Erosion Resistant Soils (m/s) (fps)		
	% Slope in Channel		
Cover	*0–5*	*5–10*	*Over 10*
Bermuda grass	2.4 (8)[a]	2.1 (7)[a]	1.8 (6)[a]
Blue grama	2.1 (7)[a]	1.8 (6)[a]	1.5 (5)[a]
Buffalo grass			
Kentucky bluegrass			
Smooth brome			
Tall fescue			
Annual crops for temporary protection	1.1 (3.5)[b]	NR[c]	NR
Alfalfa			
Crabgrass			
Kudzu			
Lespedeza sericea			
Weeping lovegrass			
Grass mixture	1.5 (5)[b]	1.2 (4)[b]	NR

[a] Moderately resistant soils reduce velocities 0.3 m/s (1 fps). Easily eroded soils reduce velocities 0.6 m/s (2 fps).

[b] Easily eroded soils reduce velocities 0.3 m/s (1 fps).

[c] Not recommended.

Source: Modified from Ree (1949).

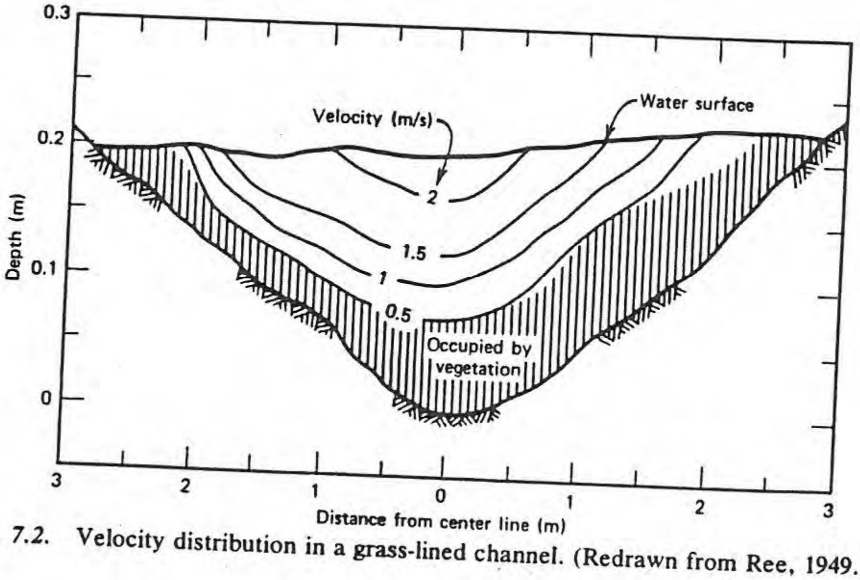


Fig. 7.2. Velocity distribution in a grass-lined channel. (Redrawn from Ree, 1949.)

Table 2-2.--Runoff curve numbers for selected agricultural, suburban, and urban land use. (Antecedent moisture condition II, and $I_a = 0.2S$)

LAND USE DESCRIPTION		HYDROLOGIC SOIL GROUP			
		A	B	C	D
Cultivated land[1]: without conservation treatment		72	81	88	91
: with conservation treatment		62	71	78	81
Pasture or range land: poor condition		68	79	86	89
good condition		39	61	74	80
Meadow: good condition		30	58	71	78
Wood or Forest land: thin stand, poor cover, no mulch		45	66	77	83
good cover[2]		25	55	70	77
Open Spaces, lawns, parks, golf courses, cemeteries, etc.					
good condition: grass cover on 75% or more of the area		39	61	74	80
fair condition: grass cover on 50% to 75% of the area		49	69	79	84
Commercial and business areas (85% impervious)		89	92	94	95
Industrial districts (72% impervious).		81	88	91	93
Residential:[3]					
Average lot size	Average % Impervious[4]				
1/8 acre or less	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
Paved parking lots, roofs, driveways, etc.[5]		98	98	98	98
Streets and roads:					
paved with curbs and storm sewers[5]		98	98	98	98
gravel		76	85	89	91
dirt		72	82	87	89

[1] For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, Aug. 1972.

[2] Good cover is protected from grazing and litter and brush cover soil.

[3] Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

[4] The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

[5] In some warmer climates of the country a curve number of 95 may be used.

then computed by dividing the total overland flow length by the average velocity.

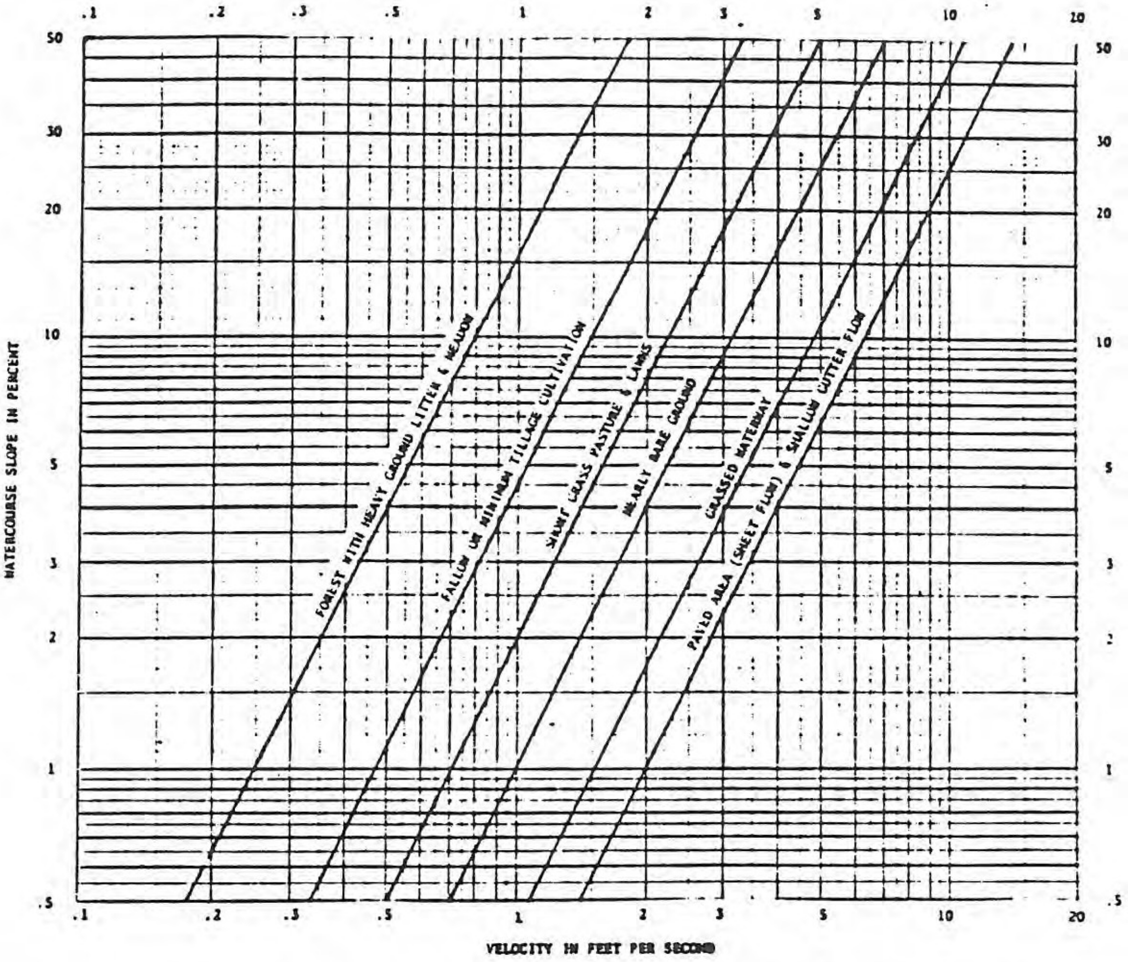


Figure 3-1.--Average velocities for estimating travel time for overland flow.

Storm sewer or road gutter flow

Travel time through the storm sewer or road gutter system to the main open channel is the sum of travel times in each individual component of the system between the uppermost inlet and the outlet. In most cases average velocities can be used without a significant loss of accuracy. During major storm events, the sewer system may be fully taxed and additional overland flow may occur, generally at a significantly lower velocity than the flow in the storm sewers. By using average conduit sizes and an average slope (excluding any vertical drops in the system), the average velocity can be estimated using Manning's formula.

Since the hydraulic radius of a pipe flowing half full is the same as when flowing full, the respective velocities are equal. Travel time may

Graphical Method of Determining Peak Discharge

The curve of T_c vs. peak discharge in csm per inch of runoff shown in figure 5-2 was developed from table 5-3 for zero T_t. It can be used for a watershed where the runoff can be represented by one curve number, i.e., the land use, soils, and cover are similar and are distributed uniformly throughout the watershed. This procedure is limited to peak discharge determination (hydrograph not required) for a watershed where valley routing is not required. The peak discharge can be calculated from figure 5-2 using T_c in hours, runoff in inches from a 24-hour rainfall, and drainage area in square miles.

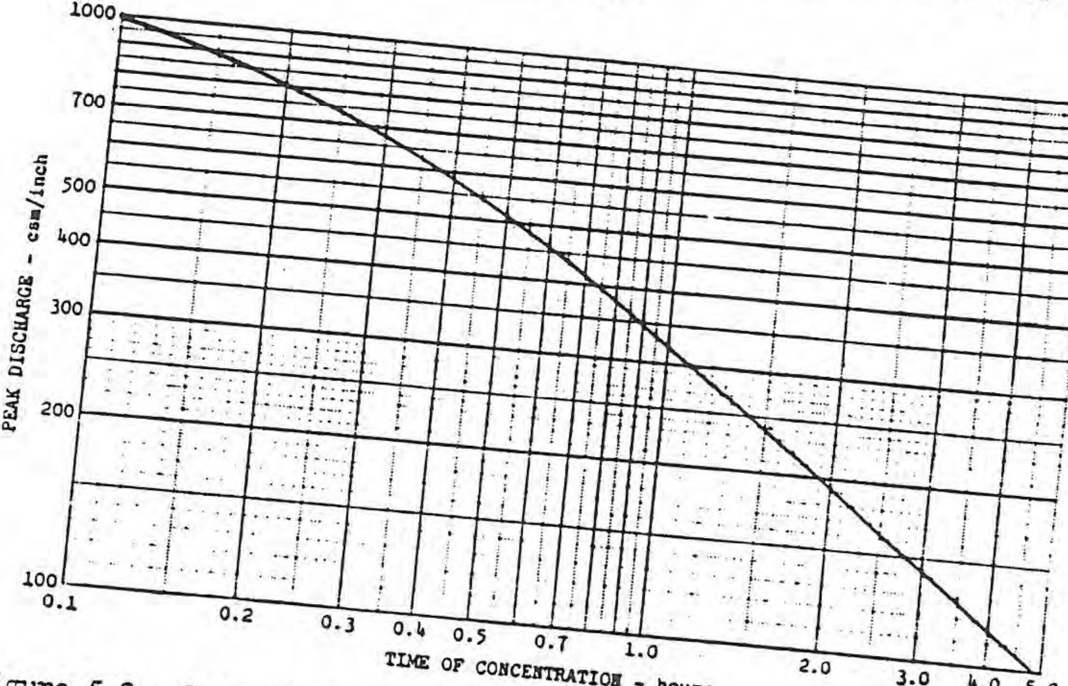


Figure 5-2.—Peak discharge in csm per inch of runoff versus time of concentration (T_c) for 24-hour, type-II storm distribution.

Example 5-2

A developer wishes to install a planned unit development in the uppermost part of a watershed. An ordinance in the township requires that a planned unit development not increase the 100-year-frequency flood flow at the downstream end of the development. The following basic data have been determined for present and future conditions:

Drainage area = 960 acres (1.5 mi^2)

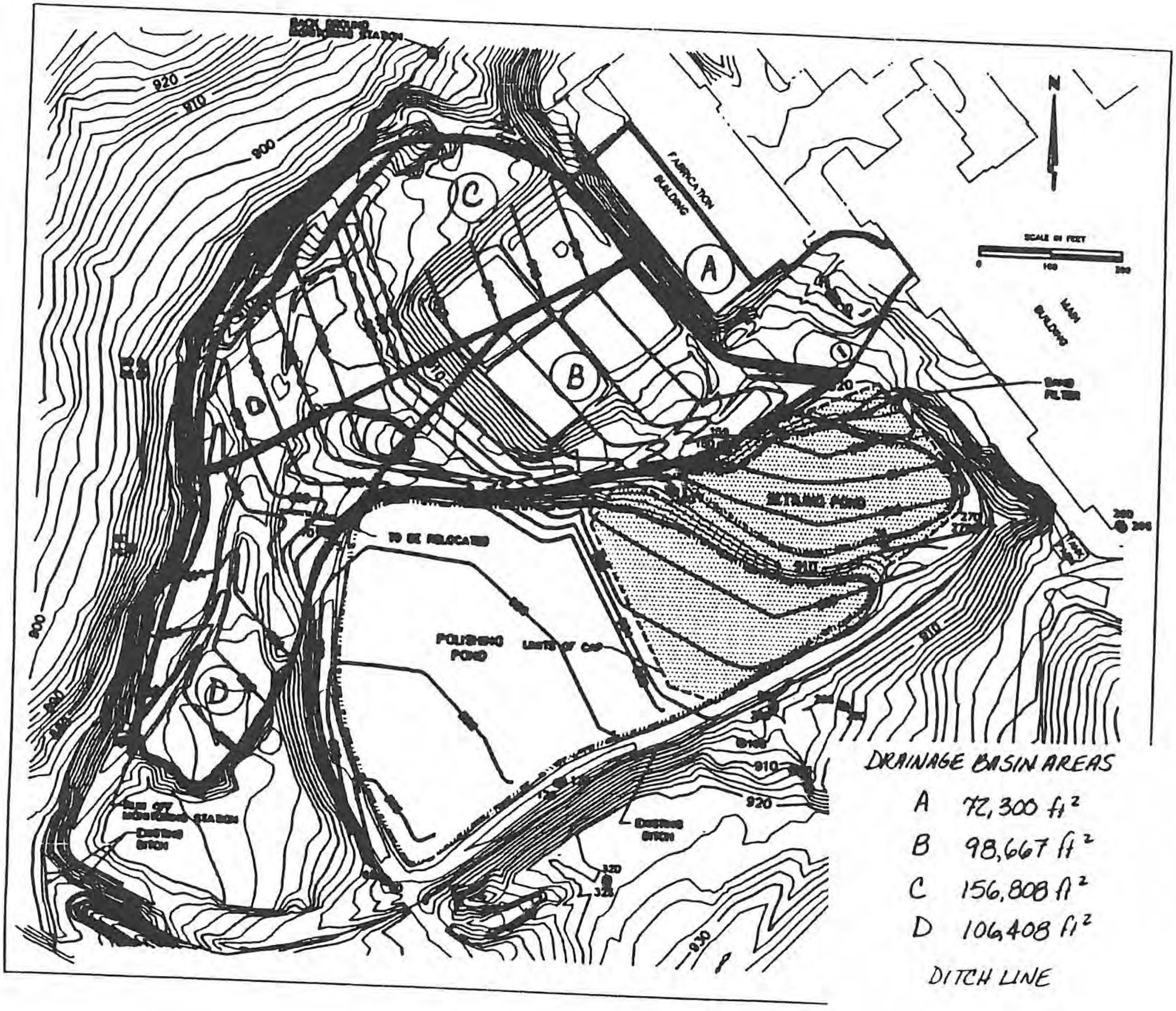
CN (present) = 80

CN (future) = 85

T_c (present) = 0.9 hr

T_c (future) = 0.6 hr

P_{24} (24-hour, 100-year frequency rainfall) = 6.0 in.


BACKGROUND MONITORING STATION
920
910
900
FABRICATION BUILDING
N
SCALE IN FEET
0
100
200
MAIN BUILDING
A
B
C
D
SAND FILTER
SETTLING POND
TO BE RELOCATED
POLISHING POND
LIMITS OF CAP
RUN OFF MONITORING STATION
EXISTING DITCH
EXISTING DITCH
910
920
930
DRAINAGE BASIN AREAS
A 72,300 ft²
B 98,667 ft²
C 156,808 ft²
D 106,408 ft²
DITCH LINE

APPENDIX H

CrOH Sludge Sand Drying Bed Area
Soil Loss Calculation

CrOH SLUDGE SAND DRYING BED AREA
SOIL LOSS CALCULATION

A = R K L S C P

where A = average annual soil loss, in tons/acre

R = rainfall and run-off erosivity index

K = soil erodability factor, tons/acre

L = slope-length factor

S = slope-steepness factor

C = cover-management factor

P = practice factor

A = 0.32 tons/acre per year

where R = 300 (Table B-2.1, Manual for Erosion and Sediment Control in Georgia, 1990)

K = 0.32 (Table 5.4, Soil and Water Conservation Engineering, Third Edition, 1981, silty clay loam)

LS = 0.83 (Table B-2.2, Manual for Erosion and Sediment Control in Georgia, 1990, 8% and 70 ft.)

C = 0.004 (Table 5.5, Soil and Water Conservation Engineering, Third Edition, 1981, Established Grass and Legume Meadow)

P = 1.0 (Table 5.6, Soil and Water Conservation Engineering, Third Edition, 1981, Up and Down Slope)

Table B-2.1 — Rainfall-Erosion Index Factor "R" Values

County	R
Appling	350
Atkinson	350
Bacon	350
Baker	350
Baldwin	250
Banks	300
Barrow	300
Bartow	300
Ben Hill	350
Berrien	350
Bibb	300
Bleckley	300
Brantley	350
Brooks	350
Bryan	350
Bulloch	300
Burke	250
Butts	300
Calhoun	350
Camden	350
Candler	300
Carroll	300
Catoosa	250
Charlton	350
Chatham	350
Chattahoochee	350
Chattooga	300
Cherokee	300
Clarke	250
Clay	350
Clayton	300
Clinch	350
Cobb	300
Coffee	350
Colquitt	350
Columbia	250
Cook	350
Coweta	300
Crawford	300
Crisp	350
Dade	250
Dawson	300
Decatur	350
DeKalb	300
Dodge	300
Dooly	300
Dougherty	350
Douglas	300
Early	350
Echols	350
Effingham	350
Elbert	250
Emanuel	300
Evans	350
Fannin	250
Fayette	300
Floyd	300
Forsyth	300
Franklin	300
Fulton	300
Gilmer	300
Glascock	250
Glynn	350
Gordon	300
Grady	350
Greene	250
Gwinnett	300
Habersham	350
Hall	300
Hancock	250
Haralson	300
Harris	350
Hart	300
Heard	350
Henry	300
Houston	300
Irwin	350
Jackson	300
Jasper	300
Jeff Davis	350
Jefferson	250
Jenkins	300
Johnson	300
Jones	300
Lamar	300
Lanier	350
Laurens	300

Table B-2.2. — Slope Effect Table (Topographic Factor, LS) — Sheet 1 of 2

Percent Slope	Slope Length in Feet													
	10	20	40	60	80	100	110	120	130	140	150	160	180	200
0.2	0.04	0.05	0.06	0.07	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.10	0.10
0.3	0.04	0.05	0.07	0.08	0.08	0.09	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.11
0.4	0.05	0.06	0.07	0.08	0.09	0.09	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.11
0.5	0.05	0.06	0.08	0.08	0.09	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.12	0.12
1.0	0.06	0.08	0.10	0.11	0.12	0.13	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.16
2.0	0.10	0.12	0.15	0.17	0.19	0.20	0.21	0.21	0.22	0.22	0.23	0.23	0.24	0.25
3.0	0.14	0.18	0.22	0.25	0.27	0.29	0.30	0.30	0.31	0.32	0.32	0.33	0.34	0.35
4.0	0.16	0.21	0.28	0.33	0.37	0.40	0.42	0.43	0.44	0.46	0.47	0.48	0.51	0.53
5.0	0.17	0.24	0.34	0.41	0.48	0.54	0.56	0.59	0.61	0.63	0.66	0.68	0.72	0.76
6.0	0.21	0.30	0.43	0.52	0.60	0.67	0.71	0.74	0.77	0.80	0.82	0.85	0.90	0.95
8.0	0.31	0.44	0.63	0.77	0.89	0.99	1.04	1.09	1.13	1.17	1.21	1.25	1.33	1.40
10.0	0.43	0.61	0.87	1.06	1.23	1.37	1.44	1.50	1.56	1.62	1.68	1.73	1.84	1.94
12.0	0.57	0.81	1.14	1.40	1.61	1.80	1.89	1.98	2.06	2.14	2.21	2.28	2.42	2.55
14.0	0.73	1.03	1.45	1.78	2.05	2.29	2.41	2.51	2.62	2.72	2.81	2.90	3.08	3.25
16.0	0.90	1.27	1.80	2.20	2.54	2.84	2.98	3.11	3.24	3.36	3.48	3.59	3.81	4.01
18.0	1.09	1.54	2.17	2.66	3.07	3.43	3.60	3.76	3.92	4.06	4.21	4.34	4.61	4.86
20.0	29	1.82	2.58	3.16	3.65	4.08	4.28	4.47	4.65	4.83	5.00	5.16	5.47	5.77
25.0	1 86	2.63	3.73	4.56	5.27	5.89	6.18	6.45	6.72	6.97	7.22	7.45	7.90	8.33
30.0	2.52	3.56	5.03	6.16	7.11	7.95	8.34	8.71	9.07	9.41	9.74	10.06	10.67	11.25
40.0	4.00	5.66	8.00	9.80	11.32	12.65	13.27	13.86	14.43	14.97	15.50	16.01	16.98	17.90
50.0	5.64	7.97	11.27	13.81	15.94	17.82	18.69	19.53	20.32	21.09	21.83	22.55	23.91	25.21
60.0	7.32	10.35	14.64	17.93	20.71	23.15	24.28	25.36	26.40	27.39	28.36	29.29	31.06	32.74

Table 5.3 Frequency of Annual and Single-Storm Erosion Index $\overline{R}$

Location	Return Period in Years			
	2	5	10	20
ANNUAL EROSION INDEX, *R*				
Little Rock, Ark.	308	422	510[a]	569
Indianapolis, Ind.	166	225	275[a]	302
Devils Lake, N.D.	56	90	120[a]	142
SINGLE-STORM EROSION INDEX, *R*				
Little Rock, Ark.	69	115	158	211
Indianapolis, Ind.	41	60	75	90
Devils Lake, N.D.	27	39	49	59

[a] Interpolated values.

Source: Wischmeier and Smith (1965).

C = cropping-management factor, which is the ratio of soil loss for given conditions to soil loss from cultivated continuous fallow as given in Table 5.5,

P = conservation practice factor, which is the ratio of soil loss for a given practice to that for up and down the slope farming as given in Table 5.6.

The index factor *R* found by Wischmeier (1959) to be most highly correlated with soil loss for a fallow condition (see (6) in Table 5.1), was a product of the kinetic energy of the storm and the maximum 30-min intensity. This product

Table 5.4 *K*. Soil-Erodibility Factor by Soil Texture in t/a[a]

Textural Class	Organic Matter Content (%)		
	0.5	2	4
Fine sand	0.16	0.14	0.10
Very fine sand	0.42	0.36	0.28
Loamy sand	0.12	0.10	0.08
Loamy very fine sand	0.44	0.38	0.30
Sandy loam	0.27	0.24	0.19
Very fine sandy loam	0.47	0.41	0.33
Silt loam	0.48	0.42	0.33
Clay loam	0.28	0.25	0.21
Silty clay loam	0.37	0.32	0.26
Silty clay	0.25	0.23	0.19

[a] Selected from USDA-EPA, Vol. I (1975) and are estimated averages of specific soil values. For more accurate values by soil types use local recommendations of Soil Conservation Service or state agencies. (1 t/a = 2.24 Mg/ha)

Table 5.5 Ratio of Soil Loss from Crops to Corresponding Loss from Continuous Fallow[a]

Cover, Sequence, and Management	*Crop Yields*		*Crop-Stage Period*[b]				
	Meadow (tons)	*Corn (bu)*	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)
1st-yr corn after meadow, *RdL*[c]	2	60	15	30	27	15	22
2nd-yr corn after meadow, *RdL*	3	70	32	51	41	22	26
2nd-yr corn after meadow, *RdR*[d]	3	70	60	65	51	24	65
3rd- or more yr corn, *RdL*	—	70	36	63	50	26	30
Small grain w/meadow seeding:							
(1) In disked corn residues							
After 1st-corn after meadow	2	60	—	30	18	3	2
After 2nd corn after meadow	2	60	—	40	24	5	3
(2) On disked corn stubble, *RdR*							
After 1st corn after meadow	2	—	—	50	40	5	3
After 2nd corn after meadow	2	—	—	80	50	7	3
Established grass and legume meadow	3	—	—	—	0.4	—	—

[a] Portion of 100-line published table (Wischmeier, 1960).

[b] Crop-stage periods are defined below:

0 Turnplowing to seedbed preparation.
1 Seedbed—first month after seeding.
2 Establishment—second month after seeding.
3 Growing cover—from 2 months after seeding to harvest.
4 Stubble or residue—harvest to plowing or new seedbed.

[c] *RdL*, crop residues left and incorporated by plowing.

[d] *RdR*, crop residues removed.

Source: Smith and Wischmeier (1962).

Table 5.6 Recommended Conservation Practice Factors P^a

Percent Slope	P_c Contouring (maximum slope length in m)	P_{sc} Strip Cropping[b]	P_{tc} Terracing and Contouring[c]
Parallel to Field Boundary	0.8[d]	—	—
1.1–2	0.6 (150)	0.30	—
2.1–7	0.5 (100)	0.25	0.10
7.1–12	0.6 (60)	0.30	0.12
12.1–18	0.8 (20)	0.40	0.16
18.1–24	0.9 (18)	0.45	—

[a] Factor for up and down slope is 1.0.

[b] A system using 4-year rotation of corn, small grain, meadow, meadow. Use with terraces for farm planning.

[c] Recommended only for computing soil loss from the field or loss to the terrace channel with upslope plowing.

[d] For slopes up to 12% only.

Source: Wischmeier and Smith (1965).

the soil loss from the standard length of 22 m (73 ft) and 9 percent slope. These factors can be calculated from the equations

$$L = (l/22)^x \tag{5.4}$$

and

$$S = \frac{(0.43 + 0.30s + 0.043s^2)}{6.574} \tag{5.5}$$

where x = a constant, 0.5 for slopes >4 percent, 0.4 for 4 percent, and 0.3 for <3 percent

l = slope length in m,

s = field slope in percent.

The product LS can be read directly from Fig. 5.7 for $x = 0.5$. The slope length is measured from the point where surface flow originates (usually the top of the ridge) to the outlet channel or a point down slope where deposition begins.

The cropping-management factor C includes the effects of cover, crop sequence, productivity level, length of growing season, tillage practices, residue management, and the expected time distribution of erosive rainstorms. The

APPENDIX I

Ground-Water Monitoring Program

E-5 GENERAL MONITORING PROGRAM REQUIREMENTS

E-5a Description of Wells

Seventy-six ground-water quality monitoring wells have been installed in the uppermost aquifer at the facility. The installation of these wells is discussed in Section E-1b. A summary of the well types and construction details is presented in Table E-1.1. The locations of these wells are shown on Figure E-1.1. The construction of individual wells is shown on the well construction diagrams in Appendix E-1.2.

The William L Bonnell Company will be in detection monitoring for the CrOH landfill and the ALOH sludge/soil mixing area. The facility will be in compliance, and corrective action monitoring for the Hazardous Waste Management Area (HWMA) consisting of the former CrOH sand drying beds, polishing pond and the settling pond. Table E-5.1 is a summary of the detection/compliance/corrective action monitoring system. Specific monitoring wells have been proposed as point of compliance (POC) monitoring wells and as corrective action performance monitoring wells.

E-5b Description of Sampling and Analysis Procedures

Revised Sampling and Analysis Procedures for the facility are included in Appendix C of the Revised Ground-Water Monitoring Plan (Appendix E-1.8). The monitoring wells will be sampled and analyzed in accordance with the Revised Sampling and Analysis Procedures.

E-5c Procedures for Establishing Background Water Quality

Monitoring well GW-13S will provide upgradient, background water quality for the ALOH sludge/soil mixting area and the waste management area consisting of the former CrOH sand drying beds, the settling pond and the polishing pond. Monitoring well GW-18S will provide upgradient, background water quality for the CrOH landfill. A minimum of one year of quarterly interim status data will be collected from the wells to develop background water quality in accordance with the Revised Ground-Water Monitoring Plan (Appendix E-1.8). At a minimum, the initial background values will be determined by taking the arithmetic mean and variance of the individual parameters analyzed during the first year of interim status monitoring. Also, analytical results for chromium or other constituents, as necessary, obtained for delisting purposes may be used to establish background values on well GW-13S. During detection and compliance monitoring, quadruplicate samples from each respective background well will be collected semi-annually and analyzed for pH, specific conductance, total organic carbon, total organic halogens and total chromium. The results of detection and compliance monitoring from the background wells will be verified with the initial (first year) background results using the students t-Test with a 0.01 level of significance except for pH where a 0.025 level of significance will be used.

E-5d Statistical Procedures

Ground-water quality data will be collected from the background and proposed POC monitoring wells during detection and compliance monitoring. These data will be used to determine if statistically significant evidence of contamination exists (detection monitoring) or contamination increases (compliance monitoring) for the parameters or hazardous constituents specified in the permit. The statistical comparisons will be made using the Students' t-test as described in 40 CFR 264 Appendix IV to the 0.01 level of significance. Non-detects will be handled by substituting the detection limit value for constituents not detected. These values will be obtained from the US EPA "Test Methods for Evaluating Solid Waste" third edition SW-846.

E-7 DESCRIPTION OF COMPLIANCE MONITORING PROGRAM

The chromium hydroxide sands drying beds, settling pond and polishing pond have been combined into a single hazardous waste management area (HWMA). Chromium has been detected in the ground water at the chromium hydroxide sand drying beds above the ground-water protection standard. A compliance monitoring program will be implemented at the proposed point of compliance wells for this HWMA. Details of this monitoring program are described below.

E-7a Description of Monitoring Program

E-7a(1) Description of Wastes Previously Handled at the Facility

The Bonnell facility operates a chemical conversion coating wastewater treatment system which produces a listed hazardous waste (F019) sludge. This F019 listed waste is managed in the regulated units at the facility. The hazardous constituent in the F019 waste is chromium.

E-7a(2) Characterization of Contaminated Ground Water

A complete description and characterization of contaminated ground water at this HWMA is provided in Section E-4.

E-7a(3) List of Hazardous Constituents to be Monitored

The identification of site-specific hazardous constituents for compliance monitoring was based on an evaluation of the waste managed in the regulated units (Section E-7a(1)) and an analysis of the ground-water quality from the interim status monitoring. The only detected Appendix IX constituent that is related to the waste in the regulated unit and present in ground-water is total chromium. Appendix IX analyses from well GW-15D are pending. If additional hazardous constituents are identified in samples analyzed for Appendix IX constituents, an application will be made to modify the permit accordingly.

E-7a(4) Proposed Concentration Limits

The maximum allowable concentration (ground-water protection standard) for chromium is defined in 40 CFR 264.94 Table 1 at 0.05 mg/l. This value will be used as the concentration limit at the point of compliance.

E-7a(5) Description of the Monitoring System

Compliance monitoring will be performed at the following proposed point of compliance monitoring wells: GW-6S, GW-7S, GW-12S and GW-27S. Well GW-13S will provide background water quality. These wells are shown on Figure E-1.1. Construction details for these wells are summarized on Table E-1.1. The construction of individual wells is shown on the well construction diagrams in Appendix E-1.2.

The ground-water direction and rate of ground-water flow in the uppermost aquifer will be determined annually. For this purpose, ground-water elevations will be measured in all wells in the facility.

E-7a(6) Description of Proposed Sampling and Statistical Analysis Procedures

The sampling and analysis will be performed using the procedures described in the Revised Sampling and Analysis Plan (Appendix E-1.8). The samples will be analyzed for pH, specific conductance, and total chromium (site specific hazardous constituent). The results of the analyses will be compared to the ground-water protection standards using the statistical procedures described in Section E-5d above.

To assess whether additional hazardous constituents are present in the uppermost aquifer, a point of compliance monitoring well will be sampled annually and analyzed for Appendix IX constituents using the procedures described in the Revised Sampling and Analysis Plan (Appendix E-1.8).

E-7a(7) Procedures to be Implemented if Ground-Water Protection Standards are Exceeded at Point of Compliance

If the concentration of any hazardous constituent exceeds the ground-water protection standard at any POC monitoring well, the following procedures will be implemented:

- The Director of Georgia EPD will be notified in writing within seven days.
- A report will be submitted to the Director of Georgia EPD within 90 days and an application will be made for a permit modification to establish a corrective action program as required by 40 CFR 264.99(h)(2).

E-7b Engineering Feasibility Plan for Corrective Action Program

The William L Bonnell Company will take corrective action to ensure that hazardous constituents from the hazardous waste management units (HWMUs) detected in the ground water do not exceed their respective concentration limits at the point-of-compliance. To date, only one hazardous constituent (chromium) associated with the HWMUs has been detected above the ground-water protection standard. The chromium contaminant plume has been described in Section E-4.

The source of the chromium plume described in Section E-4 is believed to be the former CrOH Sand Drying Beds. This unit is part of a waste management area which also includes the settling pond and polishing pond. Corrective action for chromium contaminated ground water in the vicinity of the former CrOH Sand Drying Beds will include closure of the unit (source control), and if necessary, ground-water recovery and associated treatment, and corrective action monitoring to determine the effectiveness of the corrective action program.

To date, no release of hazardous constituents above the concentration limits established under 40 CFR 264.93 has occurred from the Aluminum Hydroxide Mixing Area. Except for the ALOH Mixing Area, each HWMU will be closed with a engineered cover. The ALOH Mixing Area will be closed as a land treatment unit. Closure plans for each HWMUs are provided in Section I. If hazardous constituents are detected above the proposed concentration limits during detection or compliance monitoring (Section E-6) being performed at the ALOH Mixing Area or CrOH landfill, a corrective action program similar to that of the CrOH sand drying beds will be developed for those areas where exceedences have occurred.

The proposed methods of corrective action use proven construction techniques for dealing with ground-water contamination. Execution of the Corrective Action Program should restore ground-water quality without producing any adverse environmental conditions. For details of the Corrective Action Plan for the CrOH sand drying beds, refer to Section E-8.

TABLE E.1.1

SUMMARY OF BORING AND WELL CONSTRUCTION DATA
THE WILLIAM L BONNELL COMPANY - NEWNAN, GEORGIA
LAW ENVIRONMENTAL JOB NO. 55-0649

BORING NUMBER	DATE COMPLETED	DRILLING METHOD	BIT OR AUGER DIAMETER (INCHES)	WELL TYPE	BORING DEPTH (FEET)	APPROX. DEPTH OF SCREENED INTERVAL (FEET)	DEPTH TO TOP OF SAND PACK (FEET)	DEPTH TO TOP OF BENTONITE SEAL (FEET)	UNIT SCREENED*	TOP OF CASING ELEVATION (FEET, MSL)
1S	09/16/89	HOLLOW STEM AUGER	8.0	II	32.0	21.0-31.0	17.0	15.0	Water Table	933.46
1D	09/16/89	HOLLOW STEM AUGER	8.0	II	65.5	54.5-64.5	52.0	37.0		933.73
*2S	09/20/89	HOLLOW STEM AUGER	8.0	II	13.5	2.5-12.5	1.0	0.9	Water Table	919.74
*2D	09/21/89	HOLLOW STEM AUGER	8.0	II	39.5	29.5-39.5	19.0 —	16.0		919.53
3S	09/18/89	HOLLOW STEM AUGER	8.0	II	19.0	4.5-14.5	3.5	2.5	Water Table	912.82
3D	NOT INSTALLED	—	—	—	—	—	—	—	—	—
4S	09/19/89	HOLLOW STEM AUGER	8.0	II	28.0	18.0-28.0	16.0	14.0	Water Table	909.26
4D	05/01/90	HOLLOW STEM AUGER	8.25	II	35.0	24.8-34.8	22.8	20.8	Water Table/TOR	909.04
5S	09/20/89	HOLLOW STEM AUGER	8.0	II	30.0	20.0-30.0	9.0	7.0	Water Table	909.26
5D	NOT INSTALLED	—	—	—	—	—	—	—	—	—
6S	09/20/89	HOLLOW STEM AUGER	8.0	II	23.0	10.0-20.0	9.0	7.5	Water Table	906.05
6D	05/03/90	HOLLOW STEM AUGER	8.25	II	43.8	33.4-43.4	31.4	29.4	Top of Rock	905.77
7S	09/20/89	HOLLOW STEM AUGER	8.0	II	23.0	9.0-19.0	8.0	6.0	Water Table	902.31
7D	09/22/89	HOLLOW STEM AUGER	8.0	II	47.5	37.0-47.0	34.0	30.0	Top of rock	902.82
8S	09/20/89	HOLLOW STEM AUGER	8.0	II	15.0	3.0-13.0	2.0	1.0	Water Table	891.46
8D	09/20/89	HOLLOW STEM AUGER	8.0	II	39.5	29.5-39.5	24.5	7.6	Top of rock	891.08
9S	09/19/89	HOLLOW STEM AUGER	8.0	II	15.0	3.2-13.0	1.8	0.8	Water Table	882.74
9D	05/05/90	HOLLOW STEM AUGER	8.25	II	50.0	37.8-47.8	35.8	33.8	Top of Rock	881.37
10S	05/24/90	HOLLOW STEM AUGER	8.25	II	10.0	3.2-8.2	1.2	0.2	Water Table/TOR	907.67
10D	NOT INSTALLED	—	—	—	—	—	—	—	—	—
11S	09/19/89	HOLLOW STEM AUGER	8.0	II	29.0	18.0-28.0	13.5	11.5	Water Table	950.63
11D	NOT INSTALLED	—	—	—	—	—	—	—	—	—
12S	09/25/89	HOLLOW STEM AUGER	8.0	II	13.0	2.5-12.5	1.5	1.0	Water Table	906.48
12D	05/04/90	HOLLOW STEM AUGER	8.25	II	38.0	27.7-37.7	25.7	23.7	Top of rock	906.69
13S	11/29/89	HOLLOW STEM AUGER	9.0	II	25.0	15.0-25.0	13.0	10.5	Water Table	952.40
13D	NOT INSTALLED	—	—	—	—	—	—	—	—	—
14S	11/30/89	HOLLOW STEM AUGER	9.0	II	28.0	13.0-23.0	10.0	8.0	Water Table	947.31
14D	NOT INSTALLED	—	—	—	—	—	—	—	—	—
15S	04/19/90	HOLLOW STEM AUGER	8.25	II	20.1	9.7-19.7	7.7	5.7	Water Table	920.92
15D	04/18/90	HOLLOW STEM AUGER	8.25	II	49.9	38.5-48.5	37.0	35.0	Top of rock	920.80
16S	04/16/90	HOLLOW STEM AUGER	8.25	II	14.9	4.4-14.4	2.4	0.4	Water Table	912.14
16D	04/17/90	HOLLOW STEM AUGER	8.25	II	32.0	20.1-30.1	19.0	17.0	Top of rock	912.98
17S	04/27/90	HOLLOW STEM AUGER	8.25	II	26.2	20.8-25.8	18.8	16.8	Water Table	912.51
17D	04/27/90	HOLLOW STEM AUGER	8.25	II	35.0	24.9-34.9	22.0	20.0	Water Table/TOR	912.28
18S	05/01/90	HOLLOW STEM AUGER	8.25	II	20.8	10.3-20.3	8.3	6.3	Water Table	903.50
18D	05/01/90	HOLLOW STEM AUGER	8.25	II	35.0	24.2-34.2	22.1	20.1	Top of rock	903.58
19S	04/26/90	HOLLOW STEM AUGER	8.25	II	31.2	20.8-30.8	18.8	16.8	Water Table	906.83
19D	04/20/90	HOLLOW STEM AUGER	8.25	II	43.0	32.8-42.8	30.8	28.8	Top of rock	906.67
20S	04/30/90	HOLLOW STEM AUGER	8.25	II	15.5	5.1-15.1	3.1	1.1	Water Table	880.01
20D	04/30/90	HOLLOW STEM AUGER	8.25	II	40.0	29.6-39.6	27.6	25.6	Top of rock	879.69

SUMMARY OF BORING AND WELL CONSTRUCTION DATA
THE WILLIAM L BONNELL COMPANY - NEWNAN, GEORGIA
LAW ENVIRONMENTAL JOB NO. 55-0649

BORING NUMBER	DATE COMPLETED	DRILLING METHOD	BIT OR AUGER DIAMETER (INCHES)	WELL TYPE	BORING DEPTH (FEET)	APPROX. DEPTH OF SCREENED INTERVAL (FEET)	DEPTH TO TOP OF SAND PACK (FEET)	DEPTH TO TOP OF BENTONITE SEAL (FEET)	UNIT SCREENED*	TOP OF CASING ELEVATION (FEET,MSL)
21S	05/03/90	HOLLOW STEM AUGER	8.25	II	15.3	4.9-14.9	2.9	0.9	Water Table	871.73
21D	05/03/90	HOLLOW STEM AUGER	8.25	II	40.6	30.2-40.2	28.2	26.2	Top of rock	871.65
22S	05/04/90	HOLLOW STEM AUGER	8.25	II	24.6	14.1-24.1	12.1	10.1	Water Table	901.95
22D	05/04/90	HOLLOW STEM AUGER	8.25	II	43.8	38.3-43.3	36.3	34.3	Top of rock	902.46
23S	05/04/90	HOLLOW STEM AUGER	8.25	II	22.1	11.7-21.7	9.7	7.7	Water Table	912.47
23D	05/04/90	HOLLOW STEM AUGER	8.25	II	41.0	30.3-40.3	28.3	26.3	Top of rock	913.14
24S	NOT INSTALLED	—	—	—	—	—	—	—	—	—
24D	05/03/90	HOLLOW STEM AUGER	8.25	II	39.0	28.0-38.0	26.0	24.0	Water Table/TOR	925.73
25S	05/01/90	HOLLOW STEM AUGER	8.25	II	15.0	4.5-14.5	2.5	0.5	Water Table	920.72
25D	05/02/90	HOLLOW STEM AUGER	8.25	II	41.0	30.3-40.3	28.3	26.3	Top of rock	920.48
26S	05/21/90	HOLLOW STEM AUGER	8.25	II	21.9	11.5-21.5	9.5	7.5	Water Table	931.15
26D	05/22/90	HOLLOW STEM AUGER	8.25	II	46.0	35.1-45.1	33.1	31.0	Top of rock	931.40
27S	05/22/90	HOLLOW STEM AUGER	8.25	II	11.7	1.3-11.3	0.3	0.0	Water Table	911.82
27D	05/22/90	HOLLOW STEM AUGER	8.25	II	30.0	18.8-28.8	16.8	14.8	Top of rock	911.91
28S	05/23/90	HOLLOW STEM AUGER	8.25	II	12.7	2.3-12.3	0.3	0.0	Water Table	909.31
28D	05/24/90	HOLLOW STEM AUGER	8.25	II	29.0	18.4-28.4	16.4	14.4	Top of rock	909.51
29S	05/24/90	HOLLOW STEM AUGER	8.25	II	12.6	2.2-12.2	0.2	0.0	Water Table	904.70
29D	05/24/90	HOLLOW STEM AUGER	8.25	II	21.5	16.1-21.1	14.1	12.1	Top of rock	904.86
30D	NOT INSTALLED	—	—	—	—	—	—	—	—	—
31D	7/10/90	HOLLOW STEM AUGER	8.0	II	37.0	27.0-37.0	25.0	22.5	Water Table/TOR	928.44
32D	7/10/90	HOLLOW STEM AUGER	8.0	II	45.0	35.0-45.0	33.1	30.2	Top of rock	922.14
32S	7/10/90	HOLLOW STEM AUGER	8.0	II	35.0	25.0-35.0	23.0	20.3	Water Table	922.31
33D	7/12/90	HOLLOW STEM AUGER	8.0	II	30.0	19.7-29.7	16.8	14.3	Water Table/TOR	939.59
34D	7/14/90	HOLLOW STEM AUGER	8.0	II	35.0	20.0-35.0	19.0	16.5	Top of rock	938.94
35D	7/16/90	HOLLOW STEM AUGER	8.0	II	24.0	14.0-24.0	11.5	9.5	Water Table/TOR	921.90
36S	08/07/90	HOLLOW STEM AUGER	8.0	II	25.0	5.0-25.0	13.0	10.5	Water Table	940.80
36D	08/07/90	HOLLOW STEM AUGER	8.0	II	40.4	35.0-40.0	33.0	30.5	Top of rock	940.84
37S	08/08/90	HOLLOW STEM AUGER	8.0	II	18.0	8.0-18.0	6.0	3.0	Water Table	932.24
37D	08/08/90	HOLLOW STEM AUGER	8.0	II	63.0	53.0-63.0	51.0	48.0	Top of rock	932.04
38S	08/09/90	HOLLOW STEM AUGER	8.0	II	20.5	23.0-33.0	20.5	18.0	Water Table	962.24
38D	08/09/90	HOLLOW STEM AUGER	8.0	II	52.0	41.0-51.0	41.0	39.0	Top of rock	962.29
39D	08/13/90	HOLLOW STEM AUGER	8.0	II	35.2	25.0-35.0	23.0	20.0	Top of rock	927.56
40D	08/17/90	HOLLOW STEM AUGER	7.0	II	26.0	16.0-26.0	14.2	11.0	Top of rock	937.86
41D	08/17/90	HOLLOW STEM AUGER	7.0	II	28.0	18.0-28.0	16.0	13.0	Top of rock	937.79

SUMMARY OF BORING AND WELL CONSTRUCTION DATA
THE WILLIAM L BONNELL COMPANY - NEWNAN, GEORGIA
LAW ENVIRONMENTAL JOB NO. 55-0649

BORING NUMBER	DATE COMPLETED	DRILLING METHOD	BIT OR AUGER DIAMETER (INCHES)	WELL TYPE	BORING DEPTH (FEET)	APPROX. DEPTH OF SCREENED INTERVAL (FEET)	DEPTH TO TOP OF SAND PACK (FEET)	DEPTH TO TOP OF BENTONITE SEAL (FEET)	UNIT SCREENED*	TOP OF CASING ELEVATION (FEET, MSL)
OS-1D	07/09/90	HOLLOW STEM AUGER	8.0	II	30.0	20.0-30.0	17.5	15.3	Top of rock	868.49
OS-1S	07/09/90	HOLLOW STEM AUGER	8.0	II	15.0	5.0-15.0	4.0	2.0	Water Table	868.45
OS-2D	07/11/90	HOLLOW STEM AUGER	8.0	II	28.5	18.7-28.7	16.7	14.7	Top of rock	884.34
OS-2S	07/11/90	HOLLOW STEM AUGER	8.0	II	16.0	6.0-16.0	5.0	3.0	Water Table	884.85
OS-3D	07/12/90	HOLLOW STEM AUGER	8.0	II	44.8	35.8-44.8	32.7	14.3	Top of rock	865.54
OS-3S	07/12/90	HOLLOW STEM AUGER	8.0	II	15.0	5.0-15.0	4.0	2.2	Water Table	865.39
OS-4D	07/12/90	HOLLOW STEM AUGER	8.0	II	45.0	35.0-45.0	33.0	30.5	Top of rock	878.79
OS-4S	07/12/90	HOLLOW STEM AUGER	8.0	II	16.0	6.0-16.0	4.5	2.2	Water Table	878.36
OS-5D	07/19/90	HOLLOW STEM AUGER	8.0	II	70.0	60.0-70.0	57.5	55.0	Top of rock	876.82
OS-5S	07/17/90	HOLLOW STEM AUGER	8.0	II	35.0	19.0-29.0	17.0	14.5	Water Table	879.32

NOTES:

Water Table = Screen interval generally spans the surface of the fluctuating water table.
Top of rock = Bottom of screen interval generally located at auger refusal depth (top of rock).
TOR = Top of Rock

* Well 2S and 2D were destroyed during interim closure of the sand drying beds near the settling pond.

APPENDIX J

Financial Assurance for Closure/ Post-Closure and Liability Coverage

Coopers
&Lybrand

certified public accountants

Suite 1000
Seventh and Franklin Building
Richmond, Virginia 23219-2512

telephone (804) 643-0234

in principal areas of the world

October 23, 1990

Tredegar Industries, Inc.
1100 Boulders Parkway
Richmond, VA 23225

Dear Sirs:

We have audited the consolidated financial statements of Tredegar Industries, Inc. and Subsidiaries (the "Company") as of December 31, 1989 and for the year then ended and have issued our report thereon dated January 31, 1990. These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with generally accepted auditing standards. These standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

Subsequent to our audit, which was made for the purpose of enabling us to express an opinion on the aforementioned financial statements, we reviewed the letter submitted by Mr. Norman A. Scher, Executive Vice President of Tredegar Industries, Inc., to the Director, Environmental Protection Division, Georgia Department of Natural Resources, whose administering functions are similar to those required by regulation 40 CFR Parts 264 and 265, and compared the data specified as having been derived from the aforementioned financial statements for the year ended December 31, 1989 to these financial statements. In connection with this procedure, we obtained no knowledge of any matter that would require that the specified data be adjusted.

This letter is solely for the information of, and assistance to, state regulatory agencies in conducting their investigation of the affairs of the Company in connection with regulations similar to 40 CFR Parts 264 and 265 and is not to be used, circulated, quoted, or otherwise referred to, for any other purposes.

Very truly yours,

Coopers & Lybrand

Tredegar
INDUSTRIES

October 22, 1990

Lonice C. Barrett, Director
Environmental Protection Division
Department of Natural Resources
205 Butler Street, S.E.
Atlanta, Georgia 30334

LETTER FROM CHIEF FINANCIAL OFFICER

Dear Sir:

I am the chief financial officer of Tredegar Industries, Inc. ("Tredegar"), 1100 Boulders Parkway, Richmond, Virginia 23225. This letter is in support of the use of the financial test to demonstrate financial responsibility for liability coverage and closure and post-closure care as specified in paragraph 391-3-11-.05 of the Rules of the Department of Natural Resources, Environmental Protection Division.

The firm identified above is the owner or operator of the following facilities for which liability coverage for both sudden and nonsudden accidental occurrences is being demonstrated through the financial test specified in paragraph 391-3-11-.05, and/or Subpart H of 40 CFR Parts 264 and 265: NONE.

The firm identified above guarantees, through the corporate guarantee specified in paragraph 391-3-11-.05 and/or Subpart H of 40 CFR Parts 264 and 265, liability coverage for both sudden and nonsudden accidental occurrences at the following facilities owned or operated by the following subsidiaries of the firm: The William L Bonnell Company, Inc., Newnan, Georgia (GAD 003273224).

1. The firm identified above (Tredegar) owns or operates the following facilities which are located in the State of Georgia and for which financial assurance for closure and/or post-closure care is demonstrated through the financial test specified in paragraph 391-3-11-.05. The current closure and/or post-closure cost estimate covered by the test are shown for each facility: NONE.

1100 Boulders Parkway • Richmond, Virginia 23225

2. The firm identified above guarantees, through the corporate guarantee specified in paragraph 391-3-11-.05, the closure and/or post-closure care of the following facilities which are located in the State of Georgia and which are owned or operated by its subsidiaries. The current cost estimates for the closure and post-closure care so guaranteed are shown for each facility:

	Closure/Post-Closure Cost Estimate
The William L Bonnell Company, Inc. Newnan, Georgia GAD 003273224	$2.3 million

3. In States outside of Georgia, where EPA or some designated authority is administering financial responsibility requirements, this firm is demonstrating financial assurance for the closure and/or post-closure care of the following facilities through the financial test or corporate guarantee specified in Subpart H of 40 CFR Parts 264 and 265 or through a test which is equivalent or substantially equivalent to it. The current closure and/or post-closure cost estimates covered by such a test or guarantee are shown for each facility: <u>NONE</u>.

4. The firm identified above owns or operates the following hazardous waste management facilities for which financial assurance for closure and, if a disposal facility, post-closure care, is <u>not</u> demonstrated either to EPA or a State through the financial test or any other financial assurance mechanism specified in Subpart H of 40 CFR Parts 264 and 265 or equivalent or substantially equivalent State mechanisms. The current closure and/or post-closure cost estimates not covered by such financial assurance are shown for each facility: <u>NONE</u>.

5. This firm (Tredegar) is the owner or operator of the following UIC facilities for which financial assurance for plugging and abandonment is required under 40 CFR Part 144. The current closure cost estimates as required by 40 CFR 144.62 are shown for each facility: <u>NONE</u>.

The total of the current cost estimates for closure and/or post-closure care, listed in the five numbered paragraphs above, is $2.3 million. To the best of my knowledge, this figure is sufficient to execute the closure plans and to perform post-closure care responsibilities for all the facilities listed in paragraphs 1. through 5. above.

This firm is required to file a Form 10K with the Securities and Exchange Commission (SEC) for the latest fiscal year.

The fiscal year of this firm ends on December 31. The figures for the following items marked with an asterisk are derived from this firm's independently audited, consolidated, year-end financial statements for the latest completed fiscal year, ended December 31, 1989.

Closure/Post-Closure Care and Liability Coverage ($ in Millions)

Alternative I

1.	Sum of current closure and post-closure cost estimates (total of all cost estimates shown in the five numbered paragraphs above).	$ 2.3	
2.	Amount of annual aggregate liability coverage to be demonstrated.	$ 8.0	
3.	Sum of lines 1 and 2.	$ 10.3	
*4.	Total liabilities (if any portion of your closure or post-closure cost estimates is included in your total liabilities, you may deduct that portion from this line and add that amount to lines 5 and 6).	$ 182.8	
*5.	Tangible net worth.	$ 154.0	
*6.	Net worth............	$ 185.1	
*7.	Current assets........	$ 127.1	
*8.	Current liabilities.	$ 49.3	
9.	Net working capital (line 7 minus line 8).	$ 77.8	
*10.	The sum of net income plus depreciation, depletion, and amortization.	$ 45.7	
*11.	Total assets in U.S. (required only if less than 90% of assets are located in the U.S.).	$ N/A	
		Yes	No
12.	Is line 5 at least $10 million?	X	

13.	Is lines 5 at least 6 times line 3?	X	
14.	Is line 9 at least 6 times line 3?	X	
15.	Are at least 90% of assets located in the U.S.? If not, complete line 16.—	X	
16.	Is line 11 at least 6 times line 3?	N/A	
17.	Is line 4 divided by line 6 less than 2.0?	X	
18.	Is line 10 divided by line 4 greater than 0.1?	X	
19.	Is line 7 divided by line 8 greater than 1.5?	X	

I hereby certify that the wording of this letter is substantially the same as the wording specified in paragraph 391-3-11-.05 of the Rules of the Georgia Department of Natural Resources, Environmental Protection Division.

Tredegar Industries, Inc.

By: N A Scher

Norman A. Scher
Its: Chief Financial Officer

Date: 10/22/90

Tredegar
INDUSTRIES

CORPORATE GUARANTEE FOR CLOSURE AND POST-CLOSURE CARE

Guarantee made this October 22, 1990 by Tredegar Industries, Inc. ("Tredegar"), a business corporation organized under the laws of the State of Virginia, herein referred to as guarantor, to the Georgia Department of Natural Resources, Environmental Protection Division ("EPD"), obligee, on behalf of our subsidiary, The William L Bonnell Company, Inc. ("Bonnell"), of 25 Bonnell Street, Newnan, Georgia 30263, herein referred to as principal.

RECITALS

1. Guarantor meets or exceeds the financial test criteria and agrees to comply with the reporting requirements for guarantors as specified in paragraph 391-3-11-.05 of the Rules of the Department of Natural Resources, Environmental Protection Division.

2. Bonnell owns or operates the following hazardous waste management facility covered by this guarantee:

Aluminum Extrusion Plant
Wastewater Treatment Facilities
25 Bonnell Street
Newnan, Georgia 30263
EPA ID#: GAD 003273224

Guarantee is for closure and post-closure care for selected hazardous waste treatment, storage or disposal units at the plant.

3. "Closure plans" and "post-closure plans" as used below refer to the plans maintained as required by paragraph 391-3-11-.05 for the closure and post-closure care of facilities as identified above.

4. For value received from Bonnell, guarantor guarantees to EPD that in the event that Bonnell fails to perform closure and post-closure care of the above facility in accordance with the closure or post-closure plans and other permit or interim status requirements whenever required to do so, the guarantor shall do so or establish a trust fund as specified in paragraph 391-3-11-.05 in the name of Bonnell in the amount of the current closure and/or post-closure cost estimates as specified in paragraph 391-3-11-.05.

5. Guarantor agrees that if, at the end of any fiscal year before termination of this guarantee, the guarantor fails to meet the financial test criteria, guarantor shall send within 90 days, by certified mail, notice to the EPD Director and to Bonnell that he intends to provide alternate financial assurance as specified in paragraph 391-3-11-.05 in the name of Bonnell. Within 120 days after the end of such fiscal year, the guarantor shall establish such financial assurance unless Bonnell has done so.

6. The guarantor agrees to notify the EPD Director by certified mail, of a voluntary or involuntary proceeding under Title 11 (Bankruptcy), U.S. Code, naming guarantor as debtor, within 10 days after commencement of the proceeding.

7. Guarantor agrees that within 30 days after being notified by the EPD Director of a determination that guarantor no longer meets the financial test criteria or that he is disallowed from continuing as a guarantor of closure and/or post-closure care, he shall establish alternate financial assurance as specified in paragraph 391-3-11-.05 in the name of Bonnell unless Bonnell has done so.

8. Guarantor agrees to remain bound under this guarantee notwithstanding any or all of the following: amendment or modification of the closure or post-closure plan, amendment or modification of the permit, the extension or reduction of the time of performance of closure or post-closure, or any other modification or alteration of an obligation of the owner or operator pursuant to paragraph 391-3-11-.05.

9. Guarantor agrees to remain bound under this guarantee for so long as Bonnell must comply with the applicable financial assurance requirements of paragraph 391-3-11-.05 for the above-listed facilities, except that guarantor may cancel this guarantee by sending notice by certified mail to the EPD Director and to Bonnell, such cancellation to become effective no earlier than 120 days after receipt of such notice by both EPD and Bonnell, as evidenced by the return receipts.

10. Guarantor agrees that if Bonnell fails to provide alternative financial assurance as specified in paragraph 391-3-11-.05 and obtain written approval of such assurance from the EPD Director within 90 days after a notice of cancellation by the guarantor is received by the EPD Director from guarantor, guarantor shall provide such alternate financial assurance in the name of Bonnell.

11. Guarantor expressly waives notice of acceptance of this guarantee by the EPD or by Bonnell. Guarantor also expressly waives notice of amendments or modifications of the closure

and/or post-closure plan and of amendments or modifications of the facility permit.

12. Any notice or other communication required by this guarantee shall be deemed sufficient if sent by certified U.S. Mail to the appropriate party at the following address:

Guarantor: Tredegar Industries, Inc.

Address:
1100 Boulders Parkway
Richmond, Virgínia 23225
ATTN: Norman A. Scher
Chief Financial Officer

Owner or Operator: The William L Bonnell Company, Inc.

Address:
25 Bonnell Street
Newnan, Georgia 30263
ATTN: Leo F. Harlan

EPD Director:
Lonice C. Barrett, Director
Environmental Protection Division
Department of Natural Resources
205 Butler Street, S.E.
Atlanta, Georgia 30334

It shall be the responsibility of each party to notify the other parties in writing of any changes to its address stated above.

I hereby certify that the wording of this guarantee is substantially the same as the wording specified in paragraph 391-3-11-.05 of the Rules of the Georgia Department of Natural Resources, Environmental Protection Division.

Effective date: 10/22/90

Tredegar Industries, Inc.

By: N A Scher

Norman A. Scher
Its: Chief Financial Officer

Signature of witness
or notary:

Tredegar
INDUSTRIES

GUARANTEE FOR LIABILITY COVERAGE

Guarantee made this October 22, 1990 by Tredegar Industries, Inc. ("Tredegar"), a business corporation organized under the laws of the State of Virginia, herein referred to as guarantor, on behalf of our subsidiary, The William L Bonnell Company, Inc. ("Bonnell"), of 25 Bonnell Street, Newnan, Georgia 30263, to any and all third parties who have sustained or may sustain bodily injury or property damage caused by sudden and/or nonsudden accidental occurrences arising from operation of the facility covered by this guarantee.

RECITALS

1. Guarantor meets or exceeds the financial test criteria and agrees to comply with the reporting requirements for guarantors as specified in paragraph 391-3-11-.05 of the Rules of the Department of Natural Resources, Environmental Protection Division, and/or specified in 40 CFR 264.147(g) and 265.147(g).

2. Bonnell owns or operates the following hazardous waste management facility covered by this guarantee:

Aluminum Extrusion Plant
Wastewater Treatment Facilities
25 Bonnell Street
Newnan, Georgia 30263
EPA ID# GAD 003273224

This corporate guarantee satisfies RCRA and Georgia Hazardous Waste Management Act third-party liability requirements for both sudden and nonsudden accidental occurrences in above-named owner or operator facilities for coverage in the amount of $4 million for each occurrence and $8 million annual aggregate.

3. For value received from Bonnell, guarantor guarantees to any and all third parties who have sustained or may sustain bodily injury or property damage caused by sudden and/or nonsudden accidental occurrences arising from operations of the facility covered by this guarantee that in the event that Bonnell fails to satisfy a judgment or award based on a determination of liability for bodily injury or property damage to third parties caused by sudden and/or nonsudden accidental occurrences, arising from the operation of the above-named facilities, or fails to pay an amount agreed to in settlement of a claim arising from or alleged to arise from such injury or damage, the guarantor will satisfy such judgment(s), award(s) or settlement agreement(s) up to the limits of coverage identified above.

4. Such obligation does not apply to any of the following:

(a) Bodily injury or property damage for which Bonnell is obligated to pay damages by reason of the assumption of liability in a contract or agreement. This exclusion does not apply to liability for damages that Bonnell would be obligated to pay in the absence of the contract or agreement.

(b) Any obligation of Bonnell under a workers' compensation, disability benefits, or unemployment compensation law or any similar law.

(c) Bodily injury to:

(1) An employee of Bonnell arising from, and in the course of, employment by Bonnell; or

(2) The spouse, child, parent, brother or sister of that employee as a consequence of, or arising from, and in the course of employment by Bonnell.

This exclusion applies:

(A) Whether Bonnell may be liable as an employer or in any other capacity; and

(B) To any obligation to share damages with or repay another person who must pay damages because of the injury to persons identified in paragraphs (1) and (2).

(d) Bodily injury or property damage arising out of the ownership, maintenance, use, or entrustment to others of any aircraft, motor vehicle or watercraft.

(e) Property damage to:

(1) Any property owned, rented, or occupied by Bonnell;

(2) Premises that are sold, given away or abandoned by Bonnell if the property damage arises out of any part of those premises;

(3) Property loaned to Bonnell;

(4) Personal property in the care, custody or control of Bonnell;

(5) That particular part of real property on which Bonnell or any contractors or subcontractors

working directly or indirectly on behalf of Bonnell are performing operations, if the property damage arises out of these operations.

5. Guarantor agrees that if, at the end of any fiscal year before termination of this guarantee, the guarantor fails to meet the financial test criteria, guarantor shall send within 90 days, by certified mail, notice to the EPD Director and to Bonnell that he intends to provide alternate liability coverage as specified in paragraph 391-3-11-.05 in the name of Bonnell. Within 120 days after the end of such fiscal year, the guarantor shall establish such liability coverage unless Bonnell has done so.

6. The guarantor agrees to notify the EPD Director, by certified mail of a voluntary or involuntary proceeding under Title 11 (Bankruptcy), U.S. Code, naming guarantor as debtor, within 10 days after commencement of the proceeding.

7. Guarantor agrees that within 30 days after being notified by the EPD Director of a determination that guarantor no longer meets the financial test criteria or that he is disallowed from continuing as a guarantor, he shall establish alternate liability coverage as specified in paragraph 391-3-11-.05 in the name of Bonnell, unless Bonnell has done so.

8. Guarantor reserves the right to modify this agreement to take into account amendment or modification of the liability requirements set by paragraph 391-3-11-.05, provided that such modification shall become effective only if the EPD Director does not disapprove the modification within 30 days of receipt of notification of the modification.

9. Guarantor agrees to remain bound under this guarantee for so long as Bonnell must comply with the applicable requirements of paragraph 391-3-11-.05 for the above-listed facility, except as provided in paragraph 9 of this agreement.

10. Guarantor may terminate this guarantee by sending notice by certified mail to the EPD Director and to Bonnell, provided that this guarantee may not be terminated unless and until Bonnell obtains, and the EPD Director approves, alternate liability coverage complying with paragraph 391-3-11-.05.

11. This guarantee is to be interpreted and enforced in accordance with the laws of Virginia.

12. Guarantor hereby expressly waives notice of acceptance of this guarantee by any party.

Georgia Department of Natural Resources
205 Butler Street, S.E., Suite 1252, Atlanta, Georgia 30334
Joe D. Tanner, Commissioner
Harold F. Reheis, Director
Environmental Protection Division

MAY 2 6 1992

May 22, 1992

Mr. Loren McCune
Sr. Technical Associate
William L Bonnell Company, Inc.
25 Bonnell Street
Post Office Box 428
Newnan, Georgia 30264

Re: Closure Certification

Dear Mr. McCune:

The Georgia Environmental Protection Division (EPD) has received and reviewed the Certification of Closure for the CrOH sand drying beds. The document meets the requirements of 40 CFR 265.115. As the certification is acceptable, the regulatory status of the unit has been changed to reflect closure. Pursuant to the requirements of 40 CFR 265.143(h), you are hereby notified that financial assurance for closure is not required for the CrOH sand drying beds.

If you have any questions regarding this matter, please contact Ms. Susan Eason at 404/656-7802.

Sincerely,

Bill Mundy

Bill Mundy
Program Manger
Hazardous Waste Management Branch

File: Bonnell

Tredegar
ALUMINUM EXTRUSIONS

Subsidiaries,

The William L Bonnell Co., Inc.
Capitol Products Corporation

March 23, 1992

Mr. Bill Mundy, Unit Coordinator
Georgia Department of Natural Resources
Environmental Protection Division
Floyd Towers East, Suite 1154
205 Butler Street
Atlanta, Georgia 30334

Subject: Closure of the CrOH Sand Drying Beds

Dear Mr. Mundy:

Enclosed are three copies of the Closure Certification for Chromium Hydroxide Sand Drying Beds, Newnan, Georgia Facility. The certification was prepared by Terry Snell and Associates of Stone Mountain, Georgia.

As stated in my letter of March 19, 1992, physical closure of the CrOH sand drying beds was completed on March 9, 1992. The only outstanding requirement is a survey plat which should be delivered within two weeks. This will be forwarded to you upon receipt.

Please call if you have any questions.

Sincerely,

Loren McCune

Loren McCune
Sr. Technical Associate

EPDLOG 85

CERTIFICATION OF CLOSURE

BACKGROUND

The WILLIAM L BONNELL COMPANY, INC., (Bonnell) operates an aluminum extrusion facility in Newnan, Georgia. Prior to November 1989, chromium hydroxide sludge (F019) produced in the Chemical Conversion Coating of Aluminum wastewater treatment system was dewatered in the chromium hydroxide sand drying beds (CrOH sand drying beds). In November 1989, a filter press was installed to handle the CCC clarifier sludge (F019), and use of the CrOH sand drying beds was discontinued.

In March and April, 1990, the CrOH sand drying beds and associated drainage piping were removed. The F019 sludge and chromium contaminated soils in and around the CrOH sand drying beds were excavated and transported to the Chemical Waste Management disposal facility in Emelle, Alabama. Gravel was placed into the excavation to a point above the groundwater. A perforated corrugated metal stand pipe was also installed to allow for possible future groundwater recovery. The area was then backfilled with on-site soil. A summary of those clean-up activities is presented in an appendix to the approved closure plan.

In July 1991, Bonnell submitted to EPD a revised Closure and Post-closure Plan for the CrOH sand drying beds. EPD approved the Closure and Post-Closure Plan on September 30, 1991. Closure activities began on October 15, 1991. Closure of the CrOH sand drying bed was completed on March 9, 1992.

HEALTH AND SAFETY

A site health and safety plan was developed. Site workers reviewed the health and safety plan and signed that they had read it. A copy of the health and safety plan is included as Appendix A.

Air quality monitoring was performed for chromium during early construction activities. The results were below the detection limit. A copy of the results are included as Appendix B.

CONSTRUCTION ACTIVITIES

Field notes were kept during construction activities. A copy of the field notes are included as Appendix C.

The Contractor began construction activities by installing the decontamination station on January 25, 1992. The location of the decontamination station is shown in Exhibit 1. The contamination reduction and exclusion zones were established on January 26.

On January 26, the Contractor cut the corrugated metal standpipe, triple rinsed it on the decontamination pad, visually assured decontamination was successful, and removed it from the site. Next, the Contractor removed the corrugated metal effluent pipe and associated manholes that once served the anodizing wastewater treatment facility. The pipe and manholes were placed into rolloff containers and disposed as hazardous wastes.

The Contractor then placed the six-inch subgrade. The subgrade materials were soil classification. A copy of the geotechnical certification is included as Appendix D. The subgrade was placed in six-inch lifts and compacted. The compaction test results are included in Appendix E. A cover drainage collection system was constructed on the north, east, and south sides of the unit. An anchor trench was constructed on the west side of the unit.

The HDPE was placed over the subgrade. HDPE material certifications are included in Appendix F. Next, a layer of drainage net with geofabric on the bottom side was placed over the HDPE. Six-inch PVC pipe was placed in the drainage collection system ditch on top of the drainage net. The PVC pipe was pre-drilled to allow water to enter it. Crushed stone was placed on top of the PVC pipe. The second layer of geofabric was placed over the drainage net and extended over the crushed stone.

Topsoil was placed over the top layer of geofabric. The first eighteen inches were placed in six-inch lifts and compacted. The compaction test results are included in Appendix E. The final lift of topsoil was not compacted. Finish grading was performed to achieve a final grade of 6.7 percent. A run-on prevention drainage swale was constructed on the north side of the unit. Seed, fertilizer, and straw were placed on the topsoil.

The decontamination station was triple rinsed and inspected, and the decontamination waters were pumped into the chemical conversation coating of aluminum wastewater treatment system for treatment and discharge through the NPDES outfall. The tank was triple rinsed and inspected, and the rinse waters were pumped into the chemical conversation coating of aluminum wastewater treatment system for treatment and discharge through the NPDES outfall.

The six-inch PVC drainage pipe in the cover drainage collection system was connected to the storm sewer to complete construction. Final inspection was performed on March 9, 1992. As-built drawings are included in Appendix G. The approved Closure and Post-closure Care Plan are included in Appendix H.

DEVIATIONS FROM CLOSURE PLAN

There were four minor deviations from the Closure Plan. The changes were as follows:

First, the drainage systems that collects water from the drainage net was expanded to the north side of the unit. This addition improves collection of rain waters draining though the topsoil. EPD was not notified of this change because it was an improvement in the cap.

Second, a drainage swale was constructed on the north side of the unit. However, the drainage ditch shown in the Closure Plan on the north side of the unit running westward from the unit was not constructed because the AlOH wastewater treatment system was constructed over that area. Drainage features of the AlOH wastewater treatment construction prevent run-on from the west toward the unit. Therefore, the drainage ditch shown in the closure plan could not be constructed and was not necessary. EPD was aware of the construction of the AlOH wastewater treatment system. Since run-on protection was achieved, the system as constructed is equivalent to the approved Closure Plan.

Third, the slope of the cover was reduced from eight percent to 6.7 percent due to the final grading achieved. Although soil erosion losses were calculated to be minimal, this flattening of the slope reduces the possibility of soil erosion. EPD was not notified of the change since it was an improvement in the cap system, and it occurred as a result of final grading.

Fourth, Unified Classification System soils CH were used as the subgrade instead of CL soils. CL soils were not available, and the CH soil properties meet or exceed the properties of CL soils. A letter to that effect is included in Appendix D. EPD was not notified of this change since the soils were equivalent and, therefore, the constructed cap is equivalent to the approved Closure Plan.

QA/QC DOCUMENTATION

Appendix D contains the soil classification certifications.
Appendix E contains the soil compaction test certifications.
Appendix F contains the HDPE materials test certifications.

AREAS OF RESPONSIBILITY

The areas of responsibility and lines of authority were defined and explained to all parties involved, except ATEC Associates, in a meeting on January 16, 1992. ATEC Associates received written communication regarding their responsibility. Summarizing, the areas of responsibility were as follows:

The William L. Bonnell Co., Inc.: Owner

Terry Snell & Associates: Closure Design, Closure Certification

ATEC Associates: Compaction Testing, Soil Classification Certification

Payton & Sons Construction Co., Inc.: Contractor

OWNER CERTIFICATION

I, Douglas R. Monk, of The WILLIAM L. BONNELL COMPANY, INC., hereby state and certify that, to the best of my knowledge and belief, the Chromium Hydroxide Sand Drying Beds located at The WILLIAM L. BONNELL COMPANY, INC., 25 Bonnell Street, Newnan, Georgia, 30263, has been closed in accordance with the attached approved closure plan, and that the closure was completed on the 9th day of March, 1992.

3/20/92

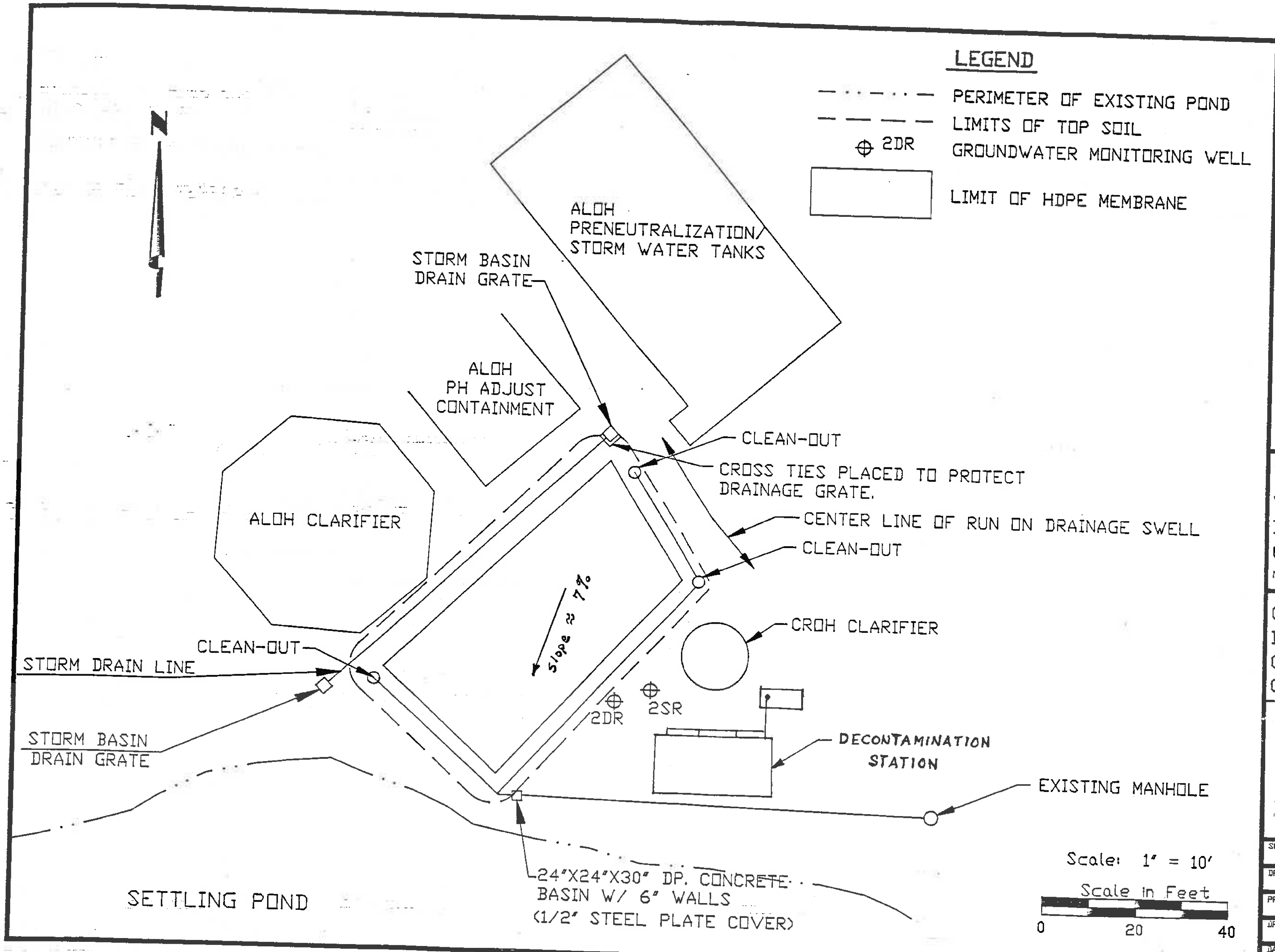
ENGINEER CERTIFICATION

I, Terry D. Snell, a registered professional engineer, hereby certify that I have made visual inspections of the Chromium Hydroxide Sand Drying Beds located at The WILLIAM L. BONNELL COMPANY, INC., 25 Bonnell Street, Newnan, Georgia, 30263; and, to the best of my knowledge and belief, closure of the facility has been performed in accordance with the attached approved closure plan; and that the closure was completed on the 9th day of March, 1992.

Terry D Snell 3/20/92

Georgia Professional Engineer License No. 012711

Terry Snell & Associates
1111 Valerie Woods Drive
Stone Mountain, GA 30083
404/294-8335



TERRY SNELL
& ASSOC.
STONE MOUNTAIN, GEORGIA

FOR:

WILLIAM L
BONNELL
COMPANY
NEWNAN, GEORGIA

CROH SAND
DRYING BEDS
CLOSURE
CERTIFICATION

EXHIBIT 1
LOCATION OF
DECONTAMINATION
STATION

SCALE: 1" = 10'
DRAWING NO.: EXHIBIT 1
PROJECT NO.: 92SDBCLOCERT
DRAWN BY: TDS
CHECK BY: TDS
DATE: 3/19/92
DATE LAST REVISED:

APPENDIX A

SITE HEALTH AND SAFETY PLAN

SITE HEALTH AND SAFETY PLAN
FOR THE CLOSURE OF THE CrOH SANDBEDS

THE WILLIAM L. BONNELL COMPANY
NEWNAN, GA

SITE HEALTH AND SAFETY PLAN
FOR THE CLOSURE OF THE CrOH SANDBEDS

TABLE OF CONTENTS

ARTICLE PAGE

I. SITE DESCRIPTION....1

II. PROJECT OBJECTIVES....1

III. SITE/WASTE CHARACTERISTICS....2

IV. HAZARD EVALUATION....3

V. PROJECT ORGANIZATION AND PERSONNEL....3

VI. SITE ENTRY AND CONTROL PROCEDURES....5

VII. SAFETY PLAN....7

VIII. DECONTAMINATION....12

EXHIBITS

EXHIBIT A - PROJECT LOCATION MAP

EXHIBIT B - TRAINING CERTIFICATES

EXHIBIT C - ZONE MAP

EXHIBIT D - EMERGENCY CONTACTS AND TELEPHONE NUMBERS & EMERGENCY ROUTE MAP

EXHIBIT E - CHROMIUM CONCENTRATIONS AFTER EXCAVATION

EXHIBIT F - RESPIRATOR FIT PROCEDURE

EXHIBIT G - RESPIRATOR FIT TEST CERTIFICATIONS

SITE SAFETY AND HEALTH PLAN

Project Title: CrOH Sandbed Closure   Project No.: A-013

Site Name: William L. Bonnell Company   Date: January 2, 1991
Newnan, Georgia   EPA I.D. No. GAD003273224

Prepared By: T.B. Schexnayder

Approved By: Terry D. Snell

I. SITE DESCRIPTION AND EVALUATION

Site Location: 25 Bonnell Street, Newnan, GA

County: Coweta

Surrounding Population: 16,000

Plant Site Topography: Slightly Rolling

Size of Closure Site: Approximately 4000 sf

Proposed Start Of Closure Activities: January 13, 1991

A location map is presented as Exhibit A.

II. PROJECT OBJECTIVES

The project objective is to preform the work necessary to close the site of a Chromium Hydroxide (CrOH) Sand Drying Bed as described in Bonnell's <u>Closure and Post-Closure Plan for the Chromium Hydroxide Sludge Drying Bed</u>, Revised August, 1991. In general, the work shall consist of the following items:

1. Excavation, removal and disposal of the existing anodizing piping and catch basins, and a 4-6 foot section of 42 inch CMP standpipe located in the CrOH sludge drying area.

2. Installation of an impermeable HDPE cap over the area.
3. Construction of run-on and runoff control ditches.
4. Removal and appropriate disposal of contaminated materials generated during the cleaning of the site.
5. Decontamination of the equipment utilized.

Project duration is expected to require 5-15 working days depending on weather.

III. SITE/WASTE CHARACTERISTICS

Material/Type:

Aqueous ___ Non-Aqueous ___ Sludge ___

Gas ___ Solid XXX

Material Characteristics:

Toxic ___ Corrosive ___ Ignitable ___

Volatile ___ Reactive ___

Other XXX - Potentially Toxic

Storage Methods: None Required

Site Features:

1. Site adjacent to .75 acre settling pond.
2. Site egress restricted by adjacent waste water equipment, settling pond and topography.

Site Status:

Active ___ Inactive XXX

Site History:

Site had been previously the location of sand drying beds used to dewater chromium hydroxide sludge. All sludge has been removed from the site. Approximately 1225 tons of contaminated soils were also removed and sent to an approved landfill in Emelle, AL. The site was then backfilled with clean soils.

IV. HAZARD EVALUATION

Compounds or substances identified or suspected to be on-site.

Primary Hazard(s)

Compound	Identified	Concentration	Other
Chromium (III)	Lab Analysis	0-150 mg/kg	Toxic by Ingestion

Hazardous Substances Information:

Forms for the known or suspected compounds/substances are attached.

Yes ___ No XXX If no explain: No known NIOSH information available specificly for Cr (III)

Additional Hazards:

Proximity to settling pond and waste water equipment.

V. PROJECT ORGANIZATION AND PERSONNEL

A. Project Organization

The listed personnel are assigned specific site responsibilities. Note that one individual may perform more than one responsibility.

On-Site Personnel

Name	Title	Responsibility
Joe Lewis	Project Team Leader (PTL)	Project Manager
Joe Lewis	Site Health and Safety Officer (SHSO)	SHSO
Rodney Payton		Equipment Operator
Rickie Veal		Worker
Bobbie Beasley		Worker

Support Personnel

Name	Title	Responsibility
O.C. Williams	Safety Supervisor	Provide additional safety supervision and coordinate air monitoring with PTL
T.B. Schexnayder	Civil Engineer	Off-Site Project Management
T.D. Snell	Consulting Engineer	Closure Certification
S.M. Cook	Medical Doctor	Medical Monitoring

B. Training

Bonnell and subcontractors personnel assigned to or regularly entering areas of the site, other than the Support Zone, for the purpose of performing or supervising work, for health, safety, security, or administrative purposes or any other site related function, have received the appropriate safety training in accordance with 29CFR1910.120. Only personnel having completed the required training shall be permitted to enter the contaminated area of the site. Copies of the on site teams training certificates are included in this plan as Exhibit B.

Prior to the initiation of field activities personnel scheduled to perform on-site activities shall attend a health and safety meeting where site specific considerations will be reviewed and to ensure that all personnel are capable of and familiar with use of safety, health, respiratory and protective equipment and with specific procedures required for this site.

Should an operational change which effects on-site activity be made, a meeting prior to implementation of the change shall be convened to explain the change. Daily safety and operations meetings will be held. Operational issues and procedures will be reviewed and addressed as warranted. All personnel will attend the daily meeting.

C. Personnel Medical Surveillance

Personnel engaged in any on-site activities shall have participation in a medical surveillance program in accordance with 29CFR1910.120 (f). All personnel shall have been provided with medical surveillance within one year prior to the project activity. Mr. O.C. Williams, Bonnell Safety Supervisor, will have responsibility for coordination of this program and records maintenance. Medical records shall be made available to the proper authorities upon request.

VI. SITE ENTRY AND CONTROL PROCEDURES

Specific areas of operation will be delineated to coordinate access control and site security. A safe perimeter will be established as per Exhibit C.

The Exclusion Zone is the area where contamination does or could occur. Work to be carried out in this area is described on page 2 of this plan as Section II. Project Objectives.

No unauthorized person will be permitted in this area. All persons arriving or departing the site will be required to log in and out with Project Team Leader or his designate. All activities must be coordinated with and cleared through the Project Team Leader.

A Contaminant Reduction Zone will be designated between the Exclusion and Support Zones and will provide for:

1. The transfer of equipment from the Support Zone to the Exclusion Zone;
2. Decontamination of vehicles, equipment and personnel prior to moving from the Exclusion to the Support Zone; and,
3. For physical separation of the Support and Exclusion Zones.

A Support Zone shall be designated in an area outside the zone of significant contamination. The Support Zone shall be clearly marked and shall be secured from active or passive contamination from the Exclusion Zone. The Support Zone shall be used for:

1. Ingress and egress for all site operations;
2. Location of support activities and facilities and;
3. Staging for required site operation and equipment.

Communications shall be maintained between safety and on-site personnel by visual or audio contact. Emergency numbers including police, fire, ambulance, hospital, poison control center, and state and federal agencies shall be prominently displayed at the Support Zone.

VII. SAFETY PLAN

A. Emergency Response and Contingency Procedures

In the event of any emergency associated with the project activities, the Project Team Leader (PTL) shall without delay take diligent action to remove or otherwise minimize the cause of the emergency and institute measures necessary to prevent recurrence of the conditions or actions leading to or resulting in the emergency. The PTL will promptly notify Bonnell's Plant Safety Supervisor.

Emergency medical services shall be identified and routes to the services verified prior to commencing any on-site activities . The name of this facility, name of the contact person, communications information, and emergency routes shall be posted at the site. All emergency contact names and telephone numbers shall be prominently posted at the site and are presented in Exhibit D.

All site support vehicles shall be equipped with route maps providing directions to off-site medical services. All drivers of site support vehicles shall become familiar with the emergency route and the required travel time. At least one vehicle shall be available for use for emergency transport from the site at all times.

B. Emergency Medical Care

Joe Lewis has been designated as the Site Health and Safety Officer (SHSO).

Hospital: Newnan Humana Hospital
Phone: 253-1912
Contact: Emergency Room
Address: 60 Hospital Road, Newnan, GA
Directions: Exit Bonnell Property on Bonnell St. turn left on Temple Ave. proceed approximately 1/2 mile and turn right onto Hospital Rd. then proceed 3/4 mile to Hospital on left.

Ambulance: Newnan Humana Hospital
Phone: 253-3221

Other Emergency Numbers

Police: 253-1221
Fire Department: 253-1122
Poison Control Center: 253-1912 1-800-282-5846
Bonnell Plant Security: Extension 240
Bonnell Safety Supervisor: Extension 668

C. Site Safety and Health Officer Responsibilities

The Responsibilities of the SHSO are summarized as follows:

1. Selects protective clothing and equipment
2. Periodically inspects protective clothing and equipment.
3. Ensures that protective clothing and equipment are properly stored and maintained.
4. Controls entry and exit at access control points.
5. Coordinates safety and health program with Plant Safety Supervisor and Industrial Hygienist.
6. Monitors the work parties for signs of stress, such as cold exposure, heat stress and fatigue.
7. Monitors on-site hazards and conditions.
8. Participates in the preparation of and implements the Site Safety Plan.
9. Conducts periodic inspections to determine if the site safety plan is being followed.
10. Enforces the Buddy System.
11. Knows emergency procedures, evacuation routes and telephone numbers for emergency services.
12. Coordinates emergency medical care.

D. Personnel Protection Equipment (PPE)

On-site personnel shall be provided with the appropriate personal safety equipment and protective clothing . All safety equipment and protective clothing shall be kept clean and well maintained. The SHSO shall establish upgrade/downgrade action levels From the specified minimum levels. At a minimum the following items shall be provided for each level of protection.

<u>Level D</u>

- Coveralls
- Safety boots or shoes
- Hard hat
- Safety glasses or face shield
- Gloves

Optional
- Neoprene over-boots
- Neoprene gloves

<u>Modified Level C</u>

- Tyvek coveralls
- Latex under gloves
- Neoprene outer gloves
- Hard hat
- Safety boots or shoes
- Neoprene over-boots
- Safety glasses or face shield
- Half face air purifying respirator

Combinations of levels of protection may be employed as directed by the SHSO. The SHSO must document the rationales for any variation in levels of protection.

All prescription eyeglasses in use on site will be safety glasses. Prescription lens inserts will be worn for full face respirators. Contact lenses are prohibited.

All on-site personnel must take a respirator fit test prior to entering the Exclusion or Contamination Reduction Zone. The Bonnel PLant Safety Supervisor shall administer each test. Any person unable to pass the test shall not enter the Exclusion or Contamination Reduction Zone.

Half face respirators shall be dual cartridge and filter air -purifing respirators, as manufactured by North Safety Equipment, Model 7700 Series and fitted with disposable cartridge, N-7500-8, designed for dust, fumes, mist and radionuclides.

All personnel shall wear disposable outerwear, gloves, neoprene over boots, safety glasses, half face respirator and a hard hat during excavation activities. All PPE worn on-site shall be decontaminated or properly disposed of at the end of the work day. The SHSO shall be responsible for ensuring all PPE is decontaminated before reissue.

Each respirator shall be assigned to an individual and not interchanged between workers without cleaning and sanitizing. Cartridges and canisters shall be changed weekly or upon breakthrough whichever occurs first. Documentation for assuring periodic cleaning, maintenance and changeout of cartridges shall be provided by the SHSO.

All protective clothing and over boots which have entered the Contamination Reduction and Exclusion Zone shall be decontaminated or properly disposed of at the completion of the work day.

E. Respirator and Personnel Monitoring

Contaminated soils from the Exclusion Zone were excavated and disposed of in June, 1990. The excavation was then backfilled with clean native soils. Samples tested after the excavation and prior to backfilling indicates that the concentration of total chromium to vary up to approximately 150 ppm. See Exhibit E for actual results.

The potential for exposure to air born contaminates is therefore minimal. During periods of excavation, backfilling there is potential for exposure to air born contaminates (dusting). During these activities Modified Level C PPE will be utilized and air monitoring for chromium contaminants will be conducted. The SHSO will ensure that Modified Level C is being worn by all on-site personnel.

Air monitoring shall be conducted during periods when dust is being generated. The SHSO will coordinate the air monitoring program with the Industrial Hygienist.

All monitoring equipment shall be calibrated as a minimum at the start of each day and end of each day in accordance with the manufactures specifications and directions. Additional calibration will be at the discretion of the SHSO. Date, time, procedure, results and the person preforming the calibration shall be documented in the site logbook.

At each break or cessation of work on-site personnel shall be closely monitored by the SHSO for signs of fatigue or other work related symptoms which may affect their safety, health or work ability. Each individual working on-site shall visually monitor other workers while on-site. Any indication of stress or other impairment shall be reported to the SHSO who will institute actions to remedy the condition as appropriate.

VIII. DECONTAMINATION

A. Personal Hygiene and Decontamination

Disposable outerwear shall not be reused, and when removed, shall be placed inside disposal containers provided for the purpose located in the Contamination Reduction Zone.

Eating, drinking, smoking and chewing shall be prohibited except in a designated break area in the Support Zone.

All outerwear shall be removed prior to entering the break area and prior to cleansing hands.

Personnel shall be required to thoroughly cleanse their hands and other exposed areas before entering the Support Zone.

All personnel working in the Exclusion Zone or Contamination Reduction Zone shall be required to decontaminate and change to fresh clothing after each working period or shift, prior to leaving the site. Decontamination procedures shall be set up in general accordance with the following Modified Level C decontamination program.

The decontamination procedure outlined is for workers wearing Modified Level C protection (with taped joints between gloves, boots, and suit).

B. Procedure for Decontamination

Station 1: Equipment Drop

Deposit equipment used on the site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Each will be contaminated to a different degree. Segregation at the drop rduces the probability of cross contamination.

Station 2: Outer Garment, Over-Boot and Glove Wash and Rinse

Scrub over-boot and outer gloves and splash outer suit with decon solution or detergent/water solution. Rinse off using copious amounts of water.

Station 3: Over-Boot and Glove Removal

Remove over-boot and gloves. Deposit in storage container.

Station 4: Canister or Mask Change

If worker leaves Exclusion Zone to change canister or mask, this is the last step in the decontamination procedure. Workers canister is exchanged, new outer gloves and decontaminated over boots donned, joints taped and worker returns to duty.

Station 5: Gloves and Outer Garment Removal

Splash suit and inner gloves removed and deposited in separate containers lined with plastic.

Station 6: Face Piece Removal

Face piece is removed. Avoid touching face with fingers. Facepiece is deposited on plastic sheet.

Station 7: Field Wash

Hands and face are thoroughly washed. Shower as soon as possible.

C. Equipment Decontamination

All equipment and vehicles used in the Exclusion Zone shall be thoroughly decontaminated in the Contamination Reduction Zone prior to removal from the site. Personnel performing equipment or vehicle decontamination shall be equipped with appropriate PPE and shall go through the personnel decontamination procedure before entering the Support Zone.

D. Review

All site personnel have read and reviewed the above Plan in detail and are familiar with all its provisions.

Name	Title	Signature	Date
Joe Lewis	PTL & SHSO	Joe Lewis	1/16/92
Rodney Payton	Equip. Operator	Rodney Payton	1/16/92
Bobby Beasley	Worker	Bobby Beasley	1/16/92
Ricky Veal	Worker	Ricky Veal	1/16/92

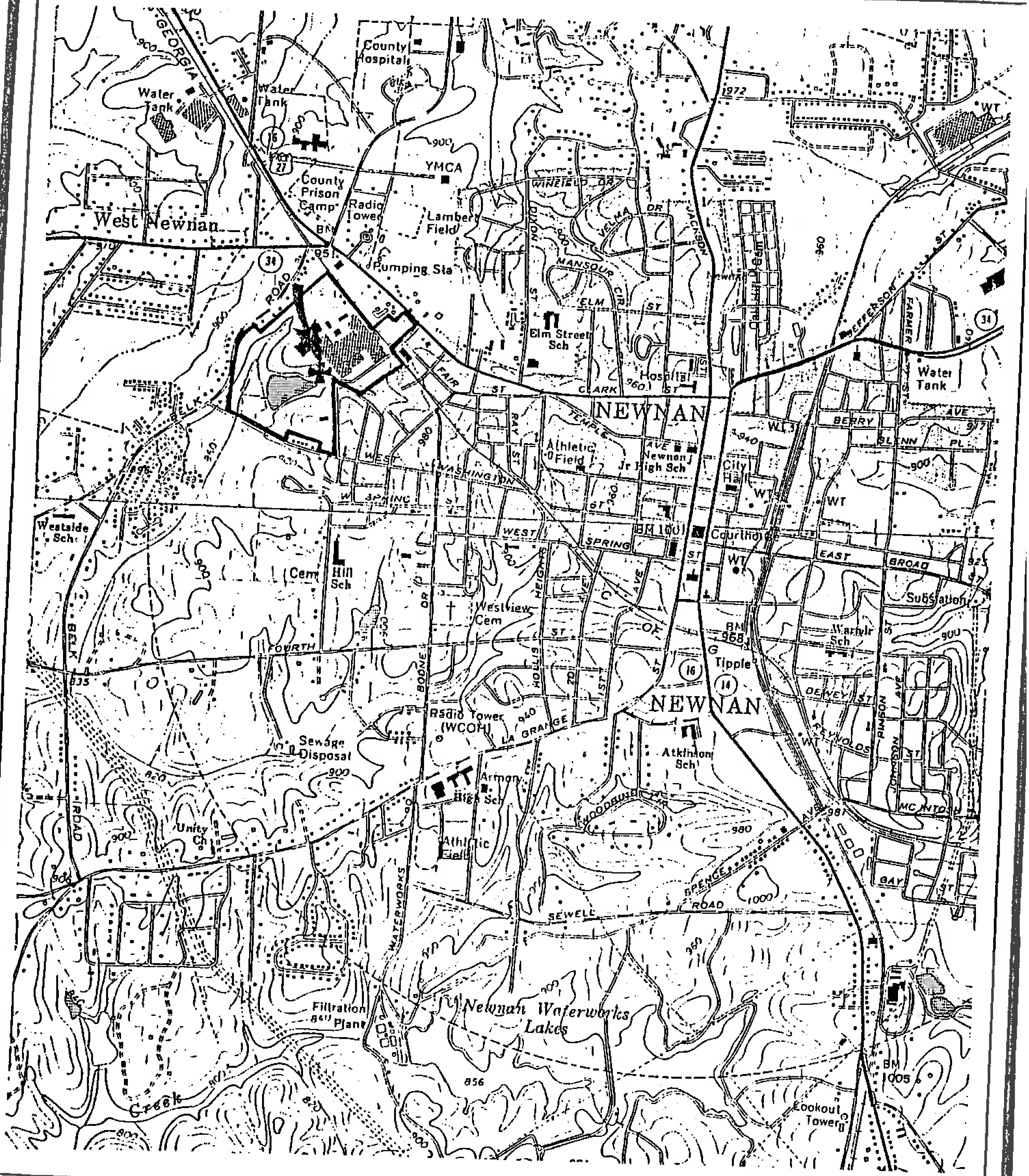


EXHIBIT A

PROJECT LOCATION MAP

EXHIBIT B

TRAINING CERTIFICATES

Special Environmental Services, Inc.

This Certifies that

Ricky Veal

has satisfactorily completed the course study covering

40-HOUR TRAINING FOR HAZARDOUS WASTE SITE HEALTH AND SAFETY

and is therefore entitled to this

CERTIFICATE OF ACHIEVEMENT

12 OCT 1990

Date

James J. Templeton

Course Director

TERRY D. SNELL AND ASSOCIATES
1111 VALERIE WOODS DRIVE
STONE MOUNTAIN, GEORGIA 30083
404/294-8335

December 12, 1991

Leo Harlan
Technical Director
William L Bonnell Company, Inc.
25 Bonnell Street
Newnan, GA 30263

Re: OSHA 8-Hour Refresher Course
Ricky C. Veal

Dear Leo

The purpose of this brief letter is to document that Ricky C. Veal of Jones Sheet Metal, Inc., sucessfully completed the required annual 8-hour refresher training required by 29 CFR 1910.120(e)(8). The refresher course was conducted on December 10, 1991.

If you have any questions, please contact me.

Sincerely

Terry D. Snell

Terry D. Snell, P.E.

cc: Brad Landreau
Ricky C. Veal

Special Environmental Services, Inc.

This Certifies that

Bobby Beasley

has satisfactorily completed the course study covering

40-HOUR TRAINING FOR HAZARDOUS WASTE SITE HEALTH AND SAFETY

and is therefore entitled to this

CERTIFICATE OF ACHIEVEMENT

SEAL

19 OCT 1990
Date

James L Templeton
Course Director

TERRY D. SNELL AND ASSOCIATES
1111 VALERIE WOODS DRIVE
STONE MOUNTAIN, GEORGIA 30083
404/294-8335

December 12, 1991

Leo Harlan
Technical Director
William L Bonnell Company, Inc.
25 Bonnell Street
Newnan, GA 30263

Re: OSHA 8-Hour Refresher Course
Bobby Beasley

Dear Leo

The purpose of this brief letter is to document that Bobby Beasley of Payton & Sons Construction Company, Inc., sucessfully completed the required annual 8-hour refresher training required by 29 CFR 1910.120(e)(8). The refresher course was conducted on December 10, 1991.

If you have any questions, please contact me.

Sincerely

Terry D Snell

Terry D. Snell, P.E.

cc: Brad Landreau
Bobby Beasley
Rodney Payton