Carmen Johnson

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INTERNATIONAL PAPER

RIEGELWOOD MILL
JOHN L. RIEGEL ROAD
RIEGELWOOD NC 28456

November 23, 1997

NOV 1997
Received
Solid Waste
Section

Mr. James C. Coffey, Supervisor
Permitting Branch
North Carolina Division of Waste Management
PO Box 27687
Raleigh, North Carolina 27611-7687

Subject: Additional Information For Evaluation of Existing Industrial Landfill
Permit No. 24-02
Columbus County

Dear Mr. Coffey:

International Paper is hereby submitting the enclosed report in accordance with your letter of December 6,1996 requesting additional information to assist the Division in evaluating our existing landfill's compliance with Solid Waste Rule .0503(2)(d)(ii).

The report details a construction and operational plan which limits the development of the landfill to the lateral expansion of the waste "footprint" established as of January 1, 1998, a water quality monitoring plan, and a closure plan including a final cap system design.

International Paper proposes to operate the existing landfill after January 1,1998 while continuing to site and permit a new landfill. We look forward to working with you to successfully resolve solid waste disposal issues at the Riegelwood mill. If you have questions or need additional information, please contact Joe Zuncich at 910-655-6309.

Sincerely,

INTERNATIONAL PAPER
Riegelwood Mill

W. A. Soders
Manager, Environment, Health, and Safety

cc: Terry Dover, SWS Fayetteville
John Funk, Rust E&I

INTERNATIONAL PAPER

RIEGELWOOD, NORTH CAROLINA

CONCEPTUAL LANDFILL DESIGN PLAN

Prepared For:

International Paper Company

Riegelwood, North Carolina

Prepared by:

Rust Environment & Infrastructure

5510 Six Forks Road

Raleigh, North Carolina 27609

November 1997

TABLE OF CONTENTS

DRAWINGS

APPENDICES

1.0 INTRODUCTION

International Paper Riegelwood Mill proposes to operate its existing industrial waste landfill after January 1, 1998. To that end, International Paper submitted a report titled "*Preliminary Evaluation of the Existing Landfill,*" dated June 1996. The report was intended to provide the information requested in a letter International Paper (Federal paper Board) received from the Division of Solid Waste Management dated January 18, 1996. The Division of Solid Waste reviewed the June 1996 report, and requested additional information in a letter to International Paper dated December 6, 1996. To assist the Division in its evaluation of the existing landfill's compliance with Solid Waste Rule .0503(2)(d)(ii), the December 1996 letter requested the submittal of the following information 30 days prior to January 1, 1998:

1. A construction and operational plan which limits the development of the landfill to the lateral expansion of the waste "footprint" established as of January 1, 1998. The plan shall be developed in one-year phases and operated in such a manner that the landfill may be closed at any time. The capacity of the landfill design plan shall not exceed five (5) years.

2. A water quality monitoring plan including additional wells located, sampled, and analyzed in a way that demonstrates compliance with 2L.

3. A closure plan including a final cap system designed to ensure compliance with 2L as demonstrated by modeling methods acceptable to the Section.

The following sections of this plan contain the above information as requested by the Solid Waste Section.

2.0 CONSTRUCTION AND OPERATIONAL PLAN

2.1 Waste Description and Volume

International Paper Company operates a pulp and paper mill in Riegelwood, North Carolina. The Mill was previously operated by Federal Paper Board, which was acquired by International Paper Company in early 1996. The Mill and landfill began operations in 1952. The landfill is contained within the Mill Site. This landfill is owned and operated by International Paper Company pursuant to a permit from the Solid Waste Section of DENR issued in 1972. The landfill provides a disposal area for process and other solid wastes associated with the operation of the Mill.

Estimated current waste quantities to be placed in the landfill are as follows:

WASTE	ESTIMATED QUANTITY (TONS/WEEK)	ESTIMATED QUANTITY (YD^3/WEEK)
Woodyard	510	1,430
Bottom Ash	210	280
Grits	130	150
Dregs	400	400
General Mill	70	460
Sawmill Waste: Ash	60	70
Sawmill Waste: Bark/Wood	50	50
Sludge	240	260
TOTAL	1,670	3,100

Woodyard waste is composed of old logs and wood chips, bark, wood chips mixed with soil, and miscellaneous types of wood. Bottom ash is ash from the moving grate from the power boilers. Grits are caustic rejects from lime slakers used in the process. Dregs are kiln waste recovered in the dregs filter. General Mill waste is included of loose trash from the mill; dirt; and rejects, sludge, and biosolids from the paper making operation. As described in the above table the sawmill waste is comprised of ash, bark and miscellaneous types of wood. Sludge is generated in the wastewater treatment process, and can originate from clarifiers or ponds/lagoons. Sludge can be in the form of dewatered sludge (mechanically dewatered) or in the form of thickened sludge (thickening by natural evaporation and consolidation in the sludge ponds.

2.2 Operation Plan

This section presents a plan for utilizing the remaining volume of the landfill contained within the January 1, 1998 landfill footprint for the years 1998 through 2002. The plan was developed such that the landfill could be closed, at the request of the Division of Solid Waste, during the remaining operational period of the landfill. This section also presents a plan for biweekly rather than daily cover for the landfill.

2.2.1 Landfill Development

Based on the estimated 3,100 cubic yards of waste material placed in the landfill weekly, the yearly volume of waste is 161,200 cubic yards. Using a 10 percent factor for waste compression, yields an estimated in-place volume of approximately 145,000 cubic yards per year. The landfill contours developed for December of years 1998, 1999, 2000, 2001 and 2002 as provided in Sheet 1 through 5 of drawing 37243-C-01 were based on a rounded-off volume of 150,000 cubic yards per year. The preliminary contours for years 1998 through 2002 are contained within the landfill boundary established for January 1, 1998.

The contours are based upon placing the waste on a 3 to 3.5 foot horizontal to 1 foot vertical slope with waste placement proceeding from south to north with a maximum waste elevation of 130 feet msl. At the beginning of each year starting in January 1998 and through January 2002, control points will be surveyed and staked for the year. These controls will define the horizontal and vertical waste boundaries for the year. Periodically, Mill personnel will survey the waste to compare the location and elevation of the waste with the established survey controls. If required, the landfill operators will be instructed to move waste material to the established survey points such that the waste will be contained within the envelope defined by the contours for each year as depicted on the drawings. If the actual volume of waste placed on the landfill during a year is greater then or less then the estimated annual volume of 150,000 cubic yards, then waste will be placed as close as practical to the contours depicted on the drawings for that year. The projected contours of waste placement for the subsequent year will be adjusted accordingly, and the drawings for subsequent years will be revised to show the new projected extent of waste placement for the remaining life of the landfill (year 2002).

In 1998, the waste material forming the steep slope on the southeast corner of the landfill will be excavated to form a 3 to 3.5 horizontal to 1 vertical slope. The material excavated to form the shallower slope will be placed on the southwest corner of the landfill. During 1998, waste material will be placed on the south side of the landfill until a final elevation of 130 feet msl is achieved. Waste placement will then proceed to the north as indicated on drawing 201482-C-01, Sheet 1. On the north side of the landfill, the waste will be placed and contoured to form an approximate 10 horizontal to 1 vertical slope to permit access to the top of the landfill by the Mill's waste hauling trucks. It is expected that by the end of 1998, the southern portion of the landfill will be closed by covering the waste with the soil cover described in Section 4.0. During the anticipated 5 years of landfill operations, closure of the landfill will proceed as final waste contours are achieved. For years 1999 through 2002, waste will be placed in the landfill proceeding to the north and west as depicted on the drawings, and as waste is placed to the north, the southern and central portions of the landfill will be closed.

2.2.2 Landfill Cover

From July 1997 through November 1997, the Mill conducted a 120-day cover trial approved by the Division of Solid Waste for covering the waste placed in the landfill every two weeks rather than daily. During the 120-day trial, typical waste materials such as construction debris, wood waste and broken pallets, cardboard and waste paper, pulp mill rejects, and power boiler ash were placed in the landfill. The waste was covered every two weeks using mill wood waste. Results of the 120-day trial with photographs were submitted to the Division in November 1997. The use of biweekly cover greatly reduced the amount of wood waste needed for landfill cover. Based on the results of the 120-day trial, the Mill proposes to cover the landfill waste material every two weeks using wood waste, soil, or other suitable material for the remaining life of the landfill.

3.0 WATER QUALITY MONITORING PLAN

This section briefly describes the existing groundwater monitoring program, presents the results of landfill and groundwater modeling for the assessment of existing and potential future landfill impact on site groundwater, and a proposed plan for continued groundwater monitoring after January 1, 1998.

3.1 Existing Landfill Monitoring Program

3.1.1 Monitoring Wells

The 50-acre landfill at the Riegelwood Mill is constructed on a peninsula within the Mill's wastewater treatment basin. The landfill groundwater monitoring well network originally consisted of 16 wells, but groundwater quality in the landfill area is currently monitored through semi-annual sample collection and analysis of groundwater collected from six wells (MW-1A, MW-1B, MW-4A, MW-5A, MW-7A and MW-08A). MW-1A and MW-1B are located up gradient of the landfill and wastewater treatment basin and the other wells are located down gradient of the landfill and basin. The groundwater flow direction in the vicinity of the landfill is toward the Cape Fear River and Livingston Creek. The monitoring well locations, groundwater flow direction, hydrogeologic description, monitoring data summary were provided to the Division of Solid Waste in the June 1996 landfill evaluation report.

3.1.2 Monitoring Parameters

Currently, landfill semi-annual monitoring parameters include:

BOD	Sulfate	Arsenic
COD	Chloride	Barium
TOX	Fluoride	Cadmium
TOC	Nitrate	Chromium
TDS		Copper
pH		Iron
Conductivity		Lead
		Manganese
		Mercury
		Selenium
		Silver
		Zinc

All results are reported in parts per million (milligrams per liter), except the field parameters of conductivity and pH.

3.2 Proposed Landfill Monitoring Plan

Due to the proximity of the monitoring wells to the wastewater basin and the results of chemical analysis of wastewater and groundwater, it is likely that the wells at the toe of the basin dike are influenced by the wastewater in the basin. Therefore, any changes in groundwater quality produced by the landfill would likely be masked by the water in the basin. The results of the modeling presented in Section 4.0 using the results of landfill leachate analysis demonstrates that the landfill is not the cause of the observed exceedances in the groundwater quality standards (15A NCAC 2L) in the down gradient wells. To provide a means of detecting potential changes in groundwater quality due solely to the landfill, it is proposed to amend the existing monitoring plan to include the addition of annual leachate sampling in the landfill. Annual leachate sampling and analysis in conjunction with solute transport modeling would provide a means for estimating potential changes in groundwater quality down gradient of the landfill.

Samples of leachate would be collected manually using hand or power augers, the samples would be composited, and the composite sample would be analyzed for the landfill monitoring parameters. Solute transport modeling would then be used to predict selected parameter concentrations in groundwater down gradient from the landfill. The results of the modeling would be compared with the measured parameters in the monitoring wells and with the groundwater standards to determine the landfill's potential impact on groundwater quality. This plan is conservative in that the modeling presented in Section 4.0 assumes that all the leachate in the landfill flows into the groundwater beneath the landfill. Water level elevations in piezometers installed in 1997 along the access road in the landfill were 2 to 3 feet higher than the water level in the basin. This would indicate that there is some leachate flow from the landfill directly into the basin and that only a portion of leachate flows into the groundwater beneath the landfill.

Groundwater sampling and analysis conducted in 1997 demonstrated the absence of volatile organic compounds (VOCs) in the basin - groundwater system in the vicinity of the landfill and basin. Therefore, this monitoring plan proposes no changes to the existing landfill analytical parameters identified in Section 3.1.2 above.

4.0 LANDFILL CLOSURE PLAN

This section provides the results of landfill and groundwater modeling to demonstrate the landfill's current and future compliance with the groundwater quality standards (15A NCAC 2L), and it also contains a conceptual landfill cap design.

4.1 Landfill and Groundwater Modeling

The purpose of landfill and groundwater modeling was to evaluate the present and future effects of operation of the landfill on groundwater quality. The movement of leachate constituents in the groundwater from the landfill to monitoring well MW-7A was modeled by first using the Hydrologic Evaluation of Landfill Performance (HELP) Model, version 3.04, of the USEPA Risk Reduction Engineering Laboratory (Schroeder, 1994) to estimate the quantity of leachate generated in the landfill. Then the Radial Model, version 3.0 of Solute modeling package (Beljin, 1993) was used to estimate the constituent concentrations in groundwater in the vicinity of monitoring well MW-7A. Monitoring well MW-7A was selected as the modeling evaluation point since it is the closest down gradient well to the landfill. The results of the modeling show that iron, manganese, and chloride in groundwater will not exceed the 2L standards.

4.1.1 Landfill Modeling

To provide source terms for the groundwater model, a sample of leachate was collected from beneath waste materials in the landfill; and the sample was analyzed for total and dissolved iron, total and dissolved manganese, and chloride (see Appendix A). The results of the analyses yielded concentrations of 0.489 mg/l of total iron, 0.183 mg/l of dissolved iron, 2.110 mg/l of total manganese, 1.910 mg/l of dissolved manganese, and 1860.0 mg/l of chloride. These concentrations were used in the groundwater model to estimate the concentration of those parameters at monitoring well MW-7A. Those parameters were selected for modeling since semi-annual monitoring indicates potential exceedance of background and the 2L standard at MW-7A for those parameters.

The HELP computer program is a quasi-two-dimensional hydrologic model of water movement within and out of landfills. The model accepts weather, soil and design data and uses solution techniques that account for the effects of the surface storage, runoff, infiltration, evapotranspiration, and others to conduct a water balance analysis of a landfill's cover systems to determine the amounts of runoff, evapotranspiration, drainage, leachate collection, and liner leakage in the landfill.

Model assumptions and landfill parameters included:

1. The predicted average height and areal extent of the landfill (70 feet and 50 acres, respectively) were used based on year 2002 contours.
2. For precipitation records, weather and climatological data from Greensboro, North Carolina were used. Greensboro is the nearest city in the model's database.
3. For evapotranspiration, temperature, and solar radiation the nearest city included in the model data base was Raleigh, NC, and it was selected as input for these parameters.

4. The portion of the landfill where possible runoff may occur was set at 100%. The slope of the landfill was set at 28.5% with a length of 832.6 ft.

When present, capping layers were modeled as vertical percolation layers. The waste material layer was modeled as a vertical percolation layer. The HELP model contains 42 layer (soil, waste material and or liner) types which have varying values of porosity, field capacity, wilting point, and hydraulic conductivity, along with others not relevant to this modeling effort. For the waste layer, compacted municipal flyash was chosen as representative of the waste material generated by the Mill based on its values of porosity (0.45), field capacity (0.116), and hydraulic conductivity ($1x10^{-2}$ cm/sec.).

This layer was kept at a consistent thickness of 70 ft. (840 in.). Soils present beneath waste materials were expected to be a unit(s) of the Waccamaw Sands Formation (Law, 1988), and were modeled as a vertical percolation layer. A silty sand was selected as a model supplied soil type representative of this unit based on values of porosity (0.35), field capacity (0.222), and hydraulic conductivity ($5.2x10^{-4}$ cm/sec.). The unit was assigned a thickness of 4 ft. (48 in.), below which groundwater was expected to be present. The model run was performed for a simulation period of 5 years. HELP model printouts are provided in Appendix B.

The first landfill configuration modeled was a 2-layer system consisting of the waste materials and the underlying sands. No vegetative cover was included. This model un was intended to simulate the landfill condition during operation with no soil cover. The evaporative zone depth was set a 10 inches. This run resulted in a leachate generation rate of 144,760 ft^3/yr (11,229 l/day).

A second HELP model run was performed to simulate conditions that would likely be present after the landfill is closed. The two-foot soil/sludge cap was modeled based upon a compacted low plasticity clay (porosity 0.464, field capacity 0.310, and hydraulic conductivity $6.4x10^{-5}$ cm/sec.) included in the model data based which closely matched the laboratory measured hydraulic conductivities of $1x10^{-4}$ and $7x10^{-5}$ cm/sec. A fair stand of grass was modeled as present on the cap with a leaf area index of 2 (consistent with this type of vegetative cover). The evaporative zone depth was set at 22 in. Although the vegetative cover greatly increased water loss from the system due to evapotranspiration, the loss of runoff caused a higher leachate generation rate (813,334 ft^3/yr or 63,088 l/day) than the landfill without a soil cover.

Based on a volume of 63,088 liters per day of leachate and the concentration of iron, manganese, and chloride present in the leachate, the maximum daily contributions of leachate constituents available to the groundwater are 30.84 kg of iron, 133.11 kg of manganese, and 117,347 kg of chloride. Since portions of the landfill will be closured during operation, these more conservative constituent mass loadings were used in subsequent groundwater modeling

4.1.2 Groundwater Modeling

The Radial module calculates solute transport in a plane radial flow field. The program allows for continuous input of a fluid with a consistent concentration of a compound and then calculates the concentration distribution along the radial coordinate away from a recharge well.

Assumptions of the Radial module include: uniformly porous, homogeneous and isotropic aquifer of infinite areal extent and constant thickness; the groundwater flow regime is fully saturated, radial-symmetric steady-state flow away from the well; flow velocity is a function of the distance from the well; injection rate of fluid is constant; injection concentration is constant; there is no regional flow component; the density and viscosity of the groundwater and injected fluid are identical and constant; and there is no solute advection or dispersion into or out of confining layers.

For modeling of "injection" of constituents from the landfill, quantities of leachate from the HELP modeling run were used. One fifth of the 63,088 l/day of leachate (12,618 l/day) generated were assumed to travel in the direction of monitoring well MW-7A, located approximately 400 meters from the edge of the landfill. The aquifer thickness was set at 3.05 m (10 ft.). The underlying Pee Dee Formation, which has a much lower hydraulic conductivity than the surficial Waccamaw Sands, was considered an aquitard. The porosity was set at 0.35 m^3/m^3. Longitudinal dispersivity was set at 10 m, and, to be conservative, no degradation or retardation factor was assumed. Concentrations of total iron, total manganese and chloride detected in the leachate sample were modeled as being injected in the groundwater beneath the landfill.

Injection of each of the concentrations was simulated for periods of 5, 10, 20 and 50 years. At the distance of 400 meters from the landfill (the approximate location of MW-7A), the concentrations were maximum at the 50 year time period (see Appendix B). Those resultant values were approximately 0.0066 mg/l iron, 0.0284 mg/l manganese, and 25.00 mg/l chloride. The comparable 2L standards for those parameters are iron 0.3 mg/l, manganese 0.05 mg/l, and chloride 250 mg/l. It is evident that the landfill leachate does not adversely impact groundwater quality, and the cap design as described in Section 4.2 would meet the requirements of the groundwater quality standards.

4.2 Landfill Cap Design

The layout of the landfill and contours for the one-year phases of landfill operation are provided in Drawing 201482-C-01, Sheets 1 - 5. This section of the plan provides a conceptual landfill cap design, and a closure plan for the sludge areas of the landfill.

4.2.1 Landfill Cover System

The cover material proposed is a mixture of on-site soils and paper sludge, and this section provides a summary of the geotechnical properties of the soil and sludge mixture.

Borrow area soils at the Riegelwood Mill are predominantly of the Blanton and Goldsboro series as indicated in the US Department of Agriculture, Soil Conservation Service, "Soil Survey of Columbus County, North Carolina." Blanton soils are sands and are listed as "poor, too sandy" for landfill daily cover, and Goldsboro sandy loams and soils are listed as "fair, wetness" for landfill daily cover. To improve properties of the Blanton and Goldsboro soils for landfill cover, the sludge from the Mill's sludge lagoon was tested as an amendment to the soils. At other mills, International Paper has lowered the permeability of site soils and produced suitable landfill cover material by mixing the site soils with sludge. The sludge in the Riegelwood Mill lagoons is a mixture of paper sludge, wastewater treatment sludge and ash from the bark incinerator. Since the sludge properties and soils differ from mill to mill, a test program was developed and carried out to evaluate the feasibility of mixing sludge with site soil and to determine the engineering properties of the mixture.

For the test, approximately 12 cubic yards of sludge were spread out and soils from the site borrow area were added and mixed using a rotary tiller. The addition of soil and mixing continued until the tractor pulling the tiller and loader spreading the soil rode above the mixture. At that point (approximately 2 parts soil to 1 part sludge), the mixture supported the weight of construction equipment. Samples of mixture were collected and a standard proctor test was performed. Test samples were then compacted to 85% and 90% of the maximum dry density determined from the proctor moisture density curve. Then falling head permeability tests were performed on the compacted samples. The permeability of the sample at 85% density was 1×10^{-4} cm/sec and at 90% the permeability was 7×10^{-5} cm/sec. Copies of test results are provided in Appendix C.

For landfill final cover, it is proposed to use the soil and sludge mixture. A mixing area will be sited in the landfill area, and soil mixed with the sludge until the operator of the mixing equipment observes that his equipment runs on top of the mixture. The sludge and soil mixture will be hauled to the area of the landfill to be covered, placed on the area in lift of 8 to 12 inches and compacted using a rubber tire roller or equipment tracks until ruts greater than 6 inches are not formed. The mixture will be placed to a minimum depth of 2 feet as measured by staking. After the soil cover is placed, it will be seeded and fertilized in accordance with the recommendation of the North Carolina Erosion and Sediment Control Manual for permanent grass cover in the coastal area.

4.2.2 Sludge Area Closure Plan

The enclosed drawing 201482-C-01 show three sludge areas within the boundary of the landfill. Two of the areas are identified as new sludge and one area is identified as old sludge. Sludge from the Mill's lagoons was disposed in the new sludge area on the east side of the landfill during 1997 to a depth in some areas of approximately 15 feet. The sludge on the west side of the landfill has been in place of several years. The sludge in all three areas is pager mill sludge and is predominantly fibrous in nature and retains liquids. The sludge in the new sludge areas will not support the weight of construction equipment or a soil cover. If a soil cover could be placing over the sludge on the east side of the landfill using geotextile with reinforcement grid, the weight of the soil on the grids and the weight of construction equipment would likely cause displacement of the soft sludge and subsequent movement of sludge into the wastewater basin and beyond January 1, 1998 landfill foot-print identified on the drawings. The old sludge on the west side of the landfill has an established vegetative cover, and it is proposed leave those areas not used for additional waste disposal undisturbed and with the existing vegetative cover intact. In the new sludge areas, the Mill will attempt to dewater and stabilize the sludge by installation of drain pipe in the sludge. If the sludge can be stabilized sufficiently such that it could be contoured, additional sludge would be placed in those areas. Contours for those areas are not shown on the drawings since the slope stability of the sludge is not know at this time.

At final closure of the new sludge areas, it is proposed to establish a vegetative cover on the sludge consisting of deep rooting grasses such as Big Blue Stem (*Andropogon Gerardii),* Indian Grass (*Sorghastrum nutans),* Switch Grass (*Panicum virgatum),* and Cord Grass (*Spartina pectinata).*

These grasses form dense root systems with tap roots which can extend to depths of 5 to 10 feet. The grasses will assist in stabilizing the sludge by establishing a root system which would draw moisture from the sludge. The sludge will support vegetation as evidenced by the existing vegetation on the Mills sludge lagoon and vegetation which is already established on the old sludge area. It is planned to place a fence around the sludge areas to provide additional protection for Mill personnel.

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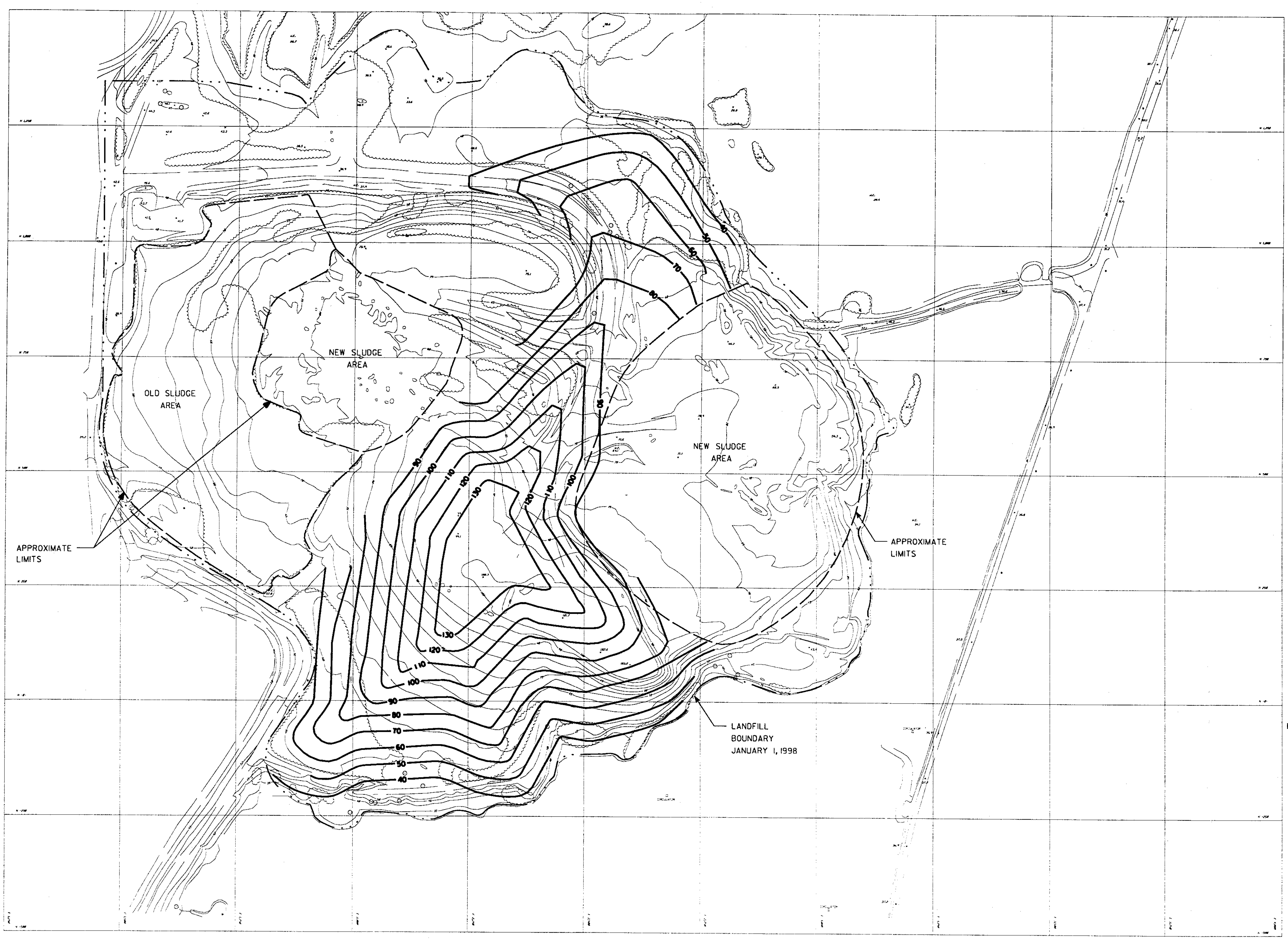
Rust Environment & Infrastructure, (June 1996). "Preliminary Evaluation of the Existing Landfill, International Paper, Riegelwood, North Carolina."

Figures



NOTE: PROPOSED CONTOURS ARE BASED UPON AN ANNUAL WASTE VOLUME OF 150,000 CUBIC YARDS PER YEAR. ACTUAL CONTOURS WILL BE ADJUSTED BASED UPON THE ACTUAL VOLUME OF WASTE PLACED IN THE LANDFILL.

SCALE 0' 50' 100' 200'

LEGEND
- MAY 1996 CONTOURS
- PROPOSED CONTOURS
- LANDFILL BOUNDARY

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

TOPOGRAPHIC SURVEY MADE
FROM AERIAL PHOTOGRAPHY
AND GROUND CONTROL
BY
DAVID B. GOLDSTON JR., R.L.S., R.F.
109 WASHINGTON ST. WHITEVILLE, NC 28472
BUS:(910)642-2203 RES:(910)646-4370
MAY 20, 1996

NO	REVISIONS	DRN	CHK	DATE
1	DIVISION OF SOLID WASTE REVIEW			11-14-97
0	INTERNATIONAL PAPER REVIEW		JGF	10-22-97

RALEIGH, NC

DRN	RCS LHM	10-8-97
DES	JGF	10-8-97
CHK	RLF	10-8-97
APP		- -

RUST Rust Environment & Infrastructure Inc.

CLOSURE PLAN
PROJECTED LANDFILL CONTOURS - DEC 1998

INTERNATIONAL PAPER
RIEGELWOOD NORTH CAROLINA

DATE	09-26-97
PROJECT NO	201482
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SHEET NO	1 OF 5
DRAWING NO	201482-C-01

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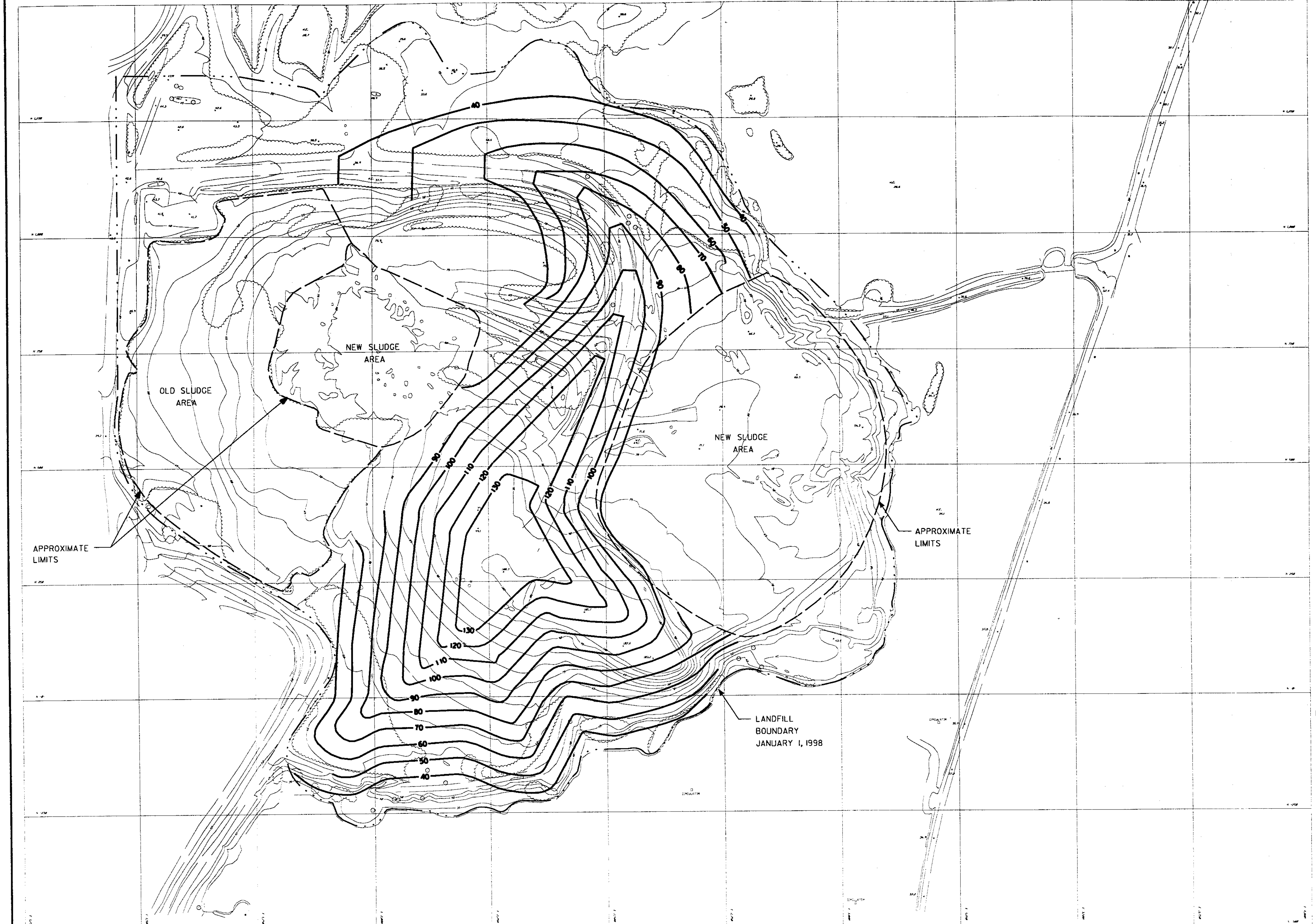

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1	DIVISION OF SOLID WASTE REVIEW			11-14

RALEIGH, NC

DRN	RCS	LHM	10-8-97
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CHK	RLF		10-8-97
APP			-

RUST
Rust Environment & Infrastructure Inc.

CLOSURE PLAN
PROJECTED LANDFILL CONTOURS - DEC 1999

INTERNATIONAL PAPER
RIEGELWOOD NORTH CAROLINA

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PROJECT NO	201482
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DRAWING NO	201482-C-01

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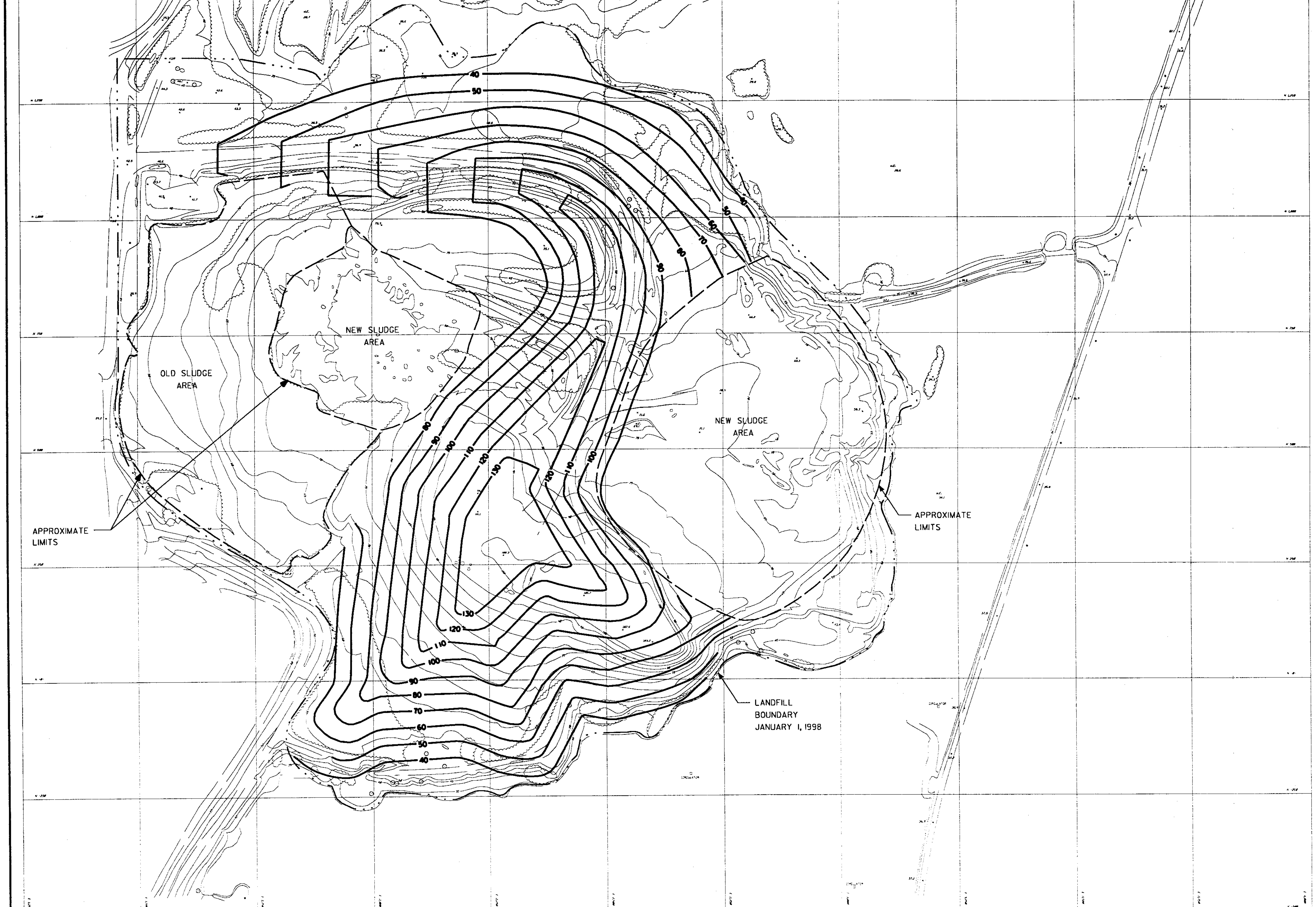

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SCALE 0' 50' 100' 200'

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RALEIGH, NC

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RUST
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CLOSURE PLAN
PROJECTED LANDFILL CONTOURS - DEC 2000

INTERNATIONAL PAPER
RIEGELWOOD NORTH CAROLINA

DATE	09-26-97
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FILENAME	0020.DGN
SHEET NO	3 OF 5
DRAWING NO	201482-C-01

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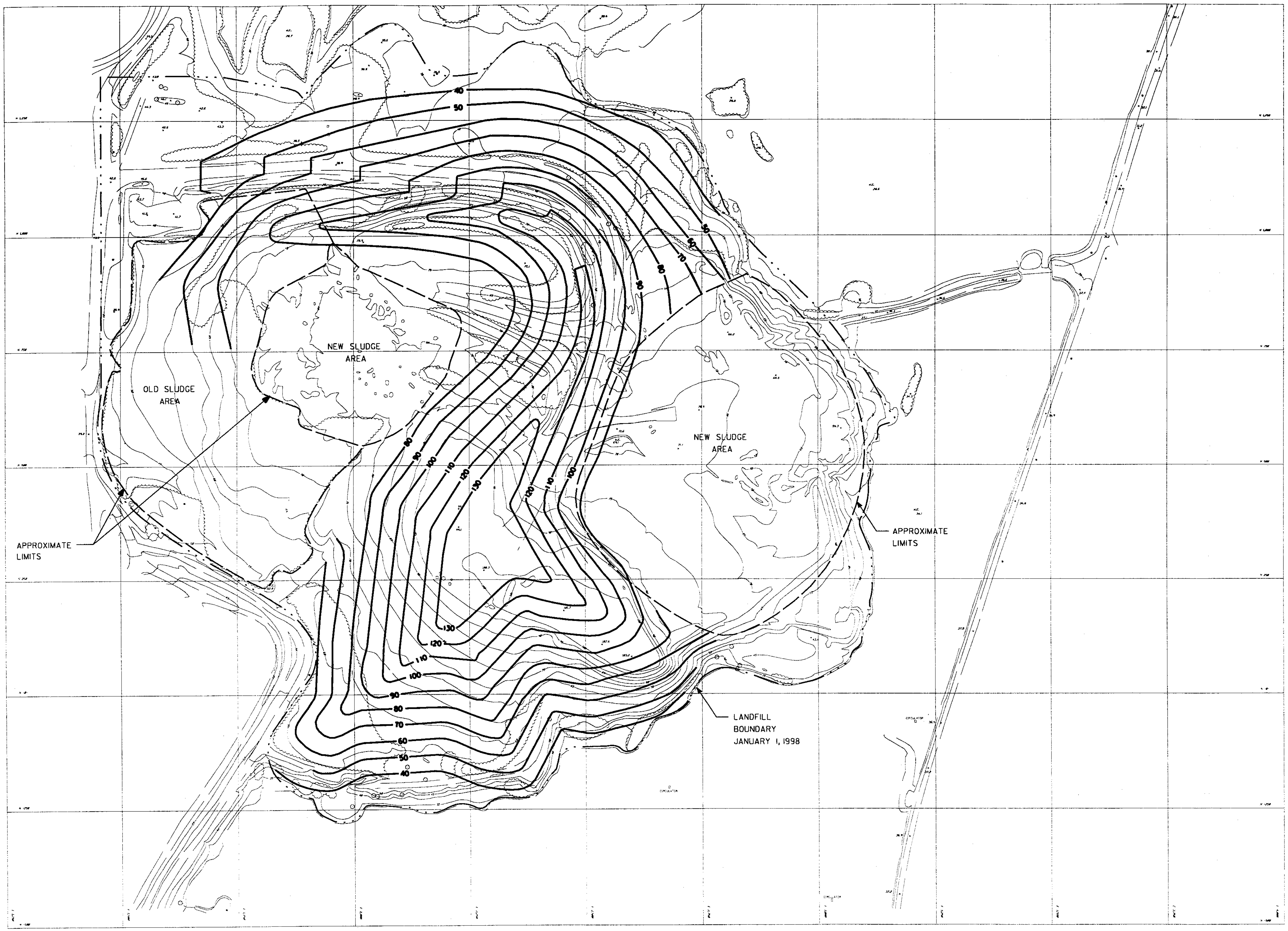

LEGEND

- MAY 1996 CONTOURS
- PROPOSED CONTOURS
- LANDFILL BOUNDARY

NOTE: PROPOSED CONTOURS ARE BASED UPON AN ANNUAL WASTE VOLUME OF 150,000 CUBIC YARDS PER YEAR. ACTUAL CONTOURS WILL BE ADJUSTED BASED UPON THE ACTUAL VOLUME OF WASTE PLACED IN THE LANDFILL.

SCALE 0' 50' 100' 200'

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

TOPOGRAPHIC SURVEY MADE
FROM AERIAL PHOTOGRAPHY
AND GROUND CONTROL
BY
DAVID B. GOLDSTON JR., R.L.S., R.F.
109 WASHINGTON ST. WHITEVILLE, NC 28472
BUS:(910)642-2203 RES:(910)646-4370
MAY 20,1996

NO	REVISIONS	DRN	CHK	DATE
1	DIVISION OF SOLID WASTE REVIEW			11-14-97
0	INTERNATIONAL PAPER REVIEW		JCF	10-22-97

RALEIGH, NC

DRN	RCS	LHM	10-8-97
DES	JCF		10-8-97
CHK	RLF		10-8-97
APP			- -

RUST
Rust Environment & Infrastructure Inc.

CLOSURE PLAN
PROJECTED LANDFILL CONTOURS - DEC 2001

INTERNATIONAL PAPER
RIEGELWOOD NORTH CAROLINA

DATE	09-26-97
PROJECT NO	201482
FILENAME	012D.DGN
SHEET NO	4 OF 5
DRAWING NO	201482-C-01

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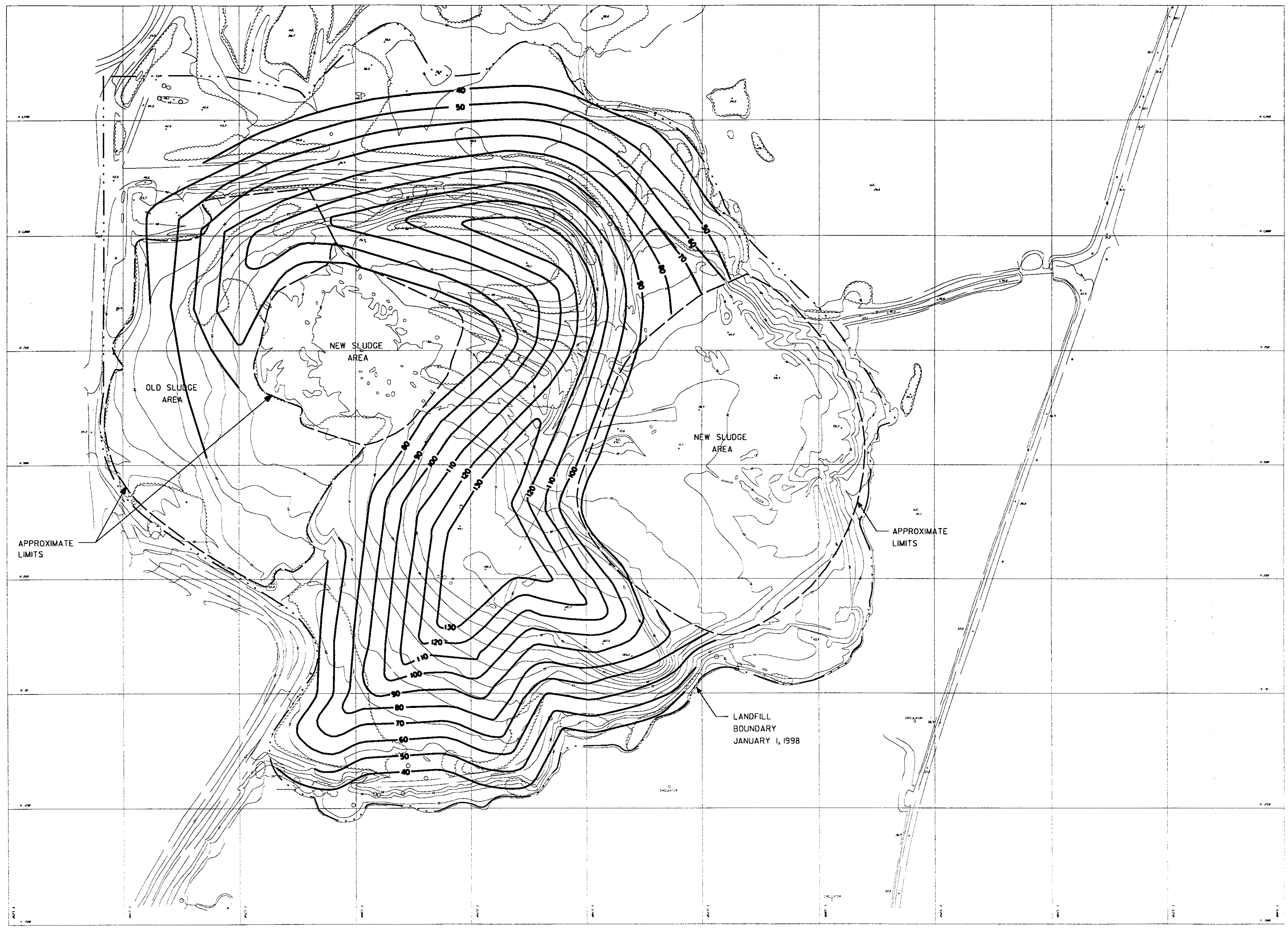

NOTE: PROPOSED CONTOURS ARE BASED UPON AN ANNUAL WASTE VOLUME OF 150,000 CUBIC YARDS PER YEAR. ACTUAL CONTOURS WILL BE ADJUSTED BASED UPON THE ACTUAL VOLUME OF WASTE PLACED IN THE LANDFILL.

SCALE 0' 50' 100' 200'

LEGEND

- MAY 1996 CONTOURS
- PROPOSED CONTOURS
- LANDFILL BOUNDARY

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

TOPOGRAPHIC SURVEY MADE FROM AERIAL PHOTOGRAPHY AND GROUND CONTROL BY DAVID B. GOLDSTON JR., R.L.S., R.F. 109 WASHINGTON ST. WHITEVILLE, NC 28472 BUS:(910)642-2203 RES:(910)646-4370 MAY 20,1996

NO	REVISIONS	DRN	CHK	DATE
1	DIVISION OF SOLID WASTE REVIEW			11-14-9
0	INTERNATIONAL PAPER REVIEW		JGF	10-22-9

RALEIGH, NC

DRN	RCS LHM	10-8-97
DES	JGF	10-8-97
CHK	RLF	10-8-97
APP	-	-

RUST
Rust Environment & Infrastructure Inc.

CLOSURE PLAN
PROJECTED LANDFILL CONTOURS - DEC 2002

INTERNATIONAL PAPER
RIEGELWOOD NORTH CAROLINA

DATE	09-26-1997
PROJECT NO	201482
FILENAME	0220.DGN
SHEET NO	5 OF 5
DRAWING NO	201482-C-01

p:\37243.010\cadd\022d.dgn Nov. 17, 1997 11:26:48

Appendix - A

Appendix A

Leachate Analytical Results

PARADIGM ANALYTICAL LABORATORIES, INC.

Results for Inorganics

Client Sample ID:	PZ-3	Analyzed By:	JMF
Client Project ID:	37243	Date Collected:	9/18/97
Lab Sample ID:	30009	Date Received:	9/24/97
Lab Project ID:	G113-122	Matrix:	Water

Metals	**Result**	**Quantitation Limit**	**Units**	**Procedure**	**Date Analyzed**
Iron	**0.489**	0.100	MG/L	6010A	10/3/97
Manganese	**2.11**	0.0100	MG/L	6010A	10/3/97
DISSOLVED					
Iron	**0.183**	0.100	MG/L	6010A	10/3/97
Manganese	**1.91**	0.0100	MG/L	6010A	10/3/97

Comments

BQL = Below Quantitation Limits

Reviewed By: RNP

PARADIGM ANALYTICAL LABORATORIES, INC.

Results for Inorganics

Client Sample ID: PZ-3
Client Project ID: 37243
Lab Sample ID: 30009
Lab Project ID: G113-122

Analyzed By: EC
Date Collected: 9/18/97
Date Received: 9/24/97
Matrix: Water

Parameter	Result	Quantitation Limit	Units	Procedure	Date Analyzed
Chloride	**1860**	0.100	mg/L	SM4500Cl-B	9/26/97
TSS	**183**	1.00	mg/L	160.2	9/25/97

Note :
BQL = Below Quantitation Limit
Analysis performed by Envirochem,Inc.

Reviewed By: [signature]

Appendix-B

Appendix B

Landfill HELP Model Runs

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

****************************************************************************
**                                                                        **
**                                                                        **
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                 **
**             HELP MODEL VERSION 3.04a  (10 JULY 1995)                   **
**             DEVELOPED BY ENVIRONMENTAL LABORATORY                      **
**               USAE WATERWAYS EXPERIMENT STATION                        **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
**                                                                        **
**                                                                        **
****************************************************************************

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PRECIPITATION DATA FILE: C:\MLT\HELP\DATA4.D4
TEMPERATURE DATA FILE: C:\MLT\HELP\DATA7.D7
SOLAR RADIATION DATA FILE: C:\MLT\HELP\DATA13.D13
EVAPOTRANSPIRATION DATA: C:\MLT\HELP\DATA11.D11
SOIL AND DESIGN DATA FILE: C:\MLT\HELP\ipredocp.D10
OUTPUT DATA FILE: C:\MLT\HELP\ipredocp.OUT

TIME: 12:34 DATE: 11/17/1997

****

TITLE: RIEGLEWOOD/IP MODEL WITH 2' CAP, K = 7 E -05, FAIR GRASS

****

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 11
THICKNESS = 24.00 INCHES
POROSITY = 0.4640 VOL/VOL
FIELD CAPACITY = 0.3100 VOL/VOL
WILTING POINT = 0.1870 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3455 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.639999998000E-04 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 32
THICKNESS = 840.00 INCHES
POROSITY = 0.4500 VOL/VOL
FIELD CAPACITY = 0.1160 VOL/VOL
WILTING POINT = 0.0490 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1273 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.999999978000E-02 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0
THICKNESS = 48.00 INCHES
POROSITY = 0.3500 VOL/VOL
FIELD CAPACITY = 0.2220 VOL/VOL
WILTING POINT = 0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2220 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.520000001000E-03 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #11 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 28.% AND A SLOPE LENGTH OF 832. FEET.

SCS RUNOFF CURVE NUMBER = 87.00
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 50.000 ACRES
EVAPORATIVE ZONE DEPTH = 22.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 7.603 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 10.208 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 4.114 INCHES
INITIAL SNOW WATER = 0.000 INCHES
INITIAL WATER IN LAYER MATERIALS = 125.843 INCHES
TOTAL INITIAL WATER = 125.843 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM RALEIGH NORTH CAROLINA

STATION LATITUDE = 35.87 DEGREES
MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 86
END OF GROWING SEASON (JULIAN DATE) = 310
EVAPORATIVE ZONE DEPTH = 22.0 INCHES
AVERAGE ANNUAL WIND SPEED = 7.70 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 66.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 70.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 78.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 72.00 %

NOTE: PRECIPITATION DATA FOR GREENSBORO NORTH CAROLINA WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR RALEIGH NORTH CAROLINA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
39.60	41.60	49.30	59.50	67.20	73.90
77.70	77.00	71.00	59.70	50.00	42.00

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR RALEIGH NORTH CAROLINA
AND STATION LATITUDE = 35.87 DEGREES

****

ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.47	8252804.500	100.00
RUNOFF	3.008	545864.500	6.61
EVAPOTRANSPIRATION	31.770	5766311.000	69.87
PERC./LEAKAGE THROUGH LAYER 3	0.396171	71904.977	0.87
CHANGE IN WATER STORAGE	10.296	1868722.120	22.64
SOIL WATER AT START OF YEAR	125.843	22840586.000	
SOIL WATER AT END OF YEAR	136.139	24709308.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.677	0.00

****

ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	56.51	10256564.000	100.00
RUNOFF	6.359	1154094.620	11.25
EVAPOTRANSPIRATION	34.549	6270730.500	61.14
PERC./LEAKAGE THROUGH LAYER 3	2.900163	526379.500	5.13
CHANGE IN WATER STORAGE	12.702	2305354.000	22.48
SOIL WATER AT START OF YEAR	136.139	24709308.000	
SOIL WATER AT END OF YEAR	148.841	27014662.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	5.106	0.00

****

ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.64	6287159.000	100.00
RUNOFF	2.486	451266.875	7.18
EVAPOTRANSPIRATION	26.501	4809871.000	76.50
PERC./LEAKAGE THROUGH LAYER 3	6.160531	1118136.250	17.78
CHANGE IN WATER STORAGE	-0.507	-92109.812	-1.47
SOIL WATER AT START OF YEAR	148.841	27014662.000	
SOIL WATER AT END OF YEAR	148.334	26922552.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-4.933	0.00

****

ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.26	6218190.500	100.00
RUNOFF	3.810	691525.187	11.12
EVAPOTRANSPIRATION	25.240	4581000.500	73.67
PERC./LEAKAGE THROUGH LAYER 3	5.955298	1080886.620	17.38
CHANGE IN WATER STORAGE	-0.745	-135222.156	-2.17
SOIL WATER AT START OF YEAR	148.334	26922552.000	
SOIL WATER AT END OF YEAR	147.589	26787330.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.433	0.00

****

ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	55.97	10158555.000	100.00
RUNOFF	7.245	1315038.120	12.95
EVAPOTRANSPIRATION	35.781	6494286.500	63.93
PERC./LEAKAGE THROUGH LAYER 3	6.993725	1269361.120	12.50
CHANGE IN WATER STORAGE	5.950	1079869.000	10.63
SOIL WATER AT START OF YEAR	147.589	26787330.000	
SOIL WATER AT END OF YEAR	153.538	27867198.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.433	0.00

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.54	1.88	4.38	2.21	4.14	2.73
	5.32	4.79	5.44	3.60	2.36	3.98
STD. DEVIATIONS	2.16	1.22	2.58	1.21	2.31	1.09
	5.09	3.03	2.32	3.18	0.62	0.26
RUNOFF						
TOTALS	0.552	0.048	0.303	0.144	0.238	0.041
	0.976	0.461	0.995	0.536	0.023	0.265
STD. DEVIATIONS	0.682	0.101	0.579	0.248	0.461	0.060
	1.364	0.435	0.959	0.855	0.029	0.107

EVAPOTRANSPIRATION

TOTALS	1.491	1.753	2.762	2.399	4.167	3.748
	3.258	3.221	2.555	2.930	1.355	1.128
STD. DEVIATIONS	0.241	0.255	0.482	0.530	1.384	1.097
	2.208	0.867	0.951	0.345	0.472	0.085

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.1595	0.0718	0.3659	0.4374	0.3247	0.4479
	0.5366	0.3869	0.4556	0.4339	0.4517	0.4093
STD. DEVIATIONS	0.1593	0.0685	0.3232	0.3823	0.3256	0.2680
	0.3981	0.2934	0.2659	0.3645	0.4066	0.2513

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.37 (10.898)	8234655.5	100.00
RUNOFF	4.582 (2.1046)	831557.81	10.098
EVAPOTRANSPIRATION	30.768 (4.7225)	5584440.00	67.816
PERCOLATION/LEAKAGE THROUGH LAYER 3	4.48118 (2.76103)	813333.687	9.87696
CHANGE IN WATER STORAGE	5.539 (6.1268)	1005322.69	12.208

****

PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	4.73	858495.000
RUNOFF	2.344	425467.5310
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.068303	12397.01860
SNOW WATER	2.68	487060.4370
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3864	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1870	

****

****

FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	7.8939	0.3289
2	135.5272	0.1613
3	10.1172	0.2108

SNOW WATER 0.000

****

****

****
** **
** **
** HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE **
** HELP MODEL VERSION 3.04a (10 JULY 1995) **
** DEVELOPED BY ENVIRONMENTAL LABORATORY **
** USAE WATERWAYS EXPERIMENT STATION **
** FOR USEPA RISK REDUCTION ENGINEERING LABORATORY **
** **
** **

****

****

PRECIPITATION DATA FILE: C:\MLT\HELP\DATA4.D4
TEMPERATURE DATA FILE: C:\MLT\HELP\DATA7.D7
SOLAR RADIATION DATA FILE: C:\MLT\HELP\DATA13.D13
EVAPOTRANSPIRATION DATA: C:\MLT\HELP\DATA11.D11
SOIL AND DESIGN DATA FILE: C:\MLT\HELP\ipredonc.D10
OUTPUT DATA FILE: C:\MLT\HELP\ipredonc.OUT

TIME: 12:30 DATE: 11/17/1997

****
TITLE: RIEGLEWOOD/IP MODEL WITH NO CAP
****

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 32

THICKNESS = 840.00 INCHES
POROSITY = 0.4500 VOL/VOL
FIELD CAPACITY = 0.1160 VOL/VOL
WILTING POINT = 0.0490 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1207 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.999999978000E-02 CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS = 48.00 INCHES
POROSITY = 0.3500 VOL/VOL
FIELD CAPACITY = 0.2220 VOL/VOL
WILTING POINT = 0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2217 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.520000001000E-03 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE #32 WITH BARE
GROUND CONDITIONS, A SURFACE SLOPE OF 28.% AND
A SLOPE LENGTH OF 832. FEET.

SCS RUNOFF CURVE NUMBER = 96.80
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 50.000 ACRES
EVAPORATIVE ZONE DEPTH = 22.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 3.410 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 9.900 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 1.078 INCHES
INITIAL SNOW WATER = 0.000 INCHES
INITIAL WATER IN LAYER MATERIALS = 112.066 INCHES
TOTAL INITIAL WATER = 112.066 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
RALEIGH NORTH CAROLINA

STATION LATITUDE = 35.87 DEGREES
MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 86
END OF GROWING SEASON (JULIAN DATE) = 310
EVAPORATIVE ZONE DEPTH = 22.0 INCHES
AVERAGE ANNUAL WIND SPEED = 7.70 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 66.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 70.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 78.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 72.00 %

NOTE: PRECIPITATION DATA FOR GREENSBORO NORTH CAROLINA
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR RALEIGH NORTH CAROLINA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
39.60	41.60	49.30	59.50	67.20	73.90
77.70	77.00	71.00	59.70	50.00	42.00

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR RALEIGH NORTH CAROLINA
AND STATION LATITUDE = 35.87 DEGREES

****

ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.47	8252804.500	100.00
RUNOFF	14.955	2714327.000	32.89
EVAPOTRANSPIRATION	26.325	4778031.000	57.90
PERC./LEAKAGE THROUGH LAYER 2	0.180780	32811.656	0.40
CHANGE IN WATER STORAGE	4.009	727634.000	8.82
SOIL WATER AT START OF YEAR	112.066	20340056.000	
SOIL WATER AT END OF YEAR	116.075	21067690.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.025	0.00

****

ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	56.51	10256564.000	100.00
RUNOFF	23.388	4244939.000	41.39
EVAPOTRANSPIRATION	27.972	5076971.500	49.50
PERC./LEAKAGE THROUGH LAYER 2	0.289396	52525.426	0.51
CHANGE IN WATER STORAGE	4.860	882128.875	8.60
SOIL WATER AT START OF YEAR	116.075	21067690.000	
SOIL WATER AT END OF YEAR	120.936	21949820.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-1.039	0.00

****

ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.64	6287159.000	100.00
RUNOFF	11.250	2041827.370	32.48
EVAPOTRANSPIRATION	21.657	3930764.000	62.52
PERC./LEAKAGE THROUGH LAYER 2	1.221073	221624.797	3.53
CHANGE IN WATER STORAGE	0.512	92943.422	1.48
SOIL WATER AT START OF YEAR	120.936	21949820.000	
SOIL WATER AT END OF YEAR	121.448	22042764.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.541	0.00

****

ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.26	6218190.500	100.00
RUNOFF	12.456	2260796.000	36.36
EVAPOTRANSPIRATION	19.696	3574791.250	57.49
PERC./LEAKAGE THROUGH LAYER 2	1.147309	208236.609	3.35
CHANGE IN WATER STORAGE	0.961	174364.453	2.80
SOIL WATER AT START OF YEAR	121.448	22042764.000	
SOIL WATER AT END OF YEAR	122.408	22217128.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.926	0.00

****

ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	55.97	10158555.000	100.00
RUNOFF	25.724	4668978.000	45.96
EVAPOTRANSPIRATION	26.683	4842925.000	47.67
PERC./LEAKAGE THROUGH LAYER 2	1.149313	208600.266	2.05
CHANGE IN WATER STORAGE	2.414	438052.656	4.31
SOIL WATER AT START OF YEAR	122.408	22217128.000	
SOIL WATER AT END OF YEAR	124.822	22655180.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.649	0.00

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.54	1.88	4.38	2.21	4.14	2.73
	5.32	4.79	5.44	3.60	2.36	3.98
STD. DEVIATIONS	2.16	1.22	2.58	1.21	2.31	1.09
	5.09	3.03	2.32	3.18	0.62	0.26
RUNOFF						
TOTALS	1.852	0.404	1.345	0.707	1.449	0.623
	2.607	2.043	2.880	1.736	0.558	1.352
STD. DEVIATIONS	1.516	0.375	1.493	0.799	1.087	0.337
	3.210	1.756	1.607	1.940	0.147	0.291

EVAPOTRANSPIRATION

TOTALS	1.382	1.515	2.464	1.854	3.341	2.499
	2.575	2.429	2.148	2.045	1.150	1.064
STD. DEVIATIONS	0.193	0.427	0.689	0.403	1.350	0.653
	1.720	0.859	0.783	0.719	0.391	0.160

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	0.0934	0.0574	0.0434	0.0145	0.0145	0.0217
	0.0434	0.0648	0.1074	0.1076	0.1006	0.1289
STD. DEVIATIONS	0.0541	0.0599	0.0471	0.0324	0.0199	0.0198
	0.0301	0.0469	0.0713	0.0668	0.0588	0.0823

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	45.37	(10.898)	8234655.5	100.00
RUNOFF	17.555	(6.5818)	3186173.75	38.692
EVAPOTRANSPIRATION	24.467	(3.5815)	4440696.50	53.927
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.79757	(0.51577)	144759.750	1.75793
CHANGE IN WATER STORAGE	2.551	(1.8817)	463024.69	5.623

****

PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	4.73	858495.000
RUNOFF	3.952	717203.0620
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.036674	6656.33447
SNOW WATER	2.68	487060.4370
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.1920
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0490

****

FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	114.1801	0.1359
2	10.6419	0.2217
SNOW WATER	0.000	

****

****

Appendix-C

Appendix C

Groundwater Radial Modeling Run

International Paper simulation of chloride from industrial landfill to MW-7A for 5 years

Model: RADIAL

PROJECT......... = CL RAD R5 5Y
USER NAME....... = MLT
DATE............ = 10-16-1997
DATA FILE....... = l:\ip2\cl5y.dat

INPUT DATA:

WELL RECHARGE RATE................ = 12.6 [m3/d]
AQUIFER THICKNESS................. = 3.05 [m]
POROSITY.......................... = .35
LONGITUDINAL DISPERSIVITY......... = 10 [m]
CONCENTRATION OF INJECTED FLUID... = 1860 [mg/l]
RETARDATION FACTOR................ = 1
DISTANCE INCREMENT................ = 50 [m]
NUMBER OF DISTANCE INCREMENTS..... = 10
NUMBER OF TIME PERIODS............ = 1
1 TIME....................... = 1825 [d]

CONCENTRATION C [mg/l]

DISTANCE [m]	1 TIME 1825.00 [d]
0.0000	1.8600D+03
50.0000	1.8442D+03
100.0000	5.0474D+02
150.0000	9.2217D+01
200.0000	2.1630D+01
250.0000	5.9626D+00
300.0000	1.8084D+00
350.0000	5.8238D-01
400.0000	1.9528D-01
450.0000	6.7397D-02
500.0000	2.3776D-02

International Paper simulation of chloride from industrial landfill to MW-7A for 10 years

Model: RADIAL

PROJECT......... = CL RAD R5 10Y
USER NAME....... = MLT
DATE............ = 10-16-1997
DATA FILE....... = l:\ip2\cl10y.out

INPUT DATA:

WELL RECHARGE RATE................ = 12.6 [m3/d]
AQUIFER THICKNESS................. = 3.05 [m]
POROSITY.......................... = .35
LONGITUDINAL DISPERSIVITY......... = 10 [m]
CONCENTRATION OF INJECTED FLUID... = 1860 [mg/l]
RETARDATION FACTOR................ = 1
DISTANCE INCREMENT................ = 50 [m]
NUMBER OF DISTANCE INCREMENTS..... = 10
NUMBER OF TIME PERIODS............ = 1
1 TIME...................... = 3650 [d]

CONCENTRATION C [mg/l]

DISTANCE [m]	1 TIME 3650.00 [d]
0.0000	1.8600D+03
50.0000	1.8600D+03
100.0000	1.4210D+03
150.0000	3.2954D+02
200.0000	6.6872D+01
250.0000	1.5667D+01
300.0000	4.1556D+00
350.0000	1.2035D+00
400.0000	3.7086D-01
450.0000	1.1954D-01
500.0000	3.9869D-02

International Paper simulation of chloride from industrial landfill to MW-7A for 20 years

Model: RADIAL

PROJECT......... = CL RAD R5 20Y
USER NAME....... = MLT
DATE............ = 10-16-1997
DATA FILE....... = l:\ip2\cl20y.dat

INPUT DATA:

WELL RECHARGE RATE................ = 12.6 [m3/d]
AQUIFER THICKNESS................. = 3.05 [m]
POROSITY.......................... = .35
LONGITUDINAL DISPERSIVITY......... = 10 [m]
CONCENTRATION OF INJECTED FLUID... = 1860 [mg/l]
RETARDATION FACTOR................ = 1
DISTANCE INCREMENT................ = 50 [m]
NUMBER OF DISTANCE INCREMENTS..... = 10
NUMBER OF TIME PERIODS............ = 1
1 TIME....................... = 7300 [d]

CONCENTRATION C [mg/l]

DISTANCE [m]	1 TIME 7300.00 [d]
0.0000	1.8600D+03
50.0000	1.8600D+03
100.0000	1.8593D+03
150.0000	1.2987D+03
200.0000	3.6208D+02
250.0000	7.9752D+01
300.0000	1.8323D+01
350.0000	4.5826D+00
400.0000	1.2384D+00
450.0000	3.5638D-01
500.0000	1.0783D-01

International Paper simulation of chloride from industrial landfill to MW-7A for 50 years

Model: RADIAL

PROJECT......... = CL RAD R5 50Y
USER NAME....... = MLT
DATE........... = 10-16-1997
DATA FILE....... = l:\ip2\cl50y.dat

INPUT DATA:

WELL RECHARGE RATE................ = 12.6 [m3/d]
AQUIFER THICKNESS................ = 3.05 [m]
POROSITY.......................... = .35
LONGITUDINAL DISPERSIVITY......... = 10 [m]
CONCENTRATION OF INJECTED FLUID... = 1860 [mg/l]
RETARDATION FACTOR................ = 1
DISTANCE INCREMENT................ = 50 [m]
NUMBER OF DISTANCE INCREMENTS..... = 10
NUMBER OF TIME PERIODS............ = 1
1 TIME...................... = 18250 [d]

CONCENTRATION C [mg/l]

DISTANCE [m]	1 TIME 18250.00 [d]
0.0000	1.8600D+03
50.0000	1.8600D+03
100.0000	1.8600D+03
150.0000	1.8600D+03
200.0000	1.8131D+03
250.0000	1.1473D+03
300.0000	3.9472D+02
350.0000	1.0296D+02
400.0000	2.5000D+01
450.0000	6.1269D+00
500.0000	1.5577D+00

International Paper simulation of total iron from industrial landfill to MW-7A for 5 years

Model: RADIAL

PROJECT......... = T FE R5 RAD 5Y
USER NAME....... = MLT
DATE............ = 10-16-1997
DATA FILE....... = l:\ip2\tfe5y

INPUT DATA:

WELL RECHARGE RATE................ = 12.6 [m3/d]
AQUIFER THICKNESS................ = 3.05 [m]
POROSITY......................... = .35
LONGITUDINAL DISPERSIVITY......... = 10 [m]
CONCENTRATION OF INJECTED FLUID... = .489 [mg/l]
RETARDATION FACTOR................ = 1
DISTANCE INCREMENT................ = 50 [m]
NUMBER OF DISTANCE INCREMENTS..... = 10
NUMBER OF TIME PERIODS............ = 1
1 TIME...................... = 1825 [d]

CONCENTRATION C [mg/l]

DISTANCE [m]	1 TIME 1825.00 [d]
0.0000	4.8900D-01
50.0000	4.8484D-01
100.0000	1.3270D-01
150.0000	2.4244D-02
200.0000	5.6867D-03
250.0000	1.5676D-03
300.0000	4.7543D-04
350.0000	1.5311D-04
400.0000	5.1339D-05
450.0000	1.7719D-05
500.0000	6.2508D-06

International Paper simulation of total iron from industrial landfill to MW-7A for 10 years

Model: RADIAL

PROJECT......... = T FE R5 RAD 10Y
USER NAME....... = MLT
DATE............ = 10-16-1997
DATA FILE....... = l:\ip2\tfe10y.dat

INPUT DATA:

WELL RECHARGE RATE................ = 12.6 [m3/d]
AQUIFER THICKNESS................. = 3.05 [m]
POROSITY.......................... = .35
LONGITUDINAL DISPERSIVITY......... = 10 [m]
CONCENTRATION OF INJECTED FLUID... = .489 [mg/l]
RETARDATION FACTOR................ = 1
DISTANCE INCREMENT................ = 50 [m]
NUMBER OF DISTANCE INCREMENTS..... = 10
NUMBER OF TIME PERIODS............ = 1
1 TIME....................... = 3650 [d]

CONCENTRATION C [mg/l]

DISTANCE [m]	1 TIME 3650.00 [d]
0.0000	4.8900D-01
50.0000	4.8900D-01
100.0000	3.7358D-01
150.0000	8.6638D-02
200.0000	1.7581D-02
250.0000	4.1189D-03
300.0000	1.0925D-03
350.0000	3.1641D-04
400.0000	9.7499D-05
450.0000	3.1429D-05
500.0000	1.0482D-05

International Paper simulation of total iron from industrial landfill to MW-7A for 20 years

Model: RADIAL

PROJECT......... = T FE RAD R5 20Y
USER NAME....... = MLT
DATE............ = 10-16-1997
DATA FILE....... = l:\ip2\tfe20y.dat

INPUT DATA:

WELL RECHARGE RATE................ = 12.6 [m3/d]
AQUIFER THICKNESS................. = 3.05 [m]
POROSITY.......................... = .35
LONGITUDINAL DISPERSIVITY......... = 10 [m]
CONCENTRATION OF INJECTED FLUID... = .489 [mg/l]
RETARDATION FACTOR................ = 1
DISTANCE INCREMENT................ = 50 [m]
NUMBER OF DISTANCE INCREMENTS..... = 10
NUMBER OF TIME PERIODS............ = 1
1 TIME....................... = 7300 [d]

CONCENTRATION C [mg/l]

DISTANCE [m]	1 TIME 7300.00 [d]
0.0000	4.8900D-01
50.0000	4.8900D-01
100.0000	4.8882D-01
150.0000	3.4144D-01
200.0000	9.5192D-02
250.0000	2.0967D-02
300.0000	4.8173D-03
350.0000	1.2048D-03
400.0000	3.2557D-04
450.0000	9.3692D-05
500.0000	2.8349D-05

International Paper simulation of total iron from industrial landfill to MW-7A for 50 years

Model: RADIAL

PROJECT......... = T FE RAD R5 50Y
USER NAME....... = MLT
DATE............ = 10-16-1997
DATA FILE....... = l:\ip2\tfe50y.dat

INPUT DATA:

WELL RECHARGE RATE................ = 12.6 [m3/d]
AQUIFER THICKNESS................. = 3.05 [m]
POROSITY.......................... = .35
LONGITUDINAL DISPERSIVITY......... = 10 [m]
CONCENTRATION OF INJECTED FLUID... = .489 [mg/l]
RETARDATION FACTOR................ = 1
DISTANCE INCREMENT................ = 50 [m]
NUMBER OF DISTANCE INCREMENTS..... = 10
NUMBER OF TIME PERIODS............ = 1
1 TIME...................... = 18250 [d]

CONCENTRATION C [mg/l]

DISTANCE [m]	1 TIME 18250.00 [d]
0.0000	4.8900D-01
50.0000	4.8900D-01
100.0000	4.8900D-01
150.0000	4.8900D-01
200.0000	4.7666D-01
250.0000	3.0164D-01
300.0000	1.0377D-01
350.0000	2.7068D-02
400.0000	6.5725D-03
450.0000	1.6108D-03
500.0000	4.0954D-04

C:\MLT\PRN\P\RADSUM2.MLT

International Paper simulation of total manganese from industrial landfill to MW-7A for 5 years

Model: RADIAL

PROJECT......... = T MN RAD R5 5Y
USER NAME....... = MLT
DATE............ = 10-16-1997
DATA FILE....... = l:\ip2\tmn5y.dat

INPUT DATA:

WELL RECHARGE RATE................ = 12.6 [m3/d]
AQUIFER THICKNESS................ = 3.05 [m]
POROSITY.......................... = .35
LONGITUDINAL DISPERSIVITY......... = 10 [m]
CONCENTRATION OF INJECTED FLUID... = 2.11 [mg/l]
RETARDATION FACTOR................ = 1
DISTANCE INCREMENT................ = 50 [m]
NUMBER OF DISTANCE INCREMENTS..... = 10
NUMBER OF TIME PERIODS............ = 1
1 TIME....................... = 1825 [d]

CONCENTRATION C [mg/l]

DISTANCE [m]	1 TIME 1825.00 [d]
0.0000	2.1100D+00
50.0000	2.0920D+00
100.0000	5.7258D-01
150.0000	1.0461D-01
200.0000	2.4538D-02
250.0000	6.7640D-03
300.0000	2.0514D-03
350.0000	6.6066D-04
400.0000	2.2152D-04
450.0000	7.6456D-05
500.0000	2.6972D-05

C:\MLT\PRJNP\RADSUM2.MLT

International Paper simulation of total manganese from industrial landfill to MW-7A for 10 years

Model: RADIAL

PROJECT......... = T MN RAD R5 10Y
USER NAME....... = MLT
DATE............ = 10-16-1997
DATA FILE....... = l:\ip2\tmn10y.dat

INPUT DATA:

WELL RECHARGE RATE................ = 12.6 [m3/d]
AQUIFER THICKNESS................. = 3.05 [m]
POROSITY.......................... = .35
LONGITUDINAL DISPERSIVITY......... = 10 [m]
CONCENTRATION OF INJECTED FLUID... = 2.11 [mg/l]
RETARDATION FACTOR................ = 1
DISTANCE INCREMENT................ = 50 [m]
NUMBER OF DISTANCE INCREMENTS..... = 10
NUMBER OF TIME PERIODS............ = 1
1 TIME....................... = 3650 [d]

CONCENTRATION C [mg/l]

DISTANCE [m]	1 TIME 3650.00 [d]
0.0000	2.1100D+00
50.0000	2.1100D+00
100.0000	1.6120D+00
150.0000	3.7384D-01
200.0000	7.5860D-02
250.0000	1.7773D-02
300.0000	4.7142D-03
350.0000	1.3653D-03
400.0000	4.2070D-04
450.0000	1.3561D-04
500.0000	4.5228D-05

International Paper simulation of total manganese from industrial landfill to MW-7A for 20 years

Model: RADIAL

PROJECT......... = T MN RAD R5 20Y
USER NAME....... = MLT
DATE............ = 10-16-1997
DATA FILE....... = l:\ip2\tmn20y.dat

INPUT DATA:

WELL RECHARGE RATE................ = 12.6 [m3/d]
AQUIFER THICKNESS................. = 3.05 [m]
POROSITY.......................... = .35
LONGITUDINAL DISPERSIVITY......... = 10 [m]
CONCENTRATION OF INJECTED FLUID... = 2.11 [mg/l]
RETARDATION FACTOR................ = 1
DISTANCE INCREMENT................ = 50 [m]
NUMBER OF DISTANCE INCREMENTS..... = 10
NUMBER OF TIME PERIODS............ = 1
1 TIME...................... = 7300 [d]

CONCENTRATION C [mg/l]

DISTANCE [m]	1 TIME 7300.00 [d]
0.0000	2.1100D+00
50.0000	2.1100D+00
100.0000	2.1092D+00
150.0000	1.4733D+00
200.0000	4.1075D-01
250.0000	9.0472D-02
300.0000	2.0786D-02
350.0000	5.1986D-03
400.0000	1.4048D-03
450.0000	4.0428D-04
500.0000	1.2233D-04

International Paper simulation of total manganese from industrial landfill to MW-7A for 50 years

Model: RADIAL

PROJECT......... = T MN RAD R5 50Y
USER NAME....... = MLT
DATE............ = 10-16-1997
DATA FILE....... = l:\ip2\tmn50y.dat

INPUT DATA:

WELL RECHARGE RATE................ = 12.6 [m3/d]
AQUIFER THICKNESS................. = 3.05 [m]
POROSITY.......................... = .35
LONGITUDINAL DISPERSIVITY......... = 10 [m]
CONCENTRATION OF INJECTED FLUID... = 2.11 [mg/l]
RETARDATION FACTOR................ = 1
DISTANCE INCREMENT................ = 50 [m]
NUMBER OF DISTANCE INCREMENTS..... = 10
NUMBER OF TIME PERIODS............ = 1
1 TIME....................... = 18250 [d]

CONCENTRATION C [mg/l]

DISTANCE [m]	1 TIME 18250.00 [d]
0.0000	2.1100D+00
50.0000	2.1100D+00
100.0000	2.1100D+00
150.0000	2.1100D+00
200.0000	2.0567D+00
250.0000	1.3016D+00
300.0000	4.4777D-01
350.0000	1.1680D-01
400.0000	2.8360D-02
450.0000	6.9504D-03
500.0000	1.7671D-03

Appendix- D

Appendix D

Soil Test Results

S&ME

June 30, 1997

International Paper Company
John L. Riegel Road
Riegelwood, North Carolina 28456

Attention: Ms. Rhonda Hall

Reference: Laboratory Soils Testing
Sand and Sludge Material
International Paper Company
Riegelwood, North Carolina
Job No. 1063-97-269

Dear Ms. Hall:

As requested, S&ME personnel have conducted laboratory soils testing of two bulk samples obtained by others at the subject site. The sludge material was subjected to standard Proctor compaction testing (ASTM D-698), whereas the mixture of sand and sludge was subjected to standard Proctor compaction testing and remolded permeability testing (ASTM D-5084).

The results of this laboratory testing indicate the following:

Sample:	1	2
Soil Description:	Black Fine to Medium SAND – Some Silt, Sludge, and Organics	Black Sludge
Maximum Dry Density:	115.0 pcf	60.4 pcf
Optimum Moisture Content:	11.5%	45.0%
Hydraulic Conductivity:	1.0×10^{-4} cm/sec	--

We appreciate having the opportunity to provide our services. Should you have any questions after reviewing this letter, please do not hesitate to contact us.

Very truly yours,

S&ME, INC.

Steven D. Kelly, P.E.
Branch Manager

Michael W. Behen, P.E.
Senior Geotechnical Engineer

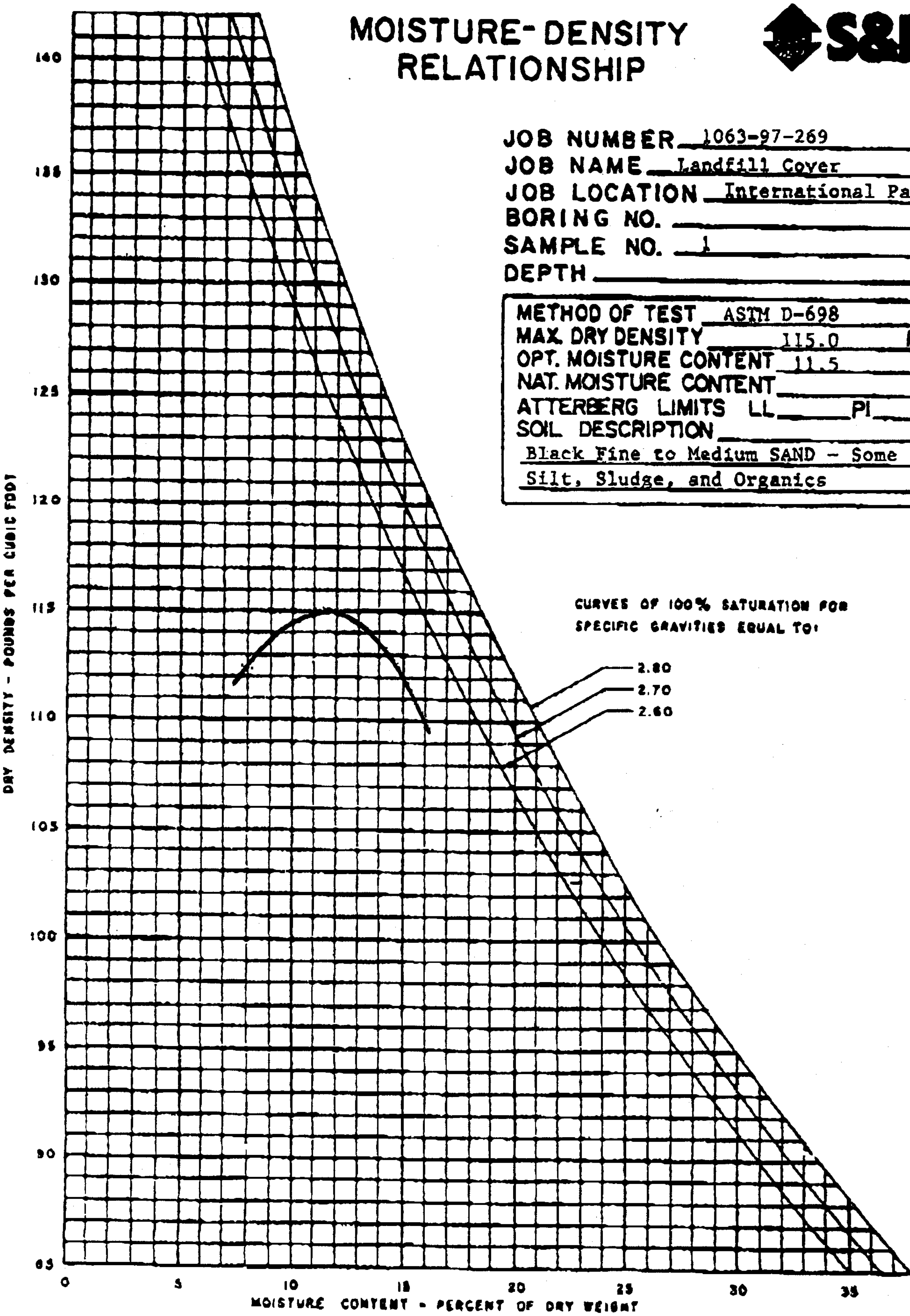
SDK:MWB/jns
Attachments

MOISTURE-DENSITY RELATIONSHIP

S&ME

JOB NUMBER 1063-97-269
JOB NAME Landfill Cover
JOB LOCATION International Paper
BORING NO.
SAMPLE NO. 1
DEPTH

METHOD OF TEST ASTM D-698
MAX. DRY DENSITY 115.0 PCF
OPT. MOISTURE CONTENT 11.5 %
NAT. MOISTURE CONTENT %
ATTERBERG LIMITS LL PI
SOIL DESCRIPTION
Black Fine to Medium SAND - Some Silt, Sludge, and Organics

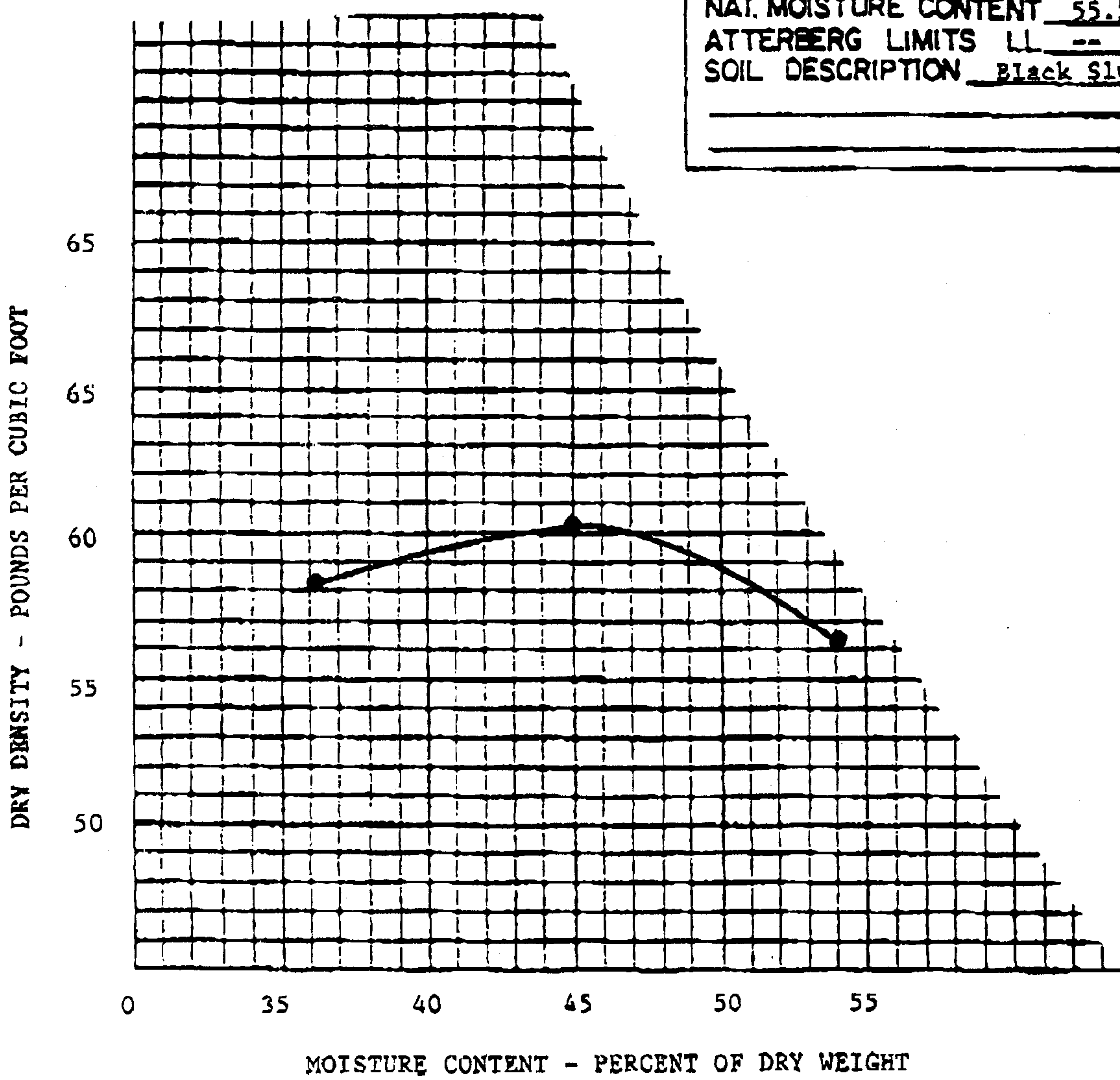


MOISTURE-DENSITY RELATIONSHIP

S&ME

JOB NUMBER 1063-97-269
JOB NAME Landfill Cover
JOB LOCATION International Paper
BORING NO.
SAMPLE NO. 2
DEPTH

METHOD OF TEST ASTM D-698
MAX. DRY DENSITY 60.4 PCF
OPT. MOISTURE CONTENT 45.0 %
NAT. MOISTURE CONTENT 55.5 %
ATTERBERG LIMITS LL -- PI --
SOIL DESCRIPTION Black Sludge



PROJECT		
LANDFILL COVER INTERNATIONAL PAPER CO. RIEGELWOOD, NC	S&ME	SCALE: Not to scale JOB NO: 1063-97-269 FIG. NO:

HYDRAULIC CONDUCTIVITY TEST
(Falling Head\Increasing Tailwater)
ASTM C 5084 METHOD (C)

JOB # 1063-97-269 JOB NAME: INTERNATIONAL PAPER

DATE: 6-27-97 SAMPLE: 1 BAG DEPTH : N/A

SOIL DESCRIPTION: BLACK SILTY MED TO FINE SAND WITH SLUDGE AND ORGANICS

NOTES : Test specimen remolded from bag sample delivered to office.

TARGET: Remold compaction of 85% @ 15% moisture content.
Test specimen was consolidated with 3 PSI confining pressure

PROCTOR DATA:
MAX DRY DENSITY: 115 PCF
OPTIMUM MOISTURE 11.5 %

REMOLD DATA:
MDD: 97.9 PCF
MOISTURE: 15.1 %
COMPACTION: 85.2 %

SAMPLE DATA :
Length: 7.740 cm.
Diameter: 7.300 cm.
Area: 41.85 sq.cm.
Volume: 323.95 cu.cm.
Wet Weight 585.00 grams
Dry Weight 508.3 grams
WATER TEMP. (C) 26.0
CORR. FACTOR 0.8694

Moisture Content: 15.1 %
Wet Density: 112.7 PCF
Dry Density: 97.9 PCF
Initial Saturation: 58.1 %
Final Saturation: 98.6 %
Initial Void Ratio: 0.689
Porosity: 0.408
Spec. G. (apparent): 2.65
Final Moisture (After Test) 22.7 %

TEST DATA

k = (aL/2At) X In(h1/h2)
RATIO = Hv1-Hv2 / Hc2
(hv1-hc1=h1) INITIAL LOSS
(hv2-hc2=h2) FINAL LOSS
i = h1/L

k = HYDRAULIC CONDUCTIVITY
L = 7.74 cm. length of sample
A = 41.85 sq.cm. area of sample
a = 0.72 sq.cm. area of burett
t = Elapsed time of test (seconds)
i = MAXIMUM HYDRAULIC GRADIENT

Elapsed t/sec	Hv1	Hc1	Hv2	Hc2	h1	h2	(i) H.G.
180	15.0	0.0	13.0	2.0	15.0	11.0	1.9
120	15.0	0.0	13.6	1.4	15.0	12.2	1.9
180	15.0	0.0	13.0	2.0	15.0	11.0	1.9
120	15.0	0.0	13.6	1.4	15.0	12.2	1.9

1. k =1.15E-04 cm./sec.
2. k =1.15E-04 cm./sec.
3. k =1.15E-04 cm./sec.
4. k =1.15E-04 cm./sec.

AVERAGE :
k = 9.97E-05 cm./sec.
i = 1.9

FINAL (k) VALUE AVERAGE WITH WATER TEMPERATURE CORRECTION.

Tested by: M. KRAJAN Checked by: D. CARVER

HYDRAULIC CONDUCTIVITY TEST
(Falling Head\Increasing Tailwater)
ASTM C 5084 METHOD (C)

JOB # 1063-97-269 JOB NAME: INTERNATIONAL PAPER

DATE: 7-7-97 SAMPLE: 2 BAG DEPTH : N/A

SOIL DESCRIPTION: BLACK SILTY MED TO FINE SAND WITH SLUDGE AND ORGANICS

NOTES : Test specimen remolded from bag sample delivered to office.

TARGET: Remold compaction of 90% @ 15% moisture content.
Test specimen was consolidated with 3 PSI confining pressure.

PROCTOR DATA:
MAX DRY DENSITY: 115 PCF
OPTIMUM MOISTURE 11.5 %

REMOLD DATA:
MDD: 103.7 PCF
MOISTURE: 15.2 %
COMPACTION: 90.2 %

SAMPLE DATA :
Length: 7.740 cm.
Diameter: 7.300 cm.
Area: 41.85 sq.cm.
Volume: 323.95 cu.cm.
Wet Weight 620.00 grams
Dry Weight 538.2 grams
WATER TEMP. (C) 26.0
CORR. FACTOR 0.8694

Moisture Content: 15.2 %
Wet Density: 119.5 PCF
Dry Density: 103.7 PCF
Initial Saturation: 67.7 %
Final Saturation: 99.8 %
Initial Void Ratio: 0.595
Porosity: 0.373
Spec. G. (apparent): 2.65
Final Moisture (After Test) 19.8 %

TEST DATA

k = (aL/2At) X ln(h1/h2)
RATIO = Hv1-Hv2 / Hc2
(hv1-hc1=h1) INITIAL LOSS
(hv2-hc2=h2) FINAL LOSS
i = h1/L

k = HYDRAULIC CONDUCTIVITY
L = 7.74 cm. length of sample
A = 41.85 sq.cm. area of sample
a = 0.72 sq.cm. area of burett
t = Elapsed time of test (seconds)
i = MAXIMUM HYDRAULIC GRADIENT

Elapsed t/sec.	Hv1	Hc1	Hv2	Hc2	h1	h2	(i) H.G.
120	15.0	0.0	13.9	1.1	15.0	12.8	1.9
240	15.0	0.0	13.0	2.1	15.0	10.9	1.9
180	15.0	0.0	13.4	1.6	15.0	11.8	1.9
120	15.0	0.0	13.9	1.1	15.0	12.8	1.9

1. k =8.80E-05 cm./sec.
2. k =8.86E-05 cm./sec.
3. k =8.87E-05 cm./sec.
4. k =8.80E-05 cm./sec.

AVERAGE :
k = 7.68E-05 cm./sec.
i = 1.9

FINAL (k) VALUE AVERAGE WITH WATER TEMPERATURE CORRECTION.

Tested by: M. KRAJAN Checked by: D. CARVER