Prepared for

Loudon County Solid Waste Disposal Commission
Loudon County, Tennessee

FINANCIAL AND COMPLIANCE REVIEW
MATLOCK BEND LANDFILL
LOUDON COUNTY, TENNESSEE

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Project Number KX5238

June 2013

EXECUTIVE SUMMARY

Geosyntec Consultants, Inc. (Geosyntec) completed a financial and compliance review of the Matlock Bend Landfill (the Landfill) in Loudon, Loudon County, Tennessee. The Landfill is located on 21712 Highway 72 North in Loudon, Loudon County, Tennessee and is a Tennessee Department of Environment and Conservation (TDEC) permitted Class I municipal solid waste (MSW) landfill. The Landfill is owned by the Loudon County Solid Waste Disposal Commission (LCSWDC) and is operated, under contract, by Santek Waste Services, Inc. (Santek) headquartered in Cleveland, Tennessee. LCSWDC currently owns approximately 247 acres of contiguous property, of which approximately 41.5 acres is currently permitted for the Landfill. Santek submitted a permit application to TDEC for an expansion of the Landfill footprint to approximately 67 acres. To date, this permit modification for the Landfill expansion has not been approved but it remains pending before TDEC.

This review was conducted to assess the financial viability of the Landfill, specifically to determine if sufficient funds are being accrued to eventually close the landfill and fund post-closure care. The current contract between LCSWDC and Santek was also evaluated to assess compliance with contractual obligations and applicable regulations and permit requirements.

Geosyntec constructed a Financial Model of the Landfill to forecast the LCSWDC revenue and its ability to accrue adequate funds for Closure/Post-Closure Care (C/PCC) obligations. The C/PPC Security Fee provides a method of accruing for certain of such costs. While the liability for C/PCC was adequately funded at the start of the 2007 Operation Agreement (OA) between the LCSWDC and Santek, the C/PPC Security Fee of $1.00 per ton or 5% of the tipping fee has not been adequate to accrue funds for the C/PCC liability associated with each ton of waste. While lower than proposed tipping fees may contribute to the shortfall, it does not appear that the contract C/PCC security fee should have been expected to cover the $2.92 per ton liability for C/PCC costs of the currently permitted landfill. While the proposed expansion has a lower per ton liability for C/PCC, the required $2.35 still exceeds the C/PCC cost accrual rate. With or without the expansion, the current C/PCC accrual will not meet the associated liability. The currently permitted landfill will likely exhaust its remaining capacity in 2019, prior to the termination of the OA, with a shortfall of approximately $4.9 million. Similarly, with the proposed expansion, the LCSWDC will have under accrued for the C/PCC liability at the end of the OA by approximately $5.3 million. In order to ensure that the accrual compensates for the under accrual to date and adequately covers the liability for the additional tonnage, a C/PCC accrual of $3.86 per ton would be

needed for the currently permitted landfill and $2.46 per ton would be needed for the expanded facility. Additionally, the permitted impact of an active gas extraction system and acquisition of soil from outside of the waste boundaries should be further evaluated to determine if it is appropriate to include them in the C/PCC cost per ton. These issues could potentially increase the C/PCC liability by an additional $0.55 per ton for the currently permitted landfill and $2.00 per ton for the expanded facility.

An assessment was conducted to identify potential compliance concerns that could affect operations of the Landfill. Inspections were conducted between November 2012 and March 2013 to assess the Landfill for potential compliance concerns. The TDEC Facility Evaluation Checklist provided the items examined during this assessment. Overall, the Landfill is operated in general accordance with industry standards and TDEC regulations. Some potential issues were observed with stormwater controls at the Landfill which included lack of vegetative cover, potentially accumulated sediment in one of the stormwater ponds, indications of downstream discharges of sediment from this pond, and inadequate mud removal controls before trucks leave the Landfill and enter Highway 72 North.

Overall results of the assessment indicate that there is a shortfall in revenue to cover C/PCC costs either currently or over the life of the Landfill with or without the major permit modification. Additional sources of revenue to make up for the shortfall in C/PCC accruals will need to be explored; however, an anticipated C/PCC cost savings can be realized with approval and execution of the major permit modification. Generally, the Landfill is operated in accordance with industry standards, applicable regulations, and the Landfill OA between the LCSWDC and Santek.

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1. INTRODUCTION

1.1 Terms of Reference

The Matlock Bend Landfill (Landfill) is owned by the Loudon County Solid Waste Disposal Commission (LCSWDC) and operated by Santek Waste Services, Inc. (Santek) under contract to LCSWDC pursuant to the 2007 Operation Agreement (OA). In its 21 September 2012 Request for Qualifications/Proposal (RFQ/P), LCSWDC requested a technical and cost proposal for professional services to conduct a critical review of Landfill operations and financial accruals to assess: (i) Santek's compliance with the 2007 OA between LCSWDC and Santek and applicable Tennessee Department of Environment and Conservation (TDEC) regulations; and (ii) whether sufficient funds were being accrued to cover the anticipated closure/post closure care (C/PCC) obligations at the Landfill. Geosyntec Consultants, Inc. (Geosyntec) was retained by LCSWDC to provide this review. The contract between Geosyntec and LCSWDC was executed on 11 January 2013.

1.2 Scope of Work

The scope of work as identified in the RFQ/P indicated that the selected consultant should:

- conduct an evaluation of the financial sustainability of the landfill to determine if sufficient revenues were being generated under the OA to operate and eventually close the Landfill in accordance with all C/PCC requirements (financial evaluation), and

- assess Santek's compliance with terms of the OA and applicable TDEC rules and regulations to assure a well-run facility in keeping with the best interest of LCSWDC and governmental stakeholders (operational evaluation).

The specific activities identified in the RFQ/P regarding the financial and operational evaluations are identified in the remainder of this section.

1.2.1 Financial Evaluation

The financial evaluation of the Landfill consisted of the following activities:

- interviews of the LCSWDC members, and Loudon County's Auditor, General Counsel, Mayor, and Finance Director as necessary to understand the financial aspects of the Landfill's operations and the future needs for sustainability;

- review of records compiled over at least three full calendar years commencing on or after 1 October 2007 that provide: (i) monthly tonnage reports provided to LCSWDC by Santek; (ii) annual audit reports; (iii) annual TDEC reports; and (iv) other available financial records;

- review of records and reports provided by Santek to verify that the reported waste receipts (i.e., tonnage) were properly recorded and that appropriate fees were paid to LCSWDC;

- review and independently estimate the projected closure and post-closure costs at the end of the OA's term assuming that the currently proposed major permit modification is approved by TDEC and implemented by LCSWDC and Santek;

- provide an estimation of the revenue that should be received by LCSWDC based on the current provisions of the OA and available historical and current projections based on Geosyntec's best estimate of waste receipts; and

- provide shortfall/surplus projections for the estimated costs of C/PCC at the termination of the OA.

1.2.2 Compliance Evaluation

The compliance evaluation of the Landfill consisted of the following activities:

- walking inspection of the current footprint and perimeter of the Landfill to verify the compliance of Landfill operations with applicable TDEC regulations;

- inspection of the stormwater management features and measures implemented by Santek to assure trucks leave the Landfill with clean tires;

- observation of operations during wet weather to report procedures used to assure cleanup of mud at the Landfill exit onto Highway 72 North; and

- observation of waste and estimation of the tonnage received at the Landfill over a minimum of four days to compare estimated tonnage with Santek's recorded weigh tickets.

1.3 Matlock Bend Landfill Overview

The Landfill is located at 21712 Highway 72 North in Loudon, Loudon County, Tennessee and is a TDEC permitted Class I municipal solid waste (MSW) landfill. The

Landfill is bordered by a mixture of residential properties, industrial properties, and wooded, vacant land. According to Loudon County property inventory cards provided in LCWDC's 9 October 2012 meeting minutes (LCSWDC, October 2009), the initial 151 acres was acquired by the LCSWDC in 1994.

Approximately 41.5 acres are currently permitted to accept municipal solid waste and special waste, which includes industrial waste and sludge, asbestos, and tires. Tires are separated for recycling. The Landfill has a roll-off container for metal recycling located near the maintenance building. Phase I of the Landfill (previously owned and operated by the City of Loudon) was closed in the early 1990s and post closure care (PCC) is the responsibility of Santek in accordance with terms in the OA. In 2010, LCSWDC purchased approximately 46 acres in two different property purchases. In 2011, LCSWDC purchased two parcels that comprised approximately 58 acres. A property exchange in February 2013 reduced the acreage by approximately eight acres. Currently, LCSWDC owns approximately 247 acres of contiguous property. According to the property inventory cards, LCSWDC expended approximately $1.15 million in property purchases since 2010 inclusive of sale price, real estate commissions, survey costs, title insurance and closing costs.

As stated in the OA, unless otherwise expressly permitted in writing by LCSWDC, Santek is not allowed to accept more than 800 tons of waste per day as calculated on a daily average for any running 30 day period. Santek's Landfill Manager, Mr. Levi Higdon, reported to Geosyntec that the Landfill is permitted to accept up to 17 percent of the total tonnage per day as industrial waste sludge (i.e., special waste); however, the Landfill currently accepts approximately 10 to 12 percent sludge on a daily basis.

According to Santek's 1996 permit drawings (Santek, 1996), the Phase II/IV upgrade comprises ten modules designated Modules A through J. When Geosyntec visited the Landfill on 31 October 2012, Santek was placing waste in Module F. During a 30 November 2012 Landfill visit, Geosyntec noted that Santek was placing waste in Module H. Mr. Higdon indicated that an intermediate cover had been placed over Module F and that this module was not at final grade.

1.4 Density and Airspace Reports

Geosyntec reviewed the annual Airspace Utilization Factors (AUF) as calculated by Santek and presented in Table 1. This table also includes information provided by Santek regarding the quantity of soil that was used for daily cover during these time intervals. The annual AUF has ranged from 2.82 to 1.15 cubic yards (CY) of airspace per ton of waste (CY/Ton). The AUF seems to have a direct correlation with the

amount of soil used for daily cover, in that periods of high AUF (i.e., low utilization of airspace) typically correlate to periods of high soil usage. In September of 2012 Santek calculated the life-of-site AUF to be 1.38 CY/Ton. For the purpose of this evaluation, Geosyntec used this value for projecting life expectancy and capacity. AUF numbers are highly variable depending on the site and various other factors. Based on Geosyntec's experience with landfill operations, we consider an AUF of 1.38 CY/ton to be an average value.

These data provide information regarding the operational performance of the Landfill, the amount of consumed airspace, and the soil usage. This information will be used in the financial assessment and the evaluation of the C/PCC costs.

1.5 November 2010 Slope Failure

A waste slope failure (failure) occurred on 3 November 2010 in Module G of the Landfill. As a result of the failure, TDEC issued a Director's Order (Order) to LCSWDC and Santek (Geosyntec, 2011). The Order identified specific requirements including the preparation of a root cause assessment report, which included both short- and long-term recommendations regarding the stabilization of the Landfill. The assessment was conducted by Geosyntec.

The assessment findings indicated that increased liquid levels in the landfill, which were not being effectively conveyed to the leachate collection system (LCS), contributed to the failure (Geosyntec, 2011). According to the report, the elevated liquid levels were the result of large amounts of sludge (approximately 40% of the total volume and the root cause of the failure) that had been placed, mixed, and compacted in this Module.

By 20 November 2012, Santek had completed the last of the rehabilitation activities (i.e. graded soil cover over exposed waste). Geosyntec assisted Santek in determining a mixing ratio of solids and sludge to reduce the amount of free liquids during future waste placement. According to Mr. Higdon, the percentage of sludge placed in the Landfill on a daily basis was also reduced by administrative controls. Since the slope failure in 2010 and subsequent corrective actions, additional slope failures have not occurred.

1.6 Landfill Expansion - Major Permit Modification

Santek submitted the document titled *Matlock Bend Class I Landfill – Expansion Part 2B Permit Application* (Major Modification Permit Application) to TDEC in August

2009 (Santek, 2009). The Major Modification Permit Application describes the construction and expansion of the Landfill from its current footprint of approximately 40 acres to a new footprint of approximately 67 acres. As of 8 March 2013, Santek indicated to Geosyntec that it is addressing what is believed to be the final TDEC comments. If the expansion of the Landfill is approved and implemented, the Phase II/IV modules will be incorporated into the final closure of the expanded footprint.

1.7 Interviews

All of the Commissioners for the LCSWDC were interviewed as part of this assessment with the exception of Ms. Aprell Patterson. Mr. Robert Harrison, Mr. Jim Aikens, Mr. Bill Waldrop, and Mr. John Watkins were interviewed individually on 8 January 2012. Mr. Ted Sitzlar was interviewed on 1 March 2013. Mr. Steve Field was interviewed on various occasions throughout the course of this assessment.

In addition to the LCSWDC commissioner interviews, Geosyntec interviewed: (i) Ms. Estelle Herron, the Loudon County Mayor; (ii) Ms. Tracy Blair, the Budget Director for Loudon County; (iii) Mr. Richard Hill of Mitchell Emert & Hill, P.C., LCSWDC's Auditor; and (iv) Mr. Kevin Stevens, Esq., LCSWDC's General Counsel. The purpose of these interviews was to get the opinions from these interested stakeholders regarding perceptions and/or concerns regarding operation and financial performance of the Landfill. The results of the interviews are summarized as follows:

- Landfill Operations: Most of those interviewed reported that they had received concerns from the public (or had personal concerns) regarding aspects of Landfill operations, including stormwater management, mud on the highway during periods of wet weather, absence of a recycling program, and questions of adequate waste compaction. The issues identified during these interviews were specifically investigated during Geosyntec's site inspection visits and compliance review.

- Landfill Financial Performance: All of those interviewed were aware of the scope of Geosyntec's current study regarding the financial and compliance review and expressed concerns that there is reportedly an inadequate accrual of funds to cover long-term closure and post-closure obligations. They all expressed a desire for this independent assessment of the financial performance of the Landfill to investigate the current reported shortfall.

2. FINANCIAL EVALUATION

2.1 Overview

As part of the project, Geosyntec was requested to conduct a review of the financial records from Santek and Loudon County and then provide an assessment of these records and compliance with the OA between LCSWDC and Santek. To accomplish these tasks, Geosyntec was provided for its review the following documents related to the transactions between Santek and LCSWDC and records maintained by Loudon County:

- tonnage receipts by customer type (i.e., Stakeholder, Gate Rate Customers, and Customers receiving special pricing);
- tipping fees by customer type;
- contractor revenue by customer;
- host fees and C/PCC security fees to LCSWDC;
- LCSWDC audited financials 2007 through 2012;
- OA between LCSWDC and Santek;
- RFP from LCSWDC for the 2007 OA;
- Santek's proposal to LCSWDC for the 2007 OA
- annual inflation adjustment from the Tennessee Department of Environment and Conversation (TDEC);
- remaining life form from Santek dated March 2, 2012; and
- LCSWDC meeting minutes.

2.2 Review of Costs for Landfill Closure and Post-Closure Care Monitoring

A review of the C/PCC costs was performed. The review considered material quantities, unit costs for materials, normalized cost per acre and operational and compliance considerations. The review included information provided by Santek in its 1996 permit application and cost details for C/PCC of the potential expansion.

Appendix A provides the relevant portions of these documents. Using the unit cost and material quantities for closure as provided by Santek, Geosyntec calculated C/PCC costs for the currently permitted Landfill comprising 41.5 acres and for proposed landfill expansion comprising a total of 67 acres. A cost comparison of these two conditions is presented in Tables 2 and 3. These costs were used to project the liability and accruals for C/PCC. Table 4 provides summary details regarding these projections and the ability of the C/PCC accrual mechanisms to cover the liability associated with each ton. The table provides liability and accrual data for periods of the Landfill's life. Assumptions include:

- The C/PCC cost for the currently permitted landfill was calculated by applying the inflationary factors provided by the state from 1996 through 2012 and 3 percent annual inflation from 2013 to closure.

- The C/PCC cost for the proposed expansion applied a 3 percent inflation factor annually until closure. This rate is consistent with the rate used in Santek's 1996 Closure/Post-Closure Plan (Santek, 1996).

- Cost per Permit Ton was based on the volume of the landfill and an assumed AUF of 1.38 CY/Ton.

- Cost per Remaining Ton was calculated from the C/PCC cost, the tons remaining at each period and any accrual variance. This is the accrual cost per ton needed for all remaining tons to meet the C/PCC reserves at closure.

For each period shown in Table 4, the C/PCC liability represents the anticipated airspace depletion percentage of the Landfill for the given period. The Accrual Variance is the difference between the calculated liability and the accrual (actual or forecasted). The accrual is the sum of the PCC Security Fee and the $2.47 million accrued by LCSWDC prior to the execution of the OA. This accrual does not account for non-liquid assets such as land. Land purchases may provide cost savings for long term operation, construction and post-closure care; however, potential cost savings are dependent on the LCSWDS's long term plans for the property. Detailed results are presented in Appendix B (Model Runs).

Based on Geosyntec experience, these calculated costs per acre for these scenarios appear to be consistent with similarly designed facilities. However, the Geosyntec review identified two important factors that currently are not being considered by Santek. The C/PCC costs presented in Table 2 and Table 3 for both the "as permitted" and "expansion" conditions do not anticipate: (i) installation, operation, and

maintenance of an active landfill gas extraction system; and (ii) depletion of on-site soil during the OA. The impacts of these factors are summarized below.

- Active gas collection and control system (GCCS): Based on the design capacity of both the current Landfill and the proposed expansion, Geosyntec anticipates that Landfill emissions will necessitate an active GCCS. This system would replace the current passive system considered by Santek. Geosyntec estimates that the GCCS could potentially increase Closure costs by $10,000 to $20,000 per acre and the annual PCC cost by $1,000 per acre. Table 5 summarizes the potential incremental increase in the previously calculated C/PCC costs for the Landfill, assuming a mid-range cost of $15,000 per acre for the cost of the GCCS.

- Soil Depletion: With regards to the potential impact related to the site soil balance, Santek reported an average soil utilization of 27.7 percent (see Table 6) to support operations (i.e., liner, berms, and daily cover). In the permit application for the expansion, Santek assumed an average soil utilization of 15 percent usage. While significantly less than the recently reported average, this latter value seems a more reasonable estimate based on Geosyntec's experience. Using 15 percent for the target soil utilization, the expansion condition anticipates a soil deficit of 1.2 million CY. The cost to purchase the soil should be included in the closure cost estimate. As referenced in the OA, any land purchased for the purpose of providing soil shall be at Santek's expense. The cost of soil from an offsite source can be highly variable; however, $7 to $9 per CY is a reasonable estimate in Geosyntec's experience. Table 6 provides a summary of the potential incremental impact of the offsite purchase of soils based on 15 percent soil utilization for operations and a cost of $7 per CY (i.e., assuming the LCSWDC will provide soil to Santek at the lower limit of the anticipated price range). This table makes an adjustment to the soil cost presented by Santek in the closure cost, in which Santek only assumed soil excavation costs from an onsite source of $1.80.

Specific details regarding the need for a GCCS and the actual amount of soil that may need to be imported to meet TDEC requirements and OA obligations are not fully understood by Geosyntec at this time. However, information presented in this section indicates that the cost accruals required to meet the C/PCC obligations over the life of the OA are potentially significant.

- In the case of the currently permitted landfill, a price per ton of $3.86 would be needed to catch-up with C/PCC liabilities. An additional fee of $0.55 per ton would potentially be needed for a GCCS increasing the price to approximately $4.41 per ton.

- If the Landfill is expanded, a current price per ton of $2.46 would be needed to meet C/PCC liabilities. Fees for a GCCS and offsite soils purchases of $1.43 and $0.57 per ton, respectively, would increase the price per ton to approximately $4.46.

This amount is higher than Geosyntec would consider being "typical" due in large measure by insufficient C/PCC accruals to date and the higher-than-normal soil utilization by Santek at the Landfill. These calculations clearly indicate that the current C/PCC Security Fee of $1.00/ton is not sufficient to cover current or future C/PCC liabilities.

The model developed by Geosyntec for this financial assessment was contained in multiple spreadsheets and could not easily be incorporated into this document. Figure 1 provides a conceptual illustration of the financial assessment model and provides the inputs used to calculate accruals and C/PCC liability. C/PCC cost estimates were provided by Santek and included in Appendix A.

2.2.1 Interpretation of C/PCC Responsibilities

Geosyntec reviewed pertinent documents regarding the C/PCC obligations associated with Phase I and Phase II/IV of the Landfill, which included a review of the January 2007 Request for Proposals (RFP) issued by the LCSWDC for operation of the Landfill. Geosyntec also reviewed Santek's response to the RFP dated April 3, 2007, which resulted in its selection as the Landfill operator. Geosyntec reviewed the applicable C/PCC Plan for the Landfill previously submitted to TDEC by Santek in December 1996. Finally, Geosyntec reviewed the OA between the LCSWDC and Santek, effective as of July 1, 2007. Geosyntec reviewed these specific documents to assess the respective financial obligations of Santek and the LCSWDC for C/PCC of the Landfill. Geosyntec's interpretation of the pertinent documents reveals that Santek is responsible for the following costs:

- PCC of Phase I during the term of the OA;

- PCC of any portion of Phase II and/or IV that is closed during the term of the Contract; and

- Closure of any portion of Phase II/IV that receives waste during the OA.

LCSWDC is responsible for PCC after the expiration of the Contract and C/PCC for any cells or phases constructed after the term of the Contract.

The following excerpts from the RFP, the Response, the Closure Plan, and the OA provide the basis of Geosyntec's interpretation of Santek's financial obligations for C/PCC of the Landfill.

2007 RFP

The relevant excerpts below are from the January 2007 RFP. Key phrases are underlined in these documents for emphasis. As indicated below, the Introduction of the RFP clearly states that the Contractor will be responsible for performing all Closure activities during the term of the contract.

> **Section 3.01 Introduction – Alternative 1:**
>
> *The successful Proposer for Alternative 1, if that alternative is chosen by the LCSWDC, will perform on a turnkey basis all activities associated with the daily operation and maintenance of the Matlock Bend Landfill during the term of the awarded Contract, including without limitation the permitting, design, engineering and construction of any future cells and phases, the acceptance and proper disposal of all tires delivered to the Landfill, the performance of administrative responsibilities relative to meetings and functions of the LCSWDC and all closure and post-closure work at the Landfill specified in the Specifications, including without limitation any and all necessary post-closure responsibilities and costs associated with Phase I of the Landfill (pre-Title D closed phase).*

The General Scope of Work essentially reiterates the language in the Introduction and reaffirms that the Contractor will be responsible for Closure activities during the term of the contract.

> **Section 8.01 – General Scope of Work**
>
> *If Alternative 1 is chosen by the LCSWDC, Contractor will perform on a turnkey basis all activities associated with the daily operation and maintenance of the Matlock Bend Landfill during the term of the awarded Contract, including without limitation the permitting, design, engineering and construction of any future cells and phases, the acceptance and*

proper disposal of all tires delivered to the Landfill, the performance of administrative responsibilities relative to meetings and functions of the LCSWDC and all closure and post-closure work at the Landfill specified in the Specifications, including without limitation any and all necessary post-closure responsibilities and costs associated with Phase I of the Landfill (pre-Title D closed phase).

Section 8.21 provides the most explicit explanation for the Contractor's responsibility relative to Closure. According to Section 8.21, the Commission placed the financial responsibility on the Contractor for the Closure of any module that was opened.

Section 8.21 – Closure and Post-Closure Responsibility/Required Bond

Contractor shall throughout the Contract term provide at its cost all post-closure for Phase I of the Landfill, which shall be provided in accordance with the closure/post-closure plans submitted and approved by the state for Phase I and all other requirements of the state. To the extent the state of Tennessee, the Permit or applicable law requires during the Contract term the closure or post-closure of any portion of Phase II/IV of the Landfill or any other phases opened by Contractor, the Contractor shall also provide such closure and post-closure in accordance with the applicable closure/post-closure plans submitted and approved by the state for such phases and all other requirements of the state. Any increased bonding requirements related to the opening of new phases of the Landfill by the Contractor during the Contract term or resulting from a modification of the existing Permit shall be the responsibility of the Contractor.

1996 Closure/Post-Closure Plan

The December 1996 Closure/Post-Closure Plan (Santek, 1996) provides a general indication of when closure should be performed. Specifically, the final cap must be installed after the module reaches final grade. When read in context with Section 8.21 of the RFP, it seems clear that it was the intent of the LCSWDC that the Operator close each module that it opened as it reached final grade.

Section 1.2.2 – Closure Schedule

At least 60 days prior to beginning any final closure activities, Santek Environmental Inc. will notify the Director of the Solid Waste Division of the

Tennessee Department of Environment and Conservation (TDEC) of its intent to perform closure. Interim closure activities, including grading and establishing vegetative cover, will be accomplished as waste placement of each module achieves final grade. It is noted that a minor portion of each module shall be allowed to be incomplete in order to provide an access road the width of three times the maximum construction equipment width. This is necessary to allow for ingress and egress at uncompleted phases that are located beyond completed phases. Within 90 days after any entire module reaches final grade, construction of the final cap system will begin. These time allowances are in accordance with Rule 1200-1-7-.04(8)(c)1 through 3, respectively. If contingencies force exceptions to the schedule times set forth above, a waiver will be requested.

Exhibit E – 2007 Santek Proposal

Santek included as Exhibit E (Santek, 2007) of its proposal a projection of its estimated Tipping Fees. Santek states in Exhibit E that these tipping fees include financing of any required C/PCC costs. The quote is as follows:

10-Year Schedule of Estimated Yearly Tipping Fees (which includes any required closure and post-closure, engineering and operations, and financing and amortization of capital projects)

2007 OA

The LCSWDC's RFP included a two-page Operating Agreement. Santek's proposal included a new agreement and requested that the Commission adopt it as the vehicle to execute the agreement to operate the landfill. According to LCSWDC Minutes, the LCSWDC's attorney worked with Santek to rectify discrepancies in Santek's contract with the language and intent of the RFP. Relevant portions from the OA are provided below.

The Definitions section of the agreement refers to Tennessee Solid Waste Rule (TSWR) to define C/PCC as provided below. The TSWR further incorporates the facility's Closure Plan, which was discussed previously. The definition of Work (provided below) states that it is the Contractors obligation to manage, construct, and finance closure during the term of the agreement. These definitions seem consistent with the language in the previously discussed documents.

Closure

The taking of those actions to close a landfill that are necessary to meet the closure requirements of Tennessee Rule 1200-1-7-.04(8), or such subsequent regulation that replaces or supersedes such rule.

Post-Closure Care

The taking of those actions after Closure of a landfill or a landfill property, or portion thereof, that are necessary to meet the post-closure care requirements of Tennessee Rule 1200-1-7-.04(8), or such subsequent regulation that replaces or supersedes such rule.

Work

Contractor's work obligations, in conformance with the terms of Sections 3.1 and 3.2 hereof, during the term of this Agreement, which in general consist of the following:

(a) Manage, operate and maintain the Landfill;

(b) Design, construct and finance the operation of the Landfill;

(c) Manage, construct and finance Closure and Post-Closure Care of the closed portions of the Landfill during the term of this Agreement;

(d) Operate and maintain equipment as necessary to perform the Work;

(e) Provide and train personnel as necessary to perform the Work;

(f) Furnish all supplies, materials, and equipment necessary to perform the Work;

(g) Pay the expenses of all utilities needed to perform the Work;

(h) Conduct all billings and collection of revenue for the disposal of waste at the Landfill;

(i) Undertake good faith efforts to develop markets for Solid Waste for disposal at the Landfill;

(j) Maintain and renew or modify the Landfill permit, as required or necessary in order to perform the Work; and

(k) Administrative activities to assist the Commission, such as reports and minutes of meetings, and such additional duties as more specifically prescribed herein.

III. SCOPE OF WORK, Section 3.1

Intent. In order to assure viability for the Landfill, the parties hereto intend to develop markets for Solid Waste to increase the anticipated volume to be received at the Landfill. The Contractor shall perform all Work hereunder in compliance with all applicable federal, state, county, and municipal laws, ordinances and regulations. It shall be the financial responsibility of the Contractor to maintain any and all existing permits and/or licenses, and timely pay any and all fees required by said permits and/or licenses, and, utilize its reasonable efforts to obtain in the Commission's name any and all new permits and/or licenses and/or renewals or modifications of any existing permits and/or licenses as may be required in order to operate said Landfill as anticipated by this Agreement. Subject to the requirements of this Agreement, it is further intended that the Contractor shall have maximum flexibility in performing the landfill operations and other solid waste management operations contemplated by this Agreement, which includes, without limitation, performance of the Work…

VIII. CLOSURE OF LANDFILL, Section 8.2

Closure/Post-Closure Care of Existing Landfill. The Contractor shall be responsible for compliance and all costs associated with interim closure requirements under the Solid Waste Laws with respect to those cells receiving Solid Waste during the term of this Agreement. The Contractor shall be responsible for compliance with Post-Closure Care for all closed portions of the Landfill during the term of this Agreement….

VIII. CLOSURE OF LANDFILL, Section 8.4

Early Termination of Agreement. In the event that this Agreement is terminated during and/or prior to the end of the Landfill's operational life, the Commission shall immediately assume full responsibility for Closure

and Post-Closure Care for the Landfill. Upon such termination, Contractor shall be relieved of any further responsibility for Closure of and Post-Closure Care for the Landfill. If the early termination is exercised by the Contractor pursuant to Subsection 3.5(c) of this Agreement, then the Contractor shall conduct Closure on any portion of the Landfill that has accepted waste, unless the Commission provides written instructions to the Contractor to not conduct such activities within sixty (60) days of the termination of the Agreement.

X. REVENUE COLLECTION & COMPENSATION, Section 10.7

Closure and Post-Closure Security Fees. The Contractor shall pay the Commission a per ton closure and post-closure security fee for all Solid Waste disposed of at the Landfill during the term of this Agreement in an amount equal to the greater of $1.00 per ton or five percent (5%) of the tipping fee received from the customer by Contractor. The security fee shall be used by the Commission to establish and maintain adequate financial reserves for the payment of Closure and Post-Closure Care required at the Landfill. The payment of the security fee shall not relieve Contractor of any of its obligations for Closure and Post-Closure Care under this Agreement and Contractor shall have no entitlement to the same. The Commission reserves the right to use excess reserves accumulated from said security fee, in such amounts as it shall determine, for any lawful purpose. Notwithstanding the foregoing, the Contractor shall not pay a closure and post-closure security fee for waste disposed of at the Landfill property pursuant to the Commission's Reserved Rights unless specifically provided for by a subsequent written agreement between the Commission and Contractor.

2.2.2 8 March 2013 Meeting with Santek

On 8 March 2013, Mr. Leroy Leonard, Dr. Robert Bachus, and Mr. Robby White of Geosyntec along with Mr. Steve Field, Chairman of the LCSWDC, and Mr. Kevin Stevens, attorney for the LCSWDC, met with Santek representatives at their office in Cleveland, Tennessee to discuss the obligations of the parties under the OA including C/PCC responsibilities. In advance of the meeting, a memorandum was prepared outlining Geosyntec's interpretation of the documents discussed above in Section 2.3.1. Santek representatives included Ms. Cheryl Dunson, Mr. Edward Caylor, Mr. Robert Burnett, and Mr. Ron Vail. Santek's counsel, Mr. Scott

Thomas, participated in the meeting via conference call. Key points from the meeting included:

- Santek does not intend to close any modules within Phase II/IV during the term of the current contract;
- Santek indicated that the major permit modification would decrease C/PCC costs on a per cubic yard basis;
- The new cover system specified in the major permit modification application will reduce closure cost according to Santek;
- Santek is willing to "partner" with LCSWDC to maximize airspace and minimize closure cost; and
- Mr. Thomas indicated that the LCSWDC is only entitled to the greater of $1.00 per ton or five percent (5%) of the tipping fee received for C/PCC.

2.3 Review of the Historical Performance

The Historical Financial Performance review covers the period from October 2007, the commencement of the current turnkey contract between LCSWDC and Santek, to December 2012. This analysis covers the market rate (i.e., Tipping Fee reported in dollars/ton), the increase, or decrease in tonnage over this time period, and the compilation of the annual audit results and the annual TDEC reports. Geosyntec's strategy for performing the Historical Financial Performance review entailed:

- comparing the actual average tipping fee in dollar/ton at the Landfill to the market tipping fee in East Tennessee, and to projections provided in the OA contract;
- verifying revenues on the LCSWDC financial reports are consistent with Ticket Reports to ensure that the Host and C/PCC Security Fee were calculated and recorded correctly based on the tonnage reported by Santek;
- comparing financial revenues of LCSWDC to the OA contract; and
- summarizing the Annual Audit Results and the annual TDEC Report to understand the estimated/required C/PCC accruals.

Tipping Fee: In the OA, the general tipping fee for gate rate customers for at least the first two years was to be $28.00/ton and the tipping fee for area governmental customers (Stakeholders) was to be $19.85/ton. Santek could discount its general tipping fee to volume users or for special waste in accordance with area market conditions. Following the initial two-year period, these tipping fees were to be adjusted on July 1st of each year to reflect cost increases, if any, during the previous twelve months. Table 7 shows that over the time period from 2008 through 2012, the general tipping fee average was $28.21/ton, the stakeholder average tipping fee was $20.48/ton, and the customers receiving special pricing averaged $18.68/ton. Table 7 shows 88% of the tons disposed in the Landfill came from special pricing. Table 8 presents the average tipping fee per month at the Landfill as presented in the Santek reports to LCSWDC. There does not appear to be a seasonal or overall trend in these data. The overall average tipping fee was calculated to be $19.30/ton (Table 8). Table 9 indicates an average market rate of $32.79/ton from other nearby landfills.

Tonnage Report and LCSWDC Fees: Santek provides a monthly Operations Report to LCSWDC, which includes the Tonnage Report as well as the revenue calculation. Geosyntec reviewed these reports and the detailed Tonnage Report for the time period of 2008 to 2012 to confirm the LCSWDC revenue as reported in the financial statement. In the OA, revenues are to be based on a monthly Host Fee and C/PCC Security Fee. According to the OA, the Host Fee is calculated as the amount equal to or greater than 3.75 percent of the tipping fee received from the customers every month or $10,000 per month. The C/PCC Security Fee is the amount equal to the greater of $1.00/ton or 5 percent of the tipping fee received. The five percent fee will only prevail when the tipping fee is more than $20.00/ton. Geosyntec notes that 83% of the customers pay more than $20.00 tipping fee per ton. However, the other 17% were responsible for 78% of the total waste disposed into the Landfill.

Host Fee and C/PCC Security Fee: In reviewing the OA, Geosyntec believes that the intent is that the C/PCC Security Fee should be calculated on a per customer basis. Currently, Santek is calculating the C/PCC Security Fee on the total tonnage and the monthly average tipping fee. Calculating the C/PCC Security Fee on a per customer basis, which accounts for the 83% of the customers that pay more than $20.00 tipping fee per ton, LCSWDC would have collected an additional $25,000 in C/PCC Security Fees from the time period of 2008 through 2012. Even though the analysis could not exactly match the revenue related to the Host Fee and C/PCC Security Fee to LCSWDC, the audited monthly financials and the tonnage receipts by customer, Geosyntec findings would indicate that the LCSWDC has been slightly under paid by Santek relative to the contract obligations. In summary, Table 10 shows with an average

C/PCC Security Fee of $1.01/ton and the average Host Fee of $0.79/ton, the Commission collected an average of $1.80/ton in revenue during the years of 2008 to 2012.

Review of Financial Statements: Geosyntec's review started with the Loudon County audited financial statement dated June 2007, which was the last financial statement before the start of the current turnkey contract between Santek and LCSWDC. This statement showed Unrestricted Net Assets of -$212,297, i.e. ($212,297) calculated as current cash minus liabilities. Review of the financial statement at the end of June 2012 found the Unrestricted Net Assets to be ($1,776,510). Unrestricted Net Assets reflect the fact that cash on hand of $2,380,571 is not enough to cover the liability of $4,133,850. The contributing factors of the change in Unrestricted Net Assets are largely due to the increase in the long-term liability related to the estimated C/PCC costs and the lack of C/PCC Security Fee and Host Fee to cover all cost associated with the Landfill. Table 11 presents the Statement of Net Assets for LCSWDC.

For this assessment, Geosyntec compiled a Statement of Revenue, Expenses and Change in Net Assets. The financial report reflects all the yearly income, operating expenses that include the accrual for C/PCC, and any non-operating revenue. This summary information is calculated for each year since 2007 and is presented as Table 12. This table shows that the annual Change in Net Assets (i.e., difference between revenue and expenses) has decreased each year since 2008 and has resulted in LCSWDC showing a loss of ($406,023) over a five year period (2008 to 2012).

A summary of the financial position of LCSWDC from the time the OA commenced in 2007 to June 2012 is shown below and provided in Table 11.

- Unrestricted Net Assets June 30, 2007: $(212,297)
- Change in Net Assets up to June 30, 2012: $(406,022)
- Cash used for purchase of land: $(1,158,190)
- Total Shortfall: $(1,776,509)

In summary, although the tonnage disposed in the landfill has increased since 2008, the generally decreasing average tipping fee per ton has resulted in lower-than-expected revenue to LCSWDC. Santek's proposal to LCSWDC for the 2008 OA in Exhibit E (Santek, 2007) anticipated Tipping Fees greater than $30.00 per ton in 2012. The difference between the average tipping fee of $19.30 compared to the $30.00 in the

original proposal and the calculation of the C/PCC Security Fee are both be factors related to the LCSWDC shortfall.

2.4 Revenue Model

Geosyntec reviewed relevant documents to determine LCSWDC and Santek financial responsibilities during the term of the OA. Specific emphasis was given to portions of the OA that defined the parties' roles relevant to C/PCC costs. As stated previously, Geosyntec interprets the OA such that Santek is responsible for any closure costs associated with any module that is opened during the term of the contract. The LCSWDC will be responsible for PCC after the term of the contract and closure of subsequently opened modules. However, Santek has stated that the LCSWDC is responsible for the cost of Closure. While Geosyntec does not agree with this position, the following discussion and assessment of LCSWDC revenue will consider full C/PCC costs. Geosyntec compiled historical data to establish a baseline for building a financial model. The historical data included:

- Tonnage Receipts by customer type (Stakeholder, Gate Rate Customers, and Customers receiving special pricing;
- Tipping Fees by customer type;
- Contractor Revenue by customer; and
- Host Fees and PCC Security Fees.

The baseline data were used to forecast the LCSWDC reserves at the end of the OA and at the end of life of the landfill. The forecast allows multiple scenarios to be analyzed to help LCSWDC make informed decisions on a go forward basis. Variables that may be adjusted include:

- volume growth with a contract cap of 800 tons per day;
- tipping fee;
- total airspace (as-permitted vs. anticipated-expansion);
- rate of inflation during the operating life of the landfill and during post-closure;
- interest rate earned on LCSWDC reserves;

- Host Fee and PCC Security allocation;
- volume adjustments based on customer type;
- volume and price adjustments for specific customers receiving special pricing;
- adjustment to the anticipated C/PCC costs; and
- adjustments to LCSWDC expenses.

LCSWDC forecasted reserves were compared to the anticipated C/PCC obligations for the remainder of the Landfill life. The forecast applies a rate of inflation to the C/PCC costs based on the calculated year of closure to estimate the LCSWDC liability and accruals. To better understand the revenue that LCSWDC may expect to receive for future waste receipts, Geosyntec's model allows multiple scenarios to be considered and manipulated simultaneously. The Model uses historical volume and pricing trends to forecast LCSWDC revenue on a go-forward basis. The Model also allows the user to consider the impact of the planned expansion on LCSWDC revenue as well as on C/PCC costs. The current OA was executed on 1 July 2007. By current estimates of waste disposal provided by Santek, Geosyntec anticipates that without the expansion the Landfill has approximately six years of remaining life. Therefore closure of the Landfill would occur in 2019 prior to the expiration of the OA in 2027.

The model may be used for forecasting potential revenues (and obligations) through the current OA and through the life of the Landfill as projected by Santek for the currently proposed expansion, commencing with the current condition. The Model is based on historical waste disposal volumes that consider:

- 2 percent annual volume growth;
- 2 percent annual price increases; and
- 3 percent inflation.

The model inputs and summaries are in Appendix B. These model inputs provide a summary of the current and projected LCSWDC revenues and the required reserves for the current Landfill condition (i.e., through 2012), at the end of the contract period (i.e., Life of OA), and at the projected end of the Landfill life as projected in Santek's proposed expansion (i.e., Life of Site). The table provides the following information:

- Total C/PCC Liability Based on Percent Depletion;
- Accrual from C/PCC Security (the accrual is the sum of the PCC Security Fee and the $2.47 million accrued prior to the execution of the OA);
- C/PCC Variance Per Remaining Ton;
- C/PCC Reserve Amount Outstanding (this is calculated to estimate future accrual); and
- Cost Per Remaining Ton Needed to Satisfy C/PCC Liability (this is the fee that should be assessed for each remaining ton to ensure that the C/PCC Accrual matches the C/PCC Liability).

This Model suggests that there will be a shortfall of $4.9 million (As Permitted) to $5.3 million (Expansion) at the end of the contract term. Importantly, the shortfall may be avoided if the C/PCC accrual is adjusted to $3.86 per ton (As Permitted) or $2.46 per ton (Expansion) for the remaining tons.

3. OPERATIONS AND COMPLIANCE

A compliance inspection was conducted on 30 November 2012 that included an interview with Santek's Landfill Manager, Mr. Levi Higdon. A second inspection was conducted on 1 March 2013 with Mr. Ted Sitzlar, a LCSWDC Commissioner, to further inspect the drainage channel leading from Stormwater Pond #3 to Watts Bar Lake. Waste mixing, spreading, and compaction observations were made on 10 January 2013. Landfill ingress/egress controls were observed on 9 January 2013 through 11 January 2013. TDEC's Solid Waste Disposal Facility Evaluation checklist, included in Appendix C, was used for guidance during the inspection. Photographs taken on various dates are included in Appendix D.

3.1 Landfill Compliance Inspection

3.1.1 Record Keeping and Permits

The Landfill has two permits associated with the facility operations: an operations permit and a stormwater permit. On 7 August 1997, TDEC issued the LCSWDC an operations permit (SNL 53-103-0203) that allowed the construction and operation of a Class I sanitary landfill and required provisions for C/PCC and maintenance of the Landfill. On 14 March 2012, TDEC issued Tennessee Stormwater Multi-Sector General Permit (TSMP) #TNR05-1889 for industrial activities. The permit is valid until 14 May 2014. The TSMP permit allows for the discharge of stormwater from the facility to Watts Bar Lake via a conveyance channel.

Onsite records for the Landfill are kept at the scale house building. These documents are maintained by Santek and include, but are not limited to:

- Operations Plan (dated December 1996);
- Stormwater Pollution Prevention Plan (dated July 2010);
- Greenhouse Gas Monitoring Plan (dated March 2010);
- certifications for onsite personnel;
- random waste inspection logs;
- equipment maintenance logs;
- weigh tickets and manifests;

- permit documentation; and
- design drawings.

3.1.2 Landfill Staffing

Generally, the Landfill is operated using ten workers including the facility manager, one scale house operator, one compactor operator, one dozer operator, one mechanic, three additional operators, and two laborers. Mr. Higdon is the primary State of Tennessee Certified Landfill Operator.

3.1.3 Hours of Operation

According to Mr. Higdon and Santek's website, the landfill operation hours are 7:30 AM to 4:00 PM Monday through Friday and 7:30 AM to 12:00 PM on Saturday. Vehicular access to the Landfill is restricted by a locked gate during non-operational hours. Vehicular traffic in and out of the Landfill was observed from 9 to 11 January 2013 from 7:30 AM until 4:00 PM by Geosyntec. Weigh tickets were provided to Geosyntec by Santek for these dates. A 10 January 2013 weigh ticket (ticket #200572), labeled as "reprint", was observed for auto fluff waste. This ticket indicated that the truck entered the Landfill at 6:53 AM and left at 6:54 AM. Two weigh tickets were observed on 11 January 2013 for auto fluff waste before 7:30 AM. The first weigh ticket (ticket #200693) indicated the truck entered the Landfill at 6:56 AM and exited the Landfill at 6:56 AM and the other weigh ticket (ticket #200694) indicated the truck entered the Landfill at 6:59 AM and exited the Landfill at 6:59 AM. Geosyntec asked Mr. Higdon if there was an explanation for truck entry into the Landfill before operational hours. Mr. Higdon indicated that Santek transports the auto fluff waste with their trucks and the driver could have entered the Landfill early to visit the shop for a maintenance issue or use the restroom. He further indicated that the Landfill does not allow dumping of waste during non-operational hours and that the truck driver probably waited until 7:30 AM before driving to the tipping pad.

3.1.4 Landfill Ingress/Egress

The entrance to the Landfill is off of Highway 72 North, which is an asphalt-paved, two-lane thoroughfare with a turn lane dividing the east bound and west bound lanes. Several of the Commissioners indicated that they have received complaints from local residents about mud and debris on Highway 72 North that has been tracked from the Landfill on tires. Mr. Sitzlar indicated that mud on the road has been excessive at times, especially during extended periods of wet weather.

During our compliance inspections in November 2012 and March 2013, gravel and soil were observed on Highway 72 emanating from a gravel driveway entrance located approximately 1,100 feet west of the Landfill entrance.

Section V, 5.7 of the OA states that:

> *The Contractor shall use all reasonable efforts to maintain and keep free of litter and all other foreign material all areas within the Landfill and all Access Roads with one-quarter mile of the gate to the Landfill.*

Furthermore, Section VI, 6.1 of the OA states that:

> *The Contractor shall not be responsible for maintenance of public roads outside the landfill property.*

Portions of Highway 72 North near the Landfill ingress/egress were observed on the following dates (and during the following weather conditions):

- 31 October 2012 (no rain – moist conditions);
- 30 November 2012 (no rain – dry to moist conditions);
- 9 January 2013 (occasional rain – moist to wet conditions);
- 10 January 2013 (no rain – moist to wet conditions);
- 11 January 2013 (occasional rain – wet conditions); and
- 1 March 2013 (no rain – moist to wet conditions).

Generally, mud and debris from tires on trucks leaving the landfill was either not observed on the road or observed in *de minimis* quantities on the days Geosyntec observed the road conditions. On 9 January 2013 and 10 January 2103, a Santek water truck was observed on Highway 72 North cleaning the road with water. Mr. Higdon indicated that Santek uses a water truck to clean the road during wet weather and sometimes a tractor with a pull-behind brush in freezing conditions.

The Monterey Mushrooms facility is located immediately to the east of the Landfill. This facility grows mushrooms in composted material. Once the compost is of no further use to Monterey Mushrooms, it is shipped via truck to the Landfill. On 9 January 2013 through 11 January 2013, soil and debris were observed on the driveway

to the Monterey Mushrooms facility and some of this soil and debris appeared on Highway 72 North.

The Landfill does not have a truck-tire wash station. Mr. Higdon indicated that typically the gravel haul road from the scale house to the waste tipping pad is sufficient in removing mud from the tires. Based on Geosyntec's observations during the numerous site visits, there is a low likelihood that any mud and debris on the road emanating from the Landfill at these time periods would be considered a violation of applicable regulations. Washing mud and debris into drainage channels alongside Highway 72 North with a water truck could be considered an indirect violation of the TSMP permit and a possible violation of the Federal Clean Water Act depending on the conditions and interpretation of the law by a regulator, although Geosyntec acknowledges that this method for cleaning roads is commonly adopted by many landfill operators.

3.1.5 Facilities and Equipment

There are two buildings at the Landfill, the scale house/office and the maintenance building. The scale house/office is located at the entrance to the Landfill off of Highway 72 North. The maintenance building is located adjacent to the northern boundary of Phase I.

The onsite machinery is owned, operated, and maintained by Santek and includes (as observed on 30 November 2012):

- a Caterpillar (CAT) 963 loader;
- a Komatsu PC200 excavator;
- a D6R dozer;
- a CAT 826G compactor;
- a 1,500-gallon water truck;
- an International service truck;
- a CAT 621 earth scarper (pan);
- a 3920 Ford tractor; and

- a Ford F-150 pick-up truck.

The following fuel and oil tanks are located at the maintenance building:

- a 2,000-gallon diesel tank (double walled);
- a 1,000-gallon transmission oil tank;
- a 1,000-gallon hydraulic oil tank;
- a 1,000-gallon waste oil tank; and
- two, 250-gallon waste oil tanks.

All of the tanks were observed to be in secondary containment. According to Mr. Higdon, Enterprise Oil Company, LLC in Knoxville, Tennessee delivers new oil and transports used oil offsite for recycling.

The landfill has three surveillance cameras and the video stream is recorded electronically based on motion activation. One of the cameras is located in the office, which is located in the scale house. The second camera has a view of the scale house operator. The third camera has a view of the scale as trucks leave the landfill. Mr. Higdon indicated that the camera surveillance system is maintained by a third party. A day of video footage from the camera focused on the scale was reviewed for the evaluation of ingress/egress controls at the Landfill.

3.1.6 Erosion and Stormwater Control

Numerous non-vegetated, non-operational areas were observed especially around the Phase II/IV Stormwater Pond #3 during various site visits. Numerous rills and gullies were observed with no obvious erosion controls in many locations. On 30 November 2012, Mr. Higdon indicated that he had recently purchased approximately 300 cubic yards of #4 stone that was to be used to construct sediment check dams and diversion dams in wet weather conveyance channels leading to the pond and in other locations around the Landfill. Geosyntec was able to verify visually that the stone had been used for stormwater control features at various locations around the Landfill.

Erosion and stormwater controls at the Landfill are managed under the *Matlock Bend Landfill Stormwater Pollution Prevention Plan* (Santek, 2010). The Landfill currently has three stormwater ponds as depicted on Figure 2. Stormwater Pond #1 is located near the scale house on the southern portion of the property, Stormwater Pond #2 is

located on the eastern side of the haul road leading from the scale house to the active part of the Landfill on the southeastern portion of the property, and Stormwater Pond #3 is located on the western side of Phase II/IV. At the time of the compliance inspection on 30 November 2012, Stormwater Pond #1 was covered with vegetation and trees were observed growing inside the basin. Water was not observed in this pond and there were no indications of sediment recently entering the pond. Stormwater Pond #2 contained mostly clear water. Indications of sediment recently entering this pond were not observed. A gasoline powered pump was observed at Stormwater Pond #2. According to Mr. Higdon, this pump is used to fill up the water truck for dust control or spraying mud off of Highway 72 North during wet weather.

Stormwater Pond #3 was observed on three occasions including 31 October 2012, 30 November 2012, and 1 March 2013. Muddy water was observed in the pond on all three occasions. The pond appears to have accumulated sediment to the extent that it is potentially reducing the designed water retention times. Geosyntec did not measure the sediment in the bottom nor was an evaluation performed regarding the design requirements for the pond. Mr. Higdon indicated that there is no set schedule for pond cleanout; however, he indicated he had cleaned it out approximately two years ago. The upper portion of the Pond #3 discharge channel was inspected on 30 November 2012. At that time, sediment from the pond was not observed; however, most of the drainage channel was covered by leaves. The channel was inspected again on 1 March 2013; Mr. Sitzlar accompanied Geosyntec during this inspection. Muddy water was observed discharging from the pond and there were indications that sediment had left the pond as evidenced by what appeared to be recently deposited sediment in the drainage channel. Water from the pond travels the course of the drainage channel through wooded land before it eventually discharges into Watts Bar Lake, approximately 4,400 feet away from the outlet of Stormwater Pond #3. Discharges of sediment from the pond are not allowed under the TSMP permit and could be the basis for a violation.

3.1.7 Waste, Cover, and Compaction Management

The waste stream disposed of at the Landfill is composed of municipal solid waste (MSW) and industrial wastes including sludge and auto fluff. The wastes are deposited at the open working face and then spread in approximate two-foot thick lifts.

According to Mr. Higdon, open faces are covered at the end of each working day with tarps and/or cover soil from the onsite borrow area. Typically, Santek maintains an approximate 100 foot by 100 foot working area throughout the day.

Waste at the Landfill is compacted with a CAT 826G compactor. According to Mr. Higdon, the compactor runs almost continuously during the operational hours of the Landfill and he indicated that a relief operator is used during the primary operator's lunch period. The compactor operation was observed during the course of a day by Geosyntec on 10 January 2013. We observed that the compactor ran continuously during this observational period. Geosyntec contacted Mr. Higdon on 7 January 2013 to request permission to be on Site. At that time, Mr. Higdon indicated that the compactor was not operational due to a hydraulic system failure. He further indicated that he was using a dozer to compact waste material. On 9 January 2012, another compactor was delivered to the Landfill until the primary compactor could be repaired.

Santek records the quantity of soil used for daily cover. Annual data provided by Santek indicate that since Module A opened in 1995, the volume of soil used for daily cover has ranged from 8 percent to 57 percent of the consumed airspace. The life of site volume of soil used for daily cover is reported to be 27.7 percent of the consumed airspace. The soil balance calculations provided in the current expansion permit application uses 15 percent soil usage for daily cover. Based on the 15 percent value the permit application projects a soil deficit of 1,187,369 cubic yards. However, if the historical trends continue, the actual deficit would be 2,327,002 cubic yards. In other words if the available soil was used only for cell construction daily cover and closure, the facility would exhaust its soil reserves shortly after year 2018. After that time, the facility would either need to purchase soil offsite or purchase additional land as a source of borrow material. Soils purchased offsite may range from $7 to $9 per cubic yard. If additional land is purchased as a source of borrow, the current OA states that the Commission is required to make the acquisition at the Contractor's expense. Section 3.3 of the OA states:

> *…To fulfill such responsibilities, the Commission agrees to exercise, at Contractor's reasonable expense, any and all lawful means available to it, including without limitation, the obtaining of all necessary permits, licenses and approvals, or any amendments, modifications or supplements to existing permits, licenses and approvals, and the causing of any and all needed utilities to be available for the operation and/or development of the Landfill. To fulfill such responsibilities, the Commission agrees to exercise any and all lawful· means available to it, for the acquisition, at Contractor's reasonable expense, of additional interests in real estate, such as rights of ingress or egress, rights of way, easements, access to utilities, and soil for cover material. All interests purchased pursuant to this Section shall be titled to the Commission.*

If recent land purchases by LCSWDC have been made pursuant to Section 3.3 of the OA, it appears that the Contractor is obligated to reimburse LCSWDC for said expenses. If this land has been purchased for other uses, LCSWDC should make steps to acquire sufficient land to provide access to soil for cell construction, daily cover, and closure. Depending on the volume of soil used for daily cover, the site may have a deficit for the Contract period between 484,931 and 1,220,583 cubic yards of soil.

In general, the goal of 15 percent for daily cover seems reasonable and consistent with industry standards. While the amount of daily cover can depend on a facility's waste mix, landfill operating companies will use 10% to 15% as a goal where Santek has used over 30% at Matlock Bend. This quantity of soil is high and inconsistent with industry practices. Specific conditions at the time may have necessitated above average soil use but long term soil usage may be minimized by:

- developing and using a long term fill sequencing plan;
- long term planning of temporary and permit access roads;
- minimizing erosion by establishing vegetation on intermediate slopes;
- enacting other erosion Best Management Practices (BMPs); and
- stripping intermediate and daily cover each morning so that previously placed cover may be reused.

3.1.8 Interim Cover

According to Mr. Higdon, none of the cells at the Landfill in Phase II/IV have reached final grade. When a cell approaches final grade, waste placement in that cell is stopped, interim cover soil from the onsite borrow area is placed on top of the waste, and the soil is vegetated. Mr. Higdon indicated that this allows for settling over time so additional airspace can be utilized at a later date. Since none of the cells in Phase II/IV have reached final grade, TDEC would not require closure on those cells.

Geosyntec requested the latest topography map from Santek that was based on the 19 September 2012 aerial mapping conducted by Southern Resources Mapping Corporation. This map was compared to the Final Development Plan (Santek, 1996). Geosyntec was able to confirm that none of the cells in Phase II/IV had reached final elevation. There were some Modules where a fraction of the grades were over the final cap elevation.

3.1.9 Litter, Dust, Noise Control, Open Burning and Odors

Excessive litter was not observed on the 30 November 2012 compliance inspection. During the 1 March 2013 site visit, more litter was observed on the west face of Landfill when compared to the previous inspection. Litter was not observed in excessive quantities on Highway 72 North and the roadway litter that was observed could not be attributed to the Landfill operations.

According to Mr. Higdon, dust is controlled at the Landfill by spraying the gravel roads with water from Stormwater Pond #2 using a dedicated water truck. On 30 November 2012, dust was observed from truck traffic on roads inside the Landfill and a water truck was observed spraying the roads to control the dust. On this day, water was pumped into a water truck from Stormwater Pond #2.

Based on the location of the permitted waste disposal modules on the property and general site setting, noise is not anticipated to be an issue. Excessive noise was not noted on days when Geosyntec conducted the compliance inspections and observed the Landfill operations.

According to Mr. Higdon, open burning does not occur at the Landfill. Open burning was not observed on days when Geosyntec conducted the compliance inspections and observed Landfill operations.

On the days when Geosyntec was onsite, odors at the Landfill did not seem excessive. Strong odors from the Monterey Mushrooms facility, located adjacent to the landfill, were noted within the Landfill property.

3.1.10 Vectors

During the 30 November 2012 compliance inspection, vectors including birds and rodents were not observed in any substantial numbers. On 10 January 2013 and 1 March 2013, numerous seagulls and turkey vultures were observed in and around Module H where waste was being placed. Geosyntec is unaware of any complaints or violations regarding excessive birds or other vectors at the Landfill; however, TDEC could request bird control.

3.1.11 Leachate Management

Leachate at the Landfill is collected into three 10,000-gallon tanks and a relatively new 100,000-gallon tank. Leachate from the Phase II/IV portion of the Landfill is pumped to the 100,000-gallon tank from two of the three 10,000-gallon tanks. A tanker truck is

used to remove leachate from a 10,000-gallon tank that is used to collect leachate from the Phase I portion of the Landfill. According to Mr. Higdon, Phase I generates a negligible amount of leachate. Leachate is removed from the 100,000-gallon tank through a pipe that is routed to a force main that is subsequently treated at the Loudon Utility Board's (LUB's) wastewater treatment plant. This plant is reportedly designed to handle large volumes of industrial liquids. Approximately 5,000 gallons of leachate is discharged each day to the force main from the Phase II/IV portion of the Landfill. The leachate discharge is sampled once a year by Santek at a pump station located near the Landfill ingress/egress. According to Mr. Higdon, the leachate is sampled at a location adjacent to Monterey Mushrooms' driveway and Highway 72. The volume of discharged leachate is also monitored at this location.

3.1.12 Landfill Gas Management

Passive gas vents were observed in various locations in the Phase I and Phase II/IV portion of the Landfill. Six passive gas flares were observed in Phase II/IV. According to Mr. Higdon, there are four gas flares located in Module G, one gas flare is located in Module F, and there is one flare located in Module H near the Module G boundary. An active GCCS is not anticipated by Santek in the current permit or in the permit expansion.

3.2 Daily Inspections of Waste Shipments to Landfill

3.2.1 Comparison of Observed Additions versus Reported Additions

Landfill traffic was observed on 9 January 2013 through 11 January 2013. Additionally, Geosyntec reviewed recorded video of the scale on 30 January 2013. The purpose of this task was to compare visual observations with actual scale house weigh tickets that were obtained from Santek to determine if ingress/egress controls at the Landfill were sufficient and to independently confirm the accuracy of the recorded waste receipts. Truck descriptions, entry times, and exit times were recorded. Observations from different vantage points were conducted and recorded as follows:

1. **9 January 2013 (0730 until 1600):** Geosyntec observed vehicular traffic from a vantage point along Huntington Park Dr., a two-lane road located on the south side of Highway 72 North. Traffic could be observed on the haul road in the Landfill leading from the scale house to the active portions of the Landfill. Due to the distance of this vantage point from the Landfill, binoculars were used to record descriptions of vehicles entering the Landfill.

2. **10 January 2013 (0730 until 1600):** Geosyntec observed vehicular traffic from a vantage point above the Module H tipping pad. On this day, waste placement and compaction were also observed.

3. **11 January 2013 (0730 until 1600)**: Geosyntec observed vehicular traffic from the vantage point of a driveway that was located adjacent to the west of the Landfill ingress/egress location. The driveway and associated house at this location are owned by the LCSWDC.

The results from the visual observations were compared to weigh tickets and tabulated. Every truck entering or leaving the landfill was not observed but observations and weigh tickets matched 90.2 percent, 94.4 percent, and 93.2 percent of the time for 9, 10, and 11 January 2013, respectively. One hundred (100) percent of the tickets matched video observations on 30 January 2013. These observations indicate accurate logging of trucks entering the landfill. Some of the discrepancies in matches on 9, 10, 11 January 2013 stemmed from not being able to physically observe a truck entering the Landfill because Geosyntec personnel had to take a break or the truck entering the Landfill was missed due to the vantage point being used and conditions at the time (e.g. fog in the morning on 9 January 2013).

One to five weigh tickets per day were missing on 9 January 2013 through 11 January 2013 and 30 January 2013. Geosyntec provided the missing ticket numbers to Santek for clarification. Mr. David Hollinshead with Santek was able to provide the missing tickets, which were voided at the scale house. Mr. Hollinshead indicated that the voided tickets should have been kept with the daily tickets and he further indicated that voided tickets will be kept with the daily tickets as a matter of procedure going forward.

On 30 January 2013, a tri-axle dump truck with a red bed and white cab was observed in the video footage entering the Landfill around 10:48 AM and exiting the Landfill around 11:03 AM. The truck bypassed the scale when entering and exiting the Landfill. The truck driver was observed exchanging paperwork with the scale house operator prior to entering the Landfill. Mr. Higdon indicated that the truck was most likely delivering a load of stone to the Landfill based on a description of the truck.

Based on physical observations over three consecutive days and observations made from the video footage recorded at the scale house, Geosyntec did not observe any anomalous activities that would suggest deficient entry and exit controls and scale house record keeping at the Landfill.

4. CONCLUSIONS

Geosyntec has completed a financial and compliance review of the Matlock Bend Landfill in Loudon, Loudon County, Tennessee. The Landfill is located west of Interstate 75 at 21712 Highway 72 North. The Landfill is owned by the LCSWDC and operated under contract by Santek. The Landfill is bordered by a mixture of residential properties, industrial properties, and wooded, vacant land. LCSWDC currently owns approximately 255 acres of contiguous property, of which 41.5 acres is currently permitted for the landfill. Santek submitted a permit application to the Tennessee Department of Environment and Conservation (TDEC) for the expansion of the landfill footprint to approximately 67 acres.

This review was conducted to assess the financial stability of the Landfill, specifically to determine if sufficient funds were being accrued to eventually close the landfill and fund post-closure care. The current contract between LCSWDC and Santek was also evaluated to assess whether or not contractual obligations regarding compliance with TDEC regulations were being met.

4.1 Financial Evaluation Summary

Geosyntec's review of the Operating Agreement indicates that Santek is responsible for Closure of any cell which is opened and receives waste during the term of the agreement. Additionally Santek is responsible for Post Closure Care of any closed portion of the landfill during the term of the agreement. Numerous sections of the contract support this conclusion.

Geosyntec constructed a Financial Model of the Landfill to forecast the LCSWDC revenue and its ability to accrue adequate funds for C/PCC obligations. The C/PPC Security Fee provides a method of accruing for certain of such costs. While the liability for C/PCC was adequately funded at the start of the 2007 OA between the LCSWDC and Santek, the C/PPC Security Fee of $1.00 per ton or 5% of the tipping fee has not been adequate to accrue funds for the C/PCC liability associated with each ton of waste. While lower than proposed tipping fees may contribute to the shortfall, it does not appear that the C/PCC security fee should have been expected to cover the $2.92 per ton liability for C/PCC costs of the currently permitted landfill. While the proposed expansion has a lower per ton liability for C/PCC, the required $2.35 still greatly exceeds the C/PCC cost accrual rate. With or without the expansion, the current C/PCC accrual will not meet the associated liability. The currently permitted landfill will likely exhaust its remaining capacity in 2019, prior to the termination of the OA, with a shortfall of approximately $4.9 million. Similarly, with the proposed expansion, the

LCSWDC will have under accrued for the C/PCC liability at the end of the OA by approximately $5.3 million. In order to ensure that the accrual compensates for the under accrual to date and adequately covers the liability for the additional tonnage, a catch-up C/PCC accrual of $3.86 per ton would be needed for the currently permitted landfill and $2.46 per ton would be needed for the expanded facility. Additionally, the permitted impact of an active gas extraction system and acquisition of soil from outside of the waste boundaries should be further evaluated to determine if it is appropriate to include them in the C/PCC cost per ton. These issues could potentially increase the C/PCC liability by an additional $0.55 per ton for the currently permitted landfill and $2.00 per ton for the expanded facility.

4.2 Compliance Evaluation Summary

The Landfill was observed to be operating a manner generally consistent with industry standards. Overall, the Landfill operations were compliant with applicable TDEC rules and regulations. However, some exceptions were noted and are described below.

- Sediment that apparently originated from the Landfill and Stormwater Pond #3 was observed in the drainage channel between the pond and Watts Bar Lake. Based on observations of this drainage channel in dry and wet conditions, it would appear that sediment leaves the Stormwater Pond #3 during wet weather, which could be a basis for violation of the TSMP permit. The sediment discharges can be interpreted as a violation of the terms of the OA. Section III, 3.1 of the OA states that: "The Contractor shall perform all Work hereunder in compliance with all applicable federal, state, county, and municipal laws, ordinances and regulations".

- The design and/or the designed capacity of Stormwater Pond #3 was not evaluated as part this assessment; however, the design of the pond should have the capacity to receive stormwater from a 25-year, 24 hour storm event. Based on visual observations of the pond, there appears to be an excess of accumulated sediments in the pond. Water enters the pond at various locations around the perimeter and numerous rills and gullies were observed. The edges of the pond were not vegetated and; therefore, there was no buffer for water entering the pond which would lead to more rapid accumulations of sediment in the pond. Based on the observations on 1 March 2013, the outlet structure in the pond does not appear to be effective in filtering water exiting the pond and entering the drainage channel.

- Vegetation (i.e. grass cover) was observed to be sparse in operational and non-operational areas of the Landfill (both Phase I and Phase II/IV) including the banks and roads around Stormwater Pond #3. The exposed areas observed at the Landfill could result in sediment entering Stormwater Pond #3. Lack of vegetation at the Landfill, especially areas where waste was not being placed, could be considered a violation of regulations and, therefore, a violation of the OA.

- During wet weather, complaints have been made to LCSWDC regarding mud and debris on Highway 72 North near the Landfill ingress/egress location. This portion of the road was observed during six days from November 2012 to March 2013. On these observation days, significant quantities of mud and debris from the Landfill were not observed on the road; however, Mr. Sitzlar indicated that the mud on the road has been bad at times. Mr. Higdon indicated that he uses a water truck and a pull-behind brush to clean the roads. The water truck was observed on two of the six days Geosyntec observed this portion of the road. Based on Geosyntec's observations on these dates, if the practices observed were utilized consistently as a matter of procedure, there is a low likelihood that any mud and debris on the road emanating from the Landfill would be considered a violation of applicable regulations. Washing mud and debris into drainage channels alongside Highway 72 North with a water truck could be considered an indirect violation of the TSMP permit and a possible violation of the Federal Clean Water Act depending on the conditions and actions of a regulator. Santek does not appear to be violating the terms of the OA because the OA indicated that Santek was not responsible for the maintenance of the access roads outside of the Landfill.

- The Landfill does not have a tire-wash station. Mr. Higdon indicated that the gravel haul road leading from the scale house to the waste tipping pad is usually sufficient in removing mud from tires before trucks enter the Highway.

4.3 Summary

Overall results of the assessment indicate that there is a shortfall in revenue to cover C/PCC costs either currently or over the life of Landfill with or without the major permit modification. Additional sources of revenue to make up for the shortfall in C/PCC accruals will need to be explored; however, a C/PCC cost savings can be realized with approval and execution of the major permit modification. Generally, the

Landfill is operated in accordance with industry standards, applicable regulations, and the Landfill OA between the LCSWDC and Santek.

5. REFERENCES

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TABLES

Table 1
Summary of Waste Disposal, Soil Usage, and AUF since Commencing OA
Financial and Compliance Review, Matlock Bend Landfill

End of Period	Tons	Percent Cover Usage (%)	AUF[1] CY/Ton
Jan-97	54,631	48	2.82
Dec-97	45,212	52	2.28
Dec-98	52,125	46	2.25
Dec-99	60,656	32	1.90
Nov-00	54,706	0	1.86
Dec-01	51,919	26	1.75
Nov-02	42,571	23	1.77
Dec-03	55,549	27	1.70
Dec-04	67,074	28	1.61
Oct-05	70,703	27	1.40
Oct-06	86,427	27	1.20
Sep-07	114,207	9	1.45
Sep-08	161,840	14	1.25
Sep-09	164,875	18	1.34
Oct-10	122,834	43	1.71
Oct-11	187,531	24	1.35
Sep-12	240,314	8	1.15
Cumulative	**1,633,174**	**27.7**	**1.38**

[1] AUF, airspace utilization factor (highly variable and site specific)
CY/Ton = cubic yards of airspace per ton of waste

Table 2
Closure Cost Comparison
Financial and Compliance Review, Matlock Bend Landfill

Description	Units	Expansion Closure Cost - 67 Acres					Permitted Closure Cost - 41.5 Acres				
		Quantity	Unit Cost	Total Unit Cost	Subtotal	Cost Per Acre	Quantity	Unit Cost	Total Unit Cost	Subtotal	Cost Per Acre
Vegetative Cover Layer											
Excavation Cost	CY	216,142	$2	$432,284			135,520	$1.46	$197,859		
Placement Cost	CY	216,142	$1	$216,142	$648,426	$9,678	84,022	$0.62	$52,094	$249,953	$ 6,023
Compacted Soil Cover											
Excavation Cost	CY	108,093	$1.39	$150,249			67,760	$1.75	$118,580		
Placement & Spreading Cost	CY	108,093	$0.97	$104,850			67,760	$0.62	$42,011		
Compaction Cost	CY	108,093	$0.75	$81,070	$336,169	$5,017	67,760	$1.30	$88,088	$248,679	$5,992
Quality Control for Compacted Soil Cover											
Testing on Borrow Soil Cost	CY	108,093	$0.50	$54,046			67,760	$0.30	$20,328		
Testing Soil Placement Cost	CY	108,093	$1.35	$145,926	$199,972	$2,985	67,760	$0.50	$33,880	$54,208	$1,306
Geosynthetics											
Quality control testing cost	acre	67	$6,000	$402,000			41.5	$21,638	$897,977		
Geocomposite cost	acre	67	$26,136	$1,751,112			41.5	$24,589	$1,020,443		
Geomembrane cost	acre	67	$20,909	$1,400,903	$3,554,015	$53,045	41.5	$22,130	$918,395	$2,836,815	$68,357

Table 2
Closure Cost Comparison
Financial and Compliance Review, Matlock Bend Landfill

Description	Units	Expansion Closure Cost - 67 Acres					Permitted Closure Cost - 41.5 Acres				
		Quantity	Unit Cost	Total Unit Cost	Subtotal	Cost Per Acre	Quantity	Unit Cost	Total Unit Cost	Subtotal	Cost Per Acre
Stormwater Drainage Structures											
Drainage stone	TONS	850	$16.25	$13,812.50			985	$20	$19,700		
Channel to pipe transitions	EA	4	$ 25	$100							
Toe drain pipe	EA	28	$25.00	$700							
24-in drainage pipe	LF	1,100	$15	$16,500			275	$1.20	$330		
Concrete/plastic inlets	EA	4.00	$350	$1,400							
Geotextile	SF	34,750	$0.12	$4,170			47,200	$ 0.18	$8,496		
Labor cost	LS	1	$26,000	$26,000	$62,682.50	$936				$28,526	$687
Vegetative Stabilization	acre										
Labor	acre	67	$500	$33,500			45	$400	$18,000		
Seeding	acre	67	$220	$14,740			45	$200	$9,000		
Fertilizing	acre	67	$230	$15,410			45	$150	$6,750		
Mulching	acre	67	$350	$23,450	$87,100	$1,300	45	$225	$10,125	$43,875	$1,057
STORMWATER SYSTEM											
Stormwater Basins											
Sediment Excavation	EA	3	$5,200	$15,600			1	$5,000	$5,000		
Materials (pipe, rip rap, etc.)	EA	3	$2,600	$7,800	$23,400.00	$349	1	$10,000	$10,000	$15,000	$361
Diversion Ditches											
Construction	LS	1	$10,400	$10,400			1	$20,000	$20,000		
Materials	LS	1	$20,800	$20,800	$31,200	$466	1	$40,000	$40,000	$60,000	$1,446
Temporary Structures	LS										
Construction	LS	1	$5,200	$5,200			1	$5,000	$5,000		
Materials	LS	1	$5,200	$5,200	$10,400	$155	1	$5,000	$5,000	$10,000	$241

Table 2
Closure Cost Comparison
Financial and Compliance Review, Matlock Bend Landfill

Description	Units	Expansion Closure Cost - 67 Acres					Permitted Closure Cost - 41.5 Acres				
		Quantity	Unit Cost	Total Unit Cost	Subtotal	Cost Per Acre	Quantity	Unit Cost	Total Unit Cost	Subtotal	Cost Per Acre
LANDFILL GAS VENT SYSTEM											
Gas Vents											
Materials	EA	58	$520	$30,160			46	$250	$11,500		
Equipment	EA	58	$260	$15,080			46	$500	$23,000		
Labor	EA	58	$260	$15,080	$60,320	$900	46	$350	$16,100	$50,600	$1,219
Gas Collection Trenches							Gas collection trenches not included				
Excavation cost	LF	20,453	$2.10	$42,951							
3-in HDPE pipe, perforated	LF	20,453	$5.20	$106,356							
No. 67 crushed stone	LF	20,453	$1.00	$20,453							
Geotextile, 6oz/sy	LF	20,453	$3.15	$64,427	$234,187	$ 3,495					
TOTAL CLOSURE COST											
Cost	Year	Year 2013 Dollars			$5,247,872		1996 Dollars			$3,597,657	
Cost Per Acre	acre	67			$78,326		41.5			$86,691	

CY – cubic yards
EA – each
SF – square feet
LF - linear feet

Table 3
Post Closure Care Comparison
Financial and Compliance Review, Matlock Bend Landfill

Description	Units	Permitted Closure Cost - 41.5 Acres				Expansion Closure Cost - 67 Acres			
		Quantity	Unit Cost	Total Unit Cost	Subtotal Cost	Quantity	Unit Cost	Total Unit Cost	Subtotal Cost
SURVEYING									
Transportation	LS	1.00	$600	$600		1	$200	$200	
Labor	LS	1.00	$2,450	$2,450	$3,050	1	$1,300	$1,300	$1,500
VEGETATION STABILTY									
Transportation	LS	1.00	$800	$800		1	70$0	$700	
Labor	LS	1.00	$1,800	$1,800		1	$2,100	$2,100	
Seeding	LS	1.00	$2,450	$2,450		1	$2,800	$2,800	
Fertilizing	LS	1.00	$2,450	$2,450		1	$2,800	$2,800	
Mulching	LS	1.00	$1,800	$1,800		1	$2,100	$2,100	
Rodent Control	LS	1.00	$600	$600		1	$700	$700	
Mowing	LS	1.00	$10,000	$10,000	$19,900	1	$3,500	$3,500	$14,700
DRAINAGE FACILITIES									
Transportation	LS	1.00	$800	$800		1	$700	$700	
Labor	LS	1.00	$1,200	$1,200		1	$1,400	$1,400	
Cleaning	LS	1.00	$1,800	$1,800		1	$2,100	$2,100	
Repair of gullies/rills									
Soil acquisition	CY	500.00	$1.25	$625		700	$2	$1,400	
Delivery	CY	500.00	$2.50	$1,250		700	$2	$1,400	
Placement	LS	1.00	$1,200	$1,200		700	$2	$1,400	
Revegetation	LS	1.00	$1,500	$1,500	$8,375	1,400	$1	$1,400	$9,800
LEACHATE COLLECTION SYSTEM									
Off-site treatment/disposal of leachate									
1-5 Years @ 1"/Acre	gal/yr	1,819,211	$ 0.004	$ 7,277		1,800,000	$0.002	$3,600	
6-30 Years @ 1/4"/Acre	gal/yr	454,803	$0.004	$1,819		1,800,000	$0.002	$3,600	
Maintenance									
Transportation	LS	1.00	$800	$800		1	$700	$700	
Labor	LS	1.00	$1,500	$1,500		1	$1,400	$1,400	
Pumps	EA	1.00	$1,500	$1,500		1	$1,050	$1,050	
Cleaning	LS	1.00	$600	$600		1	$700	$700	
Leak detection	LS	1.00	$600	$600		1	$ 00	$700	
Other	LS	1.00	$300	$300		1	$350	$350	
				Years 1-5	$12,577				$8,500
				Years 6-30	$7,119				$8,500

Table 3
Post Closure Care Comparison
Financial and Compliance Review, Matlock Bend Landfill

Description	Units	Permitted Closure Cost - 41.5 Acres				Expansion Closure Cost - 67 Acres			
		Quantity	Unit Cost	Total Unit Cost	Subtotal Cost	Quantity	Unit Cost	Total Unit Cost	Subtotal Cost
GAS COLLECTION SYSTEM									
Maintenance									
Transportation	LS	1.00	$730	$730		1	$ 840	$ 840.00	
Labor	LS	1.00	$1,700	$1,700		1	$ 1,960	$ 1,960.00	
Cleaning	LS	1.00	$1,500	$1,500		1	$ 1,750	$ 1,750.00	
Caps	EA	1.00	$430	$430		1	$ 490	$ 490.00	
Other	LS	1.00	$ 600	$600	$4,960	1	$ 700	$ 700.00	$5,740
GROUNDWATER MONITORING									
Monitoring									
Sampling labor	EA	7.00	$500	$3,500		3	200	$600	
Analytical testing 2.	EA	7.00	$1,000	$7,000		3	$600	$1,800	
Testing frequency		2.00				2			
Maintenance									
Transportation	LS	1.00	$240	$240		1	$100	$100	
Labor	LS	1.00	$500	$500		1	$400	$400	
Caps	EA	1.00	$100	$100		1	$100	$100	
Tubing	LS	1.00	$100	$100		1	$100	$100	
Pumps	EA	1.00	$100	$100		1	$100	$100	
Well replacement	EA	1.00	$800	$800		1	$250	$250	
Other	LS	1.00	$600	$ 600	$23,440	1	$250	$250	$6,100
Total									
Annual Cost (Years 1-5)					$72,302				$46,340
Annual Cost (Years 6-30)					$66,844				$46,340
Inflation Rate Utilized:					3%				3%
Years of Post Closure					30				30
Total Post Closure Required		Year 2013 Costs		$2,093,593	$2,032,615*	Year 1996 Costs			$ 3,861,554

- Leachate collection diminishes after five years , therefore a cost savings

Table 4
Summary of C/PCC Costs for As Permitted and Expansion Conditions
Financial and Compliance Review, Matlock Bend Landfill

Landfill Status	Calendar Year[1]	Total Tons[2]	Remaining Tons[3]	C/PCC[4]	C/PCC Accrual[5]	Remaining C/PCC Accrual[6]	C/PCC Liability[7]	Accrual Variance[8]	Depletion[9]	C/PCC Cost /Ton[10]	C/PCC Cost/Ton Remaining[11]
As Permitted[14]	1996	3,440,659	3,440,659	$10,036,478	NA	$10,036,478	NA	NA	0%	$2.92	$2.92
	2007	3,440,659	2,644,087	$10,036,478	$2,469,545	$7,566,933	$2,323,619	$145,926	23%	$2.92	$2.86
	2012	3,440,659	1,718,080	$10,036,478	$3,412,646	$6,623,832	$5,024,801	($1,612,155)	50%	$2.92	$3.86
	Life of Site[12]	3,440,659	0	$10,036,478	$5,158,059	$4,878,419	$10,036,478	($4,878,419)	100%	No Tons Left	No Tons Left
Expansion[15]	2012	7,522,087	5,799,508	$17,671,409	$3,412,646	$14,258,763	$3,862,597	($634,157)	22.9%	$2.35	$2.46
	End of Contract[13]	7,522,087	2,081,552	$17,671,409	$7,472,438	$10,198,970	$12,199,494	($5,308,844)	72.3%	$2.35	$4.90

[1] Calendar Year — End of year when calculations were performed
[2] Total Tons — Total Landfill capacity for as permitted or anticipated expansion
[3]Remaining Tons — Remaining tons at the end of the specified calendar year
[4]C/PCC — Total anticipated C/PCC Cost for as permitted or anticipated expansion
[5]C/PCC Accrual — Current cash 30 June 2007 plus the C/PCC Security Fee each year at current contract rate (i.e., $1.00 per ton or 5% of Tipping Fee)
[6]Remaining C/PCC Accrual — C/PCC minus C/PCC Accrual
[7]C/PCC Liability — C/PCC times Depletion
[8]Accrual Variance — C/PCC Accrual minus C/PCC Liability
[9]Depletion — Percent of airspace consumed calculated from Santek aerial photos
[10]C/PCC Cost /Ton — C/PCC divided by Total Tons
[11] C/PCC Cost/Ton Remaining — Remaining C/PCC Accrual divided by Remaining Tons
[12] Life of Site — End of as Permitted Landfill
[13]End of Contract — End of Contract with Santek 2027
[14] As permitted — C/PCC cost do not include $1.58/Ton for GCCS
[15] Expansion — C/PCC cost do not include $.98/Ton for GCCS and $1.40/Ton for depletion of on-site soil
NA — Not available

Table 4
Summary of C/PCC Costs for As Permitted and Expansion Conditions
Financial and Compliance Review, Matlock Bend Landfill

Landfill Status	Calendar Year[1]	Total Tons[2]	Remaining Tons[3]	C/PCC[4]	C/PCC Accrual[5]	Remaining C/PCC Accrual[6]	C/PCC Liability[7]	Accrual Variance[8]	Depletion[9]	C/PCC Cost /Ton[10]	C/PCC Cost/Ton Remaining[11]
As Permitted[14]	1996	3,440,659	3,440,659	$10,036,478	NA	$10,036,478	NA	NA	0%	$2.92	$2.92
	2007	3,440,659	2,644,087	$10,036,478	$2,469,545	$7,566,933	$2,323,619	$145,926	23%	$2.92	$2.86
	2012	3,440,659	1,718,080	$10,036,478	$3,412,646	$6,623,832	$5,024,801	($1,612,155)	50%	$2.92	$3.86
	Life of Site[12]	3,440,659	0	$10,036,478	$5,158,059	$4,878,419	$10,036,478	($4,878,419)	100%	No Tons Left	No Tons Left
Expansion[15]	2012	7,522,087	5,799,508	$16,867,027	$3,412,646	$13,454,381	$3,862,597	($449,951)	22.9%	$2.24	$2.32
	End of Contract[13]	7,522,087	2,081,552	$16,867,027	$7,472,438	$9,394,588	$12,199,494	($4,727,055)	72.3%	$2.24	$4.51

[1] Calendar Year — End of year when calculations were performed
[2] Total Tons — Total Landfill capacity for as permitted or anticipated expansion
[3]Remaining Tons — Remaining tons at the end of the specified calendar year
[4]C/PCC — Total anticipated C/PCC Cost for as permitted or anticipated expansion
[5]C/PCC Accrual — Current cash 30 June 2007 plus the C/PCC Security Fee each year at current contract rate (i.e., $1.00 per ton or 5% of Tipping Fee)
[6]Remaining C/PCC Accrual — C/PCC minus C/PCC Accrual
[7]C/PCC Liability — C/PCC times Depletion
[8]Accrual Variance — C/PCC Accrual minus C/PCC Liability
[9]Depletion — Percent of airspace consumed calculated from Santek aerial photos
[10]C/PCC Cost /Ton — C/PCC divided by Total Tons
[11] C/PCC Cost/Ton Remaining — Remaining C/PCC Accrual divided by Remaining Tons
[12] Life of Site — End of as Permitted Landfill
[13]End of Contract — End of Contract with Santek 2027
[14] As permitted — C/PCC cost do not include $1.58/Ton for GCCS
[15] Expansion — C/PCC cost do not include $.98/Ton for GCCS and $1.40/Ton for depletion of on-site soil
NA — Not available

Table 5
Incremental Increase in C/PCC Cost due to Active GCCS
Financial and Compliance Review, Matlock Bend Landfill

Item	**Cost/acre**	**Total Cost Current Permit 41.5 Acres**	**Total Cost Expansion 67 Acres**
Closure	$15,000	$622,500	$1,005,000
Post-Closure Care[1]	$1,000 per year	$41,500/year	$67,000/year
Impact to C/PCC Cost Per Remaining Ton	NA	$0.55	$1.43

GCCS, gas collection and control system
C/PCC, Closure/Post Closure Care
NA, not applicable
[1]Incremental PCC cost to operate GCCS for 30 years

Table 6
Incremental Increase in C/PCC Cost Due to Purchase of Offsite Soil
Financial and Compliance Review, Matlock Bend Landfill

Offsite Soil Cost	**Cost/CY**	**Quantity(CY)**	**Total**
Adjustment for Excavation	-$1.80	324,235	$(582,623)
Offsite Soil Delivered	$7.00	324,235	$2,269,645
Net impact	**$5.20**	**324,235**	**$1,687,022**
C/PCC Cost at Closure			**$3,329,483**
C/PCC Cost per Remaining Ton			**$0.57**

CY, Cubic yard
C/PCC, Closure/post closure care

Table 7
Tonnage Disposed by Customer Type, 2008 – 2012
Financial and Compliance Review, Matlock Bend Landfill

Customer Type	Tons	Tipping Fee	Tipping Fee/Ton	Tons - % of Total
Area Government Users (Stakeholders)	64,175	$1,314,193	$20.48	7%
Customers Receiving Special Pricing	813,863	$15,204,621	$18.68	88%
General Tipping Fee	47,884	$1,350,856	$28.21	5%

Table 8
Summary of Tonnage Reports by Year and Month, 2008 – 2012
Financial and Compliance Review, Matlock Bend Landfill

Month	Monthly Tipping Fee ($)				
	2008	2009	2010	2011	2012
January	20.12	20.49	20.75	19.04	17.14
February	20.35	20.45	20.38	17.57	17.81
March	21.10	20.29	20.71	17.44	18.31
April	20.97	20.77	20.47	17.55	18.64
May	20.24	20.77	19.59	18.20	18.52
June	20.31	20.45	19.52	18.10	19.60
July	20.09	20.28	20.30	19.06	19.54
August	21.42	20.03	19.35	17.97	19.49
September	21.07	20.45	19.73	17.38	19.21
October	21.21	21.13	19.63	18.07	19.07
November	20.58	20.47	19.02	17.49	19.02
December	20.38	20.28	18.58	17.59	18.74
Yearly Tipping Fee/Ton	20.66	20.47	19.70	17.90	18.74
Mean Tipping Fee/Ton 2008 - 2012					19.30

*Excludes Brush and Tires

Table 9
Market Tipping Fee East Tennessee
Financial and Compliance Review, Matlock Bend Landfill

County	**Department/ Employer**	**Phone Number**	**Cost Per Ton**	**Additional Taxes**	**Transportation included**	**Landfill**
Blount	Alcoa Public Works Department	865-995-2892	$42.00	No	No	Alcoa/Maryville/Blount Co. Sanitary Landfill
Knox	Knox County Solid Waste and Recycling	865-215-5816	$23.75	No	No	Waste Connections Landfill
Monroe	Solid Waste	423-442-2497	$25.41	No	No	Meadow Branch Landfill in McMinn County
Sevier	Solid Waste Department	865-428-0042	$40.00	Yes, $1.25 a ton	No, only accepts from Sevier County	Sevier Solid Waste, Inc.
Mean Tipping Fee			**$32.79**			

Table 10
Matlock Bend Landfill Revenue/Ton
Financial and Compliance Review, Matlock Bend Landfill

Item	**Total for 2008 through 2012**	**Revenue Per Ton**
Tonnage	926,007	NA
Host Fee	$727,080	$0.79
C/PCC Security Fee	$939,647	$1.01
Total Fee	$1,166,727	$1.80

NA, Not applicable

Table 11
Statement of Net Assets
Financial and Compliance Review, Matlock Bend Landfill

Assets and Liabilities	**Change from 2008 -2012**	**2012**	**2011**	**2010**	**2009**	**2008**	**2007**
Assets							
Current and other	$(52,367)	$2,380,571	$2,440,755	$2,445,039	$2,796,660	$2,535,224	$2,432,938
Capital	$1,158,190	$1,436,003	$1,029,249	$836,530	$271,704	$273,508	$277,813
Total assets	$1,105,823	$3,816,574	$3,470,004	$3,281,569	$3,068,364	$2,808,733	$2,710,751
Liabilities:							
Current	$(194,373)	$23,231	$23,332	$52,329	$6,047	$15,357	$217,604
Long-term	$1,706,219	$4,133,850	$3,664,938	$3,219,386	$2,976,979	$2,736,065	$2,427,631
Total liabilities	$1,511,846	$4,157,081	$3,688,270	$3,271,715	$2,983,026	$2,751,422	$2,645,235
Net assets:							
Invested in capital assets	$1,158,190	$1,436,003	$1,029,249	$836,530	$271,704	$273,508	$277,813
Unrestricted (deficit)[1]	$(1,564,213)	$(1,776,510)	$(1,247,515)	$(826,676)	$(186,366)	$(216,198)	$(212,297)
Total net assets	**$(406,023)**	**$(340,507)**	**$(218,266)**	**$9,854**	**$85,338**	**$57,310**	**$65,516**

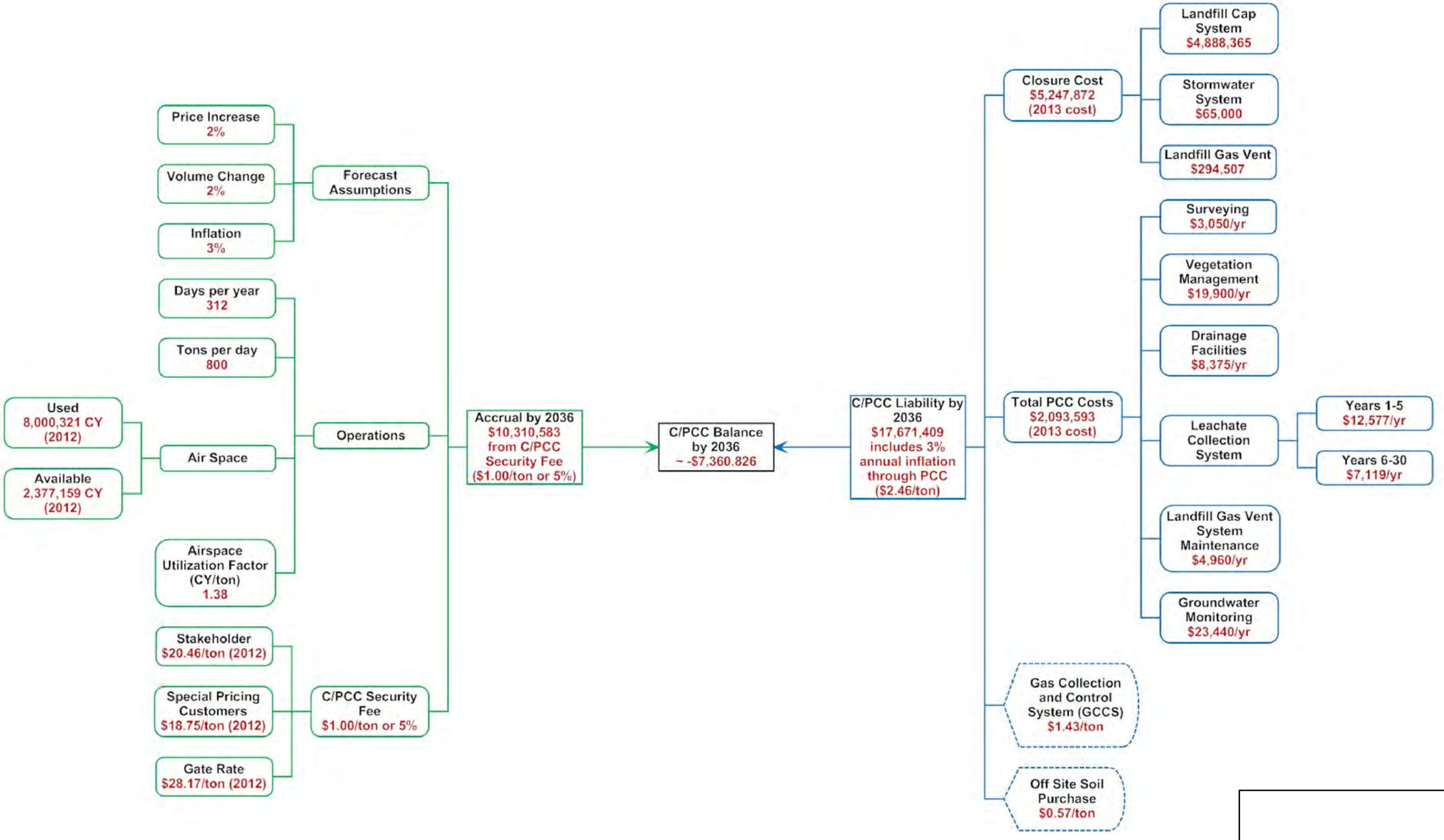
[1]Unrestricted (deficit) is calculated as “Current and Other Assets” minus “Total Liabilities”

Table 12
Statement of Revenue, Expense and Change in Net Assets
Financial and Compliance Review, Matlock Bend Landfill

ASSET ITEM	**2008 -2012**	**2012**	**2011**	**2010**	**2009**	**2008**	**2007**
Tipping fee - under the old contract	$647,844	NA	NA	NA	NA	$647,844	$2,311,000
Other Operating revenue	$2,937	NA	NA	NA	$2,937	NA	NA
Host Fee	$695,669	$183,263	$158,748	$124,596	$136,299	$92,763	NA
C/PCC Security Fee	$850,383	$256,284	$165,385	$136,997	$177,592	$114,125	NA
Revenue	$2,196,833	$439,547	$324,133	$261,593	$316,828	$854,732	$2,311,000
All Operating Expenses (excluding C/PCC)	1,178,520	$109,133	$132,193	$138,543	$128,238	$670,413	$2,283,736
Closure and postclosure care (C/PCC)	1,706,219	$468,912	$445,552	$242,407	$240,914	$308,434	$206,362
Operating Expenses	2,884,739	$578,045	$577,745	$380,950	$369,152	$978,847	$2,490,098
(Loss) from Operations[1]	$(687,906)	$(138,498)	$(253,612)	$(119,357)	$(52,324)	$(124,115)	$(179,099)
Other income	$281,883	$16,258	$25,492	$43,873	$52,514	$143,746	$140,693
Change in Net Asset[2]	**$(406,023)**	**$(122,240)**	**$(228,120)**	**$(75,484)**	**$190**	**$19,631**	**$(38,406)**

NA, not applicable
[1](Loss) from Operation calculated as "Revenue" minus "Operating Expenses
[2]Change in Net Asset calculated as "Revenue" minus "Operating Cost" plus "Other Income"
The 2008 financials reflect 3 months under the old contract with Santek and 9 months under the new turnkey contract.
The fiscal year ends June 30th.

FIGURES



Notes:

The conceptual model assumes accruals and liabilities associated with the proposed Landfill expansion.

All C/PCC costs were provided to Geosyntec by Santek. Detailed costs are provided in Appendix A

The host fee was not considered in the C/PCC accrual.

Conceptual Financial Model for Closure and Post Closure Care

Matlock Bend Landfill
Loudon, TN

Geosyntec consultants

Knoxville, TN | 10-Jun-2013

Figure 1

1,000 500 0 1,000 Feet

Site Map

Matlock Bend Landfill
Loudon, TN

Geosyntec consultants

Knoxville, TN | 10-Jun-2013

Figure **2**

APPENDIX A

Closure/Post-Closure Care Cost Details

- 1996 Closure/Post-Closure Care Plan
- Santek's Proposed Expansion Closure/ Post-Closure Care Cost

1996 Closure/Post-Closure Care Plan

MATLOCK BEND LANDFILL-PHASE II & IV UPGRADE

CLOSURE/POST-CLOSURE PLAN

December 1996

MATLOCK BEND LANDFILL - PHASE II & IV UPGRADE

CLOSURE/POST-CLOSURE PLAN

Prepared For:

Loudon County Solid Waste Disposal Commission
Loudon County, Tennessee

Prepared By:

Santek Environmental, Inc.
650 25th St. NW, Suite 100
Cleveland, Tennessee 37311-5863

and

ADAMS CRAFT HERZ WALKER, Inc.
106 Administration Road
Oak Ridge, Tennessee 37831-5838

Submitted To:

Tennessee Department of Environment and Conservation
Division of Solid Waste Management

December 1996

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Matlock Bend Landfill - Phase II & IV Upgrade

Closure/Post-Closure Plan

1.0 CLOSURE/POST CLOSURE CARE PLAN

1.1 GENERAL INFORMATION

1.1.1 Introduction

The following closure plan has been prepared for the Matlock Bend Landfill - Phase II & IV Upgrade in accordance with the closure and post-closure care requirements of the Tennessee Division of Solid Waste Management's Rule Chapter 1200-1-7-.03(2).

The Matlock Bend Landfill Phase II & IV Upgrade is a municipal solid waste landfill site to serve the sanitary and industrial waste disposal needs of Loudon, Lenoir City and Loudon County. The landfill is located on an approximate 150 acre tract of land located approximately five miles west of Loudon on Tennessee Highway 72, at latitude N 35° 44' 48" and longitude W 84° 24' 43". The above latitude and longitude are obtained from Philadelphia Tennessee 7.5' Quadrangle map which is based on National Geodetic Vertical Datum of 1929 (NGVD29).

At the time the landfill upgrade developement is completed, approximately 40 acres will have been used for solid waste disposal. The facility has a volume estimated to be 4.7 million cubic yards (cy) and has a life of approximately 20 years based on current landfill disposal rates of 160 ton per day

with 5% annual increase in daily tonnages. The life estimate is based on in-place waste densities of 800 lb/cy, 25% cover soil based on the waste volume, and 275 operations days per year. Based on current projections the final waste placement for the Matlock Bend Landfill - Phase II & IV Upgrade is year 2016.

1.1.2 Facility Contact

The Matlock Bend Landfill post-closure care-period contact shall be:

Chairman of the Board
Loudon County Solid Waste Disposal Commission
100 River Road, Box 109
Loudon, Tennessee 37774
Telephone No. (423) 966-6097

1.2 CLOSURE OPERATING PLAN

1.2.1 General Overview

The closure plan is developed in a manner to minimize maintenance needs during the post-closure care period. Features include:

- promotion of effective drainage designed to minimize infiltration and erosion,
- vegetation of the top surface and side slopes to minimize erosion, and
- use of flexible components to allow for settlement of all closure components located over the waste.

The closure plan and post-closure care activities also are developed to minimize threats to human health and the environment resulting from waste decomposition by-products, such as leachate and landfill gases.

Features to control these releases include:

- final cap design (stormwater and surfacewater management system),
- leachate collection system, and
- installation of a landfill gas management system.

Monitoring and maintenance of the landfill site will be provided for a 30-year period after closure is completed. This is in accordance with Rule 1200-1-7-.04(8)(d).

1.2.2 Closure Schedule

At least 60 days prior to beginning any final closure activities, Santek Environmental Inc. will notify the Director of the Solid Waste Division of the Tennessee Department of Environment and Conservation (TDEC) of its intent to perform closure. Interim closure activities, including grading and establishing vegetative cover, will be accomplished as waste placement of each module achieves final grade. It is noted that a minor portion of each module shall be allowed to be incomplete in order to provide an access road the width of three times the maximum construction equipment width. This is necessary to allow for ingress and egress at uncompleted phases that are located beyond completed phases. Within 90 days after any entire module reaches final grade, construction of the final cap system will begin. These time allowances are in accordance with Rule 1200-1-7-.04(8)(c) 1 through 3, respectively. If contingencies force exceptions to the schedule times set forth above, a waiver will be requested.

Santek Environmental Inc. will notify TDEC in writing when all closure activities are complete. This notification will include a certification that the area has been closed in accordance with this

Closure/Post-Closure Plan. This is in accordance with Rule 1200-1-7-.04(8)(c)9.

Within 90 days of completing final closure of the entire landfill, and prior to the sale or lease of the property, Santek Environmental Inc. will ensure that a notation is recorded on the property deed, or on some other instrument which is normally examined during a title search, that will perpetually notify any person conducting a title search that the land has been used as a waste disposal facility. This is in accordance with Rule 1200-1-7-.04(8)(f).

1.2.3 Final Cap Design

The Matlock Bend Landfill - Phase II & IV Upgrade will be closed with a final cap designed to achieve the following:

- reduce and minimize infiltration of precipitation through the top surface of the landfill so that infiltration volume will be equal to or less than the percolation volume through the bottom liner system,
- minimize maintenance,
- promote efficient drainage while preventing excessive erosion of the final cover, and
- allow for settling and subsidence while maintaining the integrity of the cap system.

The final cap will incorporate the following closure system profile:

* 24 inch vegetative cover
* A drainage layer consisting of a polyethylene geonet sandwiched between two layers of geotextile fabric
* A 40 mil very low density polyethylene geomembrane (or approved alternate)
* 12 inch soil barrier
* A gas collection layer of a polyethylene geonet sandwiched between two layers of geotextile

The barrier soil layer and the geosynthetic components of the final closure cap will utilize the same construction quality assurance plan as the composite bottom liner. The liner construction quality assurance (CQA) plan is presented in Section 2.15 of the operation plan for the Matlock Bend Landfill - Phase II & IV Upgrade.

The closure system's hydraulic performance was modeled using the Hydrologic Evaluation of Landfill Performance (HELP) computer model. The HELP model is primarily utilized to evaluate closure system profiles for comparative performance; i.e., approximate infiltration rates for different cap configurations. The HELP model is generally not used for a quantitative analysis of actual closure system infiltration rates, due to the many variables associated with actual precipitation infiltration. The complete HELP model results and analysis for the landfill closure system percolation simulation is located in Appendix A.

1.2.3.1 Acquisition of Final Cover System Soil

The current plan for cover soil acquisition is to use soil obtained from stock piled excavation from the construction of the landfill base grades and on-site borrow areas. Stabilization of the borrow area will be conducted as follows:

- Maximum finished slope $\leq 33\%$
- Sediment and erosion control devices will be placed as required to prevent excessive soil loss on the current site and sediment build up on adjacent tracts of land.
- All finished slopes are to be seeded and fertilized as required to provide healthy vegetative cover.

Alternative Off-site Borrow Material

If, for some reason, soil obtained from the borrow area fails to meet the requirements of the section

(Section 1.2.3), provisions will be made to obtained acceptable off-site borrow material. In the event off-site borrow material must be used, a procedure will be used to evaluate the best off-site option. Material obtained from off-site borrow sources must be tested using the same methods applied to evaluate on-site borrow soils.

1.2.4 Permanent Vegetative Cover

Upon completion of the placement of the vegetative cover soil, at a minimum, the following seasonal seed mixtures will be utilized for the appropriate season of planting:

SEASON	SEED	APPLICATION RATE
Spring (Mar. 15 - May 15)	Kentucky 31 Fescue Clover	100 lb/ac 5 lb/ac
Summer (May 15 - Aug. 15)	Kentucky 31 Fescue Clover	100 lb/ac 5 lb/ac
Fall (Aug. 15 - Oct. 15)	Kentucky 31 Fescue White Clover	60 lb/ac 15 lb/ac
Winter (Oct. 15 - Mar. 15)	Annual Ryegrass White Clover	80 lb/ac 10 lb/ac

Fertilizer: Readily available commercial fertilizers will be used.

Application rates will be approximate due to varying quality of cover soil material. Approximate minimum application rates will be as follows:

15-15-15	200 lb/ac, or
6-12-12	300 lb/ac
As Required:	
Limestone	1 tons/ac, or
Hydrated lime	.5 ton/ac

Mulch: Apply hay that has been thoroughly fluffed, or chopped and blown, at the rate of 3 tons per acre, or fiber as used in hydro-seeder.

The planting specifications will be modified throughout the post-closure care period as required to maintain an efficient vegetative cover. Provisions also have been made (in post-closure cost estimates) to accommodate further soil testing (as it relates to fertilizing requirements) and professional turf management assistance.

1.2.5 Surface and Stormwater Management System

1.2.5.1 Run-On Control System

Drainage of stormwater onto the Matlock Bend Landfill - Phase II & IV Upgrade will be managed by a series of permanent and temporary diversion ditches and drainage swells.

1.2.5.2 Erosion and Sediment Control System

To minimize infiltration through the cover material, and to provide adequate drainage, the final cover system will be constructed so that the finished grades for the plateau area will vary from 3% to 7%. The side slopes shall be constructed on a maximum 3 (horizontal) to 1 (vertical) slope. The 3:1 slope will facilitate adequate maintenance of the side slope vegetative cover and will simplify remediation of any rills and gullies, if required.

Silt fences/hay bales shall be constructed at the toe of all slopes greater than 100 feet in length. At periodic intervals not to exceed 200 feet silt fences/hay bales shall be provided in all collection

ditches until vegetation has been established. Actual spacing of silt fences/hay bales will be adjusted for the steepness of the ditch slope. Silt fences/hay bales will be maintained in order to assure minimization of silt transportation and cleaned when sediment exceeds one-half the height of the fence. Once vegetation is established, the use of silt fences/hay bales will not be required. Sediment fences/hay bales along with rock check dams are utilized in ditches to capture sediment before it reaches the ponds, and to reduce stormflow velocities.

Surface water run-off from stockpile areas will be routed through silt fences/hay bales to aid in prevention of siltation of on-site ditches and stormwater management basins. Vegetation will be established as soon as possible on all areas that will not be part of daily operation. The vegetation shall be properly maintained (i.e., mowed, fertilized) to assure its growth.

1.2.5.3 Run-Off Control System

To provide for controlled drainage of stormwater from the final cover system to the stormwater management basins, precipitation falling on the landfill will be directed to engineered diversion ditches by final cover contours. Drawing No. C-6 of the permit drawing package illustrates the final grading contours, which have been designed to reduce hydraulic length and the surface area contributing to sheet flow. The grading and ditch design will properly manage stormwater and will significantly reduce erosion.

All diversion ditches have been designed to accommodate a 100-year, 24-hour storm event. The ditches will be lined with graded crushed stone. Rock check dams will be located at strategic

positions along each reach to reduce flow rates.

All surface water run-on and run-off will be diverted around the operating area by the means of interceptor ditches or diversion berms as needed. Permanent run-on and run-off structures (i.e., culverts, ditches, stormwater management basins) will be designed and constructed to manage peak discharge from a 100 year/24 hour storm event.

Two stormwater management basins are utilized to control storm water run-off and the off-site migration of silt. One of the basins has been in service for a number of years in conjunction with the Phase I development of the facility and was designated as "Pond 2." Pond 2 will receive and manage the surface water run-off from approximately 14 acres of the Phase II & IV Upgrade development. The second basin, Basin No. 1 will manage the run-off from the remainder of the site and was constructed in conjunction with the Phase II Upgrade development of the facility.

The capacity of Basin No. 1 was evaluated as part of the "Matlock Bend Landfill - Phase II Upgrade Facility and Operations Plan". The stormwater management basin design calculation package for Basin No. 1 is presented in Appendix B of this plan.

Both of the stormwater management basins have been designed and constructed to contain the run-off from a 25 year/24 hour storm event and pass the run-off from a 100 year/24 hour storm event through the basin emergency spillway. The detention basins are being managed to assure the design capacity is maintained.

The capacity of Pond 2 was evaluated as a part of the Matlock Bend Landfill - Phase II & IV Upgrade facility design. The evaluation calculation package is presented in Appendix B of this plan. The ditches and culverts which comprise the permanent drainage structure system, as shown on Drawing No. C-6 of the permit drawing package, have been designed as part of this landfill development. Ditch and culvert schedules are shown on Drawing No. CD-1 of the permit drawing package. The design calculation package is presented in Appendix B of this plan.

1.2.6 Groundwater Monitoring Plan

1.2.6.1 Compliance Monitoring Boundary

The compliance monitoring boundary shall be an imaginary line encompassing the limits of waste for all of the disposal areas on the landfill property. For this site the compliance monitoring boundary is a 50 foot off set, to the inside, of the property line.

1.2.6.2 Groundwater Monitoring Wells and Analysis

Phase II and IV Upgrade will utilize three monitoring wells (GW-3, GW-4, and GW-5) for groundwater quality monitoring. GW-5 is the upgradient well and GW-3 and GW-4 are the downgradient wells, as illustrated on Drawing No. C-5 of the permit drawing package.

The groundwater monitoring plan for the remaining closure/post closure period calls for semi-annual sampling and analysis of the following groundwater parameters:

INORGANIC CONSTITUENTS

1. Antimony
2. Arsenic
3. Barium
4. Beryllium
5. Cadmium
6. Chromium
7. Cobalt
8. Copper
9. Fluoride
10. Lead
11. Mercury
12. Nickel
13. Selenium
14. Silver
15. Thallium
16. Vanadium
17. Zinc

ORGANIC CONSTITUENTS

18. Acetone
19. Acrylonitrile
20. Benzene
21. Bromochloromethane
22. Bromodichloromethane
23. Bromoform; Tribromomethane
24. Carbon disulfide
25. Carbon tetrachloride
26. Chlorobenzene
27. Chloroethane; Ethyl chloride
28. Chloroform; Trichloromethane
29. Dibromochloromethane; Chlorodibromomethane
30. 1,2-Dibromo-3-chloropropane; DBCP
31. 1,2-Dibromoethane; Ethylene dibromide; EDB
32. o-Dichlorobenzene; 1,2-Dichlorobenzene
33. p-Dichlorobenzene; 1,4-Dichlorobenzene
34. trans-1,4-Dichloro-2-butene
35. 1,1-Dichloroethane; Ethylidene chloride
36. 1,2-Dichloroethane; Ethylene dichloride
37. 1,1-Dichloroethylene; 1,1,-Dichloroethene; Vinylidene chloride
38. cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene

39. trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene
40. 1,2-Dichloropropane; Propylene dichloride
41. cis-1,3-Dichloropropene
42. trans-1,3-Dichloropropene
43. Ethylbenzene
44. 2-Hexanone; Methyl butyl ketone
45. Methyl bromide; Bromomethane
46. Methyl chloride; Chloromethane
47. Methylene bromide; Dibromomethane
48. Methylene chloride; Dichloromethane
49. Methyl ethyl ketone; MEK; 2-Butanone
50. Methyl iodide; Iodomethane
51. 4-Methyl-2-pentanone; Methyl isobutyl ketone
52. Styrene
53. 1,1,1,2-Tetrachloroethane
54. 1,1,2,2-Tetrachloroethane
55. Tetrachloroethylene; Tetrachloroethene; Perchloroethylene
56. Toluene
57. 1,1,1-Trichloroethane; Methylchloroform
58. 1,1,2-Trichloroethane
59. Trichloroethylene; Trichloroethene
60. Trichlorofluoromethane; CFC-11
61. 1,2,3-Trichloropropane
62. Vinyl acetate
63. Vinyl chloride
64. Xylenes

All monitoring data will be reported in writing to the TDEC within 15 days after completion of the analysis. Additionally, records of all groundwater monitoring activities will be maintained throughout the active life of the facility and the post-closure care period.

1.2.6.3 Groundwater Sampling Protocol

Prior to any pumping or bailing of wells, the groundwater surface elevation will be determined and recorded at each monitoring well before each sample extraction. Prior to sample collection, three well volumes will be purged from each well. Wells which have a slow recovery rate will be allowed

a maximum recovery period of 72 hours. Wells which cannot recover sufficiently for sampling in the allowed period will be considered dry for that sampling event.

Sampling will be accomplished with disposable PVC bailers. All groundwater samples will be placed in properly prepared and preserved bottles equipped with teflon lined caps then packed in ice for transportation to the laboratory. A Chain-of-Custody form will accompany all samples from the time they are collected until they are relinquished to the laboratory.

In addition to the laboratory analysis to be performed on all water samples, field analysis will include water level, pH, specific conductance, and temperature. A groundwater sampling form will be utilized to record pertinent information derived in the field for each sampling event. The monitoring records will include the following information:

- date, exact place, and time of sampling;
- individual(s) performing sampling;
- date(s) analyses were performed;
- techniques (including equipment utilized) used for the analysis; and,
- analysis results.

1.2.7 Leachate Collection, Removal and Treatment System

The leachate management system will continue to operate as described in the facility/operational plan.

Closure activities which will limit the amount of leachate to be handled include:

* Well graded top and sideslopes to quickly convey rainfall off the landfill thus minimizing ponding and infiltration.

* A surfacewater management system consisting of swales and corrugated plastic pipe to remove stormwater from the landfill surface while minimizing erosion.

* A VLDPE or approved alternate top cap liner to reduce percolation into the landfill thus limiting leachate generation.

* A well vegetated final cover to limit percolation, improve evapotranspiration and prevent erosion of the cover soil.

The HELP computer model was used to simulate the amount of leachate collected by the system.

The system profile is detailed as follow:

* 24 inch vegetative cover

* 12 inch soil barrier

* A drainage layer consisting of a polyethylene geonet sandwiched between two layers of geotextile fabric

* A 40 mill very low density polyethylene geomembrane (or approved alternate)

* A gas collection layer of a polyethylene geonet sandwiched between two layers of geotextile

Leachate from the disposal area will drain by gravity to a collection tank located outside the composite liner system. The leachate storage tank will be surrounded by a secondary containment system. A sump pump will be provided as required to remove stormwater that collects in the containment area and to transfer leachate in the event of a spill.

Leachate will be removed from the storage tanks as needed. Leachate shall be removed by pumping the leachate into a storage tank truck. Collected leachate will only be applied within the landfill footprint where there is a leachate collection system. Leachate will only be applied back to the landfill when the soil is dry enough to readily absorb all of the leachate, so that no runoff or leachate ponding is created. Plans are also underway to construct a lift station and force main sewer line from the Matlock Bend Landfill - Phase II & IV Upgrade storage tank to an existing sewer line managed by the Loudon County Utilities Board. The leachate would then be treated at the city of Loudon Wastewater Treatment Plant. The leachate collection tanks and secondary containment shall be visually inspected on a daily basis for any damage. Any damage or malfunction of these components will be recorded and corrective action will be implemented immediately.

The Hydrologic Evaluation of Landfill Performance (HELP) model was used in the design of the leachate collection and temporary storage facilities. Results of the HELP model and a brief narrative are presented in Appendix A of this plan.

1.2.8 Landfill Gas Management System

The migration of landfill gases generated by the decomposition of solid wastes at the Matlock Bend Landfill - Phase II and IV Upgrade will be controlled through a passive venting system.

To determine if landfill gas begins to migrate off-site, methane gas will be monitored at the compliance monitoring boundary. Monitoring will also be conducted in facility structures. Monitoring procedures are in accordance with Section 1.2.8.2, "Landfill Gas Sampling Protocol,"

of this document. Methane gas concentration monitoring will be a part of the post-closure care period activities. If necessary, gas migration control will be performed in accordance with Rule 1200-1-7-.04(5)(a).

Passive gas vents will be placed as indicated on Drawing No. C-6 of the permit drawing package to control landfill gas. The gas venting layer is composed of a geonet placed between two layers of geotextile and the placed below the geomembrane. This layer will control the buildup of landfill gas pressure under the final cover and allow gas to migrate towards the vents.

1.2.8.1 Landfill Gas Monitoring Plan

Landfill gas will be monitored in the following locations:

- Every 100 feet along the compliance monitoring boundary.
- Monitoring inside all permanent structures at a rate of one test every 2,000 ft^2 or one test in every structure. Tests should be performed along exterior walls at columns and/or construction joints. In addition, cracks or expansion joints of building slabs on grade are possible monitoring locations.

If concentrations of explosive gases at the compliance monitoring boundary exceed the lower explosive limit (LEL), the following precautions shall be met:

- Immediate implementation of all necessary steps to ensure protection to human health.
- Within 48 hours, notification of the Tennessee Division of Solid Waste Management.
- Within 14 days, chronicle in the facility's operating records detectable gas levels and steps taken to protect human health.

- Within 90 days of detection, propose remediation plan for release of methane gas. The Tennessee Division of Solid Waste Management will be notified of remedial plan and implementation schedule.

If explosive gas concentrations in facility structures exceed 25% of LEL, the following precautions will be taken:

- excavate facility structures,
- ventilate facility structures,
- notify fire department, and
- post notification on all facility entrances stating occupying building is prohibited.

1.2.8.2 Landfill Gas Sampling Protocol

A. Monitoring Equipment

Methane gas monitoring is to be performed with a meter scaled at 0-100% of LEL and Percent of Total Gases. The LEL is the lowest concentration of a gas (as a part of total gases) that will result in an explosion if an ignition source is present (at 25°C and atmospheric pressure).

B. Monitoring Frequency

Monitoring is to take place at least quarterly. Monitoring must also take place immediately if regular inspection reveals signs of landfill gas (LFG) migration. Signs of LFG migration are as follows:

1. stress in vegetation in or around site (stress includes stunted growth, wilting, color changes, etc.), and

2. inability to grow vegetation (bare spots) in or around site.

C. Monitoring Methodology

1. Always extinguish all smoking materials before testing for LFG.

2. Methodology at location of LFG migration signs which are not in a final cover area:

   a. Dig a hole approximately 3 ft deep.

   b. Take readings in the bottom of hole.

   c. Record readings and location.

   d. Backfill hole.

3. Methodology at location of LFG migration signs which are in a final cover area:

   a. Inspect the area for cracks or signs of damage to the final cover.

   b. Take readings in the area of vegetative stress.

   c. Record readings and location.

1.3 POST CLOSURE PLAN

1.3.1 General

The post-closure care activities for the Matlock Bend Landfill - Phase II and IV Upgrade will include routine site inspections, monitoring, maintenance, and repair. The objective of these activities is to continue to minimize:

- maintenance requirements and
- threats to human health and the environment from waste constituents or by-products.

The post-closure activities will continue for a period of 30 years after closure is complete. This is in accordance with Rule 1200-1-7-.04(8)(d).

1.3.2 Maintenance of Final Cap System

The final cap system will be inspected to ensure that the integrity of the closure cap is maintained. Any effects of erosion will be remediated as soon as possible. Any damaged materials will be repaired with the same type of material originally installed and constructed in accordance with the original plans.

The operator will ensure that a healthy vegetative cover is maintained over the cap system and the remainder of the site. This will include re-seeding, mulching, fertilizing, mowing, as well as final cover and side-slope repair, on an as-needed basis.

1.3.3 Maintenance of Surface and Stormwater Management System

All drainage structures will be inspected and maintained to prevent settlement, erosion, and clogging, and to ensure proper drainage of the landfill as designed. Culvert inlets and outlets will be visually inspected and cleaned as necessary to ensure proper operation of the landfill drainage system design.

Stormwater management basins will be dredged, as necessary during the post-closure care period to remove silt accumulation, as required to maintain the designed stormwater storage volume.

1.3.4 Maintenance of Groundwater Management System

1.3.4.1 Groundwater Monitoring Wells

The groundwater monitoring wells are described in Section 1.2.6.2. These wells are intended to be used for the entire post-closure period.

1.3.4.2 Groundwater Analysis

Beginning at the post-closure care period, all wells shall be monitored in accordance with Tennessee Rule Chapters 1200-1-7-.04(7)(a)4 through 6.

Throughout the post-closure care period, each well will be sampled on a semi-annual basis for the following parameters:

INORGANIC CONSTITUENTS

1. Antimony
2. Arsenic
3. Barium
4. Beryllium
5. Cadmium
6. Chromium
7. Cobalt
8. Copper
9. Fluoride
10. Lead
11. Mercury
12. Nickel
13. Selenium
14. Silver
15. Thallium
16. Vanadium
17. Zinc

ORGANIC CONSTITUENTS

18. Acetone
19. Acrylonitrile
20. Benzene
21. Bromochloromethane
22. Bromodichloromethane
23. Bromoform; Tribromomethane
24. Carbon disulfide
25. Carbon tetrachloride
26. Chlorobenzene
27. Chloroethane; Ethyl chloride
28. Chloroform; Trichloromethane
29. Dibromochloromethane; Chlorodibromomethane
30. 1,2-Dibromo-3-chloropropane; DBCP
31. 1,2-Dibromoethane; Ethylene dibromide; EDB
32. o-Dichlorobenzene; 1,2-Dichlorobenzene
33. p-Dichlorobenzene; 1,4-Dichlorobenzene
34. trans-1,4-Dichloro-2-butene
35. 1,1-Dichloroethane; Ethylidene chloride
36. 1,2-Dichloroethane; Ethylene dichloride
37. 1,1-Dichloroethylene; 1,1,-Dichloroethene; Vinylidene chloride
38. cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene
39. trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene
40. 1,2-Dichloropropane; Propylene dichloride
41. cis-1,3-Dichloropropene
42. trans-1,3-Dichloropropene
43. Ethylbenzene
44. 2-Hexanone; Methyl butyl ketone
45. Methyl bromide; Bromomethane
46. Methyl chloride; Chloromethane
47. Methylene bromide; Dibromomethane
48. Methylene chloride; Dichloromethane
49. Methyl ethyl ketone; MEK; 2-Butanone
50. Methyl iodide; Iodomethane
51. 4-Methyl-2-pentanone; Methyl isobutyl ketone
52. Styrene
53. 1,1,1,2-Tetrachloroethane
54. 1,1,2,2-Tetrachloroethane
55. Tetrachloroethylene; Tetrachloroethene; Perchloroethylene
56. Toluene
57. 1,1,1-Trichloroethane; Methylchloroform
58. 1,1,2-Trichloroethane

59. Trichloroethylene; Trichloroethene
60. Trichlorofluoromethane; CFC-11
61. 1,2,3-Trichloropropane
62. Vinyl acetate
63. Vinyl chloride
64. Xylenes

1.3.5 Monitoring and Maintenance of the Leachate Management System

The leachate collection and removal system will be maintained throughout the post-closure care period. Inspection of all appurtenances (e.g., valves, pumps, storage tanks, etc.) of the system, including the leachate transfer facility, will be conducted with any necessary remedial actions performed as soon as possible. Leachate will continue to be collected in the leachate storage tanks and treated at the Loudon Wastewater Treatment Plant, as required, during the post-closure care period.

Samples of the leachate will be collected and analyzed as required by the water treatment plant.

1.3.6 Monitoring and Maintenance of the Landfill Gas Management System

The primary function of the landfill gas management system is to control odor, explosive gas emissions, and their migration off-site.

Methane gas surveys will be conducted during the first year of post-closure activities, and semi-annually thereafter. The survey shall be composed of ambient air samples collected once every 100 ft along the compliance monitoring boundary, and once in every room of every structure on the

landfill property. Samples shall be analyzed by the use of a combustible gas indicator, which has direct methane gas measurement capability. The results of the semi-annual survey will be maintained as part of the permanent records, with a copy submitted to the TDEC, Division of Solid Waste Management.

The landfill gas vents will be visually inspected periodically to ensure proper operation. Any damage to the vents will be repaired as soon as possible.

1.3.7 Schedule for Inspections during Post-Closure

A schedule for performing inspections will be as follows:

Item	Frequency
Final Cap System	1 per 3 Months
Surface and Stormwater Management System	1 per 3 Months
Groundwater Management System	1 per 6 Months
Leachate Management System	1 per 1 Months
Landfill Gas Management System	1 per 3 Months

Any systems that are found to be functioning improperly or are damaged, will be repaired immediately in accordance to this plan.

1.3.8 Post-Closure Land Use

There is no proposed land use for the closed landfill at the time of this submission.

2.0 CLOSURE AND POST-CLOSURE CARE COST ESTIMATES

2.1 Introduction

The cost estimates in this document are budgetary estimates. Costs are based on a variety of information including quotes from manufacturers, generic unit costs, vendor information, and prior experience. Cost estimates are developed for total closure of the Matlock Bend Landfill - Phase II & IV Upgrade of which 40 acres will be used for disposal. Actual closure and post-closure costs depend on true labor and material costs, actual site conditions, competitive market conditions, final project scope, implementation schedule, and any other variable factors.

Regarding financial assurance, the planned cost to completely close the Matlock Bend Landfill - Phase II & IV Upgrade is defined. Cost information represented in the following sections of this document, "Closure Cost" and "Post-Closure Cost," are in a format which models Cost Estimate Work Sheets A and B, as recommended by the Tennessee Division of Solid Waste Management. All unit prices and subtotals are in 1996 dollars. The total closure cost and annual post-closure costs are presented in 1996 and 2016 dollars.

2.2 Closure Cost

Cost estimates to close the landfill, consisting of approximately 40 acres, are calculated as follows:

Closure Activity Cost Estimates

I. Establishing final cover system:

A. Vegetative Cover

1.	Quantity needed (yd^3)	135,520.00
2.	Excavation unit cost ($/$yd^3$)	1.46
3.	Excavation cost ($)	197,859.20
4.	Placement and spreading unit cost ($/$yd^3$)	0.62
5.	Placement cost ($)	84,022.40
	Subtotal:	**$ 281,881.60**

B. Landfill cap (Barrier layer)

1. Barrier soil

a.	Quantity needed (yd^3)	67,760.00
b.	Excavation unit cost ($/$yd^3$)	1.75
c.	Excavation cost ($)	118,580.00
d.	Placement/spreading unit cost ($/$yd^3$)	0.62
e.	Placement cost ($)	42,011.20
f.	Compaction unit cost ($/$yd^3$)	1.30
g.	Compaction cost ($)	88,088.00
	Subtotal:	**$ 248,679.20**

2. Quality control/testing of on-site/off-site clay borrow material

a.	Quantity needed (cy)	67,760
b.	Testing unit cost ($/cy)	0.30
c.	Testing cost ($)	20,328.00
	Subtotal :	**$ 20,328.00**

3. Quality control/testing for placement of final cover system

a.	Quantity needed (cy)	67,760
b.	Testing unit cost ($/cy)	0.50
c.	Testing cost ($)	33,880.00
	Subtotal:	**$33,880.00**

4. Geosynthetics - Geotextiles, Geonet and Geomembrane

a.	Four layers of Geotextile ($/acre)	21,638.00
b.	Two layers of Geonet ($/acre)	24,589.00
c.	One layer of Geomembrane ($/acre)	22,130.00
d.	Number of Acres	41.50
	Subtotal:	**$ 2,836,815.50**

5. Perimeter Stormwater Drain

a.	Drainage stone (tons)	985
b.	Drainage media (cost/ton)	20.00
c.	Drainage pipe (lf)	275
d.	Drainage pipe Cost ($/lf)	1.20
e.	Geotextile (sf)	47,200.00
c.	Geotextile ($/sf)	0.18

Subtotal: **$ 28,526.00**

C. Establishing vegetation cover:

1.	Labor ($/acre)	400.00
2.	Seeding ($/acre)	200.00
3.	Fertilizing ($/acre)	150.00
4.	Mulching ($/acre)	225.00
5.	Number of acres	45.00

Subtotal: **$ 43,875.00**

TOTAL to establish final cover system: **$ 3,493,985.30**

II. Establishing or completing a system to minimize and control erosion/sedimentation:

A. Stormwater Management Basins

1.	Sediment excavation ($)	10,000.00
2.	Materials (e.g. pipe, riprap) ($)	5,000.00

Subtotal: **$ 15,000.00**

B. Diversion ditches

1.	Construction ($)	20,000.00
2.	Materials ($)	40,000.00

Subtotal: **$ 60,000.00**

C. Temporary structures

1.	Construction ($)	5,000.00
2.	Materials ($)	5,000.00

	Subtotal:	$ 10,000.00
	TOTAL to establish or complete a system to minimize and control erosion and sedimentation:	$ 85,000.00

III. Establishing a system to monitor and vent gases:

B. Gas vent system

1.	Materials ($/vent)	250.00
2.	Equipment ($/vent)	500.00
3.	Labor ($/vent)	350.00
4.	Number of vents	46
	TOTAL for establishing system to vent gas:	$ 50,600.00

TOTAL CLOSURE COSTS (October 1996):	$3,629,585.30
TOTAL CLOSURE COSTS (Year 2016):	$ 6,555,434.79

MATLOCK BEND LANDFILL
PHASE II AND IV UPGRADE
CLOSURE COST ESTIMATE

1996 Cost of Closure	$3,629,585.30
Annual Inflation Rate:	3.00%
Years to Closure	20
Inflated Total Closure Cost:	$6,555,434.79

Year	Rate	Amount
1996	3.00%	$3,629,585.30
1997	3.00%	$3,738,472.86
1998	3.00%	$3,850,627.04
1999	3.00%	$3,966,145.86
2000	3.00%	$4,085,130.23
2001	3.00%	$4,207,684.14
2002	3.00%	$4,333,914.66
2003	3.00%	$4,463,932.10
2004	3.00%	$4,597,850.07
2005	3.00%	$4,735,785.57
2006	3.00%	$4,877,859.13
2007	3.00%	$5,024,194.91
2008	3.00%	$5,174,920.76
2009	3.00%	$5,330,168.38
2010	3.00%	$5,490,073.43
2011	3.00%	$5,654,775.63
2012	3.00%	$5,824,418.90
2013	3.00%	$5,999,151.47
2014	3.00%	$6,179,126.01
2015	3.00%	$6,364,499.79
2016	3.00%	$6,555,434.79

2.3 POST-CLOSURE CARE COST

Post-Closure care cost estimates include all costs required for monitoring programs, site maintenance, and repairs for 30 years after the closure is completed. Post-Closure costs are calculated on an annual basis and are as follows:

Post-Closure Activity Cost Estimates:

I.	Surveying inspections to confirm final grade and drainage are maintained:		
	A.	Transportation ($)	200.00
	B.	Labor ($)	1,300.00
		TOTAL for surveying inspections:	**$ 1,500.00**
II.	Maintain healthy vegetation		
	A.	Transportation ($)	700.00
	B.	Labor ($)	2,100.00
	C.	Seeding ($)	2,800.00
	D.	Fertilizing ($)	2,800.00
	E.	Mulching ($)	2,100.00
	F.	Rodent Control ($)	700.00
	G.	Mowing ($)	3,500.00
		TOTAL for maintaining health vegetation:	**$ 14,700.00**
III.	Maintain the drainage facilities, sediment ponds and other erosion/sedimentation control measures:		
	A.	Transportation ($)	700.00
	B.	Labor ($)	1,400.00
	C.	Cleaning out of systems ($)	2,100.00
	D.	Repair of gullies or rills	
	1.	Soil acquisition	
	a.	Quantity (yd^3)	700.00
	b.	Unit cost ($/$yd^3$)	2.00
	c.	Cost ($)	1,400.00
	d.	Delivery unit cost ($/$yd^3$)	2.00
	e.	Delivery cost ($)	1,400.00

2.	Placement/spreading/compaction ($)	1,400.00
3.	Revegetation	1,400.00
	TOTAL for maintaining drainage:	**$ 8,400.00**

IV. Maintain and monitor leachate collection, removal and treatment system:

A. Off-site treatment of leachate

1.	Quantity (gallons)	1,800,000.00
2.	Hauling unit cost($)	N.A.
3.	Hauling cost ($)	N.A.
4.	Treatment cost ($\gallon)	0.002
5.	Treatment cost ($)	$ 3,600.00
	Subtotal:	**$ 3,600.00**

B. Maintenance of leachate collection system

1.	Transportation ($)	700.00
2.	Labor ($)	1,400.00
3.	Repairs/Materials	
a.	Pumps ($)	1,050.00
b.	Cleaning out system ($)	700.00
c.	Leak detection ($)	700.00
d.	Other ($)	350.00
	Subtotal:	**$4,900.00**
	TOTAL for monitoring and maintaining leachate system:	**$ 8,500.00**

V. Maintain and monitor gas venting system:

A.	Transportation ($)	840.00
B.	Labor ($)	1,960.00
C.	Repairs/Materials	
1.	Cleaning ($)	1,750.00
2.	Caps ($)	490.00
3.	Other ($)	700.00
	TOTAL for maintaining and monitoring gas control system:	**$ 5,740.00**

VI. Maintain and monitor groundwater and/or surface water monitoring system:

A.	Monitoring of groundwater systems:		
1.	Number of wells/springs		3
2.	Number of samples/well		1
3.	Unit cost of analysis ($/well)		600.00
4.	Cost of sampling and analysis ($)		1,800.00
5.	Labor cost per well ($/well)		200.00
6.	Labor costs ($)		600.00
7.	Testing Frequency Twice Per Year		2
		Subtotal:	**$ 4,800.00**
B.	Inspection and maintenance of system:		
1.	Transportation ($)		100.00
2.	Labor ($)		400.00
3.	Repairs/Materials		
a.	Caps ($)		100.00
b.	Tubing ($)		100.00
c.	Pumps ($)		100.00
d.	Well replacement ($)		250.00
e.	Other ($)		250.00
		Subtotal:	**$ 1,300.00**
TOTAL for maintaining and monitoring groundwater system:			**$ 6,100.00**

TOTAL POST-CLOSURE COSTS:

Annual Post-Closure (1996):	**$ 44,940.00**
Annual Post-Closure (2016):	**$ 81,167.00**
Inflation Rate Utilized:	**3.00 %**
30-Year Basis:	**$ 3,861,553.77**

MATLOCK BEND LANDFILL
PHASE II AND IV UPGRADE
POST-CLOSURE ESTIMATE

1996 Post Closure Cost:	$44,940.00
2016 Value of Annual Costs:	$81,167.00
Annual Inflation Rate starting 2016:	3.00%
Years of Post-Closure Care:	30
Cumulative Post-Closure Costs:	$3,861,553.77

Year	Yearly Expenses	Cumulative Costs
2016	$81,167.00	$81,167.00
2017	$83,602.01	$164,769.01
2018	$86,110.07	$250,879.08
2019	$88,693.37	$339,572.45
2020	$91,354.17	$430,926.63
2021	$94,094.80	$525,021.43
2022	$96,917.64	$621,939.07
2023	$99,825.17	$721,764.24
2024	$102,819.93	$824,584.17
2025	$105,904.53	$930,488.69
2026	$109,081.66	$1,039,570.35
2027	$112,354.11	$1,151,924.46
2028	$115,724.73	$1,267,649.20
2029	$119,196.48	$1,386,845.67
2030	$122,772.37	$1,509,618.04
2031	$126,455.54	$1,636,073.58
2032	$130,249.21	$1,766,322.79
2033	$134,156.68	$1,900,479.48
2034	$138,181.38	$2,038,660.86
2035	$142,326.83	$2,180,987.69
2036	$146,596.63	$2,327,584.32
2037	$150,994.53	$2,478,578.85
2038	$155,524.37	$2,634,103.21
2039	$160,190.10	$2,794,293.31
2040	$164,995.80	$2,959,289.11
2041	$169,945.67	$3,129,234.78
2042	$175,044.04	$3,304,278.82
2043	$180,295.36	$3,484,574.19
2044	$185,704.23	$3,670,278.41
2045	$191,275.35	$3,861,553.77

MATLOCK BEND LANDFILL
PHASE II AND IV UPGRADE
POST-CLOSURE ESTIMATE
INFLATION COST IN YEAR 2016

1996 Cost of Post-Closure	$44,940.00
Annual Inflation Rate:	3.00%
Years to Post-Closure	20
Inflated Closure Cost in 2016:	$81,166.64

Year	Rate	Amount
1996	3.00%	$44,940.00
1997	3.00%	$46,288.20
1998	3.00%	$47,676.85
1999	3.00%	$49,107.15
2000	3.00%	$50,580.37
2001	3.00%	$52,097.78
2002	3.00%	$53,660.71
2003	3.00%	$55,270.53
2004	3.00%	$56,928.65
2005	3.00%	$58,636.51
2006	3.00%	$60,395.60
2007	3.00%	$62,207.47
2008	3.00%	$64,073.69
2009	3.00%	$65,995.91
2010	3.00%	$67,975.78
2011	3.00%	$70,015.06
2012	3.00%	$72,115.51
2013	3.00%	$74,278.97
2014	3.00%	$76,507.34
2015	3.00%	$78,802.56
2016	3.00%	$81,166.64

APPENDIX B

Stormwater Management System Design Calculations Watershed Peak Discharge, Drainage Ditch, Culvert, and Detention Basins

Basin #1

Design Calculations

APPENDIX A

HELP Model Results and Analysis

Leachate Generation and Management during Post Closure

The landfill closure system for Matlock Bend Landfill, Phase II and IV Upgrade, was evaluated to estimate it's peak daily leakage rate and monthly leachate generation rate during the post-closure care period. Approximately 52 acres of the landfill will eventually be covered with the final closure profile. From the ground surface downward, the profile is as follows:

- Layer 1
  vegetative soil layer, 24 inch thickness;
  (default soil characteristic data set no. 5)

- Layer 2
  geonet drainage layer, 0.2 inch thickness;

- Layer 3
  composite barrier layer, 40 mil VLDPE over 12 inch thick low permeability soil layer;

- geotextile gas venting layer;

- Layer 4
  interim cover soil layer, 12 inch thickness;
  (default soil characteristic data set no. 9)

- Layer 5
  municipal solid waste, average 360 inch thickness.
  (default soil characteristic data set no. 18-MSW)

The performance of the landfill closure system was evaluated using the USEPA Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 2.05, April 1992. The following assumptions were utilized in the HELP model evaluation:

- the climatological data was synthetically generated based on data for Knoxville, Tennessee, for an average 5 year weather pattern;

- the climatological data set included the 25-year/24-hour storm event (5.7 inches) as reported in the US Department of Agriculture Soil Conservation Service Technical Paper No. 40;

- the evaporative zone depth was 24 inches, which is equal to the thickness if the cover system vegetative layer;

- default soil characteristics most closely approximating the actual site soils were used;
- the default soil characteristics used to simulate the performance of the geonet in the lateral drainage layer (layer 2) are from a USEPA design seminar on Final Covers;

- a liner leakage fraction (0.001 cm/sec) consistent with current industry installation practice and the landfill Construction Quality Assurance (CQA) Plan was used;

- good grass cover and a compatible Soil Conservation Service runoff curve number of 75 were assumed for the vegetative soil layer;

- the slope of the cover drain system was 33% (3H:1V);

- an average cover drain system flow length of 200 feet was used;

- and, the soil water content was initialized according to the default program parameters.

Leakage through composite cover systems (i.e., low hydraulic conductivity soil in direct uniform contact with an overlying geomembrane) is controlled by defects in the geomembrane, the hydraulic conductivity of the soil component, and hydrostatic head pressure on the geomembrane. Cover system defects in the geomembrane typically include improperly bonded seams and small punctures and pinholes during installation. With a high level of CQA monitoring during geomembrane installation, the number of defects may be reduced to as few as one or two per acre. The average size of such defects tends to be approximately 1 centimeter (cm) in diameter because defects such as larger diameter holes and improperly bonded seams are easily identified during the CQA process.

The HELP Model uses a leakage fraction methodology to approximate the anticipated leakage through a composite cover system. The leakage fraction of $1x10^{-3}$ utilized in this modeling effort is comparable to a good installation scenario (one to two defects per acre) which is realistically obtainable from an installation inspection perspective.

Discussion of Results

An evaluation of the HELP model results shows that approximately 72% of the average annual precipitation of 47.85 inches is released back to the environment as a combination of surface runoff and evapotranspiration. The cover drainage system captures an additional 27% of the average annual precipitation. The modeling of the cover drainage system predicts negligible infiltration rates to the municipal solid waste material (Layer 5) from Layer 3 (composite barrier layer) during both the peak daily and annual average conditions.

The combination of slope and high transmissivity in the lateral drainage layer preclude the formation of head pressures which would drive infiltration through barrier layer holes or defects. Analysis of the Monthly Summaries For Daily Heads shows head pressures varying from a low of 0 inches to a high of 0.20 inches in April of Simulation Year 3. April of Simulation Year 3 is the month that contains the 25 yr/24 hr storm event of 5.7 inches. Evaluation of the Peak Daily Values for the 5.7 inch precipitation event show an average percolation of 0.0006 inches/acre of water from an associated maximum head pressure of 5.5 inches.

Evaluation of the Average Annual Totals shows an annual average of 0.0250 inches/acre percolation from Layer 3 to the underlying daily/weekly cover soils and municipal solid waste. This represents approximately 0.05% of the average annual precipitation. The annual average of 0.6840 inches/acre percolation from Layer 5 or about 1.4% of the annual precipitation is from the natural decomposition and dewatering of the solid waste. The leachate collection system is more than adequate to remove this amount of liquid, as the system was designed to rapidly remove liquids from the composite liner during the operational phase of the landfill facility.

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Matlock Bend Landfill - Phase II and IV Upgrade
Post Closure Leachate Generation Evaluation
Loudon County, Tennessee October 30, 1996

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Composite Closure system Profile

LAYER 1 - 24" Vegetative Cover

VERTICAL PERCOLATION LAYER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.004190000240 CM/SEC

LAYER 2 - Geonet Drainage Layer

LATERAL DRAINAGE LAYER

THICKNESS	=	0.20 INCHES
POROSITY	=	0.8000 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	=	19.690000534058 CM/SEC
SLOPE	=	33.00 PERCENT
DRAINAGE LENGTH	=	200.0 FEET

LAYER 3 - 40 mil VLDPE Geomembrane/12" Low Permeability Soil

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4224 VOL/VOL
FIELD CAPACITY	=	0.3495 VOL/VOL
WILTING POINT	=	0.2648 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4224 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000085000000 CM/SEC
LINER LEAKAGE FRACTION	=	0.00100000

LAYER 4 - 12" Weekly Soil Cover

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5010 VOL/VOL
FIELD CAPACITY	=	0.2837 VOL/VOL
WILTING POINT	=	0.1353 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2645 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000188999998 CM/SEC

LAYER 5 - 360" (30') Average Thickness of MSW

VERTICAL PERCOLATION LAYER

THICKNESS	=	360.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2731 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

General Simulation Data

SCS RUNOFF CURVE NUMBER	=	75.00
TOTAL AREA OF COVER	=	43560. SQ FT
EVAPORATIVE ZONE DEPTH	=	24.00 INCHES
UPPER LIMIT VEG. STORAGE	=	10.9680 INCHES
INITIAL VEG. STORAGE	=	3.6484 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	109.7196 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

Climatological Data

USER SPECIFIED RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR KNOXVILLE TENNESSEE

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 95
END OF GROWING SEASON (JULIAN DATE) = 306

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
38.20	41.50	49.70	59.60	67.40	74.30
77.60	77.00	71.50	59.50	48.80	41.10

Simulation Year 1

MONTHLY TOTALS FOR YEAR 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.82	4.54	4.85	3.08	2.92	3.99
	3.46	3.06	4.21	0.68	5.29	5.57
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.137
EVAPOTRANSPIRATION	1.005	1.934	3.488	2.287	2.946	5.905
(INCHES)	2.750	3.748	2.974	1.674	1.422	1.413
LATERAL DRAINAGE FROM	0.3681	2.0678	2.2069	0.8363	0.3289	0.0415
LAYER 2 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.4510	5.4610
PERCOLATION FROM	0.0033	0.0030	0.0037	0.0032	0.0033	0.0026
LAYER 3 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0003	0.0037
PERCOLATION FROM	0.0711	0.0637	0.0701	0.0673	0.0690	0.0663
LAYER 5 (INCHES)	0.0680	0.0675	0.0648	0.0665	0.0639	0.0655

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.03	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	0.00	0.10	0.01	0.00	0.00	0.00
ON LAYER 3 (INCHES)	0.00	0.00	0.00	0.00	0.01	0.44

ANNUAL TOTALS FOR YEAR 1

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	43.47	157796.	100.00
RUNOFF	0.137	497.	0.31
EVAPOTRANSPIRATION	31.546	114513.	72.57
LATERAL DRAINAGE FROM LAYER 2	11.7616	42695.	27.06
PERCOLATION FROM LAYER 3	0.0230	83.	0.05
PERCOLATION FROM LAYER 5	0.8038	2918.	1.85
CHANGE IN WATER STORAGE	-0.778	-2826.	-1.79
SOIL WATER AT START OF YEAR	109.37	397008.	
SOIL WATER AT END OF YEAR	108.59	394182.	
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

Simulation Year 2

MONTHLY TOTALS FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.28	3.16	4.18	5.57	3.38	5.82
	0.99	5.25	1.81	2.80	4.85	4.85
RUNOFF (INCHES)	0.000	0.000	0.050	0.000	0.000	0.001
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.077	1.963	2.666	4.328	3.537	6.421
(INCHES)	2.015	5.250	1.529	1.171	1.917	1.347
LATERAL DRAINAGE FROM	0.3684	0.6284	1.7109	1.2038	0.4090	0.2094
LAYER 2 (INCHES)	0.0240	0.0000	0.0000	0.0000	1.2638	3.3657
PERCOLATION FROM	0.0033	0.0029	0.0034	0.0032	0.0033	0.0031
LAYER 3 (INCHES)	0.0003	0.0000	0.0000	0.0000	0.0020	0.0036
PERCOLATION FROM	0.0650	0.0583	0.0641	0.0616	0.0632	0.0607
LAYER 5 (INCHES)	0.0623	0.0618	0.0594	0.0609	0.0585	0.0600

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.00	0.04	0.01	0.00	0.00
LAYER 3 (INCHES)	0.00	0.00	0.00	0.00	0.02	0.02
STD. DEV. OF DAILY HEAD	0.00	0.00	0.20	0.01	0.00	0.00
ON LAYER 3 (INCHES)	0.00	0.00	0.00	0.00	0.10	0.03

ANNUAL TOTALS FOR YEAR 2

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	43.94	159502.	100.00
RUNOFF	0.052	189.	0.12
EVAPOTRANSPIRATION	33.222	120595.	75.61
LATERAL DRAINAGE FROM LAYER 2	9.1833	33335.	20.90
PERCOLATION FROM LAYER 3	0.0250	91.	0.06
PERCOLATION FROM LAYER 5	0.7358	2671.	1.67
CHANGE IN WATER STORAGE	0.747	2711.	1.70
SOIL WATER AT START OF YEAR	108.59	394182.	
SOIL WATER AT END OF YEAR	109.34	396894.	
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

Simulation Year 3

MONTHLY TOTALS FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	3.64	6.79	8.06	11.45	4.71	3.54
	10.93	6.15	3.96	1.53	5.55	4.11
RUNOFF (INCHES)	0.000	0.000	0.009	1.970	0.000	0.000
	0.215	0.009	0.000	0.000	0.000	0.017
EVAPOTRANSPIRATION (INCHES)	1.637	2.044	3.053	3.658	5.104	5.240
	6.769	5.340	4.674	2.191	1.616	1.357
LATERAL DRAINAGE FROM LAYER 2 (INCHES)	2.3611	4.9594	5.1318	6.3958	0.3037	0.0174
	1.4549	0.0154	0.7768	0.0608	0.9694	3.9719
PERCOLATION FROM LAYER 3 (INCHES)	0.0034	0.0032	0.0035	0.0039	0.0033	0.0009
	0.0027	0.0012	0.0035	0.0031	0.0030	0.0037
PERCOLATION FROM LAYER 5 (INCHES)	0.0596	0.0535	0.0588	0.0565	0.0580	0.0557
	0.0572	0.0568	0.0546	0.0560	0.0539	0.0553

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 3 (INCHES)	0.01	0.09	0.10	0.20	0.00	0.00
	0.04	0.00	0.01	0.00	0.01	0.06
STD. DEV. OF DAILY HEAD ON LAYER 3 (INCHES)	0.01	0.23	0.27	0.99	0.00	0.00
	0.20	0.00	0.01	0.00	0.02	0.22

ANNUAL TOTALS FOR YEAR 3

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	70.42	255625.	100.00
RUNOFF	2.220	8058.	3.15
EVAPOTRANSPIRATION	42.684	154943.	60.61
LATERAL DRAINAGE FROM LAYER 2	26.4185	95899.	37.52
PERCOLATION FROM LAYER 3	0.0354	128.	0.05
PERCOLATION FROM LAYER 5	0.6759	2454.	0.96
CHANGE IN WATER STORAGE	-1.578	-5729.	-2.24
SOIL WATER AT START OF YEAR	109.34	396894.	
SOIL WATER AT END OF YEAR	107.76	391165.	
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

Simulation Year 4

MONTHLY TOTALS FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	2.43	5.97	7.28	1.30	1.42	2.56
	2.99	7.47	0.72	0.21	4.97	1.73
RUNOFF (INCHES)	0.000	0.000	0.019	0.000	0.000	0.009
	0.000	0.210	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.625	1.750	2.961	1.998	2.870	2.720
(INCHES)	2.689	5.481	2.703	0.195	1.366	1.516
LATERAL DRAINAGE FROM	0.5870	2.7409	5.3302	0.7954	0.1585	0.0006
LAYER 2 (INCHES)	0.0000	0.1439	0.1045	0.0000	0.0177	1.6418
PERCOLATION FROM	0.0033	0.0030	0.0037	0.0032	0.0032	0.0001
LAYER 3 (INCHES)	0.0000	0.0006	0.0017	0.0000	0.0007	0.0033
PERCOLATION FROM	0.0549	0.0510	0.0542	0.0521	0.0535	0.0514
LAYER 5 (INCHES)	0.0528	0.0525	0.0504	0.0518	0.0498	0.0511

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	0.00	0.07	0.10	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	0.00	0.28	0.28	0.00	0.00	0.00
ON LAYER 3 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.01

ANNUAL TOTALS FOR YEAR 4

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.05	141751.	100.00
RUNOFF	0.238	863.	0.61
EVAPOTRANSPIRATION	27.873	101178.	71.38
LATERAL DRAINAGE FROM LAYER 2	11.5206	41820.	29.50
PERCOLATION FROM LAYER 3	0.0227	82.	0.06
PERCOLATION FROM LAYER 5	0.6256	2271.	1.60
CHANGE IN WATER STORAGE	-1.207	-4381.	-3.09
SOIL WATER AT START OF YEAR	107.76	391165.	
SOIL WATER AT END OF YEAR	106.55	386784.	
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

Simulation Year 5

MONTHLY TOTALS FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	4.38	2.25	4.65	3.73	3.38	3.96
	7.54	1.97	2.09	2.56	2.42	3.44
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION (INCHES)	1.454	2.095	2.543	2.300	3.631	4.801
	7.541	2.999	2.361	2.026	1.519	1.617
LATERAL DRAINAGE FROM LAYER 2 (INCHES)	2.4005	0.7762	1.6687	0.9739	0.5158	0.0416
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0578
PERCOLATION FROM LAYER 3 (INCHES)	0.0034	0.0030	0.0034	0.0032	0.0033	0.0016
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0011
PERCOLATION FROM LAYER 5 (INCHES)	0.0508	0.0456	0.0502	0.0483	0.0496	0.0477
	0.0490	0.0487	0.0468	0.0481	0.0463	0.0475

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 3 (INCHES)	0.04	0.00	0.01	0.01	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 3 (INCHES)	0.18	0.00	0.01	0.01	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 5

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	42.37	153803.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	34.887	126639.	82.34
LATERAL DRAINAGE FROM LAYER 2	6.4344	23357.	15.19
PERCOLATION FROM LAYER 3	0.0189	69.	0.04
PERCOLATION FROM LAYER 5	0.5786	2100.	1.37
CHANGE IN WATER STORAGE	0.470	1707.	1.11
SOIL WATER AT START OF YEAR	106.55	386784.	
SOIL WATER AT END OF YEAR	107.02	388491.	
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

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.71	4.54	5.80	5.03	3.16	3.97
	5.18	4.78	2.56	1.56	4.62	3.94
STD. DEVIATIONS	1.28	1.89	1.74	3.90	1.18	1.18
	4.00	2.25	1.49	1.13	1.26	1.47
RUNOFF						
TOTALS	0.000	0.000	0.016	0.394	0.000	0.002
	0.043	0.044	0.000	0.000	0.000	0.031
STD. DEVIATIONS	0.000	0.000	0.021	0.881	0.000	0.004
	0.096	0.093	0.000	0.000	0.000	0.060
EVAPOTRANSPIRATION						
TOTALS	1.360	1.957	2.942	2.914	3.618	5.017
	4.353	4.564	2.848	1.452	1.568	1.450
STD. DEVIATIONS	0.301	0.132	0.370	1.020	0.898	1.426
	2.589	1.121	1.156	0.804	0.217	0.115
LATERAL DRAINAGE FROM LAYER 2						
TOTALS	1.2170	2.2345	3.2097	2.0410	0.3432	0.0621
	0.2958	0.0319	0.1763	0.0122	0.5404	2.8996
STD. DEVIATIONS	1.0662	1.7618	1.8586	2.4396	0.1323	0.0841
	0.6480	0.0630	0.3388	0.0272	0.5658	2.0968

PERCOLATION FROM LAYER 3

TOTALS	0.0033	0.0030	0.0035	0.0033	0.0033	0.0016
	0.0006	0.0004	0.0010	0.0006	0.0012	0.0031
STD. DEVIATIONS	0.0001	0.0001	0.0001	0.0003	0.0000	0.0012
	0.0012	0.0005	0.0016	0.0014	0.0012	0.0011

PERCOLATION FROM LAYER 5

TOTALS	0.0603	0.0544	0.0595	0.0572	0.0587	0.0564
	0.0579	0.0575	0.0552	0.0567	0.0545	0.0559
STD. DEVIATIONS	0.0080	0.0069	0.0079	0.0075	0.0077	0.0074
	0.0075	0.0075	0.0071	0.0073	0.0070	0.0071

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	47.85	(12.761)	173696.	100.00
RUNOFF	0.529	(0.949)	1921.	1.11
EVAPOTRANSPIRATION	34.042	(5.485)	123574.	71.14
LATERAL DRAINAGE FROM LAYER 2	13.0637	(7.7690)	47421.	27.30
PERCOLATION FROM LAYER 3	0.0250	(0.0062)	91.	0.05
PERCOLATION FROM LAYER 5	0.6840	(0.0889)	2483.	1.43
CHANGE IN WATER STORAGE	-0.469	(1.028)	-1704.	-0.98

PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	5.70	20691.0
RUNOFF	1.936	7027.6
LATERAL DRAINAGE FROM LAYER 2	3.4147	12395.4
PERCOLATION FROM LAYER 3	0.0006	2.1
HEAD ON LAYER 3	5.5	
PERCOLATION FROM LAYER 5	0.0023	8.4
SNOW WATER	2.44	8857.2

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3154
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0579

FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	4.59	0.1912
2	0.01	0.0581
3	5.07	0.4224
4	2.54	0.2114
5	94.82	0.2634
SNOW WATER	0.00	

STORMWATER DETENTION BASIN DESIGN VOLUME

The stormwater detention basin for the site has been designed to contain the 25yr/24hr storm run off volume and pass the 100yr/24hr storm peak discharge through a combination of the primary spillway (48" diameter perforated riser pipe) and the basin emergency spillway. The 25yr/24hr run off volume for the detention basin was determined by the hydrological routing of the design storm hydrographs through the watershed to the basin.

The 25yr/24hr design storm used to model the basin performance was the Soil Conservation Service Type II storm of 5.7 inches for Loudon County. The 100yr/24hr design storm used to model the basin performance was the Soil Conservation Service Type II storm of 6.8 inches for Loudon County. The following summary indicates the required storage volume and peak discharge for the detention basin.

Structure	25yr/24hr Storm Run Off Volume (ac-ft)	100yr/24hr Storm Peak Discharge (cfs)
Basin No. 1	17.75	55.81

Once the total detention volume is known, the SEDCAD Basin Capacity utility is used to determine the lepth of the basin that will contain the design detention volume. The Basin Capacity utility determines capacity and elevation from the original input parameters of area at key basin elevations. Detention Basin No. 1 has been designed with 3H:1V side slopes for slope stability and ease of basin maintenance. Two feet of sediment storage volume has been provided in the basin. An additional two feet of freeboard to the first elevation of spillway riser pipe perforations (elev. 873.0) has been provided to maximize sediment deposition in the basin. The following summary provides the required and actual storage capacities and corresponding elevations for the basin.

Structure		Design Capacity (ac-ft)	Actual Capacity (ac-ft)	Elevation (ft)
Basin No. 1	17.75	22.64	880.0	

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD6 User: James Bauman
Date: 03-26-1996 Time: 12:37:42
100YR/24HR Discharge - Matlock Bend PH II & IV Subwatershed D
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	3	150.00	30.00	3.83	0.01			
				-b	6	950.00	3.00	2.60	0.10	0.112		
1	1	3	1	-a	3	110.00	30.00	3.83	0.01			
				-b	9	1400.00	3.00	15.59	0.02	0.032		

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD6 User: James Bauman
Date: 03-26-1996 Time: 12:37:42
100YR/24HR Discharge - Matlock Bend PH II & IV Subwatershed D
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

NON-POND STRUCTURE INPUT/OUTPUT TABLE

J1, B1, S1
Ditch J

Drainage Area from J1, B1, S1, SWS(s)1: 2.4 acres
Total Contributing Drainage Area: 2.4 acres

MATERIAL: TALL FESCUE
Trapezoidal Vegetated Channel
Limiting Variable: Velocity = 7.000 fps

Design Discharge (cfs)	Bottom Width (ft)	ZLeft	ZRight	Slope (%)
9.79	2.0	2.5:1	2.5:1	3.0

Retardance Class	Depth (ft)	Velocity (fps)	Top Width (ft)	Manning's N	Hydraulic Radius	Froude Number
Stability B	1.28	1.48	8.4	0.144	0.746	0.29
Capacity B	1.28	1.48	8.4	0.144	0.746	0.29
w/ Freeboard + B	1.78		10.9			

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	0.81	9.79

****

J1, B1, S2

Culvert DS-10

Drainage Area from J1, B1, S2, SWS(s)1: 1.0 acres
Total Contributing Drainage Area: 3.4 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	2.0	100.0	25.0	0.014	1.0

Minimum Pipe Diameter Required: 30.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	1.39	14.52

****

J1, B1, S3
Ditch T

Drainage Area from J1, B1, S3, SWS(s)1: 3.7 acres
Total Contributing Drainage Area: 7.1 acres

MATERIAL: Rock Riprap
Trapezoidal Riprap Channel
Steep Slope Design - Simons/OSM Method

Design Discharge (cfs)	Bottom Width (ft)	ZLeft	ZRight	Slope (%)	Manning's n
29.62	6.0	3.0:1	3.0:1	3.0	0.034

	Depth (ft)	Velocity (fps)	Top Width (ft)	Hydraulic Radius	Froude Number
	0.44	9.08**	8.7	0.370	2.61
w/ Freeboard:	0.94		11.7		

** Non-uniform flow - Velocity shown is V=Q/A and may not be applicable

----DMax----		----D50----		----D10----	
(ft)	(in)	(ft)	(in)	(ft)	(in)
0.63	7.50	0.50	6.00	0.17	2.00

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	2.64	29.62

****

J1, B1, S4
Ditch T

Drainage Area from J1, B1, S4, SWS(s)1: 0.0 acres
Total Contributing Drainage Area: 7.1 acres

MATERIAL: Rock Riprap
Trapezoidal Riprap Channel
Steep Slope Design - Simons/OSM Method

Design Discharge (cfs)	Bottom Width (ft)	ZLeft	ZRight	Slope (%)	Manning's n
29.66	6.0	3.0:1	3.0:1	3.0	0.034

	Depth (ft)	Velocity (fps)	Top Width (ft)	Hydraulic Radius	Froude Number
	0.45	9.08**	8.7	0.371	2.61
w/ Freeboard:	0.95		11.7		

** Non-uniform flow - Velocity shown is V=Q/A and may not be applicable

----DMax----		----D50----		----D10----	
(ft)	(in)	(ft)	(in)	(ft)	(in)
0.63	7.50	0.50	6.00	0.17	2.00

	Runoff	Peak

	Volume (ac-ft)	Discharge (cfs)
IN/OUT	2.64	29.66

****

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

25YR/24HR DISCHARGE - MATLOCK BEND PH. II & IV DRAINAGE TO POND 2

by

Name: James Bauman

Company Name: SANTEK ENVIRONMENTAL, INC.
File Name: C:\SEDCAD3\PHASE44

Date: 07-25-1996

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE44 User: James Bauman
Date: 07-25-1996 Time: 15:10:07
25yr/24hr Discharge - Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
2	1	1	1	3	210.61	33.00	4.02	0.01		
			2	6	1200.96	4.00	3.00	0.11		
			3	8	951.19	5.00	6.71	0.04		
			4	9	400.02	1.00	9.00	0.01	0.176	0.377
3	1	1	1	6	279.42	18.00	6.36	0.01		
			2	8	1203.83	8.00	8.49	0.04	0.051	0.413

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE44 User: James Bauman
Date: 07-25-1996 Time: 15:10:07
25yr/24hr Discharge - Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	7.90	75	F	0.164	0.000	0.000	0.0	1.99	23.09
		Type: Culvert Label: 24"culvert @ HW-6								
111	Structure	7.90							1.99	
111	Total IN/OUT	7.90							1.99	23.09
121	1	2.20	75	F	0.025	0.000	0.000	0.0	0.56	6.85
		Type: Null Label: Area B-3								
121	Structure	2.20							0.56	
121	Total IN/OUT	2.20							0.56	6.85
131	1	4.20	75	F	0.070	0.000	0.000	0.0	1.06	13.08
		Type: Culvert Label: 24" culvert @ HW-4								
131	Structure	4.20							1.06	
131	Total IN/OUT	4.20							1.06	13.08
211	1	0.00	0	F	0.000	0.000	0.000	0.0	0.00	0.00
		Type: Culvert Label: 48" culvert @ HW-5								
211	Structure	0.00							3.61	
211	Total IN/OUT	14.30							3.61	42.00
111	to 211 Routing					0.176	0.377			
221	1	22.70	65	M	0.176	0.000	0.000	0.0	4.04	40.71
		Type: Null Label: Eastern watershed								
221	Structure	22.70							4.04	
221	Total IN/OUT	22.70							4.04	40.71
231	1	10.20	75	F	0.133	0.000	0.000	0.0	2.57	29.81
		Type: Culvert Label: 36" culvert								
231	Structure	10.20							2.57	
231	Total IN/OUT	10.20							2.57	29.81
311	1	1.00	75	F	0.010	0.000	0.000	0.0	0.25	3.12
		Type: Pond Label: Phase I - Pond 2								

311 Structure	1.00		10.47	
311 Total IN	48.20		10.47	105.06
311 Total OUT			10.28	34.61
211 to 311 Routing		0.051 0.413		

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE44 User: James Bauman
Date: 07-25-1996 Time: 15:10:07
25yr/24hr Discharge - Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	3	200.00	33.00	4.02	0.01			
				-b	6	1200.00	4.00	3.00	0.11			
				-c	8	950.00	5.00	6.71	0.04	0.164		
1	2	1	1	-a	3	350.00	30.00	3.83	0.03	0.025		
1	3	1	1	-a	3	150.00	33.00	4.02	0.01			
				-b	8	1450.00	5.00	6.71	0.06	0.070		
2	2	1	1	-a	1	300.00	10.00	0.80	0.10			
				-b	6	500.00	8.00	4.24	0.03			
				-c	8	1200.00	8.00	8.49	0.04	0.176		
2	3	1	1	-a	3	200.00	5.00	1.57	0.04			
				-b	6	1400.00	7.00	3.97	0.10	0.133		

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE44 User: James Bauman
Date: 07-25-1996 Time: 15:10:07
25yr/24hr Discharge - Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

NON-POND STRUCTURE INPUT/OUTPUT TABLE

J1, B1, S1
24"culvert @ HW-6

Drainage Area from J1, B1, S1, SWS(s)1: 7.9 acres
Total Contributing Drainage Area: 7.9 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	3.0	360.0	1.0	0.014	3.0

Minimum Pipe Diameter Required: 30.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	1.99	23.09

****

J1, B3, S1
24" culvert @ HW-4

Drainage Area from J1, B3, S1, SWS(s)1: 4.2 acres
Total Contributing Drainage Area: 4.2 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	3.0	45.0	1.0	0.014	3.0

Minimum Pipe Diameter Required: 30.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	1.06	13.08

****

J2, B1, S1
48" culvert @ HW-5

Drainage Area from J2, B1, S1, SWS(s)1: 0.0 acres
Total Contributing Drainage Area: 14.3 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	5.0	46.0	1.0	0.014	3.0

Minimum Pipe Diameter Required: 30.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	3.61	42.00

****

J2, B3, S1
36" culvert

Drainage Area from J2, B3, S1, SWS(s)1: 10.2 acres
Total Contributing Drainage Area: 10.2 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	5.0	60.0	2.0	0.014	3.0

Minimum Pipe Diameter Required: 30.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	2.57	29.81

****

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE44 User: James Bauman
Date: 07-25-1996 Time: 15:10:07
25yr/24hr Discharge - Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

J3, B1, S1
Phase I - Pond 2

Drainage Area from J3, B1, S1, SWS(s)1: 1.0 acres
Total Contributing Drainage Area: 48.2 acres

DISCHARGE OPTIONS:

	Perf. Riser	Emergency Spillway
Riser Diameter (in)	48.0	----
Riser Height (ft)	8.00	----
Barrel Diameter (in)	36.0	----
Barrel Length (ft)	80.00	----
Barrel Slope (%)	4.00	----
Manning's n of Pipe	0.024	----
Spillway Elevation	858.0	----
Lowest Elevation of Holes	852.0	----
# of Holes/Elevation	4	----
Entrance Loss Coefficient	----	----
Tailwater Depth (ft)	----	----
Notch Angle (degrees)	----	----
Weir Width (ft)	----	----
Siphon Crest Elevation	----	----
Siphon Tube Diameter (in)	----	----
Siphon Tube Length (ft)	----	----
Manning's n of Siphon	----	----
Siphon Inlet Elevation	----	----
Siphon Outlet Elevation	----	----
Emergency Spillway Elevation	----	859.0
Crest Length (ft)	----	10.0
Z:1 (Left and Right)	-- --	1 1
Bottom Width (ft)	----	15.0

POND RESULTS:

Permanent Pool (ac-ft)
0.8

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	10.47	105.06
OUT	10.28	34.61

Peak Elevation	Hydrograph Detention Time (hrs)
858.9	4.49

Dewatering Time (Max. Perf. Riser Elev to Lowest Orifice): 1.3 days

****

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE44 User: James Bauman
Date: 07-25-1996 Time: 15:10:07
25yr/24hr Discharge - Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-DISCHARGE TABLE

J3, B1, S1
Phase I - Pond 2

Drainage Area from J3, B1, S1, SWS(s)1: 1.0 acres
Total Contributing Drainage Area: 48.2 acres

Elevation	Perf. Riser (cfs)	Emergency Spillway (cfs)	Total Discharge (cfs)
850.00	0.0	0.0	0.0
850.50	0.0	0.0	0.0
851.00	0.0	0.0	0.0
851.50	0.0	0.0	0.0
852.00	0.0>2.00	0.0	0.0
852.50	0.3	0.0	0.3
853.00	0.4>2.00	0.0	0.4
853.50	0.9	0.0	0.9
854.00	1.0>2.00	0.0	1.0
854.50	1.7	0.0	1.7
855.00	2.7>3.00	0.0	2.7
855.50	4.4	0.0	4.4
856.00	4.5>3.00	0.0	4.5
856.50	6.5	0.0	6.5
857.00	6.7>3.00	0.0	6.7
857.50	8.9	0.0	8.9
858.00	9.0	0.0	9.0
858.50	13.8	0.0	13.8
859.00	39.0	0.0	39.0
859.50	71.6	13.5	85.1
859.60	74.4	16.2	90.6
859.70	77.2	21.6	98.7
859.80	80.0	27.4	107.3
859.90	82.8	33.7	116.5
860.00	85.6	39.8	125.3

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE44 User: James Bauman
Date: 07-25-1996 Time: 15:10:07
25yr/24hr Discharge - Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J3, B1, S1
Phase I - Pond 2

Drainage Area from J3, B1, S1, SWS(s)1: 1.0 acres
Total Contributing Drainage Area: 48.2 acres

SW#1: Perforated Riser
SW#2: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
850.00	0.00	0.37	0.00	0.00	
850.50	0.50	0.40	0.19	0.00	
851.00	1.00	0.42	0.40	0.00	
851.50	1.50	0.45	0.61	0.00	
52.00	2.00	0.48	0.85	0.00	Low Orifice of SW#1
852.50	2.50	0.51	1.09	0.30	
853.00	3.00	0.54	1.36	0.42	
853.50	3.50	0.57	1.63	0.93	
854.00	4.00	0.60	1.93	1.01	
854.50	4.50	0.64	2.24	1.68	
855.00	5.00	0.67	2.56	2.65	
855.50	5.50	0.69	2.90	4.42	
856.00	6.00	0.70	3.25	4.54	
856.50	6.50	0.72	3.60	6.55	
857.00	7.00	0.73	3.96	6.66	
857.50	7.50	0.75	4.33	8.87	
858.00	8.00	0.76	4.71	8.97	Stage of SW#1
858.50	8.50	0.78	5.10	13.77	
858.91	8.91	0.79	5.42	34.61	Peak Stage
859.00	9.00	0.80	5.49	38.96	Stage of SW#2
859.50	9.50	0.81	5.90	85.10	
859.60	9.60	0.82	5.98	90.61	
859.70	9.70	0.82	6.06	98.72	
859.80	9.80	0.82	6.14	107.34	
859.90	9.90	0.83	6.22	116.45	
860.00	10.00	0.83	6.31	125.32	

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE45 User: James Bauman
Date: 07-25-1996 Time: 15:32:31
100yr/24hr Discharge-Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
2	1	1	1	3	210.61	33.00	4.02	0.01		
			2	6	1200.96	4.00	3.00	0.11		
			3	8	951.19	5.00	6.71	0.04		
			4	9	400.02	1.00	9.00	0.01	0.176	0.377
3	1	1	1	6	279.42	18.00	6.36	0.01		
			2	8	1203.83	8.00	8.49	0.04	0.051	0.413

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

100YR/24HR DISCHARGE-MATLOCK BEND PH. II & IV DRAINAGE TO POND 2

by

Name: James Bauman

Company Name: SANTEK ENVIRONMENTAL, INC.
File Name: C:\SEDCAD3\PHASE45

Date: 07-25-1996

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE45 User: James Bauman
Date: 07-25-1996 Time: 15:32:31
100yr/24hr Discharge-Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
					-Hydrology-					
111	1	7.90	75	F	0.164	0.000	0.000	0.0	2.73	31.39
		Type: Culvert Label: 24"culvert @ HW-6								
111	Structure	7.90							2.73	
111	Total IN/OUT	7.90							2.73	31.39
121	1	2.20	75	F	0.025	0.000	0.000	0.0	0.76	9.15
		Type: Null Label: Area B-3								
121	Structure	2.20							0.76	
?1	Total IN/OUT	2.20							0.76	9.15
131	1	4.20	75	F	0.070	0.000	0.000	0.0	1.45	17.47
		Type: Culvert Label: 24" culvert @ HW-4								
131	Structure	4.20							1.45	
131	Total IN/OUT	4.20							1.45	17.47
211	1	0.00	0	F	0.000	0.000	0.000	0.0	0.00	0.00
		Type: Culvert Label: 48" culvert @ HW-5								
211	Structure	0.00							4.94	
211	Total IN/OUT	14.30							4.94	57.14
111	to 211 Routing					0.176	0.377			
221	1	22.70	65	M	0.176	0.000	0.000	0.0	5.87	59.56
		Type: Null Label: Eastern watershed								
221	Structure	22.70							5.87	
221	Total IN/OUT	22.70							5.87	59.56
231	1	10.20	75	F	0.133	0.000	0.000	0.0	3.53	40.52
		Type: Culvert Label: 36" culvert								
231	Structure	10.20							3.53	
.31	Total IN/OUT	10.20							3.53	40.52
311	1	1.00	75	F	0.010	0.000	0.000	0.0	0.35	4.16
		Type: Pond Label: Phase I - Pond 2								

311 Structure	1.00		14.69	
311 Total IN	48.20		14.69	147.71
311 Total OUT			14.47	97.02
11 to 311 Routing		0.051 0.413		

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE45 User: James Bauman
Date: 07-25-1996 Time: 15:32:31
100yr/24hr Discharge-Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	3	200.00	33.00	4.02	0.01			
				-b	6	1200.00	4.00	3.00	0.11			
				-c	8	950.00	5.00	6.71	0.04	0.164		
1	2	1	1	-a	3	350.00	30.00	3.83	0.03	0.025		
1	3	1	1	-a	3	150.00	33.00	4.02	0.01			
				-b	8	1450.00	5.00	6.71	0.06	0.070		
2	2	1	1	-a	1	300.00	10.00	0.80	0.10			
				-b	6	500.00	8.00	4.24	0.03			
				-c	8	1200.00	8.00	8.49	0.04	0.176		
2	3	1	1	-a	3	200.00	5.00	1.57	0.04			
				-b	6	1400.00	7.00	3.97	0.10	0.133		

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE45 User: James Bauman
Date: 07-25-1996 Time: 15:32:31
100yr/24hr Discharge-Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

NON-POND STRUCTURE INPUT/OUTPUT TABLE

J1, B1, S1
24"culvert @ HW-6

Drainage Area from J1, B1, S1, SWS(s)1: 7.9 acres
Total Contributing Drainage Area: 7.9 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	3.0	360.0	1.0	0.014	3.0

Minimum Pipe Diameter Required: 36.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	2.73	31.39

****

J1, B3, S1
24" culvert @ HW-4

Drainage Area from J1, B3, S1, SWS(s)1: 4.2 acres
Total Contributing Drainage Area: 4.2 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	3.0	45.0	1.0	0.014	3.0

Minimum Pipe Diameter Required: 30.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	1.45	17.47

****

J2, B1, S1
48" culvert @ HW-5

Drainage Area from J2, B1, S1, SWS(s)1: 0.0 acres
Total Contributing Drainage Area: 14.3 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	5.0	46.0	1.0	0.014	3.0

Minimum Pipe Diameter Required: 36.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	4.94	57.14

****

J2, B3, S1
36" culvert

Drainage Area from J2, B3, S1, SWS(s)1: 10.2 acres
Total Contributing Drainage Area: 10.2 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	5.0	60.0	2.0	0.014	3.0

Minimum Pipe Diameter Required: 30.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	3.53	40.52

****

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE45 User: James Bauman
Date: 07-25-1996 Time: 15:32:31
100yr/24hr Discharge-Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

J3, B1, S1
Phase I - Pond 2

Drainage Area from J3, B1, S1, SWS(s)1: 1.0 acres
Total Contributing Drainage Area: 48.2 acres

DISCHARGE OPTIONS:

	Perf. Riser	Emergency Spillway
Riser Diameter (in)	48.0	----
Riser Height (ft)	8.00	----
Barrel Diameter (in)	36.0	----
Barrel Length (ft)	80.00	----
Barrel Slope (%)	4.00	----
Manning's n of Pipe	0.024	----
Spillway Elevation	858.0	----
Lowest Elevation of Holes	852.0	----
# of Holes/Elevation	4	----
Entrance Loss Coefficient	----	----
Tailwater Depth (ft)	----	----
Notch Angle (degrees)	----	----
Weir Width (ft)	----	----
Siphon Crest Elevation	----	----
Siphon Tube Diameter (in)	----	----
Siphon Tube Length (ft)	----	----
Manning's n of Siphon	----	----
Siphon Inlet Elevation	----	----
Siphon Outlet Elevation	----	----
Emergency Spillway Elevation	----	859.0
Crest Length (ft)	----	10.0
Z:1 (Left and Right)	-- --	1 1
Bottom Width (ft)	----	15.0

POND RESULTS:

Permanent Pool (ac-ft)
0.8

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	14.69	147.71
OUT	14.47	97.02

Peak Elevation	Hydrograph Detention Time (hrs)
859.7	3.65

Dewatering Time (Max. Perf. Riser Elev to Lowest Orifice): 1.3 days

****

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE45 User: James Bauman
Date: 07-25-1996 Time: 15:32:31
100yr/24hr Discharge-Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-DISCHARGE TABLE

J3, B1, S1
Phase I - Pond 2

Drainage Area from J3, B1, S1, SWS(s)1: 1.0 acres
Total Contributing Drainage Area: 48.2 acres

Elevation	Perf. Riser (cfs)	Emergency Spillway (cfs)	Total Discharge (cfs)
850.00	0.0	0.0	0.0
850.50	0.0	0.0	0.0
851.00	0.0	0.0	0.0
851.50	0.0	0.0	0.0
852.00	0.0>2.00	0.0	0.0
852.50	0.3	0.0	0.3
853.00	0.4>2.00	0.0	0.4
853.50	0.9	0.0	0.9
854.00	1.0>2.00	0.0	1.0
854.50	1.7	0.0	1.7
855.00	2.7>3.00	0.0	2.7
855.50	4.4	0.0	4.4
856.00	4.5>3.00	0.0	4.5
856.50	6.5	0.0	6.5
857.00	6.7>3.00	0.0	6.7
857.50	8.9	0.0	8.9
858.00	9.0	0.0	9.0
858.50	13.8	0.0	13.8
859.00	39.0	0.0	39.0
859.50	71.6	13.5	85.1
859.60	74.4	16.2	90.6
859.70	77.2	21.6	98.7
859.80	80.0	27.4	107.3
859.90	82.8	33.7	116.5
860.00	85.6	39.8	125.3

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\PHASE45 User: James Bauman
Date: 07-25-1996 Time: 15:32:31
100yr/24hr Discharge-Matlock Bend Ph. II & IV drainage to Pond 2
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J3, B1, S1
Phase I - Pond 2

Drainage Area from J3, B1, S1, SWS(s)1: 1.0 acres
Total Contributing Drainage Area: 48.2 acres

SW#1: Perforated Riser
SW#2: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
850.00	0.00	0.37	0.00	0.00	
850.50	0.50	0.40	0.19	0.00	
851.00	1.00	0.42	0.40	0.00	
851.50	1.50	0.45	0.61	0.00	
852.00	2.00	0.48	0.85	0.00	Low Orifice of SW#1
852.50	2.50	0.51	1.09	0.30	
853.00	3.00	0.54	1.36	0.42	
853.50	3.50	0.57	1.63	0.93	
854.00	4.00	0.60	1.93	1.01	
854.50	4.50	0.64	2.24	1.68	
855.00	5.00	0.67	2.56	2.65	
855.50	5.50	0.69	2.90	4.42	
856.00	6.00	0.70	3.25	4.54	
856.50	6.50	0.72	3.60	6.55	
857.00	7.00	0.73	3.96	6.66	
857.50	7.50	0.75	4.33	8.87	
858.00	8.00	0.76	4.71	8.97	Stage of SW#1
858.50	8.50	0.78	5.10	13.77	
859.00	9.00	0.80	5.49	38.96	Stage of SW#2
859.50	9.50	0.81	5.90	85.10	
859.60	9.60	0.82	5.98	90.61	
859.68	9.68	0.82	6.04	97.02	Peak Stage
859.70	9.70	0.82	6.06	98.72	
859.80	9.80	0.82	6.14	107.34	
859.90	9.90	0.83	6.22	116.45	
860.00	10.00	0.83	6.31	125.32	

Pond #2

Design Calculations

Stormwater Management System Design Calculation Package

The permanent drainage structures for the stormwater management system for the Matlock Bend Landfill, Phase II and IV Upgrade were designed utilizing the SEDCAD Version 3.0 software system, as published by Civil Software Design, Ames, IA. The permanent drainage structures include a system of ditches and culverts which convey surface run-off to the two stormwater management basins.

The design of the newer stormwater management basin, which controls the majority of the run-off from the site, was done in conjunction with the permitting and construction of the Phase II Upgrade in August of 1994. The older basin, Pond 2, was originally designed as part of the Phase I development of the facility. The capacity of Pond 2 was evaluated as a part of the design effort for the Phase II and IV Upgrade for the facility. The results of the evaluation indicate that Pond 2 will still contain the run-off from the 25 year/24 hour duration design storm for its original contributing watershed as well as the approximate 14 acre contribution from the Phase II and IV Upgrade. Discharge for the 100 year/24 hour duration design storm is passed in a controlled manner through the Pond 2 emergency spillway.

The calculation package prepared for the Phase II and IV Upgrade, and presented in this appendix, contains the peak discharge calculations utilized for the design of the permanent ditches and culverts identified on the Facility Final Development Plan and the evaluation of the existing Pond 2.

The Facility Final Development Plan for the landfill was divided into five subwatersheds for the purpose of peak discharge determination. Peak discharge from the site, as a result of the 100 year/24 hour duration design storm of 7 inches of precipitation, was calculated for each site subwatershed. A summary table of the peak discharges is presented below.

Subwatershed	Area (acres)	Peak Discharge (cfs)
A	7.8	30.8
A1	15.6	37.6
B	14.3	51.2
C	7.4	29.2
D	7.1	29.7

The ditches and culverts which comprise the permanent drainage structure system were all designed to carry the 100 year/24 hour duration storm flows. In order to model the peak discharge and routing through the subwatersheds, a preliminary design of the ditches and culverts was done as a part of the peak discharge determination. These preliminary results are shown in the non-pond structure input/output tables for each subwatershed.

The detailed ditch and culvert designs were done utilizing the ditch and culvert utilities which are part of the SEDCAD software package. The results of this design effort are presented in the culvert and ditch schedules shown on drawing No. CD-1 of the permit drawing package.

The evaluation of Pond 2 was done for both the 25 year/24 hour and 100 year/24 hour duration design storms. The "as built" configuration for Pond 2 was input to the models for both storms. The bottom of Pond 2 is approximately elevation 850. The primary spillway (SW#1) is a 48" diameter CMP perforated riser attached to a 36" diameter CMP discharge barrel. The discharge barrel is approximately 80 feet in length and is set on a 4% slope. The perforated riser for SW#1 is set at elevation 858. The emergency spillway (SW#2) is set at elevation 859, and is a 10 foot wide by 15 foot long trapezoidal weir, with 1:1 side slopes up to the embankment top elevation of 860.

The results of the 25 year/24 hour duration design storm of 5.7 inches of precipitation yield a peak discharge into the basin of 105 cfs. The peak elevation of 858.9 just overtops SW#1. A maximum dewatering period of 1.3 days is projected for the basin. The results of the 100 year/24 hour duration design storm of 7 inches of precipitation yield a peak discharge into the basin of 148 cfs. The peak elevation of 859.7 overtops SW#2 by 0.7 feet. This storm peak is expected to pass through SW#2 in a relatively short timeframe, with SW#1 providing the majority of the basin discharge. Basin dewatering is projected at approximately 1.3 days.

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

100YR/24HR DISCHARGE - MATLOCK BEND PH II & IV SUBWATERSHED A

by

Name: James Bauman

Company Name: SANTEK ENVIRONMENTAL, INC.
File Name: C:\SEDCAD3\MATLKBD1

Date: 03-26-1996

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLK3D1 User: James Bauman
Date: 03-26-1996 Time: 10:28:56
100yr/24hr Discharge - Matlock Bend Ph II & IV Subwatershed A
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	B	S	To #	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
2	1	1		1	3	208.81	30.00	3.83	0.01		
				2	6	500.40	4.00	3.00	0.05	0.060	0.327

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD1 User: James Bauman
Date: 03-26-1996 Time: 10:28:56
100yr/24hr Discharge - Matlock Bend Ph II & IV Subwatershed A
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	3.00	74	F	0.060	0.000	0.000	0.0	1.01	12.24
		Type: Culvert Label: Culvert DS-5								
111	Structure	3.00							1.01	
111	Total IN/OUT	3.00							1.01	12.24
121	1	4.80	74	F	0.113	0.000	0.000	0.0	1.62	19.58
		Type: Null Label:								
121	Structure	4.80							1.62	
121	Total IN/OUT	4.80							1.62	19.58
211	1	0.00	0	F	0.000	0.000	0.000	0.0	0.00	0.00
		Type: Culvert Label: Culvert DS-6								
211	Structure	0.00							2.63	
211	Total IN/OUT	7.80							2.63	30.80
111 to 211 Routing						0.060	0.327			

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD1 User: James Bauman
Date: 03-26-1996 Time: 10:28:56
100yr/24hr Discharge - Matlock Bend Ph II & IV Subwatershed A
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	3	200.00	30.00	3.83	0.01			
				-b	6	500.00	4.00	3.00	0.05	0.060		
1	2	1	1	-a	3	200.00	20.00	3.13	0.02			
				-b	6	900.00	3.00	2.60	0.10	0.113		

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD1 User: James Bauman
Date: 03-26-1996 Time: 10:28:56
100yr/24hr Discharge - Matlock Bend Ph II & IV Subwatershed A
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

NON-POND STRUCTURE INPUT/OUTPUT TABLE

J1, B1, S1
Culvert DS-5

Drainage Area from J1, B1, S1, SWS(s)1: 3.0 acres
Total Contributing Drainage Area: 3.0 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	2.0	187.0	30.0	0.014	1.0

Minimum Pipe Diameter Required: 30.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	1.01	12.24

****

J2, B1, S1
Culvert DS-6

Drainage Area from J2, B1, S1, SWS(s)1: 0.0 acres
Total Contributing Drainage Area: 7.8 acres

Entrance Loss Coefficient	Maximum Headwater	Pipe Length	Pipe Slope	Manning's n	Tailwater

(ft)	(ft)	(%)		(ft)
0.50	2.0	287.0	28.0	0.014	1.0

Minimum Pipe Diameter Required: 66.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	2.63	30.80

****

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

100YR/24HR DISCHARGE - MATLOCK BEND PH II & IV SUBWATERSHED A1

by

Name: James Bauman

Company Name: SANTEK ENVIRONMENTAL, INC.
File Name: C:\SEDCAD3\MATLKBD3

Date: 03-26-1996

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD3 User: James Bauman
Date: 03-26-1996 Time: 11:14:04
100yr/24hr discharge - matlock bend ph II & IV subwatershed a1
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

To J	B	S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
1	1	2	1	3	135.72	30.00	3.83	0.01		
			2	6	321.29	9.00	4.50	0.02	0.029	0.358
1	1	3	1	8	804.83	11.00	9.95	0.02		
			2	9	700.56	4.00	18.00	0.01	0.033	0.444
1	1	4	1	9	162.86	19.00	39.23	0.00	0.001	0.479

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD3 User: James Bauman
Date: 03-26-1996 Time: 11:14:04
100yr/24hr discharge - matlock bend ph II & IV subwatershed a1
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	1.40	74	F	0.029	0.000	0.000	0.0	0.47	5.71
		Type: Vegetated Channel Label: Ditch L								
111	Structure	1.40							0.47	
111	Total IN/OUT	1.40							0.47	5.71
112	1	4.00	74	M	0.022	0.000	0.000	0.0	1.35	16.32
		Type: Riprap Channel Label: Ditch L2 - Upper								
112	Structure	4.00							1.82	
112	Total IN/OUT	5.40							1.82	22.03
111 to 112 Routing						0.029	0.358			
113	1	9.20	60	S	0.127	0.000	0.000	0.0	2.00	13.67
		Type: Riprap Channel Label: Ditch L2 - Lower								
113	Structure	9.20							3.82	
113	Total IN/OUT	14.60							3.82	33.52
112 to 113 Routing						0.033	0.444			
114	1	1.00	74	F	0.018	0.000	0.000	0.0	0.34	4.08
		Type: Riprap Channel Label: Ditch L3								
114	Structure	1.00							4.15	

114 Total IN/OUT	15.60			4.15	37.60
113 to 114 Routing		0.001	0.479		

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEX ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD3 User: James Bauman
Date: 03-26-1996 Time: 11:14:04
100yr/24hr discharge - matlock bend ph II & IV subwatershed a1
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	3	130.00	30.00	3.83	0.01			
				-b	6	320.00	9.00	4.50	0.02	0.029		
1	1	2	1	-a	8	800.00	11.00	9.95	0.02	0.022		
	1	3	1	-a	1	300.00	13.00	0.91	0.09			
				-b	6	400.00	9.00	4.50	0.02			
				-c	9	710.00	4.00	18.00	0.01	0.127		
1	1	4	1	-a	3	180.00	17.00	2.89	0.02			
				-b	9	160.00	19.00	39.23	0.00	0.018		

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLK3D3 User: James Bauman
Date: 03-26-1996 Time: 11:14:04
100yr/24hr discharge - matlock bend ph II & IV subwatershed a1
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

NON-POND STRUCTURE INPUT/OUTPUT TABLE

J1, B1, S1
Ditch L

Drainage Area from J1, B1, S1, SWS(s)1: 1.4 acres
Total Contributing Drainage Area: 1.4 acres

MATERIAL: TALL FESCUE
Trapezoidal Vegetated Channel
Limiting Variable: Velocity = 6.000 fps

Design Discharge (cfs)	Bottom Width (ft)	ZLeft	ZRight	Slope (%)
5.71	2.0	2.5:1	2.5:1	9.0

Retardance Class	Depth (ft)	Velocity (fps)	Top Width (ft)	Manning's N	Hydraulic Radius	Froude Number
Stability B	0.81	1.73	6.1	0.165	0.513	0.42
Capacity B	0.81	1.73	6.1	0.165	0.513	0.42
w/ Freeboard + B	1.31		8.6			

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	0.47	5.71

****

J1, B1, S2

Ditch L2 - Upper

Drainage Area from J1, B1, S2, SWS(s)1: 4.0 acres
Total Contributing Drainage Area: 5.4 acres

MATERIAL: Rock Riprap
Trapezoidal Riprap Channel
Steep Slope Design - PADER Method

Design Discharge (cfs)	Bottom Width (ft)	ZLeft	ZRight	Slope (%)	Manning's n
22.03	4.0	3.0:1	3.0:1	9.0	0.042

	Depth (ft)	Velocity (fps)	Top Width (ft)	Hydraulic Radius	Froude Number
	0.61	6.25	7.6	0.450	1.62
w/ Freeboard:	1.11		10.6		

----DMax----		----D50----		----D10----	
(ft)	(in)	(ft)	(in)	(ft)	(in)
0.31	3.75	0.25	3.00	0.08	1.00

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	1.82	22.03

****

J1, B1, S3
Ditch L2 - Lower

Drainage Area from J1, B1, S3, SWS(s)1: 9.2 acres
Total Contributing Drainage Area: 14.6 acres

MATERIAL: Rock Riprap
Trapezoidal Riprap Channel
Steep Slope Design - Simons/OSM Method

Design Discharge	Bottom Width	ZLeft	ZRight	Slope	Manning's n

(cfs)	(ft)			(%)	
33.52	8.0	3.0:1	3.0:1	4.0	0.034

	Depth (ft)	Velocity (fps)	Top Width (ft)	Hydraulic Radius	Froude Number
	0.41	8.88**	10.5	0.356	2.61
w/ Freeboard:	0.91		13.5		

** Non-uniform flow - Velocity shown is V=Q/A and may not be applicable

----DMax----		----D50----		----D10----	
(ft)	(in)	(ft)	(in)	(ft)	(in)
0.63	7.50	0.50	6.00	0.17	2.00

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	3.82	33.52

****

J1, B1, S4
Ditch L3

Drainage Area from J1, B1, S4, SWS(s)1: 1.0 acres
Total Contributing Drainage Area: 15.6 acres

MATERIAL: Rock Riprap
Trapezoidal Riprap Channel
Steep Slope Design - Simons/OSM Method

Design Discharge (cfs)	Bottom Width (ft)	ZLeft	ZRight	Slope (%)	Manning's n
37.60	12.0	3.0:1	3.0:1	19.0	0.037

Depth (ft)	Velocity (fps)	Top Width (ft)	Hydraulic Radius	Froude Number

	0.23	13.04**	13.4	0.215	4.95
w/ Freeboard:	0.73		16.4		

** Non-uniform flow - Velocity shown is V=Q/A and may not be applicable

----DMax----		----D50----		----D10----	
(ft)	(in)	(ft)	(in)	(ft)	(in)
0.94	11.25	0.75	9.00	0.25	3.00

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	4.15	37.60

****

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

100YR/24HR DISCHARGE - MATLOCK BEND PH II & IV SUBWATERSHED B

by

Name: James Bauman

Company Name: SANTEK ENVIRONMENTAL, INC.
File Name: C:\SEDCAD3\MATLKBD4

Date: 03-26-1996

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLK3D4 User: James Bauman
Date: 03-26-1996 Time: 11:53:37
100yr/24hr discharge - matlock bend ph II & IV subwatershed b
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	To B	S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
1	1	2	1	3	157.96	33.00	4.02	0.01		
			2	6	980.78	4.00	3.00	0.09	0.101	0.324
1	1	3	1	6	1.00	4.00	3.00	0.00	0.000	0.319
1	1	4	1	3	125.28	30.00	3.83	0.01		
			2	8	420.76	6.00	7.35	0.02	0.024	0.397
2	1	1	1	8	1.00	6.00	7.35	0.00	0.000	0.406
2	2	2	1	3	104.40	30.00	3.83	0.01		
			2	8	1000.80	4.00	6.00	0.05	0.053	0.386
3	1	1	1	9	50.00	1.00	9.00	0.00	0.001	0.420

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD4 User: James Bauman
Date: 03-26-1996 Time: 11:53:37
100yr/24hr discharge - matlock bend ph II & IV subwatershed b
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	2.90	74	F	0.101	0.000	0.000	0.0	0.98	11.83
		Type: Vegetated Channel Label: Ditch K								
111	Structure	2.90							0.98	
111	Total IN/OUT	2.90							0.98	11.83
112	1	0.01	74	F	0.000	0.000	0.000	0.0	0.00	0.04
		Type: Culvert Label: Culvert DS-8								
112	Structure	0.01							0.98	
112	Total IN/OUT	2.91							0.98	11.21
111 to 112 Routing						0.101	0.324			
113	1	5.00	60	M	0.024	0.000	0.000	0.0	1.08	14.16
		Type: Riprap Channel Label: Ditch M								
113	Structure	5.00							2.07	
113	Total IN/OUT	7.91							2.07	25.37
112 to 113 Routing						0.000	0.319			
114	1	0.01	90	F	0.000	0.000	0.000	0.0	0.00	0.05
		Type: Culvert Label: Culvert DS-15								
114	Structure	0.01							2.07	

114 Total IN/OUT	7.92						2.07	25.42
113 to 114 Routing				0.024	0.397			
121 1	2.20	74	F	0.022	0.000	0.000	0.0	0.74	8.97
	Type: Null Label:							
121 Structure	2.20							0.74	
121 Total IN/OUT	2.20							0.74	8.97
211 1	0.00	0	F	0.000	0.000	0.000	0.0	0.00	0.00
	Type: Null Label:							
211 Structure	0.00							2.81	
211 Total IN/OUT	10.12							2.81	34.40
114 to 211 Routing				0.000	0.406			
221 1	4.20	74	M	0.053	0.000	0.000	0.0	1.41	17.13
	Type: Riprap Channel Label: Ditch S							
221 Structure	4.20							1.41	
221 Total IN/OUT	4.20							1.41	17.13
222 1	0.01	100	F	0.000	0.000	0.000	0.0	0.01	0.05
	Type: Culvert Label: Culvert DS-12							
222 Structure	0.01							1.42	
222 Total IN/OUT	4.21							1.42	16.71
221 to 222 Routing				0.053	0.386			
311 1	0.01	100	F	0.000	0.000	0.000	0.0	0.01	0.05
	Type: Culvert Label: Culvert DS-13							
311 Structure	0.01							4.24	
311 Total IN/OUT	14.34							4.24	51.16
211 to 311 Routing				0.001	0.420			

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD4 User: James Bauman
Date: 03-26-1996 Time: 11:53:37
100yr/24hr discharge - matlock bend ph II & IV subwatershed b
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	3	150.00	33.00	4.02	0.01			
				-b	6	980.00	4.00	3.00	0.09	0.101		
1	1	2	1	-a	6	1.00	4.00	3.00	0.00	0.000		
	1	3	1	-a	3	120.00	30.00	3.83	0.01			
				-b	8	420.00	6.00	7.35	0.02	0.024		
1	1	4	1	-a	8	1.00	6.00	7.35	0.00	0.000		
1	2	1	1	-a	3	180.00	28.00	3.70	0.01			
				-b	6	180.00	14.00	5.61	0.01	0.022		
2	2	1	1	-a	3	100.00	30.00	3.83	0.01			
				-b	8	1000.00	4.00	6.00	0.05	0.053		

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD4 User: James Bauman
Date: 03-26-1996 Time: 11:53:37
100yr/24hr discharge - matlock bend ph II & IV subwatershed b
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

NON-POND STRUCTURE INPUT/OUTPUT TABLE

J1, B1, S1
Ditch K

Drainage Area from J1, B1, S1, SWS(s)1: 2.9 acres
Total Contributing Drainage Area: 2.9 acres

MATERIAL: TALL FESCUE
Trapezoidal Vegetated Channel
Limiting Variable: Velocity = 7.000 fps

Design Discharge (cfs)	Bottom Width (ft)	ZLeft	ZRight	Slope (%)
11.83	2.0	2.5:1	2.5:1	4.0

Retardance Class	Depth (ft)	Velocity (fps)	Top Width (ft)	Manning's N	Hydraulic Radius	Froude Number
Stability B	1.23	1.88	8.2	0.128	0.725	0.38
Capacity B	1.23	1.88	8.2	0.128	0.725	0.38
w/ Freeboard + B	1.73		10.7			

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	0.98	11.83

****

J1, B1, S2

Culvert DS-8

Drainage Area from J1, B1, S2, SWS(s)1: 0.0 acres
Total Contributing Drainage Area: 2.9 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	2.0	216.0	11.0	0.014	1.0

Minimum Pipe Diameter Required: 24.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	0.98	11.21

****

J1, B1, S3
Ditch M

Drainage Area from J1, B1, S3, SWS(s)1: 5.0 acres
Total Contributing Drainage Area: 7.9 acres

MATERIAL: Rock Riprap
Trapezoidal Riprap Channel
Steep Slope Design - PADER Method

Design Discharge (cfs)	Bottom Width (ft)	ZLeft	ZRight	Slope (%)	Manning's n
25.37	4.0	3.5:1	3.0:1	6.0	0.041

	Depth (ft)	Velocity (fps)	Top Width (ft)	Hydraulic Radius	Froude Number
	0.71	5.66	8.6	0.507	1.38
w/ Freeboard:	1.21		11.9		

----DMax----	----D50----	----D10----

(ft)	(in)	(ft)	(in)	(ft)	(in)
0.31	3.75	0.25	3.00	0.08	1.00

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	2.07	25.37

****

J1, B1, S4
Culvert DS-15

Drainage Area from J1, B1, S4, SWS(s)1: 0.0 acres
Total Contributing Drainage Area: 7.9 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	2.0	260.0	1.0	0.014	1.0

Minimum Pipe Diameter Required: 54.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	2.07	25.42

****

J2, B2, S1
Ditch S

Drainage Area from J2, B2, S1, SWS(s)1: 4.2 acres
Total Contributing Drainage Area: 4.2 acres

MATERIAL: Rock Riprap
Trapezoidal Riprap Channel
Steep Slope Design - Simons/OSM Method

Design Discharge	Bottom Width	ZLeft	ZRight	Slope	Manning's n

(cfs)	(ft)			(%)	
17.13	6.0	3.0:1	3.0:1	4.0	0.032

	Depth (ft)	Velocity (fps)	Top Width (ft)	Hydraulic Radius	Froude Number
	0.29	8.47**	7.8	0.257	2.92
w/ Freeboard:	0.79		10.8		

** Non-uniform flow - Velocity shown is V=Q/A and may not be applicable

----DMax----		----D50----		----D10----	
(ft)	(in)	(ft)	(in)	(ft)	(in)
0.63	7.50	0.50	6.00	0.17	2.00

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	1.41	17.13

****

J2, B2, S2
Culvert DS-12

Drainage Area from J2, B2, S2, SWS(s)1: 0.0 acres
Total Contributing Drainage Area: 4.2 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	2.0	450.0	3.0	0.014	1.0

Minimum Pipe Diameter Required: 36.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)

IN/OUT	1.42	16.71

****

J3, B1, S1
Culvert DS-13

Drainage Area from J3, B1, S1, SWS(s)1: 0.0 acres
Total Contributing Drainage Area: 14.3 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	2.0	46.0	3.0	0.014	1.0

Minimum Pipe Diameter Required: 108.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	4.24	51.16

****

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

100YR/24HR DISCHARGE - MATLOCK BEND PH II & IV SUBWATERSHED C

by

Name: James Bauman

Company Name: SANTEK ENVIRONMENTAL, INC.
File Name: C:\SEDCAD3\MATLKBD5

Date: 03-26-1996

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD5 User: James Bauman
Date: 03-26-1996 Time: 12:20:50
100Yr/24Hr Discharge - Matlock Bend Ph II & IV Subwatershed C
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	B	S	To #	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
2	1	1	1	3		208.81	30.00	3.83	0.01		
			2	6		500.22	3.00	2.60	0.05	0.067	0.317

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLK3D5 User: James Bauman
Date: 03-26-1996 Time: 12:20:50
100Yr/24Hr Discharge - Matlock Bend Ph II & IV Subwatershed C
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	3.40	74	F	0.067	0.000	0.000	0.0	1.15	13.87
		Type: Null Label:								
111	Structure	3.40							1.15	
111	Total IN/OUT	3.40							1.15	13.87
121	1	4.00	74	F	0.061	0.000	0.000	0.0	1.35	16.32
		Type: Null Label:								
121	Structure	4.00							1.35	
121	Total IN/OUT	4.00							1.35	16.32
211	1	0.01	100	F	0.000	0.000	0.000	0.0	0.01	0.05
		Type: Culvert Label: Culvert DS-2								
211	Structure	0.01							2.50	
211	Total IN/OUT	7.41							2.50	29.15
111 to 211 Routing						0.067	0.317			

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLK3D5 User: James Bauman
Date: 03-26-1996 Time: 12:20:50
100Yr/24Hr Discharge - Matlock Bend Ph II & IV Subwatershed C
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	3	200.00	30.00	3.83	0.01			
				-b	6	500.00	3.00	2.60	0.05	0.067		
1	2	1	1	-a	3	150.00	30.00	3.83	0.01			
				-b	6	550.00	4.00	3.00	0.05	0.061		

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD5 User: James Bauman
Date: 03-26-1996 Time: 12:20:50
100Yr/24Hr Discharge - Matlock Bend Ph II & IV Subwatershed C
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

NON-POND STRUCTURE INPUT/OUTPUT TABLE

J2, B1, S1
Culvert DS-2

Drainage Area from J2, B1, S1, SWS(s)1: 0.0 acres
Total Contributing Drainage Area: 7.4 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	2.0	288.0	33.0	0.014	1.0

Minimum Pipe Diameter Required: 60.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	2.50	29.15

****

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

100YR/24HR DISCHARGE - MATLOCK BEND PH II & IV SUBWATERSHED D

by

Name: James Bauman

Company Name: SANTEK ENVIRONMENTAL, INC.
File Name: C:\SEDCAD3\MATLKBD6

Date: 03-26-1996

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLKBD6 User: James Bauman
Date: 03-26-1996 Time: 12:37:42
100YR/24HR Discharge - Matlock Bend PH II & IV Subwatershed D
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
1	1	2	1	3	156.60	30.00	3.83	0.01		
			2	6	950.43	3.00	2.60	0.10	0.112	0.309
1	1	3	1	8	103.08	25.00	15.00	0.00	0.001	0.449
1	1	4	1	9	1400.63	3.00	15.59	0.02	0.024	0.450

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\MATLK3D6 User: James Bauman
Date: 03-26-1996 Time: 12:37:42
100YR/24HR Discharge - Matlock Bend PH II & IV Subwatershed D
Storm: 7.00 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	2.40	74	F	0.112	0.000	0.000	0.0	0.81	9.79
		Type: Vegetated Channel Label: Ditch J								
111 Structure		2.40							0.81	
111 Total IN/OUT		2.40							0.81	9.79
112	1	1.00	100	F	0.000	0.000	0.000	0.0	0.58	5.36
		Type: Culvert Label: Culvert DS-10								
112 Structure		1.00							1.39	
112 Total IN/OUT		3.40							1.39	14.52
111 to 112 Routing						0.112	0.309			
113	1	3.70	74	M	0.032	0.000	0.000	0.0	1.25	15.09
		Type: Riprap Channel Label: Ditch T								
113 Structure		3.70							2.64	
113 Total IN/OUT		7.10							2.64	29.62
112 to 113 Routing						0.001	0.449			
114	1	0.01	74	M	0.000	0.000	0.000	0.0	0.00	0.04
		Type: Riprap Channel Label: Ditch T								
114 Structure		0.01							2.64	

114 Total IN/OUT	7.11		2.64	29.66
113 to 114 Routing		0.024 0.450		

STORMWATER DETENTION BASIN SPILLWAY DESIGN

Basin No. 1

The capacity of Basin No. 1 will exceed the design requirement of 17.75 acre-feet of storage volume. Calculations for the basin capacity by stage show that 19.99 ac-ft of storage is provided at elevation 879.0 feet. The emergency spillway will be set at this elevation and provide one foot of freeboard to the top of the basin. The primary spillway elevation will be set at 877.0 feet to provide 2 feet of freeboard to the emergency spillway elevation.

The primary spillway will consist of a perforated 48 inch diameter riser pipe and a discharge barrel of 36 inch diameter. Both pipes will be corrugated metal pipe (CMP). The primary spillway is designed to limit discharge to approximately 14 cfs (elev. 877.5), to minimize the post-development impact on the down-gradient areas during normal basin operation. The primary riser perforations consist of six holes per elevation, each two inches in diameter. The holes are spaced radially in 60° increments. This design will extend the basin dewatering time to 3.3 days in order to maximize sediment deposition.

The emergency spillway is designed to pass the 100yr/24hr storm flow. The spillway is designed to utilize weir flow. With 1.0 feet of head on the emergency spillway (elev. 880.0), the primary spillway will flow approximately 104 cfs, while the emergency spillway will flow 27 cfs. This flow combination provides approximately 1.7 feet of freeboard for the peak stage elevation of 878.26 feet.

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

LOUDON COUNTY LANDFILL EXPANSION - STORMWATER MANAGEMENT SYSTEM

by

Name: James Bauman

Company Name: SANTEK ENVIRONMENTAL, INC.
File Name: C:\SEDCAD3\LOUDON\RUN10

Date: 07-25-1994

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\LOUDON\RUN10 User: James Bauman
Date: 07-25-1994 Time: 10:39:59
Loudon County Landfill Expansion - Stormwater Management System
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
2	1	1	1	3	385.45	17.00	2.89	0.04		
			2	6	771.88	7.00	3.97	0.05	0.090	0.339

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\LOUDON\RUN10 User: James Bauman
Date: 07-25-1994 Time: 10:39:59
Loudon County Landfill Expansion - Stormwater Management System
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	31.30	71	M	0.090	0.090	0.339	0.0	6.94	87.76
111	2	7.00	91	M	0.081	0.081	0.364	0.0	2.72	28.99
		Type: Null Label: Area I Drainage								
111	Structure	38.30							9.66	
111	Total IN/OUT	38.30							9.66	109.96
121	1	31.00	71	M	0.098	0.081	0.364	0.0	6.87	86.92
		Type: Null Label: Areas II & III								
121	Structure	31.00							6.87	
121	Total IN/OUT	31.00							6.87	81.25
211	1	2.70	98	F	0.001	0.021	0.000	0.0	1.23	11.76
		Type: Pond Label: Phase II Basin								
211	Structure	2.70							17.75	
211	Total IN	72.00							17.75	186.46
211	Total OUT								13.95	20.60
111 to 211 Routing						0.090	0.339			

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\LOUDON\RUN10 User: James Bauman
Date: 07-25-1994 Time: 10:39:59
Loudon County Landfill Expansion - Stormwater Management System
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	3	380.00	17.00	2.89	0.04			
				-b	6	770.00	7.00	3.97	0.05	0.090		
1	1	1	1	-1	3	385.45	17.00	2.89	0.04			
				-2	6	771.88	7.00	3.97	0.05		0.090	0.339
1	1	1	2	-a	6	750.00	13.00	5.41	0.04			
				-b	6	520.00	5.00	3.35	0.04	0.081		
1	1	1	2	-1	6	756.31	13.00	5.41	0.04			
				-2	6	520.65	5.00	3.35	0.04		0.081	0.364
	1	1		-a	6	750.00	13.00	5.41	0.04			
				-b	6	520.00	5.00	3.35	0.04			
				-c	8	450.00	6.00	7.35	0.02	0.098		
1	2	1	1	-1	6	756.31	13.00	5.41	0.04			
				-2	6	520.65	5.00	3.35	0.04		0.081	0.364

Company Name: SANTEK ENVIRONMENTAL, INC.
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Loudon County Landfill Expansion - Stormwater Management System
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

J2, B1, S1
Phase II Basin

Drainage Area from J2, B1, S1, SWS(s)1: 2.7 acres
Total Contributing Drainage Area: 72.0 acres

DISCHARGE OPTIONS:

	Perf. Riser	Emergency Spillway
Riser Diameter (in)	48.0	----
Riser Height (ft)	8.00	----
Barrel Diameter (in)	36.0	----
Barrel Length (ft)	120.00	----
Barrel Slope (%)	1.00	----
Manning's n of Pipe	0.015	----
Spillway Elevation	877.0	----
Lowest Elevation of Holes	873.0	----
# of Holes/Elevation	6	----
Entrance Loss Coefficient	----	----
Tailwater Depth (ft)	----	----
Notch Angle (degrees)	----	----
Weir Width (ft)	----	----
Siphon Crest Elevation	----	----
Siphon Tube Diameter (in)	----	----
Siphon Tube Length (ft)	----	----
Manning's n of Siphon	----	----
Siphon Inlet Elevation	----	----
Siphon Outlet Elevation	----	----
Emergency Spillway Elevation	----	879.0
Crest Length (ft)	----	15.0
Z:1 (Left and Right)	-- --	2 2
Bottom Width (ft)	----	10.0

POND RESULTS:

Permanent Pool (ac-ft)
6.3

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	17.75	186.46
OUT	13.95	20.60

Peak Elevation	Hydrograph Detention Time (hrs)
877.6	4.86

Dewatering Time (Max. Perf. Riser Elev to Lowest Orifice): 3.3 days

****

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\LOUDON\RUN10 User: James Bauman
Date: 07-25-1994 Time: 10:39:59
Loudon County Landfill Expansion - Stormwater Management System
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-DISCHARGE TABLE

J2, B1, S1
Phase II Basin

Drainage Area from J2, B1, S1, SWS(s)1: 2.7 acres
Total Contributing Drainage Area: 72.0 acres

Elevation	Perf. Riser (cfs)	Emergency Spillway (cfs)	Total Discharge (cfs)
869.00	0.0	0.0	0.0
869.50	0.0	0.0	0.0
870.00	0.0	0.0	0.0
870.50	0.0	0.0	0.0
871.00	0.0	0.0	0.0
71.50	0.0	0.0	0.0
872.00	0.0	0.0	0.0
872.50	0.0	0.0	0.0
873.00	0.0>2.00	0.0	0.0
873.50	0.4	0.0	0.4
874.00	0.6>2.00	0.0	0.6
874.50	1.4	0.0	1.4
875.00	1.5>2.00	0.0	1.5
875.50	2.5	0.0	2.5
876.00	2.6	0.0	2.6
876.50	2.7	0.0	2.7
877.00	2.8	0.0	2.8
877.50	13.8	0.0	13.8
878.00	39.0	0.0	39.0
878.50	71.6	0.0	71.6
879.00	85.6	0.0	85.6
879.50	95.7	8.8	104.5
879.60	97.3	10.6	107.8
879.70	98.9	13.9	112.8
879.80	100.4	18.0	118.5
879.90	102.0	22.3	124.4
880.00	103.6	27.0	130.6

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\LOUDON\RUN10 User: James Bauman
Date: 07-25-1994 Time: 10:39:59
Loudon County Landfill Expansion - Stormwater Management System
Storm: 5.70 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J2, B1, S1
Phase II Basin

Drainage Area from J2, B1, S1, SWS(s)1: 2.7 acres
Total Contributing Drainage Area: 72.0 acres

SW#1: Perforated Riser
SW#2: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
869.00	0.00	0.20	0.00	0.00	
869.50	0.50	0.77	0.23	0.00	
870.00	1.00	1.70	0.83	0.00	
°70.50	1.50	1.74	1.69	0.00	
1.00	2.00	1.79	2.57	0.00	
˙71.50	2.50	1.84	3.48	0.00	
.72.00	3.00	1.88	4.41	0.00	
872.50	3.50	1.93	5.36	0.00	
873.00	4.00	1.98	6.34	0.00	Low Orifice of SW#1
873.50	4.50	2.02	7.34	0.45	
874.00	5.00	2.07	8.36	0.63	
874.50	5.50	2.12	9.41	1.40	
875.00	6.00	2.17	10.48	1.52	
875.50	6.50	2.22	11.58	2.52	
876.00	7.00	2.27	12.70	2.61	
876.50	7.50	2.32	13.85	2.70	
877.00	8.00	2.38	15.03	2.78	Stage of SW#1
877.50	8.50	2.43	16.23	13.77	
877.64	8.64	2.44	16.56	20.60	Peak Stage
878.00	9.00	2.48	17.46	38.96	
878.50	9.50	2.54	18.71	71.57	
879.00	10.00	2.59	19.99	85.57	Stage of SW#2
879.50	10.50	2.64	21.30	104.49	
879.60	10.60	2.66	21.56	107.84	
879.70	10.70	2.67	21.83	112.77	
879.80	10.80	2.68	22.10	118.48	
879.90	10.90	2.69	22.37	124.37	
880.00	11.00	2.70	22.64	130.62	

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

LOUDON COUNTY LANDFILL EXPANSION - STORMWATER MANAGEMENT SYSTEM

by

Name: James Bauman

Company Name: SANTEK ENVIRONMENTAL, INC.
File Name: C:\SEDCAD3\LOUDON\RUN10

Date: 07-25-1994

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\LOUDON\RUN10 User: James Bauman
Date: 07-25-1994 Time: 10:40:06
Loudon County Landfill Expansion - Stormwater Management System
Storm: 6.80 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	To B	S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
2	1	1	1	3	385.45	17.00	2.89	0.04		
			2	6	771.88	7.00	3.97	0.05	0.090	0.339

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\LOUDON\RUN10 User: James Bauman
Date: 07-25-1994 Time: 10:40:06
Loudon County Landfill Expansion - Stormwater Management System
Storm: 6.80 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	31.30	71	M	0.090	0.090	0.339	0.0	9.27	114.88
111	2	7.00	91	M	0.081	0.081	0.364	0.0	3.35	35.06
		Type: Null Label: Area I Drainage								
111	Structure	38.30							12.62	
111	Total IN/OUT	38.30							12.62	142.64
121	1	31.00	71	M	0.098	0.081	0.364	0.0	9.19	113.77
		Type: Null Label: Areas II & III								
	Structure	31.00							9.19	
1	Total IN/OUT	31.00							9.19	107.65
211	1	2.70	98	F	0.001	0.021	0.000	0.0	1.48	14.04
		Type: Pond Label: Phase II Basin								
211	Structure	2.70							23.29	
211	Total IN	72.00							23.29	245.98
211	Total OUT								19.45	55.81
111	to 211 Routing					0.090	0.339			

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\LOUDON\RUN10 User: James Bauman
Date: 07-25-1994 Time: 10:40:06
Loudon County Landfill Expansion - Stormwater Management System
Storm: 6.80 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	3	380.00	17.00	2.89	0.04			
				-b	6	770.00	7.00	3.97	0.05	0.090		
1	1	1	1	-1	3	385.45	17.00	2.89	0.04			
				-2	6	771.88	7.00	3.97	0.05		0.090	0.339
1	1	1	2	-a	6	750.00	13.00	5.41	0.04			
				-b	6	520.00	5.00	3.35	0.04	0.081		
1	1	1	2	-1	6	756.31	13.00	5.41	0.04			
				-2	6	520.65	5.00	3.35	0.04		0.081	0.364
1	2	1	1	-a	6	750.00	13.00	5.41	0.04			
				-b	6	520.00	5.00	3.35	0.04			
				-c	8	450.00	6.00	7.35	0.02	0.098		
1	2	1	1	-1	6	756.31	13.00	5.41	0.04			
				-2	6	520.65	5.00	3.35	0.04		0.081	0.364

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\LOUDON\RUN10 User: James Bauman
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Loudon County Landfill Expansion - Stormwater Management System
Storm: 6.80 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

==========
POND INPUT/OUTPUT TABLE
==========

J2, B1, S1
Phase II Basin

Drainage Area from J2, B1, S1, SWS(s)1: 2.7 acres
Total Contributing Drainage Area: 72.0 acres

DISCHARGE OPTIONS:

	Perf. Riser	Emergency Spillway
Riser Diameter (in)	48.0	----
Riser Height (ft)	8.00	----
Barrel Diameter (in)	36.0	----
Barrel Length (ft)	120.00	----
Barrel Slope (%)	1.00	----
Manning's n of Pipe	0.015	----
Spillway Elevation	877.0	----
Lowest Elevation of Holes	873.0	----
# of Holes/Elevation	6	----
Entrance Loss Coefficient	----	----
Tailwater Depth (ft)	----	----
Notch Angle (degrees)	----	----
Weir Width (ft)	----	----
Siphon Crest Elevation	----	----
Siphon Tube Diameter (in)	----	----
Siphon Tube Length (ft)	----	----
Manning's n of Siphon	----	----
Siphon Inlet Elevation	----	----
Siphon Outlet Elevation	----	----
Emergency Spillway Elevation	----	879.0
Crest Length (ft)	----	15.0
Z:1 (Left and Right)	-- --	2 2
Bottom Width (ft)	----	10.0

POND RESULTS:

Permanent Pool (ac-ft)
6.3

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	23.29	245.98
OUT	19.45	55.81

Peak Elevation	Hydrograph Detention Time (hrs)
878.3	4.48

Dewatering Time (Max. Perf. Riser Elev to Lowest Orifice): 3.3 days

****

Company Name: SANTEK ENVIRONMENTAL, INC.
Filename: C:\SEDCAD3\LOUDON\RUN10 User: James Bauman
Date: 07-25-1994 Time: 10:40:06
Loudon County Landfill Expansion - Stormwater Management System
Storm: 6.80 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-DISCHARGE TABLE

J2, B1, S1
Phase II Basin

Drainage Area from J2, B1, S1, SWS(s)1: 2.7 acres
Total Contributing Drainage Area: 72.0 acres

Elevation	Perf. Riser (cfs)	Emergency Spillway (cfs)	Total Discharge (cfs)
869.00	0.0	0.0	0.0
869.50	0.0	0.0	0.0
870.00	0.0	0.0	0.0
870.50	0.0	0.0	0.0
71.00	0.0	0.0	0.0
871.50	0.0	0.0	0.0
872.00	0.0	0.0	0.0
872.50	0.0	0.0	0.0
873.00	0.0>2.00	0.0	0.0
873.50	0.4	0.0	0.4
874.00	0.6>2.00	0.0	0.6
874.50	1.4	0.0	1.4
875.00	1.5>2.00	0.0	1.5
875.50	2.5	0.0	2.5
876.00	2.6	0.0	2.6
876.50	2.7	0.0	2.7
877.00	2.8	0.0	2.8
877.50	13.8	0.0	13.8
878.00	39.0	0.0	39.0
878.50	71.6	0.0	71.6
879.00	85.6	0.0	85.6
879.50	95.7	8.8	104.5
879.60	97.3	10.6	107.8
879.70	98.9	13.9	112.8
879.80	100.4	18.0	118.5
879.90	102.0	22.3	124.4
880.00	103.6	27.0	130.6

Company Name: SANTEK ENVIRONMENTAL, INC.
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Storm: 6.80 inches, 100 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J2, B1, S1
Phase II Basin

Drainage Area from J2, B1, S1, SWS(s)1: 2.7 acres
Total Contributing Drainage Area: 72.0 acres

SW#1: Perforated Riser
SW#2: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
869.00	0.00	0.20	0.00	0.00	
869.50	0.50	0.77	0.23	0.00	
870.00	1.00	1.70	0.83	0.00	
'0.50	1.50	1.74	1.69	0.00	
-71.00	2.00	1.79	2.57	0.00	
71.50	2.50	1.84	3.48	0.00	
,72.00	3.00	1.88	4.41	0.00	
872.50	3.50	1.93	5.36	0.00	
873.00	4.00	1.98	6.34	0.00	Low Orifice of SW#1
873.50	4.50	2.02	7.34	0.45	
874.00	5.00	2.07	8.36	0.63	
874.50	5.50	2.12	9.41	1.40	
875.00	6.00	2.17	10.48	1.52	
875.50	6.50	2.22	11.58	2.52	
876.00	7.00	2.27	12.70	2.61	
876.50	7.50	2.32	13.85	2.70	
877.00	8.00	2.38	15.03	2.78	Stage of SW#1
877.50	8.50	2.43	16.23	13.77	
878.00	9.00	2.48	17.46	38.96	
878.26	9.26	2.51	18.10	55.81	Peak Stage
878.50	9.50	2.54	18.71	71.57	
879.00	10.00	2.59	19.99	85.57	Stage of SW#2
879.50	10.50	2.64	21.30	104.49	
879.60	10.60	2.66	21.56	107.84	
879.70	10.70	2.67	21.83	112.77	
879.80	10.80	2.68	22.10	118.48	
879.90	10.90	2.69	22.37	124.37	
880.00	11.00	2.70	22.64	130.62	

Proposed Expansion Closure/Post-Closure Care Cost

TABLE 5

MATLOCK BEND CLASS I LANDFILL EXPANSION CLOSURE COST

Description	Quantity	Unit	Unit Cost	Total Unit Cost	Subtotal Cost
LANDFILL CAP SYSTEM					
Vegetative Cover Layer	216,142	CY			
Excavation Cost			$2.00	$432,284.00	
Placement Cost			$1.00	$216,142.00	$648,426.00
Geosynthetics - Geotextiles, Geonet and Geomemb	67	ACR			
Quality control testing cost		ACR	$6,000.00	$402,000.00	
Geocomposite cost		ACR	$26,136.00	$1,751,112.00	
Geomembrane cost		ACR	$20,909.00	$1,400,903.00	$3,554,015.00
Compacted Soil Cover	108,093	CY			
Excavation Cost		CY	$1.39	$150,249.27	
Placement & Spreading Cost		CY	$0.97	$104,850.21	
Compaction Cost		CY	$0.75	$81,069.75	$336,169.23
Quality Control for Compacted Soil Cover	108,093	CY			
Testing on Borrow Soil Cost		CY	$0.50	$54,046.50	
Testing of Compacted Soil Placement Cost		CY	$1.35	$145,925.55	$199,972.05
Stormwater Drainage Structures					
Drainage stone	850	TONS	$16.25	$13,812.50	
Channel to pipe transitions	4	EA	$25.00	$100.00	
Toe drain pipe	28	EA	$25.00	$700.00	
24-in drainage pipe	1,100	LF	$15.00	$16,500.00	
Concrete/plastic inlets	4	EA	$350.00	$1,400.00	
Geotextile	34,750	SF	$0.12	$4,170.00	
Labor cost	1	LS	$26,000.00	$26,000.00	$62,682.50
Vegetative Stabilization	67	ACR			
Labor		ACR	$500.00	$33,500.00	
Seeding		ACR	$220.00	$14,740.00	
Fertilizing		ACR	$230.00	$15,410.00	
Mulching		ACR	$350.00	$23,450.00	$87,100.00
STORMWATER SYSTEM					
Stormwater Basins	3	EA			
Sediment Excavation		EA	$5,200.00	$15,600.00	
Materials (pipe, rip rap, etc.)		EA	$2,600.00	$7,800.00	$23,400.00
Diversion Ditches					
Construction	1	LS	$10,400.00	$10,400.00	
Materials	1	LS	$20,800.00	$20,800.00	$31,200.00
Temporary Structures					
Construction	1	LS	$5,200.00	$5,200.00	
Materials	1	LS	$5,200.00	$5,200.00	$10,400.00
LANDFILL GAS VENT SYSTEM[1]					
Gas Vents	58	EA			
Materials		EA	$520.00	$30,160.00	
Equipment		EA	$260.00	$15,080.00	
Labor		EA	$260.00	$15,080.00	$60,320.00

TABLE 5

MATLOCK BEND CLASS I LANDFILL EXPANSION CLOSURE COST

Description	Quantity	Unit	Unit Cost	Total Unit Cost	Subtotal Cost
Gas Collection Trenches	20,453	LF			
Excavation cost		LF	$2.10	$42,951.30	
3-in HDPE pipe, perforated		LF	$5.20	$106,355.60	
No. 67 crushed stone		LF	$1.00	$20,453.00	
Geotextile, 6oz/sy		LF	$3.15	$64,426.95	$234,186.85

TOTAL CLOSURE COST - 67 ACRES

2013 Cost	**$**	**5,247,871.63**
Cost per acre	$	78,326.44

TABLE 6
MATLOCK BEND CLASS I LANDFILL EXPANSION
POST - CLOSURE CARE COST

Description	Quantity	Unit	Unit Cost	Total Unit Cost	Subtotal Cost
SURVEYING					
Transportation	1	LS	$600.00	$600.00	
Labor	1	LS	$2,450.00	$2,450.00	$3,050.00
VEGETATION STABILTY					
Transportation	1	LS	$800.00	$800.00	
Labor	1	LS	$1,800.00	$1,800.00	
Seeding	1	LS	$2,450.00	$2,450.00	
Fertilizing	1	LS	$2,450.00	$2,450.00	
Mulching	1	LS	$1,800.00	$1,800.00	
Rodent Control	1	LS	$600.00	$600.00	
Mowing	1	LS	$10,000.00	$10,000.00	$19,900.00
DRAINAGE FACILITIES					
Transportation	1	LS	$800.00	$800.00	
Labor	1	LS	$1,200.00	$1,200.00	
Cleaning	1	LS	$1,800.00	$1,800.00	
Repair of gullies/rills					
Soil acquisition	500	CY	$1.25	$625.00	
Delivery	500	CY	$2.50	$1,250.00	
Placement	1	LS	$1,200.00	$1,200.00	
Revegetation	1	LS	$1,500.00	$1,500.00	$8,375.00
LEACHATE COLLECTION SYSTEM					
A Off-site treatment/disposal of leachate[1]					
1-5 Years @ 1"/Acre	1,819,211	gal/yr	$0.004	$7,276.84	
6-30 Years @ 1/4"/Acre	454,803	gal/yr	$0.004	$1,819.21	
Maintenance					
Transportation	1	LS	$800.00	$800.00	
Labor	1	LS	$1,500.00	$1,500.00	
Pumps	1	EA	$1,500.00	$1,500.00	
Cleaning	1	LS	$600.00	$600.00	
Leak detection	1	LS	$600.00	$600.00	
Other	1	LS	$300.00	$300.00	
				Years 1-5	$12,576.84
				Years 6-30	$7,119.21
GAS COLLECTION SYSTEM					
Maintenance					
Transportation	1	LS	$730.00	$730.00	
Labor	1	LS	$1,700.00	$1,700.00	
Cleaning	1	LS	$1,500.00	$1,500.00	
Caps	1	EA	$430.00	$430.00	
Other	1	LS	$600.00	$600.00	$4,960.00

TABLE 6
MATLOCK BEND CLASS I LANDFILL EXPANSION
POST - CLOSURE CARE COST

Description	Quantity	Unit	Unit Cost	Total Unit Cost	Subtotal Cost
GROUNDWATER MONITORING					
Monitoring					
Sampling labor	7	EA	$500.00	$3,500.00	
Analytical testing [2]	7	EA	$1,000.00	$7,000.00	
Testing frequency			2		
Maintenance					
Transportation	1	LS	$240.00	$240.00	
Labor	1	LS	$500.00	$500.00	
Caps	1	EA	$100.00	$100.00	
Tubing	1	LS	$100.00	$100.00	
Pumps	1	EA	$100.00	$100.00	
Well replacement	1	EA	$800.00	$800.00	
Other	1	LS	$600.00	$600.00	$23,440.00

TOTAL POST CLOSURE COST - 67 ACRES

Annual Cost (Years 1-5)	$	72,301.84
Annual Cost (Years 6-30)	$	66,844.21
Inflation Rate Utilized:		3%
Years of Post Closure		30
Total Post Closure Required 2013	**$**	**2,093,592.96**

Notes:

1 Volume of leachate generated is assumed at a rate of 1" per acre per year during the first five years of closure. A rate of 1/4" per acre per year is assumed for the remaining 30 years.

2 Analytical testing includes report writing.

3 30 year cost estimate anticipates third party costs in 2013 dollars

APPENDIX B

Model Runs

- Model Run As Permitted
- Model Run Expansion

Model Run As Permitted

Model Inputs	Currently Permitted		
Volume Growth	2.0%		
Price Increase	2.0%		
Expansion ☐ Yes/No		FALSE	
CPCC Security Fee Per Customer ☐ Yes/No		FALSE	
Host Fee	4.0%		
C/PCC Fee	5.0%		
Inflation - Operational Life	3.0%		
Inflation - Post Closure	3.0%		
Discount Rate	0.0%		
Currently Permitted Airspace	4,748,110	CY	
Expansion Year	0	FALSE	
Expansion	5,632,370	CY	
Total Airspace	4,748,110		
Cumulative AUF	1.38	CY/ton	
Total Tons	3,440,659		
Maximum Tons Per Day & Year	800.00	249,600	
Operational Days Per Year	312.00		
Closure Year	2019		
Ton Per Day (TPD) Forecast Adjustment	**Adjustment**	**2013 TPD**	
Stakeholder Ton Per Day Adjustment	100.00%	42	
Special Pricing Customer TPD Adjustment	100.00%	694	
Gate Rate TPD Adjustment	100.00%	41	
Total	100.00%	778	
Cost Adjustments	**Adjustment**		
Closure Cost Adjustment	$ -	Cost in 2012 $s	
Post-Closure Care Cost Adjustment	$ -	Cost in 2012 $s	
Expense Adjustments	100%	$ (130,000.00)	Cost in 2012 $s

Closure Costs	Cost in 2012 $s	Cost At Closure - 2019	Accrual Per Permitted Ton
Closure Cost	$ 4,840,574	$ 5,953,296	$ 1.73
1st Year Post Closure Care	$ 59,934	$ 73,711	
6th Year Post Closure Care	$ 59,934	$ 85,451	
Operating Cost	$ 80,019	$ 98,413	$ 0.03
Contingency (5%)	$ 335,931	$ 477,928	$ 0.14
Cumulative PCC	$ 1,798,019	$ 3,506,841	$ 1.02
Total C/PCC Liability	**$ 7,054,542**	**$ 10,036,478**	**$ 2.92**

		2007	Through 2012	Contract Forecast	Life Of Site Forecast
Landfill Operator Revenue					
Total					
	$/ton		$ 10.37	$ 15.16	$ 21.17
	Tons		1,722,579	3,440,659	3,440,659
	Contractor Revenue		$ 17,869,040	$ 52,156,158	$ 52,156,158
Stakeholders					
	$/ton		$ 20.46	$ 21.98	$ 24.39
	Tons		67,443	165,729	14,889
	Contractor Revenue		$ 1,379,562	$ 3,643,351	$ 363,059
Customers Receiving Special Pricing					
	$/ton		$ 18.75	$ 18.86	$ 19.87
	Tons		848,246	2,173,209	2,173,209
	Contractor Revenue		$ 15,902,550	$ 40,981,581	$ 40,981,581
Gate Rate Customers					
	$/ton		$ 28.17	$ 30.06	$ 32.97
	Tons		50,233	142,019	12,870
	Contractor Revenue		$ 1,414,826	$ 4,268,392	$ 424,270

Landfill Usage	Cumulative Tons	796,573	1,722,579	3,440,659	3,440,659
	Consumed Airspace	183,124	2,377,159	4,748,110	4,748,110
	Remaining Airspace	3,648,840	2,370,951	-	-
	Remaining Tons	2,644,087	1,718,080	-	-

Commission Revenue	Cumulative Host Fee	$ 30,000	$ 759,408	$ 2,130,893	$ 2,130,893
	Cumulative CPCC Fee	$ 36,607	$ 979,708	$ 2,725,121	$ 2,725,121
	Total Fees	$ 66,607	$ 1,739,116	$ 4,856,013	$ 4,856,013
	Cumulative Net Cash	$ 2,399,545	$ 2,555,395	$ 4,676,172	$ 4,676,172

C/PCC					
	C/PCC Liability Based on % Depletion	$ 2,323,619	$ 5,024,801	$ 10,036,478	$ 10,036,478
	Accural from C/PCC Security Fee	$ 2,469,545	$ 3,412,646	$ 5,158,059	$ 5,158,059
	C/PCC Liability Variance	$ 145,926	$ (1,612,155)	$ (4,878,419)	$ (4,878,419)
	C/PCC Variance Per Remaining Ton	$ -	$ (0.94)	Closure Year 2019	Closure Year 2019
	C/PCC Reserve Amount Outstanding	$ (7,566,933)	$ (6,623,832)	$ (4,878,419)	$ (4,878,419)
	Cost/remaining ton Needed to Satisfy C/PCC Reserve	**$ (2.86)**	**$ (3.86)**	**Closure Year 2019**	**Closure Year 2019**

Model Run Expansion

Model Inputs	Expansion			
Volume Growth	2.0%			
Price Increase	2.0%			
Expansion			TRUE	
CPCC Security Fee Per Customer			FALSE	
Host Fee	4.0%			
C/PCC Fee	5.0%			
Inflation - Operational Life	3.0%			
Inflation - Post Closure	3.0%			
Discount Rate	0.0%			
Currently Permitted Airspace	4,748,110	CY		
Expansion Year	2013		TRUE	
Expansion	5,632,370	CY		
Total Airspace	10,380,480			
Cumulative AUF	1.38	CY/ton		
Total Tons	7,522,087			
Maximum Tons Per Day & Year	800.00		249,600	
Operational Days Per Year	312.00			
Closure Year	2036			
Ton Per Day (TPD) Forecast Adjustment	**Adjustment**		**2013 TPD**	
Stakeholder Ton Per Day Adjustment	100.00%		42	
Special Pricing Customer TPD Adjustment	100.00%		694	
Gate Rate TPD Adjustment	100.00%		41	
Total	100.00%		778	
Cost Adjustments	**Adjustment**			
Closure Cost Adjustment	$ -	Cost in 2013 $s		
Post-Closure Care Cost Adjustment	$ -	Cost in 2013 $s		
Expense Adjustments	100%	$ (130,000.00)	Cost in 2013 $s	

	Closure Costs		
	Cost in 2013 $s	**Cost At Closure - 2036**	**Accrual Per Permitted Ton**
Closure Cost	$ 5,247,872	$ 10,357,129	$ 1.38
1st Year Post Closure Care	$ 72,302	$ 142,694	
6th Year Post Closure Care	$ 66,844	$ 152,935	
Operating Cost	$ 70,590	$ 139,315	$ 0.02
Contingency (5%)	$ 367,554	$ 841,496	$ 0.11
Cumulative PCC	$ 2,032,615	$ 6,333,469	$ 0.84
Total C/PCC Liability	**$ 7,718,630**	**$ 17,671,409**	**$ 2.35**

		2007	Through 2012	Contract Forecast	Life Of Site Forecast
Landfill Operator Revenue					
Total					
	$/ton		$ 10.37	$ 18.09	$ 29.64
	Tons		1,722,579	5,440,535	7,522,087
	Contractor Revenue		$ 17,869,040	$ 98,443,752	$ 155,206,642
Stakeholders					
	$/ton		$ 20.46	$ 24.08	$ 34.14
	Tons		67,443	296,073	20,848
	Contractor Revenue		$ 1,379,562	$ 7,128,776	$ 711,841
Customers Receiving Special Pricin					
	$/ton		$ 18.75	$ 20.33	$ 27.83
	Tons		848,246	4,141,427	5,865,842
	Contractor Revenue		$ 15,902,550	$ 84,208,297	$ 129,027,145
Gate Rate Customers					
	$/ton		$ 28.17	$ 32.60	$ 46.16
	Tons		50,233	246,378	12,525
	Contractor Revenue		$ 1,414,826	$ 8,031,329	$ 578,156
Landfill Usage	Cumulative Tons	796,573	1,722,579	5,440,535	7,522,087
	Consumed Airspace	183,124	2,377,159	7,507,939	9,214,942
	Remaining Airspace	9,281,210	8,003,321	2,872,541	-
	Remaining Tons	6,725,514	5,799,508	2,081,552	-
Commission Revenue	Cumulative Host Fee	$ 30,000	$ 759,408	$ 3,982,396	$ 6,252,912
	Cumulative CPCC Fee	$ 36,607	$ 979,708	$ 5,039,500	$ 7,877,645
	Total Fees	$ 66,607	$ 1,739,116	$ 9,021,897	$ 14,130,557
	Cumulative Net Cash	$ 2,399,545	$ 2,555,395	$ 7,420,317	$ 10,471,395
C/PCC					
	C/PCC Liability Based on % Depletion	$ 1,871,364	$ 4,046,803	$ 12,781,283	$ 17,671,409
	Accural from C/PCC Security Fee	$ 2,469,545	$ 3,412,646	$ 7,472,438	$ 10,310,583
	C/PCC Liability Variance	$ 598,182	$ (634,157)	$ (5,308,844)	$ (7,360,826)
	C/PCC Variance Per Remaining Ton	$ -	$ (0.11)	$ (2.55)	Closure Year 2036
	C/PCC Reserve Amount Outstanding	$ (15,201,864)	$ (14,258,763)	$ (10,198,970)	$ (7,360,826)
Cost/remaining ton Needed to Satisfy C/PCC Reserv		**$ (2.26)**	**$ (2.46)**	**$ (4.90)**	**Closure Year 2036**

APPENDIX C

TDEC Facility Evaluation Checklist

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF SOLID WASTE MANAGEMENT
SOLID WASTE DISPOSAL FACILITY EVALUATION

NAME OF SITE	REGISTRATION NUMBER	DATE

LOCATION (physical)	PURPOSE ( ) Complete ( ) Follow-up ( ) Complaint ( ) Other
OWNER/OPERATOR	TYPE OF FACILITY ( ) CLASS I ( ) CLASS II ( ) CLASS III ( ) CLASS IV

		V1	V2			V1	V2
Inadequate vector control	8010			Leachate improperly managed	8330		
Access not limited to operating hours	8020			Inadequate leachate collection system	8340		
Inadequate artificial or natural barrier	8030			Leachate observed at the site	8350		
Inadequate information signs	8040			Leachate entering runoff	8360		
Unsatisfactory access road(s)/parking area(s)	8050			Leachate entering a water course	8370		
Certified personnel not present during operating hours	8060			Inadequate gas migration control system	8380		
Unapproved salvaging of waste	8070			Inadequate maintenance of gas migration control system	8390		
Evidence of open burning	8080			Potential for explosions or uncontrolled fires	8420		
Inadequate fire protection	8090			Waste not confined to a manageable area	8430		
Unsatisfactory litter control	8110			Improper spreading of waste	8440		
Inadequate employee facilities	8120			Improper compacting of waste	8450		
No communication devices	8130			Unsatisfactory initial cover	8460		
Inadequate operating equipment	8140			Unsatisfactory intermediate cover	8470		
Unavailability of backup equipment	8150			Unsatisfactory final cover	8480		
Unevailability of cover material	8160			Excessive pooling of water	8490		
Inadequate maintenance of runon/runoff system(s)	8170			Unsatisfactory stabilization of cover	8510		
Inadequate erosion control	8180			Dumping of waste into water	8520		
Inadequate dust control	8190			Unsatisfactory records or reports	8530		
Uneuthorized waste accepted	8210			Groundwater monitoring system improperly maintained	8540		
Unapproved special waste accepted	8220			Operation does not correspond with engineering plans	8570		
Tires improperly handled	8230			Operation does not correspond with permit condition(s)	8580		
Medical waste improperly handled	8240			Permit, plans, operating manual not available	8590		
Dead animals improperly handled	8250			No operating scales	8610		
Washout of solid waste	8270						
No permanent benchmark	8280						
Inadequate random inspection program	8290						
Mishandling of special waste	8300						
Buffer zone standard violated	8310						
Inadequate maintenance of leachate management system	8320						

COMMENTS:

PERSON INTERVIEWED (Signature)	INSPECTED BY (Signature)
TITLE	TITLE

TIME OF DAY	WEATHER CONDITIONS	COMPLIANCE DATE

Distribution: Facility - White Field Office - Canary Central Office - XC

APPENDIX D

Photographic Record

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 1 Date: 31 October 2012 Direction: East Comments: Landfill ingress/egress on Highway 72 North	

Photograph 2 Date: 31 October 2012 Direction: South Comments: Stormwater Pond #3	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 3 Date: 31 October 2012 Direction: Northeast Comments: Stormwater Pond #3	
Photograph 4 Date: 31 October 2012 Direction: Southeast Comments: Facing Modules A, B, and E	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 5 Date: 30 November 2012 Direction: East Comments: Stormwater Pond #1	
Photograph 6 Date: 30 November 2012 Direction: South Comments: Stormwater Pond #2	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 7 Date: 30 November 2012 Direction: Southwest Comments: Maintenance building	
Photograph 8 Date: 30 November 2012 Direction: South Comments: 2,000-gallon diesel tank	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 9 Date: 30 November 2012 Direction: Northwest Comments: 1,000-gallon tanks of transmission oil, hydraulic oil, and motor oil (right) and two, 250-gallon tanks of used oil	
Photograph 10 Date: 30 November 2012 Direction: North Comments: Tire recycling roll-off bin located near the maintenance building (foreground) and grading intermediate cover on Module F (background)	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 11 Date: 10 January 2013 Direction: East Comments: Scale house and office	
Photograph 12 Date: 10 January 2013 Direction: West Comments: 100,000-gallon leachate storage tank	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 13 Date: 30 November 2012 Direction: Northeast Comments: Two, 10,000-gallon leachate storage tanks near Stormwater Pond #3	
Photograph 14 Date: 20 November 2012 Direction: West Comments: 10,000-gallon leachate storage tank servicing the Phase I portion of the Landfill	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 15 Date: 30 November 2012 Direction: Southwest Comments: One of six gas flares located in the Phase II/IV portion of the Landfill	
Photograph 16 Date: 30 November 2012 Direction: Southwest Comments: Waste placement, mixing, spreading, and compaction in Module H	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 17 Date: 30 November 2012 Direction: Southwest Comments: Check dams in drainage channel on western slope of the Phase I portion of the Landfill (passive gas vents in background)	
Photograph 18 Date: 30 November 2012 Direction: Southwest Comments: Stormwater diversion structures located on western slope of the Phase I portion of the Landfill	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 19 Date: 30 November 2012 Direction: Northeast Comments: Check dams located in drainage channel alongside the haul road from the scale house to the waste tipping pad	
Photograph 20 Date: 30 November 2012 Direction: Northeast Comments: Soil borrow area for daily and interim cover material	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 21 Date: 30 November 2012 Direction: Northeast Comments: Check dams in drainage channel on the north edge of Module G	
Photograph 22 Date: 30 November 2012 Direction: Southeast Comments: Stormwater Pond #3	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 23 Date: 30 November 2012 Direction: South Comments: Stormwater Pond #3	
Photograph 24 Date: 30 November 2012 Direction: Northeast Comments: Gully located on the edge of Stormwater Pond #3	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 25 Date: 30 November 2012 Direction: Northeast Comments: Stormwater Pond #3	
Photograph 26 Date: 30 November 2012 Direction: Northeast Comments: Stormwater Pond #3	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 27 Date: 30 November 2012 Direction: Northwest Comments: Stormwater Pond #3	
Photograph 28 Date: 30 November 2012 Direction: West Comments: Stormwater Pond #3 outfall structure	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 29 Date: 30 November 2012 Direction: Southwest Comments: Stormwater Pond #3 overflow feature	
Photograph 30 Date: 30 November 2012 Direction: Southwest Comments: Drainage channel in woods approximately 100 yards downstream of the Stormwater Pond #3 outlet pipe	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 31 Date: 1 March 2013 Direction: North Comments: Water and sediment in drainage channel below the Stormwater Pond #3 outfall location	
Photograph 32 Date: 1 March 2013 Direction: Southwest Comments: Water and sediment in drainage channel below the Stormwater Pond #3 outfall location	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 33 Date: 1 March 2013 Direction: Southwest Comments: Water and sediment in drainage channel below the Stormwater Pond #3 outfall location	
Photograph 34 Date: 1 March 2013 Direction: Northeast Comments: Stormwater Pond #3 outfall location	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 35 Date: 1 March 2013 Direction: East Comments: Stormwater Pond #3 outfall structure	
Photograph 36 Date: 1 March 2013 Direction: Southwest Comments: Exposed soil around Stormwater Pond #3	

Matlock Bend Landfill Review

Photographic Record

Client: LCSWDC	Project Number: KX5238
Site Name: Matlock Bend Landfill	Site Location: Loudon, Tennessee

Photograph 37 Date: 1 March 2013 Direction: West Comments: Grading and Seagulls in Module H	
Photograph 38 Date: 1 March 2013 Direction: Southwest Comments: Waste placement and Seagulls in Module H