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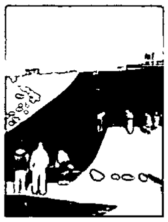
SCS ENGINEERS




APPLICATION FOR SOLID WASTE CONSTRUCTION PERMIT LANDFILL GAS COLLECTION AND CONTROL SYSTEM

CITRUS COUNTY CENTRAL LANDFILL
CITRUS COUNTY, FLORIDA

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
APR 22 2009
SOUTHWEST DISTRICT TAMPA

Prepared for:

Citrus County Board of County Commissioners

P.O. Box 340
Lecanto, Florida 34460

INSERTED INTO OCULUS
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MAY 05 2009
INITIAL MH

Prepared by:

SCS ENGINEERS
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Florida Board of Professional Engineers
Certification No. 00004892

April 22, 2009
File No. 09207049.02

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SCS ENGINEERS

August 14, 2009
File No. 09207049.02

Mr. Steven G. Morgan
Solid Waste Section
Florida Department of Environmental Protection
13051 North Telecom Parkway
Temple Terrace, Florida 33637

Subject: Citrus County Central Class I Landfill
Landfill Gas Collection and Control System Construction, Response to RAI No. 1
Pending Permit Modification No.: 21375-017-SO/08, Citrus County
WACS No.: SWD/09/39859

Dear Mr. Morgan:

In accordance with your verbal comments to SCS Engineers (SCS) on August 13, 2009 requesting revisions to the cross references for the "road crossing" and "condensate sump", we are providing four full signed, dated, and sealed drawings of the revised sheets number 4, 5, and 8.

Please advise if this pending permit requires further action by Citrus County. If you should have any questions please do not hesitate to contact either of the undersigned.

Sincerely,

D. Bramlett

Ed Hilton

Dominique H. Bramlett, P.E.
Senior Project Engineer
SCS ENGINEERS

C. Ed Hilton, Jr., P.E.
Vice President
SCS ENGINEERS

DHB/CEH:dhb

enclosure

cc: Susan Metcalfe, P.G., Citrus County

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SCS ENGINEERS

July 15, 2009
File No. 09207049.02

Mr. Steven G. Morgan
Solid Waste Section
Florida Department of Environmental Protection
13051 North Telecom Parkway
Temple Terrace, Florida 33637

Subject: Citrus County Central Class I Landfill
Landfill Gas Collection and Control System Construction, Response to RAI No. 1
Pending Permit Modification No.: 21375-017-SO/08, Citrus County
WACS No.: SWD/09/39859

Dear Mr. Morgan:

On behalf of Citrus County, SCS Engineers (SCS) submits the following responses to your request for additional information, in a letter directed to Ms. Susan Metcalfe, P.G., dated May 20, 2009 for a permit to construct a landfill gas collection and control system in Phases 1, 1A, and 2 of the existing Class I landfill. For ease of review, the Department's comments are restated in bold print, followed by our response in normal print.

We have provided revised submittals, or replacement pages to the submittals, using ~~strikethrough~~ and <u>underline</u> format, to facilitate review.

The following information is needed in support of the solid waste application [Chapter 62-701, Florida Administrative Code (F.A.C.)]:

1. **Rule 62-701.320(7)(b), F.A.C. <u>Application Form #62-701.900(1), Part A.4 "[S.I.C.]"</u> The WACS ID # for this facility is SWD/09/39859. Please revise this Part, accordingly. This comment has been made by the Department on several recent applications submitted by the applicant. Please update your records to reflect this as the DEP ID Number on future applications.**

   <u>**Response:**</u> Attachment 1 includes revised application form No. 62-701.900(1), Part A.5.

<u>**SECTION E – GENERAL REQUIREMENTS (Rule 62-701.320, F.A.C.)**</u>**:**

2. **Section E.7: Operation of the gas collection and control system will require submittal of an application for permit modification of the operation permit for the facility, including the submittal of the specific operation procedures for gas collection and control system, and issuance of the permit modification by the Department. The proposed changes to Sections 2 and 8 of the facility Operation**

Plan in Attachment L-1 of this application do not provide sufficient detail on the specific operation procedures for the gas collection and control system. However, as indicated in this section, this application is for a permit to construct the gas collection and control system. Therefore modifications to the facility's operation plan will be deferred to the operation permit modification application and not processed as part of this application. ***This comment is for information purposes and does not necessarily require a response other than acknowledgement of the comment.***

Response: Noted.

3. **Section E.13: Please publish the attached Notice of Application and provide proof of publication to the Department.**

   Response: Refer to Attachment 2 for the Notice of Application and proof of publication.

Attachment E-1 - Gas Collection and Control System Construction Drawings (Rule 62-701.320(7)(f), F.A.C.)

Please provide revised drawings that address the comments provided below, including all necessary details for the construction and operation of the facility.

4. **Recent discussions with the applicant have indicated potential problems with side slope riser piping at the facility that are currently being investigated. Please revise the design of the gas collection and control system in general and the details of tie-ins to the side slope riser piping specifically based on the results of the investigation and proposed corrective actions, as applicable.**

   Response: The landfill gas (LFG) tie-ins to the leachate collection system side slope risers will be made in the upper portion of the risers and will not be impacted by the riser investigation or proposed corrective actions.

5. **Drawing 4 of 10:**

   a. **The cross-references for the "header ditch crossing" and "condensate sump" on this sheet appear to be in error. Please verify and revise this sheet, as appropriate.**

      Response: The cross-references for the "header ditch crossing" and "condensate sump" have been revised, and a revised Drawing 4 of 10 is included in Attachment 3.

6. **Drawing 8 of 10:**

   a. **<u>Detail 4:</u> This detail does not appear to show the inlet of the 2" condensate line from the blower/flare system. Please verify and revise this detail, as applicable.**

   <u>Response:</u> Refer to Attachment 3 of this submittal for revised Drawing 8 of 10.

Attachment E-2 – Gas Collection and Control System Technical Specifications (Rules 62-701.400(3), (7) and (8), F.A.C.)

7. **Please provide Technical Specifications for the compressed air system.**

   <u>Response:</u> The compressed air system specification was included in the minor solid waste operation permit modification for the interim system, dated December 9, 2008. Since the condensate management system and blower/flare station are permitted under the interim gas collection and control system application, these particular specifications were not included in this permit application. For your convenience, the compressed air system specification is included in Attachment 4.

8. **Section 31 20 00 – Trenching and Backfilling:**

   a. **<u>Part 1.01 D:</u> The statement that, "No classification of type of excavated material will be made." appears inconsistent with specifications for reuse of excavated wastes and/or unsuitable soils. Please verify and revise this part, as applicable.**

   <u>Response:</u> Refer to Attachment 5 of this submittal for the revised Part 1.01 D of Specification Section 31 20 00.

   b. **<u>Part 3.04</u>: Please note that dewatering may require an Industrial Waste Permit from the Department. Please contact Ms. Yanisa Angulo, P.E., at 813-632-7600 x404, to determine if a permit is required. *This comment is for informational purposes only and does not require a response.***

   <u>Response:</u> Noted.

   c. **<u>Part 3.06 C:</u> The pipe surveying specifications in this part appear inconsistent with those provided in Specification Section 01 50 00 – Part 1.05.C. Please verify and revise these sections, as appropriate.**

   <u>Response:</u> Refer to Attachment 5 of this submittal for the revised Part 3.06 C of Specification Section 31 20 00.

SECTION O – GAS MANAGEMENT SYSTEM (RULE 62-701.520, F.A.C.):

9. **Section O.1: Please provide the supporting design calculations for the blower/flare system.**

   Response: The critical blower/flare design parameter is the expected LFG flow rate. As shown in Table O-1 and Attachment O-3, the LFG recovery model predicts a flow rate of 462 standard cubic feet per minute (scfm) in 2020. This expected LFG collection rate is well below the 700 scfm capacity that was specified in the blower/flare station specification that was included in the approved application for a minor modification to the solid waste operation permit.

10. **Section O.1.b: While the facility is not subject to NSPS and is not required to install a landfill gas management system in accordance with Rule 62-701.530, F.A.C. at this time, if the applicant chooses to voluntarily install a landfill gas recovery system, then the system must be designed to function as required by Department rule. In accordance with Rule 62-701.320(5)(b), F.A.C., the information provided with the application must be of sufficient detail to show how the system will be constructed in order to comply with Department rules. Therefore please provide radius of influence calculations and pipe sizing calculations that demonstrate that the system is designed to function as required and revise the narrative in this section accordingly.**

    Response: The expected radii of influence of the proposed wells are provided in Attachment 6. Also included in this attachment is an excerpt from a paper titled "Vertical Landfill Gas Extraction Wells – The SCS Model", authored by Darrin D. Dillah, P.E., PhD, Gregory P. McCarron, P.E., and Balwinder S. Panesar, PhD. As shown in the excerpt from this paper, the authors recommend a typical well spacing of 200 feet, based on well depths up to 100 feet. The design proposed in this permit application is generally consistent with this guideline. While there may be instances where wells are spaced greater than 200 feet apart, it should be noted that this design also includes LFG collection from the leachate collection and removal system (LCRS), which will provide supplemental coverage in addition to the vertical extraction wells.

    Landfill gas collection piping was designed to withstand crushing forces as shown in the earlier application submittal. This header/lateral pipe network consists of 8- and 10-inches diameter header pipe and 4- and 6-inch diameter laterals. If future piping upgrades are necessary due to settlement, crushing, or clogging, the County will perform these changes on an as-needed basis.

11. **Section O.4.c: While the facility is not subject to NSPS at this time and is not required to install a landfill gas management system in accordance with Rule 62-701.530, F.A.C., at this time, if the applicant chooses to voluntarily install a landfill gas recovery system, then the system must be designed to function as required by Department rule. Please revise the narrative in this section accordingly.**

Response: Refer to Attachment 7 of this submittal for revised Section O of the engineering report.

12. **Section O.4.e: Since the applicant is installing and operating the gas system on a voluntarily basis and therefore may choose not to operate the system in the future, please provide a closure plan for decommissioning and dismantling the system should the applicant choose to not operate the system in the future.**

Response: A closure plan for the gas collection and control system is located in Attachment 8.

13. **Section O.4.f and Attachment S-1: Since the applicant is installing and operating the gas system on a voluntary basis and therefore may choose not to operate the system in the future, please revise Attachment S-1 to include closure cost estimates for decommissioning and dismantling the system should the applicant choose to not operate the system in the future.**

Response: Revised text for Section O of the engineering report is included in Attachment 7. The closure cost estimate has also been revised to reflect conversion of the extraction wells to passive vents at the time of closure. Refer to Attachment 9 for the revised closure cost estimate.

14. **Attachment O-3: Please explain why the default model values used to obtain the landfill gas generation data in Attachment O-3 are different than those used in the June 29, 2006 NSPS Tier 2 report provided.**

Response: In retrospect, the contents of Attachment O-3 were slightly confusing. Therefore, we are submitting a revised Attachment O-3, which now includes the following:

- Model output table.

- Page 2.4-4 of U.S. EPA's *Compilation of Air Pollutant Emission Factors*, which is also known as AP-42. This document provides the justification for using the model parameters shown on the model output table. As stated on this page, U.S. EPA recommends using a decay rate constant (k) of 0.04 per year (yr^{-1}) and an ultimate methane recovery rate (L_o) of 100 cubic meters per megagram (m^3/Mg) of waste.

The 2006 NSPS Tier 2 report, which was included in the previous version of Attachment O-3, is not pertinent to this permit application, and therefore, has been omitted from the revised Attachment O-3.

Regarding the differences between the model parameters, the NSPS (40 CFR 60.754(a)) requires that for the purpose of Tier 1 and Tier 2 reporting, non-methane organic compound (NMOC) emissions must be calculated using the higher "regulatory default values" (i.e., L_0=170 m^3/Mg and k=0.05 yr^{-1}) instead of the "recommended AP-42 default values". As stated in the second paragraph of page 2.4-4, the regulatory default values were developed for NSPS compliance purposes only and are considered conservatively high to encourage landfill owners to use site-specific data in those calculations Therefore, the LFG recovery model included in Attachment O-3 is based on the AP-42 default values (L_0=100 m^3/Mg and k=0.04 yr^{-1}).

SCS is submitting four copies of our responses and the requested information. We appreciate your consideration of this application.

Sincerely,

No. 56045
7/15/09

David H. Penoyer, P.E.
Project Manager

Ed Hilton

C. Ed Hilton, Jr., P.E.
Vice President
SCS ENGINEERS

DHP/CEH:hjm

enclosure

cc: Frank Hornbrook, FDEP, Tallahassee
Susan Pelz, P.E., FDEP, Tampa
Susan Metcalfe, P.G., Citrus County

ATTACHMENT 1

REVISED FORM 62-701.900(1), PART A.5

ATTACHMENT 2

PROOF OF PUBLICATION

Proof of Publication

from the

CITRUS COUNTY CHRONICLE

Crystal River, Citrus County, Florida

PUBLISHED DAILY

STATE OF FLORIDA
COUNTY OF CITRUS
Before the undersigned authority personally appeared

Mary Ann Naczi

Of the Citrus County Chronicle, a newspaper published daily at Crystal River, in Citrus County, Florida, that the attached copy of advertisement being a public notice in the matter of the

598-0630 TUCRN Notice of Application PUBLIC NOTICE State of Florida Department of Environmental protection Notice of Application The Department announces receipt of an application for permit from Citrus County Solid Waste Division for a permit to constru

Court, was published in said newspaper in the issues of

June 23rd, 2009, June 30th, 2009,

Affiant further says that the Citrus County Chronicle is a Newspaper published at Crystal River in said Citrus County, Florida, and that the said newspaper has heretofore been continuously published in Citrus County, Florida, each week and has been entered as second class mail matter at the post office in Inverness in said Citrus County, Florida, for a period of one year next preceding the first publication of the attached copy of advertisement; and affiant further says that he/she has neither paid nor promised any person, firm or corporation any discount, rebate, commission or refund for the purpose of securing this advertisement for publication in the said newspaper.

Mary Ann Naczi

The forgoing instrument was acknowledged before me

This 30th day of June 2009

By: Mary Ann Naczi

who is personally known to me and who did take an oath

Nancy A Parke
Notary Public

NANCY A. PARKE
Comm# DD0698633
Expires 8/24/2011
Florida Notary Assn., Inc

598-0630 TUCRN
Notice of Application
PUBLIC NOTICE

State of Florida
Department of Environmental protection
Notice of Application

The Department announces receipt of an application for permit from Citrus County Solid Waste Division for a permit to construct a landfill gas collection and control system, subject to Department rules, in Phases 1, 1A, and 2 of an existing Class I landfill, referred to as the Citrus County Central Class I Landfill, located on S.R. 44, 3 miles east of Lecanto, Citrus County, Florida.

This application is being processed and is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at the Department of Environmental Protection, Southwest District Office, 13051 North Telecom Parkway, Temple Terrace, Florida 33637-0926.

Published one (1) time in the Citrus County Chronicle, June 30, 2009.

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
JUL 15 2009
SOUTHWEST DISTRICT
TAMPA

ATTACHMENT 3

REVISED DRAWING SHEETS

ATTACHMENT 4

SPECIFICATION SECTION 23 81 25, COMPRESSED AIR SYSTEM

ATTACHMENT 5

REVISED SPECIFICATION SECTION 31 20 00, TRENCHING AND BACKFILLING

ATTACHMENT 6

WELL SPACING INFORMATION

ATTACHMENT 6A

LFG EXTRACTION WELL RADIUS OF INFLUENCE INFORMATION

ATTACHMENT 6B

EXCERPT FROM PAPER TITLED: "VERTICAL LANDFILL GAS EXTRACTION WELLS - THE SCS MODEL"

VERTICAL LANDFILL GAS EXTRACTION WELLS - THE SCS MODEL

Darrin D. Dillah, PhD, PE
SCS Engineers
Reston, Virginia

Gregory P. McCarron, PE
SCS Engineers
Valley Cottage, New York

Balwinder S. Panesar, PhD
SCS Engineers
Reston, Virginia

ABSTRACT

Since the beginnings of the landfill gas (LFG) industry in the late 1960s to early 1970s, the vertical extraction well has been the most commonly used LFG collection device. Because of its wide-spread use, its design is almost always accepted and never questioned. This has lead to "cookie cutter" approaches to well designs and wellfield layouts. Fundamentals sometimes are overlooked, and new costly systems have not performed as expected. As such, a step back to the basics is warranted.

Our literature review on this topic uncovered that the basis for well designs has been mostly either proprietary and unpublished or based on empirical observations. This paper presents SCS Engineers' mathematical model for the LFG vertical extraction well. It provides the design engineer with a theoretical basis for establishing the key system parameters. Our model addresses radius of influence and its relationship to landfill permeability, flow rate, well depth, applied vacuum, and other parameters. Combining this theoretical basis with empirical knowledge, the design engineer can develop a sound, practical, and cost-effective design for any landfill.

To demonstrate the validity and use of the model, the paper presents a case study of a recent pump test. Using field data for model calibrations, we established and verified parameters such as required well head vacuum, landfill permeability, well depth, well radius of influence, and well spacing.

INTRODUCTION

Vertical LFG extraction wells are the most commonly used collection device in the industry, dating back over 35 years to the beginning of the LFG industry. With a mature industry, typical well construction details have become available, and we have found that some designers are simply using these typical details without tailoring them to their particular sites, leading to costly systems that do not perform as expected.

The purpose of this paper is to review the fundamentals of the vertical LFG extraction well. An extraction well operates under the basic principle that LFG generated within the landfill moves towards the well due to a pressure gradient created by vacuum applied to the well.

We present a simple mathematical model for a full-depth extraction well, the evolution of which dates back to a concept presented in a 1983 report, prepared by Dr. Dallas E. Weaver. The model gives an understanding of flow dynamics around the well and indicates how various landfill properties like permeability, waste density, LFG generation rate and well design affects the dynamics around the well.

A recent pump test case study is presented to demonstrate use of the model and to establish design parameters. Finally, we present typical design parameters for extraction wells and suggest ways they should be tailored to specific site conditions.

Design Parameters

Based on this and other pump tests performed by SCS and our design, construction, and operational experience gathered over the years, we typically select the following general design parameters for vertical extraction wells:

- Typical well spacing of 200 feet. If the landfill was not very well compacted or is lined and capped, this spacing could be increased. Well spacing is decreased in shallow waste areas, side slopes, or if the overall landfill permeability is low.

- Well depth, D (refer to Figure 1), to about 15 feet off the landfill bottom or 100 feet maximum. Particularly in a lined landfill, well depths of 100 feet are sufficient as LFG in the lower regions of the landfill finally makes its way into the influence zone of the wells. If the leachate collection piping or sumps show the presence of LFG, these devices are connected to the LFG collection system.

- Solid pipe length, D-S, is typically set at 20 feet, recognizing that landfills are filled in lifts and typically exhibit high horizontal to vertical permeability ratios (e.g., 6:1). Because of air intrusion, this design limits RI to about 120 feet (i.e., 20 times 6), but is consistent with the recommended spacing of 200 feet. The solid pipe length may be increased to further limit the potential for air intrusion, particularly at sites that have utilization projects that cannot handle air intrusion and the resulting degradation of LFG quality.

The designer should investigate how the landfill was filled. If an alternative daily cover like a tarp is utilized, the horizontal to vertical permeability ratio may decrease, and the solid pipe length or well spacing should be adjusted.

Solid pipe lengths may also be adjusted for high leachate levels. When the solid pipe is shorter, recognize that RI and the well spacing also decrease. In severe cases, consider using leachate pumps in the wells or using horizontal collectors (McCarron et al., 2003).

- Extraction blowers, header pipes, and laterals are sized such that the vacuum available to the wellhead is about 15 in.-wc. If landfill permeability is suspected to be low, such as in the test case presented in this paper, the design wellhead vacuum is increased.

- Well casings are typically constructed of 6-inch diameter PVC. We prefer PVC over HDPE because during differential settlement of the landfill, PVC typically shears and either cracks or breaks. When this happens, LFG extraction from the well is still feasible if shearing occurs in the gravel pack. If HDPE is used, the casings may pinch off, reducing the wells' effectiveness. Consideration should be given to 4-inch diameter casings if flows are anticipated to be low, due to minimal headlosses in the casing.

The model presented herein is for a full-depth vertical extraction well. Adjustment to the model is required for partial-depth wells. If the interest exists, we may publish this adjustment in the future.

REFERENCES

Weaver, D. E., 1983, "Analysis of Landfill Gas Data," Unpublished.

Dillah, D. D., E. R. Peterson and S. G. Lippy, 2001, "Air Injection to Control Off-Site Landfill Gas Migration: Design Parameters, Mathematical Model, and Case Study," WasteCon 2001 Proceedings.

McCarron, G. P., D. D. Dillah and O. R. Esterly, 2003, "Horizontal Collectors: Design Parameters, Mathematical Model, and Case Study," SWANA 26th Annual Landfill Gas Symposium Proceedings.

ATTACHMENT 7

REVISED SECTION O

ATTACHMENT 8

GAS COLLECTION AND CONTROL SYSTEM CLOSURE PLAN

ATTACHMENT 9

REVISED CLOSURE COST ESTIMATE

Environmental Consultants
and Contractors

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Suite 100
Tampa, FL 33610

813 621-0080
FAX 813 623-6757
www scsengineers com

SCS ENGINEERS

April 22, 2009
File No. 09207049.02

Ms. Susan Pelz, P.E.
Florida Department of Environmental Protection
Southwest District
13051 N. Telecom Parkway
Temple Terrace, FL 33637

Subject: Application for Construction Permit for
Installation of Landfill Gas Collection and Control System
Central Landfill, Citrus County, Florida

Dear Ms. Pelz:

SCS Engineers (SCS) is submitting this application on behalf of Citrus County Board of County Commissioners for a permit to construct a landfill gas collection and control system (GCCS) for Phases 1, 1A and 2 at Citrus County's Central Landfill.

Enclosed are four copies of the application for your use. Each copy has been signed by a responsible official and signed and sealed by a Florida Professional Engineer. A check in the amount of $1,000 payable to the Florida Department of Environmental Protection is also included.

Please do not hesitate to call should you have any questions or require additional information.

Sincerely,

4/22/09

Dominique H. Bramlett, P.E.
Senior Project Engineer
SCS ENGINEERS

for John A. Banks, P.E.
Project Director
SCS ENGINEERS

DHB/JAB:dhb

cc: Susan J. Metcalfe, P.G., Citrus County

Enclosures

Florida Department of Environmental Protection
Twin Towers Office Bldg • 2600 Blair Stone Road • Tallahassee, FL 32399-2400

DEP Form #	62-701 900(1)
Form Title	Solid Waste Management Facility Permit
Effective Date	05-27-01
DEP Application No	(Filled by DEP)

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
APR 22 2009
SOUTHWEST DISTRICT TAMPA

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

APPLICATION FOR A PERMIT TO CONSTRUCT, OPERATE, MODIFY OR CLOSE A SOLID WASTE MANAGEMENT FACILITY

APPLICATION INSTRUCTIONS AND FORMS

INSTRUCTIONS TO APPLY FOR A SOLID WASTE MANAGEMENT FACILITY PERMIT

I. General

Solid Waste Management Facilities shall be permitted pursuant to Section 403.707, Florida Statutes,(FS) and in accordance with Florida Administrative Code (FAC) Chapter 62-701. A minimum of four copies of the application shall be submitted to the Department's District Office having jurisdiction over the facility. The appropriate fee in accordance with Rule 62-701.315, FAC, shall be submitted with the application by check made payable to the Department of Environmental Protection (DEP).

Complete appropriate sections for the type of facility for which application is made. Entries shall be typed or printed in ink. All blanks shall be filled in or marked "not applicable" or "no substantial change". Information provided in support of the application shall be marked "submitted" and the location of this information in the application package indicated. The application shall include all information, drawings, and reports necessary to evaluate the facility. Information required to complete the application is listed on the attached pages of this form.

II. Application Parts Required for Construction and Operation Permits

A. Landfills and Ash Monofills - Submit parts A,B, D through T
B. Asbestos Monofills - Submit parts A,B,D,E,F,G,J,L,N, P through S, and T
C. Industrial Solid Waste Facilities - Submit parts A,B, D through T
D. Non-Disposal Facilities - Submit parts A,C,D,E,J,N,S and T

NOTE: Portions of some parts may not be applicable.

NOTE: For facilities that have been satisfactorily constructed in accordance with their construction permit, the information required for A,B,C and D type facilities does not have to be resubmitted for an operation permit if the information has not substantially changed during the construction period. The appropriate portion of the form should be marked "no substantial change".

III. Application Parts Required for Closure Permits

A. Landfills and Ash Monofills - Submit parts A,B,M, O through T
B. Asbestos Monofills - Submit parts A,B,N, P through T
C. Industrial Solid Waste Facilities - Submit parts A,B, M through T
D. Non-Disposal Facilities - Submit parts A,C,N,S and T

NOTE: Portions of some parts may not be applicable.

IV. Permit Renewals

The above information shall be submitted at time of permit renewal in support of the new permit. However, facility information that was submitted to the Department to support the expiring permit, and which is still valid, does not need to be re-submitted for permit renewal. Portions of the application not re-submitted shall be marked "no substantial change" on the application form.

V. Application Codes

S	-	Submitted
LOCATION	-	Physical location of information in application
N/A	-	Not Applicable
N/C	-	No Substantial Change

VI. LISTING OF APPLICATION PARTS

PART A: GENERAL INFORMATION

PART B: DISPOSAL FACILITY GENERAL INFORMATION

PART C: NON-DISPOSAL FACILITY GENERAL INFORMATION

PART D: PROHIBITIONS

PART E: SOLID WASTE MANAGEMENT FACILITY PERMIT REQUIREMENTS, GENERAL

PART F: LANDFILL PERMIT REQUIREMENTS

PART G: GENERAL CRITERIA FOR LANDFILLS

PART H: LANDFILL CONSTRUCTION REQUIREMENTS

PART I: HYDROGEOLOGICAL INVESTIGATION REQUIREMENTS

PART J: GEOTECHNICAL INVESTIGATION REQUIREMENTS

PART K: VERTICAL EXPANSION OF LANDFILLS

PART L: LANDFILL OPERATION REQUIREMENTS

PART M: WATER QUALITY AND LEACHATE MONITORING REQUIREMENTS

PART N: SPECIAL WASTE HANDLING REQUIREMENTS

PART O: GAS MANAGEMENT SYSTEM REQUIREMENTS

PART P: LANDFILL CLOSURE REQUIREMENTS

PART Q: CLOSURE PROCEDURES

PART R: LONG TERM CARE REQUIREMENTS

PART S: FINANCIAL RESPONSIBILITY REQUIREMENTS

PART T: CERTIFICATION BY APPLICANT AND ENGINEER OR PUBLIC OFFICER

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
APPLICATION FOR A PERMIT TO CONSTRUCT, OPERATE, MODIFY OR CLOSE
A SOLID WASTE MANAGEMENT FACILITY

Please Type or Print

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
JUL 15 2009
SOUTHWEST DISTRICT
TAMPA

A. GENERAL INFORMATION

1. Type of facility (check all that apply):

[✓] Disposal
- [✓] Class I Landfill
- [ ] Class II Landfill
- [ ] Class III Landfill
- [✓] Other Describe Yard Waste mulching and consumer goods recycling
- [ ] Ash Monofill
- [ ] Asbestos Monofill
- [ ] Industrial Solid Waste

[ ] Non-Disposal
- [ ] Incinerator For Non-biomedical Waste
- [ ] Waste to Energy Without Power Plant Certification
- [ ] Other Describe: ______

NOTE: Waste Processing Facilities should apply on Form 62-701.900(4), FAC;
Land Clearing Disposal Facilities should notify on Form 62-701.900(3), FAC;
Compost Facilities should apply on Form 62-701 900(10), FAC; and
C&D Disposal Facilities should apply on Form 62-701.900(6), FAC

2. Type of application:
- [✓] Construction
- [ ] Operation
- [ ] Construction/Operation
- [ ] Closure

3. Classification of application:
- [✓] New (LFG System)
- [ ] Renewal
- [ ] Substantial Modification
- [ ] Intermediate Modification
- [ ] Minor Modification

4. Facility name: Citrus County Central Landfill

5. DEP ID number. SWD/09/39859 County: Citrus

6. Facility location (main entrance): State Road 44 between Lecanto and Inverness, Florida

7. Location coordinates:

Section: 1 Township: 19S Range: 18E

Latitude: 28 ° 51 ' 00 " Longitude: 82 ° 26 ' 12 "

DEP FORM 62-701 900(1)
Effective 05-27-01

8. Applicant name (operating authority): Citrus County Board of County Commissioners

Mailing address: P.O. Box 340 | Lecanto | FL | 34460
(Street or P.O. Box | City | State | Zip)

Contact person: Ms. Susan Metcalfe, P.G. Telephone: (352) 527-7671

Title: Solid Waste Management Division Director

susan.metcalfe@bocc citrus.fl.us
E-Mail address (if available)

9. Authorized agent/Consultant: SCS Engineers

Mailing address: 4041 Park Oaks Blvd., Suite 100 | Tampa | FL | 33610
(Street or P.O. Box | City | State | Zip)

Contact person: Dominique H Bramlett, P.E. Telephone: (813) 621-0080

Title: Senior Project Engineer

dbramlett@scsengineers.com
E-Mail address (if available)

10. Landowner(if different than applicant): Citrus County BOCC

Mailing address: 110 N. Apopka Avenue | Inverness | FL | 34450
(Street or P.O. Box | City | State | Zip)

Contact person: John Thrumston Telephone: (352) 341-6560

E-Mail address (if available)

11. Cities, towns and areas to be served: Citrus County, including, but not limited to towns of Inverness, Lecanto & Crystal River

12. Population to be served:

Current: 138,280 (2008 Census) Five-Year Projection: 150,340 (CY 2013)

13. Date site will be ready to be inspected for completion: December 2009

14. Expected life of the facility: 11 (includes Phase 3 Expansion) years

15. Estimated costs:

Total Construction: $ 435,000 Closing Costs: $

16. Anticipated construction starting and completion dates:

From: September 2009 To: December 2009

17. Expected volume or weight of waste to be received:

_____ yds^3/day ~350 tons/day _____ gallons/day

B. **DISPOSAL FACILITY GENERAL INFORMATION**

1. Provide brief description of disposal facility design and operations planned under this application:

This application is for a construction permit for the construction of the landfill gas (LFG) collection and control system in Phase 1, 1-A and 2 at the Citrus County Central Landfill.

2. Facility site supervisor: Carmen Bruno

Title: Crew Leader Telephone: (352) 527-7670

carmen.bruno@bocc.citrus.fl.us
E-Mail address (if available)

3. Disposal area: Total 32 acres; Used 25 8* acres; Available 6.2** acres.

4. Weighing scales used: [✓] Yes [ ] No

5. Security to prevent unauthorized use: [✓] Yes [ ] No

6. Charge for waste received: ________ $/yds³ 30 $/ton

7. Surrounding land use, zoning:

[ ] Residential [✓] Industrial
[ ] Agricultural [ ] None
[✓] Commercial [ ] Other Describe: Conservation

8. Types of waste received:

[✓] Residential [✓] C & D debris
[✓] Commercial [ ] Shredded/cut tires
[ ] Incinerator/WTE ash [✓] Yard trash
[ ] Treated biomedical [ ] Septic tank
[ ] Water treatment sludge [✓] Industrial
[ ] Air treatment sludge [ ] Industrial sludge
[ ] Agricultural [✓] Domestic sludge
[✓] Asbestos
[ ] Other Describe: ________

9. Salvaging permitted: [ ] Yes [✓] No

10. Attendant: [✓] Yes [ ] No Trained operator: [✓] Yes [ ] No

11. Spotters: Yes [✓] No [ ] Number of spotters used: minimum of one

12. Site located in: [ ] Floodplain [ ] Wetlands [✓] Other Upland

*Existing Phase 1/1A, and 2 disposal areas.

**Phase 3 disposal area

13. Property recorded as a Disposal Site in County Land Records: [✓] Yes [ ] No

14. Days of operation: Monday - Saturday

15. Hours of operation: Monday-Friday: 6:30 am - 5:00 pm Holidays and Saturdays: 6:30 am - 3:00 pm

16. Days Working Face covered: Monday-Saturday

17. Elevation of water table: 7 Ft. (NGVD 1929)

18. Number of monitoring wells: 14

19. Number of surface monitoring points: 0

20. Gas controls used: [✓] Yes [ ] No Type controls: [✓] Active [ ] Passive

Gas flaring: [✓] Yes [ ] No Gas recovery: [ ] Yes [✓] No

21. Landfill unit liner type:

[ ] Natural soils
[ ] Single clay liner
[ ] Single geomembrane
[ ] Single composite
[ ] Slurry wall
[ ] Other Describe: ______
[✓] Double geomembrane
[ ] Geomembrane & composite
[ ] Double composite
[ ] None

22. Leachate collection method:

[✓] Collection pipes
[✓] Geonets
[ ] Well points
[ ] Perimeter ditch
[ ] Other Describe: ______
[ ] Sand layer
[ ] Gravel layer
[ ] Interceptor trench
[ ] None

23. Leachate storage method:

[✓] Tanks
[ ] Surface impoundments
[ ] Other Describe: ______

24. Leachate treatment method:

[ ] Oxidation
[ ] Secondary
[✓] Advanced
[ ] None
[ ] Other ______
[✓] Chemical treatment
[ ] Settling

25. Leachate disposal method:

[ ] Recirculated
[ ] Transported to WWTP
[ ] Injection well
[ ] Evaporation
[✓] Other Dry Percolation Basin
[ ] Pumped to WWTP
[ ] Discharged to surface water
[ ] Percolation ponds

26. For leachate discharged to surface waters:

Name and Class of receiving water: Leachate is not discharged into surface waters.

27. Storm Water:

Collected: [✓] Yes [ ] No

Type of treatment: Dry Retention/percolation

Name and Class of receiving water: None

28. Environmental Resources Permit (ERP) number or status:

Water Management District #402023.02. An Environmental Resource Permit was submitted in August 2008.

C. NON-DISPOSAL FACILITY GENERAL INFORMATION

1. Provide brief description of the non-disposal facility design and operations planned under this application:

   Part C is not applicable to this permit application.

2. Facility site supervisor: ______________________

   Title: ______________ Telephone: (___) ______________

   ____
   E-Mail address (if available)

3. Site area: Facility 32 acres; Property __________ acres

4. Security to prevent unauthorized use: [ ] Yes [ ] No

5. Site located in: [ ] Floodplain [ ] Wetlands [ ] Other __________

6. Days of operation: ______________________

7. Hours of operation: ______________________

8. Number of operating staff: __________

9. Expected useful life: __________ Years

10. Weighing scales used: [ ] Yes [ ] No

11. Normal processing rate: ________ yd^3/day ________ tons/day ________ gal/day

12. Maximum processing rate: ________ yd^3/day ________ tons/day ________ gal/day

13. Charge for waste received: ______________________

14. Storm Water Collected: [ ] Yes [ ] No

    Type of treatment: ______________________

    Name and Class of receiving water: ______________________

15. Environmental Resources Permit (ERP) number or status: ______________________

16. Final residue produced:

    ________ % of normal processing rate ________ % of maximum processing rate

    ________ Tons/day ________ Tons/day

    Disposed of at:

    Facility name: ______________ County: ______________

17. Estimated operating costs: $ ________________

Total cost/ton: $ ______________________ Net cost/ton: $ ______________________

18. Provide a site plan, at a scale not greater than 200 feet to the inch, which shows the facility location and identifies the proposed waste and final residue storage areas, total acreage of the site, and any other features which are relevant to the prohibitions or location restrictions in Rule 62-701.300, FAC, such as water bodies or wetlands on or within 200 feet of the site, and potable water wells on or within 500 feet of the site.

19. Provide a description of how the waste and final residue will be managed to not be expected to cause violations of the Department's ground water, surface water or air standards or criteria

20. Provide an estimate of the maximum amount of waste and final residue that will be store on-site.

21. Provide a detailed description of the technology use at the facility and the functions of all processing equipment that will be utilized. The descriptions shall explain the flow of waste and residue through all the proposed unit operations and shall include: (1) regular facility operations as they are expected to occur; (2) procedures for start up operations, and scheduled and unscheduled shut down operations; (3) potential safety hazards and control methods, including fire detection and control; (4) a description of any expected air emissions and wastewater discharges from the facility which may be potential pollution sources; (5) a description and usage rate of any chemical or biological additives that will be used in the process; and (6) process flow diagrams for the facility operations.

22. Provide a description of the loading, unloading and processing areas.

23. Provide a description of the leachate control system that will be used to prevent discharge of leachate to the environment and mixing of leachate with stormwater. Note: Ground water monitoring may be required for the facility depending on the method of leachate control used.

24. Provide an operation plan for the facility which includes: (1) a description of general facility operations, the number of personnel responsible for the operations including their respective job descriptions, and the types of equipment that will be used at the facility; (2) procedures to ensure any unauthorized wastes received at the site will be properly managed; (3) a contingency plan to cover operation interruptions and emergencies such as fires, explosions, or natural disasters; (4) procedures to ensure operational records needed for the facility will be adequately prepared and maintained; and (5) procedures to ensure that the wastes and final residue will be managed to not be expected to cause pollution.

25. Provide a closure plan that describes the procedures that will be implemented when the facility closes including: (1) estimated time to complete closure; (2) procedures for removing and properly managing or disposing of all wastes and final residues; (3) notification of the Department upon ceasing operations and completion of final closure.

D. PROHIBITIONS (62-701.300, FAC)

S	LOCATION	N/A	N/C		
		✓		1.	Provide documentation that each of the siting criteria will be satisfied for the facility; (62-701.300(2), FAC)
		✓		2.	If the facility qualifies for any of the exemptions contained in Rules 62-701.300(12) through (16), FAC, then document this qualification(s).
		✓		3.	Provide documentation that the facility will be in compliance with the burning restrictions; (62-701.300(3), FAC)
		✓		4.	Provide documentation that the facility will be in compliance with the hazardous waste restrictions; (62-701.300(4), FAC)
		✓		5.	Provide documentation that the facility will be in compliance with the PCB disposal restrictions; (62-701.300(5), FAC)
		✓		6.	Provide documentation that the facility will be in compliance with the biomedical waste restrictions; (62-701.300(6), FAC)
		✓		7.	Provide documentation that the facility will be in compliance with the Class I surface water restrictions; (62-701.300(7), FAC)
		✓		8.	Provide documentation that the facility will be in compliance with the special waste for landfills restrictions; (62-701.300(8), FAC)
		✓		9.	Provide documentation that the facility will be in compliance with the special waste for waste-to-energy facilities restrictions; (62-701.300(9), FAC)
		✓		10.	Provide documentation that the facility will be in compliance with the liquid restrictions; (62-701.300(10), FAC)
		✓		11.	Provide documentation that the facility will be in compliance with the used oil restrictions; (62-701.300(11), FAC)

E. SOLID WASTE MANAGEMENT FACILITY PERMIT REQUIREMENTS, GENERAL (62-701.320, FAC)

S	LOCATION	N/A	N/C		
✓	Section E 1			1.	Four copies, at minimum, of the completed application form, all supporting data and reports; (62-701.320(5)(a),FAC)
✓	Section E 2			2.	Engineering and/or professional certification (signature, date and seal) provided on the applications and all engineering plans, reports and supporting information for the application; (62-701.320(6),FAC)
✓	Section E 3			3.	A letter of transmittal to the Department; (62-701.320(7)(a),FAC)
✓	Section E.4			4.	A completed application form dated and signed by the applicant; (62-701.320(7)(b),FAC)
✓	Section E.5			5.	Permit fee specified in Rule 62-701.315, FAC in check or money order, payable to the Department; (62-701.320(7)(c),FAC)
✓	Section E 6			6.	An engineering report addressing the requirements of this rule and with the following format: a cover sheet, text printed on 8 1/2 inch by 11 inch consecutively numbered pages, a table of contents or index, the body of the report and all appendices including an operation plan, contingency plan, illustrative charts and graphs, records or logs of tests and investigations, engineering calculations; (62-701.320(7)(d),FAC)
✓	Section E.7			7.	Operation Plan and Closure Plan; (62-701.320(7)(e)1,FAC)
			✓	8.	Contingency Plan; (62-701.320(7)(e)2,FAC)
				9.	Plans or drawings for the solid waste management facilities in appropriate format (including sheet size restrictions, cover sheet, legends, north arrow, horizontal and vertical scales, elevations referenced to NGVD 1929) showing; (62-702.320(7)(f),FAC)
			✓	a.	A regional map or plan with the project location;
			✓	b.	A vicinity map or aerial photograph no more than 1 year old;
			✓	c.	A site plan showing all property boundaries certified by a registered Florida land surveyor;

S	LOCATION	N/A	N/C		PART E CONTINUED
✓	Section E 9				d. Other necessary details to support the engineering report.
			✓	10.	Documentation that the applicant either owns the property or has legal authority from the property owner to use the site; (62-701.320(7)(g),FAC)
		✓		11.	For facilities owned or operated by a county, provide a description of how, if any, the facilities covered in this application will contribute to the county's achievement of the waste reduction and recycling goals contained in Section 403.706,FS; (62-701.320(7)(h),FAC)
			✓	12.	Provide a history and description of any enforcement actions taken by the Department against the applicant for violations of applicable statutes, rules, orders or permit conditions relating to the operation of any solid waste management facility in this state; (62-701.320(7)(i),FAC)
✓	Section E.13			13.	Proof of publication in a newspaper of general circulation of notice of application for a permit to construct or substantially modify a solid waste management facility; (62-702.320(8),FAC)
		✓		14.	Provide a description of how the requirements for airport safety will be achieved including proof of required notices if applicable. If exempt, explain how the exemption applies; (62-701.320(13),FAC)
		✓		15.	Explain how the operator training requirements will be satisfied for the facility; (62-701.320(15), FAC)

F. LANDFILL PERMIT REQUIREMENTS (62-701.330, FAC)

S	LOCATION	N/A	N/C		
		✓		1.	Vicinity map or aerial photograph no more than 1 year old and of appropriate scale showing land use and local zoning within one mile of the landfill and of sufficient scale to show all homes or other structures, water bodies, and roads other significant features of the vicinity. All significant features shall be labeled; (62-701.330(3)(a),FAC)
		✓		2.	Vicinity map or aerial photograph no more than 1 year old showing all airports that are located within five miles of the proposed landfill; (62-701.330(3)(b),FAC)
		✓		3.	Plot plan with a scale not greater than 200 feet to the inch showing; (62-701.330(3)(c),FAC)
		✓			a. Dimensions;
		✓			b. Locations of proposed and existing water quality monitoring wells;
		✓			c. Locations of soil borings;
		✓			d. Proposed plan of trenching or disposal areas;
		✓			e. Cross sections showing original elevations and proposed final contours which shall be included either on the plot plan or on separate sheets;
		✓			f. Any previously filled waste disposal areas;
		✓			g. Fencing or other measures to restrict access.
				4.	Topographic maps with a scale not greater than 200 feet to the inch with 5-foot contour intervals showing; (62-701.330(3)(d),FAC):
		✓			a. Proposed fill areas;
		✓			b. Borrow areas;
		✓			c. Access roads;
		✓			d. Grades required for proper drainage;
		✓			e. Cross sections of lifts;

S	LOCATION	N/A	N/C		PART F CONTINUED
		✓			f. Special drainage devices if necessary;
		✓			g. Fencing;
		✓			h. Equipment facilities.
				5.	A report on the landfill describing the following; (62-701.330(3)(e),FAC)
		✓			a. The current and projected population and area to be served by the proposed site;
		✓			b. The anticipated type, annual quantity, and source of solid waste, expressed in tons;
		✓			c. The anticipated facility life;
		✓			d. The source and type of cover material used for the landfill.
		✓		6.	Provide evidence that an approved laboratory shall conduct water quality monitoring for the facility in accordance with Chapter 62-160,FAC; (62-701.330(3)(h),FAC)
✓	Section S			7.	Provide a statement of how the applicant will demonstrate financial responsibility for the closing and long-term care of the landfill; (62-701.330(3)(i),FAC)

G. GENERAL CRITERIA FOR LANDFILLS (62-701.340,FAC)

S	LOCATION	N/A	N/C		
		✓		1.	Describe (and show on a Federal Insurance Administration flood map, if available) how the landfill or solid waste disposal unit shall not be located in the 100-year floodplain where it will restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain unless compensating storage is provided, or result in a washout of solid waste; (62-701.340(4)(b),FAC)
		✓		2.	Describe how the minimum horizontal separation between waste deposits in the landfill and the landfill property boundary shall be 100 feet, measured from the toe of the proposed final cover slope; (62-701.340(4)(c),FAC)
		✓		3.	Describe what methods shall be taken to screen the landfill from public view where such screening can practically be provided; (62-701.340(4)(d),FAC)

H. LANDFILL CONSTRUCTION REQUIREMENTS (62-701.400,FAC)

S	LOCATION	N/A	N/C	
___	___________	✓	___	1. Describe how the landfill shall be designed so that solid waste disposal units will be constructed and closed at planned intervals throughout the design period of the landfill; (62-701.400(2),FAC)
				2. Landfill liner requirements; (62-701.400(3),FAC)
				a. General construction requirements; (62-701.400(3)(a),FAC):
___	___________	✓	___	(1) Provide test information and documentation to ensure the liner will be constructed of materials that have appropriate physical, chemical, and mechanical properties to prevent failure;
___	___________	✓	___	(2) Document foundation is adequate to prevent liner failure;
___	___________	✓	___	(3) Constructed so bottom liner will not be adversely impacted by fluctuations of the ground water;
___	___________	✓	___	(4) Designed to resist hydrostatic uplift if bottom liner located below seasonal high ground water table;
___	___________	✓	___	(5) Installed to cover all surrounding earth which could come into contact with the waste or leachate.
				b. Composite liners; (62-701.400(3)(b),FAC)
___	___________	✓	___	(1) Upper geomembrane thickness and properties;
___	___________	✓	___	(2) Design leachate head for primary LCRS including leachate recirculation if appropriate;
___	___________	✓	___	(3) Design thickness in accordance with Table A and number of lifts planned for lower soil component.

S	LOCATION	N/A	N/C	PART H CONTINUED
				c. Double liners; (62-701.400(3)(c),FAC)
		✓		(1) Upper and lower geomembrane thicknesses and properties;
		✓		(2) Design leachate head for primary LCRS to limit the head to one foot above the liner;
		✓		(3) Lower geomembrane sub-base design;
		✓		(4) Leak detection and secondary leachate collection system minimum design criteria (k ≥ 10 cm/sec, head on lower liner ≤ 1 inch, head not to exceed thickness of drainage layer);
				d. Standards for geosynthetic components; (62-701.400(3)(d),FAC)
		✓		(1) Field seam test methods to ensure all field seams are at least 90 percent of the yield strength for the lining material;
		✓		(2) Geomembranes to be used shall pass a continuous spark test by the manufacturer;
		✓		(3) Design of 24-inch-thick protective layer above upper geomembrane liner;
		✓		(4) Describe operational plans to protect the liner and leachate collection system when placing the first layer of waste above 24-inch-thick protective layer.
		✓		(5) HDPE geomembranes, if used, meet the specifications in GRI GM13;
		✓		(6) PVC geomembranes, if used, meet the specifications in PGI 1197;
		✓		(7) Interface shear strength testing results of the actual components which will be used in the liner system;
		✓		(8) Transmissivity testing results of geonets if they are used in the liner system;
		✓		(9) Hydraulic conductivity testing results of geosynthetic clay liners if they are used in the liner system;

S	LOCATION	N/A	N/C	PART H CONTINUED
				e. Geosynthetic specification requirements; (62-701.400(3)(e),FAC)
___	___	✓	___	(1) Definition and qualifications of the designer, manufacturer, installer, QA consultant and laboratory, and QA program;
___	___	✓	___	(2) Material specifications for geomembranes, geocomposites, geotextiles, geogrids, and geonets;
___	___	✓	___	(3) Manufacturing and fabrication specifications including geomembrane raw material and roll QA, fabrication personnel qualifications, seaming equipment and procedures, overlaps, trial seams, destructive and nondestructive seam testing, seam testing location, frequency, procedure, sample size and geomembrane repairs;
___	___	✓	___	(4) Geomembrane installation specifications including earthwork, conformance testing, geomembrane placement, installation personnel qualifications, field seaming and testing, overlapping and repairs, materials in contact with geomembrane and procedures for lining system acceptance;
___	___	✓	___	(5) Geotextile and geogrid specifications including handling and placement, conformance testing, seams and overlaps, repair, and placement of soil materials and any overlying materials;
___	___	✓	___	(6) Geonet and geocomposite specifications including handling and placement, conformance testing, stacking and joining, repair, and placement of soil materials and any overlying materials;
	___	✓	___	(7) Geosynthetic clay liner specifications including handling and placement, conformance testing, seams and overlaps, repair, and placement of soil material and any overlying materials;
				f. Standards for soil components (62-710.400(3)(f),FAC):
___	___	✓	___	(1) Description of construction procedures including overexcavation and backfilling to preclude structural inconsistencies and procedures for placing and compacting soil component in layers;

S	LOCATION	N/A	N/C	PART H CONTINUED
		✓		(2) Demonstration of compatibility of the soil component with actual or simulated leachate in accordance with EPA Test Method 9100 or an equivalent test method;
		✓		(3) Procedures for testing in-situ soils to demonstrate they meet the specifications for soil liners;
				(4) Specifications for soil component of liner including at a minimum:
		✓		(a) Allowable particle size distribution, Atterberg limits, shrinkage limit;
		✓		(b) Placement moisture and dry density criteria;
		✓		(c) Maximum laboratory-determined saturated hydraulic conductivity using simulated leachate;
		✓		(d) Minimum thickness of soil liner;
		✓		(e) Lift thickness;
		✓		(f) Surface preparation (scarification);
		✓		(g) Type and percentage of clay mineral within the soil component;
		✓		(5) Procedures for constructing and using a field test section to document the desired saturated hydraulic conductivity and thickness can be achieved in the field.
				3. Leachate collection and removal system (LCRS); (62-701.400(4),FAC)
				a. The primary and secondary LCRS requirements; (62-701.400(4)(a),FAC)
		✓		(1) Constructed of materials chemically resistant to the waste and leachate;
		✓		(2) Have sufficient mechanical properties to prevent collapse under pressure;
		✓		(3) Have granular material or synthetic geotextile to prevent clogging;
		✓		(4) Have method for testing and cleaning clogged pipes or contingent designs for rerouting leachate around failed areas;

S	LOCATION	N/A	N/C	PART H CONTINUED
				b. Primary LCRS requirements; (62-701.400(4)(b),FAC)
		✓		(1) Bottom 12 inches having hydraulic conductivity $\geq$ 1 x 10^{-3} cm/sec;
		✓		(2) Total thickness of 24 inches of material chemically resistant to the waste and leachate;
		✓		(3) Bottom slope design to accomodate for predicted settlement;
		✓		(4) Demonstration that synthetic drainage material, if used, is equivalent or better than granular material in chemical compatibility, flow under load and protection of geomembrane liner.
				4. Leachate recirculation; (62-701.400(5),FAC)
		✓		a. Describe general procedures for recirculating leachate;
		✓		b. Describe procedures for controlling leachate runoff and minimizing mixing of leachate runoff with storm water;
		✓		c. Describe procedures for preventing perched water conditions and gas buildup;
		✓		d. Describe alternate methods for leachate management when it cannot be recirculated due to weather or runoff conditions, surface seeps, wind-blown spray, or elevated levels of leachate head on the liner;
		✓		e. Describe methods of gas management in accordance with Rule 62-701.530, FAC;
		✓		f. If leachate irrigation is proposed, describe treatment methods and standards for leachate treatment prior to irrigation over final cover and provide documentation that irrigation does not contribute significantly to leachate generation.

S	LOCATION	N/A	N/C

PART H CONTINUED

5. Leachate storage tanks and leachate surface impoundments; (62-701.400(6),FAC)

a. Surface impoundment requirements; (62-701.400(6)(b),FAC)

S	LOCATION	N/A	N/C	
		✓		(1) Documentation that the design of the bottom liner will not be adversely impacted by fluctuations of the ground water;
		✓		(2) Designed in segments to allow for inspection and repair as needed without interruption of service;
				(3) General design requirements;
		✓		(a) Double liner system consisting of an upper and lower 60-mil minimum thickness geomembrane;
		✓		(b) Leak detection and collection system with hydraulic conductivity ≥ 1 cm/sec;
		✓		(c) Lower geomembrane placed on subbase ≥ 6 inches thick with $k \leq 1x10^{-5}$ cm/sec or on an approved geosynthetic clay liner with $k \leq 1x10^{-7}$ cm/sec;
		✓		(d) Design calculation to predict potential leakage through the upper liner;
		✓		(e) Daily inspection requirements and notification and corrective action requirements if leakage rates exceed that predicted by design calculations;
		✓		(4) Description of procedures to prevent uplift, if applicable;
		✓		(5) Design calculations to demonstrate minimum two feet of freeboard will be maintained;
		✓		(6) Procedures for controlling disease vectors and off-site odors.

S	LOCATION	N/A	N/C	PART H CONTINUED
				b. Above-ground leachate storage tanks; (62-701.400(6)(c),FAC)
		✓		(1) Describe tank materials of construction and ensure foundation is sufficient to support tank;
		✓		(2) Describe procedures for cathodic protection if needed for the tank;
		✓		(3) Describe exterior painting and interior lining of the tank to protect it from the weather and the leachate stored;
		✓		(4) Describe secondary containment design to ensure adequate capacity will be provided and compatibility of materials of construction;
		✓		(5) Describe design to remove and dispose of stormwater from the secondary containment system;
		✓		(6) Describe an overfill prevention system such as level sensors, gauges, alarms and shutoff controls to prevent overfilling;
				(7) Inspections, corrective action and reporting requirements;
		✓		(a) Overfill prevention system weekly;
		✓		(b) Exposed tank exteriors weekly;
		✓		(c) Tank interiors when tank is drained or at least every three years;
		✓		(d) Procedures for immediate corrective action if failures detected;
		✓		(e) Inspection reports available for department review.
				c. Underground leachate storage tanks; (62-701.400(6)(d),FAC)
		✓		(1) Describe materials of construction;
		✓		(2) A double-walled tank design system to be used with the following requirements;

S	LOCATION	N/A	N/C	PART H CONTINUED
		✓		(a) Interstitial space monitoring at least weekly;
		✓		(b) Corrosion protection provided for primary tank interior and external surface of outer shell;
		✓		(c) Interior tank coatings compatible with stored leachate;
		✓		(d) Cathodic protection inspected weekly and repaired as needed;
		✓		(3) Describe an overfill prevention system such as level sensors, gauges, alarms and shutoff controls to prevent overfilling and provide for weekly inspections;
		✓		(4) Inspection reports available for department review.
		✓		d. Schedule provided for routine maintenance of LCRS; (62-701.400(6)(e),FAC)
				6. Liner systems construction quality assurance (CQA); (62-701.400(7),FAC)
		✓		a. Provide CQA Plan including:
		✓		(1) Specifications and construction requirements for liner system;
		✓		(2) Detailed description of quality control testing procedures and frequencies;
		✓		(3) Identification of supervising professional engineer;
		✓		(4) Identify responsibility and authority of all appropriate organizations and key personnel involved in the construction project;
		✓		(5) State qualifications of CQA professional engineer and support personnel;
		✓		(6) Description of CQA reporting forms and documents;

S	LOCATION	N/A	N/C	PART H CONTINUED
		✓		b. An independent laboratory experienced in the testing of geosynthetics to perform required testing;
				7. Soil Liner CQA (62-701.400(8)FAC)
		✓		a. Documentation that an adequate borrow source has been located with test results or description of the field exploration and laboratory testing program to define a suitable borrow source;
		✓		b. Description of field test section construction and test methods to be implemented prior to liner installation;
		✓		c. Description of field test methods including rejection criteria and corrective measures to insure proper liner installation.
				8. Surface water management systems; (62-701.400(9),FAC)
		✓		a. Provide a copy of a Department permit for stormwater control or documentation that no such permit is required;
		✓		b. Design of surface water management system to isolate surface water from waste filled areas and to control stormwater run-off;
		✓		c. Details of stormwater control design including retention ponds, detention ponds, and drainage ways;
				9. Gas control systems; (62-701.400(10),FAC)
✓	Section O			a. Provide documentation that if the landfill is receiving degradable wastes, it will have a gas control system complying with the requirements of Rule 62-701.530, FAC;
		✓		10. For landfills designed in ground water, provide documentation that the landfill will provide a degree of protection equivalent to landfills designed with bottom liners not in contact with ground water; (62-701.400(11),FAC)

I. **HYDROGEOLOGICAL INVESTIGATION REQUIREMENTS** (62-701.410(1), FAC)

S	LOCATION	N/A	N/C		
				1.	Submit a hydrogeological investigation and site report including at least the following information:
		✓		a.	Regional and site specific geology and hydrogeology;
		✓		b.	Direction and rate of ground water and surface water flow including seasonal variations;
		✓		c.	Background quality of ground water and surface water;
		✓		d.	Any on-site hydraulic connections between aquifers;
		✓		e.	Site stratigraphy and aquifer characteristics for confining layers, semi-confining layers, and all aquifers below the landfill site that may be affected by the landfill;
		✓		f.	Description of topography, soil types and surface water drainage systems;
		✓		g.	Inventory of all public and private water wells within a one-mile radius of the landfill including, where available, well top of casing and bottom elevations, name of owner, age and usage of each well, stratigraphic unit screened, well construction technique and static water level;
		✓		h.	Identify and locate any existing contaminated areas on the site;
		✓		i.	Include a map showing the locations of all potable wells within 500 feet, and all community water suupply wells within 1000 feet, of the waste storage and disposal areas;
		✓		2.	Report signed, sealed and dated by PE or PG.

J. GEOTECHNICAL INVESTIGATION REQUIREMENTS (62-701.410(2),FAC)

S	LOCATION	N/A	N/C		
				1.	Submit a geotechnical site investigation report defining the engineering properties of the site including at least the following:
		✓		a.	Description of subsurface conditions including soil stratigraphy and ground water table conditions;
		✓		b.	Investigate for the presence of muck, previously filled areas, soft ground, lineaments and sink holes;
		✓		c.	Estimates of average and maximum high water table across the site;
				d.	Foundation analysis including:
		✓		(1)	Foundation bearing capacity analysis;
		✓		(2)	Total and differential subgrade settlement analysis;
		✓		(3)	Slope stability analysis;
		✓		e.	Description of methods used in the investigation and includes soil boring logs, laboratory results, analytical calculations, cross sections, interpretations and conclusions;
		✓		f.	An evaluation of fault areas, seismic impact zones, and unstable areas as described in 40 CFR 258.13, 40 CFR 258.14 and 40 CFR 258.15.
		✓		2.	Report signed, sealed and dated by PE or PG.

K. VERTICAL EXPANSION OF LANDFILLS (62-701.430,FAC)

S	LOCATION	N/A	N/C		
		✓		1.	Describe how the vertical expansion shall not cause or contribute to leachate leakage from the existing landfill or adversely affect the closure design of the existing landfill;
		✓		2.	Describe how the vertical expansion over unlined landfills will meet the requirements of Rule 62-701.400, FAC with the exceptions of Rule 62-701.430(1)(c),FAC;
		✓		3.	Provide foundation and settlement analysis for the vertical expansion;
		✓		4.	Provide total settlement calculations demonstrating that the final elevations of the lining system, that gravity drainage, and that no other component of the design will be adversely affected;
		✓		5.	Minimum stability safety factor of 1.5 for the lining system component interface stability and deep stability;
		✓		6.	Provide documentation to show the surface water management system will not be adversely affected by the vertical expansion;
		✓		7.	Provide gas control designs to prevent accumulation of gas under the new liner for the vertical expansion.

L. LANDFILL OPERATION REQUIREMENTS (62-701.500,FAC)

___ ___ ✓ ___ 1. Provide documentation that landfill will have at least one trained operator during operation and at least one trained spotter at each working face; (62-701.500(1),FAC)

2. Provide a landfill operation plan including procedures for: (62-701.500(2), FAC)

___ ___ ✓ ___ a. Designating responsible operating and maintenance personnel;

___ ___ ✓ ___ b. Contingency operations for emergencies;

___ ___ ✓ ___ c. Controlling types of waste received at the landfill;

___ ___ ✓ ___ d. Weighing incoming waste;

___ ___ ✓ ___ e. Vehicle traffic control and unloading;

___ ___ ✓ ___ f. Method and sequence of filling waste;

___ ___ ✓ ___ g. Waste compaction and application of cover;

___ ___ ✓ ___ h. Operations of gas, leachate, and stormwater controls;

___ ___ ✓ ___ i. Water quality monitoring.

___ ___ ✓ ___ j. Maintaining and cleaning the leachate collection system;

___ ___ ✓ ___ 3. Provide a description of the landfill operation record to be used at the landfill; details as to location of where various operational records will be kept (i.e. FDEP permit, engineering drawings, water quality records, etc.) (62-701.500(3),FAC)

___ ___ ✓ ___ 4. Describe the waste records that will be compiled monthly and provided to the Department quarterly; (62-701.500(4),FAC)

___ ___ ✓ ___ 5. Describe methods of access control; (62-701.500(5),FAC)

___ ___ ✓ ___ 6. Describe load checking program to be implemented at the landfill to discourage disposal of unauthorized wastes at the landfill; (62-701.500(6),FAC)

7. Describe procedures for spreading and compacting waste at the landfill that include: (62-701.500(7),FAC)

___ ___ ✓ ___ a. Waste layer thickness and compaction frequencies;

S	LOCATION	N/A	N/C	PART L CONTINUED
		✓		b. Special considerations for first layer of waste placed above liner and leachate collection system;
		✓		c. Slopes of cell working face and side grades above land surface, planned lift depths during operation;
		✓		d. Maximum width of working face;
				e. Description of type of initial cover to be used at the facility that controls:
		✓		(1) Disease vector breeding/animal attraction
		✓		(2) Fires
		✓		(3) Odors
		✓		(4) Blowing litter
		✓		(5) Moisture infiltration
		✓		f. Procedures for applying initial cover including minimum cover frequencies;
		✓		g. Procedures for applying intermediate cover;
		✓		h. Time frames for applying final cover;
		✓		i. Procedures for controlling scavenging and salvaging.
		✓		j. Description of litter policing methods;
		✓		k. Erosion control procedures.
				8. Describe operational procedures for leachate management including; (62-701.500(8),FAC)
			✓	a. Leachate level monitoring, sampling, analysis and data results submitted to the Department;
			✓	b. Operation and maintenance of leachate collection and removal system, and treatment as required;
			✓	c. Procedures for managing leachate if it becomes regulated as a hazardous waste;
			✓	d. Agreements for off-site discharge and treatment of leachate;
			✓	e. Contingency plan for managing leachate during emergencies or equipment problems;

S	LOCATION	N/A	N/C	PART L CONTINUED
			✓	f. Procedures for recording quantities of leachate generated in gal/day and including this in the operating record;
			✓	g. Procedures for comparing precipitation experienced at the landfill with leachate generation rates and including this information in the operating record;
			✓	h. Procedures for water pressure cleaning or video inspecting leachate collection systems.
✓	Section L.9			9. Describe how the landfill receiving degradable wastes shall implement a gas management system meeting the requirements of Rule 62-701.530, FAC; (62-701.500(9),FAC)
		✓		10. Describe procedures for operating and maintaining the landfill stormwater management system to comply with the requirements of Rule 62-701.400(9); (62-701.500(10),FAC)
				11. Equipment and operation feature requirements; (62-701.500(11),FAC)
		✓		a. Sufficient equipment for excavating, spreading, compacting and covering waste;
		✓		b. Reserve equipment or arrangements to obtain additional equipment within 24 hours of breakdown;
		✓		c. Communications equipment;
		✓		d. Dust control methods;
		✓		e. Fire protection capabilities and procedures for notifying local fire department authorities in emergencies;
		✓		f. Litter control devices;
		✓		g. Signs indicating operating authority, traffic flow, hours of operation, disposal restrictions.
		✓		12. Provide a description of all-weather access road, inside perimeter road and other roads necessary for access which shall be provided at the landfill; (62-701.500(12),FAC)
		✓		13. Additional record keeping and reporting requirements; (62-701.500(13),FAC)

S	LOCATION	N/A	N/C	PART L CONTINUED
		✓		a. Records used for developing permit applications and supplemental information maintained for the design period of the landfill;
		✓		b. Monitoring information, calibration and maintenance records, copies of reports required by permit maintained for at least 10 years;
		✓		c. Maintain annual estimates of the remaining life of constructed landfills and of other permitted areas not yet constructed and submit this estimate annually to the Department;
		✓		d. Procedures for archiving and retrieving records which are more than five year old.

M. WATER QUALITY AND LEACHATE MONITORING REQUIREMENTS (62-701.510, FAC)

S	LOCATION	N/A	N/C		
___	___	✓	___	1.	Water quality and leachate monitoring plan shall be submitted describing the proposed ground water, surface water and leachate monitoring systems and shall meet at least the following requirements;
___	___	✓	___	a.	Based on the information obtained in the hydrogeological investigation and signed, dated and sealed by the PG or PE who prepared it; (62-701.510(2)(a),FAC)
___	___	✓	___	b.	All sampling and analysis preformed in accordance with Chapter 62-160, FAC; (62-701.510(2)(b),FAC)
				c.	Ground water monitoring requirements; (62-701.510(3),FAC)
___	___	✓	___	(1)	Detection wells located downgradient from and within 50 feet of disposal units;
___	___	✓	___	(2)	Downgradient compliance wells as required;
___	___	✓	___	(3)	Background wells screened in all aquifers below the landfill that may be affected by the landfill;
___	___	✓	___	(4)	Location information for each monitoring well;
___	___	✓	___	(5)	Well spacing no greater than 500 feet apart for downgradient wells and no greater than 1500 feet apart for upgradient wells unless site specific conditions justify alternate well spacings;
___	___	✓	___	(6)	Well screen locations properly selected;
___	___	✓	___	(7)	Procedures for properly abandoning monitoring wells;
___	___	✓	___	(8)	Detailed description of detection sensors if proposed.

S	LOCATION	N/A	N/C	PART M CONTINUED
				d. Surface water monitoring requirements; (62-701.510(4),FAC)
		✓		(1) Location of and justification for all proposed surface water monitoring points;
		✓		(2) Each monitoring location to be marked and its position determined by a registered Florida land surveyor;
		✓		e. Leachate sampling locations proposed; (62-701.510(5),FAC)
				f. Initial and routine sampling frequency and requirements; (62-701.510(6),FAC)
		✓		(1) Initial background ground water and surface water sampling and analysis requirements;
		✓		(2) Routine leachate sampling and analysis requirements;
		✓		(3) Routine monitoring well sampling and analysis requirements;
		✓		(4) Routine surface water sampling and analysis requirements.
		✓		g. Describe procedures for implementing evaluation monitoring, prevention measures and corrective action as required; (62-701.510(7),FAC)
		✓		h. Water quality monitoring report requirements; (62-701.510(9),FAC)
		✓		(1) Semi-annual report requirements;
		✓		(2) Bi-annual report requirements signed, dated and sealed by PG or PE.

N. **SPECIAL WASTE HANDLING REQUIREMENTS** (62-701.520, FAC)

S	LOCATION	N/A	N/C		
		✓		1.	Describe procedures for managing motor vehicles; (62-701.520(1),FAC)
		✓		2.	Describe procedures for landfilling shredded waste; (62-701.520(2),FAC)
		✓		3.	Describe procedures for asbestos waste disposal; (62-701.520(3),FAC)
		✓		4.	Describe procedures for disposal or management of contaminated soil; (62-701.520(4), FAC)
		✓		5.	Describe procedures for disposal of biological wastes; (62-701.520(5), FAC)

O. **GAS MANAGEMENT SYSTEM REQUIREMENTS** (62-701.530,FAC)

S	LOCATION	N/A	N/C		
				1.	Provide the design for a gas management systems that will (62-701.530(1), FAC):
✓	Section O.1.a			a.	Be designed to prevent concentrations of combustible gases from exceeding 25% the LEL in structures and 100% the LEL at the property boundary;
✓	Section O.1.b			b.	Be designed for site-specific conditions;
✓	Section O.1.c			c.	Be designed to reduce gas pressure in the interior of the landfill;
✓	Section O.1 d			d.	Be designed to not interfere with the liner, leachate control system or final cover.
✓	Section O.2			2.	Provide documentation that will describe locations, construction details and procedures for monitoring gas at ambient monitoring points and with soil monitoring probes; (62-701.530(2), FAC):
✓	Section O.3			3.	Provide documentation describing how the gas remediation plan and odor remediation plan will be implemented; (62-701.530(3), FAC):
				4.	Landfill gas recovery facilities; (62-701.530(5), FAC):
✓	Section O.4 a			a.	Information required in Rules 62-701.320(7) and 62-701.330(3), FAC supplied;
✓	Section O.4.b			b.	Information required in Rule 62-701.600(4), FAC supplied where relevant and practical;
✓	Section O.4 c			c.	Estimate of current and expected gas generation rates and description of condensate disposal methods provided;
✓	Section O 4.d			d.	Description of procedures for condensate sampling, analyzing and data reporting provided;

S	LOCATION	N/A	N/C		
✓	Section O.4.e			e.	Closure plan provided describing methods to control gas after recovery facility ceases operation and any other requirements contained in Rule 62-701.400(10), FAC;
✓	Section O.4 f			f.	Performance bond provided to cover closure costs if not already included in other landfill closure costs.

P. LANDFILL FINAL CLOSURE REQUIREMENTS (62-701.600,FAC)

1. Closure schedule requirements; (62-701.600(2),FAC)

S	LOCATION	N/A	N/C		
		✓		a.	Documentation that a written notice including a schedule for closure will be provided to the Department at least one year prior to final receipt of wastes;
		✓		b.	Notice to user requirements within 120 days of final receipt of wastes;
		✓		c.	Notice to public requirements within 10 days of final receipt of wastes.

2. Closure permit general requirements; (62-701.600(3),FAC)

S	LOCATION	N/A	N/C		
		✓		a.	Application submitted to Department at least 90 days prior to final receipt of wastes;
				b.	Closure plan shall include the following:
		✓		(1)	Closure report;
		✓		(2)	Closure design plan;
		✓		(3)	Closure operation plan;
		✓		(4)	Closure procedures;
		✓		(5)	Plan for long term care;
		✓		(6)	A demonstration that proof of financial responsibility for long term care will be provided.

3. Closure report requirements; (62-701.600(4),FAC)

S	LOCATION	N/A	N/C		
				a.	General information requirements;
		✓		(1)	Identification of landfill;

S	LOCATION	N/A	N/C	PART P CONTINUED
		✓		(2) Location, description and vicinity map;
		✓		(3) Total acres of disposal areas and landfill property;
		✓		(4) Legal property description;
		✓		(5) History of landfill;
		✓		(6) Identification of types of waste disposed of at the landfill.
		✓		b. Geotechnical investigation report and water quality monitoring plan required by Rule 62-701.330(3),FAC;
		✓		c. Land use information report indicating: identification of adjacent landowners; zoning; present land uses; and roads, highways right-of-way, or easements.
		✓		d. Report on actual or potential gas migration at landfills containing degradable wastes which would allow migration of gas off the landfill property;
		✓		e. Report assessing the effectiveness of the landfill design and operation including results of geotechnical investigations, surface water and storm water management, gas migration and concentrations, condition of existing cover, and nature of waste disposed of at the landfill;
				4. Closure design requirements to be included in the closure design plan: (62-701.600(5),FAC)
		✓		a. Plan sheet showing phases of site closing;
		✓		b. Drawings showing existing topography and proposed final grades;
		✓		c. Provisions to close units when they reach approved design dimensions;
		✓		d. Final elevations before settlement;
		✓		e. Side slope design including benches, terraces, down slope drainage ways, energy dissipators and discussion of expected precipitation effects;
				f. Final cover installation plans including:
		✓		(1) CQA plan for installing and testing final cover;

S	LOCATION	N/A	N/C	PART P CONTINUED
		✓		(2) Schedule for installing final cover after final receipt of waste;
		✓		(3) Description of drought-resistant species to be used in the vegetative cover;
		✓		(4) Top gradient design to maximize runoff and minimize erosion;
		✓		(5) Provisions for cover material to be used for final cover maintenance.
				g. Final cover design requirements·
		✓		(1) Protective soil layer design;
		✓		(2) Barrier soil layer design;
		✓		(3) Erosion control vegetation;
		✓		(4) Geomembrane barrier layer design;
		✓		(5) Geosynthetic clay liner design if used;
		✓		(6) Stability analysis of the cover system and the disposed waste.
		✓		h. Proposed method of stormwater control;
		✓		i. Proposed method of access control;
		✓		j. Description of proposed final use of the closed landfill, if any;
✓	Section P.4 k			k. Description of the proposed or existing gas management system which complies with Rule 62-701.530, FAC.
				5. Closure operation plan shall include: (62-701.600(6),FAC)
		✓		a. Detailed description of actions which will be taken to close the landfill;
		✓		b. Time schedule for completion of closing and long term care;
		✓		c. Describe proposed method for demonstrating financial responsibility;
		✓		d. Indicate any additional equipment and personnel needed to complete closure.

S	LOCATION	N/A	N/C		PART P CONTINUED
		✓		e.	Development and implementation of the water quality monitoring plan required in Rule 62-701.510, FAC.
		✓		f.	Development and implementation of gas management system required in Rule 62-701.530, FAC.
		✓		6.	Justification for and detailed description of procedures to be followed for temporary closure of the landfill, if desired; (62-701.600(7),FAC)

Q. CLOSURE PROCEDURES (62-701.610,FAC)

S	LOCATION	N/A	N/C		
		✓		1.	Survey monuments; (62-701.610(2),FAC)
		✓		2.	Final survey report; (62-701.610(3),FAC)
		✓		3.	Certification of closure construction completion; (62-701.610(4),FAC)
		✓		4.	Declaration to the public; (62-701.610(5),FAC)
		✓		5.	Official date of closing; (62-701.610(6),FAC)
		✓		6.	Use of closed landfill areas; (62-701.610(7),FAC)
		✓		7.	Relocation of wastes; (62-701.610(8), FAC)

R. LONG TERM CARE REQUIREMENTS (62-701.620,FAC)

S	LOCATION	N/A	N/C		
✓	Section R.1			1.	Maintaining the gas collection and monitoring system; (62-701.620(5), FAC)
		✓		2.	Right of property access requirements; (62-701.620(6),FAC)
		✓		3.	Successors of interest requirements; (62-701.620(7),FAC)
		✓		4.	Requirements for replacement of monitoring devices; (62-701.620(9),FAC)
		✓		5.	Completion of long term care signed and sealed by professional engineer (62-701.620(10), FAC).

S. FINANCIAL RESPONSIBILITY REQUIREMENTS (62-701.630,FAC)

S	LOCATION	N/A	N/C		
✓	Section S 1			1.	Provide cost estimates for closing, long term care, and corrective action costs estimated by a PE for a third party performing the work, on a per unit basis, with the source of estimates indicated; (62-701.630(3)&(7), FAC).
			✓	2.	Describe procedures for providing annual cost adjustments to the Department based on inflation and changes in the closing, long-term care, and corrective action plans; (62-701.630(4)&(8), FAC).
			✓	3.	Describe funding mechanisms for providing proof of financial assurance and include appropriate financial assurance forms; (62-701.630(5),(6),&(9), FAC).

T. CERTIFICATION BY APPLICANT AND ENGINEER OR PUBLIC OFFICER

1. Applicant:

The undersigned applicant or authorized representative of Citrus County Board of County Commissioners is aware that statements made in this form and attached information are an application for a Construction - Other Permit from the Florida Department of Environmental Protection and certifies that the information in this application is true, correct and complete to the best of his/her knowledge and belief. Further, the undersigned agrees to comply with the provisions of Chapter 403, Florida Statutes, and all rules and regulations of the Department. It is understood that the Permit is not transferable, and the Department will be notified prior to the sale or legal transfer of the permitted facility.

Susan J Metcalfe
Signature of Applicant or Agent

Susan J Metcalfe, Director, Division of S W Mgmt
Name and Title (please type)

susan metcalfe@bocc citrus fl us
E-Mail address (if available)

P O. Box 340
Mailing Address

Lecanto, Florida 34460
City, State, Zip Code

(352) 527-7671
Telephone Number

Date: 4/8/09

Attach letter of authorization if agent is not a governmental official, owner, or corporate officer.

2. Professional Engineer registered in Florida (or Public Officer if authorized under Sections 403.707 and 403.7075, Florida Statutes):

This is to certify that the engineering features of this solid waste management facility have been designed/examined by me and found to conform to engineering principles applicable to such facilities. In my professional judgment, this facility, when properly maintained and operated, will comply with all applicable statutes of the State of Florida and rules of the Department It is agreed that the undersigned will provide the applicant with a set of instructions of proper maintenance and operation of the facility.

4/22/09
Signature

Dominique Bramlett PE (Senior Project Engr)
Name and Title (please type)

61829
Florida Registration Number
(please affix seal)

SCS Engineers
4041 Park Oaks Blvd, Suite 100
Mailing Address

Tampa, FL 33610
City, State, Zip Code

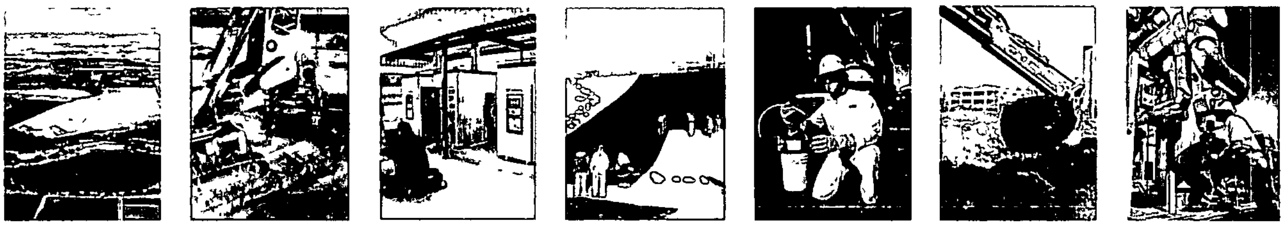
dbramlett@scsengineers com
E-Mail address (if available)

(813) 621-0080
Telephone Number

Date:

DEP FORM 62-701 900(1)
Effective 05-27-01

SCS ENGINEERS



APPLICATION FOR SOLID WASTE CONSTRUCTION PERMIT LANDFILL GAS COLLECTION AND CONTROL SYSTEM

CITRUS COUNTY CENTRAL LANDFILL
CITRUS COUNTY, FLORIDA

Prepared for:

Citrus County Board of County Commissioners

P.O. Box 340
Lecanto, Florida 34460

Prepared by:

SCS ENGINEERS
4041 Park Oaks Blvd., Suite 100
Tampa, Florida 33610
(813) 621-0080
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Florida Board of Professional Engineers
Certification No. 00004892

April 22, 2009
File No. 09207049.02

Offices Nationwide
www.scsengineers.com

APPLICATION FOR SOLID WASTE CONSTRUCTION PERMIT
LANDFILL GAS COLLECTION AND CONTROL SYSTEM
CITRUS COUNTY CENTRAL LANDFILL
CITRUS COUNTY, FLORIDA

Prepared for:

Citrus County
Board of County Commissioners
P.O. Box 340
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Florida Board of Professional Engineers
Certification No. 00004892

D. Bramlett
4/22/09
Dominique H. Bramlett, P.E.
P.E. No. 61829

April 22, 2009
File No. 09207049.02

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ATTACHMENTS

SECTION A

GENERAL INFORMATION

This construction permit application was prepared by SCS Engineers (SCS) on behalf of the Citrus County Board of County Commissioners (County) for the construction of the landfill gas collection and control system (GCCS) at the Citrus County Central Landfill. This report is divided into sections following the format of the Florida Department of Environmental Protection (FDEP) permit application form 62-701.900(1).

A.1 LANDFILL DESCRIPTION

The County's permitted Class I landfill (Phase 1 and 1A, and Phase 2), currently occupies approximately 26 acres. A construction permit application was submitted by SCS in August 2008 for a proposed Phase 3 cell which will be a lateral expansion from Phase 2. The future landfill footprint will be approximately 32 acres.

The Citrus County Central landfill is owned and operated by the Citrus County Board of County Commissioners (BOCC) under FDEP as a Class I landfill and has the following active permits:

- Class I Landfill: FDEP Operations Permit Number 21375-008-SO/01.
- Initial Title V Air Permit: FDEP Permit 0170366-001-AV.
- Air Construction Permit: FDEP Permit 0170366-002-AC.
- Stormwater Management Facilities: Southwest Florida Water Management District Permit Number 402023.02.
- Environmental Resource Permit: FDEP Pending Permit 09-0291076-001.

A.2 SITE LOCATION

The Citrus County Central Landfill is located on S.R. 44, 3 miles east of Lecanto, Citrus County, Florida. The site property lies within Section 1, Township 19 South, and Range 18 East in Citrus County, Florida. The main entrance of the Citrus County Central Landfill facility is located at latitude 28°51'20"N, longitude 82°26'22"W with the location of the proposed GCCS at approximately latitude 28°51'00"N, longitude 82°26'12"W.

A.3 SCOPE OF APPLICATION

This construction permit application encompasses the installation of a GCCS into the Class I Cells (Phases 1/1A and 2). The proposed GCCS will include the installation of vertical extraction wells and tie-ins to the existing leachate collection and removal system (LCRS).

The landfill gas (LFG) will be routed via a header/lateral system to a blower/flare station where the gas will be combusted in a candlestick flare.

SECTION B

DISPOSAL FACILITY GENERAL INFORMATION

The proposed GCCS will include the installation of vertical extraction wells, tie-ins to the existing LCRS risers, and installation of a header/lateral system that will route collected LFG to a blower/flare station where it will be combusted in a candlestick flare. The GCCS will operate under negative pressure.

The LFG management system at the site currently consists of passive vents installed in the old closed 60-acre landfill, which serves to minimize the potential for off-site migration of LFG. FDEP Solid Waste Pending Permit Operation No. 21375-016-SO/MM to Permit No. 21375-008-SO/01 also allows for LFG controls via the connection of existing LCRS risers on the east side of the active landfill with an above ground header to a blower/flare station. While that system has not yet been installed, the County expects that it will be in place before the commencement of construction of the GCCS described in this permit application. The blower/flare station will be relocated from its interim location as part of this proposed GCCS construction. The GCCS proposed for the lined Class I landfill is a voluntary active LFG collection and control system that is being installed to proactively reduce methane emissions to the atmosphere. This system is not required by Federal New Source Performance Standards (NSPS).

As shown on the drawings in Attachment E-1, the proposed GCCS for Phases 1/1A and 2 will entail the following:

- Relocation of the blower station and candlestick flare.
- Tie-ins to existing LCRS risers.
- Installation of vertical extraction wells.
- Installation of below-grade header and lateral network.
- Installation of below-grade air supply lines and condensate drain lines.
- Installation of a condensate sump and self-draining condensate traps.

SECTION C

NON-DISPOSAL FACILITY GENERAL INFORMATION

Not applicable.

SECTION D

PROHIBITIONS

Not applicable.

SECTION E

GENERAL REQUIREMENTS

E.1 APPLICATION FORM AND SUPPORTING DOCUMENTS

In accordance with Rule 62-701.320(5)(a), F.A.C., four copies of the completed State of Florida Department of Environmental Protection Application for a Permit to Construct, Operate, Modify or Close a Solid Waste Management Facility Application Form 62-701.900(1), which is attached at the beginning of this permit application report, including all supporting data are included as part of this Construction Permit Application.

E.2 ENGINEERING CERTIFICATION

Part T of the Application for a Permit to Construct, Operate, Modify or Close a Solid Waste Management Facility Application Form 62-701.900(1) has been signed and sealed by Dominique H. Bramlett, P.E., a registered Professional Engineer in the State of Florida (License No. 61829) together with all other applicable engineering plans, reports and supporting information for the application herein as required by Rule 62-701.320(6), F.A.C.

E.3 TRANSMITTAL LETTER

A transmittal letter is included at the front of this application as required by Rule 62-701.320(7)(a), F.A.C.

E.4 APPLICATION FORMS

The Application for a Permit to Construct, Operate, Modify or Close a Solid Waste Management Facility Application Form 62-701.900(1) is included in this submittal as required by Rule 62-701.320(7)(b), F.A.C.

E.5 PERMIT FEE

A check in the amount of $1,000 payable to FDEP is being submitted with this application. This is the amount required for a "Construction-Other" Permit Application.

E.6 ENGINEERING REPORT

This document with supporting Figures, Tables, and Attachments meets the requirements of an Engineering Report as required by Rule 62-701.320(7)(d), F.A.C.

E.7 OPERATION PLAN AND CLOSURE PLAN

This application is for a construction permit to install a voluntary GCCS in Phases 1/1A and 2 at the Citrus County Central Landfill. Refer to Section L.9 of this report for the GCCS Operation Plan. A copy of the Operations Plan for the facility was included and approved in Attachment L-1 of the permit modification for the interim gas collection and control system; only the revised Sections 2 and 8 are being provided as Attachment L-1 of this permit application.

After the GCCS has been activated, an Operation and Maintenance (O&M) Manual for the blower/flare station will be submitted to the FDEP with the report of construction completion.

E.8 CONTINGENCY PLAN

No changes are proposed for the facility's contingency plan.

E.9 DRAWINGS

There have been no changes to the property boundaries since the last permit renewal and therefore a site plan signed and sealed by a Florida Licensed Professional Land Surveyor is not being submitted with this application.

Copies of the design drawings (site plans and details) are located in Attachment E-1 of this submittal. Copies of the Technical Specifications are located in Attachment E-2 of this submittal.

E.10 PROOF OF OWNERSHIP

There has been no change in ownership of the property since the last operation permit renewal application.

E.11 RECYCLING GOALS

This item is not applicable.

E.12 ENFORCEMENT HISTORY

There has been no change to this Section.

E.13 PROOF OF PUBLICATION

To comply with Rule 62-701.320(8)(a), F.A.C., the County will publish a Notice of Application within 14 days after filing the application. Proof of publication will be provided to FDEP.

E.14 AIRPORT SAFETY

This item is not applicable.

E.15 OPERATOR TRAINING

This item is not applicable.

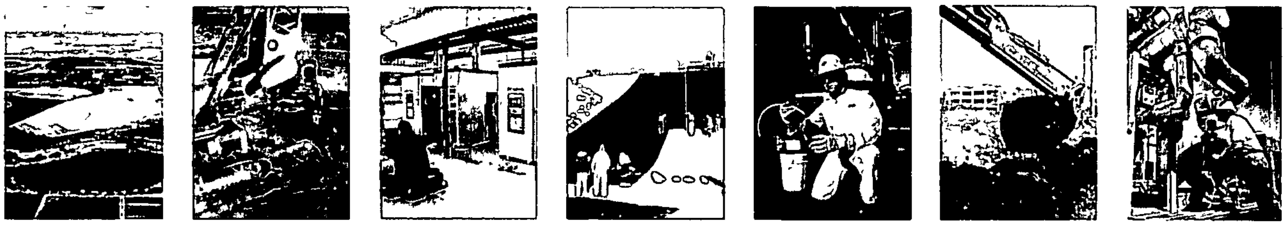
ATTACHMENT E-1

GAS COLLECTION AND CONTROL SYSTEM
CONSTRUCTION DRAWINGS

ATTACHMENT E-2

GAS COLLECTION AND CONTROL SYSTEM TECHNICAL SPECIFICATIONS

SCS ENGINEERS



CITRUS COUNTY CENTRAL LANDFILL LANDFILL GAS COLLECTION AND CONTROL SYSTEM

TECHNICAL SPECIFICATIONS

Prepared for:

Citrus County Board of

County Commissioners

P.O. Box 340
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Prepared by:

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Florida Board of Professional Engineers
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April 22, 2009
File No. 09207049.02

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SECTION 01 10 00

SUMMARY OF WORK

PART 1 – GENERAL

1.01 PROJECT DESCRIPTION

A. The WORK of this Contract consists of constructing a landfill gas collection and control system (GCCS) at the Citrus County Central Landfill. This generally includes furnishing all labor, materials, equipment, tools, transportation, services, incidentals, and performing all work necessary to complete the project, in place and ready for service in accordance with the plans and specifications prepared therefore and entitled "Citrus County Central Landfill, Landfill Gas Collection and Control System Project". The WORK generally includes but is not limited to the following items:

1. Construction staking/system layout/surveying prior to construction.

2. Drilling and installation of landfill gas (LFG) extraction wells, including wellheads.

3. Installing below grade high density polyethylene (HDPE) LFG laterals and header. Header appurtenances also to be installed include, but are not limited to, header isolation valves, road crossings, and ditch crossings.

4. Installing below grade HDPE air supply line and related components.

5. Installing condensate traps and sumps.

6. Relocating the existing blower/flare station and all peripheral equipment to operate and control the blower flare station.

7. System start-up and testing.

8. Conformance surveying.

9. Providing as-built documentation.

B. The WORK of this Contract is located in Citrus County, Florida, at the Citrus County Central Landfill. CONTRACTOR shall be aware of the nature of the activities at a landfill which may restrict access to the portions of the site due to general landfill operations.

1.02 WORK SEQUENCE

Sequence WORK to accommodate work with any other contractors on site or OWNER forces.

1.03 COUNTY OCCUPANCY AND LANDFILL OPERATIONS

The CONTRACTOR shall cooperate with the OWNER during construction operations to minimize conflicts with OWNER work and facilitate OWNER usage. The CONTRACTOR shall perform the WORK so as not to interfere with the OWNER's operations, maintenance, environmental monitoring, and other OWNER activities at the site.

1.04 ERRORS AND/OR OMISSIONS IN PLANS AND SPECIFICATIONS

The intent of the specifications is to outline or indicate the items of WORK, or both, which cannot be readily shown on the drawings and to further indicate the types and qualities of materials. Drawings and specifications shall be considered as being complimentary and items or WORK mentioned or indicated in one and not in the other shall be included as if mentioned in both. Should drawings disagree in themselves or with the specifications the better quality or greater quantity of work or materials shall be estimated upon, and shall be provided.

1.05 SITE CONDITIONS

A. The existing grades may vary from those indicated on the Plans due to landfill settlement and ongoing filling operations.

B. The Contract Documents require the CONTRACTOR to field verify the location of existing features; see Section 01 50 00, Site Conditions Survey. Existing features include but may not be limited to the following: stormwater drainage structures and underground pipes, stormwater terraces and swales, leachate collection system cleanouts, sumps, pump stations, electrical panels, forcemain, utilities, roads, drainage culverts, fences, and buildings.

C. The CONTRACTOR shall enforce safety procedures to minimize hazards to workers, the public, and the environment.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 01 20 00

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. The total Bid amount shall cover all WORK required by the Contract Documents including all costs and expenses for taxes, commissions, transportation charges and expenses, permit fees, patent fees, royalties, handling and tests, and performing all necessary labor and supervision to fully complete the WORK. All WORK not specifically set forth as a pay item on the CONTRACTOR'S Bid Form shall be considered a subsidiary obligation of CONTRACTOR and all costs in connection therewith shall be included in the unit prices bid and or the Lump Sum Price.

B. No separate payment will be made for any item that is not specifically set forth on the CONTRACTOR'S Bid Form and all costs therefore shall be included in the prices named on the CONTRACTOR'S Bid Form for the various appurtenant items of WORK.

C. The quotations for the various items of WORK are intended to establish a total price for completing the WORK in its entirety. Should the CONTRACTOR feel that the cost for any item of WORK has not been established by the CONTRACTOR'S Bid Form, he shall include the cost for that WORK in some other applicable Bid Item, so that his proposal for the project does reflect his total price for completing the WORK in its entirety.

D. All estimated quantities stipulated on the CONTRACTOR'S Bid Form or other contract documents are approximate and are to be used only (a) as a basis for estimating the probable cost of the WORK and (b) for the purpose of comparing the bids submitted for the WORK. The actual amount of WORK done and materials under unit price items may differ from the estimated quantities. The basis of payment for WORK and materials will be the actual amount of WORK done and materials furnished. CONTRACTOR agrees that he will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of WORK actually performed and materials actually furnished and the estimated amounts thereof.

1.02 COMPUTATION OF QUANTITIES

A. Measurement of quantities expressed as area shall be based upon a horizontal, planimetric projection to the WORK limits as determined by survey record drawings prepared by a surveyor licensed in the State of Florida. Cost of surveying shall be paid by CONTRACTOR, and incorporated into Bid Items, as appropriate.

B. Measurement of linear items will be for quantities actually field installed to the specified work limits, based upon surveyed stations recorded along the straight or curved centerline of each respective item. Measurement conducted by survey is to be conducted by the CONTRACTOR's approved Florida licensed land surveyor.

C. Measurement of quantities expressed as volume will be based upon a neat plan line projection to the WORK limits (planimetric measure) as determined by survey record drawings for each item, with no additional allowances for shrinkage, swelling, or creep. Quantities expressed as volume will be in-place volumes to the dimensions indicated on the Contract Drawings.

1.03 VARIATIONS IN ESTIMATED QUANTITIES

A. The quantities given in the Contract Documents are approximate, and are given as a basis for the uniform comparison of bids. The OWNER does not expressly, or by implication, agree that the actual amount of WORK will correspond therewith.

B. The CONTRACTOR must provide, for Unit Price WORK, a proposed contract price determined on the basis of estimated quantities required for each item. The estimated quantities of items are not guaranteed and are solely for the purpose of comparing bids. Each such unit will be deemed to include an amount for overhead, profit and indirect costs for each separately defined item.

1.04 BID FORM

A. Table 01 20 00-1 presents the Bid Form for the items contained within this Section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 MEASUREMENT AND PAYMENT

A. Item No. 001 – Mobilization/Demobilization (Lump Sum, Pro-Rated Basis)

1. Measurement. The WORK required for this item will not be measured for payment.

2. Payment. Payment for this item shall be on a lump sum basis as described below. No price adjustments will be made for this item due to changes in the work.

   The Contract Price for mobilization/demobilization shall be subject to the following provisions:

a. The maximum amount allowed to be bid for mobilization/demobilization is 10 percent of the total bid price.

b. Partial payments for mobilization/demobilization will be made in accordance with the following schedule.

Condition or Percent of Total Contract Amount Earned	Allowable Percent of the Lump Sum Price for the Item
Submittal/completion of items listed in Section 01 50 05, Part 1.01A	25
10 percent total contract amount earned	40
25 percent total contract amount earned	60
50 percent total contract amount earned	80
100 percent total contract amount earned	100

The final payment for mobilization/demobilization will not be made until all temporary facilities, temporary erosion and sedimentation controls, equipment, and appurtenances have been removed from the site.

B. Item No. 002 – Project Survey (Lump Sum)

1. Measurement. Measurement for this item shall be on a completed lump sum basis.

2. Payment. Payment for this item shall be on a lump sum basis for the completed survey. The project survey will include field staking of proposed vertical extraction wells, route for landfill gas header, laterals, air supply line and condensate discharge line prior to construction; layout of blower/flare station; and an as-built survey of installed wells, above and below grade pipe, fittings, tie-ins, condensate traps and sumps, road crossings, blower/flare station, and appurtenances by a Florida Licensed Professional Surveyor. The as-built survey notes will identify such items as: state plane coordinates, ground elevations, pipe depth, pipe slope, top of pipe coordinates and elevations, pipe diameter, identification of fitting sizes, and construction, pipe, and fitting notes.

C. Item No. 003 – Landfill Gas Extraction Well Installation

003a - 30-inch Diameter Bore with 6-inch Diameter Casing (Linear Foot)

1. Measurement. Landfill gas wells will be measured on a linear foot basis from existing ground surface to the bottom of the well bore as measured in the field by the ENGINEER.

2. Payment. Payment for this item will be at the contract unit price per linear foot installed. Payment will include all boring, soil, bentonite, geotextile, backfilling, health and safety requirements, well casing (solid and perforated), connections, fittings, transportation to the working face for drilling spoils, backfill, and shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

003b - Boring Refusal (Linear Foot)

1. Measurement. Wells that must be abandoned due to insufficient depth resulting from boring refusal shall be paid on a linear foot basis as measured in the field by the ENGINEER from existing ground surface to the bottom of the wellbore. No boring may be abandoned without approval of the ENGINEER.

2. Payment. Payment for this item will be at the contract unit price per linear foot of boring, and includes boring and backfilling.

D. Item No. 004 – Landfill Gas Vertical Wellheads (Each)

1. Measurement. Measurement for this item shall be on a completed and installed unit basis.

2. Payment. Payment for this item will be at the contract unit price per installed unit, including valving, fittings, piping, connections, hoses, clamps, identification markings, gauges, monitoring/access ports, flow measurement devices, testing, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

E. Item No. 005 – 4" HDPE SDR 17 Below Grade Lateral (Linear Foot)

1. Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe size as measured during the conformance survey conducted by a Florida Licensed Professional Surveyor. Measurement shall not include vertical components (i.e., riser) of laterals.

2. Payment. Payment for this item shall be at the contract unit price per horizontal linear foot for each pipe size specified on the bid form. Payment includes excavation, transportation of excavated refuse to the working face, sand and clean soil backfill material, pipe bedding, backfilling, soil compaction, fittings, piping, connections, risers for connection to wellheads, pipe location markings, quality control surveying, testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental

thereto, necessary to complete this item in accordance with the Contract Documents.

F. Item No. 006 – 6" HDPE SDR 17 Below Grade Lateral (Linear Foot)

1. Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe size as measured during the conformance survey conducted by a Florida Licensed Professional Surveyor. Measurement shall not include vertical components (i.e., riser) of laterals.

2. Payment. Payment for this item shall be at the contract unit price per horizontal linear foot for each pipe size specified on the bid form. Payment includes excavation, transportation of excavated refuse to the working face, sand and clean soil backfill material, pipe bedding, backfilling, soil compaction, repair of final cover system, fittings, piping, connections, risers for connection to wellheads, pipe location markings, quality control surveying, testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

G. Item No. 007 – 8" HDPE SDR 17 Landfill Gas Below Grade Header (Linear Foot)

1. Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe size as measured during the conformance survey conducted by a Florida Licensed Professional Surveyor.

2. Payment. Payment for this item shall be at the contract unit price per horizontal linear foot as specified on the bid form. Payment includes excavation, transportation of excavated refuse to the working face, sand and clean soil backfill material, pipe bedding, backfilling, soil compaction, repair of final cover system, fittings, piping, connections, quality control surveying, testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

H. Item No. 008 – 10" HDPE SDR 17 Landfill Gas Below Grade Header (Linear Foot)

1. Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe size as measured during the conformance survey conducted by a Florida Licensed Professional Surveyor.

2. Payment. Payment for this item shall be at the contract unit price per horizontal linear foot as specified on the bid form. Payment includes excavation, transportation of excavated refuse to the working face, sand

and clean soil backfill material, pipe bedding, backfilling, soil compaction, repair of final cover system, fittings, piping, connections, quality control surveying, testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

I. Item No. 009 – 10" HDPE SDR 17 Landfill Gas Above Grade Header (Linear Foot)

1. Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe size as measured during the conformance survey conducted by a Florida Licensed Professional Surveyor.

2. Payment. Payment for this item shall be at the contract unit price per horizontal linear foot as specified on the bid form. Payment includes fittings, piping, connections, pipe support, quality control surveying, testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

J. Item No. 010 – Air Supply Line System Installation

010a - 2" HDPE SDR 9 Air Line in Trench with Header (Linear Foot)

1. Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe size as measured during the conformance survey conducted by a Florida Licensed Professional Surveyor. Measurement shall not include vertical riser at wells, sumps, or appurtenances.

2. Payment. Payment for this item shall be at the contract unit price per linear foot for air supply pipe installed in a trench with other pipe. Payment for excavation, transportation of excavated refuse to the working face, soil, pipe bedding, backfilling, and soil compaction shall be included in bid price for the header (Item G or H). Payment for this line item shall include piping, connections, appurtenances, pipe location markings, quality control surveying, testing and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

K. 010b - 2" HDPE SDR 11 Condensate Discharge in Dedicated Trench (Linear Foot)

1. Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe size as measured during the conformance survey conducted by a Florida Licensed Professional Surveyor.

Measurement shall not include vertical riser at wells, sumps, or appurtenances.

2. Payment. Payment for this item shall be at the contract unit price per linear foot for condensate/dewatering discharge line pipe installed in a dedicated trench. Payment includes excavation, transportation of excavated refuse to the working face, soil, pipe bedding, backfilling, soil compaction, tie-in to new condensate discharge lines and sumps, piping, connections, appurtenances, pipe location markings, quality control surveying, testing and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

L. Item No. 011 – 18" Condensate Sump with Pump (Each)

1. Measurement. Measurement for this item shall be on a completed and installed unit basis.

2. Payment. Payment for this item will be at the contract unit price per installed unit, including excavation, transportation of excavated refuse to the working face, backfilling, clean soil backfill material, fittings, piping installation and connections, monitoring ports, supply and placement of the pumps, valves, testing, connection to header pipe, tie-in of condensate discharge line and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

M. Item No. 012 – 18" HDPE Self Draining Condensate Traps (Each)

1. Measurement. Measurement for this item shall be on a completed and installed unit basis.

2. Payment. Payment for this item will be at the contract unit price per installed unit, including excavation, transportation of excavated refuse to the working face, backfilling, fittings, piping installation and connections, monitoring ports, testing, connection to header pipe, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

N. Item No. 013 – Landfill Gas System Appurtenances

013a - 6" Real Environmental Products Quick Cap (Each)

1. Measurement. Measurement for this item shall be on a completed and installed unit basis.

2. Payment. Payment for this item shall be at the contract unit price per installed unit as shown on the Drawings. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

013b - 8” Header Isolation Valve (Each)

1. Measurement. Measurement for this item shall be on a completed and installed unit basis.

2. Payment. Payment for this item will be at the contract unit price per installed unit, including excavation, transportation of excavated refuse to the working face, backfilling, valving, valve stem extension controls, fittings, spacers, piping installation and connections, monitoring ports, related component, identification markings, testing, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

013c - 12” CMP Casing Road Crossing for 4” Lateral (Linear Foot)

1. Measurement. Measurement for this item shall be on an installed linear foot basis as measured during the conformance survey conducted by a Florida Licensed Professional Surveyor.

2. Payment. Payment for this item shall be at the contract unit price per linear foot as specified on the bid form. Payment is in addition to the payment for HDPE piping and includes additional excavation, transportation of excavated refuse to the working face, bedding, backfilling, piping placement inside the casing, bollards, and repair of the road to its original condition after construction.

013d - 18” CMP Casing Road Crossing for 10” Header (Linear Foot)

1. Measurement. Measurement for this item shall be on an installed linear foot basis as measured during the conformance survey conducted by a Florida Licensed Professional Surveyor.

2. Payment. Payment for this item shall be at the contract unit price per linear foot as specified on the bid form. Payment is in addition to the payment for HDPE piping and includes additional excavation, transportation of excavated refuse to the working face, bedding, backfilling, piping placement inside the casing, bollards, and repair of the road to its original condition after construction.

O. Item No. 014 – Tie-in to Leachate Holding Tank (Lump Sum)

1. Measurement. Measurement for this item shall be on a completed lump sum basis.

2. Payment. Payment for this item shall be on a lump sum basis for the completed installed unit, including excavation, backfilling, fittings, piping, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract.

P. Item No. 015 – CS-1 Modification (Lump Sum)

1. Measurement. Measurement for this item shall be on a completed lump sum basis.

2. Payment. Payment for this item shall be on a lump sum basis for the completed installed unit, including excavation, transportation of excavated refuse to the working face, backfilling, fittings, piping, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract.

Q. Item No. 016 – Relocating Blower/Flare Station (Lump Sum)

1. Measurement. Measurement for this item shall be on a completed lump sum basis.

2. Payment. Payment for this item will be on a lump sum basis for the completed relocation of the blower/flare station and electrical work for the project. This pay item shall include grading and compaction of base soils, site work, fencing, excavation, pipe installation, backfilling, compaction, fittings, blower/flare skid relocation and installation, mechanical connections, air compressor, air dryer, all electrical connections, testing, start-up services, propane supply tanks, pneumatic valves, condensate drainage lines, valves, piping, control panel, electrical conduit, wiring, setup of communications system, computer interface setup, and related work to provide a fully functional blower/flare system. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

R. Item No. 017 – Electrical Utilities (Lump Sum)

1. Measurement. Measurement for this item shall be on a completed lump sum basis.

2. Payment. Payment for this item will be on a lump sum basis for the construction of all required electrical utilities improvements. This pay item shall include placing of conduit, wire, panels, lighting, steel racks,

warning stakes, switches, breakers, grounding, connections to existing power supply and or transformer, coordination with OWNER and power company as needed to accomplish the new construction, and other work to provide a functional electrical service for the blower/flare station. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

S. Item No. 018 – Type "A" LFG Tie-in to Existing LCRS Riser (Each)

1. Measurement. Measurement for this item shall be on a completed unit basis.

2. Payment. Payment for this item shall be at the contract unit price per type "A" tie-in as specified on the bid form. Payment includes excavation, pipe bedding, backfilling, soil compaction, fittings, piping, connections, valves, monitoring ports, quality control surveying, testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

T. Item No. 019 – Type "B" LFG Tie-in to Existing LCRS Riser (Each)

1. Measurement. Measurement for this item shall be on a completed unit basis.

2. Payment. Payment for this item shall be at the contract unit price per type "B" tie-in as specified on the bid form. Payment includes excavation, pipe bedding, backfilling, soil compaction, fittings, piping, connections, valves, monitoring ports, quality control surveying, testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

U. Item No. 020 – Type "C" LFG Tie-in to Existing LCRS Riser (Each)

1. Measurement. Measurement for this item shall be on a completed unit basis.

2. Payment. Payment for this item shall be at the contract unit price per type "C" tie-in as specified on the bid form. Payment includes excavation, pipe bedding, backfilling, soil compaction, fittings, piping, connections, valves, monitoring ports, quality control surveying, testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

V. Item No. 021 – Type "D" LFG Tie-in to Existing LCRS Riser (Each)

1. Measurement. Measurement for this item shall be on a completed unit basis.

2. Payment. Payment for this item shall be at the contract unit price per type "D" tie-in as specified on the bid form. Payment includes excavation, pipe bedding, backfilling, soil compaction, fittings, piping, connections, valves, monitoring ports, quality control surveying, testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

W. Item No. 022 – Project Record Documentation (Lump Sum)

1. Measurement. Measurement for this item shall be on a completed lump sum basis.

2. Payment. Payment for this item shall be on a lump sum basis for the completed Project Record Documents. The pay item includes drawings, operation and maintenance manuals, vendor and material supply information, construction photographs, and all other items required for Project Record Documentation as described in Section 01 30 10. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

END OF SECTION

Table 01 20 00-1. Bid Form

Per Technical Specifications (Part B, Specifications) the following prices are hereby given by the bidder for each item herein below delineated to be used for the dual purpose of a) arriving at an estimated total bid price, and b) establishing price factors to be utilized in adjustments to the estimated total price resulting from change orders issued in accordance with the terms of these Contract Documents Said total price being the OWNER'S guide to the best qualified low Bidder

I Item No	II Item Description	III Unit	IV Contract Quantity	V Unit Price in Figures ($)	VI Total Item Price (Col IV x Col V) ($)
001	Mobilization/Demobilization	LS	1		
002	Project Survey	LS	1		
003	Landfill Gas Extraction Well Installation				
003a	30-inch Diameter Bore with 6-inch Diameter Casing	LF	799		
003b	Boring Refusal	LF	80		
004	Landfill Gas Vertical Wellheads	EA	17		
005	4" HDPE SDR 17 Below Grade Lateral	LF	773		
006	6"HDPE SDR 17 Below Grade Lateral	LF	887		
007	8" HDPE SDR 17 Landfill Gas Below Grade Header	LF	2896		
008	10" HDPE SDR 17 Landfill Gas Below Grade Header	LF	212		
009	10" HDPE SDR 17 Landfill Gas Above Grade Header	LF	40		
010	Air Supply Line System Installation				
010a	2" HDPE SDR 9 Air Line in Trench with Header	LF	1 467		
010b	2" HDPE SDR 11 Condensate Discharge in Dedicated Trench	LF	69		
011	18" Condensate Sump with Pump	EA	1		
012	18" HDPE Self Draining Condensate Traps	EA	2		
013	Landfill Gas System Appurtenances				
013a	6" Real Environmental Products Quick Cap	EA	2		
013b	8" Header Isolation Valve	EA	2		
013c	12" CMP Casing Road Crossing for 4" Lateral	LF	30		
013d	18" CMP Casing Road Crossing for 10" Header	LF	180		
014	Tie-in to Leachate Holding Tank	LS	1		
015	CS-1 Modification	LS	1		
016	Relocating Blower/Flare Station	LS	1		
017	Electrical Utilities	LS	1		
018	Type "A" LFG Tie-in to Existing LCRS Riser	EA	2		
019	Type "B" LFG Tie-in to Existing LCRS Riser	EA	4		
020	Type "C" LFG Tie-in to Existing LCRS Riser	EA	2		
021	Type "D" LFG Tie-in to Existing LCRS Riser	EA	2		
022	Project Record Documentation	LS	1		
				TOTAL BID PRICE	

Contractor ______________________

Authorized Signature ______________________

Date ______________________

SECTION 01 20 10

PROJECT MEETINGS

PART 1 - GENERAL

1.01 SUMMARY

This Section specifies administrative and procedural requirements for project meetings including but not limited to:

A. Pre-construction Conference

B. Progress Meetings

C. Coordination Meetings

1.02 DESCRIPTION

A. The PROJECT MANAGER will schedule and administer a preconstruction conference, weekly construction progress meetings, and specially called meetings throughout the progress of work. The ENGINEER or PROJECT MANAGER will be responsible for preparing the agenda, making arrangements, preparing the meeting summaries, and presiding at these meetings.

B. Representatives of CONTRACTOR, Subcontractor(s), and Suppliers attending these meetings shall be qualified and authorized to act on behalf of the entity each represents.

C. The CONTRACTOR shall attend meetings to ascertain that work is expedited consistent with Contract Documents and construction schedules.

1.03 PRECONSTRUCTION CONFERENCE

After award of the contract, but prior to the notice to proceed, a joint meeting shall be held with representatives of the COUNTY, ENGINEER, CONTRACTOR, including the Project Superintendent, and other invited parties which may be affected by the project.

This meeting is intended to introduce the various key personnel from each organization and to discuss the following:

- The Contract Documents
- Start date of construction
- Order of work
- Labor and legal requirements
- Approved insurance requirements
- Names of the major subcontractors

- Method of payment
- Shop drawing submittal schedule
- Protection of existing facilities and other pertinent items associated with the Project

The CONTRACTOR shall bring five (5) copies of a construction schedule, schedule of values, and shop drawing submittal log to this meeting.

The suggested agenda for the preconstruction meeting is as follows:

A. Introduction of key personnel and roles

B. Overview of project

   1. Project summary

   2. Contract completion time

   3. Liquidated damages

   4. Guarantee of work

C. Project schedule

D. Critical work sequencing

E. Labor requirements

F. Relationship and coordination with:

   1. Other Contracts

   2. On-going landfill operations

G. Use of premises

   1. Site access and traffic control

   2. Office, work and storage areas

   3. Temporary facilities/utilities

   4. Safety and first aid procedures

   5. Security procedures

   6. Posting of signs

   7. Clean-up procedures

8. Other County requirements

H. Procedures and processing of:

1. Shop drawings

2. Applications for payment

3. Partial payments

4. Change orders

5. Requests for information

6. Record documents

I. Construction facilities controls

J. Staking of work

K. Equipment to be used

L. Material/manufacturers/suppliers to be used

M. Major equipment/material deliveries

N. On-site material storage requirements

O. Project inspections

P. Record documentation

1.04 PROGRESS MEETINGS

During the course of the Contract, progress meetings will be organized and conducted by the PROJECT MANAGER and/or ENGINEER to discuss the progress of the Work weekly. Depending on the project progress and schedule, the COUNTY reserves the right to request meetings every other week instead of weekly. The CONTRACTOR and Project Superintendent shall attend these meetings.

The suggested agenda for these meetings:

A. Review summary of previous meeting

B. Work progress

1. Since last meeting

2. Expected progress during next work period

C. Field observations, problems, conflicts

D. Construction schedule

1. Problems which impede the construction schedule
2. Revisions to schedule
3. Critical/long-lead items
4. Off-site fabrication and delivery schedules

E. Coordination of work items with County activities

F. Shop drawing submittals

1. Status of reviews
2. Submittal requirements
3. Remaining submittals

G. Record documents

1. Well logs, pipe installation records
2. Photographs
3. Red-line mark-ups
4. Survey Notes

H. Maintenance of quality standards

I. Pending changes and substitutions

1. Effect on construction schedule and on completion date
2. Effect on other Contracts of the project

J. Other Business

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 01 30 00

SPECIAL PROVISIONS

PART 1 – GENERAL

1.01 ENVIRONMENTAL PROTECTION

A. Excavations: All excavations shall be confined to the immediate area of the WORK.

B. Environmental Constraints:

1. Dust Control: Trucked water from CONTRACTOR's temporary utilities hook-ups shall be used if necessary to prevent dust from the CONTRACTOR's activities.

2. Explosion Protection: Caution shall be exercised on overnight stoppage to prevent methane accumulation. CONTRACTOR shall be responsible for enforcing all additional explosion protection precautions according to the guidelines in Section 01 80 00, Health and Safety Plan.

3. Fire Control: CONTRACTOR shall be responsible for fire control and shall include fire control procedures (which will be adhered to during the entire contract time) in the Health and Safety Plan required pursuant to Section 01 80 00.

4. Litter: CONTRACTOR shall be required to control, collect, and dispose of all litter excavated or exposed by the Work on a daily basis.

1.02 WORKING HOURS

A. Limit use of premises for work, storage, and access to allow work by other contractors, owner occupancy, and normal landfill operations.

B. Allowable WORK times shall be Monday through Friday from 6:30 a.m. to 5:30 p.m. and Saturday 6:30 a.m. to 3:00 p.m., except some Legal holidays. CONTRACTOR shall submit for approval to the ENGINEER 48 hours notice prior to Sunday or Legal holiday work, and work shall be limited to 8 hours maximum on such days, if approved by the OWNER

C. No later than 5 days after notice to proceed, the CONTRACTOR shall arrange with the OWNER a sequence of procedures, means of access, space for storage of materials and equipment, and use of approaches and roadways. CONTRACTOR's use of the premises shall be confined to the areas approved by the OWNER.

1.03 TEMPORARY SERVICES

CONTRACTOR shall supply potable water and sanitary facilities for the full duration of the project.

1.04 PRECONSTRUCTION DOCUMENTATION

A. CONTRACTOR shall provide a preconstruction video documenting site conditions prior to the commencement of work. The video shall include footage of the entire project area, including but not limited to the following:

1. Contractor staging area.
2. Stormwater ditches and culverts.
3. Stormwater terraces, swales, berms, downlet structures, cleanouts, and drainage pipes.
4. Landfill surface and sideslopes.
5. Leachate collection system cleanouts, electrical service, etc.
6. Existing utility poles.
7. Paved and unpaved access roads in the vicinity of the project limits.

B. Submittal of the preconstruction video shall be made no later than 14 days after the preconstruction meeting.

1.05 PROJECT FORMS

CONTRACTOR shall use the project forms, approved by the OWNER and ENGINEER at the preconstruction meeting, for administrative submittals and shop drawings.

1.06 SUPERINTENDENT

A. CONTRACTOR shall provide a single qualified full time English-speaking superintendent for the duration of the project. CONTRACTOR shall not change superintendent without the COUNTY's prior written permission. CONTRACTOR's proposal to change personnel must be justifiable to the COUNTY, and must demonstrate that the proposed replacement possesses adequate qualifications to the satisfaction of the COUNTY.

B. Superintendent shall attend all meetings pertaining to the WORK, as requested by the COUNTY and/or ENGINEER.

C. No WORK shall be performed by either the CONTRACTOR's workforce or by CONTACTOR's subcontractors without the CONTRACTOR's Superintendent physically present on the Work site.

D. The COUNTY may, at its sole discretion, require replacement of the Superintendent, in which case CONTRACTOR shall submit an acceptable replacement at no increase in the Contract Price, nor extension in Contract Time. The Superintendent shall be CONTRACTOR's representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications given to the Superintendent shall be as binding as if given to the CONTRACTOR.

1.07 LIQUIDATED DAMAGES

A. If the Work is not completed by the Contract Date, CONTRACTOR shall pay COUNTY liquidated damages as described below:

1. Liquidated damages for each calendar day that Substantial Completion is not met shall be $2,000.

2. Liquidated damages for each calendar day that Final Completion is not met shall be $1,500.

3. Liquidated damages shall be assessed on each milestone separately until that milestone is completed up to a maximum amount of $3,500 per day.

B. In addition to the liquidated damages specified herein, CONTRACTOR shall pay or reimburse COUNTY's actual damages which may include but are not limited to regulatory fines, expenses for engineering fees, and inspection costs arising from CONTRACTOR's failure in meeting either or both the Substantial Completion and Final Completion dates.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 01 30 10

CONTRACTOR SUBMITTALS

PART 1 - GENERAL

1.01 GENERAL

A. Whenever submittals are required hereunder, all such CONTRACTOR submittals shall be submitted to the ENGINEER or as designated by the ENGINEER.

B. At the pre-construction meeting, the CONTRACTOR shall submit the following items to the ENGINEER for review:

1. A preliminary schedule of Shop Drawings submittals and target dates for the project prior to start of construction.

2. A list of any and all permits and licenses the CONTRACTOR shall obtain indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.

3. Health and Safety Plan.

1.02 SHOP DRAWINGS

A. Wherever called for in the Contract Documents, or where required by the ENGINEER, the CONTRACTOR shall furnish to the ENGINEER for review, five (5) copies of each submittal. The term "submittal" as used herein shall be understood to include detail design calculations, shop drawings, fabrication and installation drawings, erection drawings, lists, graphs, operating instructions, catalog sheets, data sheets, samples, and similar items. Any submittal which is not complete or does not provide the level of detail outlined in the specifications, shall not be considered acceptable for review and may be returned for resubmittal. Should any submittal be a part of any schedule milestone and is considered to be unacceptable by the OWNER, the appropriate milestone shall be considered as not having been met until a complete and properly detailed submittal is received.

B. Attach to the front of each submittal a title sheet stating the pertinent product information submitted and reference the appropriate Specification Section and Paragraph. Apply stamp, signed or initialed, certifying that all quantities, dimensions, field construction criteria, materials, catalog numbers, and specified performance criteria has been reviewed in accordance with the requirements of the Work and the Contract Documents.

If this information is not provided with each submittal, the submittal shall be returned to the CONTRACTOR without action taken by the ENGINEER, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.

C. All shop drawings or other submittals shall be accompanied by the OWNER'S standard submittal transmittal form. Any submittal not accompanied by such a form or if all applicable items on the form are not completed, the submittal will be returned for resubmittal. Ultimate responsibility for the accuracy and completeness of the information contained in the submittal shall remain with the CONTRACTOR.

D. Normally, a separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole. A multiple-page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the ENGINEER. Submittals shall be a complete package for each system.

E. Except as may otherwise be provided herein, the ENGINEER will return prints of each submittal to the CONTRACTOR, with its comments noted thereon, within 14 calendar days following their receipt by the ENGINEER. It is considered reasonable that the CONTRACTOR shall make a complete and acceptable submittal to the ENGINEER. The OWNER reserves the right to withhold monies due the CONTRACTOR to cover additional costs of the ENGINEER'S review when multiple submittals are required due to CONTRACTOR'S failure to comply with the specifications.

F. If two copies of a submittal are returned to the Contractor marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.

G. If two copies of a submittal are returned to the Contractor marked "MAKE CORRECTIONS NOTED," formal revision and resubmission of said submittal will not be required.

H. If one copy of the submittal is returned to the Contractor marked "AMEND - RESUBMIT," the CONTRACTOR shall have five working days to revise said submittal and shall resubmit five copies of said revised submittal to the ENGINEER.

I. If one copy of the submittal is returned to the CONTRACTOR marked "REJECTED - RESUBMIT," the CONTRACTOR shall have five working days to revise said submittal and shall resubmit five copies of said revised submittal to the ENGINEER.

J. Fabrication of an item shall not commence before the ENGINEER has reviewed the pertinent submittals and returned copies to the CONTRACTOR marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." Revisions indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra Work.

K. All CONTRACTOR submittals shall be reviewed by an authorized representative of the CONTRACTOR prior to submission to the ENGINEER. Each submittal shall be dated, signed, and certified by the CONTRACTOR as being correct. No consideration for review by the ENGINEER of any CONTRACTOR submittals will be made for any items which have not been so certified by the CONTRACTOR. All non-certified submittals will be returned to the CONTRACTOR without action taken by the ENGINEER, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.

L. The ENGINEER'S review of CONTRACTOR submittals shall not relieve the CONTRACTOR of the entire responsibility for the correctness of details and dimensions. The CONTRACTOR shall assume all responsibility and risk for any misfits due to any errors in CONTRACTOR submittals. Any fabrication or other work performed in advance of the receipt of approved submittals shall be entirely at the CONTRACTOR'S risk and expense. The CONTRACTOR shall be responsible for the dimensions and the design of adequate connections and details.

M. Product Data

1. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, reference it to Specification Section and Paragraph number. Show reference standards, performance characteristics, and capacities; dimensions; and required clearances.

2. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the Work. Delete information not applicable.

3. Failure to follow the guidelines in paragraphs 1 and 2 above shall be grounds for rejection of CONTRACTOR submittals.

N. CONTRACTOR shall notify ENGINEER in writing, at time of submittal, of proposed deviations from requirements of Contract Documents.

1.03 CONTRACTOR'S PROJECT SCHEDULES

A. The schedule shall be comprehensive, covering both activities at the site of the Work and offsite activities such as design, procurement, and fabrication. The schedule shall be orderly and realistic and shall be revised as necessary to meet this requirement. The CONTRACTOR shall promptly advise the COUNTY and ENGINEER of any occurrence that may impact the schedule. No revision to the schedule can be made without approval from the COUNTY and ENGINEER.

B. The detailed schedule and each revision thereof shall be subject to approval by the COUNTY and ENGINEER for conformity with the requirements of the Contract Documents. The CONTRACTOR shall assist the COUNTY and/or ENGINEER in reviewing and evaluating each schedule furnished. Disapproved schedules returned to the CONTRACTOR shall be revised to correct the defects noted and shall be resubmitted to the COUNTY within five (5) calendar days after receipt.

C. When required to perform and complete the changed Work in accordance with the revised schedule, the CONTRACTOR shall provide additional labor, materials, equipment, or other factors of production in excess of those in use before the changed Work was ordered.

1.04 SAMPLES

A. Unless otherwise specified, whenever in the Specifications samples are required, the CONTRACTOR shall submit one sample of each such item or material to the ENGINEER for approval at no additional cost to the COUNTY.

B. Samples, as required herein, shall be submitted for approval a minimum of 15 working days prior to ordering such material for delivery to the job site and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the WORK.

C. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and manufacturer's names for identification and submittal to the ENGINEER for approval.

D. Unless otherwise specified, all colors and textures of specified items will be selected by the COUNTY from the manufacturer's standard colors and standard product lines.

1.05 RECORD DRAWINGS

A. CONTRACTOR's Record Drawings shall be maintained in accordance with this Section, Section 01 70 30, and the General Conditions. The CONTRACTOR shall keep and maintain at the job site one set of draft Record Drawings.

1. On these, the CONTRACTOR shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction.

2. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated or which were not indicated on the Contract Drawings.

3. Said Record Drawings shall be supplemented by any detailed sketches or typewritten changes to the Specifications, as necessary or directed, to indicate fully the Work as actually constructed.

4. These master Record Drawings shall be the CONTRACTOR's representation of as-built conditions, including all revisions made necessary by addenda, change orders, and the like.

5. Record Drawings shall be maintained up-to-date during the progress of the Work and available for inspection by the PROJECT MANAGER and ENGINEER.

B. In the case of those drawings which depict the detail requirements for equipment to be assembled as wired in the factory, such as motor control centers and the like, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision number.

C. Record drawings shall be accessible to the ENGINEER at all times during the construction period and shall be delivered to the ENGINEER, upon completion of the WORK prior to final acceptance of project.

D. Application for Payment will not be approved if the record drawings are not kept up to date.

E. Final payment will not be approved until the CONTRACTOR prepared record drawings have been approved by the ENGINEER. Record drawings may be in the form of a set of prints with carefully plotted information overlaid in red pencil or in electronic format compatible with AutoCAD 2007.

F. Upon Substantial Completion of the Work and prior to final acceptance, the CONTRACTOR shall complete and deliver a preliminary set of Record Drawings and Pipe Route Survey Table to both the PROJECT MANAGER and ENGINEER for review, conforming to the construction records of the CONTRACTOR.

1. The CONTRACTOR shall take care in reviewing the preliminary Record Drawings and Pipe Route Survey Data Table for accuracy and completeness.

2. If more than one review of the Record Drawings and Pipe Route Survey Data Table is required, the CONTRACTOR shall reimburse the COUNTY for the time-and-materials cost for the ENGINEER's subsequent reviews.

3. The Record Drawings shall be generated using AutoCAD 2007 computer software and consist of corrected plans showing the reported location of the Work.

4. Upon the ENGINEER's acceptance of the Record Drawings, the CONTRACTOR shall provide five (5) complete sets of Record Drawings to the ENGINEER.

5. The information submitted by the CONTRACTOR will be assumed to be reliable, and the ENGINEER will not be responsible for the accuracy of such information, nor for any errors or omissions, which may appear on the Record Drawings as a result.

1.06 PROGRESS REPORTS

A. A progress report shall be furnished to the OWNER with each Application for Payment. If the WORK falls behind schedule, the CONTRACTOR shall submit additional progress reports at such intervals as ENGINEER may request.

B. Each progress report shall include sufficient narrative to describe any current and anticipated delaying factors, their effect on the construction schedule, and proposed corrective actions. Any WORK reported complete, but which is not readily apparent to the ENGINEER, must be substantiated with satisfactory evidence.

C. Each progress report shall include a list of the activities completed with their actual start and completion dates, a list of the activities currently in progress, and the number of working days required to complete each.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 40 00

QUALITY CONTROL

PART 1 - GENERAL

1.01 SITE INVESTIGATION AND CONTROL

A. CONTRACTOR shall verify all dimensions in the field and check field conditions continuously during construction. CONTRACTOR shall be solely responsible for any inaccuracies built into the WORK due to CONTRACTOR's failure to comply with this requirement.

B. CONTRACTOR shall inspect related and appurtenant WORK and report in writing to ENGINEER any conditions which will prevent proper completion of the WORK. Failure to report any such conditions shall constitute acceptance of all site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the CONTRACTOR at CONTRACTOR's sole cost and expense.

1.02 INSPECTION OF THE WORK

A. All work performed by the CONTRACTOR shall be inspected by the CONTRACTOR and nonconforming WORK shall be noted and promptly corrected. The CONTRACTOR is responsible for the WORK conforming to the Contract Documents.

B. The WORK shall be conducted under the general observation of the ENGINEER and is subject to inspection by representatives of the COUNTY acting on behalf of the COUNTY to ensure compliance with the requirements of the Contract Documents. Such inspection may include mill, plant, shop, or field inspection, as required. The ENGINEER or any inspector(s) shall be permitted access to all parts of the WORK, including plants where materials or equipment are manufactured or fabricated.

C. The presence of the ENGINEER or any inspector(s), however, shall not relieve the CONTRACTOR of the responsibility for the proper execution of the WORK in accordance with all requirements of the Contract Documents. Compliance is a duty of the CONTRACTOR, and said duty shall not be avoided by any act or omission on the part of the ENGINEER or any inspector(s). Inspection of WORK, later determined to be nonconforming shall not be cause or excuse for acceptance of the nonconforming WORK. The acceptance of nonconforming WORK shall be approved by the OWNER when adequate compensation is offered and it is in the OWNER's best interest.

D. All materials and articles furnished by the CONTRACTOR shall be subject to inspection, and no materials or articles shall be used in the WORK until they have been inspected and accepted by the ENGINEER or other designated representative. No WORK shall be backfilled, buried, cast in concrete, hidden, or otherwise covered until it has been inspected. Any WORK so covered in the absence of inspection shall be subject to uncovering at the CONTRACTOR's expense. Where uninspected WORK cannot be uncovered, such as in concrete cast over reinforcing steel, all such WORK shall be subject to demolition, removal, and reconstruction under proper inspection and no additional payment will be allowed.

1.03 TIME OF INSPECTION AND TESTS

Any samples and test specimens required under these Specifications shall be furnished and prepared for testing in ample time for the completion of the necessary tests and analyses before said articles or materials are to be used. CONTRACTOR shall furnish and prepare all required test specimens at CONTRACTOR's own expense. Whenever the CONTRACTOR is ready to backfill, bury, cast in concrete, hide, or otherwise cover any WORK under this Contract, the ENGINEER shall be notified not less than 24 hours in advance to request inspection before beginning any such WORK of covering. Failure of the CONTRACTOR to notify the ENGINEER at least 24 hours in advance of any such inspections shall be reasonable cause for the ENGINEER to order a sufficient delay in the CONTRACTOR's schedule to allow time for such inspection, any remedial, or corrective work required, and all costs of such delays, including its impact on other portions of the WORK, shall be borne by the CONTRACTOR.

1.04 SAMPLING AND TESTING

A. When not otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered. However, the OWNER reserves the right to use any generally-accepted system of inspection which, in the opinion of the ENGINEER, will ensure the COUNTY that the quality of the workmanship is in full accord with the Contract Documents.

B. Any waiver of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any technical or qualitative requirements of the Contract Documents.

C. Notwithstanding the existence of such waiver, the ENGINEER shall reserve the right to make independent investigations and tests as specified in the following paragraph and, upon failure of any portion of the WORK to meet any of the qualitative requirements of the Contract Documents, shall be reasonable cause for the ENGINEER to require the removal or correction and reconstruction of any such WORK.

D. In addition to any other inspection or quality assurance provisions that may be specified, the ENGINEER shall have the right to independently select, test, and analyze, at the expense of the OWNER, additional test specimens of any or all of the materials to be used. Results of such tests and analyses shall be considered along with the tests or analyses made by the CONTRACTOR to determine compliance with the applicable specifications for the materials so tested or analyzed provided that wherever any portion of the WORK is discovered, as a result of such independent testing or investigation by the ENGINEER, which fails to meet the requirements of the Contract Documents, all costs of such independent inspection and investigation and all costs of removal, correction, reconstruction, or repair of any such WORK shall be borne by the CONTRACTOR.

1.05 RIGHT OF REJECTION

A. The ENGINEER or designated representative, acting for the OWNER, shall have the right at all times and places to reject any articles or materials to be furnished hereunder which, in any respect fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the WORK at the site. If the ENGINEER or designated representative, through an oversight or otherwise, has accepted materials or WORK which is defective or which is contrary to the Contract Documents, such material, no matter in what stage or condition of manufacture, delivery, or erection, may be rejected.

B. CONTRACTOR shall promptly remove or replace rejected articles or materials from the site of the WORK after notification of rejection.

C. All costs of removal and replacement of rejected articles or materials, as specified herein, shall be borne by the CONTRACTOR.

D. Failure to promptly remove and replace rejected work shall be considered a breech of this specification and the COUNTY may after 7 days notice, terminate the CONTRACTOR'S right to proceed with the affected work and remove and replace the WORK and issue a backcharge to cover the cost of the WORK.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 50 00

SITE CONDITIONS SURVEYS

PART 1 - GENERAL

1.01 SUMMARY

A. The CONTRACTOR shall perform, or obtain other professional subcontractors to complete topographic surveys that meet the minimum standards of Chapter 61-G17 of the Florida Administrative Code, to document elevations, grades, locations, maintain survey control during construction, and perform related field engineering as specified in the Contract Documents.

B. The CONTRACTOR shall provide civil, structural or other professional engineering services specified or required to execute the CONTRACTOR'S construction methods.

1.02 SURVEY REFERENCE POINTS

A. The CONTRACTOR shall locate reference points prior to starting WORK and CONTRACTOR shall protect and preserve all permanent reference points during construction.

1. CONTRACTOR shall make no changes or relocate any reference point without prior written notice to the ENGINEER.

2. CONTRACTOR shall report to the ENGINEER when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

3. CONTRACTOR, at no additional cost to the OWNER, shall replace and resurvey reference points that have been lost or destroyed. The replaced reference point shall be surveyed by a Florida licensed professional land surveyor. Replacement will be based on original survey control.

B. Prior to any WORK, the CONTRACTOR shall immediately notify the ENGINEER of any discrepancies with the reference points from the coordinates and elevations provided.

C. The CONTRACTOR shall be responsible for the preservation of all benchmarks, stakes, and marks. If any benchmarks, stakes, or marks are disturbed by the CONTRACTOR, the CONTRACTOR shall not proceed with any WORK until he has established such points, marks, lines and elevations as may be necessary for the prosecution of the WORK.

1. The accuracy of any method of staking shall be the responsibility of the CONTRACTOR. All engineering for vertical and horizontal control shall be the responsibility of the CONTRACTOR.

1.03 SURVEY DATA

All field books, notes, as-built pipe slope calculations, photographs, sketches and other data developed by the CONTRACTOR in performing the surveys required by the Work shall be available to the ENGINEER and PROJECT MANAGER for examination throughout the construction period. All such data shall be submitted to the PROJECT MANAGER with documentation required for final acceptance of the Work.

1.04 RECORD DRAWINGS

A. All survey record documents, submitted to the ENGINEER for approval, shall be signed and sealed by a professional land surveyor licensed in the State of Florida.

B. Submitted survey record documents shall include the following:

1. As stages of the WORK are completed, submit a site survey, signed and sealed by a Florida licensed professional surveyor. The Record Drawing information shall be submitted on 24-inch by 36-inch sheets, as well as AutoCAD drawing files on CD-ROM.

2. AutoCAD drawing file requirements: Contour lines shall be continuous, unbroken polylines with a width of zero and an elevation (z-coordinate) assigned according to the elevation of the contour line. All spot elevations shall have horizontal controls with vertical z-coordinates. Contours shall be at 1-foot intervals, with index contours at every fifth interval. Objects in the Record Drawing shall be drawn to scale.

3. All survey information submitted shall be on the State Coordinate System.

4. All submitted Record Drawings shall survey monuments shown on the Drawings for the purposes of orientation, both horizontally and vertically.

5. If multiple sheets are required for the Record Drawings, each sheet shall include match lines.

1.05 SUBMITTALS

A. The CONTRACTOR shall submit the name and address of the registered professional land surveyor licensed in the State of Florida to the ENGINEER.

B. Upon request of the ENGINEER, the CONTRACTOR shall submit documentation signed by the licensed surveyor in the State of Florida, certifying that elevations and locations of improvements are in conformance with the

Contract Documents, or if not in conformance, certifying variances from the Contract Documents.

C. The CONTRACTOR shall include a survey site plan and pipe route survey table with the Record Drawings showing coordinates and elevations of all leachate collection system tie-ins, wellheads, condensate sumps/traps, valves, electrical work, flare station, air compressor, etc., and piping installed.

1. Piping shall be located every 50 feet and at grade breaks and changes in pipe slope and direction, fittings, tie-ins, appurtenances, etc., as required for the conformance survey.

2. For pipe runs of 100 feet or less, the pipe shall be located a minimum of every 20 feet.

3. For pipe runs 20 feet or less, the pipe shall be located a minimum of three times.

4. Coordinates and elevations shall be included in the survey for pipe fittings, changes in pipe slope and direction, valves, buried flanges, appurtenances and other similar connections to the header piping, and the ground surface at each tie-in to the leachate collection and removal system and appurtenance, and for all pipe location shots.

5. All locations shall be shown in the coordinate system identical to that used for the Construction Drawings.

6. A Florida Licensed Professional Surveyor shall certify all survey work pertaining to the Record Drawings.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 RECORD KEEPING/AS-BUILTS

A. The surveyor shall maintain a complete, accurate log of all control and survey WORK as it progresses. This log shall be available for periodic review by the ENGINEER.

B. Grade elevations and locations will be required at certain phases (or stages) of construction. The CONTRACTOR'S Florida Licensed Professional Surveyor will provide and maintain as-built notes and a finished as-built drawing at the completion of each phase as listed in Paragraph 1.03 of this Section. Each phase must be accepted by the ENGINEER in writing before the start of the next phase. Record Drawings reflecting elevations and location information shall be submitted to the ENGINEER.

3.02 TOLERANCES

A. General elevations and grade shall have a tolerance of 0.1 feet vertical and 0.5 feet horizontal with the following exceptions:

1. A stated specific elevation shall be constructed to that exact elevation.

2. If a minimum thickness of material is required then that thickness shall be met and not subject to a tolerance.

3.03 PHOTOGRAPHIC RECORD

A. Preliminary Photos: The CONTRACTOR shall also provide a photographic record of the project site prior to the start of any work. At a minimum, the photographic record shall consist of two sets of 48 photographs, each 4 inches by 6 inches. Significant items (i.e., roads, wells, and vegetation) shall be chosen for a record of the initial site conditions. The back of each photograph shall include project name, view orientation, the date the picture was taken, name of photographer, and a brief description of the activity covered in the picture.

B. Progress Photos: The CONTRACTOR shall provide a photographic record of construction progress every other week to the ENGINEER. At a minimum, the photographic record shall consist of two sets of 12 color photographs, each 4 inches by 6 inches and a CD containing the photographic images. The ENGINEER shall reserve the right to select the views to be photographed. The back of each photograph shall include project name, view orientation, the date the picture was taken, name of photographer, and a brief description of the activity covered in the picture. Polaroid or similar instant type photographs will not be acceptable, nor will video recordings.

END OF SECTION

SECTION 01 50 05

MOBILIZATION AND DEMOBILIZATION

PART 1 - GENERAL

1.01 DEFINITION AND SCOPE

A. Mobilization shall include the obtaining of all permits, bonds, and insurance; transportation to the site of all equipment and construction facilities; and all other preparatory work and operations required for the proper performance, clean-up, and completion of the WORK. Mobilization shall include the following:

1. Move onto the site all CONTRACTOR's equipment and materials required for the project.

2. Provide on-site sanitary facilities, utilities, and potable water for CONTRACTOR uses.

3. Established fire protection and safety program.

4. Arrange for and erect CONTRACTOR's work and storage yard and employees' parking facility as directed by the OWNER.

5. Submit all required insurance certificates and bonds.

6. Obtain all required permits.

7. Post all OSHA, EPA, Department of Labor, and all other required notices.

8. Submit a detailed construction schedule acceptable to the OWNER.

9. Submit a finalized Schedule of Values of the WORK.

10. Submit a finalized Schedule of Submittals.

B. Demobilization includes removing from the site any private or public properties which are accessed by the CONTRACTOR to perform the WORK, all resources, equipment, materials, temporary support facilities, utilities, and all remaining construction debris at the completion of the project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 50 30

PROTECTION OF EXISTING FACILITIES

PART 1 - GENERAL

1.01 GENERAL

A. CONTRACTOR shall protect all existing utilities and improvements not designated for removal and restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with requirements specified herein, and in accordance with the requirements of the Contract Documents.

B. CONTRACTOR shall determine the exact locations and depths of all utilities indicated on the drawings which affect the WORK. In addition to those indicated, CONTRACTOR shall make exploratory excavations of all utilities. All such exploratory excavations shall be performed as soon as practicable after award of Contract and, in any event, a sufficient time in advance of construction to avoid possible delays to CONTRACTOR's WORK. When such exploratory excavations show the utility location as indicated on the drawings to be in error, CONTRACTOR shall so notify ENGINEER. CONTRACTOR shall notify ENGINEER 48 hours prior to performing any exploratory excavations.

C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and depth of the utility.

1.02 RIGHTS-OF-WAY

CONTRACTOR shall not do any WORK that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, fiber optic, or electric transmission line; any fence; or any other structure, nor shall CONTRACTOR enter upon the rights-of-way involved until notified by the ENGINEER that the OWNER has secured authority therefor from the property owner. After authority has been obtained, CONTRACTOR shall give said owner due notice of CONTRACTOR intention to begin WORK, and shall give said owner convenient access and every facility for removing, shoring, supporting, or otherwise protecting such pipeline, transmission line, ditch, fence, or structure and for replacing same. When two or more Contracts are being executed at one time on the same or adjacent land in such manner that WORK on one Contract may interfere with that on another, the COUNTY shall decide which CONTRACTOR shall have priority to perform and in what manner. When the territory of one Contract is the necessary or convenient means of access for the execution of another Contract, such privilege of access or any other reasonable privilege may be granted by the OWNER to the CONTRACTOR so desiring, to the extent, amount, manner, and times permitted. No such decision regarding the method or time of conducting the WORK or the use of territory shall be made the basis of any claim for delay or damage.

1.03 EXISTING UTILITIES AND IMPROVEMENTS

A. CONTRACTOR shall protect all utilities and other improvements which may be impaired during construction operations. It shall be CONTRACTOR's responsibility to ascertain the actual location of all existing utilities and other improvements indicated on the drawings that will be encountered in his construction operations, and to see that such utilities or other improvements are adequately protected from damage due to such operations. CONTRACTOR shall take all possible precautions for the protection of unforeseen utility lines for uninterrupted service and such special protection as may be directed by the ENGINEER.

B. In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon proper application by the CONTRACTOR, be notified by the ENGINEER to move such property within a specified reasonable time. CONTRACTOR shall not interfere with said property until after the expiration of the time stipulated.

C. The right is reserved to the OWNER and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the WORK of this Contract.

D. Existing utility lines that are shown on the drawings or the locations of which are made known to the CONTRACTOR prior to excavation that are to be retained and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired by CONTRACTOR at CONTRACTOR's expense.

E. If CONTRACTOR damages any existing utility lines that are not shown on the drawings or the locations of which are not made known to CONTRACTOR prior to excavation, or were, or could not have been verified or located by the CONTRACTOR prior to starting WORK, a written report thereof shall be made immediately to the ENGINEER.

F. All repairs to a damaged improvement shall be inspected and approved by an authorized representative of the improvement before being concealed by backfill or other WORK.

G. Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing utility or other improvement which is shown on the drawings, CONTRACTOR shall at CONTRACTOR's own expense, remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the ENGINEER and the OWNER of the facility. In all cases of temporary removal or relocation, restoration to former location shall be accomplished by CONTRACTOR in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

H. All pipelines, power, telephone, fiber optic, or other communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the WORK shall be maintained continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the ENGINEER are made with the OWNER of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, wire, or cable. CONTRACTOR shall be responsible for and shall make good all damage due to CONTRACTOR's operations and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

1.04 SUBSURFACE OBSTRUCTIONS

A. CONTRACTOR shall field determine, before pipeline trenching and associated excavations are begun, the depth and location of existing utilities. Utility locations indicated on the plans were obtained from the records available, but have not been field verified, nor have depths been measured or observed. CONTRACTOR shall submit descriptions, depths, and locations of subsurface obstructions to the ENGINEER for review.

B. In excavation, backfilling, and laying pipe, care shall be taken not to remove, disturb, or injure existing pipes, conduits, or structures. If necessary, CONTRACTOR at his own expense shall sling, shore-up, and maintain such structures in operation.

C. CONTRACTOR shall obtain the permission of and give sufficient notice to the proper authorities of CONTRACTOR's intention to remove or disturb any pipe, conduit, etc., and shall abide by their regulations governing such WORK.

D. In the event subsurface structures are broken or damaged in the execution of the WORK, CONTRACTOR shall immediately notify the proper authorities and, at the option of said authorities, either repair the damage at once at his own expense or pay the proper charges for repairing said damage. Repairs shall be made to the satisfaction of the ENGINEER. CONTRACTOR shall be responsible for any damage to persons or property caused by such breaks or due to his own neglect in reporting and/or repairing such damages.

E. OWNER or ENGINEER will not be liable for any claims made by the CONTRACTOR based on underground obstructions that could have been reasonably identified as being different than that indicated on the plans. CONTRACTOR shall uncover subsurface obstructions in advance of construction so that the method of avoiding same may be determined before the work reaches the obstruction.

1.05 CONFLICTS WITH OTHER UTILITIES

A. CONTRACTOR shall coordinate and cooperate with the OWNER to ensure that no damages to existing utilities occur.

B. All temporary support or minor adjustment which does not require replacement or direct bypass connections to these existing services (such as all direct-buried telephone cables or two-inch and smaller gas lines) will be the responsibility of the CONTRACTOR.

C. OWNER will not be responsible for any delay or inconvenience to the CONTRACTOR resulting from the existence, removal, or adjustment of any public or private utility that could have been reasonably identified. Additional costs incurred as a result thereof shall be borne by the CONTRACTOR and considered as included in the Contract Price.

1.06 EXISTING FENCE

A. Any fence removed or temporarily relocated shall be restored to its original condition and location.

B. All cost for such temporary removal or replacement shall be included as indicated in the unit prices bid. No direct payment will be made for fence replacement unless specifically noted otherwise.

1.07 UTILITY INVESTIGATION

A. Prior to commencing with trench or other excavations required for the performance of the WORK, CONTRACTOR shall conduct a field investigation for the purpose of determining existing locations of all underground utilities and facilities which are shown on the drawings. The investigation shall be made by hand or machine excavation. All such excavations shall include removal of surface material and obstructions required to perform the excavations. CONTRACTOR shall provide sheeting, shoring, and bracing, as required, to minimize the required size of the excavation and support adjacent ground, structures, roadways, and utilities. After the data is obtained at each excavation site, CONTRACTOR shall immediately backfill each excavation site. Backfill shall be compacted sand for the full depth. The surface shall be returned to its original grade and condition except that paved areas may be temporarily surfaced and maintained where excavations required for the performance of the WORK coincide with the location of the investigative location. CONTRACTOR shall be responsible for all costs associated with repair of roadways, paving, structures, underground and above ground utilities and facilities damaged in conducting the investigations.

B. Findings of the investigation shall be reported to the ENGINEER. The ENGINEER shall furnish two sets of full-size blueline drawings for CONTRACTOR's field use in recording the findings of the investigation and for CONTRACTOR's office use in transcribing the field investigation information onto same for submission to the ENGINEER. CONTRACTOR shall clearly designate all found utilities and facilities discovered whether or not shown on the Contract Drawings. CONTRACTOR shall provide written detailed description of any underground utility or facility conflicting with the elevation or alignment of the WORK.

C. CONTRACTOR shall describe size, material, and location of existing underground utilities and facilities. Locations and elevations shall be referenced to project stationing, distance from base line, and project bench marks.

1.08 PROTECTION OF EXISTING LANDFILL

A. The CONTRACTOR shall use extreme care during construction activities on or near the landfill to not damage any existing features.

B. Assistance will be given to the CONTRACTOR in determining the toe of the landfill as needed to avoid damage to the liner and existing features. CONTRACTOR shall not penetrate the liner and it shall be the CONTRACTOR's responsibility and liability in maintaining the integrity of the liner. This assistance shall in no way relieve the CONTRACTOR from responsibility and liability in maintaining site conditions.

C. Any damage resulting from the CONTRACTOR's operations shall be repaired by the CONTRACTOR to original conditions or replaced with new materials at no additional cost to the OWNER. Repairs shall be as directed by the ENGINEER with approved materials.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 50 50

SITE ACCESS AND TRAFFIC CONTROL

PART 1 – GENERAL

1.01 HIGHWAY LIMITATIONS

CONTRACTOR shall make an investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the WORK. It shall be CONTRACTOR's responsibility to construct and maintain at CONTRACTOR's own expense any haul roads required for its construction operations.

1.02 SITE ACCESS

CONTRACTOR's access to the construction site, including all employees, subcontractors, and material deliveries, shall be through the existing main gate entrance, unless otherwise approved by the OWNER.

1.03 CONTRACTOR'S WORK AND STORAGE AREA

A. The ENGINEER will designate and arrange for CONTRACTOR to use a portion of site property as a storage and shop area for CONTRACTOR's construction operations during the term of the Contract, subject to approval by the OWNER.

B. The CONTRACTOR will be permitted to store equipment needed for the immediate work on hand adjacent to the work area as approved by the ENGINEER. Equipment not in use will be returned to the appropriate CONTRACTOR's staging area. All equipment booms shall be lowered at the close of each day's work or when stored.

C. All equipment will be parked in the staging area at the close of work each day and whenever it is not in use. Provide temporary parking areas to accommodate construction and OWNER's personnel.

D. The CONTRACTOR (and his Subcontractors) shall provide all necessary temporary fencing and gates to protect materials and equipment from vandalism. The OWNER will not be responsible for any vandalized equipment or material stored on the property.

E. Any area occupied by the CONTRACTOR shall be maintained in a clean and orderly condition satisfactory to the OWNER. Particular attention shall be given to the elimination of rubbish or debris in the areas and none shall be left exposed overnight or at other periods of time the work is shut down.

F. At the completion of the Contract, all CONTRACTOR's and Subcontractor's facilities will be removed promptly in a workmanlike manner and the area left clean and free of all debris or surplus material.

G. No employees' vehicles will be permitted at the work site, but shall be parked in the staging area or area designated by the OWNER.

H. CONTRACTOR shall make arrangements for any offsite storage or shop areas necessary for the proper execution of the WORK hereunder, and all costs therefor shall be borne by the CONTRACTOR.

I. CONTRACTOR shall remove temporary equipment and facilities when no longer required and shall restore grounds to original or specified conditions.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 50 60

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 – GENERAL

1.01 DUST ABATEMENT

CONTRACTOR shall furnish all labor, equipment, and means required and shall carry out effective dust abatement measures wherever and as often as necessary and as directed by the PROJECT MANAGER to prevent CONTRACTOR's operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals or causing a nuisance to persons living in or occupying buildings in the vicinity or as directed by PROJECT MANAGER. CONTRACTOR shall be responsible for any damage resulting from any dust originating from CONTRACTOR's operations. The dust abatement payment measures shall be continued until CONTRACTOR is relieved of further responsibility by the PROJECT MANAGER. No separate payment will be allowed for dust abatement measures and all costs therefor shall be included in the CONTRACTOR's Bid Price.

1.02 RUBBISH CONTROL

During the progress of the WORK, CONTRACTOR shall keep the site of the WORK and other areas used by the CONTRACTOR in a neat and clean condition and free from any accumulation of rubbish. CONTRACTOR shall dispose of all rubbish and waste materials of any nature occurring at the WORK site and establish regular intervals of collection and disposal of all such materials and waste. Equipment and material storage shall be confined to areas approved by the PROJECT MANAGER. Disposal of rubbish and surplus materials shall at the CONTRACTOR's expense, according to Section 02 41 16, Refuse Handling, Storage, and Disposal, and in accordance with local codes and ordinances governing locations and methods of disposal, in conformance with all applicable safety laws, and to the particular requirements of Subpart H, Section 1926.252 of the OSHA Standards for Construction.

1.03 TEMPORARY DRAINAGE PROVISIONS

CONTRACTOR shall provide for the drainage of stormwater and such water as may be applied or discharged on the site in performance of the WORK. Stormwater drainage and dewatering shall be conveyed to the temporary sediment basins shown on the Drawings. Drainage provisions shall be adequate to prevent damage and turbidity problems to the WORK, the site, and adjacent property. CONTRACTOR shall repair construction impacts to the existing drainage swales to a pre-construction condition at no additional cost to the COUNTY.

1.04 POLLUTION CONTROL

CONTRACTOR shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 01 60 00

MATERIAL AND EQUIPMENT

PART 1 – GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

A. CONTRACTOR furnished materials and equipment shall be new and shall not have been in service at any other installation unless otherwise provided. Material and equipment shall conform to applicable specifications unless otherwise approved in writing by the ENGINEER.

B. Fabricated and manufactured products shall be designed, fabricated, and assembled in accordance with the best engineering and shop practices. Like parts of duplicate units shall be manufactured to standard sizes and gauges to be interchangeable.

C. Two or more things of the same kind shall be identical, by the same manufacturer.

D. Products shall be suitable for the intended service conditions.

E. Equipment dimensions, sizes, and capacities shown or specified shall be adhered to unless variations are specifically approved in writing by the ENGINEER.

F. Equipment and material shall not be used for any purpose other than that for which it is specified or designed.

G. Where equipment or material is specifically shown or specified to be reused in the Work, special care shall be used in removal, handling, storage, and reinstallation, to assure proper function in the completed Work. Any items specified to be reused that are damaged by the CONTRACTOR shall be replaced with new units at no additional cost to the OWNER.

H. CONTRACTOR shall arrange for transportation, storage, and handling of products which require off-site storage, restoration, or renovation.

I. Installation of all WORK shall comply with manufacturer's printed instructions. All equipment and products shall be handled, installed, connected, cleaned, conditioned, and adjusted in accordance with the manufacturer's instructions and specified instructions. Should specified requirements or job conditions conflict with the manufacturer's instructions, these conflicts shall be called to the ENGINEER's attention for review and revised instructions.

J. All materials and equipment which are furnished and/or installed by the CONTRACTOR shall be guaranteed. The guarantee shall be against manufacturing and/or design inadequacies, materials and workmanship not in conformity with the paragraph above, hidden damage, improper assembly, failure of device and/or components, excessive leakage or other circumstances which would cause the equipment to fail under normal design and/or specific operating conditions for a period of one year or a longer period as may be shown and/or specified from the date of acceptance of the equipment by the OWNER. If a piece of equipment, device, or component fails within the above specified term of the guarantee, it shall be replaced and installed with reasonable promptness by the CONTRACTOR without cost to the OWNER.

1.02 TRANSPORTATION AND HANDLING

A. Equipment and materials shall be loaded and unloaded by methods affording adequate protection against damage. Precaution shall be taken to prevent injury to the equipment or materials during transportation and handling. Suitable equipment will be used and the materials or equipment shall be under control at all times. Under no condition shall the material or equipment be dropped, bumped, or dragged. When a crane is used, a suitable hook or lift sling shall be used. The crane shall be placed so that all lifting is done in a vertical plane.

B. Equipment and materials shall be delivered to the job site by means that will adequately support it and not subject it to undue stress.

1.03 STORAGE AND PROTECTION

A. All equipment, products, and materials shall be stored in accordance with the manufacturer's instructions, with seals and labels intact and legible. Humidity and temperature shall be maintained within the ranges required by the manufacturer's instructions.

1. Products subject to damage by the elements shall be stored in weather-tight enclosures.

2. Fabricated products shall be stored above the ground on blocks or skids.

3. Products which are subject to deteriorations shall be covered with impervious coatings with adequate ventilation to avoid condensation.

4. Loose granular materials shall be stored in a well-drained area on solid surfaces to prevent mixing with foreign matter.

5. Pipe shall be stored in a manner to prevent the entry of dirt and debris.

B. Storage shall be arranged in such a manner so as to provide easy access for inspection. Periodic inspections shall be made of all stored products to assure that they are maintained under specified conditions and free from damage or deterioration.

1.04 SALVAGED MATERIAL AND EQUIPMENT

The OWNER reserves all rights to salvage any abandoned material and equipment. Materials not used or salvaged by the OWNER shall be disposed of by the CONTRACTOR at no additional cost to the OWNER.

1.05 SUBMITTALS

CONTRACTOR shall obtain and distribute copies of the manufacturer's instructions to the parties involved in the installation, including two copies to the ENGINEER. A set of instructions also shall be available at the job site during installation and until completion. This requirement is separate from the requirements for installation and operations manual for the Record Drawings.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 01 70 10

START-UP

PART 1 - GENERAL

1.01 DESCRIPTION

A. Startup certifications are required for the condensate sumps, pumps, air compressor, blower station, and flare. Certifications include the MANUFACTURER's Check-Out Certification and the Demonstration Certification. The CONTRACTOR shall satisfy the requirements of these certifications as specified herein.

B. Related Work Described Elsewhere:

1. Section 33 21 70: LFG Extraction Wellheads
2. Section 44 11 20: Blower/Flare System
3. Section 44 42 60: Condensate Management System

PART 2 – PRODUCTS

2.01 INSTALLATION, OPERATION, AND MAINTENANCE MANUALS

A. CONTRACTOR shall supply two (2) copies of installation, operation, and maintenance manuals for the following equipment:

1. Pneumatic pump and appurtenances
2. LFG wellheads (Manufacturer's Check-Out Certification not required).
3. Air compressor and related components
4. Control panel and components
5. Blower/Flare station including information on all components

B. Manuals for each piece of equipment shall include the following:

1. Manufacturer's recommended installation procedures
2. Product specifications
3. Parts list and diagrams
4. Maintenance procedures and frequency

5. Method of operation

6. Safety precautions

7. Troubleshooting guide

8. Contact information for customer service and support

9. Name, address, phone and fax numbers for supplier of equipment

PART 3 - EXECUTION

3.01 PRELIMINARY MATTERS

A. Startup Certification: Prior to system startup, successfully complete all testing required of the individual components. Complete and submit two copies of the attached "Manufacturer's Check-Out Certification" form for the condensate sump and pump and blower/flare control panel. The submitted copies shall have signatures of the CONTRACTOR, the Subcontractor (if involved), and the Manufacturer's representative. All copies shall be provided with the respective Operation and Maintenance (O&M) Manual. This form and the O&M Manual shall be submitted prior to providing operational training to the OWNER and prior to conducting the Substantial Completion inspection.

B. Demonstrate to the ENGINEER all temporary jumpers and/or bypasses have been removed and that all components are operating under their own controls as designated.

C. Coordinate startup activities with the ENGINEER prior to commencing system start-up at least two days prior to commencing system start-up.

3.02 START-UP OF PNEUMATIC PUMPING SYSTEM

A. Confirm that all equipment is properly energized and that all switches are set to their normal operating condition.

B. Initiate start-up in accordance with the start-up sequence. This start-up sequence shall follow, exactly, the sequence in the submitted O&M manuals.

C. Observe individual component operations and make adjustments as necessary to optimize the performance of the condensate sump, pump, and drain line.

   1. Fill condensate sump with water, taking care to not introduce silt or debris.

   2. Observe air compressor operation and supply pressure.

   3. Observe pump discharge rates, liquid level sensor, cycle counters, pump rate, and other manufacturer recommended criteria.

4. Observe liquid discharge into the condensate discharge line and leachate cleanout riser.

5. Demonstrate operation of valves.

D. Coordinate with the ENGINEER before performing any adjustments that may disturb other landfill operations.

3.03 START-UP OF BLOWER/FLARE STATION

A. Confirm that all equipment is properly energized and that all switches are set to their normal operating condition.

B. Initiate start-up in accordance with the start-up sequence. This start-up sequence shall follow, exactly, the sequence in the submitted O&M manuals.

C. Observe individual component operations and make adjustments as necessary to optimize the performance of the blower/flare station and control panel.

1. Follow start-up sequence for flare.

2. Perform automatic and manual restarts.

3. Observe and document proper operation of flow meter, chart recorder, displays, gauges, valves, and warning light.

4. Perform shutdown sequence.

D. Coordinate with the ENGINEER before performing any adjustments that may disturb other landfill operations.

3.04 DEMONSTRATION AND TESTING

A. After all work components have been constructed, field tested, and started-up in accordance with the individual specifications and manufacturer requirements perform the demonstration and testing in the presence of the ENGINEER. The demonstration shall be held upon completion of all systems concurrent with the Substantial Completion inspection. Prior to the demonstration, CONTRACTOR shall indicate in writing to the ENGINEER that the WORK is complete, has been tested by the CONTRACTOR, and is ready for demonstration.

B. The demonstration and testing shall be conducted for two consecutive days. The WORK must operate successfully throughout the two-day testing period in the manner intended. If the WORK does not operate successfully, the problems shall be corrected, and the two-day test shall be restarted to Day 1. If more than two days are needed for the demonstration test, the CONTRACTOR shall reimburse the OWNER for the cost of the additional costs for the ENGINEER.

C. Acceptability of the WORK's performance will be based on the WORK performing as specified in the Contract Documents, either under actual or simulated operating conditions as approved by the ENGINEER. The intent of the demonstration and testing is for the CONTRACTOR to demonstrate to the ENGINEER that the WORK will function as a completed and operable system under normal operating conditions and is ready for acceptance.

D. In conjunction with the demonstration and testing, the CONTRACTOR shall provide a training session or sessions for a minimum of 4 hours to adequately instruct designated OWNER personnel on system start-up, operations, maintenance, shutdown, and other essential features of the system equipment.

1. The training shall detail the function of the various systems and system components and their relationships to each other.

2. System operations under typical and alarm conditions shall be demonstrated; some of these alarm conditions may be simulated (e.g., via electrical jumpers) for training purposes.

3. Prior to Substantial Completion, the CONTRACTOR shall submit for approval, a detailed agenda for the training sessions and the experience of the person(s) conducting the training.

4. Training shall be conducted during the Substantial Completion inspection, following the completion of the start-up testing.

E. Demonstration Certification: Complete and submit two copies of the attached "Demonstration Certification" form. The submitted copies shall have signatures of CONTRACTOR, the Subcontractor (if involved), and the Manufacturer's representative (if involved). All copies shall be provided with the respective O&M Manual.

MANUFACTURER'S CHECK-OUT CERTIFICATION

____ OWNER: ______________________

____ ENGINEER: ______________________ Check-out

____ CONTRACTOR: ______________________ Memo No. _____

PROJECT DATA		**CONTRACT DATA**	
NAME:	Citrus County Central Landfill		
	Landfill Gas Collection and		
	Control System		
		NUMBER:	________
LOCATION:	Citrus County Central Landfill	DATE:	________
	230 W. Gulf to Lake Highway	DRAWING #	________
	Lecanto, Florida 34461	SPECIFICATION	________
	________	SECTION:	________
COUNTY:	Citrus County		
	Solid Waste Management Division		

Name of equipment checked: ______________________________________

Name of manufacturer of equipment: ______________________________________

1. The equipment furnished by us has been checked on the job by us. We have reviewed (where applicable) the performance verification information submitted to us by the Contractor.
2. The equipment is properly installed, except for items noted below.*
3. The equipment is operating satisfactorily, except for items noted below.*
4. The written operating and maintenance information (where applicable) has been presented to the Contractor, and gone over with him in detail. At least two copies of all applicable operating and maintenance information and parts lists have been furnished to the Contractor for insertion in each of the Equipment Brochures.

Checked By:

______________________	______________________
Name of Manufacturer's Rep.	Name of General Contractor
______________________	______________________
Address and Phone No Of Rep.	Authorized Signature/Title/Date
______________________	______________________
Signature/Title/Person Making Check	Name of Subcontractor
______________________	______________________
Date Checked	Authorized Signature/Title/Date

* Manufacturer's Representative Notations - Exceptions noted at time of check were:

____

____

____

____

____

____

Manufacturer's Representative to note adequacy of related equipment that directly affects operation, performance or function of equipment checked. (No comment presented herein will indicate adequacy of related systems or equipment):

____

____

____

____

____

____

DEMONSTRATION CERTIFICATION

____ COUNTY:	____________________		
____ ENGINEER:	____________________	Check-out	
____ CONTRACTOR:	____________________	Memo No. _____	

PROJECT DATA		**CONTRACT DATA**	
NAME:	Citrus County Central Landfill		
	Landfill Gas Collection and		
	Control System		
		NUMBER:	____________
LOCATION:	Citrus County Central Landfill	DATE:	____________
	230 W. Gulf to Lake Highway	DRAWING #	____________
	Lecanto, Florida 34461	SPECIFICATION	____________
		SECTION:	____________
COUNTY:	Citrus County		
	Solid Waste Management Division		

NOTE TO CONTRACTOR:

Submit two copies of all information listed below under (a) and (b) for review at least two days before scheduled demonstration of the Work. After all information has been approved by the ENGINEER, give the OWNER a Demonstration of Completed Systems as specified and have the OWNER sign two copies of this form. After this has been done, a written request for a final inspection of the system shall be made by the CONTRACTOR.

MEMORANDUM:

Approval of this certificate indicates that the OWNER has been given a Demonstration of Completed Systems on the Work covered under this Specification Section. Operation of the overall system and of major equipment items were described and demonstrated. The following items were given to the OWNER:

(a) OWNER's two copies of Operation and Maintenance Manuals for equipment or systems specified under this section containing approved submittal sheets on all items, including the following:

(1) Maintenance information published by manufacturer on equipment items.

(2) Printed warranties by manufacturers on equipment items.

(3) Check-Out Certification on equipment signed by manufacturer's representative.

(4) Written operating instructions on any specialized items.

(5) Explanation of guarantees and warranties on the system.

(b) Record documentation showing as-built conditions.

(c) A demonstration/training session presenting system operation and maintenance procedures.

____
(Name of Contractor)

By: ____
(Authorized Signature, Title & Date)

____
(Name of Subcontractor)

By: ____
(Authorized Signature, Title & Date)

Received the following: Operations and Maintenance manual, as-built documentation, demonstration and instructions on system operation

____
(Citrus County)

By: ______________________________
(Authorized Signature, Title & Date)

END OF SECTION

SECTION 01 70 20

CONTRACT CLOSEOUT

PART 1 – GENERAL

1.01 COMPLETION PROCEDURES

A. Substantial Completion shall be when, in the opinion of the ENGINEER and OWNER, all work is completed to provide for the safe, proper, and complete use or operation of the facility as intended.

B. When the CONTRACTOR believes Substantial Completion has been achieved, CONTRACTOR shall request, in writing, to the ENGINEER, that Substantial Completion be recognized as having been achieved and request that the COUNTY issue a Certificate of Substantial Completion. Prior to making such a request, the CONTRACTOR must:

1. Completed all WORK necessary to comply with the Contract Documents.

2. Submit and receive acceptance of accurate Record Drawings for all WORK completed to date.

3. Submit and receive acceptance of all specified warranties, guaranties and operation and maintenance manuals.

4. Complete all required vendor training, testing, and where required, start-up.

5. Deliver all required spare parts.

C. Upon receipt of the request from the CONTRACTOR, the ENGINEER shall review the request and inspect the WORK relative to the above requirements to determine whether the CONTRACTOR has achieved Substantial Completion. If this inspection fails to support Substantial Completion, the ENGINEER shall so notify the CONTRACTOR in writing citing the reasons for rejection. If the ENGINEER determines the CONTRACTOR has reached Substantial Completion, the following procedures will be followed:

1. The ENGINEER will review the WORK and the CONTRACTOR's punch list to assure all remaining deficiencies are noted on a final punch list.

2. The ENGINEER will schedule and conduct a pre-final walk-through of the system with the OWNER's representatives, the CONTRACTOR and others, for the purpose of formally reviewing the WORK and the final punch list. A copy of the final punch list will be provided to all participants and any additional items noted during the walk-through will be added to the list.

3. Upon completion of the pre-final walk-through the ENGINEER shall prepare a request to the OWNER requesting they establish the date for Substantial Completion as the date of the walk-through, provided the walk-through has verified that the construction is in fact Substantially Complete. Upon approval of this request by the OWNER, the construction will be considered Substantially Complete.

D. Final Completion will be deemed to have occurred when all WORK is completed in accordance with the Contract Documents including the following:

1. All final punch list items have been corrected, signed off by the CONTRACTOR, the ENGINEER and demonstrated during a final walk-through.

2. All updates to the Record Drawings have been made.

3. Demobilization and site cleanup are complete.

4. All facilities and/or equipment have been properly demonstrated to be functioning as required.

5. The ENGINEER has issued a Certificate of Final Completion.

1.02 START-UP PROCEDURES

A. CONTRACTOR is responsible for the complete test, checkout, and start-up preparation of the project. The CONTRACTOR shall verify these activities through daily inspection reports, test records, on-site vendor certifications, and by other appropriate means.

1. Component test and check out is the verification that each component of the WORK is in compliance with the Contract Documents, and is ready to perform its intended function.

2. Start-up preparation is preparing the entire project to be placed into service.

B. CONTRACTOR shall conduct all test, check out, and start-up requirements specified in the Contract Documents and provide documentation of same to the ENGINEER prior to start-up. Where vendor on-site inspections are required prior to or during start-up, the CONTRACTOR shall require each vendor to provide a written statement that the installation and check out is complete and proper and that the item(s) are ready for start-up.

1.03 CLOSE-OUT PROCEDURE

A. ENGINEER, OWNER, and CONTRACTOR shall meet and resolve all outstanding issues including, but not limited to:

1. Claims and adjustments for time or costs.
2. Outstanding, unused allowances.
3. Procedures for handling warranty issues.

B. A Final Change Order shall be processed if required. Final payment and close out procedures shall comply with all requirements of the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXCAVATION (Not Used)

END OF SECTION

SECTION 01 70 30

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. The CONTRACTOR shall maintain at the site one hard copy record set of:

1. Drawings
2. Project Manual
3. Addenda
4. Change orders and other modifications to Contract
5. Project Manager field orders, written instructions or clarifications
6. Approved submittals
7. Field test records
8. Survey notes and calculations
9. Construction photographs
10. Associated permits
11. Certificates of inspection and approvals

1.02 SUBMITTALS

A. Upon Substantial Completion the CONTRACTOR shall:

Deliver two identical, complete review sets of Record Documents within 14 calendar days after Substantial Completion to the ENGINEER. Each set of Record Documents shall consist of: one set of 24 x 36-inch blueline drawings and one copy of record documentation and vendor and material supply information. The ENGINEER shall comment and return one set to the CONTRACTOR. The final Record Drawings shall be generated using computer software as specified in Part 3.03 F of this Section.

B. Accompany the submittals with a transmittal letter containing the following:

1. Date
2. County project title and number
3. CONTRACTOR's name and address
4. Title of record document
5. Signature of CONTRACTOR or authorized representative

C. At COUNTY's acceptance:

Upon receipt of the ENGINEER's comments, CONTRACTOR shall deliver within 14 days to the ENGINEER four (4) complete sets of Record Drawings incorporating the ENGINEER's comments. Record Drawings submitted by the

CONTRACTOR shall be sealed by a Professional Land Surveyor registered in the State of Florida. If the second submittal of the Record Documents is deemed incomplete or does not address all of the ENGINEER's comments, the submittal shall be returned to the CONTRACTOR. The CONTRACTOR shall reimburse the COUNTY for the ENGINEER's expense for the additional reviews.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

A. CONTRACTOR shall store documents and samples in CONTRACTOR's field office apart from documents used for construction.

1. Provide files and racks for storage of documents.

2. Provide secure storage space for storage of samples.

B. Maintain documents in clean, dry, legible condition and in good order. Record Documents shall not be used for construction purposes.

C. Make documents and samples available at all times for inspection by ENGINEER or COUNTY.

D. Failure to properly maintain Record Documents as stated herein may be reason to delay a portion of progress payments until the requirements of this Section are satisfied.

3.02 CONSTRUCTION PHOTOGRAPHS

A. Progress Photos: The CONTRACTOR shall provide a photographic record of construction progress every other week to the COUNTY. For each submittal, at a minimum, the photographic record shall consist of two sets of 12 color photographs, each 4 inches by 6 inches as well as an electronic copy of the photos on a CD. The ENGINEER and PROJECT MANAGER shall reserve the right to select the views to be photographed. The photographs shall be of good quality as determined by the ENGINEER and PROJECT MANAGER, and camera date stamped. Polaroid or similar instant type photographs will not be acceptable, nor will video recordings. Each photograph shall have the following items identified in a caption:

- County project name and number
- Date photograph was taken
- Detailed description identifying location and name of feature photographed
- Name of Contractor

B. Photographs shall be taken weekly or during execution of individual WORK items, whichever is more frequent, beginning prior to the start of construction and continuing through the completion of all construction.

C. Photographs shall be taken to document each major WORK item, including:

1. Pre-construction conditions.

2. Mobilization and storage of materials. Materials photographed shall include the rock, pipe (slotted and solid-wall), and fittings to be used in the WORK.

3. Installation of the gas extraction wells, including drilling, inspection of refuse, backfilling, installation of hydrated bentonite plug, pipe joining, well bore seal, and above ground completion.

4. Installation of the gas lateral and header piping, including pipe fusion.

5. Connection of gas lateral piping to header.

6. Tie-ins of laterals to the header to the existing header system.

7. Tie-ins to the leachate collection and removal system (LCRS).

8. Installation of air supply line.

9. Backfilling of installed pipe, including placement of warning tape and compaction.

10. Road crossings, ditch crossings, and stormwater swale crossings.

11. Installation of each of the condensate traps/sumps.

12. Pump installation.

13. Installation of header isolation valves.

14. Installation of air supply line and air line isolation valves.

15. Pressure testing.

16. Site cleaning and demobilization.

3.03 RECORD DOCUMENTS

A. Label each document "RECORD DOCUMENTS" in large printed letters.

B. Maintain Blueline set of Drawings and specifications legibly annotated to show all changes made during construction.

1. Graphically depict changes by modifying or adding to plans, details, sections, elevations, or schedules.

2. Make changes on each sheet affected by changes.

C. Record information concurrently with construction progress.

D. Record Drawings shall include the following:

1. Title Sheet (includes COUNTY project name and number, site location map, site address and phone number, and names, addresses and phone numbers of design engineer and CONTRACTOR).

2. Well, horizontal collector, Header Layout (as-built and drawn using surveyed horizontal and vertical coordinates) shown with most recent site topography. Site plan layout shall include existing and new features, identification of pipe locations and sizes, and callouts of all surveyed points (well locations, pipe tie-ins, fittings, appurtenances, road crossings, changes in pipe direction and slope, etc.). The well and header layout site plan shall be at a scale providing appropriate clarity to the drawing as approved by the ENGINEER.

3. Record Construction Well and Pipe Route Survey Table showing coordinates and elevations of surveyed top of pipe, fittings, tie-ins and appurtenances, length of pipe segments, pipe slope between each surveyed station, and ground surface elevation. Each pipe segment shall be given a unique description as approved in advance by the ENGINEER. Pipe Route Survey data shall be provided in a tabular format, which shall be approved by the ENGINEER. An example format is provided below.

STATION	GRID COORDINATES (north)	(east)	Header Invert Elev. (ft)	Ground Elev. (ft)	Header Depth (ft)	Header Slope	Const. Notes and Fittings	Pipe Info.
Line F-F 0+00	5078 45	22997 65	1235 58	1239 66	3 8	-2 13%	Sta 0+02 Line E-E' 12"x4" Branch Saddle	31 ft of 4" Dia HDPE at 2 13%
0+04	50704 56	22997 42	1235 74	1240 40	4 47		Begin 8" CMP Road Casing	
0+26	50694 44	22977 80	1235 28	1239 09	3 8		End 8" CMP Road Casing	
0+31	50712 65	22981 02	1235 17	123 54	3 4		Sta 1+28 C-C' 4" Tee and Riser	
Lateral to EW-A								
0+00	50601 26	23272 90	1274 62	1278 90	4 3	2 00%	Sta 2+00 Line A-A' 6"x4" Branch Saddle	5 ft of 4" Dia HDPE at 2 00%
0+05	50606 27	23271 25	1274 72	1278 66	3 9		Well EW-A	
Lateral to EW-B								
0+00	50591 22	23078 87	1264 31	1268 29	4 0	2 00%	Sta 4+00 Line A-A' 6"x4" Branch Saddle	5 ft of 4" Dia HDPE at 2 00%
0+05	50595 82	23081 00	1264 41	1268 86	4 5		Well EW-B	

4. As-Built Typical Details.

5. Pipe profiles of all header and lateral pipes. Profiles shall include pipe diameter, slope, grade breaks, section view of ground surface along pipe segment, location and description of existing utilities encountered, pipe crossings and vertical and horizontal scale bar.

E. Project Documentation Manual:

1. Each copy of the Project Manual shall be bound, consist of clean legible copies or originals, and at the minimum consist of the following information:

a. Cover Sheet

b. Table of Contents

c. List of Addenda

d. Project Contact List - includes the names, phone numbers and address of the following:

Project Manager
Site Representative
Drilling Contractor
Pipe Contractor
Surveyor

Record Documenter

e. Project Vendor List including list of materials provided by each vendor, and address, phone, fax number of each vendor.

f. Project Record Drawing Summary

g. Well As-Builts and Boring Logs. Upon completion of the project, the CONTRACTOR shall furnish a typed set of well Boring and Well As-Built Logs documenting the following information:

<u>Well Boring Log</u>
Site Location
Date and time of drilling operation
Well number
Detailed refuse description, degree of decomposition, temperature, and moisture content recorded in 5-foot increments, per the guidance sheet provided in Section 33 21 70.
All pertinent comments including refuse age, presence of liquids, and temperature

<u>Well As-Built Log</u>
Site Location
Well Number
Drilling Date
Drilling Contractor
Well Coordinates (as-built)
Ground Elevation at base of installed well after grading of ground surface around well (as-built)
Refuse Base Grade (provided by the COUNTY)
Bore Size
Pipe Size
Bore Depth
Slotted Pipe Length and Interval (i.e., depth to top and bottom of segment below grade)
Solid Pipe Length and Interval Depth
Riser Pipe Length (above grade at time of survey)
Cover Depth
Bentonite Layer Thickness and Interval Depths
Backfill Depth
Stone Backfill
Liquid Level Measurement
All Pertinent Notes

h. Route Survey Data Table - referencing pipeline station with appropriate grid coordinates, ground surface elevation, depth of cover soil, top of pipe elevation at a minimum of every 50 feet, slope at all major line, angle and grade change points, valves, tees, and other appurtenances, and connection locations.

i. Pressure Test Reports

j. Contractor's Daily Work Logs

k. Construction Meeting Notes/Status Reports

2. Project Document appendices shall include:

a. HDPE pipe specifications
- Pipe Installation Manual
- Engineering Characteristics Manual
- Pipe Material Data Sheet
- Fabricated fittings specification sheets

b. PVC pipe specifications

c. Slotted and perforated pipe details

d. Valve specifications
- Header underground isolation valves (stem extension)
- Check valves
- Ball valves
- Monitoring ports

e. Flexible hose and clamp specifications and manufacture's literature

f. Dewatering sumps
- Details including height pump is suspended off bottom of wells
- Pump Installation and O&M manuals
- Hose and fitting identification, manufacturer, and supplier
- Pump curves
- Pump accessories installed
- Materials of Construction

g. Condensate Sump/Trap Quick Cap

h. Well cap for Dewatering Pump and Wellhead Installation

i. Wellhead installation and operations manual

j. Photographs

F. General File Requirements:

1. Drawings shall be generated using AutoCAD Release 2007 software. The Record Drawings shall be drawn to include the following:

   a. 3-dimensional, 1:1 format.
   b. Existing survey reference points.
   c. Breaklines that define all surface features.
   d. Contours and spot elevations must be at correct elevation.

2. Electronic copies of the Contract Documents drawings will only be available to the CONTRACTOR in AutoCAD Release 2007 format. Neither the COUNTY nor ENGINEER shall be responsible for conversion of files to other file formats.

3. Use CD-ROM for submittal of electronic files. Two complete CDs of the Record Document electronic files shall be supplied along with each set of Record Documents.

4. Label each disk with COUNTY project name and number, CONTRACTOR's name, address and phone number, date of submittal, and file reference names.

END OF SECTION

SECTION 01 80 00

HEALTH AND SAFETY PLAN

PART 1 - GENERAL

1.01 GENERAL

A. The CONTRACTOR will use only site crew members in the exclusion zone that are currently trained in accordance with the United States Occupational Safety and Health Administration (OSHA) regulations 29 CFR 1910.120. The workers also need to have completed the minimum 40-hour Hazardous Materials training course and necessary refresher courses. The exclusion zone refers to areas of open refuse. A copy of the current training certificate will be provided to the OWNER and the ENGINEER for each site worker prior to the start of site work. These certificates shall be submitted with the Health and Safety Plan, and whenever new workers are assigned to the job. This applies to both the CONTRACTOR's workers and any Subcontractor site workers. No workers will be permitted to work on the site without these certificates.

B. All site workers that work in the exclusion zone must be under a Medical Monitoring Program as outlined in 29 CFR 1910.120, and be physically capable of wearing a respirator, if necessary. Proof of participation in this program must be provided to the ENGINEER prior to the start of work.

C. No smoking will be allowed on the landfill or work areas including the exclusion zone.

D. Actions that potentially endanger workers shall be stopped immediately and brought to the ENGINEER's attention. Health and Safety for the CONTRACTOR's and subcontractor's forces is the responsibility of the CONTRACTOR.

1.02 SITE-SPECIFIC HEALTH AND SAFETY PLAN

A. CONTRACTOR shall prepare a written site-specific Health and Safety Plan (Plan) for use by the CONTRACTOR and Subcontractor site workers. This plan must be prepared to meet the 29 CFR 1910.120 OSHA regulations and shall include as a minimum, the following:

1. Organizational Structure; to include general supervision, Health and Safety officer, lines of authority, and responsibility and communication. The Health and Safety Officer shall be a worker who will be present at all times during site construction, in addition to his/her other site duties.

2. Comprehensive Work Plan; to include the work tasks and objectives, resources needed, and training requirements for workers (health and safety, machine operations license, etc.). This shall also include a section on safety procedures to be followed for excavation and well drilling.

3. Asbestos Work Plan; to include approach for workers to excavation and drilling in environments with asbestos containing materials present. Plan shall include the WORK tasks and objective and resources needed.

4. Health and Safety; to include identification of possible site hazards, training levels for each category of site workers, personal protective equipment and medical surveillance needed, site control measures, and confined space entry procedures.

5. Emergency Response Plans; to include all emergency telephone numbers, a highlighted map showing the quickest route to the nearest emergency care facility and directions to such facility.

6. Air Monitoring Procedures; to include frequency and type of air monitoring of exposed refuse and site worker areas, calibration of air monitoring equipment, and action levels of air contaminants for site worker protection. All equipment calibration and field gas measurements shall be recorded with the date and time of sample, and the sampler's name. Sampling shall be done by a CONTRACTOR worker trained in the use of the gas sampling equipment. These trained workers shall be designated in the CONTRACTOR's Plan.

7. Respiratory Protection Program; to include written documentation of the CONTRACTOR's respiratory program.

8. A signature page for all site workers covered by the Plan (CONTRACTOR and Subcontractor site workers).

B. The CONTRACTOR shall consider the various materials disposed of (municipal solid waste) that may be encountered during excavation in preparing the Health and Safety Plan.

C. Special consideration shall be made for the potential dangers of hydrogen sulfide, which may be present in landfill gas.

1.03 SUBMITTALS

A. CONTRACTOR shall submit copies of the site-specific Health and Safety Plan to the ENGINEER at the pre-construction meeting. ENGINEER will review the plan for information purposes only. It is the CONTRACTOR's responsibility to prepare and implement a Health and Safety Plan appropriate for the work to be conducted at the landfill.

1.04 SITE OPERATIONS

A. The Plan will be kept on site in a known and easily accessible spot during all site operating hours. All site workers will be notified of the location of the Plan.

B. A Safety Meeting will be held by the CONTRACTOR and attended by all CONTRACTOR site workers prior to starting construction. At this safety meeting, the Plan will be reviewed with the site workers, and all site workers will sign the Plan indicating that they have been apprised of the Plan's contents. New site workers must review the Plan with the CONTRACTOR's Health and Safety Officer prior to beginning work on site, and must sign that they have been apprised of the Plan's contents.

C. Site operations will take place in conditions of adequate light only.

D. Excavations, trenches, boreholes, and areas of open refuse will be monitored for combustible gases, methane, volatile organics, hydrogen sulfide and oxygen through the use of field gas meters. Respiratory protection for acid gases and organic vapors will be used by the worker while monitoring gas levels. Appropriate respiratory protection will be taken by other workers as necessary.

E. No workers will be allowed in any trench or excavation while excavation of the area is in progress. Entry into the excavation shall be made only after the CONTRACTOR's site worker has monitored the air in the excavation and determined the appropriate level of personal protection required for entry into the excavation. Site workers in excavations must be supervised at all times.

F. Site workers will limit their dermal exposure to excavated refuse. Minimal skin protection includes safety-toe boots, long pants, long-sleeved shirts, safety glasses, hard hats, and rubber gloves to be used when handling refuse.

G. Start-up and shutdown of engines will not be done in areas of excavated refuse.

H. "A Compilation of Landfill Gas Field Practices and Procedures", Solid Waste Association of North America (SWANA), March 1992, shall be reviewed by the CONTRACTOR for further safety information and requirements. This document may be obtained from SWANA by calling (800) 467-9262, or may be purchased at http://swanastore.stores.yahoo.net/comoflangasf.html.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION (Not used)

END OF SECTION

SECTION 02 41 16

REFUSE HANDLING, STORAGE, AND DISPOSAL

PART 1 - GENERAL

1.01 NOTIFICATION

A. The CONTRACTOR shall notify the OWNER a minimum of 24 hours in advance of planned excavation of landfill refuse.

B. No excavated materials shall be removed from the site or disposed of by the CONTRACTOR except as specified below and approved by the COUNTY.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

3.01 REQUIREMENT

A. Excavated refuse shall be loaded onto dump truck or other vehicle and moved to working face as soon as possible after excavation for disposal.

B. In the event that refuse is excavated and cannot be immediately taken to the working face the refuse may be stored adjacent to the excavation until it can be taken to the working face before the end of the same working day. Refuse shall remain within close proximity to the location from which it was removed. All excavated refuse must be removed from all locations at the end of each working day.

END OF SECTION

SECTION 31 20 00

TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals to excavate and trench designated areas, install pipe and appurtenances, haul and install bedding and backfill material, compact backfill, and regrade disturbed areas as shown on the Drawings, and described in this Section.

B. The WORK specified in this Section includes filling, trenching, and backfilling activities associated with installation of the landfill gas extraction wells, piping, condensate management features, blower/flare station, and any other WORK requiring excavation, trenching, backfilling, grading, or filling.

C. WORK under this Section includes trenching and grading activities both in and outside of municipal solid waste (MSW).

D. For excavations within the landfill footprint, no classification of type of excavated materials will be made. Excavation includes all soil and refuse materials regardless of type, character, composition, moisture, or condition thereof.

E. Any damage to existing features shall be repaired as directed by the ENGINEER, at the CONTRACTOR's expense.

1.02 PROJECT CONDITIONS

A. Existing project conditions are shown on the Drawings or otherwise described herein.

B. Site information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of the CONTRACTOR. The CONTRACTOR shall explore ahead of the required excavation to determine the exact location of all structures, utilities, etc.

C. Structures shall be supported and protected from damage by the CONTRACTOR. If structures are broken or damaged, CONTRACTOR shall restore structures, utilities, etc. to their original condition at no additional cost to the OWNER. Repair of damaged features or structures shall be approved by the ENGINEER and OWNER.

1.03 SITE ACCESS

WORK shall be performed so as to not block or hinder site access, except as authorized by the ENGINEER or OWNER.

1.04 SAFETY

A. All WORK shall be performed in strict accordance with the Health and Safety requirements set forth in the General Conditions of the Contract Documents.

B. All WORK shall be performed in strict accordance with all local, State, U.S. Occupational Safety and Health Administration (OSHA) and other applicable Federal regulations regarding trenching operations and trench safety.

C. Excavation may be made without sheeting and bracing within the limitations and requirements of the governmental agencies having jurisdiction. Failure of the ENGINEER to order the use of bracing or sheeting and shoring or direct changes to systems in place, shall not in any way or to any extent relieve the CONTRACTOR of any responsibility concerning the condition of excavations or of his obligations under the Contract. The CONTRACTOR shall be responsible for the condition of all excavations. All slides and caves shall be removed without extra compensation, at whatever time and under whatever circumstances that they may occur.

D. All excavation shall comply with the applicable requirements as stated in the following:

1. OSHA excavation safety standards 29 CFR 1926.650, subpart P.

2. State (Trench Safety Act Section 553.60-553.64 Florida Statutes) and OWNER construction safety regulations.

3. Trench safety guidelines as specified by the Landfill Gas Division of the Solid Waste Association of North America (SWANA).

E. The CONTRACTOR shall include for any excavation, temporary controls for stormwater runoff and erosion control in full conformance with all existing permits and/or applicable regulations.

1.05 SUBMITTALS

A. Health and Safety Plan, as described in Section 01 80 00. The review of the Health and Safety Plan by the ENGINEER shall be for method only. The CONTRACTOR shall retain complete responsibility for the application, adequacy and safety of the methods. However, construction shall not begin until the Health and Safety Plan has been submitted and reviewed by the ENGINEER.

B. Results of sieve analysis and calcium carbonate test for stone backfill.

C. Pipe slope calculations and survey notes for pre-construction layout, including header/lateral route, horizontal collector layout (including transition point of solid-wall to perforated pipe), and air supply/dewatering discharge lines.

D. Pipe survey notes for installed pipe pursuant to Part 3.06 of this Section.

E. Proposed stationing and pipeline identification procedures. Prior to the start of any pipe installation, CONTRACTOR shall supply an example layout drawing showing how the header and laterals will be marked with stations for the conformance surveys. The example layout drawing and stations must be consistent with the requirements of Sections 01 30 10, 01 70 30, and 33 51 10 of the Contract Documents.

F. CONTRACTOR daily logs detailing length of trench excavated and backfilled, with reference to pipe stationing and details sufficient to properly describe the WORK completed to date.

G. The CONTRACTOR shall notify the ENGINEER in writing of the material source for each of the soils specified within Part 2 of this Section at least 14 calendar days prior to the date of anticipated use of such material. Notification shall include:

1. Supplier's name.
2. Borrow location.
3. Documentation confirming adequate quantities are available to complete the WORK.
4. A representative sample of the proposed material, consisting of three 1-gallon, sealed containers.
5. Soil field-moisture, laboratory proctor-density tests, and field compaction test results as required within Part 2 of this Section.

H. Certification that the soil is not petroleum-contaminated or contaminated with other chemicals or compounds that may be deemed hazardous or harmful to human health or the environment.

1.06 NOTIFICATION

Upon identification, the CONTRACTOR shall notify the ENGINEER in writing if the site conditions encountered during construction differ from that indicated on the Drawings. Notification shall include an explicit description of the differences.

PART 2 - PRODUCTS

2.01 PIPE BEDDING AND SOIL BACKFILL

A. For excavations outside the limits of refuse, CONTRACTOR shall reuse excavated soils from trenching for backfilling around installed pipe, unless directed otherwise by ENGINEER. Reused soils shall conform to Part 2.01 C. and D. of this Section.

B. Beyond the reusable quantities of soil described above, the CONTRACTOR shall use County provided bedding and soil backfill material excavated and stockpiled by County on-site.

C. These soils shall generally be free of sticks, roots, organic matter, and stones larger than 1-inch in any dimensions. Pipe bedding and backfill soils shall be approved by the ENGINEER.

D. Pipe bedding material shall be appropriate for spreading with hand tools and compaction with vibratory compactor to provide a level and stable surface for pipe placement. Pipe bedding and backfill soils shall be approved by the ENGINEER.

2.02 NON-CALCAREOUS STONE

A. Stone backfill shall be hard, durable non-calcareous rock. Stone shall be washed as a component of the manufacturing process and be free of organics, lumps or balls of clay, and other deleterious materials.

Stone shall be FDOT No. 4 and conform to the following gradation requirements:

Sieve Size	% Passing (by Weight)
2-inch	100
1½-inch	90
1-inch	35
3/4-inch	5
3/8-inch	0

2.03 SAND BEDDING MATERIAL

A. Clean dry sand shall be used for pipe bedding and backfill to at least 6 inches above the top of the installed pipe. Sand shall be coarse-grained and conform to the following gradation unless otherwise approved by the ENGINEER in writing.

Sieve Size	% Passing (by weight)
3/8"-inch	100
No. 4	95
No. 200	5

B. Sand shall be free of sticks, roots, vegetation, organic matter, and stones larger than 1-inch in any dimension.

2.04 CLEAN SOIL BACKFILL MATERIALS

A. Soil material may be reused for clean soil backfill provided it is free of sticks, roots, organic matter, MSW, and stones larger than 1-inch in any dimension. Remove any material that cannot be made to compact readily and replace with suitable material.

B. Clean soil shall be used in the following areas of work and as shown on the Drawings:

1. Above the geotextile to ground surface in all horizontal collector trenches, unless specified otherwise on the Drawings.

2. Any location on Drawings that calls for "clean soil backfill" if excavated material is waste or is otherwise not suitable for reuse.

PART 3 – EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours and datum locations.

B. Locate, identify and protect utilities from damage.

C. Protect benchmarks, survey control points, monitoring wells, existing structures and fences from excavating equipment and vehicular traffic.

3.02 PRE-CONSTRUCTION LAYOUT

A. Prior to trenching and pipe installation, CONTRACTOR shall stake out the entire proposed trench alignment both within and outside the limits of refuse. Assistance will be given to the CONTRACTOR in determining the toe of the landfill as needed to avoid damage to the liner and existing features. CONTRACTOR shall not penetrate or otherwise impact the landfill liner and it shall be the CONTRACTOR's responsibility and liability in maintaining the integrity of the liner. This assistance shall in no way relieve the CONTRACTOR from responsibility and liability in maintaining site conditions. The proposed alignment must be approved by the ENGINEER and OWNER prior to the CONTRACTOR beginning excavation activities.

B. Survey notes with proposed pipe slope shall be submitted to the ENGINEER for approval prior to pipe installation. Notes of pre-construction survey shall identify conflicts between the proposed WORK and existing features.

3.03 EXCAVATION

A. Refuse materials shall be handled as directed in Section 02 41 16, Refuse Handling, Storage, and Disposal.

B. Excavate to lines, grades and dimensions necessary to complete the WORK.

C. Trenching Tolerances:

1. Excavate to install pipes in straight runs at a uniform grade, without sags or humps, between vertical and horizontal control points in accordance with the Contract Drawings.

2. Minimum trench width shall be as shown on the Drawings.

3. Maintain thickness of soil cover over the top of the pipe, as shown on the Drawings, or approved by the ENGINEER.

D. CONTRACTOR may not excavate more trench daily than can be completely backfilled after installation of the pipe the same day. Excavations shall not be left open overnight. In the event that a trench must be left open overnight the CONTRACTOR must get permission from the OWNER to leave trench open and trench must be encircled in safety/warning tape attached to stakes placed along the perimeter on all edges of the trench. In the event that the trench has exposed refuse, all refuse must be covered with a tarp that is secured on all corners and along its perimeter.

E. CONTRACTOR shall use appropriate survey/level instrumentation during excavation to ensure proper trench slope. Verification of installed pipe slope shall be as specified in Part 3.06.

F. Minimum trench slope shall be as shown on the Drawings, or approved by the ENGINEER.

3.04 DEWATERING

A. Water that enters excavations into refuse shall be considered landfill leachate and shall not be discharged to the ground or other means that are typical for stormwater. Water in trench excavations into refuse shall be pumped into sealed tanks, hauled to the main leachate pump station, or as directed by the PROJECT MANAGER, and discharged into the pump station. The CONTRACTOR must notify the OWNER prior to dewatering, and allow the OWNER to witness the dewatering and discharge to the leachate sump.

B. The CONTRACTOR shall at all times during construction provide and maintain proper equipment and facilities to remove water entering excavations.

CONTRACTOR shall keep such excavations dry so as to obtain a satisfactory foundation condition for all WORK.

C. CONTRACTOR shall establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

D. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottom, and soil changes detrimental to stability of subgrades and foundations. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory for support of structure as a result of inadequate dewatering or other construction methods shall be removed and replaced by crushed stone or gravel as required by the ENGINEER at the CONTRACTOR's expense. The bottom of excavations shall be firm and without standing water before placing structures or pipes. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

E. Disposal of Water Removed by Dewatering System:

1. Water conveyed away from excavations which has not contacted refuse materials shall be discharged to areas approved by the ENGINEER.

2. Dispose of water by procedures approved by the ENGINEER in such a manner as to cause no inconvenience to the OWNER, the ENGINEER, or others involved in work about the site.

3. Water conveyed away from excavations which has contacted refuse materials shall be pumped into spill-proof containers and discharged into the leachate sump as directed by the OWNER.

F. If pipe trench becomes watered-in after placement of pipe, but before backfilling, CONTRACTOR shall dewater the trench, demonstrate that the pipe bedding and pipe slope remain satisfactory, and upon approval by the ENGINEER, backfill the pipe with clean dry soil in accordance with Part 2 of this Section.

3.05 ROAD CROSSING

A. CONTRACTOR shall schedule and coordinate all road crossings with the OWNER to minimize disruption of the OWNER's operations.

B. HDPE pipes shall be encased in a larger diameter casing for protection. The inner diameter of the casing shall be a minimum of 5 inches larger than the cumulative outside diameters of the HDPE pipes encased. See Drawings for road crossing details.

3.06 PIPE SURVEY

A. CONTRACTOR shall verify that slope of above and below grade pipe meets the requirements specified in this Section and on the Drawings at 10-foot intervals along LFG laterals and header and record such information in the project notes. Station numbering shall be used and marked on the pipe, as approved by the ENGINEER.

A. CONTRACTOR shall verify that pipe slope meets the requirements specified inthis Section and on the Drawings at 10-foot intervals along LFG laterals and header and record such information in the project notes. Station numbering shall be used and marked on the pipe, as approved by the ENGINEER.

1. CONTRACTOR shall measure each length of installed pipe and mark the 10-foot stations. Stationing of laterals shall begin with 0+00 at the header, ending at the riser for the well.

2. Stationing of the header shall begin with 0+00 at a location approved by the ENGINEER. Station numbering for pipe installed each day shall be consecutive with pipe installed on previous days. The CONTRACTOR shall not restart station numbering at 0+00 for any header segment without advance approval from the ENGINEER.

3. Survey equipment shall be used to measure the change in relative elevation between each 10-foot station prior to burial of any pipe.

4. The surveyed elevations and calculated change in elevation and slope for each 10-foot section shall be recorded in the CONTRACTOR's project notes.

5. A trench laser will not be considered acceptable survey equipment for the purpose of verifying pipe slope.

B. The project notes detailing the required pipe slope confirmation shall be provided daily to the ENGINEER.

C. A conformance survey shall be conducted on all installed pipe in accordance with specification Section 01 50 00 – Site Conditions Survey. ~~Below grade pipe shall be surveyed prior to backfilling the trench~~.

~~1. The survey shall document the horizontal and vertical location of the top of the landfill gas header, laterals, air supply lines, condensate discharge line and drain line pipes, electrical conduit, and propane supply lines at minimum 50-foot intervals and at each change in pipe direction, ground surface grade break, change in pipe grade, fitting, connection, pipe crossover, and tie-in along the entire pipeline routes.~~

2. ~~If a run of pipe is 100 feet or less in length, CONTRACTOR shall provide survey shots at a 20-foot interval or less. For a run of pipe of 50 feet or less, CONTRACTOR shall provide survey shots at a 10-foot interval or less to document the pipe as-built conditions.~~

3. ~~The survey shall also document the type of pipe, location (horizontal and vertical coordinate) of structures and appurtenances such as, but not limited to, valves, road crossing casing, pipe crossing, and tie-ins.~~

4. ~~This surveying shall be sealed by a Florida Licensed Professional Land Surveyor as described in Section 01 70 30, Project Record Documents.~~

3.07 BACKFILLING

A. Backfill materials shall be as described in Part 2 of this Section.

B. CONTRACTOR shall notify the ENGINEER prior to beginning backfilling. The ENGINEER shall inspect all pipe, fittings and connections prior to approving backfilling. If CONTRACTOR backfills pipe without inspection of the pipe while pipe is installed in the open trench, CONTRACTOR shall uncover all uninspected buried pipe so that it may be properly inspected. This shall be done at no additional cost to the OWNER or ENGINEER.

C. Place bedding material in trench to the lines and grades shown on the Drawings.

D. Bedding material (sand) shall be placed in the trench ensuring material is placed under the haunch of the pipe. The bedding shall be poured into place, not pushed, and shall be raked by hand and then compacted, using a mechanical compaction device such as walk-behind vibratory compactor, in a loose lift not to exceed six (6) inches above the top of the pipe.

E. Backfilling procedures shall be modified as necessary as approved by the ENGINEER in order to not displace (either horizontally or vertically) piping installed in the trench during backfill or bedding placement.

F. Place soil backfill in maximum 6 inch lifts above pipe bedding to the existing grade. CONTRACTOR shall compact soil backfill in 6-inch lifts with a mechanical compaction device such as a walk-behind vibratory compactor. Compaction shall be to a density where subsequent passes with the mechanical compaction device will not reduce the surface elevation of the bedding material by more than three-quarters of an inch.

G. The CONTRACTOR shall place clean soil to achieve an equal or “higher” degree of compaction than undisturbed materials adjacent to the work.

3.08 REFUSE DISPOSAL

The CONTRACTOR shall be responsible for loading and transporting refuse to the working face as specified in Section 02 41 16. No excavated waste shall be left overnight at any excavation at any time.

3.09 GRADING DISTURBED AREAS

CONTRACTOR shall regrade and return to their original condition, as determined by the ENGINEER, all areas disturbed by CONTRACTOR's work. This includes, but is not limited to ruts caused by construction equipment, soil stockpile areas, and landfill benches and terraces used for access.

3.10 REVEGETATION

A. Disturbed areas shall be sodded with bahia sod or mulched and seeded, as directed by the ENGINEER. In general, all disturbed side slopes will receive sod while areas on top of the landfill will receive seed and mulch. CONTRACTOR shall apply fertilizer and topsoil as necessary to provide suitable conditions for sod growth.

B. CONTRACTOR shall maintain (i.e., fertilize and water only, as necessary) revegetated areas until grass becomes established.

C. Until accepted by the OWNER as established vegetation, areas of dead grass shall be replaced by CONTRACTOR at no additional cost to the OWNER

END OF SECTION

SECTION 33 21 70

LFG EXTRACTION WELLS AND WELLHEADS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: The CONTRACTOR shall provide all labor, equipment, materials, and appurtenances necessary to drill, install and make ready landfill gas (LFG) extraction wells and wellheads as specified herein and as indicated on the Drawings.

B. The slotted pipe, stone, geotextile, bentonite, and soil backfill shall be set at depths and thicknesses shown on the Drawings or as designated in the field by the ENGINEER. It is expected that combustible and asphixiant gases will be venting from boreholes drilled in to waste within the footprint of the landfill. The CONTRACTOR's bid price shall include provision for all equipment and procedures necessary to safely install wells and borings under this condition. All WORK shall be performed by qualified workers in accordance with the best standards and practices available.

C. Upon completion of each new extraction well or boring, CONTRACTOR shall dispose of all construction and drilling refuse materials as specified in Section 02 41 16 or as directed by the PROJECT MANAGER.

D. Related Work Described Elsewhere:

1. Section 02 41 16: Refuse Handling, Storage, and Disposal
2. Section 31 20 00: Excavating, Trenching, Backfilling and Grading
3. Section 31 51 10: Pipe and Pipe Fittings

1.02 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
STANDARD TEST METHODS/PRACTICE

ASTM D 420-98	Standard Guide to Site Characterization for Engineering, Design, and Construction Purposes
ASTM D 422-63	Standard Method for Particle-Size Analysis of Soils
ASTM D 1452-80	Standard Practice for Soil Investigation and Sampling by Auger Borings

ASTM D 2487-00	Standard Classification of Soils for Engineering Purposes (Unified Classification System)
ASTM D 2488-00	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

1.03 SUBMITTALS

A. The CONTRACTOR shall prepare and submit to the ENGINEER, for review and approval, Certificates of Compliance on materials furnished, and manufacturer's brochures containing complete information and instructions pertaining to the storage, handling, installation, and inspection of pipe and appurtenances furnished as described in Section 01 30 10, Contractor Submittals.

B. The CONTRACTOR shall prepare and submit to the ENGINEER for review and approval, Shop Drawings showing dimensions, materials, and manufacturer's information for pipe, pipe perforations, fittings, bentonite, and wellhead components.

C. One week prior to well drilling, CONTRACTOR shall submit an example well boring log and construction log. The example log shall be completed with all of the required descriptions and pertinent information required under Part 3.04 of this Section.

D. At least two weeks prior to construction, the CONTRACTOR shall submit to the ENGINEER for review and approval, results of the calcium carbonate test for the stone backfill, samples of all well backfill materials (if requested), the name of the vendor(s), and source of backfill materials furnished.

E. At the end of each day, CONTRACTOR shall provide copies of the handwritten well boring and completion logs for each well drilled on that day. Information to be included on the well logs is listed in Part 3.04 of this Section.

F. Final boring logs based on field information shall be typewritten and submitted with the Record Documents, as stated in Section 01 70 20. Description of the boring and excavated material shall be according to the guideline sheet at the end of this Section.

1.04 QUALITY ASSURANCE

A. A professional experienced in installation of LFG wells shall be responsible for observing and documenting information related to all boring and installation activities.

B. Inspect well materials for cleanliness, deformations, and imperfections, and ensure conformance with Specifications prior to use.

PART 2 - PRODUCTS

2.01 SOIL

Soil backfill material shall be granular material free of clay, sticks, roots organic material from an the COUNTY'S on-site borrow source.

2.02 STONE

STONE shall be as specified in Section 31 20 00.

2.03 BENTONITE

A. "Bentonite Plug" as used in the Drawings, shall refer to a well seal comprised of hydrated sodium bentonite pellets or chips of a thickness as indicated on the Drawings. Bentonite shall be Volclay bentonite as produced by American Colloid Company or approved equal. Bentonite material shall consist of clay greater than 85% sodium montmorillonite, without additives.

B. Bentonite shall be hydrated per manufacturer's instructions prior to backfilling with soil. Bentonite shall be hydrated in 6-inch lifts as per Paragraph 3.05 B of this Section.

C. Under no circumstances will the use of granular bentonite be permitted for the vertical extraction wells.

2.04 PVC PIPE

Pipe for extraction wells shall be Schedule 80 poly-vinyl chloride (PVC) pipe as shown on the Drawings and conforming to the requirements of Section 33 51 10. The slots in the extraction well piping shall be as specified on the Drawings. Slots may be pre-fabricated or fabricated by the CONTRACTOR.

2.05 WELLHEAD MATERIALS

A. Wellheads shall be 2-inch diameter wellhead with gate valve and orifice plate provided by Forrer Supply, Shaw/LFG Specialties, or equivalent.

2.06 MONITORING PORTS

Monitoring ports shall be ¼ inch NPT polypropylene barbed fittings with vinyl dust cap.

2.07 WELL IDENTIFICATION

Upon completion of well drilling, CONTRACTOR shall paint the well identification number on the well casing using 3-inch tall stenciled letters and white or yellow paint. Lettering by hand or by any other means shall not be permitted.

2.08 SPARE PARTS

The CONTRACTOR shall supply two spare wellheads and 20 feet of spare flexible PVC pipe to the COUNTY.

PART 3 - EXECUTION

3.01 PRE-CONSTRUCTION SERVICES

A. The CONTRACTOR shall survey and stake the extraction well locations prior to drilling. Pre-construction layout surveying shall be done by a Florida Licensed Professional Surveyor.

B. CONTRACTOR shall supply surveyed ground elevations of the proposed extraction wells to the ENGINEER so that the design well depths may be confirmed at least one week prior to drilling.

C. Extraction well locations must be approved and may be adjusted by the ENGINEER prior to beginning drilling. Surveying required to accommodate adjustments made by ENGINEER shall be paid for by the CONTRACTOR.

3.02 DRILLING

A. The CONTRACTOR shall coordinate the start of drilling with the ENGINEER and PROJECT MANAGER.

B. The CONTRACTOR shall provide at all times a thoroughly experienced, competent driller during all operations at the drill site.

C. The CONTRACTOR must use dry drilling equipment.

D. Wells are to be drilled to the depth and diameter as shown on the Drawings. The boring depths shown on the Drawings may be adjusted in the field by the ENGINEER. Under no circumstances are the drilling depths from the well schedule on the Drawings to be exceeded unless approved by the ENGINEER in advance.

   1. Wet Borings:

      a. The PROJECT MANAGER and ENGINEER shall be notified of wet boring conditions.

      b. If water is encountered in a boring, the CONTRACTOR may be directed by the PROJECT MANAGER and ENGINEER to drill beyond the point at which it was encountered. If wet conditions remain, at the direction of the PROJECT MANAGER and

ENGINEER, the boring may be terminated (after driller has attempted to advance boring for 2 hours) and the length of perforated pipe adjusted by the ENGINEER. If wet conditions cease (e.g., due to a perched water layer), then drilling will continue to the design depth.

c. If water is encountered in a boring at a shallow depth, the ENGINEER may decrease the well depth and length of perforated pipe, or relocate the well.

2. Abandoned Borings:

a. If, in the opinion of the PROJECT MANAGER and ENGINEER, the borehole has not reached a sufficient depth to function as an effective extraction well, the CONTRACTOR shall abandon this borehole by backfilling it with cuttings removed during drilling. Soil shall be backfilled and compacted to ground surface. CONTRACTOR shall supply additional soil backfill to refill any settlement within the abandoned borehole, as approved by the ENGINEER.

b. If cuttings are unsuitable as backfill (for example, box springs, tires, etc.) the CONTRACTOR shall use soil backfill material.

c. Compensation for abandoned borings shall be at the unit price for boring refusal.

E. The bore for the well shall be straight and the well pipe shall be installed in the center of the borehole.

1. The CONTRACTOR shall take all necessary precautions to maintain the well pipe vertically plumb during the entire backfill operation of the borehole to the satisfaction of the ENGINEER.

2. The grate over the borehole that is used to keep the well casing plumb shall not be removed until the borehole is backfilled to within 2 feet of ground surface.

3. If the pipe is installed out of plumb, as determined by the ENGINEER, the CONTRACTOR, at his own expense, shall correct the alignment.

4. The well casing shall extend above ground surface as shown on the drawing. No pipe couplings shall be installed above grade or within 10 feet of ground surface below grade.

3.03 WELL LOGS

A. CONTRACTOR shall keep detailed well logs for all wells drilled. Information recorded on the well logs shall include the following:

1. Total depth of well.

2. Visual description of refuse at 5-foot intervals:

   a. Type of refuse encountered including the estimated percentage of the following components (by volume) on visual inspection:

      – Paper/Cardboard
      – Plastic
      – Yard refuse
      – Construction debris
      – Textiles
      – Tires
      – Sludge
      – Dirt

   b. Moisture content (in percentages) based on the guidelines attached to the end of this Section.

   c. State of decomposition based on the guidelines attached to the end of this Section.

   d. Temperature of excavated refuse.

3. Occurrence, depth, and thickness of water-bearing zones

4. Length of slotted pipe and solid pipe below grade.

5. Thickness, description and depth from ground surface of backfill layers.

6. Length of above ground riser stick-up pipe.

B. CONTRACTOR shall use the well borings description sheet provided at the end of this Section as a guideline for describing excavated materials.

C. Field copies of the well logs shall be provided to the ENGINEER. If the CONTRACTOR fails to provide field copies of well logs to the PROJECT MANAGER at the end of each day, the CONTRACTOR will not be allowed to conduct any further drilling activities until the logs have been submitted and reviewed by the ENGINEER.

D. Typed final copies of the well logs shall be submitted with the Record Drawings in accordance with Section 01 70 00. Handwritten logs will not be acceptable for submittal with the Record Drawings.

3.04 JOINING OF PIPES

A. Pipes shall be joined as specified in Section 33 51 10, Pipe and Pipe Fittings. In addition, lag screws shall be installed at each PVC coupling to secure vertical piping during placement in well boring.

1. Four lag screws per coupling or two lag screws per bell fitting shall be installed.

2. The length of the lag screws shall equal, but not exceed, the sum of the pipe and coupling (or bell fitting) wall thicknesses. Under no circumstances may the screw length exceed the sum of the pipe and coupling wall thickness.

B. At the end of each day, CONTRACTOR shall cap the ends of all joined pipes longer than 20 feet to prevent entry by animals and debris.

3.05 BACKFILLING

A. Backfilling of the well shall commence immediately after well drilling is completed and the well piping has been installed in the borehole.

1. Backfill materials shall be placed carefully within the wells to the dimensions shown on the Drawings and as approved by the ENGINEER.

2. Stone, tire chip, and soil backfill containing foreign material may be rejected by the PROJECT MANAGER or ENGINEER on the basis of a visual examination.

3. Both well piping and backfill shall be installed with a safety grate installed over the boring. The safety grate shall remain in place until backfill is within 2 feet of existing ground surface.

B. Bentonite Plug shall be backfilled and hydrated in 6-inch lifts. The CONTRACTOR shall soak each lift according to the manufacturer's instructions prior to filling the next one. A minimum of 6 bags of bentonite shall be poured into the center of the borehole per 6-inch lift.

C. Soil backfill shall be rodded in the boring to provide even distribution and compaction.

3.06 REFUSE DISPOSAL

The CONTRACTOR shall dispose of excavated refuse as specified in Section 02 41 16, Refuse Handling, Storage, and Disposal.

3.07 TEMPORARY CAP

The CONTRACTOR shall temporarily cap the riser pipe of the vertical extraction well immediately after well pipe installation to prevent venting of LFG into the atmosphere. The CONTRACTOR shall remove this cap during the installation of the wellheads. Lag screws may be necessary due to the internal gas pressure within the well.

3.08 WELLHEAD INSTALLATION

A. Vertical extraction well and horizontal collector wellheads shall be installed in accordance with manufacturer's recommendations. PVC pipe sections of the wellhead shall be air-tight. Any leaks shall be repaired by CONTRACTOR at no additional cost to the COUNTY.

B. Install flexible hose on all wells so that hose has no sags, as shown on the Drawings. However, flexible hose shall not be taut. Provide enough slack to accommodate minor pipe settlement, as approved by the ENGINEER.

END OF SECTION

SECTION 33 21 70
LANDFILL BOREHOLE AND WELL LOGGING GUIDANCE - REFUSE

Moisture Content Scale

15% Dry Refuse	20-25% Normal	25-35% Damp	35-50% Wet	50% Saturated
Rock, dirt, etc; no trace of moisture paper will be fuzzed up	Newspaper, etc; still not noticeably wet but normal moisture	Paper shows dampness lawn clippings, tree branches, stiff & hold together	Paper saturated but no free water, just getting sloppy; water emanates when squeezed	Mud or free water present

Decomposition Scale

Little	Some	Moderate	Much	Severe
Newspaper readable; refuse looks new		Newspaper not legible; branches intact		Newspaper not legible; crumble; black/brown mucky material

<u>Log the following (in 5' intervals)</u>:

- Note apparent Intermediate cover thickness and presence of intermediate cell cover
- Ratio of refuse to cover soil
- Degree of compaction (i.e., loose, moderate, tight)
- Composition description (i.e., household, garden, commercial, demolition, sludge, medical, or other)
- Percent of refuse components (plastic, metal, yard waste, etc.)
- Note color and unusual odors or appearances
- Degree of decomposition
- Percent of moisture
- Approximate dates of refuse as an indicator (only) of dates of placement (i.e., newspaper, etc.)
- Refuse temperature
- Gas presence and relative pressure and temperature
- Presence of perched or free liquid
- Note elevations and observations of changes in refuse/soil/liquid conditions

SECTION 33 51 10

PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: The CONTRACTOR shall supply all materials, equipment, and labor needed to install complete and make ready for use all pipe, pipe fittings, and valves as specified herein and as indicated on the Drawings.

B. Related Work Described Elsewhere

1. Section 31 20 00 – Trenching and Backfilling
2. Section 33 21 70 – LFG Extraction Wells and Wellheads
3. Section 44 11 20 – Landfill Gas Blower/Flare System

1.02 SUBMITTALS

A. The CONTRACTOR shall prepare and submit to the ENGINEER, for review and approval prior to commencement of construction, certificates of compliance on materials furnished and manufacturer's brochures containing complete information and instructions pertaining to the storage, handling, installation, inspection, maintenance, and repair of each type of pipe, pipe fitting, and valve furnished.

B. The CONTRACTOR shall prepare and submit Shop Drawings to the ENGINEER for review and approval. The Shop Drawings shall show the following:

1. All dimensions, slopes, and invert elevations at connections to tie-ins and other pipes.

2. All tie-ins to the existing leachate collection system shall be field-verified and shown on the Shop Drawings. This shall include the pipe size, configuration, and caps.

3. Pipe Dimensions for each pipe size used:

    a. Average outside diameter.
    b. Average inside diameter.
    c. Minimum average wall thickness.

4. Each pipe and fitting size to be used.

5. Standard dimension ratio (SDR) for each pipe and fitting to be used.

1.03 REFERENCE

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Use of the most recent version is required.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1248	Standard Specification for Polyethylene Plastics Molding and Extrusion Materials
ASTM D 1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other gravity-flow applications.
ASTM D 2467	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2513	Standard Specification for Thermoplastic Gas Pressure Pipe Tubing and Fittings
ASTM D 2564	Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2774	Standard Practice for Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

AMERICAN NATIONAL STANDARD INSTITUTE (ANSI)

ANSI B 31.8	Code for Pressure Piping, Appendix N

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. All PVC pipe and pipe fittings, except where indicated on the Drawings, shall be Schedule 80 PVC conforming to ASTM D 1784, ASTM D 1785 (for pipe), and ASTM D 2467 (for fittings). Acceptable manufacturers include Nibco Chemtrol (574-295-3000), CertainTeed (610-341-7000), ASAHI/America (800-343-3618), or approved equal.

B. PVC pipe and pipe fittings shall be manufactured from a compound which meets the requirements of Type 1, Grade 1, Polyvinyl Chloride PVC 1120, Cell Classification 12454-B, as outlined in ASTM D 1784. This compound shall be gray in color. A Type 1, Grade 1 compound is characterized as having the highest requirements for mechanical properties and chemical resistance.

1. Compound from which pipe is produced shall have a design stress rating of 2,000 psi at 73 degrees F, listed by the Plastic Piping Institute.

2. Materials from which pipe and pipe fittings are manufactured shall have been tested and approved by NSF International.

3. Pipe shall be homogenous throughout and shall be free from cracks, holes, foreign inclusions, and other defects.

2.02 PVC FLANGES

A. Flanges shall be Schedule 80 PVC and shall be plate type, ANSI Class 150 pounds.

B. The studs, nuts, and washers for the flanges shall be hot dipped galvanized steel. Stainless steel bolts and nuts are not an acceptable alternative. All below grade studs shall be thoroughly coated with Polyken Technologies 1027 Primer (508-261-6200), or rubberized emulsion undercoating spray, or approved substitute, with no gaps in coverage. Below grade flanges shall be wrapped in 5-mil polyethylene sheeting just after installation and prior to backfilling to help prevent corrosion.

C. Flange gaskets shall be full-face Neoprene.

2.03 FLEXIBLE PVC PIPE

A. Flexible PVC pipe shall be as manufactured by Kanaflex Corporation, Compton, California (310-637-1616), Series 101-PS, or approved equal.

B. Fasteners for flexible PVC pipe shall be Kanaflex 101-PS power lock clamps, or approved equal.

2.04 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

A. General:

1. All HDPE pipe and fittings 4-inch diameter and greater as indicated on the Drawings shall be Standard Dimension Ratio (SDR) 17 high density polyethylene pipe using a 3608 type resin or approved equal. HDPE pipe and fittings for landfill gas or condensate flow that are 2-inch diameter and less shall be SDR 11.

2. Air supply pipes and fittings shall be 2-inch diameter SDR 9 with yellow striping.

3. Pipe shall be extruded from a Type III, Class C, Category 5, Grade PE36 compound as described in ASTM D 1248. It shall be classified as cell 345464C according to ASTM D 3350 and have the material designation of PE 3408. The pipe shall be manufactured to meet the requirements of ASTM D 2513. Manufacturer's literature shall be adhered to when "manufacturer's recommendations" are specified. All pipe and fittings shall be provided by one manufacturer. Acceptable manufacturers include Performance Pipe (800-527-0662), PolyPipe, Inc. (800-433-5632), or approved equal.

B. HDPE Fittings

1. Fittings shall be manufactured from polyethylene compound having cell classification equal to or exceeding the compound used in the pipe.

2. All fittings 12 inches and smaller shall be molded, unless approved by the ENGINEER.

3. All fittings shall have an SDR equal to or lower than the pipe to which they will be fused.

C. All pipe and fittings must be supplied by the same manufacturer.

2.05 FLANGES FOR HDPE PIPE

A. Flanges for HDPE pipe shall be convoluted ductile iron back-up rings with a minimum thickness of 1-inch, as manufactured by Improved Piping Products, Inc. (800-969-0962), of Orinda, California or approved equal. Back-up rings shall be finished with zinc chromate primer.

B. The studs, nuts, and washers for the flanges shall be hot dipped galvanized steel. Stainless steel bolts and nuts are not an acceptable alternative. All below grade studs, nuts, and washers shall be thoroughly coated with Polyken Technologies 1027 Primer (508-261-6200), or rubberized emulsion undercoating spray, or approved substitute, with no gaps in coverage. Below grade flanges shall be wrapped in 5-mil polyethylene sheeting just after installation and prior to backfilling to help prevent corrosion.

C. Flange gaskets shall be full-face Neoprene.

2.06 PIPE MARKINGS

A. All PVC and HDPE pipe shall be stamped by the manufacturer with the following information at five foot intervals:

1. Manufacturer name or trademark
2. Nominal pipe size
3. Type of plastic (e.g., PE 3608)
4. Standard dimension ration (SDR) or Schedule (SCH) value
5. ASTM designations (e.g., ASTM D 2513)

2.07 BLOWER/FLARE PIPE SUPPORTS

All pipe supports for the blower/flare skid shall be support saddles with yokes as manufactured by Cooper B-Line model B092 and B-Line base stand B3088 or ENGINEER approved equal. CONTRACTOR shall anchor base stand directly to the skid where appropriate. Pipe supports shall be installed at a minimum spacing of every 8 feet for straight pipe sections and otherwise as necessary to adequately support piping, valves, etc.

2.08 ABOVE GRADE HEADER PIPE SUPPORTS

All pipe supports for the 4-inch LFG above grade header shall be constructed of 2"x4" pressure treated lumber or ENGINEER approved equal. Pipe supports shall be installed at a minimum spacing of 8 feet for straight pipe sections and otherwise as necessary to adequately support piping, valves, etc. CONTRACTOR shall anchor base 3 feet below grade.

2.09 VALVES

A. All valves shall be complete with all necessary operators and other accessories or appurtenances which are required for the proper completion of the WORK. Operators and other accessories shall be sized and furnished by the valve supplier and factory mounted.

B. Valves and operators shall be suitable for the exposure they are subject to, e.g., buried and landfill gas. Valves shall have all safety features required by OSHA.

C. Unless otherwise shown, valves shall be the same size as the adjoining pipe.

D. Valve position indicators shall be installed correctly to properly identify the valve position.

E. Valve spacers shall be used for all valves 6 inches and larger.

2.10 FLANGED LID WITH QUICK RELEASE CAP

A. Quick release caps shall be manufactured by Real Environmental Products (209-296-7900), or approved equal.

B. Connections to lid shall be made with stainless steel quick clamps in accordance with manufacturer's step-by-step procedures and recommendations, and as approved by the ENGINEER.

2.11 PIPELINE LOCATOR/WARNING TAPE

For LFG header and laterals as shown on the Drawings, tape shall be a standard locator/warning tape imprinted with the words "Caution Gas Line Buried Below," as supplied by Reef Industries, Inc. (800-231-6074), or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Pipe shall be stored or stacked so as to prevent damage by marring, crushing, or piercing. Maximum stacking height shall be limited to 6 feet.

B. Pipe and pipe fittings shall be handled carefully in loading and unloading. They shall be lifted by hoists and lowered on skidways in such a manner as to avoid shock. Derricks, ropes, or other suitable equipment shall be used for lowering the pipe into the extraction well borings. Pipe and pipe fittings shall not be dropped or dumped.

3.02 FIELD QUALITY CONTROL

A. Pipe may be rejected for failure to conform to the Specifications or for the following reasons:

1. Fractures or cracks passing through pipe wall, except single crack not exceeding 2 inches in length at either end of the pipe which could be cut off and discarded. Pipes within one shipment shall be rejected if defects exist in more than 5 percent of shipment or delivery.

2. Cracks sufficient to impair strength, durability or serviceability of pipe.

3. Defects indicating improper proportioning, mixing, or molding.

4. Damaged ends, where such damage prevents making a satisfactory joint.

5. Scratches or gouges of depth greater than 10 percent of pipe wall thickness.

B. Acceptance of fittings, stubs, or other specially fabricated pipe sections shall be based on visual inspection at job site and documentation of conformance to these Specifications.

C. The ENGINEER shall be notified by CONTRACTOR prior to burial of pipe.

D. The CQA REPRESENTATIVE and ENGINEER reserve the right to require destructive testing of any fusion weld on HDPE pipe.

3.03 PIPE STORAGE

At the end of each day, all open ends of joined pipe shall be capped or otherwise covered to prevent entry by animals or debris.

3.04 PVC PIPE INSTALLATION

A. PVC pipe installation shall conform to these Specifications, the manufacturer's recommendations, and as outlined in ASTM D 2774.

B. If perforations in pipe are made in the field by CONTRACTOR, CONTRACTOR shall remove all pipe shavings from the ground and dispose of them in a trash receptacle.

C. Pipe shavings from perforations shall be removed from the inside of all pipes using a method approved by the ENGINEER.

3.05 JOINING OF PVC PIPE

A. Joining of pipe shall be in accordance with ASTM D 2855.

B. Preparation:

1. All pipe shall be inspected for cuts, scratches, or other damage prior to installation. Pipe with imperfections shall not be used. All burrs, chips, etc. shall be removed from pipe interior and exterior.

2. The interior of the pipe shall be cleared of foreign matter; e.g., loose dirt, tape, pipe shavings, and paper. All loose dirt and moisture shall be wiped from the interior and exterior of the pipe end and the interior of the fitting.

3. All pipe cuts shall be square, perpendicular to the center line of pipe. Pipe ends shall be beveled prior to applying primer and solvent cement so that the cement is not wiped off during insertion into the fitting socket.

C. Solvent Welding:

A coating of primer as recommended by pipe supplier shall be applied to the entire interior surface of the fitting socket and to an equivalent area on the exterior of the pipe prior to applying solvent cement. The solvent cement shall comply with the requirements of ASTM D 2564 and shall be applied in strict accordance with manufacturer's specifications. Pipe shall not be primed or solvent welded during precipitation or when atmospheric temperature is below 40 degrees F or above 90 degrees F.

D. Curing:

After solvent welding, the pipe shall remain undisturbed until cement has thoroughly set. As a guideline for joint setting time, use 1 hour for ambient temperatures 60-90 degrees F, or 2 hours when ambient temperature is 40-60 degrees F.

E. Alignment:

Pipe and pipe fittings shall be selected so as to minimize the linear deviation at the joints, and so that inverts present a smooth surface. Pipe and fittings which do not fit together to form a tight fitting will be rejected.

3.06 FLEXIBLE PVC PIPE CONNECTIONS

Connections to pipe shall be made with clamps in accordance with manufacturer's step-by-step procedures and recommendations, and as approved by the ENGINEER.

3.07 HDPE PIPE HANDLING

A. HDPE pipe shall not be bent more than the minimum radius recommended by the manufacturer for type, grade, and SDR. Care shall be taken to avoid imposing strains that will overstress or buckle the HDPE piping or impose excessive stress on the joints.

B. Joining HDPE Pipe:

1. Only two methods shall be utilized to join HDPE pipe: heat fusion and mechanical joining.

a. Mechanical Joining shall be accomplished with HDPE flange adapters, neoprene gaskets, and ductile iron back-up flanges, and shall be used only where shown on the Drawings. Refer also to Part 3.09.

b. Heat Fusion joints shall be made in accordance with manufacturer's step-by-step procedures and recommendations.

1) Fusion equipment and a trained operator shall be provided by the CONTRACTOR. Pipe fusion equipment shall be of the size and nature to adequately weld all pipe sizes and fittings necessary to complete the project (refer to Part 2.10).

2) Branch saddle fusions shall be made in accordance with manufacturer's recommendations and step-by-step procedures. Branch saddle fusion equipment shall be of the size to facilitate saddle fusion within the pipe trench.

3) Heat fusion shall be performed outside of the trench whenever practical.

4) Before heat fusing pipe, each length shall be inspected for the presence of dirt, sand, mud, shavings, and other debris, and any foreign material shall be completely removed.

5) At the end of each day, all open ends of fused pipe shall be capped or otherwise covered to prevent entry by animals or debris.

c. As per the manufacturer's instructions, no fusion shall be performed in precipitation unless a shelter is provided.

2. Electrofusion couplings will not be permitted in any part of the WORK.

3.08 HDPE PIPE INSTALLATION

A. Pipe installation shall comply with the requirements of ASTM D 2321, PPI TR-31/9-79, and the manufacturer's recommendations.

B. Lengths of fused pipe to be handled as one segment shall not exceed 500 feet.

C. The ENGINEER shall be notified prior to any pipe being installed in the trench in order to have an opportunity to inspect the following items:

1. All butt and saddle fusions.
2. Pipe integrity.
3. Trench excavation and bedding material for rocks and foreign material.
4. Proper trench slope.
5. Trench contour to ensure the pipe will have uniform and continuous support.
6. Proposed backfill sand and soil.

D. Any irregularities found by the ENGINEER during this inspection must be corrected before lowering the pipe into the trench. Pipe shall be allowed sufficient time to adjust to trench temperature prior to any testing, segment tie-ins, and/or backfilling.

E. Tie-ins shall be made out of the trench whenever possible. When tie-ins are to be made in a trench, a bell hole shall be excavated large enough to ensure an adequate and safe work area.

F. Below grade piping shall be marked with warning tape to be buried in the trench above the pipe as indicated on the Drawings.

G. CONTRACTOR shall collect all pipe shavings and discard in a trash receptacle. Shavings shall not be left on the ground.

H. All installed HDPE pipe shall be marked in 10-foot intervals corresponding to the stationing required for slope confirmation and conformance surveying. For main pipeline, station numbering shall be continuous and sequential. Station numbering shall be referenced in daily logs to document pipe installation progress.

3.09 FLANGED CONNECTIONS

A. Flanges shall be joined with hot dipped galvanized steel studs and nuts. Stud lengths shall accommodate the required distance between flanges including valve spacers, if necessary. Stainless steel studs and nuts are not an acceptable alternative.

B. For flanged connections within the limits of refuse, all below grade back-up rings, studs, nuts and washers shall be thoroughly coated with Polyken Technologies 1027 Primer (508-261-6200), or rubberized emulsion undercoating spray, or approved substitute.

C. The CONTRACTOR shall wrap and tape the flanges and bolts in 5 mil polyethylene sheeting prior to backfilling.

3.10 PIPE SUPPORTS

All piping and valves shall be supported in such a manner as to prevent any stress being transmitted between sections and connected equipment and appurtenances.

3.11 SEGMENT TESTING

A. The HDPE laterals and connections to LFG header, air supply lines, and condensate discharge line pipelines shall be subjected to pressure tests as described herein to detect any leaks in the piping. Testing shall be performed below grade (inside the trench). The CONTRACTOR shall accept the responsibility for locating, uncovering (if previously backfilled), and repairing any leaks detected during testing.

B. Polyethylene piping shall be butt welded together into testing segments. Segments shall be connected to a testing apparatus on one end and fitted with fusion-welded caps on all openings.

C. The segment to be tested shall be allowed time to reach constant and/or ambient temperature before initiating the test.

D. The test must be performed during a period when the pipe segment will be out of direct sunlight; i.e., early morning, late evening, or overcast days in order to minimize the pressure and temperature fluctuations during the test. No testing will be allowed during the middle of the day or when pipe segments are exposed to sunlight.

E. The test pressure for LFG laterals, header, and condensate/dewatering pipes shall be 4 psig. The test pressure for air supply line shall be 100 psig.

F. Pressure drop during the test shall not exceed one percent of the testing gauge pressure over a period of one hour. This pressure drop shall be corrected for temperature changes before determining pass or failure. (See Section 3.12 for test failures). The ENGINEER shall sign off on a test form to indicate test compliance.

G. The ENGINEER shall be notified prior to commencement of the testing procedure and shall be present during the test.

H. All equipment for this testing procedure, including an adequately sized air compressor, fittings, caps/pipe plugs, etc., shall be furnished by the CONTRACTOR. Other necessary equipment includes a flange adaptor with a steel or brass blind flange. Tapped and threaded into the blind flange will be a temperature gauge with a scale of 0 to 100 degrees C with 1-deg. intervals, a pressure gauge with a scale that spans the test pressure range with increments equal to 0.1 percent of the test pressure, an appropriate valve to facilitate an air compressor hose, and a ball valve to release pipe pressure at completion of test. Pipe reducers shall be utilized to adapt test flange to size of pipe being tested.

3.12 TEST FAILURE

A. The following steps shall be performed when a pipe segment fails the one percent/one hour test described in Section 3.11 F, above.

1. The pipe and all welds shall be inspected for cracks, pinholes, or perforations.

2. All blocked risers and capped ends shall be inspected for leaks.

3. Leaks shall be located and/or verified by applying a soapy water solution and observing soap bubble formation.

B. All pipe and fused joint leaks shall be repaired by cutting out the leaking area and refusing the pipe.

C. After all leaks are repaired, a retest shall be performed in accordance with Section 3.11.

3.13 TEST REPORTING

A. Each test (pass or failure) shall be reported in writing on a form approved by the ENGINEER.

B. If failure occurs, CONTRACTOR shall note the following:

1. Location of failure segment.
2. Nature of leaks.
3. Repairs performed.
4. Results of test.

END OF SECTION

SECTION 33 51 20

LFG HEADER ISOLATION VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: The CONTRACTOR shall provide all materials, equipment, and labor needed to install complete and ready-for-use all header isolation valves as specified herein and as indicated on the Plans.

B. Related Work Described Elsewhere

1. Section 33 51 10: Pipe and Pipe Fittings

1.02 SUBMITTALS

The CONTRACTOR shall prepare and submit to the ENGINEER, for review and approval, manufacturer's cut sheets, certificates of compliance on materials furnished and manufacturer's brochures containing complete information and instructions pertaining to the storage, handling, installation, inspection, maintenance, operation, and repair of each type of valve furnished. Shop drawings shall be submitted for butterfly valve assemblies requiring spacers per paragraph 3.01 B of this Section.

PART 2 - MATERIALS

2.01 BUTTERFLY VALVES

A. All valves shall be complete with all necessary operators, actuators, handwheels, extension stems, worm gear operators, operating nuts, wrenches, and other accessories or appurtenances which are required for the proper completion of the Work. Operators and other accessories shall be sized and furnished by the valve supplier and factory mounted.

B. Valves shall be suitable for the intended service. Renewable parts including discs, packing, and seats shall be of types recommended by valve manufacturer for intended service, but not of a lower quality than specified herein.

C. Valves and operators shall be suitable for burial within a landfill.

D. Unless otherwise shown, valves shall be the same size as the adjoining pipe.

E. Header isolation valves shall be butterfly bubble tight, wafer design, gear operated, with a PVC body, polypropylene disc, nitrile seats and seals, 316 SS valve stem, and compatible with a flat face flange. Valves shall be Asahi/America Type 57, if 1-1/2 inches to 14 inches in size.

F. Stem extensions shall be stainless steel in an epoxy coated carbon steel outer housing with a diecast aluminum alloy gear box assembly mounted on top and equipped with a removable manual operating wheel.

2.02 MONITORING PORTS

Monitoring ports shall be installed at each isolation valve and shall include the following items, or approved substitutes. Monitoring hose shall be stainless steel with outer braid Swagelok (407-894-7191) flexible metal hose, part no. SS-FM4PM4PF4, of adequate length to extend above grade as shown on the Plans. The male NPT end shall be threaded into the top of the header. Sampling end shall have a ¼-inch NPT polypropylene male barb port by Parker P4MCB4 tubing barb with a McMaster-Carr 9753K38 vinyl cap. The hose shall be secured to the valve stem outer boring by stainless steel worm-gear clamps.

2.03 IDENTIFICATION TAGS

A. CONTRACTOR shall supply and affix to each valve monitoring port a plastic tag marked with pre-printed letters designating the valve number followed by the letters "A" or "B" (e.g., V-1A, V-1B, V-2A, etc.). The tags imprinted with an "A" shall be placed on the monitoring port closest to the blower/flare station. Those marked with a "B" shall be affixed to the other valve monitoring port. Tags shall not be marked with pen or marker.

B. Tags shall be 2½-inch square tag, yellow with black lettering, Square Setonply® tag, style M4550, by Seton (800-243-6624), or equal. Tag shall be secured to the wellhead with a plastic "zip tie" or as approved by the ENGINEER.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Valves shall be installed in accordance with the manufacturer's recommendations and the following:

1. Butterfly valves shall be installed between two flanges as shown on the Drawings; care shall be taken to avoid stripping studs when tightening.

2. Flanges shall be joined with hot dipped galvanized steel studs and nuts. Stud lengths shall accommodate the required distance between flanges including spacers, if necessary. Stainless steel studs and nuts are not acceptable substitutes.

3. All below grade back-up rings, studs, nuts and washers shall be thoroughly coated with Polyken Technologies 1027 Primer (508-261-6200), or

rubberized emulsion undercoating spray, or approved substitute. There shall be no "holidays", or areas where the coating is not completely applied.

4. The CONTRACTOR shall wrap and tape the valve, flanges, and bolts in 5 mil polyethylene sheeting prior to backfilling.

B. Flanged butterfly valves may require spacers between the flange adapters and the valve body in order to allow full travel of the internal disk. At a minimum, all valves 6 inches and larger in diameter require valve spacers. If spacers are necessary for any butterfly valve, the CONTRACTOR shall install valve spacers subject to approval by the ENGINEER.

END OF SECTION

SECTION 44 42 60

CONDENSATE MANAGEMENT SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide all materials, equipment, labor, and incidentals needed to install the condensate sumps, pneumatic pumps, air compressor, and appurtenances in accordance with the Drawings and manufacturer's instructions.

B. Related Work Described Elsewhere

1. Section 31 20 00 – Trenching and Backfilling
2. Section 33 51 10 – Pipe and Pipe Fittings

1.02 SUBMITTALS

A. The CONTRACTOR shall prepare and submit to the ENGINEER for review and approval manufacturer's literature, shop drawings, or other information pertaining to the assembly, operation, adjustments, and other maintenance and repairs of equipment to be installed under this Section, together with detailed parts lists, Drawings, dimensions, and/or photographs.

B. At start-up, CONTRACTOR shall submit Operations and Maintenance (O&M) manuals as requested in Section 01 70 10.

PART 2 - MATERIALS

2.01 CONDENSATE SUMP

A. The condensate sump shall be capable of handling a flow rate of 7.5 gallons per minute (gpm) with a total dynamic head of 10.5 feet.

B. The sump shall be a welded, single-walled HDPE assembly. The reservoir shall be fabricated from SDR 17 pipe and designed to withstand a vacuum of 120 inches-w.c. and a pressure of 5 PSIG at 130 degrees F.

C. The condensate pump shall have pneumatic level controls. The pump shall pump condensate to a discharge line. Discharge piping from the sump to the condensate discharge line shall be of a size and material recommended by the manufacturer such that the pneumatic pump can deliver the anticipated condensate load.

2.02 ACCESS PORT

Port shall be a $1^1/_2$- inch diameter black polypropylene quick connect coupling consisting of two parts: a male pipe threaded adapter and cap with steel cam locking levers.

2.03 MONITORING PORT

Monitoring port shall be ¼ inch NPT polypropylene male barb monitoring ports, Parker P4MLBA Tubing Barb, with McMaster Carr 9753K38 vinyl cap or equivalent.

2.04 PNEUMATIC PUMP

A. Pump shall be submersible air displacement pump, internally controlled and designed for leachate and condensate systems. Pump shall be bottom-loading with fiberglass body. Major metal components shall be 316 grade stainless steel, this shall include the pump head assembly, center dip tube, discharge check valve assembly, chain support harness, 3.5 inch extended inlet screen, and bottom check collar. Plastic components shall be PVDF (kynar) or UHMWPE.

B. Pumps shall be QED Environmental Systems (800-624-2026) Auto Pump (AP-4), bottom load short body.

C. Pump installed in condensate sump shall include the following components:

1. Air filter/regulator
2. Air inlet supply pressure gauge
3. Pump cycle counter

D. Pump shall have a minimum pumping capacity of 7.5 gallons per minute at 10.5 feet total dynamic head and an air supply pressure of 40 pounds per square inch, gauge (psig).

E. Pump accessories to include are 4 inch vacuum fit cap and hose set, including the discharge hose (3/4-inch I.D. Nylon Tube) from the pneumatic pump to the HDPE forcemain and the 150 psig rated, 1/4-inch I.D. air hose to the HDPE air supply line.

F. Air and discharge hose lengths outside the sump/wells shall be field determined and approved by the ENGINEER.

G. Each pump will include a ½ inch nylon support rope from pump to sealing cap. A stainless steel quick link connector will be used to attach the rope to the pump support harness.

2.05 AIR SUPPLY LINE

The air supply line from the compressor shall be as specified in Section 33 51 10 and on the Drawings.

2.06 CONDENSATE DISCHARGE LINE/DRAINAGE LINE

The condensate discharge line shall be 2-inch diameter HDPE SDR 11 pipe as specified in Section 33 51 10 and shown on the Drawings.

PART 3 - EXECUTION

3.01 AIR SUPPLY LINE

The air supply line from the compressor to the pneumatic pumps shall be 2-inch diameter SDR 9 HDPE pipe with yellow stripe. Air supply line shall be located in the same trench as the header/lateral piping (where possible) at a minimum depth as shown on the Drawings.

3.02 CONDENSATE SUMP INSTALLATION

A. CONTRACTOR shall install condensate sump in the location and to the lines shown on the Drawings. Sump shall be installed vertically plumb.

B. HDPE pipe connections shall be in accordance with Section 33 51 10, Pipe and Pipe Fittings.

C. Caution shall be exercised when backfilling around the sump to prevent damaging air and discharge lines.

3.03 PUMP INSTALLATION

A. Pump shall be installed in accordance with manufacturer's recommendations. Pump vent line shall be installed to discharge inside the sump.

B. Install pump so that bottom of pump is suspended off the bottom of the sump as shown on the Drawings and recommended by the manufacturer and approved by the ENGINEER.

3.04 TESTING

A. Upon completion of the installation, tests shall be performed by the CONTRACTOR with the assistance of the manufacturer's representative, in the presence of the ENGINEER. These tests shall demonstrate condensate pump, startup, shutdown, operation, and maintenance. Test shall demonstrate the pumping of water from the sump for the full drawdown of the pump. Equipment and other requirements necessary to perform the tests shall be furnished by the CONTRACTOR.

END OF SECTION

SECTION 23 81 25

COMPRESSED AIR SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

Scope of Work: The CONTRACTOR shall supply all materials, equipment, and labor needed to install complete and make ready for use the air compressor and refrigerated air dryer as specified herein and as indicated on the Drawings.

1.02 SUBMITTALS

The CONTRACTOR shall prepare and submit to the ENGINEER, for review and approval prior to commencement of construction, manufacturer's/suppliers cut sheets on materials to be furnished and manufacturer's information containing complete information and instructions pertaining to the storage, handling, installation, inspection, maintenance, and repair of the air compressor and air dryer to be furnished.

PART 2 - PRODUCTS

2.01 AIR COMPRESSOR

A. This equipment shall be capable of providing compressed air to the condensate sump pump.

B. The unit shall be a two stage cast iron pump, air compressor with a vertical or horizontal mount 80 gallon tank.

C. The unit shall be powered by a 5 horsepower, electric motor. The motor shall be a standard AC motor with NEMA T frame with drip-proof enclosure, Class-B insulation, 1.15 Service Factor, and grease lubricated ball bearings. The motor shall be a standard three phase motor with a voltage of 460 volts and have an amp rating of approximately 15 amperes.

D. The unit shall have a maximum pressure capacity of 175 psi.

E. A pressure regulator, and bleed-off valve shall be installed prior to the HDPE air supply line. The pressure regulator shall have a gauge and be capable of decreasing the supplied pressure to 60 psi, if necessary.

F. The unit shall be able to provide a minimum air flow of 13 cfm at a pressure of at least 100 psi.

G. The unit shall have auto shutoff and start up capabilities based upon pre-set pressure settings.

H. The unit shall have the Ingersoll Rand general purpose filter model number F35IG as supplied by Air Centers of Florida, (813-621-9671), or approved equal.

I. The unit shall be an Ingersoll Rand model number 32342420, or approved equal.

2.02 AIR DRYER

A. This equipment shall be capable of effectively drying the air supplied from the air compressor detailed in Part 2.01 above.

B. The motor shall be single phase with a voltage of 115 volts.

C. The unit shall be designed to accommodate up to a 5 horsepower air compressor.

D. The unit shall be designed to accommodate a maximum air flow of 15 cfm from the air compressor.

E. The unit shall be designed to withstand a maximum pressure of 175 psi.

F. The refrigerant used shall have a designation of R134a.

G. The unit shall be an Ingersoll Rand model number D25IN, or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

The air compressor and air dryer shall be stored so as to prevent damage by marring, crushing, or piercing. The air compressor and air dryer shall be handled carefully in loading and unloading to prevent any damage.

3.02 FIELD QUALITY CONTROL

A. The air compressor and air dryer may be rejected for failure to conform to the Specifications or for the following reasons:

1. Fractures or cracks passing through the air compressor tank, motor or drive belt. Fractures or cracks in the air dryer refrigerant tank.

2. Scratches or gouges into the air compressor or dryer.

3. Dents in air compressor tank.

4. Damage to the power supply of the air compressor and air dryer

B. Acceptance of the air compressor and air dryer shall be based on visual inspection, a demonstration of performance at job site following installation and documentation of conformance to these Specifications.

C. The ENGINEER shall be notified by CONTRACTOR prior to installation of air compressor and air dryer.

END OF SECTION

SECTION F

LANDFILL PERMIT REQUIREMENTS

Not applicable.

SECTION G

GENERAL CRITERIA FOR LANDFILLS

Not applicable.

SECTION H

LANDFILL CONSTRUCTION REQUIREMENTS

Not applicable.

SECTION I

HYDROGEOLOGICAL INVESTIGATION REQUIREMENTS

Not applicable.

SECTION J

GEOTECHNICAL INVESTIGATION REQUIREMENTS

Not applicable.

SECTION K

VERTICAL EXPANSION OF LANDFILLS

Not applicable.

SECTION L

LANDFILL OPERATIONS REQUIREMENTS

L.1 THROUGH L.7

Not applicable.

L.8 LEACHATE MANAGEMENT

The proposed GCCS design includes tie-ins to the existing leachate collection and removal system (LCRS) risers on Class I landfill. If it is necessary to perform video inspection or cleanout the LCRS via these risers, this can be accomplished by closing the 2-inch wellhead gate valve, disconnecting the flexible hose, and removing the quick release caps or flanged lids and associated piping.

L.9 GAS MONITORING PROGRAM

The proposed GCCS is designed to meet the requirements specified in Rule 62-701.530, F.A.C. Citrus County Central Landfill is proposing to install an active LFG extraction system that uses a candlestick flare to combust LFG.

L.9.a Design Requirements

The proposed GCCS is designed to provide a means of relieving internal gas pressures within the landfill and prevent fugitive emissions of LFG to the atmosphere through the cover soils and the subsurface migration of LFG to the surrounding areas.

The proposed GCCS for Phases 1/1A and 2 include the following features:

- LFG extraction wells composed of 6-inch PVC pipe, installed in a 30-inch borehole and backfilled with FDOT No. 4 stone. The borehole will be sealed with a hydrated bentonite plug and backfilled to grade with clean soil backfill.

- Tie-ins will be made to the existing LCRS risers and these will be connected to the header/lateral system, routing LFG to the blower/flare station.

- A below grade header/lateral network will be installed. All piping will be HDPE SDR 17.

- A 2" HDPE SDR 9 air supply line will be installed from the relocated blower/flare and compressor location to CS-1 on the east side of the Class I cells.

- A condensate sump with a pneumatic pump will be installed at the relocated blower/flare station. An O&M manual for the pneumatic pump will be submitted to the FDEP with the report of construction completion.

- Self-draining condensate traps will be located at engineered low points in the header system for the collection of condensate. The traps will allow for the drainage of condensate from the header and lateral system back into the landfill. Refer to Attachment E-1 for the condensate trap details.

- The existing blower/flare station will be relocated next to the leachate holding tank facility. Collected LFG will be routed to this new location for combustion via the candlestick flare. Refer to Attachment E-1 for blower/flare details.

L.9.a.1 Gas Monitoring Probes

Gas monitoring is performed in accordance with Rule 62-701.530, F.A.C. The existing gas monitoring probes and monitoring points are located in strategic areas throughout the facility to properly monitor for gas migration. There are no changes to the locations of the gas monitoring probes and monitoring points.

L.9.b Monitoring Requirements

L.9.b.1 NSPS Requirements

The proposed GCCS is not required by any state or federal regulation, and therefore the system will not be subject to any regulatory required monitoring. Based on the results of the most recent New Source Performance Standards (NSPS) Tier 2 test and non-methane organic compound (NMOC) emission rate report, a landfill gas collection and control system (GCCS) will not be required at the site until at least 2013. This is because the 2006 Tier 2 report shows NMOC emissions through 2011 are below 50 megagrams (Mg) per year.

L.9.b.2 Perimeter Monitoring Probes

Monitoring of gas probes along the property boundary will continue to be conducted. Monitoring of gas concentrations in gas monitoring probes will be performed to detect possible subsurface migration of LFG. The regulatory limit for methane at the property boundary is 100 percent of the lower explosive limit (LEL) for combustible gases and 25 percent of the LEL in structures.

There are no changes to the locations of the gas monitoring probes.

At a minimum, the LFG monitoring probes and monitoring points will be tested quarterly and the results forwarded to FDEP. If methane gas levels exceed the LEL in probes or 25 percent of the LEL in structures, excluding gas control or recovery components, the landfill operator shall:

- Immediately take all necessary steps to ensure protection of human health and notify FDEP;

- Within seven days of detection, submit to FDEP for approval a remediation plan for the methane gas releases. The plan shall describe the nature and extent of the problem and the proposed remedy. The remedy shall be completed within 60 days of detection unless otherwise approved by FDEP.

Personnel will abide by the following precautions before entering areas where dangerous gases may be present and before entering confined spaces, at a minimum, for worker safety:

- Personnel shall follow the requirements in the "Code of Federal Regulations Title 29, Part 1910.146 OSHA" and the safety guidelines outlined in "A Compilation of Landfill Gas and Field Practices and Procedures" prepared by the SWANA Landfill Gas Division Health and Safety Task Force.

- The Landfill Manager will keep the most up-to-date version of the above documents available at the facility for personnel to use.

- The above documents can be obtained at the following websites:

  - Title 29 CFR Part 1910.146 – **http://www.gpoaccess.gov/cfr/index.html** (Browse for Latest version of Title 29 CFR Part 1910.146)

  - SWANA Landfill Gas Document – **http://www.swanastore.com** (Publications – Landfill Gas Publications)

- Notify the Landfill Manager prior to entry into the area.

- Follow all County safety procedures.

- Ventilate the area with blowers or fans, if possible, or allow to vent a minimum of 24 hours.

- Monitor the air for explosive or hazardous gases, oxygen, and hydrogen sulfide levels, at a minimum, prior to entering the area.

- Monitor the air quality within the immediate working area at all times, using a hand-held or personal monitoring device.

- Provide safety equipment (radios, respirators, gas monitors, air supplies, ladders, ropes, harnesses, first aid kits, emergency contact list, etc) in case of emergency.

L.9.b.3 Closure Requirements

Waste disposal activities are on-going at the site. At landfill closure, the closure plan will address any integration of the GCCS with the intended end use, which has not yet been determined.

L.10THROUGH L.13

Not applicable.

ATTACHMENT L-1

OPERATIONS PLAN

(Revised Sections 2 and 8 only. Refer to Operations Minor Permit Modification for an Interim Gas Collection and Control System, Permit No. 21375-016-SO/MM for the complete Operations Plan)

SECTION 2

LANDFILL OPERATIONS AND MAINTENANCE (RULE 62-701.500(2), F.A.C.)

Figure 2-1 is a site plan of the active area of the landfill including Phase 2.

2.1 TRAINING AND CERTIFICATION OF OPERATORS AND SPOTTERS (Rule 62-701.500(1), F.A.C.)

In accordance with Rule 62-701.500(1), F.A.C., at least one trained operator will be on duty at the Citrus County Central Landfill whenever waste is received at the facility. In addition, at least one trained spotter will be present at each landfill active face when waste is received. Operator and spotter training will comply with Rule 62-701.320(15), F.A.C., as adopted May 27, 2001. Operators at the Citrus County Central Landfill shall participate in at least 24 hours of initial training. Every three years landfill operators shall participate in continuing education courses totaling 16 hours. All Operator training will consist of courses conducted by the University of Florida TREEO Center, or other courses presented by other providers that have been approved by the Florida Solid Waste Management Training Committee (SWMTC).

In accordance with Rule 62-701.320.15, F.A.C., Spotters shall participate in 8 hours of initial training that shall include Spotting at Construction and Demolition Sites, Landfills, and Transfer Stations (SWMTC 8 hours) and/or Waste Screening and Identification for Landfill Operators and Spotters (SWMTC 8 hours) conducted by the University of Florida TREEO Center or other SWMTC approved providers. Every three years landfill operators shall participate in continuing education courses totaling four hours. The compactor operator will be responsible for evaluating each load visually as it is dumped and serve as the spotter at the working face of the facility.

2.2 DESIGNATION OF PERSONS RESPONSIBLE FOR OPERATION AND MAINTENANCE (Rule 62-701.500(2)(a), F.A.C.)

The persons directly responsible for major components of the landfill follow:

Component	Responsible Party
Operations	Field Crew Leader or Customer Service Crew Leader
Repair and Maintenance	Solid Waste Management Division Director
Permitting Requirements	Solid Waste Management Division Director
Water Quality and Leachate Testing	Solid Waste Management Division Director

The landfill Field Crew Leader or Customer Service Crew Leader has overall responsibility for the operation of the landfill. The landfill Field Crew Leader or Customer Service Crew Leader is responsible for the day-to- day implementation of the operations plan and, along with the Solid Waste Management Division Director, is responsible for environmentally safe operations in accordance with state and federal regulations.

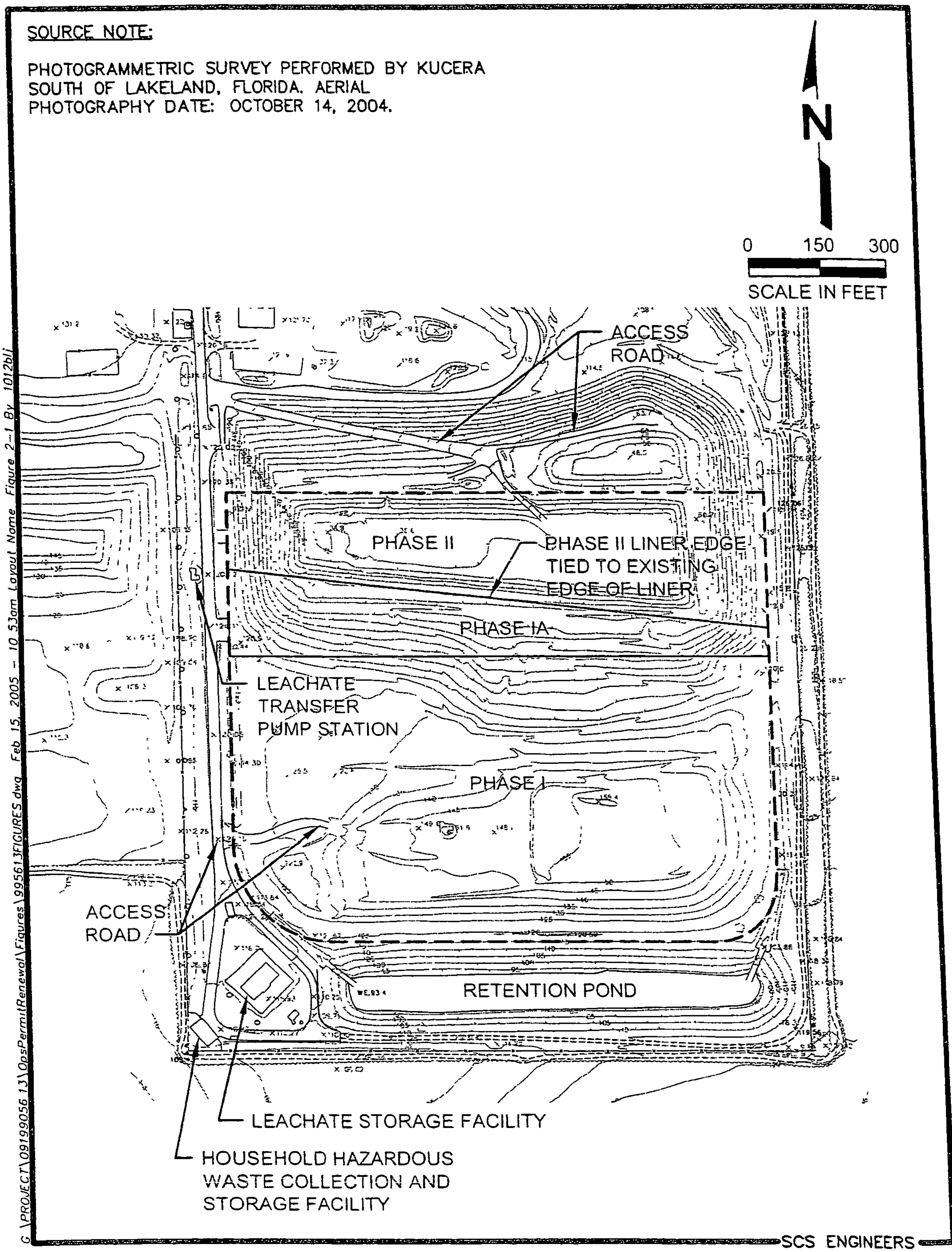


Figure 2–1. Active Area Site Plan, Citrus County Central Landfill

2.3 CONTINGENCY OPERATIONS FOR EMERGENCIES
(Rule 62-701.500(2)(b), F.A.C.)

The contingency plan for the facility addresses the following five potential emergencies:

- Equipment failure
- Unusual operating conditions resulting from poor weather conditions
- Accidents
- Fire
- Unavailable landfill capacity

2.3.1 Emergency Incidents Plan

Citrus County has developed a site specific Emergency Incidents Plan which is included in Appendix A. This plan includes additional detail for responding to emergency incidents at the Central Landfill.

2.3.2 Equipment Failure

Sufficient back-up equipment will be provided on site for equipment breakdowns and for downtime because of normal routine equipment maintenance. In the case of a major equipment failure, the following procedures will be followed:

- Maintain duplicate equipment capability

- Contact contractors and rental equipment dealers as pre-arranged, to furnish equipment on short-term notice (within 24 hours)

In the event of equipment failure, the Field Crew Leader will contact the Landfill Maintenance Coordinator. Within 24 hours of notification of the Landfill Maintenance Coordinator, the equipment will be replaced with back-up capability if necessary, or repaired and placed back in operating condition.

All equipment maintenance will either be performed by Citrus County or will be contracted by Citrus County to a maintenance contractor.

Redundant pumping systems are provided for both the leachate and stormwater transfer system.

An emergency power generator is available for stormwater and leachate facilities.

2.3.3 Poor Weather Conditions and Natural Disasters

Unusual operating conditions could result from excessive rainfall and electrical storms. The type and volume of materials to be disposed of after a hurricane or excessive storms will change normal landfill operations. During extremely high wind conditions or electrical storms, disposal operations will be temporarily suspended to protect the workers. Disposal operations will be suspended immediately before and during a hurricane or tornado.

During rainy weather, access to the working face along on-site roads must be maintained. It may be necessary to grade out ruts more frequently than during normal operations, or it may be necessary to apply additional material to the on-site access roads to counteract the effects of rain.

2.3.4 Fire

Waste loads that arrive at the landfill on fire will not be deposited at the working face. They will be deposited away from the working face on an area that has previously been covered with daily soil cover. The load will then be spread out and covered with daily cover soil cover to extinguish the fire. If a fire does occur at the landfill working face, a temporary area will be identified as far away from the fire as possible but still within the limits of the lined disposal area where daily soil cover has previously been placed. Berms will be constructed around the temporary area using on-site equipment and soil materials from the on-site stockpile. Solid waste entering the facility will be placed in the temporary area until the fire is extinguished. Then the waste will be transported from the temporary area to the working face using on-site equipment. The soil berms around the temporary area will then be leveled and spread out over the surface at the temporary area.

2.3.5 Temporary Transfer Station

Citrus County will implement a temporary transfer station if any condition prevents normal disposal operations at the landfill for more than 48 hours. This temporary transfer station will be located on top of the existing lined landfill. The transfer station will be constructed as a split-grade facility. Waste collection trucks will unload on the upper level. A front loader will lift the off-loaded waste and place into transfer vehicle located on the lower level. The transfer trucks will be weighed prior to leaving the site to ensure that they are legal for over-the-road transport. Crushed concrete and asphalt will be used as an operating surface. This provides an area for trucks to unload. Sloping the area away from the tipping area to a perimeter berm will provide drainage. This liquid will either be allowed to percolate into waste or be collected. Collected liquid will be pumped to the leachate storage tank. Precipitation that falls outside the perimeter berm will be managed as stormwater. Litter fences will be placed around the facility to reduce the potential for blowing litter. The temporary transfer station will not be operated for more than 30 days unless additional approval is granted from FDEP.

2.4 CONTROL/INSPECTION OF INCOMING WASTE (Rule 62-701.500(2)(c), F.A.C.)

All solid waste arriving at the landfill is routed through the scalehouse. Scalehouse attendants screen visible loads for unacceptable materials including recyclables, hazardous waste, and medical waste. From the scalehouse, it is directed to either the Class I disposal area or to the citizen waste drop off management area. The Citizen's Service Area provides temporary storage for recyclable material, waste oils, yard waste, white goods, batteries, and tires. A spotter will be located at the Citizen's Service Area and at the landfill working face to observe the types of waste actually deposited. If prohibited wastes are discovered, the spotter will direct the vehicle back to the office. If the waste has not yet been unloaded, the person responsible for shipping the waste will be notified. If the waste has been deposited, the area of the waste load should be blocked from public access until the generator or hauler of the waste cleans up the waste. If the generator or hauler of the waste cannot be identified or is unable to remove the waste, Citrus County will be responsible for cleanup, transportation, and disposal of the waste at an appropriate waste management facility.

Special waste shall be managed as follows:

- Used oil and antifreeze is placed at the HHW facility and collected by a contractor.
- Lawn debris is placed within the registered yard waste processing facility for management.
- Tires are placed into the permitted used tire facility for management.
- Appliances - all freon containing appliances shall have the freon removed by County personnel and then placed within the scrap metal recycling container which is collected daily by a contractor.
- Lead acid batteries are placed on pallets and collected by a recycling contractor once several pallets are loaded. (Collections will occur at a minimum of once per month)

The landfill has a permanent household hazardous waste collection and storage facility located at the southwest corner of the existing landfill site as shown in Figure 1-1. The facility is used for the collection and storage of household hazardous waste and Conditionally Exempt Small Quantity Generator (CESQG) waste. The building is engineered to comply with EPA, NFPA, and OSHA standards and regulations for storing hazardous chemicals and wastes. The household hazardous waste collection/storage ("HHW C/S") will be operated in accordance with the guidelines outlined in the Citrus County Hazardous Waste Collection and Storage Facility (2004), which is on file at the landfill office. The current schedule allows for periodic program days for HHW collection. The following is a summary of some HHW C/S guidelines:

- HHW received at the Citizen Drop-off area shall be identified and relocated for storage within the containment area of the HHW Collection/Storage Facility at the end of each collection day.
- Spillage shall be removed and properly packaged for disposal. Soils that have been contaminated by spills shall be removed and packaged for proper disposal on the same day as the spill occurred.
- Liquids, including contaminated rainwater, shall not be discharged outside of the containment structures.
- Non-latex paints shall not be air dried.

- Waste received at the HHW C/S Facility shall be stored within containment areas at all times.

- Records on the quantities of HHW collected and removed for disposal shall be compiled monthly and maintained at the facility for Department review upon request.

The specific waste handling procedures for this facility is described in the Facility Standards for the Citrus County Hazardous Waste Collection and Storage Facility, 2004, which is on file in the landfill office.

2.5 WEIGHING OF INCOMING WASTES (RULE 62-701.500(2)(D), F.A.C.)

Weighing of incoming wastes will be performed at the scalehouse. Each customer receives a receipt made out by an automatic cash register showing the type of refuse, amount, and fee. These receipts are utilized for financial accountability and to complete the necessary daily, weekly, monthly, and annual activities/materials reports required by the Florida Department of Environmental Protection (FDEP) and Citrus County.

2.6 VEHICLE TRAFFIC CONTROL AND UNLOADING
(Rule 62-701.500(2)(e), F.A.C.)

All traffic entering the landfill must pass though the scalehouse. Vehicle traffic control and unloading is directed by color-coded signage for unloading areas and the attendant in the scalehouse. The attendant will direct the vehicle to the point of unloading compatible with the waste. Additional traffic directions will be provided, when needed, by the equipment operator or spotters.

2.7 METHOD AND SEQUENCING OF FILLING WASTES
(Rule 62-701.500(2)(F), F.A.C.)

The Citrus County Landfill will be operated using the area fill method. Waste delivered to landfill will be directed to the working face area of the landfill for unloading. Once unloaded, waste will be spread in layers approximately 2-feet in thickness and compacted. Following this method waste will be placed in 10-foot lifts across the site. The fill sequencing plans for the remainder of Phase 1 and Phase 2 are provided in Attachment E-1.

2.8 WASTE COMPACTION AND APPLICATION OF COVER
(Rule 62-701.50(2)(g), F.A.C.)

2.8.1 Method of Filling Wastes/Compaction

The procedure for filling and compacting of the initial waste lifts over areas of exposed liner will be as follows:

- To protect the integrity of the leachate collection system and liner, driving vehicles directly over the liner will be prohibited.

- The liner will be covered with a minimum of two (2) feet of protective soil at least one week prior to the placement of waste.

- The protective soil layer is placed on the liner using low ground pressure tracked dozer approximately 1 week prior to the placement of waste. The equipment operator is directed by a spotter to ensure that the soil is placed correctly and that the equipment does not come in contact with the liner. The 2-foot minimum in-place thickness of the protective soil layer is verified by the landfill operator.

- The landfill spotter directs equipment away from the side slope liner during normal operations.

- The initial lift of waste will be 4 feet thick and selected for material that will not cause damage to the liner. The initial lift of waste will be spread with equipment that will preserve the integrity of the liner system.

Thc procedures for filling and compacting all waste will be as follows:

- Waste will be placed against the working face of the previous days waste, so that the first row will act as a means of access and a berm to guide the placement of waste material for the remaining rows.

- The waste will be spread and completed in 2-foot layers and compacted to approximately 1 foot in thickness by a minimum of five passes using a landfill compactor.

2.8.2 Daily and Intermediate Cover

Cover material will be utilized to minimize vector breeding, animal attraction, and fire potential, as well as to prevent blowing litter and control odors. Daily cover will be composed of soil from the on-site stockpile, a 50/50 mixture of yard waste mulch and soil, synthetic materials such as tarps and geomembranes, or approved ADC material consisting of a spray on slurry of polymer and recycled paper fibers. Daily soil cover will be placed and compacted to a minimum thickness of 6 inches; spray on daily cover will be applied per manufacturer specifications and shall not be used in the rain. The intermediate cover will be comprised of soil from the on-site stockpile or a 50/50 mixture of yard waste mulch and soil. The intermediate soil cover will be placed and compacted to a minimum thickness of 12 inches. Mulch is from on-site recycled yard waste.

2.8.3 Final Cover

The final cover system will be designed in accordance with Rule 62-701.600(5), F.A.C. The final cover will be placed on the intermediate cover as phases of the facility are closed. The conceptual final cover system for landfill closure, from top to bottom includes the following:

- 24-inch soil layer with the upper surface capable of supporting vegetative growth

- Composite drainage net layer (geosynthetic filter fabric with drainage net)
- 40-mil textured geomembrane

2.9 OPERATION OF GAS, LEACHATE, AND STORMWATER CONTROLS

(Rule 62-701.500(2)(h), F.A.C.)

2.9.1 Landfill Gas Controls

The LFG management system at the site currently consists of passive vents in the old closed 60-acre landfill, which serves to minimize the potential for off-site migration of LFG. An interim LFG control system has also been permitted that includes tie-ins to the existing LCRS risers on the east side of the active landfill routing LFG to a blower/flare station. The blower/flare station will be relocated and reused for this GCCS construction. The GCCS proposed for the Class I landfill is a voluntary active LFG collection and control system that is being installed to proactively reduce methane emissions to the atmosphere. This system is not required by the Federal New Source Performance Standards (NSPS).

~~The proposed interim GCCS will include tie-ins to the existing leachate collection and removal system (LCRS) risers on the east side of the active landfill of Phases 1 and 1A. Collected LFG will be routed to a blower/flare station where it will be combusted in a candlestick flare.~~

~~The tie-ins will be made by retro-fitting the existing cleanout flange lids to facilitate the application of vacuum via a wellhead. A 4-inch HDPE above and below grade header will pipe the landfill gas to a blower/flare station where it will be combusted. Condensate will drain to a condensate sump at the flare station. From the sump, the condensate will then be pumped into the leachate collection system.~~

~~It is anticipated that this interim system will be in place for 8 to 12 months prior to the installation of the permanent GCCS. Once the interim system is up and running there will be few operational requirements. The leachate cleanouts will continue to function as designed when needed. Cleanouts will be accessed by completely closing the supplied valves and then removing the quick caps. No maintenance will be required for the piping system and maintenance of the pump and blower/flare station should be carried out per the manufacturer's recommendations.~~

~~The LFG management system at the site currently consists of passive vents installed in the old closed 60-acre landfill, which serves to minimize the potential for off-site migration of LFG. The GCCS proposed for the lined Class I landfill is a voluntary active LFG collection and control system that is being installed to proactively reduce methane emissions to the atmosphere. This system is not required by the Federal New Source Performance Standards.~~

2.9.2 Leachate Controls

Leachate is collected by a leachate collection and transfer system. The leachate is conveyed by gravity to a leachate sump located as shown in the Citrus County Central Landfill Phase 2 Expansion Construction Plan Sets. Collected leachate is pumped from the leachate sump in the landfill to an existing leachate storage tank. Additional information is provided in Section 8.0 of this operations plan.

Leachate generation will be minimized by only operating a single working face and keeping the working face as small as possible. During special events, such as during initial lift filling of the new cell, more than one working face may be operated. Daily and/or intermediate cover will be placed with slopes to promote stormwater runoff. The mixing of stormwater with leachate will be minimized by grading the daily and/or intermediate cover away from the working face and by using soil berms to direct stormwater runoff away from the working face. Gutters and lined conveyance ditches will also be used to collect and transport stormwater to stormwater management facilities.

2.9.3 Stormwater Controls

Operation of the existing stormwater system is discussed in Section 10.0 of this operations plan. The stormwater system will be managed as required by Rule 62-701.500(10), F.A.C., to meet applicable standards for Rule 62-302, F.A.C., and Rule 62-330, F.A.C. The system shall minimize stormwater from entering waste filled areas and avoid the mixing of stormwater with leachate. All stormwater conveyances shall be inspected at least weekly to verify adequate performance. Conveyances not performing adequately will be repaired within three (3) working days. Documentation of all inspections and repairs will be kept on file at the landfill office.

2.10 WATER QUALITY MONITORING (Rule 62-701.500(2)(i), F.A.C.)

Groundwater and leachate monitoring will be conducted as described in the Citrus County Central Landfill Groundwater Monitoring Plan. The latest version of the plan was submitted and approved as part of the minor operation permit modification submitted by JEA and approved by FDEP April, 24, 2007. This document will be updated periodically based on current operation permit requirements with a current copy held in the solid waste administration offices at the landfill.

2.11 MAINTAINING AND CLEANING THE LEACHATE COLLECTION SYSTEM (Rule 62-701.500(2)(j), F.A.C.)

The leachate system at the landfill consists of collection, storage, treatment, and disposal facilities for the closed portion and the Phase 1, 1A, and 2 active portions of the landfill. Maintenance of the leachate system facilities is performed as specified in the manufacturer's manuals kept on file in the landfill office. See Section 8.2 for a description of the operation and maintenance procedures. Inspection and cleaning of the system will be performed every 5 years. Inspection of storage and treatment tanks will be performed every 3 years.

SECTION 8

LEACHATE MANAGEMENT
(RULE 62-701.500(8), F.A.C.)

Leachate is collected in 8-inch gravity header pipes that slope from east to west. These gravity header pipes drain into the leachate collection sump located on the west side of the landfill. Clean outs are provided at each end of the header pipe to allow access for inspection and cleaning. Pumps in side-slope risers pump the leachate to the leachate storage tank prior to treatment in an on-site leachate treatment plant.

8.1 MONITORING, SAMPLING, AND ANALYSIS OF LEACHATE (Rule 62-701.500(8)(a), F.A.C.)

The Division Director is responsible for leachate monitoring, sampling, and analysis, and for providing copies of the leachate analysis to FDEP. Leachate sampling and analysis is addressed in the Citrus County Central Landfill Groundwater Monitoring Plan Evaluation, Attachment M-1. Sampling and analysis will be conducted by qualified contractors and will meet applicable FDEP requirements.

The depth of leachate over the liner is monitored with level transducers on the leachate removal pumps. In addition, the leachate pump side slope risers and leachate collection pipe clean out side-slope risers provide a mechanism to observe leachate levels through physical measurements. Complete details of the pumps and side slope risers are provided in the Phase 2 Construction Plans.

8.2 OPERATION AND MAINTENANCE OF LEACHATE COLLECTION SYSTEM (Rule 62-701 .500(8)(b), F.A.C.)

The Utility Operator will be responsible for maintenance of the leachate systems, including the piping, pump stations, and piping to the leachate storage tank and treatment plant. A schematic diagram of the leachating pumping and treatment system is shown in Figure 8-1. The equipment manufacturer will provide operation and maintenance manuals for each of the system components. Maintenance of each component will be performed in accordance with manufacturer specifications and documented on a Maintenance Summary Form, included in Appendix C. Maintenance documentation may also include a video of the cleaning procedures. Operation and maintenance manuals include the following:

- Description of unit and component parts, including normal operating characteristics and limiting conditions.
- Operating procedures.
- Maintenance and overhaul procedures.

- Installation instructions.
- Original manufacturer's parts list, illustrations, and detailed assembly drawings.
- Spare parts ordering instructions.
- Manufacturer's printed operating and maintenance instructions.

Stormwater that is collected and retained within the working face area will be pumped to the leachate storage tank using the County's hydraulic pump. Contaminated stormwater will be pumped through the network of temporary pipe setup within the landfill working area. Information in the hydraulic pump and the piping network is provided in Appendix D.

Flow will be monitored from the leachate pumps. Facility personnel will record leachate flows daily. This will allow determination of leachate production as a function of rainfall and provide information to assess the efficiency of leachate and stormwater management practices. Leachate flow will be reported with the quarterly facility monitoring report. Leachate generation/flow records will be kept at the facility as part of the official operation record.

Daily maintenance on each leachate pump station will also include reading flow meters and making sure each pump is operational. Pumping rates and electrical draw will be confirmed semiannually. If these tests indicate significantly reduced performance, the pumps will be pulled for inspection and repair. A replacement pump will be installed while the repairs are being made.

If leachate flow volume is noticeably decreased, the leachate collection system will be inspected. Possible reasons for low or no flow are pump and/or level transducer malfunction or collection pipe collapse or blockage. If pipe blockage is identified, the collection pipe will be power jetted to remove sediment buildup. Power jetting or rodding will be done from either or both ends of the header.

The proposed GCCS is designed to provide a means of relieving internal gas pressures within the landfill and prevent fugitive emissions of LFG to the atmosphere through the cover soils and the subsurface migration of LFG to the surrounding areas.

The proposed GCCS for Phases 1/1A and 2 include the following features:

- LFG extraction wells composed of 6-inch PVC pipe, installed in a 30-inch borehole and backfilled with FDOT No. 4 stone. The borehole will be sealed with a hydrated bentonite plug and backfilled to grade with clean soil backfill.
- Tie-ins will be made to the existing LCRS risers and these will be connected to the header/lateral system, routing LFG to the blower/flare station.
- A below grade header/lateral network will be installed. All piping will be HDPE SDR 17.

- A 2" HDPE SDR 9 air supply line will be installed from the relocated blower/flare and compressor location to CS-1 on the east side of the Class I cells.

- A condensate sump with a pneumatic pump will be installed at the relocated blower/flare station. An O&M manual for the pneumatic pump will be submitted to the FDEP with the report of construction completion.

- Self-draining condensate traps will be located at engineered low points in the header system for the collection of condensate. The traps will allow for the drainage of condensate from the header and lateral system back into the landfill. Refer to Attachment E-1 for the condensate trap details.

- The existing blower/flare station will be relocated next to the leachate holding tank facility. Collected LFG will be routed to this new location for combustion via the candlestick flare. Refer to Attachment E-1 for blower/flare details.

If it is necessary to perform video inspection or cleanout the LCRS via these risers, this can be accomplished by closing the 2-inch wellhead gate valve, disconnecting the flexible hose, and removing the quick release caps or flanged lids and associated piping.

~~The proposed interim GCCS design will include tie-ins to the existing leachate collection and removal system (LCRS) risers on the east side of the active landfill. If it is necessary to perform video inspection or cleanout the LCRS via these risers, this can be accomplished by closing the 2-inch wellhead gate valve, disconnecting the flexible hose, and removing the 6-inch quick release cap and associated piping.~~

~~After the tie-ins are made to the LCRS they will continue to function as cleanouts. This will be achieved by fully closing the supplied valves and removing the quick caps and associated fittings when access to the LCRS is necessary.~~

~~Condensate from the interim GCCS design will drain from the knockout pot into a condensate drain line that ties into a 6-inch HDPE header tying into the condensate sump. From the sump, the condensate will then be pumped back into the leachate collection system.~~

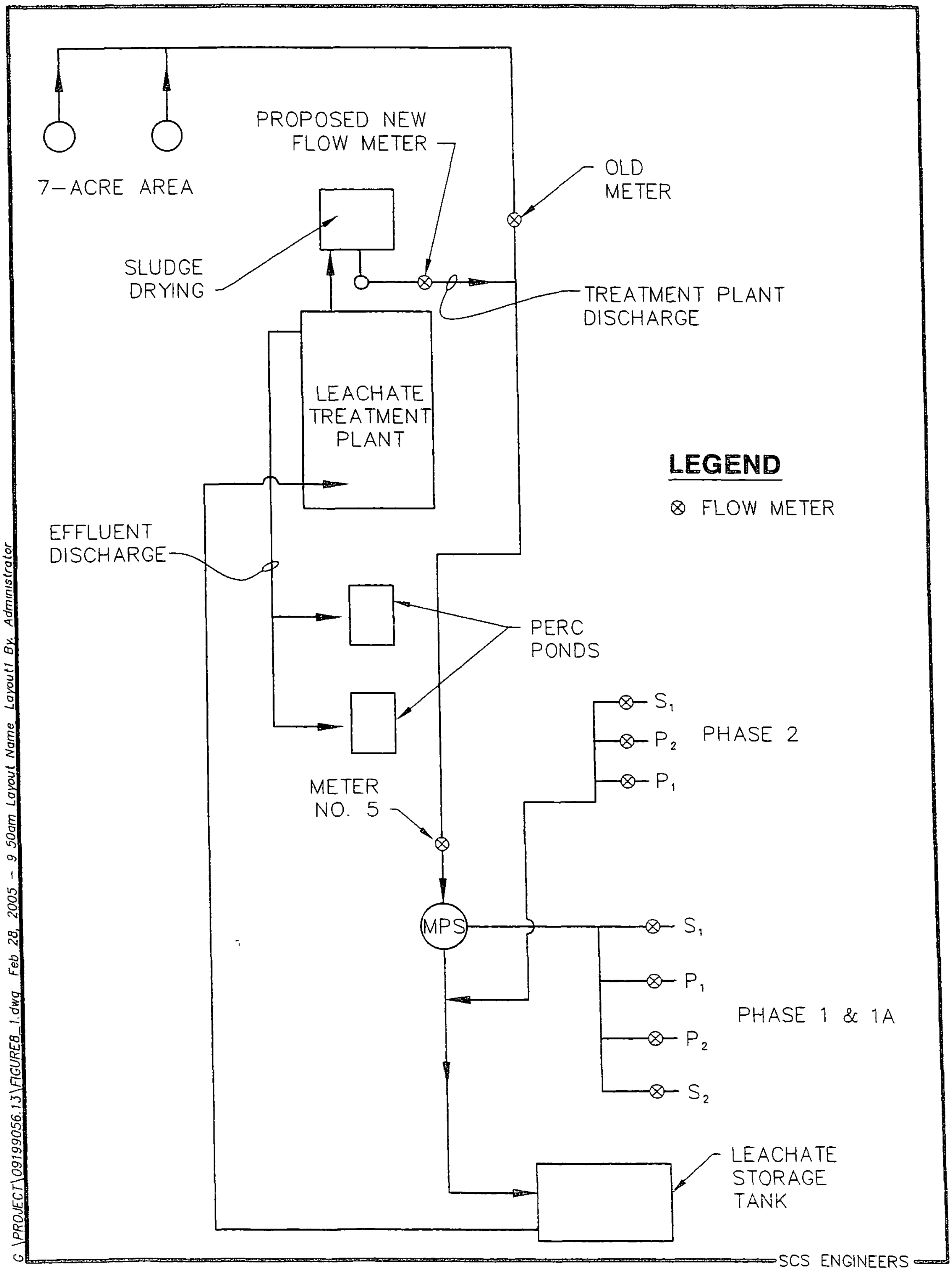


Figure 8–1. Leachate Flow Schematic

8.3 LEACHATE HANDLING (IF REGULATED AS HAZARDOUS WASTE)
(Rule 62-701 .500(8)(b), F.A.C.)

If, in the future, the leachate becomes classified as a hazardous waste, it will be managed in accordance with Rule 62-730, F.A.C., or other rules as may be applicable at the time.

8.4 OFF-SITE TREATMENT (Rule 62-701.500(8)(c), F.A.C.)

Leachate is normally treated and disposed of on site. If off site treatment and disposal is necessary, leachate will be transported to one of several Citrus County Utilities wastewater treatment plants. No written agreement exists with Citrus County Utilities because it is a division of this department.

8.5 ON-SITE TREATMENT (Rule 62-701.500(8)(d), F.A.C.)

Leachate will be treated onsite. A powdered activated carbon enhanced, activated sludge plant treats all leachate generated at the landfill. This plant, manufactured by ZIMPRO, provides sequential batch treatment in two stages. There are two first stage reactors and one-second stage reactor. The first stage is aerobic for nitrification of the ammonia in the leachate, and the second is an anoxic treatment process for denitrification. The second stage is supplemented with methanol to support the microorganisms due to low influent nutrients. Carbon provides removal of metals, complex organics and serves as microbial attachment medium. Mobile dissolved ions are not removed. After filtration and chlorination, the effluent is ready for on-site disposal. Sludge from the treatment process is dewatered and disposed in the landfill. The Leachate System Operation Process and Instrumentation Diagram (P&ID) is filed in the landfill office and provides further information on the operation of the leachate collection and treatment system.

The leachate is initially pumped to the on-site leachate storage tank prior to treatment. Liquid levels will be measured daily in the leachate storage tank units. The tank exterior will be visually inspected weekly. The tank interior will be inspected at least every three years, and more frequently if it is drained. At the time of draining, accumulated sediment will be removed and interior maintenance will be performed. If failures are detected, repairs will be made as soon as possible and before tank is brought back into operation. Electrical and mechanical equipment maintenance will follow manufacturer's recommendations. Inspection reports will be kept in the landfill office.

The leachate treatment system is permitted to treat up to 30,000 gallons per day (gpd) of raw leachate. Presently, with the operation of the 7-acre closed areas and Phases 1 and 1A, the system treats about 8,500 gpd on an annual average. The system has treated up to 14,300 gpd.

With the addition of Phase 2 landfilling operations hydrogeological modeling of the early operations sequence indicates an average flow of 3,000 gpd of leachate will be generated in addition to the leachate generated from the other areas. Using the historical leachate generation quantities for Phase 1 and 1A is considered conservative because as landfilling in these areas reaches higher elevations larger areas will be subject to steeper slopes thus less leachate should be generated.

Based on the assumptions listed above, it is expected that total average daily leachate generation from all areas should be less than 12,000 gpd. This results in a capacity excess of over 50% when compared to the permitted treatment capacity of the leachate treatment system.

Based on the operating record of the leachate treatment system, reports of influent and effluent quality and groundwater monitoring at the effluent disposal ponds, the leachate treatment system is performing adequately.

8.6 CONTINGENCY PLAN FOR MANAGING LEACHATE (Rule 62-701.500(8)(e), F.A.C.)

If on site leachate treatment is interrupted, leachate will be transported to one of several Citrus County Utilities wastewater treatment plants. Because multiple wastewater treatment plants are available for leachate disposal, complete interruption of off site disposal ability is not anticipated.

8.7 RECORDING LEACHATE QUANTITIES (Rule 62-701.500(8)(f), F.A.C.)

Quantities of leachate collected by the leachate collection and removal system are recorded in gallons per day from the leachate flow observations. Utilities staff record daily flow amounts on a standard form. Completed forms are compiled monthly with the compiled form sent to the facility manager to be filed in the facility's operating record.

Citrus County uses a number of metering points to measure leachate generation (See Figure 8-1). The flows generated from each landfill phase of the newer 80-acre area are measured directly by flow meters within the discharge line of each pump flows from the closed 7-acre area have been measured in the past with an older mechanical flow meter. It is suspected that this meter is not providing accurate readings due to repeated malfunctions. The County has calibrated flow from the 7-acre pumps against the elapsed time meters (ETMs) for each pump. The ETM readings are now taken and converted to flow in gallons in a spreadsheet. The older meter shown on Figure 8-1 is no longer being used.

A new flow meter has been ordered to be installed at the discharge location for the treatment plant discharge, which is re-circulated back to the master pump station (MPS). Flow meter number 5 records the flow coming from the 7-acre closed area and the treatment plant. By subtracting the metered flow from the treatment plant, the County will have a detinative volume for flow coming from the 7-acre closed area.

8.8 RECORDING PRECIPITATION (Rule 62-701.500(8)(g), F.A.C.)

A rain gauge has been installed and is operated and maintained by Citrus County personnel to record precipitation at the disposal facility. Precipitation records will be maintained in the facility's operating record and will be compared with leachate generation rates.

8.9 INSPECTION AND CLEANING (Rule 62-101.500(8)(h), F.A.C.)

The new leachate collection system for Phase 2 has been pressure cleaned and inspected by video recording after construction and prior to the initial placement of waste in Phase 2. Thereafter, existing leachate collection systems at the Citrus County Landfill will be pressure cleaned or inspected by video at the time of permit renewal. Results of the cleanings and inspections are kept on file in the landfill office. A copy of the most recent Inspection Report is included as Appendix E.

SECTION M

WATER QUALITY AND LEACHATE MONITORING REQUIREMENTS

Not applicable.

SECTION N

SPECIAL WASTE HANDLING REQUIREMENTS

Not applicable.

SECTION O

LANDFILL GAS MANAGEMENT SYSTEM REQUIREMENTS

O.1 LANDFILL GAS MANAGEMENT SYSTEM

The LFG management system at the site currently consists of passive vents in the old closed 60-acre landfill, which serves to minimize the potential for off-site migration of LFG. An interim LFG control system has also been permitted that includes tie-ins to the existing LCRS risers on the east side of the active landfill routing LFG to a blower/flare station. The blower/flare station will be relocated and reused for this GCCS construction. The GCCS proposed for the Class I landfill is a voluntary active LFG collection and control system that is being installed to proactively reduce methane emissions to the atmosphere. This system is not required by the Federal New Source Performance Standards (NSPS).

O.1.a Gas Migration Control

Landfill gas migration is currently being controlled by the existing LFG management system. The proposed GCCS in the lined Class I landfill will further reduce the potential for subsurface LFG migration and odors.

The proposed GCCS is designed to generate greenhouse gas (GHG) emission reduction credits, also known as verified emissions reductions (VERs).

O.1.b Site-Specific Design Conditions

The proposed GCCS will include the installation of vertical extraction wells, tie-ins to the LCRS risers, and a header/lateral system that will route collected LFG to the blower/flare station. One condensate sump will be located prior to the blower/flare station. Self-draining condensate traps will be located at low points within waste along the header.

Attachment O-1 provides the well schedule for the proposed LFG extraction wells. Each well borehole will terminate at least 15 feet above the bottom of refuse in order to not impact the bottom liner or LCRS. Attachment O-1 also includes the ~~Because this GCCS is voluntary and not being installed for NSPS compliance or landfill closure purposes,~~ estimated radius of influence (ROI) for each of the proposed wells~~calculations are not being submitted with this application~~.

The system of headers and laterals connecting the LFG vertical extraction wells and LCRS tie-ins to the blower flare station was designed using standard industry practices and materials. High density polyethylene (HDPE) SDR 17 pipe is specified for the header/lateral lines. The pipe will be buried a minimum of 2 feet below ground surface at all times. Pipe crushing calculations were performed to assure that the pipe can handle the load of the equipment on site. Attachment O-2 contains the pipe crushing calculations.

Attachments O-3 and O-4 contains the landfill gas generation estimate and condensate generation estimate respectively and the pump sizing calculations are included in Attachment O-5.

O.1.c Reducing Gas Pressure

The Class I landfill currently has an interim GCCS which extracts and combusts LFG from three LCRS risers on the east side of the landfill. The proposed GCCS will augment the LFG extraction that will be provided by the interim GCCS. It will be more extensive and exert a negative pressure via vertical extraction wells and convey collected gas to the candlestick flare. The wells will reduce internal gas pressures of the landfill which will further reduce the potential for subsurface lateral migration of LFG.

O.1.d Liner, Leachate Control System or Final Cover Non-Interference

The proposed GCCS will not interfere with the bottom liner and leachate collection system. Vertical LFG extraction wells will terminate a minimum of 15 feet above the liner system.

O.2 GAS MONITORING PROGRAM

No changes to the LFG migration monitoring plan are being proposed with this application. Gas monitoring is performed in accordance with Rule 62-701.530, F.A.C. The results of the quarterly monitoring are submitted to FDEP.

O.3 GAS AND ODOR REMEDIATION PLAN IMPLEMENTATION

No changes to the landfill gas remediation and odor remediation plans are being proposed with this application. In the event that methane is detected in concentrations that exceed the regulatory limit during quarterly monitoring, Citrus County shall submit to FDEP a gas remediation plan within seven days of detection and the remedy will be completed within 60 days of the exceedance detection, or as approved by FDEP.

In the event that an objectionable odor caused by LFG is detected, a routine odor-monitoring program will be implemented. If the odor monitoring program confirms the existence of objectionable odors, then an odor remediation plan shall be submitted to FDEP. Upon approval by FDEP, the odor remediation plan shall be implemented within 30 days.

O.4 LANDFILL GAS RECOVERY FACILITIES

The proposed GCCS will route collected LFG to the relocated candlestick flare where the gas will be combusted.

O.4.a Application Information

The information required by Rule 62-701.320(7) and 62-701.330(3), F.A.C. is included in both the permit forms and this engineering report.

O.4.b Closure Information

Waste disposal activities are on-going at the site. At landfill closure, the closure plan will address any integration of the GCCS with the intended end use, which has not yet been determined.

O.4.c Gas Generation and Condensate Management

The proposed GCCS is designed to recover and combust a portion of the LFG generated by the landfill. Even though~~Because~~ the GCCS is not required per the NSPS or as part of a landfill closure, ~~it is not necessary that~~ the GCCS has been designed to handle future generation rates in accordance with Rule 62-701.530, F.A.C. ~~However,~~ Table O-1 shows the projected LFG recovery potential (i.e., generation) and expected LFG collection rates in standard cubic feet per minute (scfm) through 2013. These flow rates are based on the model results that are provided in Attachment O-3.

The LFG recovery model estimates the annual LFG generation/recovery rates based on the amount and age of waste-in-place and the organic/biodegradable fraction of the waste. Gas generation from the lined Class I landfill was estimated using the U.S. Environmental Protection Agency's Landfill Gas Emission Model (LandGEM). Historical and projected future filling rates were input into the model, along with standard AP-42 default parameters, which are shown at the bottom of the model summary table in Attachment O-3. A summary of projected LFG generation rates for the Citrus County Central Landfill from 2008 through 2013 are shown in Table O-1. Refer to Attachment O-3 for the complete LFG generation/recovery estimate calculations.

Table O-1. Projected LFG Generation and Recovery Rates Citrus County Central Landfill

Year	LFG Recovery Potential (scfm)	Expected LFG Recovery Rate (scfm)
2008	481	337
2009	519	363
2010	553	387
2011	560	392
2012	567	397
2013	575	403

Condensate is generated when extracted gas from the landfill cools in the collection piping. Self-draining condensate traps and condensate sumps will be located at the engineered low points in the gas header pipeline to collect the condensate. The drawings in Attachment E-1 show the condensate traps and sump locations. Attachment O-4 contains the condensate generation estimate calculation for the lined Class I landfill gas system. As shown in the calculations the condensate generation rate, under worst-case conditions is estimated to be 296 gallons per day, of which approximately 63 gallons per day will end up at CS-1.

O.4.d Condensate Sampling, Analyzing, and Data Reporting

Collected condensate will drain from the self-draining traps back into the waste mass and eventually into the leachate collection system. Condensate from the condensate sump will be pumped into the leachate holding tank. Leachate sampling takes place at the landfill and as a result the County does not feel it should be necessary to conduct condensate sampling. Therefore Citrus County formally requests that no additional condensate sampling be required.

O.4.e Closure Plan

Waste disposal activities are on-going at the site. At landfill closure, the closure plan will address any integration of the GCCS with the intended end use. The GCCS Closure Plan will be submitted with the final GCCS design and will contain the following:

1. A closure report
2. A closure design plan
3. A closure operations plan
4. Closure procedures
5. A plan for long-term care
6. Demonstration of proof of financial responsibility for long-term care

O.4.f Closure Costs

~~Based upon the pre-application meeting and the fact that the GCCS proposed for the lined Class I landfill is a voluntary active LFG collection and control system a closure cost estimate is not required at this time.~~ The closure cost estimate for the proposed voluntary LFG collection and control system includes conversion of the LFG extraction points to passive vents. The closure and long-term care costs associated with the GCCS are included in the financial assurance documentation located in Attachment S-1.

ATTACHMENT O-1

WELL SCHEDULE

SCS ENGINEERS

SHEET 1 of 1

CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection & Control System	09207049 02

SUBJECT			
Well Schedule for Proposed Extraction Wells	BY IMM	DATE 2/27/2009
	REVISED BY. LEK	REVISED DATE. 6/23/2009
	CHECKED: D. Penoyer	DATE: 7/1/09

Well ID	Northing	Easting	Approx. Ground Surface	Approx. Depth of Refuse	Well Depth	Slotted Pipe Length	Solid Pipe Length Below Grade	Solid Pipe Length Above Grade	Thickness of Gravel Pack	Radius of Influence
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
EW-1	1,642,041	516,123	168	127	90	51	38	3	53	200
EW-2	1,642,018	516,437	167	127	90	45	44	3	47	200
EW-3	1,642,053	516,675	159	117	90	49	40	3	51	200
EW-4	1,642,312	516,026	126	87	72	47	24	3	49	162
EW-5	1,642,268	516,281	123	85	70	39	30	3	41	158
EW-6	1,642,287	516,504	113	72	57	36	20	3	38	127
EW-7	1,642,259	516,727	116	76	61	40	20	3	42	137
EW-8	1,642,425	516,648	120 *	77	62	41	20	3	43	140
EW-9	1,642,462	516,455	120 *	77	62	41	20	3	43	140
EW-10	1,642,502	516,259	120 *	77	62	41	20	3	43	140
EW-11	1,642,515	516,052	120 *	77	62	41	20	3	43	140
TOTALS					778	470	297	---	492	

Notes.

1 Ground surface elevations based on the topographic survey data by Kucera dated April 12, 2008.

2 Base grade information taken from PBS&J Record Drawings, CH2M HILL Record Drawings, and SCS Record Drawings

3 Well depth = Depth of refuse - 15 feet

4 * Denotes the estimated ground surface that will exist at the time of construction Contractor shall provide survey data documenting the ground surface elevation prior to construction in accordance with the Contract Document Engineer shall adjust well schedule as necessary based on the preconstruction survey in order to maintain a minimum separation of 15 ft between the bottom of boreholes and the bottom of refuse.

5. ROI assumed to be 2 25 x well depth; max ROI assumed to be 200 ft.

F \PROJECT\Citrus\09207049.02\Permit App-GCCS-SWconstruct\RAI No. 1\[Attachment 6 Revised Well Sch xls]Prop Well Schedule

No. 56085

7/1/09

STATE OF FLORIDA

ATTACHMENT O-2

PIPE CRUSHING CALCULATIONS

SCS ENGINEERS

SHEET 1 OF 1

CLIENT	PROJECT	JOB NO
Citrus County	Citrus County Landfill - Phase 3	09207049 02

SUBJECT	BY	DATE
Summary Table Pipe Crushing	VKF	4/10/2009
	CHECKED DHB	DATE 4/22/09

OPERATION

Description	Waste Height ft	Fill Height ft	Pipe Diameter in	Type of Calculation	Design Value	Calculated Value	Units	Safety Factor[1]
826G	0	2	6	Buckling	103 90	11 28	psi	9 21
				Compressive Stress	800	95 81	psi	8 35
				Bending Strain	4.2	0 61	%	6 86
826G	115	118 5	6	Buckling	105.75	21 07	psi	5 02
				Compressive Stress	800	178 97	psi	4 47
				Bending Strain	4 2	1 22	%	3 43
CAT D6	0	2	6	Buckling	104 02	2 54	psi	40 95
				Compressive Stress	800	21 58	psi	37 08
				Bending Strain	4 2	0 14	%	30 46
CAT D6	115	118 5	6	Buckling	105.88	21 04	psi	5 03
				Compressive Stress	800	178 69	psi	4 48
				Bending Strain	4 2	1 22	%	3 44

[illegible]
4/22/09

SCS ENGINEERS

CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations	VKF	4/8/2009
Operation w/ 826G	CHECKED	DATE
6" HDPE SDR 17 Header	DHB	4/22/09

Load on Pipe (Overburden)

Prism Loads, $P_E = wH$ Eq'n 7 1 See Source No 1

w = unit weight

H = depth

	Depth (ft)	Unit Weight (lb/ft^3)	P_E (lb/ft^2)
Cover Soil	2	110 0	220 0
Intermediate Cover	0	110 0	0 0
Waste	0	60 0	0 0
Drainage Sand	0	90 0	0 0
Rock	0	140 0	0 0

TOTAL SOIL PRISM LOAD P_E = 220 0 lb/ft^2

Total Depth = 2 ft

Soil Arching, $P_m = C_D wB$

NOTE The waste unit weight represents the combined unit weight of waste, daily cover, and moisture

Pm = vertical soil pressure

B = trench width at pipe crown 2 ft

C_D = load coefficient $= \dfrac{1 - e^{-2Ku\ H/B}}{2Ku'}$ Eq'n 7 3 See Source No 1

e = natural log base number

K = Rankine earth pressure coefficient = $\tan^2(45-0\ 5*\phi)$

ϕ = internal soil friction angle = 28 degrees

u' = friction coefficient between backfill and trench sides = $\tan \phi$

Soil Type	Ku'
Saturated Clay	0 110
Ordinary Clay	0 130
Saturated Top Soil	0 150
Sand and Gravel	0 165
Clean Granular Soil	0 192

	Ku'	C_D	P_m (lb/ft^2)
Cover Soil	0 150	0.86	190
Intermediate Cover	0 165	0 00	0
Waste	0 191	0 00	0
Drainage Sand	0.165	0.00	0 0
Rock	0 190	0 00	0 0

TOTAL SOIL ARCHING LOAD P_M = 190 1 lb/ft^2

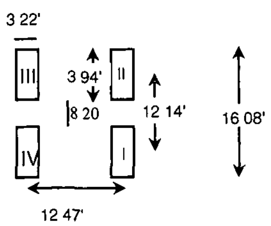
MODIFIED ARCHING LOAD = $0\ 6P_M + 0\ 4P_E$ = 202 04 lb/ft^2

OVERBURDEN LOAD = 202.04 lb/ft^2

Load on Pipe Operation w/ 826G

Track per Load = q_r = 1,670 20 psf (Rear)

Track per Load = q_{fr} = 1,541.72 psf (Front)



Length of Track = L = 3 22 ft (contact length)

Length of Track = b = 8.2 ft

Track Width = 12.47 ft

Track Width (I to II) = 16.08 ft

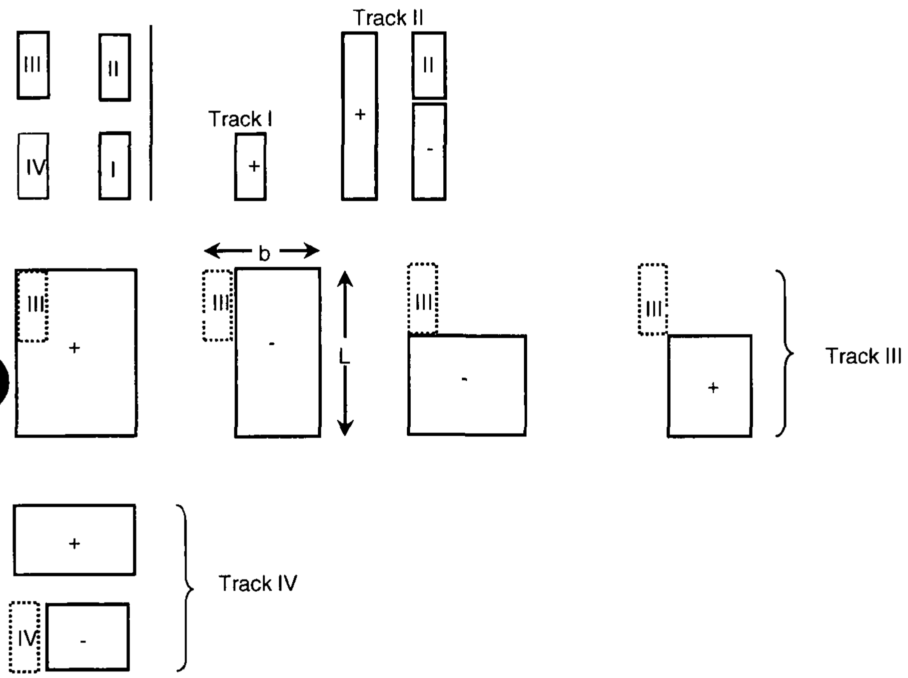
SCS ENGINEERS

CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049.02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/2009
	CHECKED	DATE
	0 HB	4/22/09

Load on Pipe Operation w/ 826G

Alternative 1: Track Adjacent and Parallel to Pipe



	b	L	z	m = b/z	n = L/z	I*	I**	I	
Track I	8 2	3	2	4.10	1.61	-0 018	0.232	0 23230	(ADD)
Track II	8.2	16.1	2	4.10	8.04	-0.002	0 248	0.24846	(ADD)
	8.2	11.4	2	4 10	5.71	-0 002	0.248	0.24821	(SUBTRACT)
Track IV	12.47	3.22	2	6.24	1 61	-0.017	0.233	0.23276	(ADD)
	4.27	3.22	2	2.14	1.61	-0.022	0.228	0 22751	(SUBTRACT)
Track III	12.47	16.08	2	6.24	8.04	-0.001	0.249	0 24944	(ADD)
	4.27	16.08	2	2.14	8.04	-0 009	0.241	0.24136	(SUBTRACT)
	12.47	11.42	2	6.24	5 71	-0.001	0.249	0.24914	(SUBTRACT)
	4.27	8.47	2	2 14	4.24	-0.009	0 241	0.24078	(ADD)

Live Load$_1$ = $q_r(\Sigma I) + q_{fr}(\Sigma II) + q_{fr}(\Sigma III) + q_r(\Sigma IV)$

Live Load$_1$ = 396.70 psf

SCS ENGINEERS

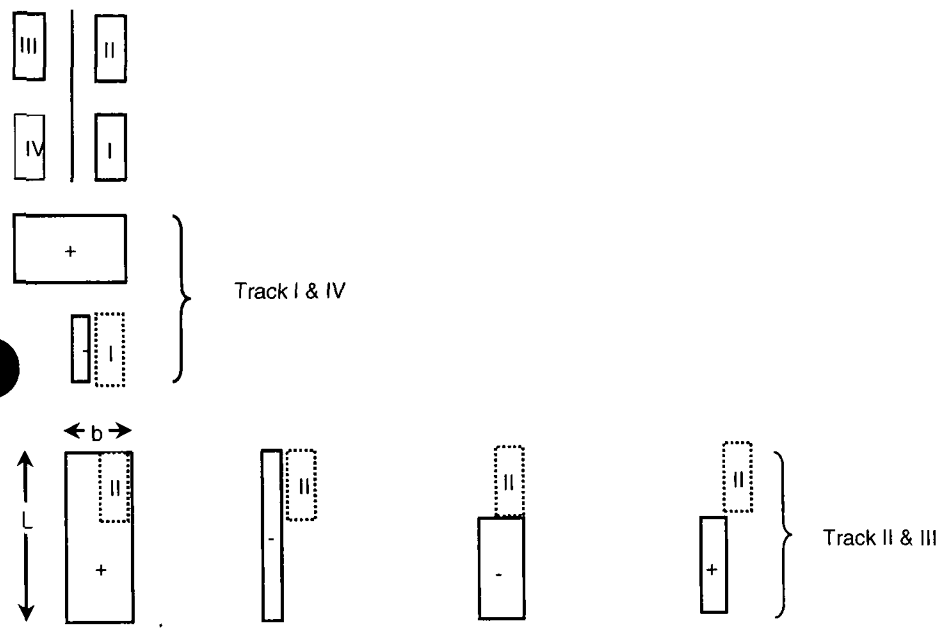
SHEET 3 of 8

CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049.02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/2009
	CHECKED	DATE
	OHB	4/22/09

Load on Pipe Operation w/ 826G

Alternative 2: Track Stradling and Parallel to Pipe



	b	L	z	m = b/z	n = L/z	I*	I**	I	
Track I	6.2	3.2	2	3.1	1.6	-0 019	0 231	0 23134	(ADD)
& IV	-2.0	3.2	2	-1.0	1 6	-0 194	0.259	-0 19433	(SUBTRACT)
Track II	6.2	16.08	2	3.1	8.0	-0.003	0.247	0.24681	(ADD)
& III	-2.0	16.08	2	-1.0	8.0	-0 203	0 292	-0.20313	(SUBTRACT)
	6.2	12.86	2	3.1	6.4	-0.003	0.247	0.24670	(SUBTRACT)
	-2.0	12.86	2	-1 0	6.4	-0.203	0.290	-0.20310	(ADD)

Live $Load_{2} = [q_r(\Sigma I) + q_{fr}(\Sigma II)] * 2$

Live $Load_{2} =$ 1422.36 psf

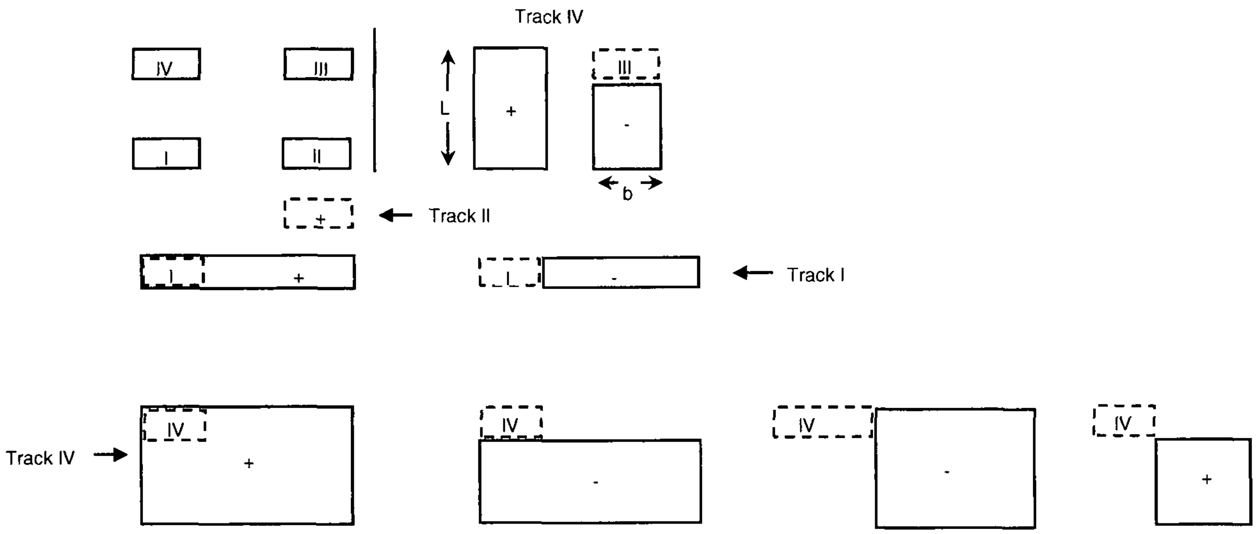
SCS ENGINEERS

CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049.02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/2009
	CHECKED	DATE
	DHB	4/22/09

Load on Pipe Operation w/ 826G

Alternative 3 Track Perpendicular to Pipe



	b	L	z	m = b/z	n = L/z	I*	I**	I	
Track I	16.1	8.2	2	8 0	4.1	-0.002	0 248	0 24846	(ADD)
	12.9	8.2	2	6.4	4 1	-0 002	0 248	0 24834	(SUBTRACT)
Track II	3.2	8.2	2	1 6	4.1	-0.018	0 232	0.23230	(ADD)
Track III	3.2	12.5	2	1.6	6 2	-0 017	0 233	0.23276	(ADD)
	3.2	4.3	2	1 6	2 1	-0 022	0 228	0 22751	(SUBTRACT)
Track IV	16.1	12.5	2	8.0	6 2	-0.001	0.249	0.24944	(ADD)
	16.1	4.3	2	8.0	2 1	-0 009	0 241	0 24136	(SUBTRACT)
	12 9	12.5	2	6 4	6.2	-0 001	0 249	0 24928	(SUBTRACT)
	12.9	4 3	2	6 4	2 1	-0 009	0 241	0 24128	(ADD)

Live $\text{Load}_{3} = q_r(\Sigma I) + q_{fr}(\Sigma II) + q_{fr}(\Sigma III) + q_r(\Sigma IV)$

Live $\text{Load}_{3} =$ 366.58 psf

LARGEST EQUIPEMENT LOAD = 1422.36 lb/ft^2

VERTICAL OVERBURDEN LOAD = 202 04 lb/ft^2

VERTICAL EQUIPMENT LOAD = 1422.36 lb/ft^2

TOTAL VERTICAL LOAD APPLIED TO PIPE, P_T = 1624.40 lb/ft^2 = 11.28 lb/in^2

SCS ENGINEERS

SHEET 5 of 8

CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049.02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/2009
	CHECKED DKB	DATE 4/22/09

Constrained Pipe Wall Buckling (for Driscoplex OD controlled pipe)

$P_{WC} = \dfrac{5.65 * \{RB'E'\,E*[12(DR-1)^3]^{-1}\}^{0.5}}{N}$ Eq'n 7-30 See Source No 1

P_{WC} = allowable constrained buckling pressure (lb/in^2)

R = buoyancy reduction factor = 1 - 0.33 * (H'/H)

H' = groundwater height above pipe (ft)	0	ft
H = cover above pipe (ft)	2	ft
B' = elastic support factor $=(1+4*e^{-0.065H})^{-1}$		
E' = soil reaction modulus (lb/in^2)	3000	lb/in^2 for moderate compaction/crushed rock, Table 7-7/Source No. 1
E = elastic modulus (lb/in^2)	100,000	lb/in^2 for short term load at 100°F, Table 5-1/Source No 1
I = moment of inertia = $t^3/12$	0.005	in^4/in
D_o = pipe outer diameter (in)	6.625	SDR 17 pipe (Driscopipe) to be used
t = pipe wall thickness (in)	0.390	SDR 17 pipe (Driscopipe) to be used
DR = pipe dimension ratio = D_o/t	17.0	SDR 17 pipe (Driscopipe) to be used
D_I = pipe inner diameter = D_o-2t (in)	5.845	SDR 17 pipe (Driscopipe) to be used
N = safety factor	2	recommended by CPChem manual

	H (ft)	H' (ft)	B'	R	P_{WC} (lb/in^2)
2 ft Cover	2	0	0.22	1.00	103.90

P_{WC} = 103.90 lb/in^2

P_{EFF} = 11.28 lb/in^2

Pipe passes contrained wall buckling calculations TRUE FS = 9.21

SCS ENGINEERS

CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049.02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/09
	CHECKED	DATE
	DHB	4/22/09

Constrained Pipe Wall Compressive Stress (for Driscoplex OD controlled pipe)

$S = \frac{P_T D_o}{288t}$ Eq'n 7-23 See Source No 1

S = pipe wall compressive stress (lb/in^2)

P_T = vertical load applied to pipe (lb/ft^2)	1624	lb/ft^2
D_o = pipe outside diameter (in)	6 625	SDR 17 pipe (Driscopipe) to be used
t = pipe wall thickness (in)	0 39	SDR 17 pipe (Driscopipe) to be used

$S = \frac{P_T D_o}{288t} =$ 95 8 lb/in^2

The recommended, long-term compressive strength (Y_s) design value for Driscoplex polyethylene pipe is 800 lb/in^2

S (psi)		Y_s (psi)
95 81	<	800

Pipe passes wall compressive stress calculations TRUE FS = 8 35

SCS ENGINEERS

CLIENT	PROJECT	JOB NO
Citrus County	Landfill Gas Collection and Control System	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/2009
	CHECKED blts	DATE 4/22/09

Iowa Formula

$\Delta X = \dfrac{D_L K W_c r^3}{EI + 0\ 06er^4}$ Eq'n 3 4 See Source No 3

ΔX = horizontal deflection (in)

D_L = deflection lag factor

K = bedding constant | 0 1 | typical value

W_c = Marston's load per unit length of pipe (lb/in)

r = mean radius of the pipe (in)

E = modulus of elasticity (lb/in^2)

I = moment of inertia of the pipe wall per unit length (in^3)

e = modulus of passive resistance fo the side fill (lb/in^2(in))

Modified Iowa Formula

$\Delta X = \dfrac{D_L K W_c r_m^3}{EI + 0\ 06E'r_m^3}$ Eq'n 3 5 See Source No 3

ΔX = horizontal deflection (in)

D_L = deflection lag factor	1 0	Prism Load used
Typical Value for Marston Load 1 5		
Typical Value for Prism Load 1 0		
K = bedding constant	0 1	typical value
P_T = Vertical load on pipe	11 28	lb/in^2
W_c = Marston's load per unit length of pipe = P_T * D_o (lb/in)	74 73	lb/in
D_o = pipe outer diameter (in)	6 625	SDR 17 pipe (Driscopipe) to be used
t = pipe wall thickness (in)	0 390	SDR 17 pipe (Driscopipe) to be used
D_I = pipe inner diameter = D_o-2t (in)	5 845	SDR 17 pipe (Driscopipe) to be used
D_m = pipe mean diameter = D_o - 1 06t	6 21	SDR 17 pipe (Driscopipe) to be used
r_m = mean radius of the pipe (in)	3 11	SDR 17 pipe (Driscopipe) to be used
E = modulus of elasticity (lb/in^2)	100,000	lb/in2 for short term load at 100oF, Table 5-1/Source No 1
I = moment of inertia of the pipe wall per unit length	0 005	in^4/in
E' = modulus of soil reaction (See Source No 1)	3000	lb/in^2 for moderate compaction and fine grained soils

$\Delta X = \dfrac{D_L K W_c r_m^3}{EI + 0\ 06E'r_m^3} =$ 0 038032 inch

% Ring Deflection = ($\Delta X/D_m$) x 100 = 0 612 % Eq'n 7-38 See Source No 1

Ring Bending Strain

$\varepsilon = \dfrac{f_D \Delta X 2C}{D_M^2} \times 100$

ε = wall strain (%)

f_D = deformation shape factor	6	non-elliptical shape
D_M = mean diameter (in)		
C = outer fiber wall centroid = 0 5 (1 06t)	0 207	Eq'n 7-41 See Source No 1
ΔX = ring deflection = $\Delta X/D_m$	0 006	

$\varepsilon = \dfrac{f_D \Delta X 2C}{D_M} \times 100 =$ 0 24 % Eq'n 7-37 See Source No 1

The maximum ring bending strain for high performance polyethylene non-pressure pipe is 4 2%

Pipe passes ring bending strain calculations TRUE

SCS ENGINEERS

CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/2009
	CHECKED	DATE
	DHB	4/22/09

Sources·

1 . CPCHEM, The Performance Pipe Engineering Manual
Book 2, Chapter 7 . Buried Pipe Design
2002

2 . Foundation Design Principles and Practices
Second Edition
Donald P Coduto
Chapter 7, Section 7 3 Induced Stresses Beneath Shallow Foundations

3 Buried Pipe Design
A P Moser
Chapter 3

4· Driscopipe Table 15 Allowable Ring Deflection

5 EPA Lining of Waste Impoundment and Disposal Facilities, SW-870

SCS ENGINEERS

SHEET 1 of 8

CLIENT	PROJECT	JOB NO
Citrus County	Landfill Gas Collection and Control System	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/2009
	CHECKED 0 HB	DATE 4/22/09

Load on Pipe (Overburden)

Prism Loads, $P_E = wH$ Eq'n 7 1 See Source No 1

w = unit weight

H = depth

	Depth (ft)	Unit Weight (lb/ft^3)	P_E (lb/ft^2)
Cover Soil	2	110 0	220 0
Intermediate Cover	1.5	110 0	165 0
Waste	115	60 0	6900 0
Drainage Sand	0	90 0	0 0
Rock	0	140 0	0 0

TOTAL SOIL PRISM LOAD P_E = 7285 0 lb/ft^2

Total Depth = 118 5 ft

Soil Arching, $P_m = C_D wB$

NOTE The waste unit weight represents the combined unit weight of waste, daily cover, and moisture

Pm = vertical soil pressure

B = trench width at pipe crown 2 ft

C_D = load coefficient $= \dfrac{1 - e^{-2Ku'H/B}}{2Ku'}$ Eq'n 7 3 See Source No 1

e = natural log base number

K = Rankine earth pressure coefficient = $\tan^2(45-0\ 5*\phi)$

ϕ = internal soil friction angle = 28 degrees

u' = friction coefficient between backfill and trench sides = $\tan\phi$

Soil Type	Ku'
Saturated Clay	0 110
Ordinary Clay	0 130
Saturated Top Soil	0 150
Sand and Gravel	0 165
Clean Granular Soil	0 192

	Ku'	C_D	P_m (lb/ft^2)
Cover Soil	0 150	0 86	190
Intermediate Cover	0 165	0 66	146
Waste	0.191	2 62	314
Drainage Sand	0 165	0 00	0 0
Rock	0 190	0 00	0 0

TOTAL SOIL ARCHING LOAD P_M = 190 1 lb/ft^2

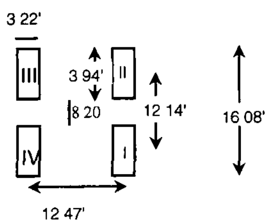
MODIFIED ARCHING LOAD = $0\ 6P_M+0\ 4P_E$ = 3,028 04 lb/ft^2

OVERBURDEN LOAD = 3,028 04 lb/ft^2

Load on Pipe Operation w/ 826G

Track per Load = q_r = 1,670.20 psf (Rear)

Track per Load = q_{fr} = 1,541.72 psf (Front)



Length of Track = L = 3.22 ft (contact length)

Length of Track = b = 8 2 ft

Track Width = 12.47 ft

Track Width (I to II) = 16 08 ft

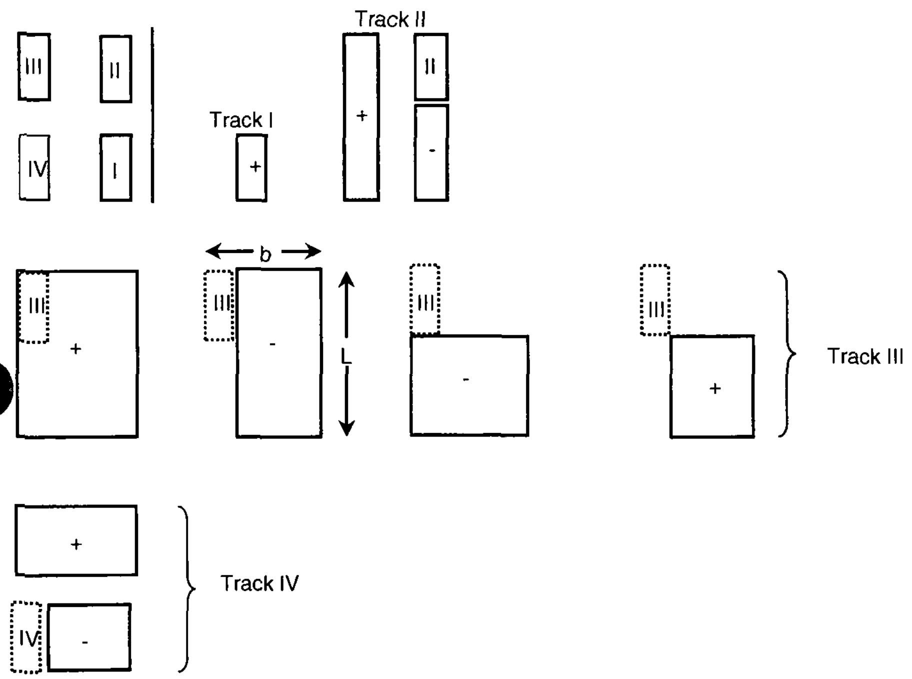
SCS ENGINEERS

CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049.02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/2009
	CHECKED	DATE
	OKB	4/22/09

Load on Pipe Operation w/ 826G

Alternative 1: Track Adjacent and Parallel to Pipe



	b	L	z	m = b/z	n = L/z	I*	I**	I	
Track I	8.2	3	118.5	0 07	0.03	0 001	0.250	0 00089	(ADD)
Track II	8.2	16.1	118 5	0.07	0.14	0.004	0 251	0.00440	(ADD)
	8.2	11.4	118.5	0.07	0.10	0.003	0 251	0.00315	(SUBTRACT)
Track IV	12.47	3.22	118.5	0.11	0.03	0.001	0.250	0.00135	(ADD)
	4.27	3.22	118.5	0.04	0.03	0.000	0.250	0.00047	(SUBTRACT)
Track III	12.47	16.08	118.5	0.11	0.14	0.007	0.252	0.00665	(ADD)
	4.27	16.08	118.5	0.04	0.14	0.002	0.251	0.00230	(SUBTRACT)
	12.47	11.42	118.5	0.11	0.10	0.005	0 252	0.00476	(SUBTRACT)
	4.27	8.47	118 5	0.04	0.07	0.001	0 250	0.00122	(ADD)

$\text{Live Load}_{1} = q_r(\Sigma I) + q_{fr}(\Sigma II) + q_{fr}(\Sigma III) + q_r(\Sigma IV)$

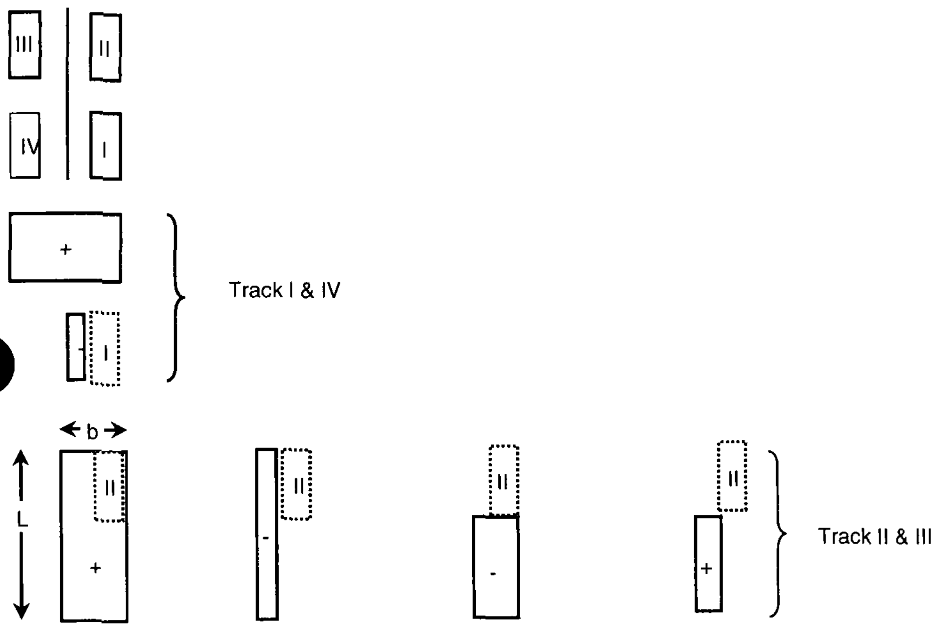
$\text{Live Load}_{1} =$ 6.16 psf

CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049.02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/2009
	CHECKED	DATE
	DHB	4/22/09

Load on Pipe Operation w/ 826G

Alternative 2: Track Stradling and Parallel to Pipe



	b	L	z	m = b/z	n = L/z	I*	I**	I	
Track I	6.2	3.2	118 5	0 1	0.0	0.001	0.250	0 00068	(ADD)
& IV	-2.0	3.2	118.5	0.0	0.0	0 000	0.250	-0.00021	(SUBTRACT)
Track II	6.2	16.08	118.5	0 1	0.1	0.003	0 251	0.00335	(ADD)
& III	-2.0	16.08	118.5	0.0	0 1	-0.001	0.250	-0 00106	(SUBTRACT)
	6.2	12.86	118.5	0.1	0.1	0 003	0.251	0.00269	(SUBTRACT)
	-2.0	12.86	118.5	0.0	0.1	-0.001	0.250	-0.00085	(ADD)

$\text{Live Load}_{2} = [q_r(\Sigma I) + q_{fr}(\Sigma II)] * 2$

$\text{Live Load}_{2} =$ 5.65 psf

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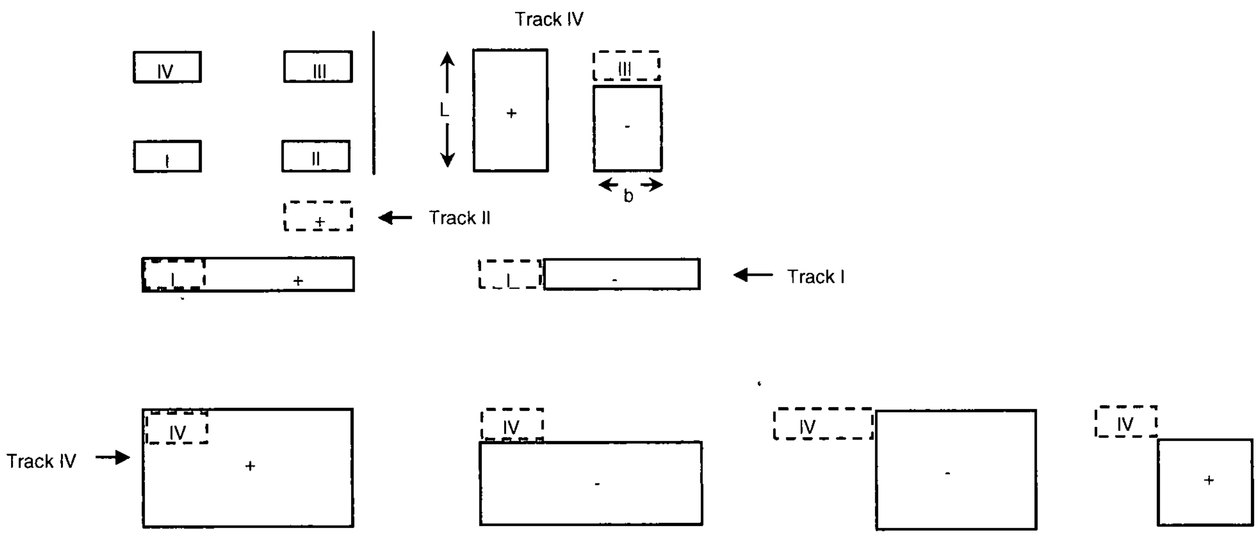
CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/2009
	CHECKED	DATE
	OHB	4/22/09

Load on Pipe Operation w/ 826G

Alternative 3: Track Perpendicular to Pipe



	b	L	z	m = b/z	n = L/z	I*	I**	I	
Track I	16 1	8.2	118.5	0 1	0.1	0 004	0 251	0 00440	(ADD)
	12.9	8.2	118.5	0 1	0 1	0.004	0 251	0 00354	(SUBTRACT)
Track II	3.2	8.2	118.5	0 0	0 1	0.001	0.250	0 00089	(ADD)
Track III	3.2	12.5	118.5	0.0	0.1	0 001	0.250	0.00135	(ADD)
	3 2	4 3	118 5	0 0	0 0	0 000	0 250	0 00047	(SUBTRACT)
Track IV	16.1	12 5	118.5	0 1	0.1	0 007	0 252	0 00665	(ADD)
	16.1	4.3	118 5	0.1	0 0	0 002	0.251	0 00230	(SUBTRACT)
	12.9	12 5	118 5	0 1	0 1	0 005	0 252	0 00535	(SUBTRACT)
	12.9	4.3	118 5	0.1	0.0	0 002	0 251	0 00185	(ADD)

Live Load$_{3}$ = $q_r(\Sigma I) + q_{fr}(\Sigma II) + q_{fr}(\Sigma III) + q_r(\Sigma IV)$

Live Load$_{3}$ = 5.61 psf

LARGEST EQUIPEMENT LOAD = 6.16 lb/ft^2

VERTICAL OVERBURDEN LOAD = 3028.04 lb/ft^2

VERTICAL EQUIPMENT LOAD = 6.16 lb/ft^2

TOTAL VERTICAL LOAD APPLIED TO PIPE, P_T = 3034.20 lb/ft^2 = 21.07 lb/in^2

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CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049.02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/2009
	CHECKED DHB	DATE 4/22/09

Constrained Pipe Wall Buckling (for Driscoplex OD controlled pipe)

$P_{WC} = \dfrac{5.65 * \{RB'E' \; E*[12(DR-1)^3]^{-1}\}^{0.5}}{N}$ Eq'n 7-30 See Source No 1

P_{WC} = allowable constrained buckling pressure (lb/in^2)
R = buoyancy reduction factor = 1 - 0.33 * (H'/H)

H' = groundwater height above pipe (ft)	0	ft
H = cover above pipe (ft)	118.5	ft
B' = elastic support factor =$(1+ 4*e^{-0.065H})^{-1}$		
E' = soil reaction modulus (lb/in^2)	3000	lb/in^2 for moderate compaction/crushed rock, Table 7-7/Source No 1
E = elastic modulus (lb/in^2)	23,000	lb/in^2 for long term load at 100°F, Table 5-1/Source No 1
I = moment of inertia = $t^3/12$	0.005	in^4/in
D_o = pipe outer diameter (in)	6.625	SDR 17 pipe (Driscopipe) to be used
t = pipe wall thickness (in)	0.390	SDR 17 pipe (Driscopipe) to be used
DR = pipe dimension ratio = D_o/t	17.0	SDR 17 pipe (Driscopipe) to be used
D_I = pipe inner diameter = D_o-2t (in)	5.845	SDR 17 pipe (Driscopipe) to be used
N = safety factor	2	recommended by CPChem manual

	H (ft)	H' (ft)	B'	R	P_{WC} (lb/in^2)
2 ft Cover	118.5	0	1.00	1.00	105.75

P_{WC} = 105.75 lb/in^2
P_{EFF} = 21.07 lb/in^2

Pipe passes contrained wall buckling calculations TRUE

FS = 5.02

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CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049.02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/09
	CHECKED	DATE
	DHB	4/22/09

Constrained Pipe Wall Compressive Stress (for Driscoplex OD controlled pipe)

$S = \frac{P_T D_o}{288t}$ Eq'n 7-23 See Source No 1

S = pipe wall compressive stress (lb/in^2)

P_T = vertical load applied to pipe (lb/ft^2) | 3034 | lb/ft^2

D_o = pipe outside diameter (in) | 6 625 | SDR 17 pipe (Driscopipe) to be used

t = pipe wall thickness (in) | 0 39 | SDR 17 pipe (Driscopipe) to be used

$S = \frac{P_T D_o}{288t} =$ $\boxed{179\ 0}$ lb/in^2

The recommended, long-term compressive strength (Y_s) design value for Driscoplex polyethylene pipe is 800 lb/in^2

S (psi)		Y_s (psi)
178 97	<	800

Pipe passes wall compressive stress calculations TRUE FS = 4 47

SCS ENGINEERS

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CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations	VKF	4/8/2009
Operation w/ 826G	CHECKED	DATE
6" HDPE SDR 17 Header	OHB	4/22/09

Iowa Formula

$\Delta X = \dfrac{D_L K W_c r^3}{EI + 0\ 06er^4}$ Eq'n 3 4 See Source No 3

ΔX = horizontal deflection (in)

D_L = deflection lag factor

K = bedding constant | 0 1 | typical value

W_c = Marston's load per unit length of pipe (lb/in)

r = mean radius of the pipe (in)

E = modulus of elasticity (lb/in^2)

I = moment of inertia of the pipe wall per unit length (in^3)

e = modulus of passive resistance fo the side fill (lb/in^2(in))

Modified Iowa Formula

$\Delta X = \dfrac{D_L K W_c r_m^3}{EI + 0\ 06E'r_m^3}$ Eq'n 3 5 See Source No 3

ΔX = horizontal deflection (in)

D_L = deflection lag factor	1 0	Prism Load used
Typical Value for Marston Load 1 5		
Typical Value for Prism Load 1 0		
K = bedding constant	0 1	typical value
P_T = Vertical load on pipe	21 07	lb/in^2
W_c = Marston's load per unit length of pipe = $P_T * D_o$ (lb/in)	139 59	lb/in
D_o = pipe outer diameter (in)	6 625	SDR 17 pipe (Driscopipe) to be used
t = pipe wall thickness (in)	0 390	SDR 17 pipe (Driscopipe) to be used
D_I = pipe inner diameter = D_o-2t (in)	5 845	SDR 17 pipe (Driscopipe) to be used
D_m = pipe mean diameter = D_o - 1 06t	6 21	SDR 17 pipe (Driscopipe) to be used
r_m = mean radius of the pipe (in)	3 11	SDR 17 pipe (Driscopipe) to be used
E = modulus of elasticity (lb/in^2)	23,000	lb/in2 for long term load at 100oF, Table 5-1/Source No 1
I = moment of inertia of the pipe wall per unit length	0 005	in^4/in
E' = modulus of soil reaction (See Source No 1)	3000	lb/in^2 for moderate compaction and fine grained soils

$\Delta X = \dfrac{D_L K W_c r_m^3}{EI + 0\ 06E'r_m^3}$ = 0 075951 inch

% Ring Deflection = ($\Delta X/D_m$) x 100 = 1 223 % Eq'n 7-38 See Source No 1

Ring Bending Strain

$\varepsilon = \dfrac{f_D \Delta X 2C}{D_M^2} \times 100$

ε = wall strain (%)

f_D = deformation shape factor	6	non-elliptical shape
D_M = mean diameter (in)		
C = outer fiber wall centroid = 0 5 (1 06t)	0 207	Eq'n 7-41 See Source No 1
ΔX = ring deflection = $\Delta X/D_m$	0 012	

$\varepsilon = \dfrac{f_D \Delta X 2C}{D_M} \times 100$ = 0 49 % Eq'n 7-37 See Source No 1

The maximum ring bending strain for high performance polyethylene non-pressure pipe is 4 2%

Pipe passes ring bending strain calculations TRUE

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CLIENT	PROJECT	JOB NO.
Citrus County	Landfill Gas Collection and Control System	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ 826G 6" HDPE SDR 17 Header	VKF	4/8/2009
	CHECKED	DATE
	DHB	4/22/09

Sources·

1 CPCHEM, The Performance Pipe Engineering Manual
Book 2, Chapter 7 · Buried Pipe Design
2002

2 Foundation Design Principles and Practices
Second Edition
Donald P Coduto
Chapter 7, Section 7 3 · Induced Stresses Beneath Shallow Foundations

3. Buried Pipe Design
A P Moser
Chapter 3

4 Driscopipe Table 15 Allowable Ring Deflection

5 EPA Lining of Waste Impoundment and Disposal Facilities, SW-870

SCS ENGINEERS

SHEET 1 of 6

CLIENT	PROJECT	JOB NO
Citrus County	Citrus County Landfill - Phase 3	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ D6 6" HDPE SDR 17 Header	VKF	4/10/090
	CHECKED DHB	DATE 4/22/09

Load on Pipe (Overburden)

Prism Loads, P_E = wH   Eq'n 7 1 See Source No 1

w = unit weight

H = depth

	Depth (ft)	Unit Weight (lb/ft^3)	P_E (lb/ft^2)
Cover Soil	2	110 0	220 0
Intermediate Cover	1 5	110 0	165 0
Waste	115	60 0	6900 0
Drainage Sand	0	90 0	0 0
Rock	0	140 0	0 0

TOTAL SOIL PRISM LOAD P_E 7,285 0 lb/ft^2

Total Depth = 118 5 ft

Soil Arching, $P_m = C_D wB$

NOTE The waste unit weight represents the combined unit weight of waste, daily cover, and moisture

Pm = vertical soil pressure

B = trench width at pipe crown 2 ft

C_D = load coefficient $= \frac{1 - e^{2Ku'H/B}}{2Ku'}$ Eq'n 7 3 See Source No 1

e = natural log base number

K = Rankine earth pressure coefficient = $\tan^2(45\text{-}0\ 5*\phi)$

ϕ = internal soil friction angle = 28 degrees

u' = friction coefficient between backfill and trench sides = tan ϕ

Soil Type	Ku'
Saturated Clay	0 110
Ordinary Clay	0 130
Saturated Top Soil	0 150
Sand and Gravel	0 165
Clean Granular Soil	0 192

	Ku'	C_D	P_m (lb/ft^2)
Cover Soil	0 150	0 86	190
Intermediate Cover	0 165	0 66	146
Waste	0 191	2 62	314
Drainage Sand	0 165	0 00	0 0
Rock	0 190	0 00	0 0

TOTAL SOIL ARCHING LOAD P_M 190 1 lb/ft^2

MODIFIED ARCHING LOAD = 0 6P_M+0 4P_E 3,028 04 lb/ft^2

OVERBURDEN LOAD 3,028 04 lb/ft^2

Load on Pipe Operation w/ D6

Equipment Weight = 45,400 lbs

Number of Tracks = 2 tracks

Track Load = 82880 lb * 0 5 = 22,700 lbs per track

Ground Contact Area /track = 32 0 ft^2

Length of Track = L = 128 in

Track Width = b = 36 in

Track Gauge = G = 87 in

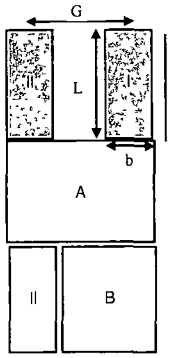
Equipment Width "A" = 128 in

Live Load = $q*I_c$

q = track load 709 38 lb/ft^2

I_c = Influence coefficient

Alternative 1 Track adjacent and parallel to pipe



	b (ft)	L (ft)	z (ft)	m = b/z	n = L/z	I* (Eq'n 7 4 See Source No 2)	I** (Eq'n 7 5 See Source No 2)	I
I	3 00	10 7	118 5	0 03	0 09	0 001	0 250	0 00108
A	10 25	10 7	118 5	0 09	0 09	0 004	0 251	0 00367
B	7 25	10 7	118 5	0 06	0 09	0 003	0 251	0 00260

Live $Load_1 = I + II = q_I(I_I) + q_A(I_A) - q_B(I_B)$ = 1 52 lb/ft^2

$q_I(I_I)$ = 0 77

$q_A(I_A)$ = 2 60

$q_B(I_B)$ = 1 85

Load on Pipe (Equipment) = 1 52 lb/ft^2

SCS ENGINEERS

CLIENT	PROJECT	JOB NO
Citrus County	Citrus County Landfill - Phase 3	09207049.02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ D6 6" HDPE SDR 17 Header	VKF	4/10/090
	CHECKED: () HB	DATE: 4/22/09

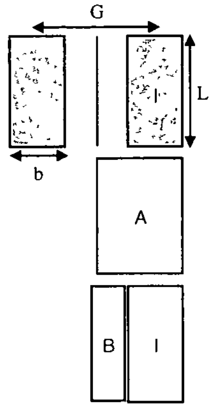
Load on Pipe (Equipment) *Continued*

Live Load = $q*I_c$

q = track load 709 38 lb/ft^2

I_c = Influence coefficient

Alternative 2 Track stradling and parallel to pipe



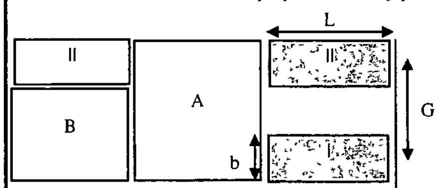
	b	L	z	m = b/z	n = L/z	I* (Eq'n 7 4 See Source No 2)	I** (Eq'n 7 5 See Source No 2)	I
A	5 33	10 7	118 5	0 05	0 09	0 002	0 251	0 00192
B	2 33	10 7	118 5	0 02	0 09	0 001	0 250	0 00084

Live Load$_2$ = 2 * (A - B) = 2 * (q_AI_A - q_BI_B) = 1 53 lb/ft^2

$q_A(I_A)$ =	1 36
$q_B(I_B)$ =	0 60

Load on Pipe (Equipment) = 1 53 lb/ft^2

Alternative 3a Track perpendicular to pipe



	b	L	z	m = b/z	n = L/z	I* (Eq'n 7 4 See Source No 2)	I** (Eq'n 7 5 See Source No 2)	I
I	3 00	10 7	118 5	0 03	0 09	0 001	0 250	0 00108
A	10 67	10 7	118 5	0 09	0 09	0 004	0 251	0 00382
B	7 67	10 7	118 5	0 06	0 09	0 003	0 251	0 00275

Live Load$_3$ = I + II = $q_I(I_I)$ + $q_A(I_A)$ - $q_B(I_B)$ = 1 52 lb/ft^2

$q_I(I_I)$ =	0 77
$q_A(I_A)$ =	2 71
$q_B(I_B)$ =	1 95

Load on Pipe (Equipment) = 1 52 lb/ft^2

LARGEST EQUIPEMENT LOAD = 1 53 lb/ft^2

VERTICAL OVERBURDEN LOAD = 3,028 04 lb/ft^2

VERTICAL EQUIPMENT LOAD = 1 53 lb/ft^2

TOTAL VERTICAL LOAD APPLIED TO PIPE, P_T = 3,029.57 lb/ft^2 = 21.04 lb/in^2

SCS ENGINEERS

SHEET 3 of 6

CLIENT	PROJECT	JOB NO.
Citrus County	Citrus County Landfill - Phase 3	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ D6 6" HDPE SDR 17 Header	VKF	4/10/090
	CHECKED VHB	DATE 4/22/09

Constrained Pipe Wall Buckling (for Driscoplex OD controlled pipe)

$P_{WC} = \dfrac{5\ 65 * \{RB'E'\ E*[12(DR-1)^3]^{-1}\}^{0\ 5}}{N}$ Eq'n 7-30 See Source No 1

P_{WC} = allowable constrained buckling pressure (lb/in^2)

R = buoyancy reduction factor = 1 - 0 33 * (H'/H)

H' = groundwater height above pipe (ft)	0	ft	
H = cover above pipe (ft)	118 5	ft	
B' = elastic support factor =$(1+ 4*e^{-0\ 065H})^{-1}$			
E' = soil reaction modulus (lb/in^2)	3000	lb/in^2 for moderate compaction/crushed rock, Table 7-7/Source No. 1	
E = elastic modulus (lb/in^2)	23,000	lb/in^2 for long term load at 100^{o}F, Table 5-1/Source No 1	
I = moment of inertia = $t^3/12$	0.005	in^4/in	
D_o = pipe outer diameter (in)	6.625	SDR 17 pipe (Driscopipe) to be used	(6-inch diameter pipe)
t = pipe wall thickness (in)	0.390	SDR 17 pipe (Driscopipe) to be used	(6-inch diameter pipe)
DR = pipe dimension ratio = D_o/t	17	SDR 17 pipe (Driscopipe) to be used	
D_I = pipe inner diameter = D_o-2t (in)	5 845	SDR 17 pipe (Driscopipe) to be used	
N = safety factor	2	recommended by CPChem manual	

	H (ft)	H' (ft)	B'	R	P_{WC} (lb/in^2)
2 ft Cover	118 5	0	1 00	1 00	105 88

P_{WC} = 105 88 lb/in^2

P_{EFF} = 21 04 lb/in^2

Pipe passes contrained wall buckling calculations TRUE FS = 5 03

SCS ENGINEERS

CLIENT	PROJECT	JOB NO.
Citrus County	Citrus County Landfill - Phase 3	09207049.02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ D6 6" HDPE SDR 17 Header	VKF	4/10/090
	CHECKED DHB	DATE 4/22/09

Constrained Pipe Wall Compressive Stress (for Driscoplex OD controlled pipe)

$S = \frac{P_T D_o}{288t}$ Eq'n 7-23 See Source No 1

S = pipe wall compressive stress (lb/in^2)

P_T = vertical load applied to pipe (lb/ft^2)	3,029.57	lb/ft^2
D_o = pipe outside diameter (in)	6.625	SDR 17 pipe (Driscopipe) to be used
t = pipe wall thickness (in)	0.39	SDR 17 pipe (Driscopipe) to be used

$S = \frac{P_T D_o}{288t} =$ $\boxed{178.7}$ lb/in^2

The recommended, long-term compressive strength (Y_s) design value for Driscoplex polyethylene pipe is 800 lb/in^2

S (psi)		Y_s (psi)
178.69	<	800

Pipe passes wall compressive stress calculations TRUE FS = 4.48

SCS ENGINEERS

CLIENT	PROJECT	JOB NO	
Citrus County	Citrus County Landfill - Phase 3	09207049.02	
SUBJECT		BY	DATE
Pipe Crushing Calculations Operation w/ D6 6" HDPE SDR 17 Header		VKF	4/10/090
		CHECKED DHB	DATE 4/22/09

Iowa Formula

$\Delta X = \dfrac{D_L K W_c r^3}{EI + 0\ 06er^4}$ Eq'n 3 4 See Source No 3

ΔX = horizontal deflection (in)

D_L = deflection lag factor

K = bedding constant | 0 1 | typical value

W_c = Marston's load per unit length of pipe (lb/in)

r = mean radius of the pipe (in)

E = modulus of elasticity (lb/in^2)

I = moment of inertia of the pipe wall per unit length (in^3)

e = modulus of passive resistance fo the side fill (lb/in^2(in))

Modified Iowa Formula

$\Delta X = \dfrac{D_L K W_c r_m^3}{EI + 0\ 06E'r_m^3}$ Eq'n 3 5 See Source No 3

ΔX = horizontal deflection (in)

D_L = deflection lag factor		1 0	Prism Load used	
Typical Value for Marston Load	1 5			
Typical Value for Prism Load	1 0			
K = bedding constant		0 1	Typical value, Source No 3 pg 51	
P_T = Vertical load on pipe		21 04	lb/in^2	3 029 57 lb/ft^2
W_c = Marston's load per unit length of pipe = $P_T * D_o$ (lb/in)		139 38	lb/in	
D_o = pipe outer diameter (in)		6 625	SDR 17 pipe (Driscopipe) to be used	
t = pipe wall thickness (in)		0 390	SDR 17 pipe (Driscopipe) to be used	
D_I = pipe inner diameter = D_o-2t (in)		5 845	SDR 17 pipe (Driscopipe) to be used	
D_m = pipe mean diameter = D_o - 1 06t		6 21	SDR 17 pipe (Driscopipe) to be used	
r_m = mean radius of the pipe (in)		3 11	SDR 17 pipe (Driscopipe) to be used	
E = modulus of elasticity (lb/in^2)		23,000	lb/in2 for long term load at 100oF, Table 5-1/Source No 1	
I = moment of inertia of the pipe wall per unit length		0 005	in^4/in	
E' = modulus of soil reaction (See Source No 1)		3000	lb/in^2 for moderate compaction and fine grained soils	

$\Delta X = \dfrac{D_L K W_c r_m^3}{EI + 0\ 06E'r_m^3}$ = 0 075835 inch

% Ring Deflection = $(\Delta X/D_m)$ x 100 = 1 221 % Eq'n 7-38 See Source No 1

Ring Bending Strain

$\varepsilon = \dfrac{f_D \Delta X 2C}{D_M^2}$ x 100

ε = wall strain (%)

f_D = deformation shape factor	6	non-elliptical shape
D_M = mean diameter (in)		
C = outer fiber wall centroid = 0 5 (1 06t)	0 207	Eq'n 7-41 See Source No 1
ΔX = ring deflection = $\Delta X/D_m$	0 012	

$\varepsilon = \dfrac{f_D \Delta X 2C}{D_M}$ x 100 = 0 49 % Eq'n 7-37 See Source No 1

The maximum ring bending strain for high performance polyethylene non-pressure pipe is 4 2%

Pipe passes ring bending strain calculations TRUE

SCS ENGINEERS			
		SHEET 6 of 6	
CLIENT Citrus County	PROJECT Citrus County Landfill - Phase 3	JOB NO 09207049 02	
SUBJECT Pipe Crushing Calculations Operation w/ D6 6" HDPE SDR 17 Header		BY VKF	DATE 4/10/090
		CHECKED OHB	DATE 4/22/09

Sources:

1 CPCHEM, The Performance Pipe Engineering Manual
Book 2, Chapter 7 Buried Pipe Design
2002

2 Foundation Design Principles and Practices
Second Edition
Donald P Coduto
Chapter 7, Section 7 3 Induced Stresses Beneath Shallow Foundations

3 Buried Pipe Design
A.P Moser
Chapter 3

4. Driscopipe Table 15 Allowable Ring Deflection

5 EPA, Lining of Waste Impoundment and Disposal Facilities, SW-870

SCS ENGINEERS

CLIENT	PROJECT	JOB NO
Citrus County	Citrus County Landfill - Phase 3	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ D6 6" HDPE SDR 17 Header	VKF	4/10/090
	CHECKED DHB	DATE 4/22/09

Load on Pipe (Overburden)

Prism Loads, $P_E = wH$ Eq'n 7 1 See Source No 1

w = unit weight

H = depth

	Depth (ft)	Unit Weight (lb/ft^3)	P_E (lb/ft^2)
Cover Soil	2	110 0	220 0
Intermediate Cover	0	110 0	0 0
Waste	0	60 0	0 0
Drainage Sand	0	90 0	0 0
Rock	0	140 0	0 0

TOTAL SOIL PRISM LOAD P_E 220 0 lb/ft^2

Total Depth = 2 0 ft

Soil Arching, $P_m = C_D wB$

Pm = vertical soil pressure

B = trench width at pipe crown 2 ft

C_D = load coefficient $= \frac{1 - e^{2Ku'H/B}}{2Ku'}$ Eq'n 7 3 See Source No 1

e = natural log base number

K = Rankine earth pressure coefficient = $\tan^2(45\text{-}0\ 5^*\phi)$

ϕ = internal soil friction angle = 28 degrees

u' = friction coefficient between backfill and trench sides = $\tan\phi$

NOTE The waste unit weight represents the combined unit weight of waste, daily cover, and moisture

Soil Type	Ku'
Saturated Clay	0 110
Ordinary Clay	0 130
Saturated Top Soil	0 150
Sand and Gravel	0 165
Clean Granular Soil	0 192

	Ku'	C_D	P_m (lb/ft^2)
Cover Soil	0 150	0 86	190
Intermediate Cover	0 165	0 00	0
Waste	0 191	0 00	0
Drainage Sand	0 165	0 00	0 0
Rock	0 190	0 00	0 0

TOTAL SOIL ARCHING LOAD P_M 190 1 lb/ft^2

MODIFIED ARCHING LOAD = $0\ 6P_M + 0\ 4P_E$ 202 04 lb/ft^2

OVERBURDEN LOAD 202 04 lb/ft^2

Load on Pipe Operation w/ D6

Equipment Weight =	45,400	lbs
Number of Tracks =	2	tracks
Track Load = 82880 lb * 0 5 =	22,700	lbs per track
Ground Contact Area /track =	32 0	ft^2

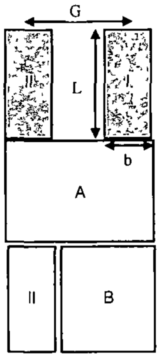
Length of Track = L =	128	in
Track Width = b =	36	in
Track Gauge = G =	87	in
Equipment Width "A" =	128	in

Live Load = q^*I_c

q = track load 709 38 lb/ft^2

I_c = Influence coefficient

Alternative 1 Track adjacent and parallel to pipe



	b (ft)	L (ft)	z (ft)	m = b/z	n = L/z	I* (Eq'n 7 4 See Source No 2)	I** (Eq'n 7 5 See Source No 2)	I
I	3 00	10 7	2	1 50	5 33	-0 020	0 230	0 22967
A	10 25	10 7	2	5 13	5 33	-0 001	0 249	0 24874
B	7 25	10 7	2	3 63	5 33	-0 002	0 248	0 24755

$\text{Live Load}_1 = I + II = q_I(I_I) + q_A(I_A) - q_B(I_B) =$ 163 77 lb/ft^2

$q_I(I_I) =$ 162 92

$q_A(I_A) =$ 176 45

$q_B(I_B) =$ 175 61

Load on Pipe (Equipment) = 163 77 lb/ft^2

SCS ENGINEERS

SHEET 2 of 6

CLIENT	PROJECT	JOB NO
Citrus County	Citrus County Landfill - Phase 3	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ D6 6" HDPE SDR 17 Header	VKF	4/10/090
	CHECKED DTB	DATE 4/22/09

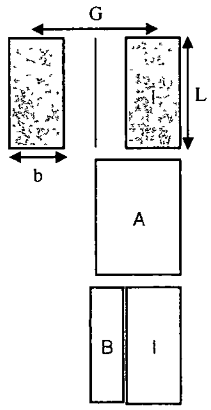
Load on Pipe (Equipment) *Continued*

Live Load = $q*I_c$

q = track load 709 38 lb/ft^2

I_c = Influence coefficient

Alternative 2 Track stradling and parallel to pipe



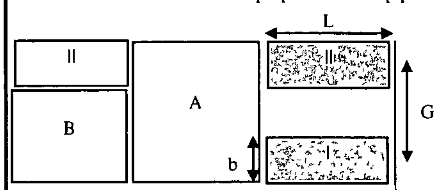
	b	L	z	m = b/z	n = L/z	I* (Eq'n 7 4 See Source No 2)	I** (Eq'n 7 5 See Source No 2)	I
A	5 33	10 7	2	2 67	5 33	-0 005	0 245	0 24490
B	2 33	10 7	2	1 17	5 33	-0 034	0 216	0 21570

Live $Load_2$ = 2 * (A - B) = 2 * $(q_AI_A - q_BI_B)$ = 41 42 lb/ft^2

$q_A(I_A)$ =	173 72
$q_B(I_B)$ =	153 01

Load on Pipe (Equipment) = 41 42 lb/ft^2

Alternative 3a Track perpendicular to pipe



	b	L	z	m = b/z	n = L/z	I* (Eq'n 7 4 See Source No 2)	I** (Eq'n 7 5 See Source No 2)	I
I	3 00	10 7	2	1 50	5 33	-0 020	0 230	0 22967
A	10 67	10 7	2	5 33	5 33	-0.001	0 249	0 24882
B	7 67	10 7	2	3 83	5 33	-0 002	0 248	0 24783

Live $Load_3$ = I + II = $q_I(I_I) + q_A(I_A) - q_B(I_B)$ = 163 62 lb/ft^2

$q_I(I_I)$ =	162 92
$q_A(I_A)$ =	176 50
$q_B(I_B)$ =	175 81

Load on Pipe (Equipment) = 163 62 lb/ft^2

LARGEST EQUIPEMENT LOAD = 163 77 lb/ft^2

VERTICAL OVERBURDEN LOAD = 202 04 lb/ft^2

VERTICAL EQUIPMENT LOAD = 163 77 lb/ft^2

TOTAL VERTICAL LOAD APPLIED TO PIPE, P_T = 365 81 lb/ft^2 = 2 54 lb/in^2

SCS ENGINEERS

CLIENT	PROJECT	JOB NO.
Citrus County	Citrus County Landfill - Phase 3	09207049.02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ D6 6" HDPE SDR 17 Header	VKF	4/10/090
	CHECKED DHB	DATE 4/22/09

Constrained Pipe Wall Buckling (for Driscoplex OD controlled pipe)

$P_{WC} = \dfrac{5.65 * \{RB'E'\,E*[12(DR-1)^3]^{-1}\}^{0.5}}{N}$ Eq'n 7-30 See Source No 1

P_{WC} = allowable constrained buckling pressure (lb/in^2)
R = buoyancy reduction factor = 1 - 0.33 * (H'/H)

H' = groundwater height above pipe (ft)	0	ft
H = cover above pipe (ft)	2	ft
B' = elastic support factor $=(1+4*e^{-0.065H})^{-1}$		
E' = soil reaction modulus (lb/in^2)	3000	lb/in^2 for moderate compaction/crushed rock, Table 7-7/Source No 1
E = elastic modulus (lb/in^2)	100,000	lb/in^2 for short term load at 100°F, Table 5-1/Source No 1
I = moment of inertia = $t^3/12$	0.005	in^4/in
D_o = pipe outer diameter (in)	6.625	SDR 17 pipe (Driscopipe) to be used (6-inch diameter pipe)
t = pipe wall thickness (in)	0.390	SDR 17 pipe (Driscopipe) to be used (6-inch diameter pipe)
DR = pipe dimension ratio = D_o/t	17	SDR 17 pipe (Driscopipe) to be used
D_I = pipe inner diameter = D_o-2t (in)	5.845	SDR 17 pipe (Driscopipe) to be used
N = safety factor	2	recommended by CPChem manual

	H (ft)	H' (ft)	B'	R	P_{WC} (lb/in^2)
2 ft Cover	2	0	0.22	1.00	104.02

P_{WC} = 104.02 lb/in^2
P_{EFF} = 2.54 lb/in^2

Pipe passes contrained wall buckling calculations TRUE

FS = 40.95

SCS ENGINEERS

SHEET 4 of 6

CLIENT	PROJECT		JOB NO.
Citrus County	Citrus County Landfill - Phase 3		09207049.02
SUBJECT	BY	DATE	
Pipe Crushing Calculations Operation w/ D6 6" HDPE SDR 17 Header	VKF	4/10/090	
	CHECKED DHB	DATE 4/22/09	

Constrained Pipe Wall Compressive Stress (for Driscoplex OD controlled pipe)

$S = \frac{P_T D_o}{288t}$ Eq'n 7-23 See Source No 1

S = pipe wall compressive stress (lb/in^2)

P_T = vertical load applied to pipe (lb/ft^2)	365 81	lb/ft^2
D_o = pipe outside diameter (in)	6 625	SDR 17 pipe (Driscopipe) to be used
t = pipe wall thickness (in)	0 39	SDR 17 pipe (Driscopipe) to be used

$S = \frac{P_T D_o}{288t} =$ $\boxed{21\ 6}$ lb/in^2

The recommended, long-term compressive strength (Y_s) design value for Driscoplex polyethylene pipe is 800 lb/in^2

S (psi)		Y_s (psi)
21 58	<	800

Pipe passes wall compressive stress calculations TRUE FS = 37 08

SCS ENGINEERS

CLIENT	PROJECT	JOB NO
Citrus County	Citrus County Landfill - Phase 3	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ D6 6" HDPE SDR 17 Header	VKF	4/10/090
	CHECKED DHB	DATE 4/22/09

Iowa Formula

$\Delta X = \dfrac{D_L K W_c r^3}{EI + 0\ 06er^4}$ Eq'n 3 4 See Source No 3

ΔX = horizontal deflection (in)
D_L = deflection lag factor
K = bedding constant | 0 1 | typical value
W_c = Marston's load per unit length of pipe (lb/in)
r = mean radius of the pipe (in)
E = modulus of elasticity (lb/in^2)
I = moment of inertia of the pipe wall per unit length (in^3)
e = modulus of passive resistance fo the side fill (lb/in^2(in))

Modified Iowa Formula

$\Delta X = \dfrac{D_L K W_c r_m^3}{EI + 0\ 06E'r_m^3}$ Eq'n 3 5 See Source No 3

ΔX = horizontal deflection (in)		
D_L = deflection lag factor	1 0	Prism Load used
Typical Value for Marston Load 1 5		
Typical Value for Prism Load 1 0		
K = bedding constant	0 1	Typical value, Source No 3 pg 51
P_T = Vertical load on pipe	2.54	lb/in^2 365 81 lb/ft^2
W_c = Marston's load per unit length of pipe = P_T * D_o (lb/in)	16 83	lb/in
D_o = pipe outer diameter (in)	6 625	SDR 17 pipe (Driscopipe) to be used
t = pipe wall thickness (in)	0 390	SDR 17 pipe (Driscopipe) to be used
D_I = pipe inner diameter = D_o-2t (in)	5 845	SDR 17 pipe (Driscopipe) to be used
D_m = pipe mean diameter = D_o - 1 06t	6 21	SDR 17 pipe (Driscopipe) to be used
r_m = mean radius of the pipe (in)	3 11	SDR 17 pipe (Driscopipe) to be used
E = modulus of elasticity (lb/in^2)	100,000	lb/in2 for short term load at 100oF, Table 5-1/Source No 1
I = moment of inertia of the pipe wall per unit length	0 005	in^4 /in
E' = modulus of soil reaction (See Source No 1)	3000	lb/in^2 for moderate compaction and fine grained soils

$\Delta X = \dfrac{D_L K W_c r_m^3}{EI + 0\ 06E'r_m^3}$ = 0 008565 inch

% Ring Deflection = ($\Delta X/D_m$) x 100 = 0 138 % Eq'n 7-38 See Source No 1

Ring Bending Strain

$\varepsilon = \dfrac{f_D \Delta X 2C}{D_M^2} \times 100$

ε = wall strain (%)		
f_D = deformation shape factor	6	non-elliptical shape
D_M = mean diameter (in)		
C = outer fiber wall centroid = 0 5 (1 06t)	0 207	Eq'n 7-41 See Source No 1
ΔX = ring deflection = $\Delta X/D_m$	0 001	

$\varepsilon = \dfrac{f_D \Delta X 2C}{D_M} \times 100$ = 0 06 % Eq'n 7-37 See Source No 1

The maximum ring bending strain for high performance polyethylene non-pressure pipe is 4 2%

Pipe passes ring bending strain calculations TRUE

SCS ENGINEERS

SHEET 6 of 6

CLIENT	PROJECT	JOB NO.
Citrus County	Citrus County Landfill - Phase 3	09207049 02

SUBJECT	BY	DATE
Pipe Crushing Calculations Operation w/ D6 6" HDPE SDR 17 Header	VKF	4/10/090
	CHECKED DHB	DATE 4/22/09

Sources·

1 CPCHEM, The Performance Pipe Engineering Manual
Book 2, Chapter 7 Buried Pipe Design
2002

2 Foundation Design Principles and Practices
Second Edition
Donald P Coduto
Chapter 7, Section 7 3 Induced Stresses Beneath Shallow Foundations

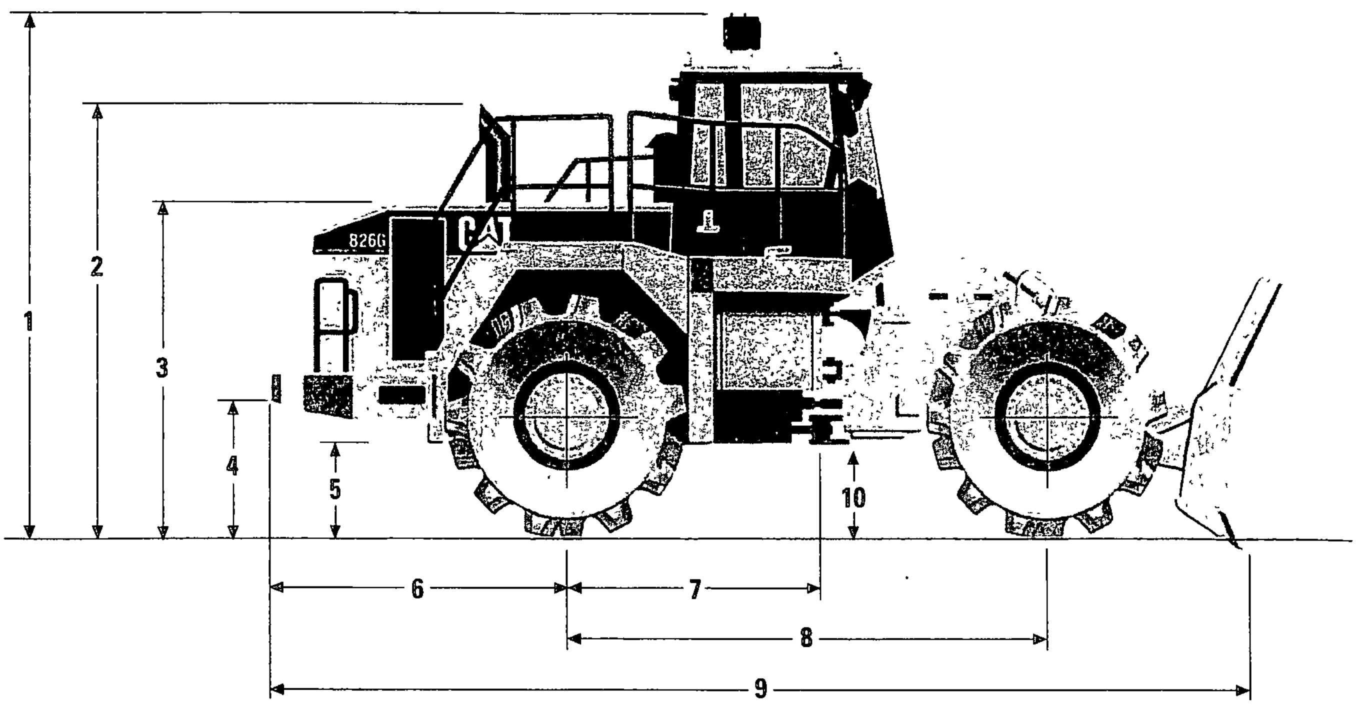
3 Buried Pipe Design
A P Moser
Chapter 3

4 Driscopipe Table 15 Allowable Ring Deflection

5 EPA, Lining of Waste Impoundment and Disposal Facilities, SW-870

Dimensions

All dimensions are approximate.



1	Height to Top of Cab with A/C	4191.1 mm	13.75 ft
2	Height to Top of Exhaust Pipe	3830 mm	12.57 ft
3	Height to Top of Hood	2700 51 mm	8.86 ft
4	Ground Clearance to Counterweight	1032.5 mm	3.38 ft
5	Height to Bottom of Ladder	709.9 mm	2 33 ft
6	Center Line of Rear Axle to Edge of Counterweight	2624 mm	8.61 ft
7	Center Line of Rear Axle to Hitch	1850 mm	6.07 ft
8	Wheelbase	3700 mm	12.14 ft
9	Length with Blade on Ground	8268 mm	27.13 ft
10	Ground Clearance	489 mm	1.6 ft

Operating weight 81,498 lb

Weight Distribution

52% Rear

48% front

Rear = 42,378.96 lb

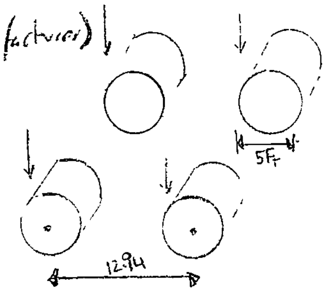
front = 39,119.04 lb

WIDTH over Drums = 12.67 ft (per manufacturer)

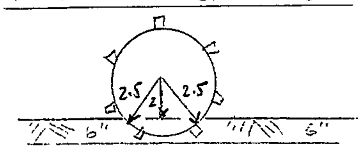
Drum width = 3.94 ft

Drum dia = 5.23 ft

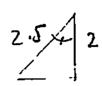
Wheel base = 12.14 ft



'Wheel' Contact AREA



Depth of Embedment

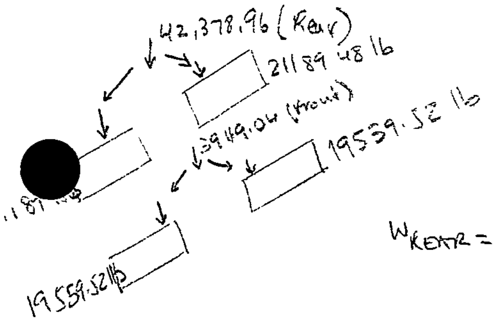


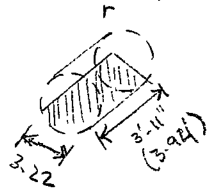
$\cos\phi = \frac{2}{2.5} \Rightarrow \phi_1 = 36.87$

$\phi_2 = 36.87$

73.74°

$\phi = \frac{s}{r} \Rightarrow s = 73.74\left(\frac{2\pi}{360}\right)2.5 = 3.22$





$W_{REAR} = \frac{21189.48}{(3.22)(3.94)} = 1670.20\ psf$

$W_{FRONT} = \frac{19559.52}{(3.22)(3.94)} = 1541.72\ psf$

Track-Type Tractors | Specifications

MODEL	D6H LGP Series II		D7G		D7H Series II		D7H XR Series II	
Flywheel Power	134 kW	160 hp	149 kW	200 hp	171 kW	230 hp	171 kW	230 hp
Operating Weight*								
(Power Shift)	20 503 kg	45,200 lb	20 094 kg	44,300 lb	24 776 kg	54,600 lb	25 193 kg	55,600 lb
(Direct Drive)	20 548 kg	45,300 lb	20 502 kg	45,200 lb	—		—	
(Power Shift Differential Steer)	20 593 kg	45,400 lb	—		25 077 kg	55,300 lb	25 492 kg	56,200 lb
Engine Model	3306		3306		3306		3306	
Rated Engine RPM	1900		2000		2100		2100	
No. of Cylinders	6		6		6		6	
Bore	121 mm	4.75"	121 mm	4.75"	121 mm	4.75"	121 mm	4.75"
Stroke	152 mm	6"	152 mm	6"	152 mm	6"	152 mm	6"
Displacement	10.5 L	638 in³	10.5 L	638 in³	10.5 L	638 in³	10.5 L	638 in³
Track Rollers (Each Side)	8		6		7		8	
Width of Standard Track Shoe	915 mm	36"	508 mm	20"	560 mm	22"	610 mm	24"
Length of Track on Ground	3.25 m	128"	2.72 m	107"	2.89 m	114"	3.05 m	120"
Ground Contact Area (W/Std Shoe)	5.97 m²	9254 in²	2.76 m²	4280 in²	3.24 m²	5016 in²	3.72 m²	5760 in²
Track Gauge	2.21 m	87"	1.98 m	78"	1.98 m	78"	1.98 m	78"
GENERAL DIMENSIONS:								
Height (Stripped Top)**	2.32 m	7'7"	2.27 m	7'5"	2.56 m	8'5"	2.56 m	8'5"
Height (To Top of ROPS)	3.16 m	10'5"	3.20 m	10'6"	3.35 m	11'0"	3.35 m	11'0"
Height (To Top of Cab ROPS)	3.16 m	10'5"	—		3.50 m	11'6"	3.50 m	11'6"
Height (To Top of ROPS Canopy)	3.16 m	10'5"	—		—		—	
Overall Length (With P Blade)	5.18 m	17'0"	—		—		—	
(Without Blade)	4.49 m	14'9"	—		—		—	
Overall Length (With S Blade)	—		5.28 m	17'4"	5.82 m	19'1"	5.82 mm	19'1"
(Without Blade)	—		4.19 m	13'9"	4.73 m	15'6"	4.73 m	15'6"
Width (Over Trunnion)	3.43 m	11'3"	—		2.87 m	9'5"	2.87 m	9'5"
Width (W/O Trunnion — Std Shoe)	3.14 m	10'3.6"	2.55 m	8'5"	2.54 m	8'4"	2.54 m	8'1"
Ground Clearance	382 mm	15"	347 mm	13.7"	414 mm	16"	414 mm	16"
Blade Types and Widths:								
Straight	3.99 m	13'1"	3.66 m	12'0"	3.90 m	12'10"	3.91 m	12'10"
Angle	—		4.27 m	14'0"	—		—	
Angle Straight	—		—		4.49 m	14'9"	4.49 m	14'9"
Full Angle	—		—		4.08 m	13'5"	4.08 m	13'5"
Universal	—		3.81 m	12'6"	3.98 m	13'1"	3.98 m	13'1"
Semi-U	—		—		3.68 m	12'1"	3.68 m	12'1"
Fuel Tank Refill Capacity	397 L	105 U.S. gal	436 L	115 U.S. gal	479 L	127 U.S. gal	479 L	127 U.S. gal

*Operating Weight includes ROPS canopy, operator, lubricants, coolant, full fuel tank, hydraulic controls and fluid, straight dozer with tilt, horn, back-up alarm, retrieval hitch and front pull hook.
— D7G includes end track guiding guards.
**Height (stripped top) — without ROPS canopy, exhaust, seat back or other easily removed encumbrances.

45,400 lb

22,700 lb/track

22,700 lb/track

Stress per track

128" 36"

$A = (10.67)(3') = 32.01\ ft^2$

Stress loading $\frac{F}{A}$ = 22,700

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7. Buried Pipe Design

The design of a subsurface pipe installation is based on principles of soil-structure interaction. that is the pipe and the surrounding soil act together to control the pipes performance. The role each plays in controlling performance depends on their stiffness relative to each other.

Pipes that are more stiff than the surrounding soil are typically called rigid. With rigid pipes, soil and surcharge loads are transmitted around the pipes ring from crown (top) to invert (bottom) by virtue of the pipes internal bending and compressive strength. Rigid pipes undergo little deflection. In some circumstances, polyethylene pipes may behave as a rigid pipe, such as the installation of low DR pipe in marsh soils. Here the pipe has greater stiffness than the surrounding soil, so the pipe properties become the major determinant of burial strength.

Pipes that are less stiff than the surrounding soil are called flexible. With weak soil support, relatively small earth loads may cause flexible pipe deflection. However, when properly buried, the surrounding soil greatly increases the pipes load-carrying capability as well as reduces the earth loads reaching the pipe.

The earth load and surcharge pressures applied to the soil backfill cause vertical and horizontal pipe deflection. The horizontal deflection, usually extension, results in the pipe wall pushing into the embedment soil. This action mobilizes passive resistance forces, which in turn limits horizontal deflection and balances the vertical load. More passive resistance is mobilized with stiffer surrounding soil, so less deflection occurs. Most polyethylene pipe should be considered flexible because the pipes contribution to resisting deflection is usually less than that of the surrounding soil.

Therefore, with polyethylene pipe it is important to check each application to ensure that the installed design (which would include both pipe and embedment soils) is adequate. The design procedures in this section may be applied to both rigid and flexible pipes

General Design Procedure

Once the pipe diameter has been determined, a pipe is selected by its wall construction. Lower DR PLEXCO pipes, and higher RSC SPIROLITE pipes have greater external load capacity. However, greater load capacity is also more costly, so the optimum design is a balance of the pipe strength and embedment quality that is capable of handling the imposed loads. The completed buried pipe design should specify the pipe size (OD or ID), wall construction (DR or RSC Class), required embedment materials, and placement (installation) requirements for that embedment.

The initial design step is to determine dead loads and surcharge loads. Following this, the pipe selection is checked for its ability to ...

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tive to the quality of the embedment surrounding the pipe.

Usually, this is an iterative process. Several pipe selections may need to be tried before settling on the optimum design. A pipe selection may need to be changed if loads or embedment are changed, or if the selected pipe is insufficient or excessive for the anticipated loads.

Typically, only the loads in the direction of the pipe ring (circumferential direction) are checked. The designer usually assumes that there are no significant loads acting in the longitudinal (axial) direction of the pipe. This is a reasonable assumption for pipe supported uniformly along its length.

In this manual, the methods for calculating loads, and the pipe's response are based on analytical and empirical equations that are appropriate for polyethylene pipe. Generally, these equations are sufficient for most designs, but they are not exact due to the non-homogeneous nature of soil, the difficulty in characterizing soil as an engineering material, the complexity of soil-pipe interaction, and the variability of construction. Other satisfactory methods for design may be available.

The design guidelines in this manual are contingent upon the pipe being installed according to recognized principles for flexible pipe installation such as those reflected in ASTM D-2321; ASTM D-2774; PLEXCO Bulletin No. 914, *SPIROLITE Installation Guide;* PLEXCO Application Note No. 7, *Pipe Embedment and Final Backfill*; and Plastics Pipe Institute publications, including TR-31, *Underground Installation of Polyolefin Piping.*

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Because of the complexities of the soil-pipe interaction, this manual should not be substituted for the judgment of a professional engineer for achieving specific project requirements. In some cases more exact solutions may be required than can be obtained from the equations and methods in this manual.

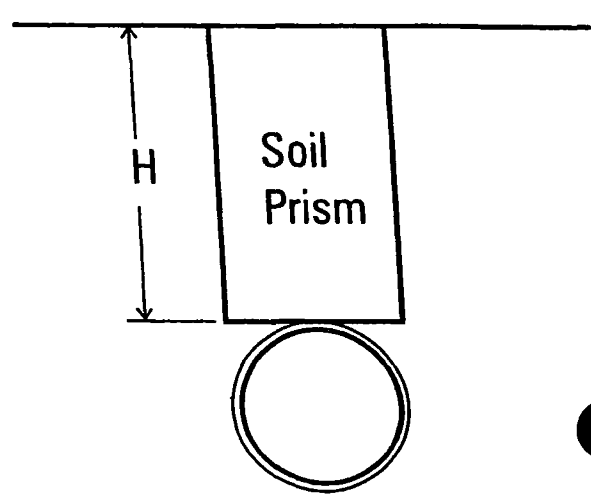
Loads on Buried Pipe

The load applied to a buried pipe consists of dead load and surcharge load. The dead load is the permanent load from the weight of soil and pavement above the pipe. Surcharge loads are loads applied at the surface and may or may not be permanent. Surcharge loads include the loads from vehicles and structures. Vehicular loads are called live loads.

Dead Loads

In designing polyethylene pipes, it is commonplace to assume that the overburden load applied to the pipe crown is equal to the weight of the soil column (or prismatic element) projecting above the pipe. Often, this is referred to as the prism load. See Figure 7-1, below.

Figure 7-1 Soil Prism



The prism load is a handy convention for calculating the earth pressure on the pipe when estimating vertical deflection, but the actual load transmitted to a pipe from the soil mass depends on the relative stiffnesses of the soil and the pipe. The load applied to a flexible plastic pipe may be considerably less than the prism load because soil shear resistance transfers part of the soil load directly above the pipe, into the trench sidewalls and the embedment. This transfer is called arching. To account for arching, pipe designers often calculate loads using the Marston method.

Design methods for both prism and arching loads follow, and the designer may use both methods for a buried pipe design.

Prism Load

The simplest case for determining the vertical earth load on a horizontal surface in a mass of soil occurs when the soil has uniform stiffness and weight throughout, with no large voids or buried structures present. Then, the vertical earth pressure acting on a horizontal surface at a depth is equal to the prism load per unit area:

$$P_E = wH \qquad (7\text{-}1)$$

Where

P_E = vertical soil pressure, lb/ft^2

w = unit weight of soil, lb/ft^3

H = soil height above pipe crown, ft

Soil Arching

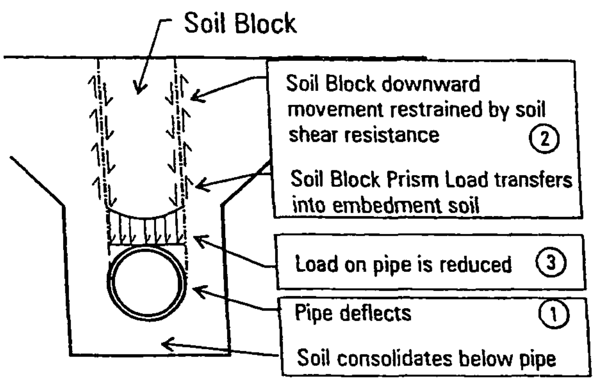
Theoretically, the prism load occurs on a buried pipe only when the pipe has stiffness equivalent to that of the surrounding soil. More commonly, the pipe and soil are not the same stiffness, so the pipe either sees more or less than the prism load, depending on the relative pipe and soil stiffnesses.

When the pipe is less stiff than the soil, as is the case with most flexible pipe, the soil above the pipe distributes load away from the pipe and into the soil beside the pipe.

Arching can be defined as the difference between the applied load and the prism load. The term arching is usually taken to imply a reduction in vertical load. When the pipe takes on more vertical load than the prism load, reverse arching is said to occur.

Arching in the backfill above a buried pipe is mobilized by downward movement of the backfill. This may be initiated by pipe deflection, compression of the deeper layers of the backfill, or settlement beneath the pipe.

Figure 7-2 **Soil Arching Development**



For a flexible pipe, arching is usually initiated by vertical deflection of the pipe crown. The soil tries to follow the pipe downward, but the soils movement is restrained by shear resistance (frictional forces and cohesion) along shear planes in the backfill. This action causes part of the weight of the backfill soil to be transferred into the adjacent soil. Therefore, the amount of force exerted on the pipe

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by the backfill is less than the weight of the backfill soil mass, that is, less than the prism load.

In most cases, arching is permanent, and it occurs in most stable applications. However, arching is maintained by soil shear stresses, and may not occur when pipe is located beneath large vibrating machines, in shallow cover locations subjected to vehicular traffic, or in soft, unstable soil backfills.

Marston Load

When calculating the earth load on a flexible pipe, the Marston load generally gives a more realistic value than the prism load. Based on experiments and field measurements, Marston published a buried pipe design method in 1930 that accounts for arching. His method is widely accepted and can be found in ASCE Manual No. 60.

Marston considered pipe buried in a trench and pipe buried in an embankment as different cases. The backfill soil in a trench was considered to be supported through shear stresses by the undisturbed trench wall soil. This is the most common case for polyethylene pipe arching. Marston's formula gives the equation for finding the loads on a flexible pipe buried in a trench. This equation can be modified to obtain the vertical soil pressure applied to a pipe installed in a trench as given in the following equation.

$$P_M = C_D\, w\, B_D \qquad (7\text{-}2)$$

Where terms are previously defined, and

P_M = vertical pressure on pipe, lb/ft^2

B_D = trench width at pipe crown, ft

C_D = load coefficient

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$$C_D = \frac{1 - e^{-2Ku' \frac{H}{B_D}}}{2Ku'} \qquad (7\text{-}3)$$

e = natural log base number, 2.71828

K = Rankine Earth Pressure

tan^2 (45 - Φ/2)

Φ = Internal friction angle, deg

H = soil cover height, ft

u′ = friction coefficient between backfill and trench sides

Ku′ values may be characterized as follows:

Table 7-1 **Ku′ Typical Values**

Soil	*Typical Ku′*
Saturated Clay	0.110
Ordinary Clay	0.130
Saturated Top Soil	0.150
Sand and Gravel	0.165
Clean Granular Soil	0.192

The load applied to a pipe in an embankment is typically higher than that for a pipe in a trench. The actual load depends on the relative stiffness between the embankment soil and the pipe. For an embankment condition, the prism load is typically used for calculating vertical pressure on flexible pipe.

Soil Creep

When analytical methods are not available for precise calculations, pipe designers frequently ignore soil creep, especially when the backfill is cohesionless. This is a conservative design approach for plastic pipe, which tends to creep at a faster rate than cohesionless soils. When subjected to 50% or more of their peak shear load strength, clayey soils exhibit considerable creep, and show significantly more creep than cohesionless soils, especially when saturated.

When a clay backfill is placed over a pipe, shear resistance mobilization occurs and, initially, arching may be high. However, where backfill stress concentrations exist such as along the shearing surfaces, the stress level in the clay may approach significant levels. Along these stress concentrations, creep occurs, allowing backfill soil movement toward the pipe and a corresponding load increase on the pipe. With the passage of time more creep occurs.

Because most clayey soils have some frictional resistance. the prism load is usually never reached. However, a conservative design approach should be taken. A low friction angle is usually assumed for clays when using Marston's equation. Typical values are 11° for ordinary clay, and 8° for a saturated clay. The Table 7-1 Ku′ values reflect these friction angles.

Example 7-1

(a) Find the Marston Load vertical soil pressure acting on a 36" OD pipe under 18 ft of 120 lb/ft^3 ordinary clay cover in a 6 ft wide trench. (b) Compare the vertical soil pressures by the Marston and prism methods.

Solution: (a) First, the load coefficient, C_D, is found using Equation (7-3) and Table 7-1, then the Marston Load soil pressure is determined using Equation (7-2).

Calculate the ratio of H/B_D.

$$\frac{H}{B_D} = \frac{18}{6} = 3$$

From Table 7-1, the Ku′ value for ordinary clay is 0.130. Solving Equation (7-3) gives

$$C_D = \frac{1 - e^{-2(0.130)(3.0)}}{2(0.130)} = 2.1$$

Equation (7-2) can now be solved for P_M.

$$P_M = 2.1(120)6 = 1512\, lb/ft^3$$

(b) The prism load soil pressure is determined using Equation (7-1).

$$P_E = (120)(18) = 2160\, lb/ft^3$$

Modified Arching Load

For flexible pipe, a more conservative approach is to use a soil pressure load between the prism load and the Marston load. One approach is to add 40 percent of the difference between the prism load and the Marston load to the Marston load. Equation (7-4) may be used to obtain the modified arching load vertical soil pressure.

$$P_C = 0.6\, P_M + 0.4\, P_E \qquad \textbf{(7-4)}$$

where terms are as defined above, and

P_C = modified arching vertical soil pressure, lb/ft^2

For Example 7-1, the modified arching vertical soil pressure is:

$$P_C = 0.6(1512) + 0.4(2160) = 1771\, lb/ft^2$$

A value for the modified arching vertical soil pressure suitable for most soils may be found using Equation (7-5).

$$P_c = F\, w\, H \qquad \textbf{(7-5)}$$

where terms are previously defined, and

F = arching coefficient

$$F = \frac{P_M + 0.4\,(P_E - P_M)}{P_E} \qquad \textbf{(7-6)}$$

Figure 7-3, next page, presents a graphical solution for the arching coefficient, F, based on the Marston load obtained with Ku′ = 0.130 for ordinary clay soil. Thus the Figure 7-3 arching coefficient is conservative for soils having a Ku′ value greater than 0.130. The arching co-

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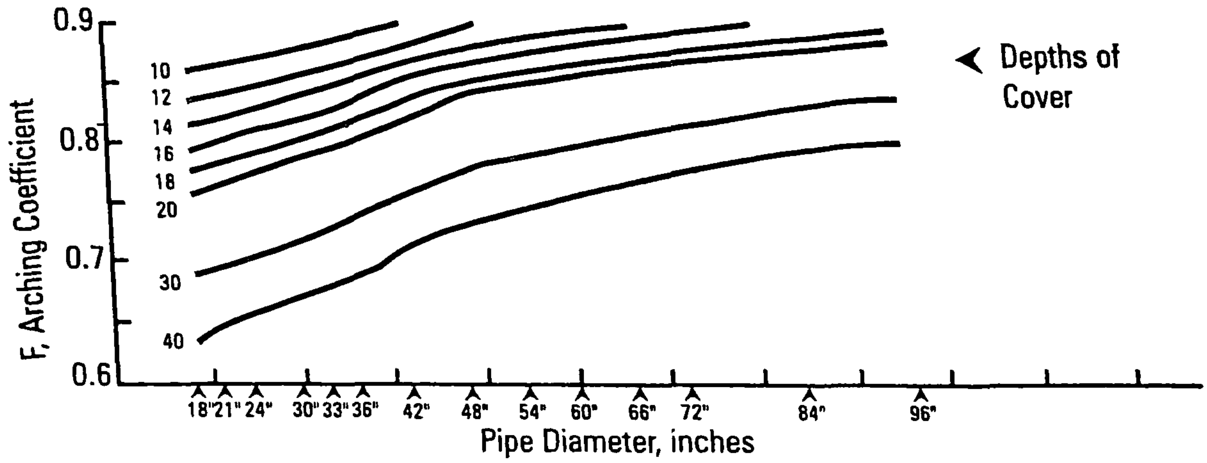
Figure 7-3 **Arching Coefficient for Modified Arching Load**

Based on clay soil, Ku′ = 0.130, and trench widths for SPIROLITE pipe of ID plus 3 ft for 18" - 42" ID and ID plus 4 ft for 48" - 96" ID.



efficient should be used only where the trench width does not exceed 3 ft plus pipe OD for 42" and smaller pipe, and 4 ft plus pipe OD for 48" and larger pipe.

For Example 7-1, the arching coefficient from Figure 7-3 is 0.82, and Equation (7-5) yields

$$P_C = 0.82\,(120)\,(18) = 1771\,lb/ft^2$$

Surcharge Load

The following design methods may be used to determine vertical pressures on the pipe from surface loads. The equations are accurate only to the extent of their appropriateness for a given application. Therefore, it is recommended that the final design be reviewed by a professional engineer.

Surcharge loads may be distributed loads, such as a footing, foundation, or an ash pile, or may be point loads, such as vehicle wheels. The load will be distributed through the soil such that there is a reduction in pressure with an increase in depth or horizontal distance from the surcharged area. The pressure at a point beneath the surcharge load depends on load magnitude, and on the surface area over which the surcharge is applied. Usual design practice is to equate the load on a buried pipe from a surcharge load with the downward pressure acting at the plane of the pipe crown. Once the surcharge load is determined, the total load acting on the pipe is the sum of the earth load and the surcharge load.

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Distributed Load Over Pipe

This design method may be used to find the rectangular area, distributed surcharge load on buried pipes beneath structures such as footings and floors, or other stationary loads such as coal or ash piles.

The method assumes the Boussinesq equation for pressure, and finds the soil pressure acting at a point below the surcharge, and located at the same depth as the crown of the pipe. This pressure is considered to be equal to the vertical pressure acting on the pipe.

Refer to Figure 7-4A, page 44. The poi pressure is found by dividing the rectangular surcharge area (ABCD) into four sub-area rectangles (a, b, c, and d) which

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have a common corner, E, in the surcharge area, and over the pipe. The surcharge load is the sum of the four sub-area loads at the subsurface point. Each sub-area load, is calculated by multiplying an influence coefficient, I_C, from Table 7-2, by the surcharge pressure.

$$P_L = P_a + P_b + P_c + P_d \qquad (7\text{-}7)$$

where

P_L = surcharge load pressure at point, lb/ft^2

P_a = sub-area surcharge load, lb/ft^2, area a

P_b = sub-area surcharge load, lb/ft^2, area b

P_c = sub-area surcharge load, lb/ft^2, area c

P_d = sub-area surcharge load, lb/ft^2, area d

$$P_a = I_C\, w_S \qquad (7\text{-}8)$$

I_C = influence coefficient from Table 7-2

w_S = distributed surcharge pressure acting over ground surface, lb/ft^2

Table 7-2 **Influence Coefficient, I_C, for Distributed Loads Over Pipe**

M/H	*N/H*						
	0.1	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*	*0.7*
0.1	0.005	0.009	0.013	0.017	0.020	0.022	0.024
0.2	0.009	0.018	0.026	0.033	0.039	0.043	0.047
0.3	0.013	0.026	0.037	0.047	0.056	0.063	0.069
0.4	0.017	0.033	0.047	0.060	0.071	0.080	0.087
0.5	0.020	0.039	0.056	0.071	0.084	0.095	0.103
0.6	0.022	0.043	0.063	0.080	0.095	0.107	0.117
0.7	0.024	0.047	0.069	0.087	0.103	0.117	0.128
0.8	0.026	0.050	0.073	0.093	0.110	0.125	0.137
0.9	0.027	0.053	0.077	0.098	0.116	0.131	0.144
1.0	0.028	0.055	0.079	0.101	0.120	0.136	0.149
1.2	0.029	0.057	0.083	0.106	0.126	0.143	0.157
1.5	0.030	0.060	0.086	0.110	0.131	0.149	0.164
2.0	0.031	0.061	0.089	0.113	0.135	0.153	0.169
∞	0.032	0.062	0.090	0.115	0.137	0.156	0.172

M/H	*N/H*						
	0.8	*0.9*	*1.0*	*1.2*	*1.5*	*2.0*	∞
0.1	0.026	0.027	0.028	0.029	0.030	0.031	0.032
0.2	0.050	0.053	0.055	0.057	0.060	0.061	0.062
0.3	0.073	0.077	0.079	0.083	0.086	0.089	0.090
0.4	0.093	0.098	0.101	0.106	0.110	0.113	0.115
0.5	0.110	0.116	0.120	0.126	0.131	0.135	0.137
0.6	0.125	0.131	0.136	0.143	0.149	0.153	0.156
0.7	0.137	0.144	0.149	0.157	0.164	0.169	0.172
0.8	0.146	0.154	0.160	0.168	0.176	0.181	0.185
0.9	0.154	0.162	0.168	0.178	0.186	0.192	0.196
1.0	0.160	0.168	0.175	0.185	0.194	0.200	0.205
1.2	0.168	0.178	0.185	0.196	0.205	0.209	0.212
1.5	0.176	0.186	0.194	0.205	0.211	0.216	0.223
2.0	0.181	0.192	0.200	0.209	0.216	0.232	0.240
∞	0.185	0.196	0.205	0.212	0.223	0.240	0.250

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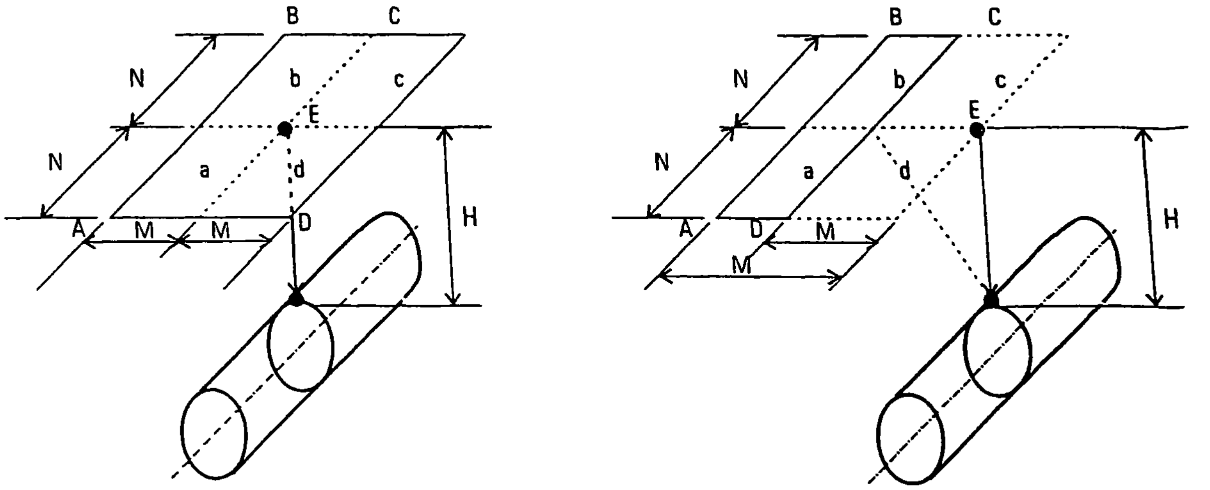
Figure 7-4 Distributed Load Over Pipe



A. Distributed Load Over Pipe

B. Distributed Load Not Over Pipe

If the four sub-areas are equivalent, then Equation (7-7) may be simplified to

$$P_L = 4\, I_C\, w_S \qquad \textit{(7-9)}$$

The influence factor is dependent upon the dimensions of the rectangular area, and upon the depth to the pipe crown. Table 7-2 Influence Coefficient terms, depicted in Figure 7-4, are defined as

H = vertical distance from surface to pipe crown, ft

M = horizontal distance, normal to the pipe centerline, from the center of the load to the load edge, ft

N = horizontal distance, parallel to the pipe centerline, from the center of the load to the load edge, ft

Interpolation may be used to find values not shown. The influence factor gives the portion (or influence) of the load that reaches a given depth beneath the corner of the loaded area.

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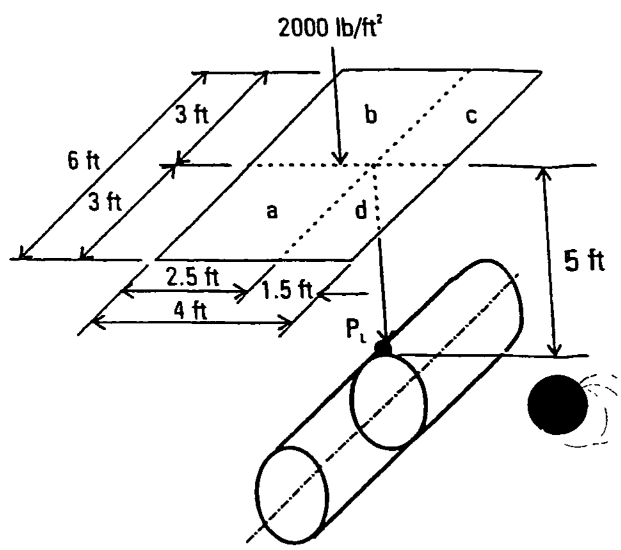
Example 7-2

Find the vertical surcharge load for the 4′ x 6′, 2000 lb/ft^2 footing shown below.

Solution: Use Equations (7-7) and (7-8), Table 7-2, and Figure 7-4. The 4′ x 6′ footing is divided into four sub-areas, such that the common corner is over the pipe.

Figure 7-5 Illustration for Use with Example 7-2



	Sub-area			
	a	b	c	d
M	2.5	2.5	1.5	1.5
N	3	3	3	3
M/H	0.5	0.5	0.3	0.3
N/H	0.6	0.6	0.6	0.6
I	0.095	0.095	0.063	0.063
Px	190	190	126	126
$P_L = 632\ \text{lb/ft}^2$				

Determine sub-area dimensions for M, N, and H, then calculate M/H and N/H. Find the Influence Coefficient from Table 7-2 (page 43), solve Equation (7-8) for each sub area, P_a, P_b, P_c, P_d, and Equation (7-7) for P_L.

Distributed Load Not Over Pipe

This design method may be used to find the surcharge load on buried pipes near, but not directly below uniformly distributed loads such as concrete slabs, footings and floors, or other stationary rectangular area loads.

The method is similar to the method for determining the surcharge load when the surcharge is directly above the pipe, except that the area directly above the pipe that is not covered by the surcharge load must be deducted from the overall load on the pipe.

Refer to Figure 7-4B, previous page. Since there is no surcharge directly above the pipe centerline, an imaginary surcharge load of the same pressure per unit area as the actual load, is applied to sub-areas c and d. The surcharge loads for sub-areas a+d and b+c, are determined, then the surcharge loads from the imaginary areas c and d are deducted to find the surcharge pressure on the pipe.

$$P_L = P_{a+d} + P_{b+c} - P_d - P_c \qquad (7\text{-}10)$$

where terms are as previously defined, and

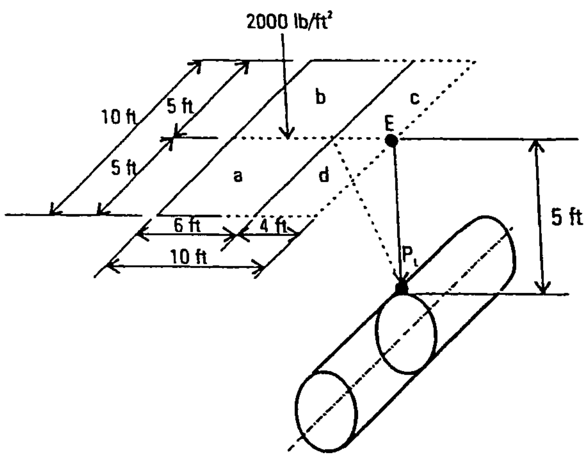
P_{a+d} = surcharge load of combined sub-areas a and d, lb/ft^2

P_{b+c} = surcharge load of combined sub-areas b and c, lb/ft^2

Example 7-3

Find the vertical surcharge pressure for the 6 x 10, 2000 lb/ft^2 slab shown below.

Figure 7-6 **Illustration for Use with Example 7-3**



Solution: Use Equations (7-7) and (7-10), Table 7-2 (page 43), and Figure 7-4B (previous page). The surcharge area includes the non-loaded area between the pipe and the slab. Divide the surcharge area into four sub-areas, a, b, c, and d. The surcharge pressures for the combined sub-areas a+d and b+c are determined, and then for the

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sub-areas c and d. The surcharge pressure is the sum of the surcharge sub-areas a+d and b+c, less the imaginary sub-areas c and d.

	Sub-area			
	ad	bc	c	d
M	10	10	4	4
N	5	5	5	5
M/H	2.0	2.0	0.8	0.8
N/H	1.0	1.0	1.0	1.0
I	0.200	0.200	0.160	0.160
Px	400	400	(320)	(320)
$P_L = 160\ lb/ft^2$				

Vehicular Loads

Wheel loads from trucks, trains, or other vehicles are significant for pipe buried at shallow depths. The pressure on the pipe due to a surface vehicular live load depends on vehicle weight, the tire pressure and size, vehicle speed, surface smoothness, the amount and type of paving, the soil, and the distance from the pipe to the point of loading.

Minimum Cover Depth

Where pipe is to be subjected to vehicular loads, it is recommended to install it under at least one pipe diameter or eighteen inches of cover, whichever is greater. However, for pipe 36" in diameter or larger, this cover depth may not always be available. For these shallow cover cases, special design considerations are required.

Highway Loads

The most common loading used for design is the H20 highway loading. The American Association of State Highway and Transportation Officials (AASHTO) publishes wheel loadings for standard H and HS trucks as shown in Figures 7-7 and 7-8. A standard H20 truck has a front axle load of 8,000 pounds, and a rear axle load of 32,000 pounds, for a total weight of 40,000 pounds or 20 tons. At the rear axle(s), each wheel load is 0.4 W, where W is the total weight of the truck. The 0.4 W wheel load may be used to represent the load applied by either a single axle or tandem axles. The heaviest tandem axle loads normally encountered on highways are around 40,000 pounds. Occasionally, vehicles may be permitted with loads up to 50 percent higher.

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The standard AASHTO wheel loading is a static load. However, a vehicle in motion will strike bumps and increase the downward force. For vehicles on paved roads, impact loading is accommodated by multiplying the static load by an impact factor of 1.5. For unpaved roads, higher impact factors may be required.

Pavement rigidity is an important variable affecting the live load surcharge pressure transmitted to the pipe. Pavement is usually considered as rigid (concrete) or flexible (asphalt). Rigid pavement distributes the load, and tends to transmit less load directly onto the pipe.

Rigid Pavement Highway Loads

For common highway surcharge loading applications, the pressure acting on the pipe can be obtained from a table developed by the American Iron and Steel Institute (AISI), which gives the H20 and HS20 highway surcharge loading on rigid pavement.

The AISI H20/HS20 highway loading assumes that the axle load is equally distributed over two, 18 by 20 inch areas, spaced 72 inches apart, and applied through a 12-inch thick rigid paveme[nt]. To account for speed, an impact factor of 1.5 is incorporated in the table values shown in Table 7-3, next page. For other

Figure 7-7 **AASHTO Standard H20 Static Loading**

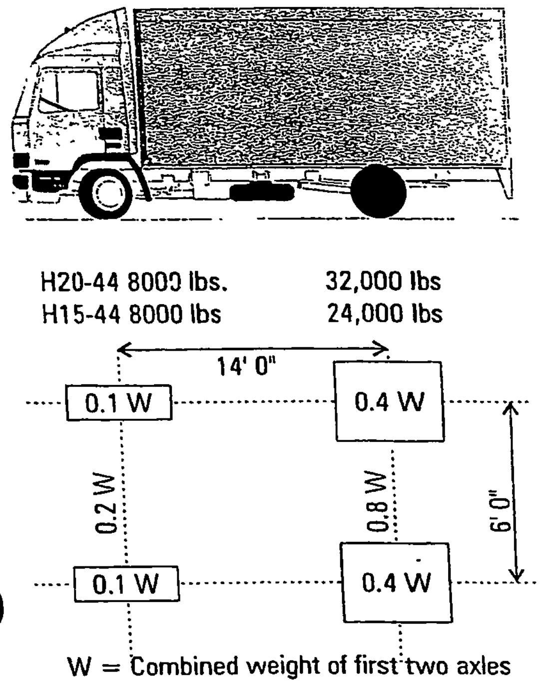


Table 7-3 **H20 and HS20 Highway Loading (AISI)**

Cover, ft	Transferred Load, lb/ft^2
1	1800
2	800
3	600
4	400
5	250
6	200
7	175
8	100
10	†

Simulates 20 ton truck traffic + impact.
†Negligible live load influence.

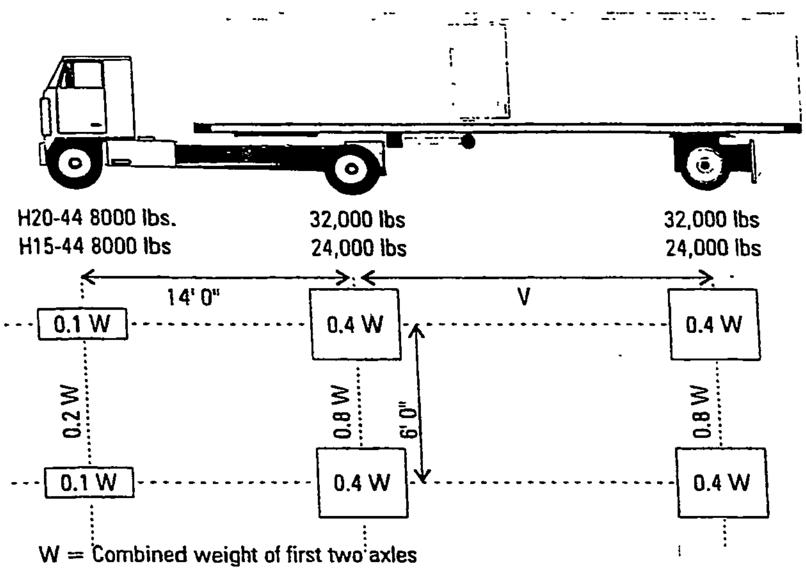
loadings, such as heavier trucks, or trucks on unpaved surfaces the AISI table cannot be used and one of the methods discussed below should be considered.

Off-Highway and Unpaved Road Loads

Off-highway vehicles may be considerably heavier than H20 or HS20 trucks, and these vehicles frequently operate on unpaved roads which may have uneven surfaces. Thus impact factors higher than 1.5 may be reached depending on the vehicle speed. Except for slow traffic, an impact factor of 2.0 to 3.0 should be considered.

During construction, both permanent and temporary underground pipelines may be subjected to heavy vehicle loading from construction equipment. A designated vehicle crossing with special de-

Figure 7-8 **AASHTO Standard HS20 Static Loading**



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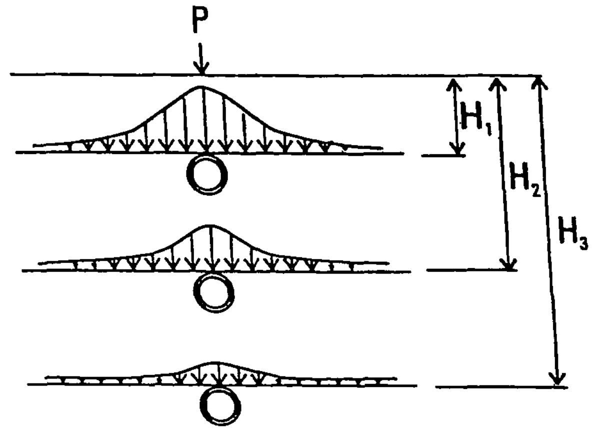
sign measures such as temporary pavement or structural sheeting may be advisable, as well as vehicle speed controls to limit impact loading.

Figure 7-9 Concentrated Load Pressure Distribution at Various Depths



Vehicular Loads As Point Loads

There are generally two approaches for calculating vehicle live load surcharge pressure. The more conservative approach is to treat the wheel load as a concentrated (point) load. The other is to treat it as a distributed load spread over the contact area of the tire with the ground (imprint area). The pressure due to a distributed load and the pressure due to a concentrated load begin to approach the same value at a depth of about twice the square root of the loaded area.

The distributed load method gives more realistic values where the depth equals less than twice the square root of the loaded area, whereas for deeper depths concentrated loads are preferred because the calculations are simpler and typically more conservative.

The pressure distribution under a concentrated load varies with depth as illustrated in Figure 7-9. When the live load is calculated using the point load methods given in the following sections, the maximum pressure occurring at the crown is assumed to be distributed across the entire pipe, which gives additional conservatism.

A key consideration in the determination of the live load pressure on the pipe is the location of the wheels relative to the pipe. A higher pressure may occur beneath a point between two vehicles passing in adjacent lanes than directly under a single vehicle wheel. This depends on the depth of cover.

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When depths are greater than four or five feet, the combined H20 load for two separate wheels straddling the pipe is greater than that for a single wheel directly over the pipe. Deeper than five feet, H20 loads are not usually significant because the load is attenuated significantly compared loads under one or two feet of cover. However, greater live loads may produce design significant effects at depths greater than five feet. Therefore, the designer should check load conditions for a single wheel directly over the pipe, and for two wheels spaced six feet apart and centered over the pipe.

Single Wheel Load Centered On Pipe

To check a single wheel load centered directly over the pipe, a method based on Holl's integration of Boussinesq's equation assumes the wheel load is a concentrated (point) load. Holl's integration finds the pressure at the pipe crown depth that is distributed over a surface three feet long, and the width of the pipe outside diameter.

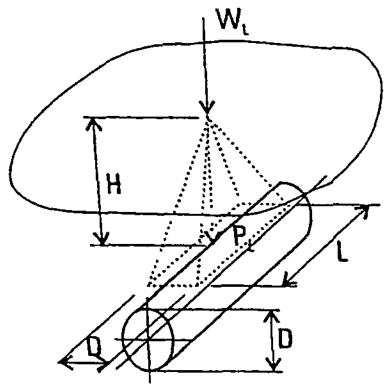
Holl's Integration

Holl's equation for the average vertical pressure acting on a pipe due to a concentrated surface load is given by:

Holl's Equation

$$P_L = C_H \frac{I_I W_L}{LD} \qquad (7\text{-}11)$$

Table 7-4 Load Coefficient, C_H, for Holl's Integration of Boussineq's Equation



D/2H	L/2H						
	0.1	0.2	0.3	0.4	0.5	0.6	0.7
0.1	0.019	0.037	0.053	0.067	0.079	0.089	0.097
0.2	0.037	0.072	0.103	0.131	0.155	0.174	0.189
0.3	0.053	0.103	0.149	0.190	0.224	0.252	0.274
0.4	0.067	0.131	0.190	0.241	0.284	0.320	0.349
0.5	0.079	0.155	0.224	0.284	0.336	0.379	0.414
0.6	0.089	0.174	0.252	0.320	0.379	0.428	0.467
0.7	0.097	0.189	0.274	0.349	0.414	0.467	0.511
0.8	0.103	0.202	0.292	0.373	0.441	0.499	0.546
0.9	0.108	0.211	0.306	0.391	0.463	0.524	0.574
1.0	0.112	0.219	0.318	0.405	0.481	0.544	0.597
1.2	0.117	0.229	0.333	0.425	0.505	0.572	0.628
1.5	0.121	0.238	0.346	0.442	0.525	0.596	0.655
2.0	0.124	0.244	0.355	0.454	0.540	0.613	0.674
20.0	0.127	0.248	0.361	0.462	0.550	0.625	0.688

D/2H	L/2H						
	0.8	0.9	1.0	1.2	1.5	2.0	20.0
0.1	0.103	0.108	0.112	0.117	0.121	0.124	0.127
0.2	0.202	0.211	0.219	0.229	0.238	0.244	0.248
0.3	0.292	0.306	0.318	0.333	0.346	0.355	0.361
0.4	0.373	0.391	0.405	0.425	0.442	0.454	0.462
0.5	0.441	0.463	0.481	0.505	0.525	0.540	0.550
0.6	0.499	0.524	0.544	0.572	0.596	0.613	0.625
0.7	0.546	0.574	0.597	0.628	0.655	0.674	0.688
0.8	0.584	0.615	0.639	0.674	0.703	0.725	0.740
0.9	0.615	0.647	0.673	0.711	0.743	0.766	0.783
1.0	0.639	0.673	0.701	0.740	0.775	0.800	0.818
1.2	0.674	0.711	0.740	0.783	0.821	0.849	0.871
1.5	0.703	0.743	0.775	0.821	0.863	0.895	0.920
2.0	0.725	0.766	0.800	0.849	0.895	0.930	0.960
20.0	0.740	0.783	0.818	0.871	0.920	0.960	1.000

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where

P_L = load, lbs/ft^2

I_I = impact factor

W_L = wheel load, lb

C_H = load coefficient from Table 7-4, next page

L = pipe length, ft

D = pipe OD, ft

If the pipe is longer than 3 ft, usual practice is to assume a length of 3 ft. C_H is found in Table 7-4 as a function of D/2H and L/2H where H = depth of cover.

Example 7-4

Find the single H20 rear wheel live load surcharge pressure on a 30" OD PLEXCO pipe buried 4 feet deep. Assume an impact factor of 1.5.

Solution: Use Equation (7-11), Table 7-4, and Figure 7-7. To solve Equation (7-11), the load coefficient, C_H, from Table 7-4 is required. For 4 ft of cover, D/2H = 0.31, and L/2H = 0.38. Interpolating Table 7-4 for C_H yields 0.189. From Figure 7-7, the H20 rear wheel live load is 0.4 x 40,000 = 16,000 lb. Solving equation (7-11) yields:

$$P_L = (0.187)\frac{(1.5)(16{,}000)}{3\left(\frac{30}{12}\right)}$$

$$P_L = 598\ lb/ft^2$$

Multiple Wheel Loads Along Pipe Length

In many cases, the maximum load on the pipe occurs when a single (or dual) wheel is located directly over the pipe. However, at some depths the combined load due to more than one wheel may be larger than the single wheel load. This usually occurs at a location along the pipe which is not directly under a wheel load. This point (Figure 7-10, Case I, Point 2, next column) will usually be centered between two wheel loads.

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Point Load on Pipe Crown

The Boussinesq point load equation may be used to find the wheel load pressure on the pipe, neglecting any pavement effects. Pavement effects are covered later using a modified form of Boussinesq's equation.

Boussinesq's Equation

$$P_L = \frac{3\, I_I\, W_L\, H^3}{2\pi\, r^5} \qquad \textbf{(7-12)}$$

where

P_L = vertical surcharge pressure at pipe crown, lb/ft^2

I_I = impact factor

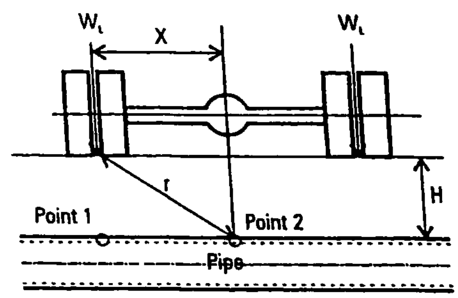
W_L = wheel load, lb

H = vertical depth to pipe crown, ft

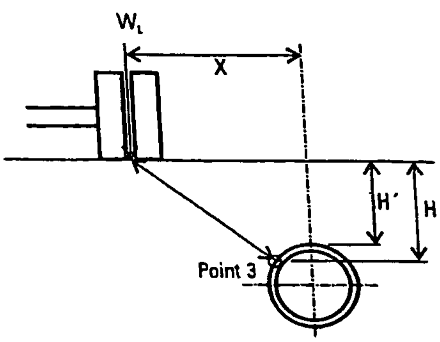
r = distance from the point of load application to pipe crown, ft

$$r = \sqrt{X^2 + H^2} \qquad \textbf{(7-13)}$$

Figure 7-10 **Concentrated Point Load**



Case I: Load Along Pipe Length



Case II: Load At Horizontal Distance From Pipe

Using the Boussinesq point load equation in this way is conservative, as the pressure applied to the point on the pipe crown is taken as the pressure applied across the pipes diameter.

Equation (7-12) applies only where the axle is located directly over the pipe, and when seeking the pipe crown load at some point between the wheel. This is pictured as Figure 7-10, Case I.

Example 7-5

Determine the vertical soil pressure exerted on a 12" pipe buried 2 ft deep when two 16,000 lb wheel loads cross simultaneously over the pipe. Assume the loads are 6 feet apart. (Six feet is the typical wheel spacing on an axle, and the normal separation for wheel loads traveling in adjacent lanes.)

Solution: Use Equations (7-12) and (7-13), and since the wheels are traveling, a 1.5 impact factor is applied. The maximum load will be at the center between the two wheels, so X = 3 ft. Determine r from Equation (7-13).

$$r = \sqrt{2^2 + 3^2} = 3.61\,ft$$

Then solve Equation (12) for P_L.

$$P_L = \frac{3\,(1.5)\,(16{,}000)\,(2)^3}{2\,\pi\,(3.61)^5}$$

$$P_L = 149.5\; lb/ft^2$$

This is the load from each wheel, however, the load on the pipe crown is from both wheels, so

$$2\,P_L = 2\,(149.5) = 299\; lb/ft^2$$

Point Load Not On Pipe Crown

With some modification of equation terms, the pressure at a point other than at the pipe crown may be determined. A pipe buried along a road shoulder would be such an application. Pictorially, this is Figure 7-10, Case II. For this application, H and r are determined using the following equations:

$$\alpha = tan^{-1}\left(\frac{X}{H' + \frac{D}{2}}\right) \qquad \textbf{(7-14)}$$

$$H = H' + \frac{D}{2}\,(1 - cos\,\alpha) \qquad \textbf{(7-15)}$$

$$r = \sqrt{X^2 + \left(H' + \frac{D}{2}\right)^2} - \frac{D}{2} \qquad \textbf{(7-16)}$$

where

X = horizontal distance from live load to pipe crown, ft

H′ = depth of cover, ft

Multiple Wheel Loads on Rigid Pavement

The Portland Cement Association method may be used to find the load on a pipe from multiple wheel loads on rigid pavement. The solution accounts for pavement rigidity, and the stiffness of the pipe embedment soil. To determine the maximum load when two vehicles pass each other, two common cases are checked. The first calculates the load directly under a wheel, and the other calculates the combined load of two passing vehicles. Usually the later case gives the highest load.

The pressure at a point beneath a single wheel is given by:

$$P_L = \frac{C\,I_f\,W_L}{(R_S)^2} \qquad \textbf{(7-17)}$$

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where

C = load coefficient from Table 7-4, page 49

R_s = radius of stiffness, ft

$$R_S = \frac{\sqrt[4]{\dfrac{E\,h^3}{12\left(1-v^2\right)E'}}}{12} \qquad (7\text{-}18)$$

where

E = pavement modulus, lb/in^2 (4,000,000 lb/in^2 for concrete)

h = pavement thickness, in

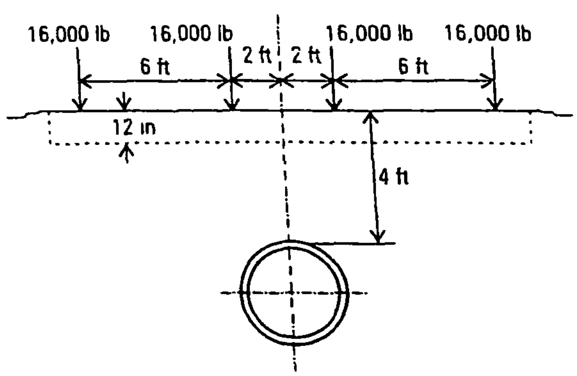
v = Poisson's ratio (0.15)

E´ = embedment soil modulus, lb/in^2 (300-700 psi)

Example 7-6

Find the pressure at the crown of the pipe shown in Figure 7-11, below, with an impact factor of 1.5. Pavement is 12" thick and the pipe is 4 feet below the pavement surface. Assume E´ = 700 lb/in^2

Figure 7-11 **Illustration for use with Example 7-6**



Solution: Using Equation (7-18), solve for Rs, then determine C from Table 7-5, page 53. Use Equation (7-17) and solve for each wheel load. Sum the four wheel load pressures for the total pressure on the pipe.

$$R_S = \frac{\sqrt[4]{\dfrac{(4{,}000{,}000)\,(12)^3}{12\left(1-0.15^2\right)(700)}}}{12}$$

$$R_S = 2.52\,ft$$

	Outer	*Inner*
X/Rs	8/2.52 = 3.2	2/2.52 = 0.8
H/Rs	4/2.52 = 1.6	4/2.52 = 1.6
C	0.011	0.054

Since the loads are cumulative, it is convenient to add the load coefficients together, then solve for the pressure on the pipe in one calculation.

$$C_{TOTAL} = 2\,(0.011 + 0.054) = 0.13$$

$$P_L = \frac{(0.13)\,(1.5)\,(16{,}000)}{2.52^2}$$

$$P_L = 492\,lb/ft^2$$

Vehicular Loads As Distributed Loads

The concentrated load methods presented above typically provide more conservative results than distributed load methods, and should be satisfactory for most applications. However, with shallow cover and heavy load concentrated load methods may give answers that are unrealistically conservative. In this event or where a more precise answer is sought, pipe loading pressure may be evaluated using distributed load methods.

Distributed Wheel Loads

The methods above for determining the pressure due to a stationary distributed load can be applied to a wheel load as well, provided that the dimensions of the area loaded by the wheel are known. Allowing for traveling vehicle impact, and

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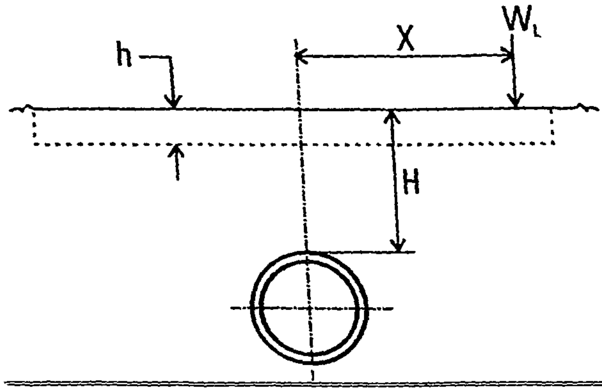
Table 7-5 Pressure Coefficient, C, for Single Load



H/Rs	X/Rs										
	0.0	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0
0.0	0.113	0.105	0.089	0.068	0.048	0.032	0.020	0.011	0.006	0.002	0.000
0.4	0.101	0.095	0.082	0.065	0.047	0.033	0.021	0.011	0.004	0.001	0.000
0.8	0.089	0.084	0.074	0.061	0.045	0.033	0.022	0.012	0.005	0.002	0.001
1.2	0.076	0.072	0.065	0.054	0.043	0.032	0.022	0.014	0.008	0.005	0.003
1.6	0.062	0.059	0.054	0.047	0.039	0.030	0.022	0.016	0.011	0.007	0.005
2.0	0.051	0.049	0.046	0.042	0.035	0.028	0.022	0.016	0.011	0.008	0.006
2.4	0.043	0.041	0.039	0.036	0.030	0.026	0.021	0.016	0.011	0.008	0.006
2.8	0.037	0.036	0.033	0.031	0.027	0.023	0.019	0.015	0.011	0.009	0.006
3.2	0.032	0.030	0.029	0.026	0.024	0.021	0.018	0.014	0.011	0.009	0.007
3.6	0.027	0.026	0.025	0.023	0.021	0.019	0.016	0.014	0.011	0.009	0.007
4.0	0.024	0.023	0.022	0.020	0.019	0.018	0.015	0.013	0.011	0.009	0.007
4.4	0.020	0.020	0.019	0.018	0.017	0.015	0.014	0.012	0.010	0.009	0.007
4.8	0.018	0.017	0.017	0.016	0.015	0.013	0.012	0.011	0.009	0.008	0.007
5.2	0.015	0.015	0.014	0.014	0.013	0.012	0.011	0.010	0.008	0.007	0.006
5.6	0.014	0.013	0.013	0.012	0.011	0.010	0.010	0.009	0.008	0.007	0.006
6.0	0.012	0.012	0.011	0.011	0.010	0.009	0.009	0.008	0.007	0.007	0.006

wheel load over a known area, Equation (7-9) becomes

$$P_L = 4\, I_c \left(\frac{I_r\, W_L}{A_c} \right) \qquad (7\text{-}19)$$

where

P_L = surcharge load pressure on pipe crown, lb/ft^2

I_r = influence coefficient from Table 7-2, page

W_L = wheel load, lb

A_c = contact area, ft^2

Load Areas

A literature search provides guidelines for wheel load areas. AISI gives dual wheel contact area for rear axle on an H20 or HS20 vehicle, as an 18 in by 20 in rectangle. For a single tire, AASHTO

Information on page rev. 10/97 supersedes all previous issue:

External Forces On Buried Pipe

Buried pipe are subjected to radially directed compressive loads and to circumferential shear loads from the surrounding soil and surcharge loads. Radially directed loads are loads that are applied to the pipe wall and have a line of action passing through the center of the pipe. These loads will produce stresses and deformations in the pipe. Radial loads will cause a minute decrease in the pipes diameter.

Normally, a radially directed load is not uniform, and this causes the pipe to undergo ring deflection. The amount of ring deflection will depend on the load, pipe stiffness, and soil stiffness. When buried in very weak, viscous soils that offer little or no stiffness compared to the pipe, the ring deflection of the pipe will be governed almost entirely by pipes properties. On the other hand, when buried in compacted granular embedment, the ring deflection is governed by the interaction between the pipe and the surrounding soil.

In buried applications, polyethylene pipe is usually characterized by ring stiffness measures such as RSC (Ring Stiffness Constant) or PS (pipe stiffness), ductility (which governs permissible deflection limits), and compressive strength. Soil stiffness is usually characterized by the modulus of passive resistance, a measure of the combined stiffness of the pipe and the soil, and related to the soil's compressibility and density.

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The radial compressive loads and the ring deflection, or bending that occurs in a flexible pipe, causes deformations and stresses in the pipe wall. Some of the more common design concerns for buried flexible pipe are presented below. All designs should be reviewed by an engineer to determine their suitability for a particular application.

Wall Compressive Stress

When a non-pressurized pipe, confined in a dense embedment, is subjected to a radially directed soil pressure, a circumferential, compressive thrust occurs in its wall. This is similar to the thrust force that occurs within the wall of a ring when it is squeezed. This thrust creates a ring (or hoop) compressive stress within the pipe wall, which is analogous to the hoop tensile stress created by internal pressure, but with an opposite sign.

As is often the case, the radial soil pressure causing the stress is not uniform. However, for wall compressive stress calculation convenience, it is commonly assumed that the radial soil pressure is uniform and equal to the vertical soil pressure at the crown of the pipe.

When pressure pipe is buried, the internal pressure may be greater than the radial external pressure applied by the soil. This results in a tensile stress rather than a compressive stress in the pipe wall. So, wall compressive stresses are normally not considered for pressure pipe. (This can be checked by calculating the wall compressive stress and comparing it with the hoop stress due to internal pressure.)

The compressive stress in the wall of PLEXCO or SPIROLITE pipe subjected to a uniform radial soil pressure is:

(PLEXCO pipe)

$$S = \frac{P_T\, D_O}{288\, t} \qquad (7\text{-}22$$

(SPIROLITE pipe)

$$S = \frac{P_T\, D_O}{288\, A} \qquad (7\text{-}2$$

where

P_T = vertical load applied to pipe, lbs/ft^2

S = pipe wall compressive stress, lb/in^2

t = wall thickness, in

A = wall profile average cross-sectional area, in^2/in

D_0 = pipe outside diameter, in

As arching commonly occurs for entrenched pipe, the modified arching load rather than the prism load is used to determine the vertical soil pressure at the pipes crown.

The pipe wall compressive stress should be compared to an allowable material stress value which should be determined by testing. The recommended, long-term compressive strength design value for Plexco/Spirolite polyethylene pipes is 800 lb/in^2.

Example 7-9

Find the pipe wall compressive ring (or hoop) stress in a SPIROLITE 36" Class 100 pipe buried under 18 ft of cover. The ground water level is at the surface, the saturated weight of the insitu silty-clay soil is 120 lbs/ft^3, and the trench width equals the pipe diameter plus 3 ft.

Solution: Determine the modified arching load using Equation (7-5), page 41. The arching coefficient may be found using Equation (7-6), page 41, or from Figure 7-4, page 44 as

$$F = 0.83$$

Although the net soil pressure is equal to the buoyant weight of the soil, the water pressure is also acting on the pipe. Therefore the total pressure (water and earth load) can be found using the saturated unit weight of the soil.

$$P_C = (0.83)(120)(18)$$

$$P_C = 1793\ lb/ft^2$$

Next, solve Equation (7-23) for the compressive stress. For SPIROLITE 36" Class 100 pipe, the wall cross sectional area, A, and outside diameter, D_o, are found in SPIROLITE product literature. A is 0.470 in^2/in, and D_O is 36 plus twice the 2.02" wall height, or 40.04 in.

$$S = \frac{1793(40.04)}{288(0.470)}$$

$$S = 530\ lb/in^2$$

The application is within the 800 lb/in^2 allowable stress guideline.

Unconstrained Pipe Wall Buckling

Flexible pipe may be considered to have the cross section of a long, slender column rolled into a circle. Compressive thrust, in combination with radially directed forces, may cause an instability or buckling, that is, a large wrinkle or dimple in the pipe wall. This type of deflection can be compared to the Euler buckling of a column.

Compared to its capacity for tensile wall stress from internal pressure, unconstrained flexible pipe has less resistance to external, radially-directed pressure. Examples of external pressures on unconstrained pipe are: external atmospheric pressure from a vacuum within the pipe; external hydrostatic load such as groundwater above a slipliner, or a partially full underwater pipeline; column separation of the flow in a downhill pipeline; siphoning, or a reduced internal pressure where a liquid line crests a rise; and cavitation due to pump shut-off or start-up. If an unconstrained pipe will be subjected to an external pressure during

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service, the unconstrained buckling resistance should be checked.

For unconstrained (not buried) pipe, the critical negative pressure or external pressure above which buckling can occur may be estimated by:

$$P_{CR} = \frac{24\,E\,I}{\left(1-\mu^2\right)D_M^3} \qquad (7\text{-}24)$$

where

P_{CR} = critical external collapse pressure, lb/in^2

E = elastic modulus, lb/in^2

I = SPIROLITE profile wall moment of inertia, in^4/in

μ = Poisson's ratio

D_M = mean diameter

PLEXCO Pipe

$$D_M = D_O - 1.06t \qquad (7\text{-}25)$$

SPIROLITE Pipe

$$D_M = D_I + 2Z \qquad (7\text{-}26)$$

D_I = inside diameter, in

D_O = outside diameter, in

Z = SPIROLITE wall centroid, in

t = PLEXCO minimum wall thickness, in

Poisson's ratio, μ, is 0.45 for long-term loading on polyethylene pipe, and 0.35 for short-term loading. Expressing critical external buckling pressure in terms of DR for PLEXCO pipe, Equation (24) becomes

$$P_{CR} = \frac{2\,E}{\left(1-\mu^2\right)}\left(\frac{1}{DR-1}\right)^3 \qquad (7\text{-}27)$$

where terms are as above, and

DR = PLEXCO pipe dimension ratio

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Ovality Effects

Ovality or deflection of the pipe diameter will increase the bending moment in the pipe wall and thus reduce buckling resistance.

$$P = f_0\,P_{CR} \qquad (7\text{-}28)$$

where

f_0 = ovality compensation factor from Figure 7-14, below

P = buckling pressure, lb/in^2

Pipe deflection is determined by

$$\%DEFLECTION = 100\left(\frac{D-D_D}{D}\right) \qquad (7\text{-}29)$$

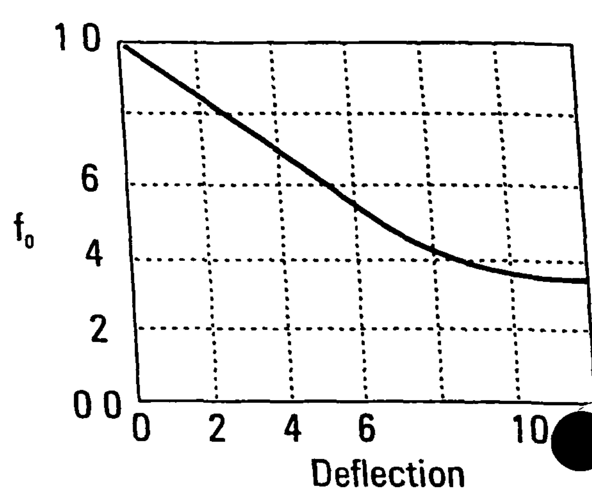
where

D = pipe average diameter, in

D_D = pipe minimum diameter, in

The elastic material properties used for calculating critical buckling pressure should be appropriate for the specific application. See Chapter 5, *Thermal Effects*, Table 5-1, Time and Temperature Elastic Modulus, page 25.

Figure 7-14 Ovality Compensation Factor for Unconstrained Buckling



The designer should compare the critical buckling pressure with the actual anticipated pressure, and apply a safety factor commensurate with his assessment of the application. Safety factors in the range of 2.5 to 1 are common, but specific circumstances may warrant a higher or lower safety factor. An alternative to a direct safety factor may be to apply a longer term elastic modulus to a short term stress event.

The resilience and toughness of PLEXCO and SPIROLITE pipe may allow the pipe to recover from a temporary buckling or flattening event. For example, a high SDR, unconstrained PLEXCO pipe may be pressed flat by a short duration vacuum inside the pipe, but relieving the vacuum can allow the pipe to recover most of its original round shape. In most cases, there will not be loss of serviceability or permanent damage. If temporary buckling events are possible with SPIROLITE pipe, bell and spigot joints should be welded, otherwise, joint sealing capability may be lost.

Example 7-10

Find the allowable ground water level above a 24" Class 160 SPIROLITE pipe installed in a casing without grout in the annular space. Consider the case where the pipe is below the normal water table, and where the water table rises during a flood.

Solution: Use Equations (7-24) and (7-26); Bulletin No. 910, *ASTM F 894 High Density Polyethylene Pipe Product Data;* Figure 7-1, page 38; and, for elastic modulus values, Table 5-1, page 25. The critical external collapse pressure depends upon the duration of the water level above the pipe. If the water level is constant, then a long term elastic modulus should be used, but if the water level rises only occasionally, a shorter term elastic modulus may be applied.

Bulletin No. 910 provides pipe dimensions and I values. For 24" Class 160 pipe, I is 0.124 in^4/in and Z, the wall centroid, is 0.50 in.

$$D_M = 24 + 2(0.50) = 25.0\ in$$

For the constant water table above the pipe, the 50 year, 73°F modulus is 28,200 lb/in^2, and

$$P_{CR} = \frac{24(28{,}200)(0.124)}{(1-0.45^2)(25.0^3)}$$

$$P_{CR} = 6.79\ lb/in^2$$

Assuming 5% ovality, and a 2 to 1 safety factor, Figure 1 provides f_O as 0.64, and

$$P = \frac{(0.64)(6.79)}{2}$$

$$P = 2.17\ lb/in^2 = 5.0\ ft\ H_2O$$

Flooding conditions are occasional happenings, usually lasting a few days to a week or so. The 1000 hour (41.6 days) elastic modulus value is about double the expected flood duration, so it provides about a 2 to 1 safety margin. Solving as above,

$$P_{CR} = \frac{24(43{,}700)(0.124)}{(1-0.45^2)(25^3)}$$

$$P_{CR} = 10.44\ lb/in^2$$

$$P = (0.64)(10.44)$$

$$P = 6.68\ lb/in^2 = 15.4\ ft\ H_2O$$

Constrained Pipe Wall Buckling

Buckling resistance is increased when flexible pipe is embedded in soil, as the soil and pipe are coupled together to re-

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sist buckling forces. A vertically applied thrust force causes the pipe to widen horizontally, and the soil restrains horizontal pipe deflection, thus forcing the pipe into a higher order buckling mode. When embedded in soil, the pipes critical buckling pressure increases. This pipe/soil interaction occurs when the depth of cover is sufficient to mobilize soil support. A publication by the American Water Works Association, AWWA C-950, indicates that at least four feet of cover is required.

AWWA C-950 provides a design equation for buckling of a buried plastic pipe. The following constrained pipe buckling equation is applicable to PLEXCO and SPIROLITE pipe.

PLEXCO Pipe

$$P_{WC} = \frac{5.65}{N}\sqrt{R\,B'\,E'\,\frac{E}{12\,(DR-1)^3}} \qquad (7\text{-}30)$$

SPIROLITE Pipe

$$P_{WC} = \frac{5.65}{N}\sqrt{R\,B'\,E'\,\frac{E\,I}{D_M^3}} \qquad (7\text{-}31)$$

where

P_{WC} = allowable constrained buckling pressure, lb/in²

N = safety factor

R = buoyancy reduction factor

$$R = 1 - 0.33\,\frac{H'}{H} \qquad (7\text{-}32)$$

H′ = groundwater height above pipe, ft

H = cover height, ft

B′ = elastic support factor

$$B' = \frac{1}{1+4e^{(-0.065\,H)}} \qquad (7\text{-}33)$$

e = natural log base number, 2.71828

E′ = soil reaction modulus, lb/in²

E = pipe material elastic modulus, lb/in²

I = pipe wall moment of inertia, in⁴/in

D_M = mean diameter, in

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The designer should apply a safety factor commensurate with the application. A safety factor of 2.0 has been used for thermoplastic pipe.

The allowable constrained buckling pressure should be compared to the total vertical stress acting on the pipe crown from the combined load of soil, and groundwater or flood water. It is prudent to check buckling resistance against a groundwater level for a 100-year-flood. In this calculation the total vertical stress is typically taken as the prism load pressure for saturated soil, plus the fluid pressure of any flood water above the ground surface.

Example 7-11

Find the allowable buckling pressure for a SPIROLITE 36" Class 100 36" pipe, installed in compacted soil embedment which develops an E′ of 2000 lb/in². Is Class 100 pipe sufficient for an applied load from 18 feet of cover and ground water to the surface?

Solution: Solve Equation (7-29) using Equations (7-26), (7-32), (7-33), and Table 5-1. SPIROLITE pipe dimensions and properties are found in product publications. For SPIROLITE 36" Class 100 pipe, I is 0.171 in⁴/in, and Z is 0.58 in. Solve for terms D_M, B, and R.

$$D_M = 36 + 2\,(0.58) = 37.16\,in$$

$$B' = \frac{1}{1+4e^{-(0.065)(18)}}$$

$$B' = 0.446$$

$$R = 1 - 0.33\,\frac{18}{18} = 0.67$$

Under the specified 100-year-flood condition, soil cover, H, and flood water height, H′, are both 18 feet.

From Table 5-1, E is 28,200 lb/in^2 for 50 years at 73°F, and common practice is a safety factor of 2. Solving Equation (7-29):

$$P_{wc} = \frac{5.65}{2}\sqrt{\frac{0.67\,(0.446)\,2000\,(28{,}200)\,.171}{37.16^3}}$$

$$P_{WC} = 21.17\,\frac{lb}{in^2} = 3051\,\frac{lb}{ft^2}$$

The load applied to the pipe is found using the prism load, Equation (7-1), page 39. (Note: For this example, the specified soil reaction modulus, E′, is an empirical value that was developed using prism load rather than arching load methods. Therefore, the prism soil load must be used. If a soil reaction modulus value is developed using arching or modified arching methods, then soil loads should be calculated using the appropriate method. See discussions on Soil Reaction Modulus (page 62) and Vertical Soil Pressure (page 63.)

$$P_E = (120)\,(18) = 2160\,\frac{lb}{ft^2}$$

Since the allowable buckling stress is greater than this pressure Class 100 pipe is satisfactory for this installation.

Another design method for determining the buckling resistance of soil constrained pipe is

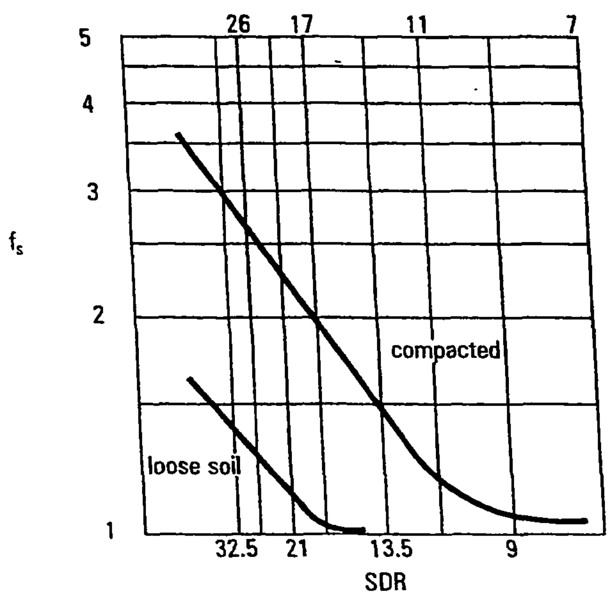
$$P = f_O\, f_S\, P_{CR} \qquad (7\text{-}34)$$

where terms are as defined above, and

f_s = support factor from Figure 7-15 for a given soil condition and DR

The constrained pipe buckling pressure for a PLEXCO pipe supported by soil may be found using Equation (7-27), then using Equation (7-34) to adjust the value for ovality and soil support. Figure 7-15 gives the adjustment factors for typical loose soil and compacted soil. For mud or marshlands soil, which give no support, f_s is equal to 1.

Figure 7-15 **Support Factor**



Ring Deflection

Some vertical pipe deflection is desirable to promote arching, and to mobilize the passive soil resistance forces which support the pipe. However, deflection may affect other pipe or system performance areas, such as pipe material long term strain capability, pipeline hydraulic capacity and compatibility with cleaning equipment, and SPIROLITE pipe deflected bell-and-spigot joint sealing capability.

There are two components of buried pipe deflection: construction deflection, and service load deflection. Construction deflection occurs during shipping, handling, and placement of the embedment around the pipe. This includes all forces

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acting on the pipe up to the point of backfill placement above the pipe. Service load deflection occurs when backfill is placed above the pipe, and surcharge loads are applied. The deflection observed in a buried pipe after the completion of an installation is the sum of the construction deflection and the service load deflection.

Several methods are available for calculating the flexible pipe deflection due to earth loads and surcharge loads. Historically, Spangler's Iowa formula has been used to find the deflection of plastic pipes. Other methods include closed form solutions, and numerical methods such as finite element solutions. Alternatives to Spangler's equation may give more accurate values, but they usually require more precise information on soil and pipe properties. So, these methods are not as commonly used as Spangler's equation.

Spangler's Modified Iowa Formula can be written for use with SPIROLITE pipe as:

$$\frac{\Delta X}{D_I} = \frac{P_T}{144}\left(\frac{KL}{\dfrac{1.24\,(RSC)}{D_I} + 0.061\,E'}\right) \qquad \textit{(7-35)}$$

PLEXCO pipe as:

$$\frac{\Delta X}{D_M} = \frac{P_T}{144}\left(\frac{KL}{\dfrac{2E}{3}\left(\dfrac{1}{DR-1}\right)^3 + 0.061\,E'}\right) \qquad \textit{(7-36)}$$

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where

ΔX = horizontal deflection, in

K = bedding factor, typically 0.1

L = deflection lag factor

P_T = pipe crown vertical pressure, lb/ft^2

E = elastic modulus, lb/in^2

E′ = soil reaction modulus, lb/in^2

RSC = Ring Stiffness Constant

DR = dimension ratio

D_M = mean diameter, in (Equation (7-25 & 26)

D_I = inside diameter

$$\%DEFLECTION = \frac{\Delta X}{D_I}(100) = \frac{\Delta X}{D_M}(100)$$

Soil Reaction Modulus, E′

The soil reaction modulus is an interactive modulus representing the support or stiffness of the embedment soil in reaction to lateral pipe deflection under load. It is dependent on both soil and pipe properties, so there are no convenient laboratory tests to determine the soil reaction modulus for a given soil.

For the most part the modulus must be determined empirically, that is, it must be found by measuring the deflection of a buried pipe, then substituting that value into Spangler's equation and back-calculating.

Table 7-7 presents soil reaction modulus values from an extensive field study for the Bureau of Reclamation performed by A. Howard. These soil reaction modulus values are commonly used for flexible pipe design.

Howard noted deflection variability along the length of a typical pipeline. To determine maximum deflection, variability should be accommodated by reducing the Table 7-7 E′ value by 25%, or by adding the deflection percentage given in Table 7-7.

As cover depth increases, so does the earth pressure on the embedment material. Both horizontal and vertical pressures exist in a soil mass, but unlike water, these pressures are not normally equal to each other. As the enveloping or confining pressure is increased on a granular material, soil grains are held together more tightly, and the entire system stiffens. J. Hartley and J. Duncan published a study of soil reaction modulus variation with depth. Their recommended soil reaction modulus values are presented in Table 7-8, and should be considered when cover depth is less than 20 feet.

The vertical soil pressure exerted on a buried flexible pipe is typically equal to the Marston load. However, the Howard's Bureau of Reclamation E´ values were based on the assumption that the pipe was subjected to the prism load, which means that the arching is incorporated in the E´ values. When using Table 7-7 or Table 7-8, the prism load should be used.

The soil reaction modulus represents the stiffness of the soil surrounding the pipe. In Tables 7-7 and 7-8, E´ values are

Table 7-7 **Bureau of Reclamation Average Values for E´ for Iowa Formula (Initial Deflection)**

Soil type—pipe bedding material (Unified Classification)[1]	*E´ for Degree of Bedding Compaction, lb/in²*			
	Dumped	*Slight: <85% Proctor, <40% relative density*	*Moderate: 85% - 95% Proctor, 40% - 70% relative density*	*High: >95% Proctor, >70% relative density*
Fine-grained Soils (LL > 50)[2] Soils with medium to high plasticity CH, MH, CH-MH	No data available: consult a competent soils engineer, otherwise, use E´ = 0			
Fine-grained Soils (LL < 50) Soils with medium to no plasticity CL, ML, CL-ML, with less than 25% coarse-grained particles	50	200	400	1000
Fine-grained Soils (LL < 50) Soils with medium to no plasticity CL, ML, CL-ML, with more than 25% coarse-grained particles Coarse-grained Soils with Fines GM, GC, SM, SC[3] contains more than 12% fines	100	400	1000	2000
Coarse-grained Soils with Little or No Fines GW, GP, SW, SP[3] contains less than 12% fines	200	1000	2000	3000
Crushed Rock	1000	3000	3000	3000
Accuracy in Terms of Percentage Deflection[4]	±2%	±2%	±1%	±0.5%

1 ASTM D 2487, USBR Designation E-3
2 LL = Liquid Limit
3 Or any borderline soil beginning with one of these symbols (i.e., GM-GC, GC-SC).
4 For ±1% accuracy and predicted deflection of 3%, actual deflection would be between 2% and 4%.

Note: Values applicable only for fills less than 50 ft (15 m). Table does not include any safety factor. For use in predicting initial deflections only; appropriate Deflection Lag Factor must be applied for long-term deflections. If bedding falls on the borderline between tow compaction categories, select lower E´ value, or average the two values. Percentage Proctor based on laboratory maximum dry density from test standards using 12,500 ft-lb/cu ft (598,000 J/m²) (ASTM D-698, AASHTO T-99, USBR Designation E-11). 1 psi = 6.9 KPa.

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Table 7-8 Duncan-Hartley Soil Reaction Modulus

Type of Soil	*Depth of Cover, ft*	*E′ for Standard AASHTO Relative Compaction, lb/in²*			
		85%	*90%*	*95%*	*100%*
Fine-grained soils with less than 25% sand content (CL, ML, CL-ML)	0 - 5	500	700	1000	1500
	5 - 10	600	1000	1400	2000
	10 - 15	700	1200	1600	2300
	15 - 20	800	1300	1800	2600
Coarse-grained soils with fines (SM, SC)	0 - 5	600	1000	1200	1900
	5 - 10	900	1400	1800	2700
	10 - 15	1000	1500	2100	3200
	15 - 20	1100	1600	2400	3700
Coarse-grained soils with little or no fines (SP, SW, GP, GW)	0 - 5	700	1000	1600	2500
	5 - 10	1000	1500	2200	3300
	10 - 15	1050	1600	2400	3600
	15 - 20	1100	1700	2500	3800

given for the embedment material. However, when the insitu trench soil is highly compressible (marsh clay, peat, saturated organic soils, etc.) compared to the embedment around the pipe, the embedment soil may not develop the E′ values given in the table, and the pipe may deflect more than the design prediction. The effect of highly plastic insitu trench soil may be minimized by increasing the trench width.

Janson recommends the use of the short term pipe elastic modulus value in Spangler's equation. The concept is that soil settlement around the buried pipe occurs in discrete events as soil grains shift or fracture. Once movement occurs, soil arching redistributes the load, and no further deflection occurs for that event. Since these load increments are felt like impulse loads, the pipe resists them with its short term elastic modulus.

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Lag Factor And Long Term Deflection

Long term buried pipe deflection is determined by both pipe and soil properties, as both pipe and soil are subjected to visco-elastic deformations. For a properly installed pipe, soil properties generally prevail.

Visco-elastic deformation can continue forever, but total deformation is typically small. For example, most buildings settle after construction due to soil creep, but rarely does this cause distress. The same is true for most flexible pipe, whether plastic or metal. Visco-elastic deformation typically accounts for only a small percentage of the total deflection of the pipe, and a large portion of this deflection normally occurs within a few weeks after installation.

Research conducted by R. Lytton at Texas A&M University, has shown that for properly installed plastic pipe, long term deflection is controlled principally by the embedment soil.

Spangler recommended addressing visco-elastic effects by using a deflection lag factor in the Iowa Formula. Recommended values range from 1.0 to 1.5.

Lytton and Brown published time factors based on a visco-elastic solution for long term deflection of pipe installed in saturated clay. The ratio of the 50-year deflection to the 30 day (or short term) deflection gave a lag factor of 1.5. Field measurements of HDPE pipe have confirmed values in the same range.

Example 7-12

Estimate the vertical deflection of a SPIROLITE 36" Class 100 installed under 18 feet of cover. The embedment material is a well-graded sandy gravel, compacted to a minimum 90 percent of Standard Proctor density.

Solution: Use the prism load, Equation (7-1) (page 39), Table 7-7, and Equation (7-35). Table 7-7 gives an E′ for a compacted sandy gravel or GW-SW soil as 2000 lb/in^2. To estimate maximum long-term deflection, this value will be reduced by 25%, or to 1500 lb/in^2. (The Duncan-Hartley value in Table 7-8 for this material with 18 ft of cover is 1700 psi.)

The prism load on the pipe is equal to:

$$P_E = (120)(18) = 2160\ lb/ft^2$$

Substituting these values into Equation (7-35) gives:

$$\frac{\Delta X}{D_I} = \frac{2160}{144}\left(\frac{(0.1)(1.5)}{\frac{(1.24)(100)}{36+2(0.58)} + (0.061)(1500)}\right)$$

$$\frac{\Delta X}{D_I} = 0.0237$$

$$\%DEFLECTION = \frac{\Delta X}{D_I}(100) = 2.37$$

Deflection Limits

Pipe deflection is a natural, essential, response to soil loading. Deflection mobilizes passive resistance in the surrounding soil, and promotes arching. Small deflections are desirable, but large deflections should be limited.

SPIROLITE pipe is manufactured to ASTM F 894 which states that profile pipe designed for 7.5% deflection will perform satisfactorily when installed in accordance with ASTM D 2321, and deflection is measured not less than 30 days following installation.

Manufacturing processes differ for SPIROLITE and PLEXCO pipe. Deflection limitations for PLEXCO pipe are controlled by long term material strain.

Ring Bending Strain

As pipe deflects, bending strains occur in the pipe wall. For an elliptically deformed pipe, the pipe wall ring bending strain, ε, can be related to deflection by:

$$\varepsilon = f_D \frac{\Delta Y}{D_M}\frac{2C}{D_M} \qquad \textit{(7-37)}$$

Where terms are previously defined, and:

ε = wall strain, %

f_D = deformation shape factor

D_M = mean diameter, in, (Equations (7-25) + (7-26))

C = outer fiber to wall centroid, in

SPIROLITE Pipe:

$$C = h - z \qquad \textit{(7-38)}$$

PLEXCO Pipe:

$$C = 0.5\,(1.06\,t) \qquad \textit{(7-39)}$$

h = pipe wall height, in

z = pipe wall centroid, in

t = pipe minimum wall thickness, in

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For elliptical deformation, $f_D = 4.28$. However, buried pipe rarely has a perfectly elliptical shape. Irregular deformation can occur from installation forces such as compaction variation alongside the pipe. To account for the non-elliptical shape many designers use $f_D = 6.0$.

Lytton and Chua report that for high performance polyethylene materials such as those used by PLEXCO, 4.2% ring bending strain is a conservative value for non-pressure pipe. Jansen reports that high performance polyethylene material at an 8% strain level has a life expectancy of a least 50 years.

When designing non-pressure heavy wall (< SDR 17) PLEXCO pipe, and high RSC (several hundred) SPIROLITE pipe, the ring bending strain at the predicted deflection should be calculated and compared to the allowable strain.

In pressure pipe, stress from deflection and internal pressure should not exceed the materials long term design stress rating. See Table 7-9, below.

Table 7-9 **Safe Pressure Pipe Deflection**

DR or SDR	*Safe Deflection as % of Diameter*
32.5	8.5
26	7.0
21	6.0
17	5.0
13.5	4.0
11	3.0
9	2.5

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Example 7-13

Find the ring bending strain in the wall of the SPIROLITE 36" Class 100 pipe in Example 7-12.

Solution: Use Equation (7-37) and $f_D = 6.0$. Bulletin No. 910 gives: h = 2.02 in., and z = 0.58 in.

$$\varepsilon = 6\,(0.0237)\,\frac{2.02 - 0.58}{36 + 2\,(0.58)}$$

$$\varepsilon = 0.0055 = 0.55\%$$

The strain is well below the allowable strain of 4.2 percent for profile pipe.

Design Considerations For Shallow Cover Pipe

Pipe installed under shallow cover does not develop a complete soil structure interaction, so design methods must be modified for these installations. The designer should consider the following three cases: (1) flotation due to insufficient soil cover, (2) ring bending due to live load, and (3) upward buckling due to flooding or high groundwater levels.

The exact depth of cover required to develop the full soil structure interaction depends on the particular installation conditions.

Shallow Cover Surcharge Load

The preceding design methods assume that the pipe behaves primarily as a membrane structure, that is, the pipe is almost perfectly flexible with little ability to resist bending.

At depths of cover less than one pipe diameter, this membrane action may not be fully developed. So, an applied surcharge load or live load places a bending load on the pipe crown. For this reason, flexible pipe manufacturers often recommend that pipe be buried at least one pipe diameter below a live load. If this cannot be accomplished, the designer should perform a special analysis to determine if the pipe has adequate beam bending strength.

R. Watkins in "Minimum Soil Cover Required Over Buried Flexible Cylinders" gives a design equation for determining pipe cross sections for shallow cover live load applications. Watkins method is based on the premise that the live load at shallow cover is resisted by a combination of the pipes flexural strength, and the ring resistance of the soil surrounding the pipe. The maximum bending stress occurring in the pipe wall can be found by considering the top half of the pipe as a pinned end arch.

For Plexco/Spirolite pipe, Watkins analysis should be used only where the depth of cover is greater than one-half of the pipe diameter and the pipe is installed at least 18 inches deep. For lesser cover depths, a reinforced concrete cap should be considered.

Based on Watkins analysis the live load pressure on the pipe, P_L, should not exceed the upper limit given in Equation (7-40).

$$P_L \leq \frac{12\,w\,(KH)^2}{N\,D_0} + \frac{7387.2\,(I)}{N\,D_0^{\,2}\,C}\left(S - \frac{w\,D_0\,H}{288\,A}\right) \qquad \textit{(7-40)}$$

where

w = unit weight of soil, lb/ft^2

D_0 = pipe outside diameter, in

H = cover height, ft

I = pipe wall moment of inertia, in^4/in

A = pipe wall area in^2/in

C = outer fiber to wall centroid, in (Equations 7-38 and 7-39, page 65)

S = material yield strength, lb/in^2

N = safety factor

K = passive earth pressure coefficient

$$K = \frac{1 + SIN\,(\phi)}{1 - SIN\,(\phi)} \qquad \textit{(7-41)}$$

ϕ = angle of internal friction, deg

Watkins developed Equation (7-40) using a load applied to a part of the pipe crown, so any surcharge load should be determined using a point load method, rather than a distributed load method.

A design safety factor of at least 2 should be applied.

In addition to the pipe bending check with Watkins formula, the designer should check pipe wall compressive stress, and pipe wall buckling due to the live load stress. When a pipe is installed with shallow cover below an unpaved surface, rutting can occur which will not only reduce cover depth, but also increase the impact factor. State highway authorities commonly set the minimum cover depth under below pavement. This cover depth varies by State, but is usually 2.5 to 5 ft.

Shallow Cover Buckling

The buckling resistance of a buried pipe increases with increasing cover depth, because the surrounding soil is stiffened by the increase in overburden pressure. However, a different buckling mechanism may occur when pipe is located near the surface.

Groundwater or flooding may apply an external pressure on the pipe, and result in upward buckling, that is the sides of the pipe deflect inward (negative horizontal deflection) and the crown deflects upward. This mechanism is possible when cover depth is insufficient to restrain upward crown movement, and when the pipe is empty or partially full.

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Shallow cover may not be sufficient for complete development of soil support. AWWA C-950 suggests that a minimum cover of four feet is required, however, larger diameter pipe may require as much as a diameter and a half to develop full support.

Shallow cover buckling may also occur if the pipe can float slightly upward and lose contact with the embedment material below its springline.

Shallow cover deserves special design attention. A conservative design alternative is to assume no soil support, and design using unconstrained pipe wall buckling methods. A concrete cap, sufficient to resist upward deflection, may also be placed over the pipe.

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Source 1: CPChem, The Performance Pipe Engineering Manual
Book 2, Chapter 5: Thermal Effects
2002

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Table 5-1 **Typical Elastic Modulus, 10^3 psi**
Nominal values based on ASTM D 638 testing of molded material specimens.

Plexco/Spirolite PE 3408								
Duration	Temperature, °F							
	-20	0	40	60	73	100	120	140
Short Term	300.0	260.0	170.0	130.0	110.0	100.0	65.0	50.0
10 h	140.8	122.0	79.8	61.0	57.5	46.9	30.5	23.5
100 h	125.4	108.7	71.0	54.3	51.2	41.8	27.2	20.9
1000 h	107.0	92.8	60.7	46.4	43.7	35.7	23.2	17.8
1 y	93.0	80.6	52.7	40.3	38.0	31.0	20.2	15.5
10 y	77.4	67.1	43.9	33.5	31.6	25.8	16.8	12.9
50 y	69.1	59.9	39.1	29.9	28.2	23.0	15.0	11.5

→ 23.0×10^3 psi = 23,000 psi

- ❑ Lateral deflection expansion loops (snaking the pipe)
- ❑ Anchor and guide the pipe
- ❑ Conventional Expansion loops
- ❑ Expansion joints
- ❑ Burying pipes

Lateral Deflection Expansion Loops

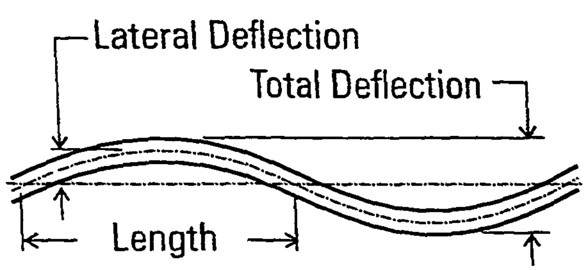
The simplest installation involves stringing pipe between end point anchor structures. If the pipe is simply laid in a straight line between the end anchors then (1) the pipeline anchoring structures must be capable of handling potentially high thermal contraction thrust loads during temperature decrease, and (2) during temperature increase, the maximum compressive thrust is the force required to cause lateral deflection at which time the compressive stress and end thrust would then decrease. To minimize these loads, pipe may be pre-snaked during installation.

Snaked piping installations are also referred to as lateral deflection expansion loops. These loops can be used for PLEXCO piping systems which are laid on the surface, supported or suspended above grade on hangers or in racks, or installed underwater, but not buried.

An effective flexible pipe expansion loop system employs the pipe's natural tendency to deflect laterally, and its high strain tolerance. Lateral deflection expansion loops are recurrent "S-curves" (snaking) along the piping runs that provide an initial lateral deflection, and allow pipe temperature changes to result in greater or lesser lateral deflection.

Surface and rack supported pipe systems designed with lateral deflection expansion loops must provide sufficient width allowance for lateral pipe deflection. The

Figure 5-1 **Lateral Deflection**



Information on this page rev. 10/97—supersedes all previous issues.

FOUNDATIONS DESIGN PRINCIPLES AND PRACTICES
DONALD P. Coduto 2nd Edition

Source 2
1/2

7.3 INDUCED STRESSES BENEATH SHALLOW FOUNDATIONS

The bearing pressure from shallow foundations induces a vertical compressive stress in the underlying soils. We call this stress $\Delta\sigma_z$, because it is the change in stress that is superimposed on the initial vertical stress:

$$\boxed{\Delta\sigma_z = I_\sigma(q - \sigma'_{zD})} \tag{7.3}$$

Where:

$\Delta\sigma_z$ = induced vertical stress due to load from foundation
I_σ = stress influence factor
q = bearing pressure along bottom of foundation
σ_{zD}' = vertical effective stress at a depth D below the ground surface

The q term reflects the increase in vertical stress caused by the applied structural load and the weight of the foundation, while the σ_{zD}' term reflects the reduction in vertical stress caused by excavation of soil to build the foundation. Thus, $\Delta\sigma_z$ reflects the net result of these two effects.

Immediately beneath the foundation, the applied load is distributed across the base area of the foundation, so $I_\sigma = 1$. However, as the load propagates through the ground, it is spread over an increasingly larger area, so $\Delta\sigma_z$ and I_σ decrease with depth, as shown in Figure 7.2.

Boussinesq's Method

Boussinesq (1885) developed the classic solution for induced stresses in an elastic material due to an applied point load. Newmark (1935) then integrated the Boussinesq equation to produce a solution for I_σ at a depth z_f beneath the corner of a rectangular foundation of width B and length L, as shown in Figure 7.3. This solution produces the following two equations:

If $B^2 + L^2 + z_f^2 < B^2L^2/z_f^2$:

$$\boxed{I_\sigma = \frac{1}{4\pi}\left[\left(\frac{2BLz_f\sqrt{B^2+L^2+z_f^2}}{z_f^2(B^2+L^2+z_f^2)+B^2L^2}\right)\left(\frac{B^2+L^2+2z_f^2}{B^2+L^2+z_f^2}\right) + \pi - \sin^{-1}\frac{2BLz_f\sqrt{B^2+L^2+z_f^2}}{z_f^2(B^2+L^2+z_f^2)+B^2L^2}\right]} \tag{7.4}$$

Otherwise:

$$\boxed{I_\sigma = \frac{1}{4\pi}\left[\left(\frac{2BLz_f\sqrt{B^2+L^2+z_f^2}}{z_f^2(B^2+L^2+z_f^2)+B^2L^2}\right)\left(\frac{B^2+L^2+2z_f^2}{B^2+L^2+z_f^2}\right) + \sin^{-1}\frac{2BLz_f\sqrt{B^2+L^2+z_f^2}}{z_f^2(B^2+L^2+z_f^2)+B^2L^2}\right]} \tag{7.5}$$

Source 2
2/2

7.3 Induc

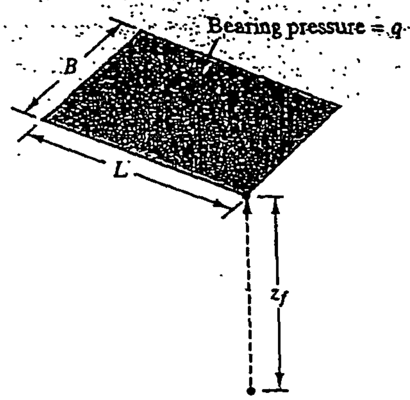


Figure 7.3. Newmark's solution for induced vertical stress beneath the corner of a rectangular footing.

where:

I_σ = strain influence factor at a point beneath the corner of a rectangular foundation
B = width of the foundation
L = length of the foundation
z_f = vertical distance from the bottom of the foundation to the point (always > 0)
q = bearing pressure

Notes:

1. The $\sin^{-1}$ term must be expressed in radians.
2. Newmark's solution is often presented as a single equation with a $\tan^{-1}$ term, but that equation is incorrect when $B^2 + L^2 + z_f^2 < B^2L^2/z_f^2$.
3. It is customary to use B as the shorter dimension and L as the longer dimension, as shown in Figure 7.3.

Example 7.1

A 1.2 m × 1.2 m square footing supports a column load of 250 kN. The bottom of this footing is 0.3 m below the ground surface, the groundwater table is at a great depth, and the unit weight of the soil is 19.0 kN/m³. Compute the induced vertical stress, $\Delta\sigma_z$, at a point 1.5 m below the corner of this footing.

Solution

Unless stated otherwise, we can assume the top of this footing is essentially flush with the ground surface.

$$\sigma'_{zD} = \gamma D - u = (19.0\ \text{kN/m}^3)(0.3\ \text{m}) - 0 = 6\ \text{kPa}$$

$$W_f = (1.2\ \text{m})(1.2\ \text{m})(0.3\ \text{m})(23.6\ \text{kN/m}^3) = 10\ \text{kN}$$

Figure 7.4
superpositi

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where E = modulus of elasticity, lb/in^2
I = moment of inertia of the wall cross-section per unit length of pipe, $in^4/in = in^3$
r = mean radius of pipe, in
D = mean diameter of pipe, in
F = force, lb/in
Δy = vertical deflection, in

The most commonly used terminology is pipe stiffness ($F/\Delta y$). For a given pipe product, this term is readily determined in the laboratory by a parallel plate loading test. In this test, a pipe sample is placed between two horizontal parallel plates in a testing machine. A compressive load is applied and increased until the vertical deflection (Δy) reaches 5 percent of the diameter. $F/\Delta y$ is the load at 5 percent divided by the sample length and divided by the vertical deflection Δy. Typical units for $F/\Delta y$ are lb/in^2. This is evident from the third equation in the above table as it is clear that $F/\Delta y$ has the same units as the modulus of elasticity (E).

In summary, the three most important parameters for flexible pipe analysis and design are (1) load, (2) soil stiffness, and (3) pipe stiffness. Any design method that does not include a consideration of these three parameters is incomplete.

For a flexible pipe, vertical deflection is the variable that must be controlled by proper installation design. This deflection is a function of the three parameters discussed above.

Spangler's Iowa formula

M. G. Spangler, a student of Anson Marston, observed that the Marston theory for calculating loads on buried pipe was not adequate for flexible pipe design. Spangler noted that flexible pipes provide little inherent stiffness in comparison to rigid pipes, yet they perform remarkably well when buried in soil. This significant ability of a flexible pipe to support vertical soil loads is derived from (1) the redistribution of loads around the pipe, and (2) the passive pressures induced as the sides of the pipe move outward against the surrounding earth. These considerations, coupled with the idea that the ring deflection may form a basis for flexible pipe design, prompted M. G. Spangler to study flexible pipe behavior to determine an adequate design procedure. His research and testing led to the derivation of the Iowa formula which he published in 1941.[22]

Spangler incorporated the effects of the surrounding soil on the pipe's deflection. This was accomplished by assuming that Marston's theory of loads applied, and that this load would be uniformly distrib-

Source No 3
"Buried Pipe Design
A.P. Moser
ISBN 0-07-043490-

uted at the plane at the top of the pipe. He also assumed a uniform pressure over part of the bottom, depending upon the bedding angle. On the sides, he assumed the horizontal pressure h on each side would be proportional to the deflection of the pipe into the soil. The constant of proportionality was defined as shown in Fig. 3.5 and was called the modulus of passive resistance of the soil. The modulus would presumably be a constant for a given soil and could be measured in a simple lab test. Through analysis he derived the Iowa formula as follows:

$$\Delta X = \frac{D_L K W_c r^3}{EI + 0.061 e r^4} \tag{3.4}$$

where D_L = deflection lag factor
K = bedding constant
W_c = Marston's load per unit length of pipe, lb/in
r = mean radius of the pipe, in
E = modulus of elasticity of the pipe material, lb/in^2
I = moment of inertia of the pipe wall per unit length, in^4/in = in^3
e = modulus of passive resistance of the side fill, lb/(in^2)(in)
ΔX = horizontal deflection or change in diameter, in

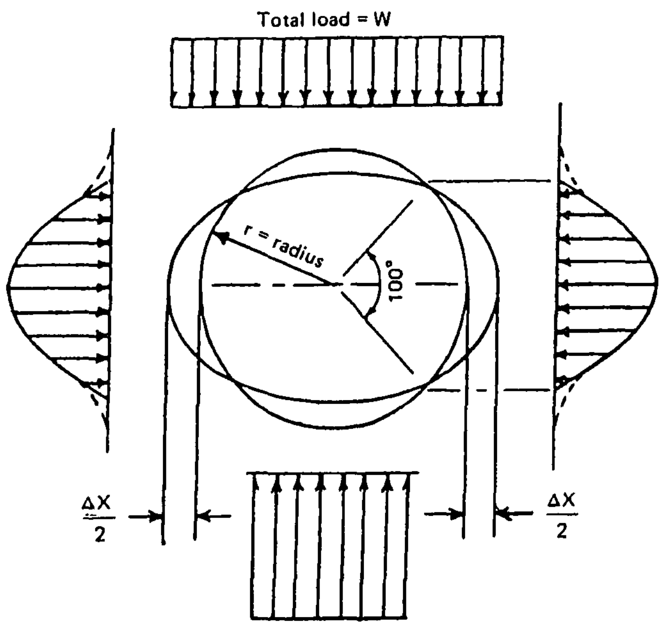

Figure 3.5 Basis of Spangler's derivation of the Iowa formula for deflection of buried pipes. [$\Delta X = D_L K W_c r^3/(EI + 0.061 e r^4)$ (the Iowa formula); where $e = 2h/\Delta X$; $2r = D$ = pipe diameter; K = Bedding constant; D_L = Deflection lag factor; and EI = Stiffness factor (related to pipe stiffness).] *(Reprinted*

Equation (3.4) can be used to predict deflections of buried pipe if the three empirical constants K, D_L, and e are known. The bedding constant, K, accommodates the response of the buried flexible pipe to the opposite and equal reaction to the load force derived from the bedding under the pipe. The bedding constant varies with the width and angle of the bedding achieved in the installation. The bedding angle is shown in Fig. 3.6. Table 3.3 contains a list of bedding factors, K, dependent upon the bedding angle. These were determined theoretically by Spangler and published in 1941. As a general rule, a value of $K = 0.1$ is assumed.

In 1958, Reynold K. Watkins, a graduate student of Spangler, was investigating the modulus of passive resistance through model studies and examined the Iowa formula dimensionally.[31] The analysis determined that e could not possibly be a true property of the soil in that its dimensions are not those of a true modulus. As a result of Watkins' effort, another soil parameter was defined. This was the modulus of soil reaction, $E' = er$. Consequently, a new formula called the modified Iowa formula was proposed.

$$\Delta X = \frac{D_L K W_c r^3}{EI + 0.061 E' r^3} \tag{3.5}$$

Two other observations from Watkins' work are of particular note. (1) There is little point in evaluating E' by a model test and then using this modulus to predict ring deflection as the model gives ring deflection directly. (2) Ring deflection may not be the only performance limit.

Another parameter in the Iowa formula, needed to calculate deflections, is the deflection lag factor D_L. Spangler recognized that in soil-pipe systems, as with all engineering systems involving soil, the soil consolidation at the sides of the pipe continues with time after installation of the pipe. His experience had shown that deflections could increase by as much as 30 percent over a period of 40 years. For this reason, he recommended the incorporation of a deflection lag factor of

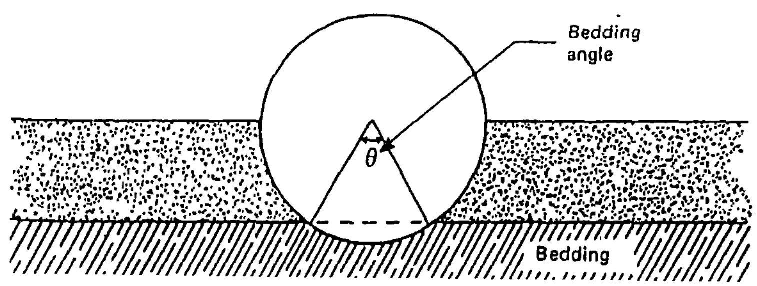

TABLE 3.3 Values of Bedding Constant, K

Bedding angle, degrees	K
0	0.110
30	0.108
45	0.105
60	0.102
90	0.096
120	0.090
180	0.083

1.5 as a conservative design procedure. However, recall that the load proposed by Spangler was the Marston load for a flexible pipe. For most sewer pipe installations the prism load is at least 1.5 times greater than the Marston load (see Chap. 2 for soil loads on pipe). If the prism load is used for design, a design deflection lag factor $D_L = 1.0$ should be used.

The remaining parameter in the modified Iowa formula is the soil modulus E'. Many research efforts have attempted to measure E' without success. The most useful method has involved the measurement of deflections of a buried pipe for which installation conditions are known, followed by a back calculation through the Iowa formula to determine the effective value of E'. This requires assumed values for the load, the bedding factor, and the deflection lag factor. Inconsistent assumptions have led to a variation in reported values of E'.

One attempt to acquire information on values of E' was conducted by Amster K. Howard of the United States Bureau of Reclamation.[5] Howard used data from laboratory and field tests to compile a table of average E' values for various soil types and densities (see Table 3.4). He assigned values to E', K, and W_c and then used the Iowa formula to calculate a theoretical value of deflection. This theoretical deflection was then compared with actual measurements. By assuming the E' values of Table 3.4 and a bedding constant $K = 0.1$, Howard was able to correlate the theoretical and empirical results to within ± 2 percent deflection when he used the prism soil load. This means that if theoretical deflections using Table 3.4 were approximately 5 percent, measured deflections would range between 3 and 7 percent. Mr. Howard is reported to have used a deflection lag factor $D_L = 1.5$ in his calculations. However if the prism load was used as reported, a lag factor $D_L = 1.0$ would have to have been used to be theoretically correct. In any case, the data in Table 3.4 is consistent with field and laboratory data taken over a 20-year period at Utah State University if the prism load is used along with a value of 1.0 for the deflection lag factor. Although the vast majority of data from Howard's study we[illegible]aken from tests on steel and reinforced plastic mortar pipe with d[illegible]ters greater than 24 in, it does provide some useful information t[illegible]uide

TABLE 3.4 Average Values of Modulus of Soil Reaction, E' (For Initial Flexible Pipe Deflection)

Soil type-pipe bedding material (Unified Classification System*)	E' for degree of compaction of bedding, lb/in^2			
	Dumped	Slight, < 85% proctor, < 40% relative density	Moderate, 85%–95% proctor, 40%–70% relative density	High, >95% proctor, > 70% relative density
Fine-grained soils (LL > 50)† Soils with medium to high plasticity CH, MH, CH-MH	No data available; consult a competent soils engineer; Otherwise use $E' = 0$			
Fine-grained soils (LL < 50) Soils with medium to no plasticity CL, ML, ML-CL, with less than 25% coarse-grained particles	50	200	400	1000
Fine-grained soils (LL < 50) Soils with medium to no plasticity CL, ML, ML-CL, with more than 25% coarse-grained particles Coarse-grained soils with fines GM, GC, SM, SC contains more than 12% fines	100	400	1000	2000
Coarse-grained soils with little or no fines GW, GP, SW, SP‡ contains less than 12% fines	200	1000	2000	3000
Crushed rock	1000	3000	3000	3000
Accuracy in terms of percentage deflection§	± 2	± 2	± 1	± 0.5

*ASTM Designation D2487, USBR Designation E-3

†LL = liquid Limit

‡Or any borderline soil beginning with one of these symbols (i.e., GM-GC, GC-SC)

§For ± 1% accuracy and predicted deflection of 3%, actual deflection would be between 2% and 4%.

NOTE: Values applicable only for fills less than 50 ft (15 m). Table does not include any safety factor. For use in predicting initial deflections only, appropriate deflection lag factor must be applied for long-term deflections. If bedding falls on the borderline between two compaction categories, select lower E' value or average the two values. Percentage proctor based on laboratory maximum dry density from test standards using about 12,500 ft-lb/ft^3 (598,000 J/m^3) (ASTM D698, AASHO T-99, USBR Designation E-11). 1 lb/in^2 = 6.9 kN/m^2.

SOURCE: Amster K. Howard, "Soil Reaction for Buried Flexible Pipe," U.S. Bureau of Reclamation, Denver, Colo. Reprinted with Permission from American Society of Civil Engineers *J. Geotech. Eng. Div.*, January 1977, pp. 33–43.

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Braja M. Das

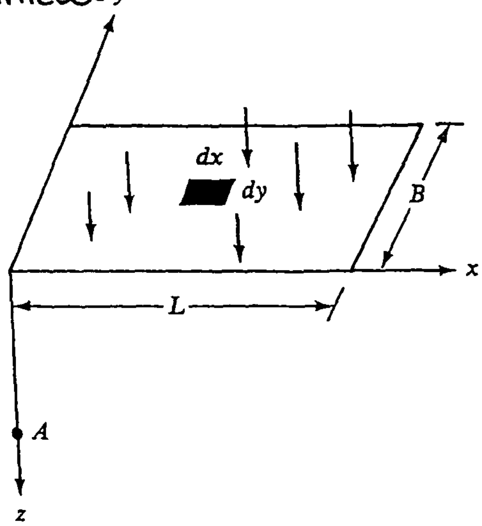

Figure 6.15 Vertical stress below the corner of a uniformly loaded flexible rectangular area

Uniform

where

$$I_2 = \frac{1}{4\pi}\left[\frac{2mn\sqrt{m^2+n^2+1}}{m^2+n^2+m^2n^2+1}\left(\frac{m^2+n^2+2}{m^2+n^2+1}\right) + \tan^{-1}\left(\frac{2mn\sqrt{m^2+n^2+1}}{m^2+n^2-m^2n^2+1}\right)\right] \quad (6.24)$$

$$m = \frac{B}{z} \quad (6.25)$$

$$n = \frac{L}{z} \quad (6.26)$$

The variation of I_2 with m and n is shown in Figure 6.16.

The increase of stress at any point below a rectangularly loaded area can be found by using Eq. (6.23) and Figure 6.16. This can be explained by reference to Figure 6.17. Let us determine the stress at a point below point A' at depth z. The loaded area can be divided into four rectangles as shown. The point A' is the corner common to all four rectangles. The increase of stress at depth z below point A' due to each rectangular area can now be calculated by using Eq. (6.23). The total stress increase due to the entire loaded area can now be given as

$$p = q[I_{2(1)} + I_{2(2)} + I_{2(3)} + I_{2(4)}] \quad (6.27)$$

where $I_{2(1)}$, $I_{2(2)}$, $I_{2(3)}$, and $I_{2(4)}$ = values of I_2 for rectangles 1, 2, 3, and 4, respectively

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$dx\,dy$ and r^2 with

(6.22)

area can now be

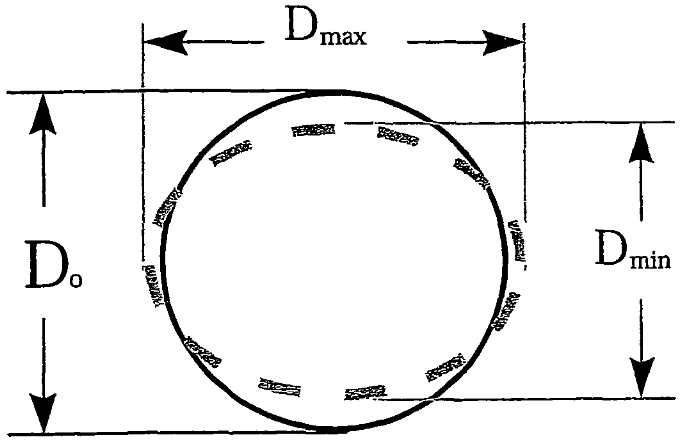
(6.23)

TABLE 15: ALLOWABLE RING DEFLECTION OF DRISCOPIPE® POLYETHYLENE PIPE BASED UPON DR

DR	Allowable Ring Deflection
32.5	8.1%
26	6.5%
21	5.2%
19	4.7%
17	4.2%
15.5	3.9%
13.5	3.4%
11	2.7%

The allowable ring deflection of polyethylene pipe is limited to create no more than 1 to 1.5% tangential strain in the outer surface of the pipe wall. As the wall of a pipe becomes thicker (a "lower" DR value), the distance from the neutral axis to the outer surface increases. As a result, less deflection is required to create the allowable tangential strain. Deflection of the pipe-soil system is controlled by proper specification of the backfill compaction.

FIGURE 8: CALCULATING RING DEFLECTION



$$\%\,RingDeflection = \left(1 - \frac{D_{min}}{D_o}\right) \times 100\%$$

The percentage ring deflection based upon strain for a given DR pipe can be calculated as follows:

$$\frac{\Delta Y}{D} = (0.25)(\varepsilon)(SDR)$$

Source 5. EPA, Lining of Waste Impoundment and Disposal Facilities, SW-870

be small compared to the pressure due to the fill, the vertical pressure on the top of the pipe can be assumed to be equal to the unit weight of the refuse fill multiplied by the distance from top of fill to top of pipe, thus:

$$\sigma_v = (\omega_f)(H_f).$$

V.2.2.3 Perforated Pipe

Perforations will reduce the effective length of pipe available to carry loads and resist deflection. The effect of perforations can be taken into account by using an increased load per nominal unit length of the pipe. If l_p equals the cumulative length in inches of perforations per foot of pipe, the increased vertical stress to be used equals:

$$\boxed{(\sigma_v)_{design} = \frac{12}{12-l_p} \times (\sigma_v)_{actual}}$$

V.2.3 Deflection

A well accepted formula for calculating flexible pipe deflection under earth loading is that developed by Spangler. This equation, also known as the Iowa formula, is presented together with suggested values for its various constants in the 1970 edition of the American Society of Civil Engineers (ASCE) Manual of Practice, No. 37, Chapter 9, Section E, Subsection 1, and is as follows:

$$\Delta y = D_e \frac{KWr^3}{EI + 0.061\, E'r^3}$$

where:

Δy = horizontal and vertical deflection of the pipe (in)

D_e = a factor, generally taken at a conservative value of 1.5, compensating for the lag or time dependent behavior of the soil/pipe systems (dimensionless)

W = vertical load acting on the pipe per unit of pipe length (lb/in)

r = mean radius of the pipe (in)

E = modulus of elasticity of the pipe materials (psi)

E' = modulus of passive soil resistance (psi) (normally estimated to be 300 psi for soils of Proctor density of 65%, and 700 psi for soils of Proctor density of at least 90%)

ATTACHMENT O-3 (Revised)

LANDFILL GAS GENERATION ESTIMATE

ATTACHMENT O-3. LANDFILL GAS GENERATION ESTIMATE

Citrus County Central Landfill - Lecanto, Florida

Year	Disposal Rate (tons/yr)	Refuse In-Place (tons)	LFG Generation (scfm)	LFG Generation (mmcf/day)	LFG Generation (mmBtu/yr)	Collection System Efficiency (%)	LFG Recovery from Planned System (scfm)	LFG Recovery from Planned System (mmcf/day)	LFG Recovery from Planned System (mmBtu/yr)
1991	43,390	43,390	0	0.0	0	0%	0	0.0	0
1992	60,791	104,181	21	0.0	5,539	0%	0	0.0	0
1993	64,197	168,378	49	0.1	13,083	0%	0	0.0	0
1994	58,435	226,813	78	0.1	20,765	0%	0	0.0	0
1995	60,046	286,859	103	0.1	27,411	0%	0	0.0	0
1996	54,500	341,359	128	0.2	34,002	0%	0	0.0	0
1997	37,070	378,429	149	0.2	39,626	0%	0	0.0	0
1998	58,548	436,977	161	0.2	42,805	0%	0	0.0	0
1999	73,491	510,468	183	0.3	48,601	0%	0	0.0	0
2000	80,873	591,341	211	0.3	56,077	0%	0	0.0	0
2001	83,358	674,699	241	0.3	64,203	0%	0	0.0	0
2002	91,436	766,135	272	0.4	72,327	0%	0	0.0	0
2003	93,523	859,658	305	0.4	81,164	0%	0	0.0	0
2004	97,662	957,320	338	0.5	89,920	0%	0	0.0	0
2005	105,000	1,062,320	372	0.5	98,862	0%	0	0.0	0
2006	109,200	1,171,520	408	0.6	108,390	0%	0	0.0	0
2007	113,568	1,285,088	444	0.6	118,081	0%	0	0.0	0
2008	118,111	1,403,199	481	0.7	127,949	70%	337	9.5	89,564
2009	113,360	1,516,559	519	0.7	138,010	70%	363	10.3	96,607
2010	58,947	1,575,506	553	0.8	147,071	70%	387	11.0	102,949
2011	61,305	1,636,811	560	0.8	148,829	70%	392	11.1	104,180
2012	63,757	1,700,568	567	0.8	150,820	70%	397	11.2	105,574
2013	66,308	1,766,876	575	0.8	153,045	70%	403	11.4	107,132
2014	68,960	1,835,836	585	0.8	155,509	70%	409	11.6	108,857
2015	71,718	1,907,554	595	0.9	158,215	70%	416	11.8	110,751
2016	74,587	1,982,141	606	0.9	161,167	70%	424	12.0	112,817
2017	77,570	2,059,712	618	0.9	164,370	70%	433	12.3	115,059
2018	80,673	2,140,385	631	0.9	167,827	70%	442	12.5	117,479
2019	83,900	2,224,285	645	0.9	171,546	70%	452	12.8	120,082
2020	87,256	2,311,541	660	1.0	175,530	70%	462	13.1	122,871

Notes:

1. Default values for k and Lo were taken from U.S. EPA's *Compilation of Air Pollutant Emission Factors*, which is commonly known as AP-42.
2. Model prepared by SCS Engineers, Tampa, Florida (831-621-0080).

Methane Content of LFG Adjusted to:	50%	
Selected Decay Rate Constant (k):	0.04 1/yr	(per AP-42)
Selected Ultimate Methane Recovery Rate (Lo):	3,204 cu ft/ton	(per AP-42)

No. 56065
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Attachment - 1
of Attachment O-3

objects. The average annual acceptance rate should only be estimated by this method when there is inadequate information available on the actual average acceptance rate. The time variable, t, includes the total number of years that the refuse has been in place (including the number of years that the landfill has accepted waste and, if applicable, has been closed).

Values for variables L_0 and k must be estimated. Estimation of the potential CH_4 generation capacity of refuse (L_0) is generally treated as a function of the moisture and organic content of the refuse. Estimation of the CH_4 generation constant (k) is a function of a variety of factors, including moisture, pH, temperature, and other environmental factors, and landfill operating conditions. Specific CH_4 generation constants can be computed by the use of EPA Method 2E (40 CFR Part 60 Appendix A).

The Landfill Air Emission Estimation model includes both regulatory default values and recommended AP-42 default values for L_0 and k. The regulatory defaults were developed for compliance purposes (NSPS/Emission Guideline). As a result, the model contains conservative L_0 and k default values in order to protect human health, to encompass a wide range of landfills, and to encourage the use of site-specific data. Therefore, different L_0 and k values may be appropriate in estimating landfill emissions for particular landfills and for use in an emissions inventory.

Recommended AP-42 defaults include a k value of 0.04/yr for areas recieving 25 inches or more of rain per year. A default k of 0.02/yr should be used in drier areas (<25 inches/yr). An L_0 value of 100 m^3/Mg
3,204 (~~3,530~~ ft^3/ton) refuse is appropriate for most landfills. Although the recommended default k and L_0 are based upon the best fit to 21 different landfills, the predicted methane emissions ranged from 38 to 492% of actual, and had a relative standard deviation of 0.85. It should be emphasized that in order to comply with the NSPS/Emission Guideline, the regulatory defaults for k and L_0 must be applied as specified in the final rule.

When gas generation reaches steady state conditions, LFG consists of approximately 40 percent by volume CO_2, 55 percent CH_4, 5 percent N_2 (and other gases), and trace amounts of NMOCs. Therefore, the estimate derived for CH_4 generation using the Landfill Air Emissions Estimation model can also be used to represent CO_2 generation. Addition of the CH_4 and CO_2 emissions will yield an estimate of total landfill gas emissions. If site-specific information is available to suggest that the CH_4 content of landfill gas is not 55 percent, then the site-specific information should be used, and the CO_2 emission estimate should be adjusted accordingly.

Most of the NMOC emissions result from the volatilization of organic compounds contained in the landfilled waste. Small amounts may be created by biological processes and chemical reactions within the landfill. The current version of the Landfill Air Emissions Estimation model contains a proposed regulatory default value for total NMOC of 4,000 ppmv, expressed as hexane. However, available data show that there is a range of over 4,400 ppmv for total NMOC values from landfills. The proposed regulatory default value for NMOC concentration was developed for regulatory compliance purposes and to provide the most cost-effective default values on a national basis. For emissions inventory purposes, site-specific information should be taken into account when determining the total NMOC concentration. In the absence of site-specific information, a value of 2,420 ppmv as hexane is suggested for landfills known to have co-disposal of MSW and non-residential waste. If the landfill is known to contain only MSW or have very little organic commercial/industrial wastes, then a total NMOC value of 595 ppmv as hexane should be used. In addition, as with the landfill model defaults, the regulatory default value for NMOC content must be used in order to comply with the NSPS/Emission Guideline.

If a site-specific total pollutant concentration is available (i.e., as measured by EPA Reference Method 25C), it must be corrected for air infiltration which can occur by two different mechanisms: LFG sample dilution, and air intrusion into the landfill. These corrections require site-specific data for the LFG CH_4,

Environmental Consultants

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SCS ENGINEERS

June 29, 2006
File No. 09204067.04

Ms. Susan J. Metcalfe, P.G., Director
Solid Waste Management Division
Citrus County Department of Public Works
P.O. Box 340
Lecanto, Florida 34460

Subject: New Source Performance Standards (NSPS) Tier 2 Sampling and Non-Methane Organic Compound Emission Estimate Report Central Landfill, Citrus County, Florida

Dear Susie:

SCS Engineers (SCS) is pleased to submit the NSPS Tier 2 non-methane organic compound (NMOC) emission report for the Central Landfill. This letter report presents the results of the Tier 2 sampling activities conducted in May 2006, and the Tier 2 estimate of the NMOC emissions from the landfill. The Tier 2 landfill gas (LFG) sampling was performed to establish a site-specific NMOC concentration in the LFG for use in determining the applicability of the NSPS to LFG collection at the landfill. The sample collection and analyses were conducted in accordance with the requirements of the NSPS for Municipal Solid Waste Landfills as published in Title 40 of the Code of Federal Regulations Part 60 (40 CFR Part 60), Subpart WWW.

BACKGROUND

The Central Landfill is a municipal solid waste (MSW) landfill that covers approximately 80 acres and consists of several closed landfill cells and a geomembrane-lined active landfill. The active landfill consists of Phases 1, 1A, and 2. Landfill areas where waste has been in place for at least two years include all of the closed landfill cells and Phases 1 and 1A. Therefore, these areas are subject to Tier 2 sampling per 40 CFR 60.754(a)(3). Refer to Attachment A for a figure of the landfill facility and Tier 2 sampling locations.

FIELD SAMPLING ACTIVITIES

Sampling activities were conducted from May 10 through 12, 2006, according to the pilot probe procedure outlined in U.S. EPA Method 25C, and as described in the Tier 2 sampling protocol which was submitted to FDEP on May 3, 2006. As stated in the sampling protocol, which is included in Attachment B, samples were collected from all areas of the landfill where the initial waste had been in place for at least two years. The sampling frequency was one probe for approximately every 1.6 acres. Attachment A, Figure 1 shows a site plan with the approximate probe locations.

SCS used a composite sampling method as allowed under 40 CFR 60.574(a)(3). Landfill gas samples were obtained from 50 locations as shown on the site plan. The samples were collected from existing passive vents and installed pilot probes. The composite sampling method resulted in 50 samples collected into 12 pre-evacuated stainless-steel SUMMA canisters. The field sampling forms are included in Attachment C.

Existing Passive Vents

In order to avoid installing probes through the closed landfill geomembrane cap in the closed areas, SCS utilized 34 existing passive vents as sampling locations. Monitoring ports were installed and each vent was capped prior to sampling in order to prevent air infiltration into the sampling train as described in the sampling protocol, located in Attachment B.

Pilot Probes

Pilot probes were installed in the active landfill and along the pyramid-shaped area of the closed landfill, which does not have a geomembrane cap. The sample probe depths ranged from 5 to 6 feet below the landfill surface.

SCS also used the pilot probe procedure at sample location 38P, which corresponds to vent V-27. While attempting to sample from this vent, SCS recorded an oxygen concentration greater than 5 percent by volume. SCS removed the gooseneck fitting to investigate the downhole conditions and found that the vent was filled with soil. Therefore, the direct-push drilling rig was set up over the vent and a pilot probe was installed through the soil within the vent pipe. After purging the probe, the oxygen concentration was below 5 percent and a sample was collected.

SUMMARY OF LABORATORY ANALYSIS RESULTS

Air Technology Laboratories, Inc. (ATL) analyzed each canister according to U.S. EPA Method 25C for NMOC and Method 3C for nitrogen and oxygen concentration. The NMOC concentrations measured by the laboratory were presented in units of parts per million by volume (ppmv) as carbon. ATL provided corrected NMOC concentrations based on sample temperature and barometric pressure at the time of sampling, moisture content, and nitrogen concentration within the sample. These results are shown in Tables 1 and 2 below, and the analytical results are included in Attachment D.

TABLE 1. TIER 2 SAMPLING ANALYTICAL RESULTS CLOSED LANDFILL CELLS

Canister No.	NMOC (ppmv-carbon)	NMOC (ppmv-hexane)	No. Samples Per Canister	Weighted NMOC (ppmv-hexane)
CCLF-1416	390	65	5	325
CCLF-1371	340	57	4	228
CCLF-1426	340	57	4	228
CCLF-3555	360	60	4	240
CCLF-1422	380	63	4	252
CCLF-1382	500	83	4	332
CCLF-3650	560	93	6	558
CCLF-3558	600	100	4	400
CCLF-1451*	--	--	--	--
Totals	3,470	578	35	2,563
Weighted Average Concentration				73

Note: Canister CCLF – 1451, which contained three samples from locations 36P, 37P, and 38P, appears to have leaked during shipment; the analysis showed the canister contained approximately 17 percent oxygen upon arrival at the laboratory. Therefore, this canister is considered invalid and the results of its analysis are not included in the NMOC emission rate calculation.

For each canister, the NMOC concentration was converted from ppmv as carbon to ppmv as hexane by dividing by a factor of 6. Because the canisters contained different numbers of samples, SCS calculated the weighted average NMOC concentrations for the closed and active landfills for use in the Tier 2 calculations. This resulted in a NMOC concentration of 73 ppmv as hexane for the closed landfill and 268 ppmv as hexane for the active landfill.

TABLE 2. TIER 2 SAMPLING ANALYTICAL RESULTS ACTIVE LANDFILL

Canister No.	NMOC (ppmv-carbon)	NMOC (ppmv-hexane)	No. Samples Per Canister	Weighted NMOC (ppmv-hexane)
CCLF-3617A	2,100	350	4	1,400
CCLF-3662A	1,800	300	5	1,500
CCLF-3592A	630	105	3	315
Totals	4,530	755	12	3,215
Average Concentration				268

TIER 2 NMOC EMISSION ESTIMATE

In order to estimate the landfill NMOC emission rate, the annual waste receipts and the site-specific NMOC concentration measured from the Tier 2 sampling were input to a spreadsheet model consistent with the U.S. EPA Landfill Gas Emission Model (LandGEM). This model estimates emissions using the equation shown in 40 CFR 60.754(a)(1).

Waste Disposal Rates

Waste disposal in the closed landfill ceased in 1990, and the active landfill began accepting waste in 1991. The waste disposal tonnages used in the NMOC emission estimate were previously submitted in the Revised Design Capacity Report for the facility, dated December 2005. The annual waste disposal quantities input to the models are presented in Table E-1 of Attachment E.

Note that under the columns labeled "Waste in Place", the value shown is the cumulative waste in place at the beginning of each year. For example, since the landfill opened in 1975, there was zero waste in place at the beginning of that year. In 1976, the total waste in place reflects the waste in place at the beginning of 1975 (i.e., zero tons) plus the waste accepted in 1975 (i.e., 25,329 tons).

Model Parameters

The NSPS default values for the methane generation potential ($L_o = 170\ m^3/Mg$) and methane generation rate constant ($k = 0.05\ yr^{-1}$) were used in the model. SCS also calculated the average methane concentration recorded during sampling. The methane concentrations for the closed and active landfills were also input to the respective models. An average methane concentration of 43 percent was used for the closed landfill model and a value of 54 percent methane was used for the active landfill model.

NMOC Emission Estimate Model Results

The model, which computes emissions based on the amount of waste in place at the beginning of each year, was run to estimate site-wide NMOC emissions. Emissions from the closed landfill were calculated based on a NMOC concentration of 73 ppmv as hexane and a methane content of 43 percent. Emissions for the active landfill were calculated based on a NMOC concentration of 268 ppmv as hexane and a methane content of 54 percent. The model results are summarized in Table 3 and presented in Attachment E. Note that the projected waste disposal rates for the active landfill for years 2006 through 2011 are based on a five percent annual increase, which is consistent with projections generated during the County's long-term planning efforts.

TABLE 3. NMOC EMISSIONS ESTIMATE MODEL RESULTS

Year	Projected MSW Disposal Rate (tons/yr)	Cumulative Waste-in-Place (tons)	NMOC Generation Rate (Mg/yr)		
			Closed Landfill	Active Landfill	Total
2006	110,739	1,062,786	0.80	10.9	11.7
2007	116,276	1,173,525	0.76	11.9	12.7
2008	122,090	1,289,802	0.72	12.8	13.5
2009	128,195	1,411,892	0.69	13.9	14.6
2010	134,604	1,540,086	0.65	14.9	15.6
2011	141,335	1,674,691	0.62	16.0	16.6

CONCLUSIONS AND RECOMMENDATIONS

The estimated Tier 2 NMOC emission rate for the site ranges from 11.7 Mg/year in 2006 to 16.6 Mg/year in 2011.

Because the site-wide emission rates are below 50 Mg per, Citrus County is not required to install a landfill gas collection and control system at Central Landfill at this time. In addition, because the estimated emissions are below 50 Mg in each of the next five years, this report serves as the five-year emission estimate in accordance with 40 CFR 60.757(b)(1)(ii). This report remains valid unless the future actual waste disposal rates exceed the projected rates used in the Tier 2 model. If future disposal rates exceed these projections, the Tier 2 model must be re-run and the results submitted to FDEP. The next Tier 2 test will be due in 2011.

Please submit one signed and sealed original of this report to David Zell of FDEP at the following address:

Mr. David Zell
Division of Air Resource Management
Florida Department of Environmental Protection
8407 Laurel Fair Circle
Tampa, Florida 33619

SCS has appreciated the opportunity to assist the County with this project. Please call us at (800) 569-9702 if you have any questions or need additional information.

Sincerely,

Lindsey Kennelly

Lindsey E. Kennelly, P.E.
Project Professional

6/29/06
John A. Banks, P.E.
Project Manager
SCS ENGINEERS

Attachments

ATTACHMENT E

NMOC EMISSION ESTIMATE CALCULATIONS

TABLE E-1. MSW DISPOSAL HISTORY
CITRUS COUNTY CENTRAL LANDFILL - LECANTO, FLORIDA

Year	MSW Disposal and Rate				Total Waste In Place	
	Closed Landfill		Active Landfill			
	(tons/yr)	(Mg/yr)	(tons/yr)	(Mg/yr)	(tons/yr)	(Mg/yr)
1975	25,329	22,978	--	--	0	0
1976	25,329	22,978	--	--	25,329	22,978
1977	25,329	22,978	--	--	50,658	45,956
1978	25,329	22,978	--	--	75,987	68,934
1979	25,329	22,978	--	--	101,316	91,912
1980	25,329	22,978	--	--	126,645	114,890
1981	25,329	22,978	--	--	151,974	137,868
1982	25,329	22,978	--	--	177,303	160,847
1983	25,329	22,978	--	--	202,632	183,825
1984	25,329	22,978	--	--	227,961	206,803
1985	25,329	22,978	--	--	253,290	229,781
1986	25,329	22,978	--	--	278,619	252,759
1987	25,329	22,978	--	--	303,948	275,737
1988	25,329	22,978	--	--	329,277	298,715
1989	64,338	58,366	--	--	354,606	321,693
1990	68,019	61,706	--	--	418,944	380,060
1991	--	--	43,390	39,363	486,963	441,765
1992	--	--	60,791	55,149	530,353	481,128
1993	--	--	64,197	58,239	591,144	536,277
1994	--	--	58,435	53,011	655,341	594,515
1995	--	--	60,046	54,473	713,776	647,527
1996	--	--	54,500	49,442	773,822	702,000
1997	--	--	37,070	33,629	828,322	751,441
1998	--	--	58,548	53,114	865,392	785,070
1999	--	--	73,491	66,670	923,940	838,184
2000	--	--	80,873	73,367	997,431	904,854
2001	--	--	83,358	75,621	1,078,304	978,221
2002	--	--	91,436	82,949	1,161,662	1,053,842
2003	--	--	93,523	84,843	1,253,098	1,136,791
2004	--	--	97,662	88,597	1,346,621	1,221,634
2005	--	--	105,466	95,677	1,444,283	1,310,232
2006	--	--	110,739	100,461	1,549,749	1,405,909
2007	--	--	116,276	105,484	1,660,488	1,506,370
2008	--	--	122,090	110,758	1,776,765	1,611,854
2009	--	--	128,195	116,296	1,898,855	1,722,612
2010	--	--	134,604	122,111	2,027,049	1,838,908
2011	--	--	141,335	128,217	2,161,654	1,961,019

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TABLE E-2. PROJECTED LFG AND NMOC GENERATION RATES
CITRUS COUNTY CENTRAL LANDFILL (CLOSED) - LECANTO, FLORIDA

Year	Disposal Rate (tons/yr)	Refuse In-Place (tons)	Disposal Rate (Mg/yr)	Refuse In-Place (Mg)	Methane Generation Rates (m^3/yr)	LFG Generation Rates (cfm)	LFG Generation Rates (Million ft^3/yr)	NMOC Generation Rates (tons/yr)	NMOC Generation Rates (Mg/yr)
1975	25,329	0	22,978	0	0 000E+00	0	0	0 00	0 00
1976	25,329	25,329	22,978	22,978	1 953E+05	31	16	0 13	0 12
1977	25,329	50,658	22,978	45,956	3 811E+05	60	31	0 25	0 23
1978	25,329	75,987	22,978	68,934	5 578E+05	87	46	0 37	0 33
1979	25,329	101,316	22,978	91,912	7 259E+05	113	60	0 48	0 43
1980	25,329	126,645	22,978	114,890	8 858E+05	138	73	0 58	0 53
1981	25,329	151,974	22,978	137,868	1 038E+06	162	85	0 68	0 62
1982	25,329	177,303	22,978	160,847	1 183E+06	185	97	0 78	0 71
1983	25,329	202,632	22,978	183,825	1 320E+06	206	108	0 87	0 79
1984	25,329	227,961	22,978	206,803	1 451E+06	227	119	0 96	0 87
1985	25,329	253,290	22,978	229,781	1 576E+06	246	129	1 04	0 94
1986	25,329	278,619	22,978	252,759	1 694E+06	265	139	1 12	1 01
1987	25,329	303,948	22,978	275,737	1 807E+06	282	148	1 19	1 08
1988	25,329	329,277	22,978	298,715	1 914E+06	299	157	1 26	1 15
1989	64,338	354,606	58,366	321,693	2 016E+06	315	166	1 33	1 21
1990	68,019	418,944	61,706	380,060	2.414E+06	377	198	1 59	1 44
1991	0	486,963	0	441,765	2 821E+06	441	232	1 86	1 69
1992	0	486,963	0	441,765	2 683E+06	419	220	1 77	1 61
1993	0	486,963	0	441,765	2 552E+06	399	210	1 68	1 53
1994	0	486,963	0	441,765	2 428E+06	379	199	1.60	1 45
1995	0	486,963	0	441,765	2 309E+06	361	190	1 52	1 38
1996	0	486,963	0	441,765	2 197E+06	343	180	1 45	1 31
1997	0	486,963	0	441,765	2 090E+06	327	172	1 38	1 25
1998	0	486,963	0	441,765	1 988E+06	311	163	1 31	1 19
1999	0	486,963	0	441,765	1 891E+06	295	155	1 25	1 13
2000	0	486,963	0	441,765	1 799E+06	281	148	1 19	1 08
2001	0	486,963	0	441,765	1 711E+06	267	141	1 13	1 02
2002	0	486,963	0	441,765	1 627E+06	254	134	1 07	0 97
2003	0	486,963	0	441,765	1 548E+06	242	127	1 02	0 93
2004	0	486,963	0	441,765	1 472E+06	230	121	0 97	0 88
2005	0	486,963	0	441,765	1 401E+06	219	115	0.92	0 84
2006	0	486,963	0	441,765	1 332E+06	208	109	0 88	0 80
2007	0	486,963	0	441,765	1 267E+06	198	104	0 84	0 76
2008	0	486,963	0	441,765	1 206E+06	188	99	0 80	0 72
2009	0	486,963	0	441,765	1 147E+06	179	94	0 76	0 69
2010	0	486,963	0	441,765	1 091E+06	170	90	0 72	0 65
2011	0	486,963	0	441,765	1 038E+06	162	85	0 68	0 62

ESTIMATED NMOC CONCENTRATION IN LFG	73	ppmv
ASSUMED METHANE CONTENT OF LFG	43%	
SELECTED DECAY RATE CONSTANT	0 05	1/yr
SELECTED ULTIMATE METHANE RECOVERY RATE	5,446	ft^3/ton
METRIC EQUIVALENT	170	m^3/Mg

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TABLE E-3. PROJECTED LFG AND NMOC GENERATION RATES
CITRUS COUNTY CENTRAL LANDFILL (ACTIVE) - LECANTO, FLORIDA

Year	Disposal Rate (tons/yr)	Refuse In-Place (tons)	Disposal Rate (Mg/yr)	Refuse In-Place (Mg)	Methane Generation Rates (m^3/yr)	LFG Generation Rates (cfm)	LFG Generation Rates (Million ft^3/yr)	NMOC Generation Rates (tons/yr)	NMOC Generation Rates (Mg/yr)
1991	43,390	0	39,363	0	0 000E+00	0	0	0 00	0 00
1992	60,791	43,390	55,149	39,363	3 346E+05	42	22	0 65	0 59
1993	64,197	104,181	58,239	94,511	7 870E+05	98	51	1 52	1 38
1994	58,435	168,378	53,011	152,750	1 244E+06	155	81	2 40	2 18
1995	60,046	226,813	54,473	205,761	1 634E+06	203	107	3 15	2 86
1996	54,500	286,859	49,442	260,234	2 017E+06	251	132	3 89	3 53
1997	37,070	341,359	33,629	309,676	2 339E+06	291	153	4 51	4 09
1998	58,548	378,429	53,114	343,305	2 511E+06	312	164	4 84	4 39
1999	73,491	436,977	66,670	396,419	2 840E+06	353	186	5 48	4 97
2000	80,873	510,468	73,367	463,089	3 268E+06	407	214	6 30	5 72
2001	83,358	591,341	75,621	536,456	3 732E+06	464	244	7 20	6 53
2002	91,436	674,699	82,949	612,077	4 193E+06	522	274	8 08	7 33
2003	93,523	766,135	84,843	695,026	4 693E+06	584	307	9 05	8 21
2004	97,662	859,658	88,597	779,869	5 186E+06	645	339	10 00	9 07
2005	105,466	957,320	95,677	868,466	5 686E+06	707	372	10 96	9 95
2006	110,739	1,062,786	100,461	964,143	6 222E+06	774	407	12 00	10 88
2007	116,276	1,173,525	105,484	1,064,604	6 772E+06	843	443	13 06	11 85
2008	122,090	1,289,802	110,758	1,170,088	7 339E+06	913	480	14 15	12 84
2009	128,195	1,411,892	116,296	1,280,847	7 922E+06	986	518	15 28	13 86
2010	134,604	1,540,086	122,111	1,397,143	8 524E+06	1,061	557	16 44	14 91
2011	141,335	1,674,691	128,217	1,519,254	9 147E+06	1,138	598	17 64	16 00

ESTIMATED NMOC CONCENTRATION IN LFG	268	ppmv
ASSUMED METHANE CONTENT OF LFG	54%	
SELECTED DECAY RATE CONSTANT	0 05	1/yr
SELECTED ULTIMATE METHANE RECOVERY RATE.	5,446	ft^3/ton
METRIC EQUIVALENT	170	m^3/Mg

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Attachment E-1

SCS ENGINEERS

SHEET 1 OF 1

CLIENT	PROJECT	JOB NO
Citrus County	Central Landfill	09204007.04

SUBJECT	BY	DATE
NMOC Emission Calculations	LEK	6/14/06
	CHECKED D. Penoyer	DATE 6/20/06

Average Site Specific NMOC Concentration (Closed Site)

Canister No.	NMOC Concentration (ppmv) (as Carbon)	NMOC Concentration (ppmv) (as Hexane)	No of Samples	Weighted NMOC Concentration (as Hexane)
CCLF-1416	390	65	5	325
-1371	340	57	4	228
-1426	340	57	4	228
-3555	360	60	4	240
-1422	380	63	4	252
-1382	500	83	4	332
-3650	560	93	6	558
-3558	600	100	4	400
-1451*	--*	--*	~~3~~*	--*
	Weighted Average		35	73

$\Sigma = 2563$

$\bar{X} = \frac{2563}{35} = 73$

NMOC as hexane = (NMOC as carbon) $\left(\frac{\text{1 part hexane}}{\text{6 part carbon}}\right)$ per 40CFR 60.754(a)(3)

Average Site Specific CH4 Concentration (Closed Site)

Canister No.	Avg CH4**	No of Samples	Weighted CH4
CCLF-1416	48	5	240
-1371	26	4	104
-1426	32	4	128
-3555	27	4	108
-1422	38	4	152
-1382	50	4	200
-3650	56	6	336
-3558	63	4	252
-1451*	--*	~~3~~*	--*
	Weighted Average		43%

$\Sigma = 1520$

$\bar{X} = \frac{1520}{35} = 43$

* Omit sample CCLF-1451 due to high O_2 concentration

** See Attachment C for Average CH_4 readings taken during sampling.

Attachment E-3

SCS ENGINEERS

SHEET 1 OF 1

CLIENT	PROJECT	JOB NO
Citrus County	Central Landfill	09204067.04

SUBJECT	BY	DATE
NMOC Emission Calculations	LEK	6/14/06
	CHECKED D. Penoyer	DATE 6/20/06

Average Site Specific NMOC Concentration (Active Site)

Canister No.	NMOC Concentration (ppmv) (as Carbon)	(as Hexane)	No of Samples	Weighted NMOC Concentration (as Hexane)	
CCLF-3617A	2,100	350	4	1,400	$\Sigma = 3215$
-3662A	1,800	300	5	1,500	$\bar{x} = \frac{3215}{12} = 268$
-3592A	630	105	3	315	
	Weighted Average =		12	268	

$$\text{NMOC as hexane} = (\text{NMOC as Carbon})\left(\frac{1\text{ part hexane}}{6\text{ part Carbon}}\right)$$ per 40CFR 60.754(a)(3)

Average Site Specific CH4 Concentration (Active Site)

Canister No.	Avg CH4*	No. of Samples	Weighted CH4	
CCLF-3617A	49	4	196	$\Sigma = 648$
-366A	55	5	275	$\bar{x} = \frac{648}{12} = 54\%$
-3592A	59	3	177	
		Weighted Average	54%	

* See Attachment C for Avg CH4 readings taken during sampling.

ATTACHMENT O-4

CONDENSATE GENERATION ESTIMATE

SCS ENGINEERS

SHEET 1 of 1

CLIENT	PROJECT	JOB NO
Citrus County	Landfill Gas Collection and Control System	09207049 02

SUBJECT	BY	DATE
Condensate Generation Estimate and Pumping Capacity of CS-2 Pump	VKF Revised by IMM	1/29/2009 2/27/2009
	CHECKED D. Penoyer	DATE 4/6/09

OBJECTIVE: Estimate condensate generation for max expected LFG flow rate.

APPROACH:

1 Calculate condensation production based on the following.
- Max LFG flows expected *(See Attachment 1)*
- Max LFG Temp. = 100 °F
- Ambient Air/Min. LFG Temp = 40 °F *(See Attachment 3)*

2. Use ***Attachment 1*** for water content of hydrocarbon gas to choose capacity of LFG to hold moisture at the given temperatures

SOLUTION:

SCENARIO 1: LFG flow expected at 2020 = 660 cubic feet per minute (ft^3/min) ***(See Attachment 2)***

LFG Flow = (660 ft^3/min) * (60 min/hr) * (24 hr/day) = 9 50E+05 ft^3/day

Using ***Attachment 2, Sheet 1/1***, the condensate production for scenario 1 is

At 100 °F, 3,000 lb liquid/10^6 ft^3 LFG
At 40 °F, 400 lb liquid/10^6 ft^3 LFG

The amount of liquid lost as LFG cools from 100 °F to 40 °F =
(3,000 lb liquid/10^6 ft^3 LFG) - (400 lb liquid/ 10^6 ft^3 LFG) = 2,600 lb liquid/10^6 ft^3 LFG

Gallons condensate/day = (2,600 lb liquid/10^6 ft^3 LFG) * (9 50E+05ft^3 LFG/day) * (gal/8 34 lb)
Gallons condensate/day = **296** gallons condensate/day
Gallons condensate/min = **0.21** gallons condensate/min

CONCLUSION: The maximum amount of condensate that will be produced is 0.21 GPM. Condensate will flow to the various sumps/traps depending on at which wellhead it is generated, but to provide a conservative design, assume that ALL of the condensate flows to CS-2. Under this scenario, CS-2 must be able to pump a minimum of 0.21 gpm.

SCENARIO 2: LFG flow expected at 2020 = 660 cubic feet per minute (ft^3/min) ***(See Attachment 2)***
AND 5 hypothetical dewatering discharge pumps (per engineer's judgment in future)

Note Dewatering pumps have not been designed for the wellfield However, in order to ensure that the pump at CS-2 could handle future potential operating conditions, this scenario shows the maximum pumping rate that might be required of the pump in CS-2 if leachate dewat pumps were installed in the vertical extraction wells and discharged the dewatered liquid into CS-2 Assuming that each of 5 pumps supplie 1 gpm of liquid to CS-2, the overall flow to CS-2 would be the condensate generation + dewatered liquids flow, as shown below.

Condensate generation (gpm) = **0.21** gallons condensate/min
Hypothetical dewatering pump discharge rate
5 pumps at 1 GPM/pump = **5.00** gallons dewatering discharge/min
Total maximum liquid flow to sump CS-2 **5.21** gallons liquid flow/min

CONCLUSION: The maximum about of liquid that would need to be pumped is 5.21 GPM.

RECOMMENDATION: CS-2 pneumatic pump must be capable of pumping up to 5 2 gpm at the required head.

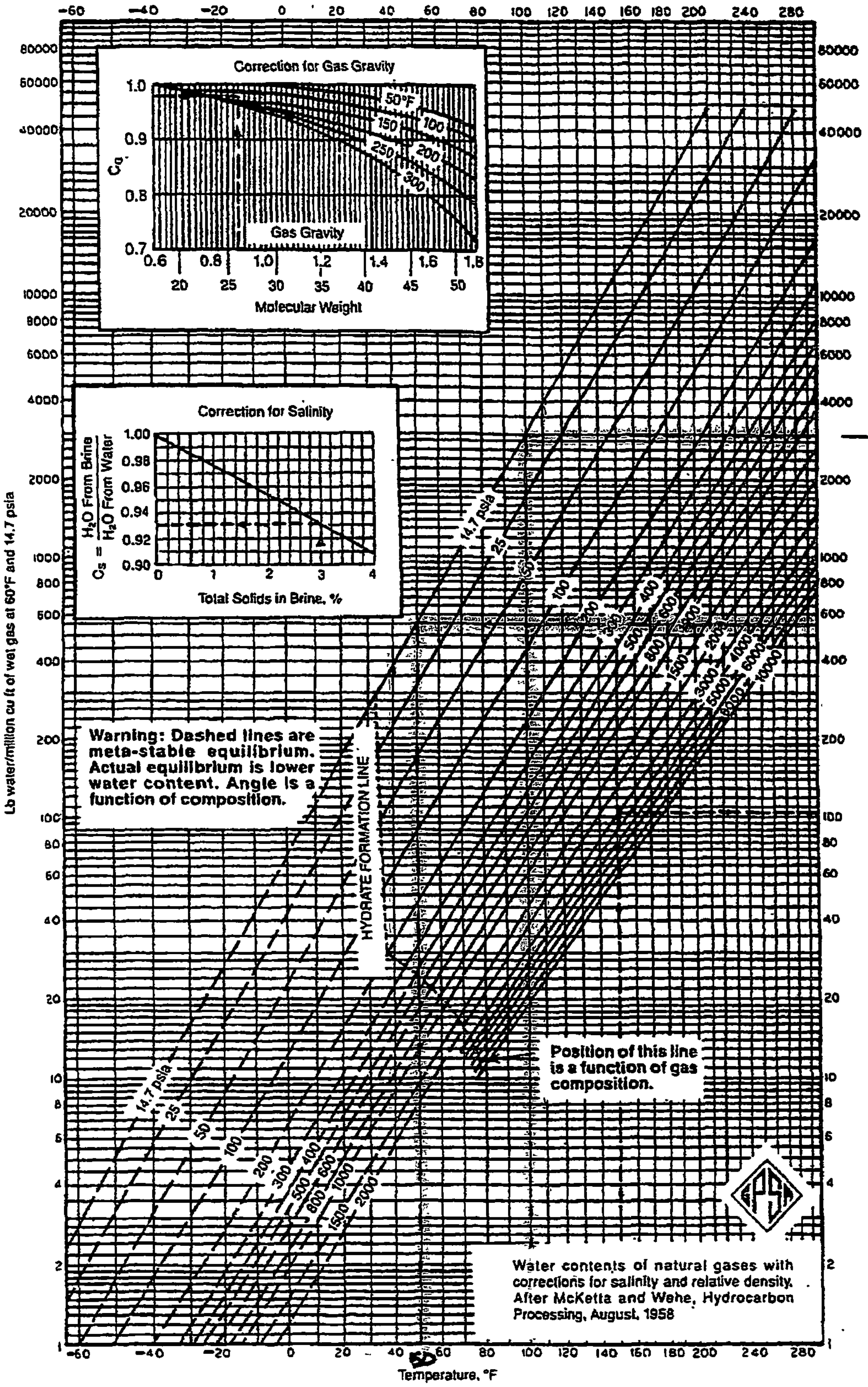
04/22/09

F \PROJECT\Citrus\09207049 02\Permit App-Construction Permit for GCCS\Calcs GCCS Design 90%\condensate_generation_GCCS_design xls

Attachment 1

FIG. 20-3

Water Content of Hydrocarbon Gas



Water contents of natural gases with corrections for salinity and relative density. After McKetta and Wehe, Hydrocarbon Processing, August, 1958

→ 3000

Attachment 2

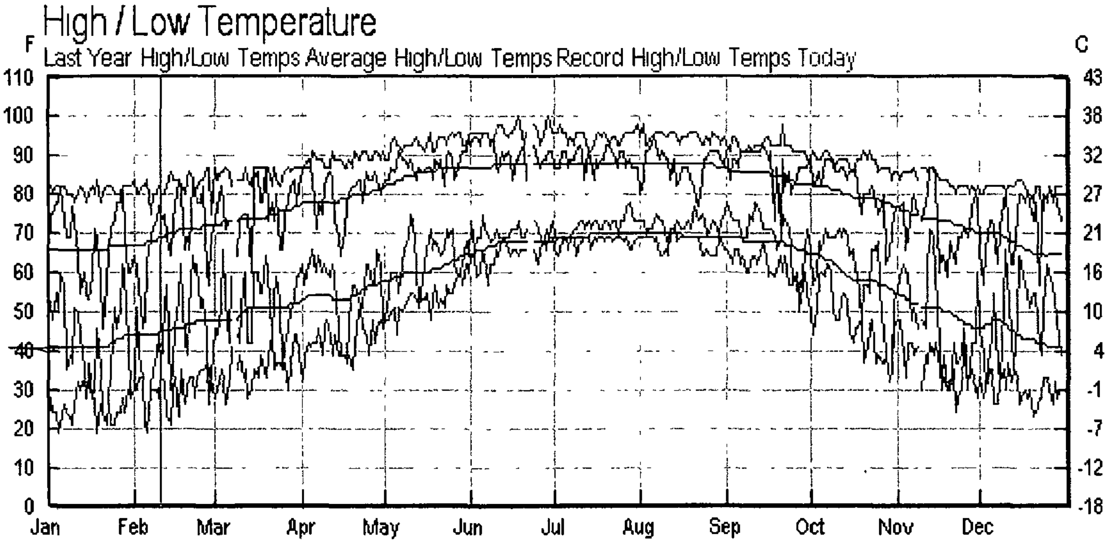
LFG RECOVERY PROJECTION
Citrus County Central Landfill - Lecanto Florida

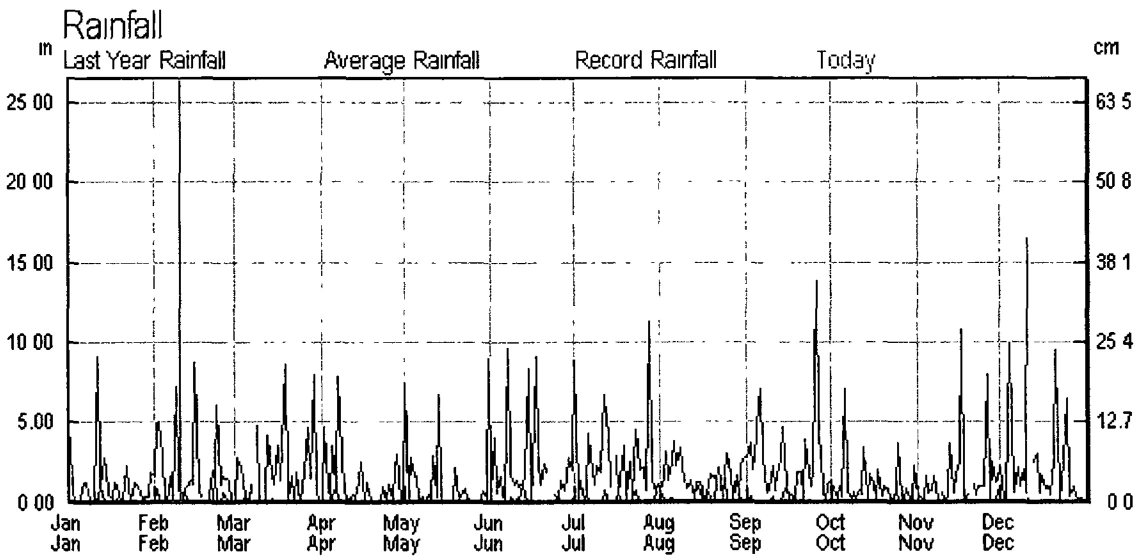
Year	Disposal Rate (tons/yr)	Refuse In-Place (tons)	LFG Generation (scfm)	LFG Generation (mmcf/day)	LFG Generation (mmBtu/yr)	Collection System Efficiency (%)	LFG Recovery from Planned System (scfm)	LFG Recovery from Planned System (mmcf/day)	LFG Recovery from Planned System (mmBtu/yr)
1991	43,390	43,390	0	0.0	0	0%	0	0.0	0
1992	60,791	104,181	21	0.0	5,539	0%	0	0.0	0
1993	64,197	168,378	49	0.1	13,083	0%	0	0.0	0
1994	58,435	226,813	78	0.1	20,765	0%	0	0.0	0
1995	60,046	286,859	103	0.1	27,411	0%	0	0.0	0
1996	54,500	341,359	128	0.2	34,002	0%	0	0.0	0
1997	37,070	378,429	149	0.2	39,626	0%	0	0.0	0
1998	58,548	436,977	161	0.2	42,805	0%	0	0.0	0
1999	73,491	510,468	183	0.3	48,601	0%	0	0.0	0
2000	80,873	591,341	211	0.3	56,077	0%	0	0.0	0
2001	83,358	674,699	241	0.3	64,203	0%	0	0.0	0
2002	91,436	766,135	272	0.4	72,327	0%	0	0.0	0
2003	93,523	859,658	305	0.4	81,164	0%	0	0.0	0
2004	97,662	957,320	338	0.5	89,920	0%	0	0.0	0
2005	105,000	1,062,320	372	0.5	98,862	0%	0	0.0	0
2006	109,200	1,171,520	408	0.6	108,390	0%	0	0.0	0
2007	113,568	1,285,088	444	0.6	118,081	0%	0	0.0	0
2008	118,111	1,403,199	481	0.7	127,949	70%	337	9.5	89,564
2009	113,360	1,516,559	519	0.7	138,010	70%	363	10.3	96,607
2010	58,947	1,575,506	553	0.8	147,071	70%	387	11.0	102,949
2011	61,305	1,636,811	560	0.8	148,829	70%	392	11.1	104,180
2012	63,757	1,700,568	567	0.8	150,820	70%	397	11.2	105,574
2013	66,308	1,766,876	575	0.8	153,045	70%	403	11.4	107,132
2014	68,960	1,835,836	585	0.8	155,509	70%	409	11.6	108,857
2015	71,718	1,907,554	595	0.9	158,215	70%	416	11.8	110,751
2016	74,587	1,982,141	606	0.9	161,167	70%	424	12.0	112,817
2017	77,570	2,059,712	618	0.9	164,370	70%	433	12.3	115,059
2018	80,673	2,140,385	631	0.9	167,827	70%	442	12.5	117,479
2019	83,900	2,224,285	645	0.9	171,546	70%	452	12.8	120,082
2020	87,256	2,311,541	660	1.0	175,530	70%	462	13.1	122,871

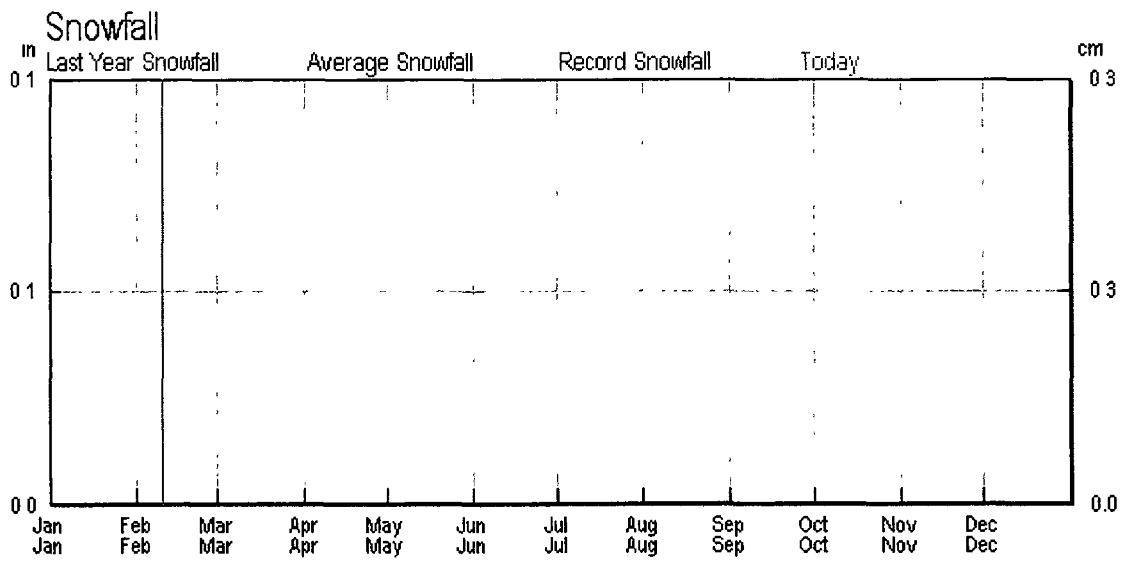
Methane Content of LFG Adjusted to: 50%
Selected Decay Rate Constant (k): 0.04 1/yr
Selected Ultimate Methane Recovery Rate (Lo): 3,204 cu ft/ton
NMOC Concentration in LFG: 268 ppmv as hexane

To be conservative, SCS has assumed the max LFG process rate to be 660 sfcm (meaning 100% collection efficiency)

* Average Temps. for 2008. Attachment 3.







Season Weather Averages for Ocala Regional-Taylor (KOCF)

*Graphs of yearly **temperature**, **rainfall**, and **snowfall**.*

Show Last Year: ☑ **Show Normals/Averages:** ☑ **Show Records:** ☑

ATTACHMENT O-5

PUMP SIZING CALCULATIONS

SCS ENGINEERS

SHEET 1 of 2

CLIENT	PROJECT	JOB NO
Citrus County	Landfill Gas Collection and Control System	09207049 02

SUBJECT	BY		DATE	
Pump Sizing Calculations Condensate Sump CS-2	BY	VKF	DATE	2/2/2009
	Revised	IMM		2/27/2009
	CHECKED	D. Perzer	DATE	4/6/09

PURPOSE

Size pneumatic pump in CS-2 Pump shall be QED AP-4 (short with a 3/4-inch ID discharge) See Attachment 5 for pump operations

KNOWN

1 Pump shall be QED AP-4, bottom loading, short body with 3/4-inch ID discharge hose

2 Condensate generation assumed to go to CS-2 = 0 21 gpm (assumes ALL condensate goes to CS-2, which is conservative since it will be distributed to multiple condensate traps/sumps across the site)

3 Sump dimensions 18 inch HDPE pipe
3 5 ft Resevoir depth (i e , depth above bottom of pump at which pump will activate)

4 Pump operation diagram - See Attachment 4

ASSUMPTIONS

1 To account for a potential future conditon where leachate dewatering pumps might be installed in vertical LFG extraction wells, assume that the dewatered liquid from 5 other AP-4 pumps, all pumping at 1 gpm, discharge to CS-2, in addition to normal condensate flow

Increase in liquid inflow to CS-2 due to future dewater 5 gpm
Resulting total liquids to be pumped at CS-2 5 21 gpm

2 Approximate elevation head against which pump will pump to discharge at top of leachate holding tanks = 25 ft

SOLUTION

1 Sump resevoir depth for liquid to accumulate

Cylinder Volume $V_{cyl} = 1/4\ \pi\ d^2 h$
d = 15 797 inches (see Attachment -1)
h = 3 5 ft
V_{cyl} = 35 63 gal

2 Total dynamic head (TDH) - See attached calculation sheet

3 Performance Curve From Attachment 2 Short AP-4/BL performance curve at 10 ft well depth, 2' submergence of pump, 40 psi, and 3/4-inch I D hose, pump will pump approximately 7 5 gpm

4 Air Consumption From Attachment 3 Short AP-4 air consumption curve with 3/4-inch ID discharge at 10 ft and 40 psi will require approximately 0 25 scf/gal Resulting air consumed is as follows

5 21 gpm x 0 25 scf/gal = 1 30 scf/min compressed air consumed

5 Air Compressor sizing

Minimum air flow required = 1 30 scfm
Minimum air pressure required = 100 psi

- This air pressure was selected to provide sufficient future capacity in case it becomes necessary to install leachate dewatering wells in vertical extraction wells or for other purposes

No. 56065
4/22/09

SCS ENGINEERS

SHEET 2 of 2

CLIENT	PROJECT	JOB NO	
Citrus County	Landfill Gas Collection and Control System	09207049 02	
SUBJECT	BY VKF	DATE 2/2/2009	
Pump Sizing Calculations	Revised IMM	2/27/2009	
Condensate Sump CS-2	CHECKED D. Penoyer	DATE 4/6/09	

Line Segment => 45.5ft - 2in DR 17 FM

Pipe Inside Diameter (in)	2.08	Refer to Table 4 Driscoplex		
Pipe Length (ft)	110.5	(10 5' vert, 100' horizontal (realistic assumption))		
C-Factor	130	Plastic		
ΔH	25	Static Head		
$S^{0\ 54} = Q / (1\ 318*C*A*R^{0\ 63}) =$		1 78 Q		
S =	2 91 $Q^{1\ 8519}$			
$H_f = L * S$	Hazen Williams	Area (sq ft)	0 0237	
$H_v = K\ V^2/(2*g)$	Fittings	R = D/4 =	0 043	
$TDH = \Delta H + H_f + H_v$	Total Dynamic Head			

K-Values		C-Values	
22 5 el	0 12	New DI	140
45 el	0 25	Old DI	100
90 el	0 3	PCCP	100
Butterfly Valve (full open)	0 3	Plastic	130
Cross (bend)	1 8	Semi-New	120
Cross (through flow)	0 6		
Entrance	0 5		
Exit	1		
Expansion Joint	0 2		
Gate Valve (open)	0 19		
Plug Valve (full open)	0 85		
Reducer	0 25		
Swing Check Valve	2 3		
Tee - branch flow	1 8		
Tee - through flow	0 6		
Ultrasonic flow meter	0		
Wye (through flow)	0 6		

Fittings	Assumed Quantity	K Value	Total K
90 el	3	0 30	0 90
Entrance Loss	1	0 50	0 50
Exit	1	1 00	1 00
Butterfly Valve (full open)	1	0 30	0 30
		Total	2.70

Q (gpm)	Q (cfs)	ΔH (ft)	H_f (ft)	V (ft/s)	H_v (ft)	TDH (ft)
0	0 000	25 0	0 00	0 00	0 00	25 00
1	0 002	25 0	0 00	0 09	0 00	25 00
2	0 004	25 0	0 01	0 19	0 00	25 02
3	0 007	25 0	0 03	0 28	0 00	25 03
4	0 009	25 0	0 05	0 38	0 01	25 06
5	0 011	25 0	0 08	0 47	0 01	25 09
6	0 013	25 0	0 11	0 56	0 01	25 12
7	0 016	25 0	0 14	0 66	0 02	25 16
8	0 018	25 0	0 19	0 75	0 02	25 21
9	0 020	25 0	0 23	0 85	0 03	25 26
10	0 022	25 0	0 28	0 94	0 04	25 32
11	0 025	25 0	0 33	1 04	0 04	25 38
12	0 027	25 0	0 39	1 13	0 05	25 45
13	0 029	25 0	0 46	1 22	0 06	25 52
14	0 031	25 0	0 52	1 32	0 07	25 59
15	0 033	25 0	0 59	1 41	0 08	25 68
16	0 036	25 0	0 67	1 51	0 10	25 76
17	0 038	25 0	0 75	1 60	0 11	25 86
18	0 040	25 0	0 83	1 69	0 12	25 95
19	0 042	25 0	0 92	1 79	0 13	26 05
20	0 045	25 0	1 01	1 88	0 15	26 16
21	0 047	25 0	1 11	1 98	0 16	26 27
22	0 049	25 0	1 21	2 07	0 18	26 39
23	0 051	25 0	1 31	2 16	0 20	26 51
24	0 053	25 0	1 42	2 26	0 21	26 63
25	0 056	25 0	1 53	2 35	0 23	26 76
26	0 058	25 0	1 64	2 45	0 25	26 89
27	0 060	25 0	1 76	2 54	0 27	27 03
37	0 082	25 0	3 16	3 48	0 51	28 67

PENOYER
PROFESSIONAL ENGINEER
FLORIDA
No. 56065
4/22/09

Attachment 1

Typical Sizes and Dimensions for Iron Pipe Size (IPS)
PE3408 High Density Polyethylene (HDPE) Pipe

Poor Image Quality

Pressure Rating		DR 17 (100psi)			DR 21 (80psi)			DR 26 (65psi)			DR 32.5 (50psi)		
Nominal Size	Actual O.D.	Min. wall	Average I.D.	Weight lb/lf	Min. wall	Average I.D.	Weight lb/lf	Min. wall	Average I.D.	Weight lb/lf	Min. wall	Average I.D.	Weight lb/lf
2"	2.375"	0.140"	[redacted]	0.429	---	---	---	---	---	---	---	---	---
3"	3.500"	0.206"	3.072"	0.932	---	---	---	---	---	---	---	---	---
4"	4.500"	0.265"	3.949"	1.540	0.214"	4.055"	1.262	0.173"	4.140"	1.030	0.138"	4.213"	0.831
5"	5.375"	0.316"	4.718"	2.197	0.256"	4.843"	1.801	0.207"	4.944"	1.470	0.165"	5.032"	1.186
5"	5.563"	0.327"	4.883"	2.353	0.265"	5.012"	1.929	0.214"	5.118"	1.574	0.171"	5.207"	1.270
6"	6.625"	0.390"	5.814"	3.338	0.315"	5.970"	2.736	0.255"	6.095"	2.233	0.204"	6.201"	1.801
7"	7.125"	0.419"	6.253"	3.860	0.339"	6.420"	3.165	0.274"	6.555"	2.582	0.219"	6.669"	2.083
8"	8.625"	0.507"	7.570"	5.657	0.411"	7.770"	4.637	0.332"	7.934"	3.784	0.265"	8.074"	3.053
10"	10.750"	0.632"	9.435"	8.788	0.512"	9.685"	7.204	0.413"	9.891"	5.878	0.331"	10.062"	4.742
12"	12.750"	0.750"	11.190"	12.362	0.607"	11.487"	10.134	0.490"	11.731"	8.269	0.392"	11.935"	6.671
14"	14.000"	0.824"	12.286"	14.905	0.667"	12.613"	12.218	0.538"	12.881"	9.970	0.431"	13.104"	8.044
16"	16.00"	0.941"	14.043"	19.467	0.762"	14.415"	15.959	0.615"	14.721"	13.022	0.492"	14.977"	10.506
18"	18.00"	1.059"	15.797"	24.638	0.857"	16.217"	20.198	0.692"	16.561"	16.480	0.544"	16.868"	13.296
20"	20.00"	1.176"	17.554"	30.418	0.952"	18.020"	24.936	0.769"	18.400"	20.346	0.615"	18.721"	16.415
22"	22.00"	1.294"	19.308"	36.805	1.048"	19.820"	30.172	0.846"	20.240"	24.619	0.677"	20.592"	19.863
24"	24.00"	1.412"	[redacted]	43.801	1.143"	21.623"	35.907	0.923"	22.080"	29.299	0.738"	22.465"	23.638
26"	26.00"	1.529"	22.820"	51.406	1.238"	23.425"	42.141	1.000"	23.920"	34.385	0.800"	24.336"	27.742
28"	28.00"	1.647"	24.574"	59.618	1.333"	25.227"	48.874	1.077"	25.760"	39.879	0.862"	26.207"	32.174
30"	30.00"	1.765"	26.329"	68.439	1.429"	27.028"	56.105	1.154"	27.600"	45.779	0.923"	28.080"	36.934
32"	32.00"	1.882"	28.085"	77.869	1.524"	28.830"	63.835	1.231"	29.440"	52.086	0.985"	29.951"	42.023
36"	36.00"	2.118"	31.595"	98.553	1.714"	32.435"	80.791	1.385"	33.119"	65.922	1.108"	33.695"	53.186
42"	42.00"	2.471"	36.860"	134.141	2.000"	37.840"	109.966	1.615"	38.641"	89.727	1.292"	39.313"	72.392
48"	48.00"	2.824	42.126"	175.205	2.286"	43.245"	143.629	1.846"	44.160"	117.194	1.477"	44.928"	94.552
52"	51.50"	---	---	---	2.452	46.400"	165.339	1.981"	47.380"	134.908	1.585"	48.203"	108.844
54"	54.00"	---	---	---	2.571	48.652"	181.781	2.077"	49.680"	148.324	1.662"	50.543"	119.668

NOTE:

- Pressures are based on using water at 23 °C (73°F) and are determined by using standard formulas for the industry.
- Average inside diameter calculated using nominal OD and minimum wall plus 4% for use in estimating fluid flows. Actual ID will vary.
- Service factors should be utilized to compensate for the effect of substances other than water, and for other temperatures.
- Fusion equipment rental available for all sizes.
- Other piping sizes or DR's may be available upon request.
- HDPE piping meets ASTM F 714. HDPE pipe meeting ASTM D 2513 is available upon request.

Attachment 2

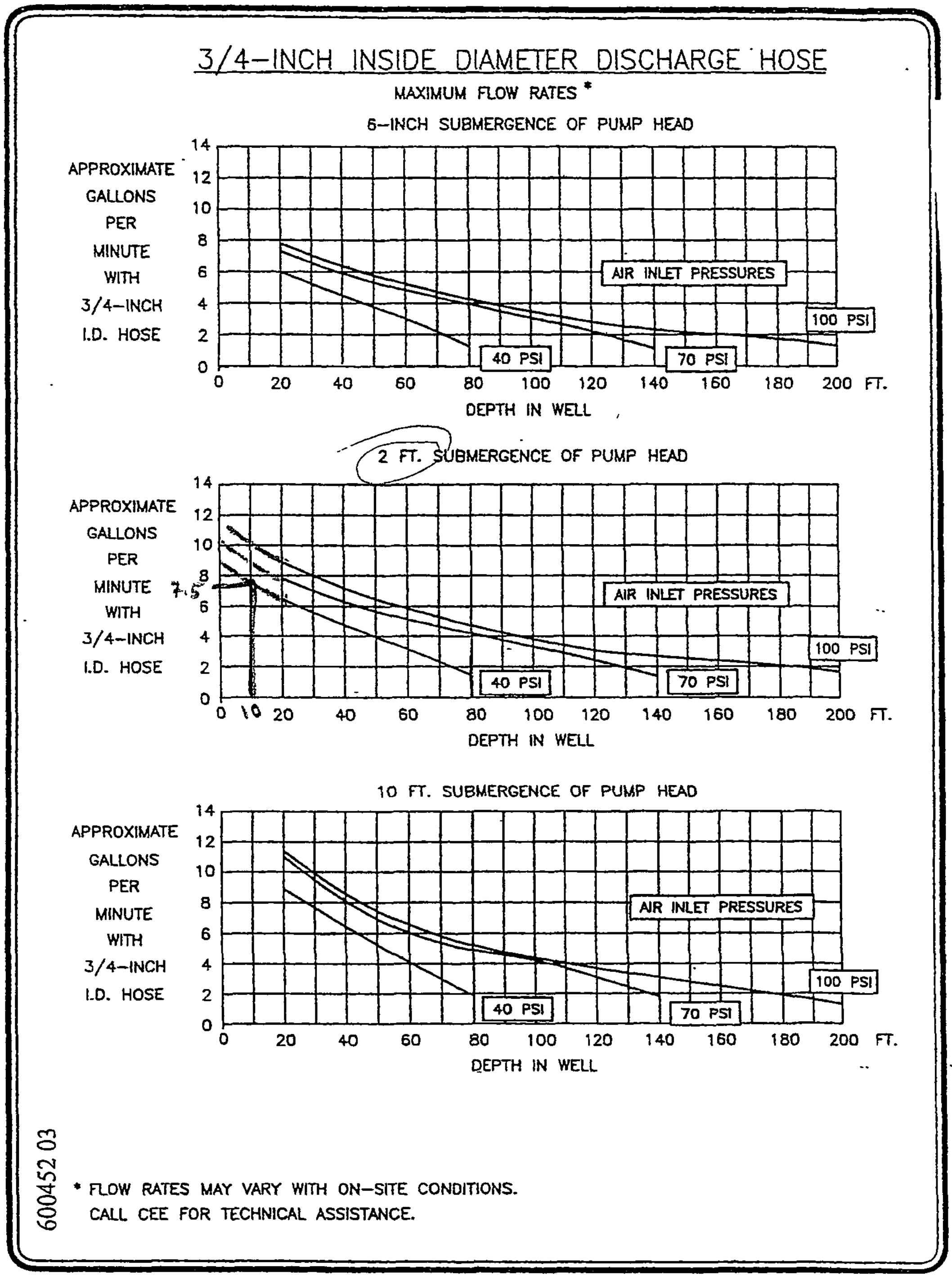


Figure 31 - Short AP-4/BL Performance Curves: 3/4-inch I.D. Discharge U.S. UNITS (Includes Leachate Models)

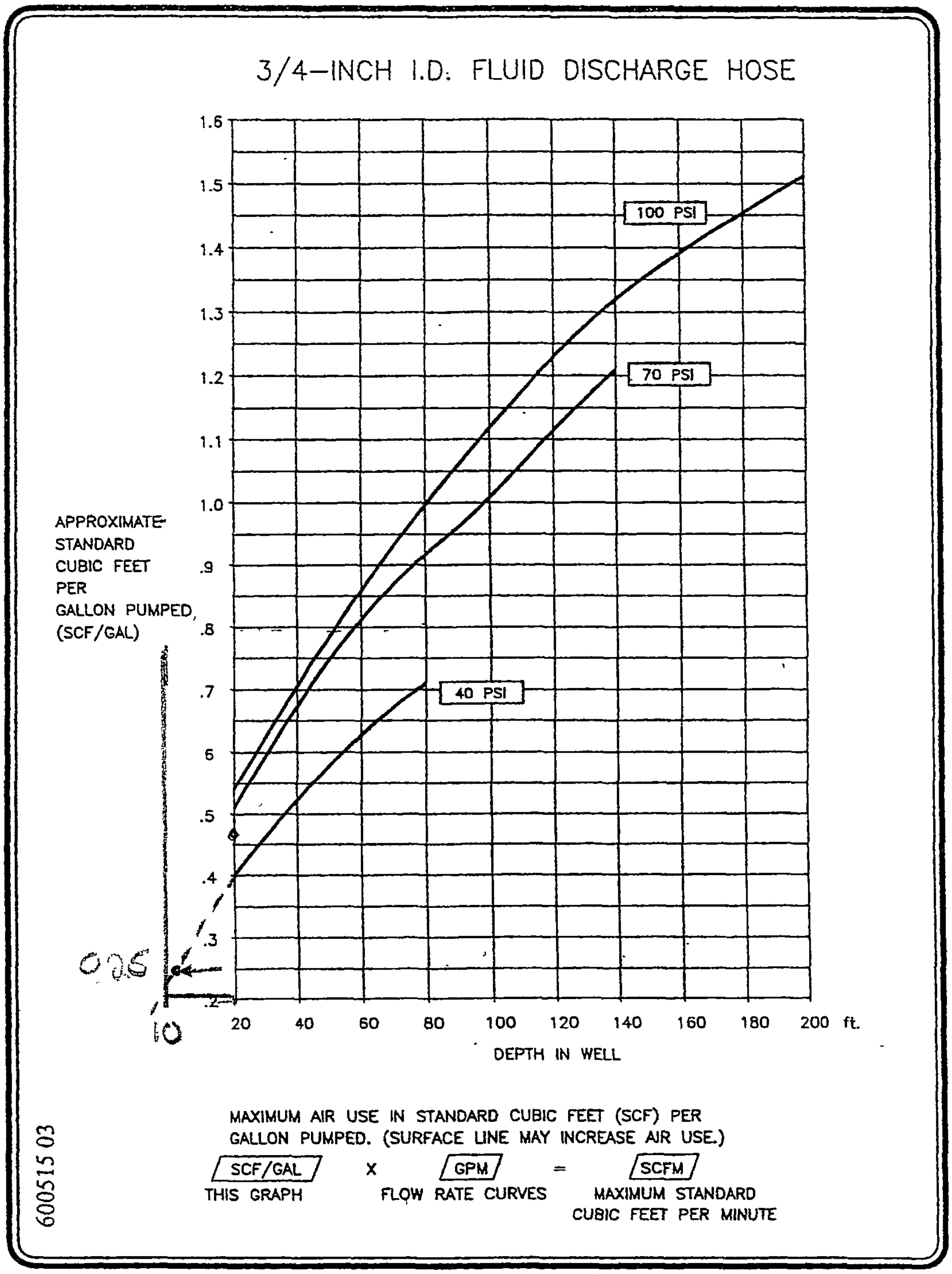
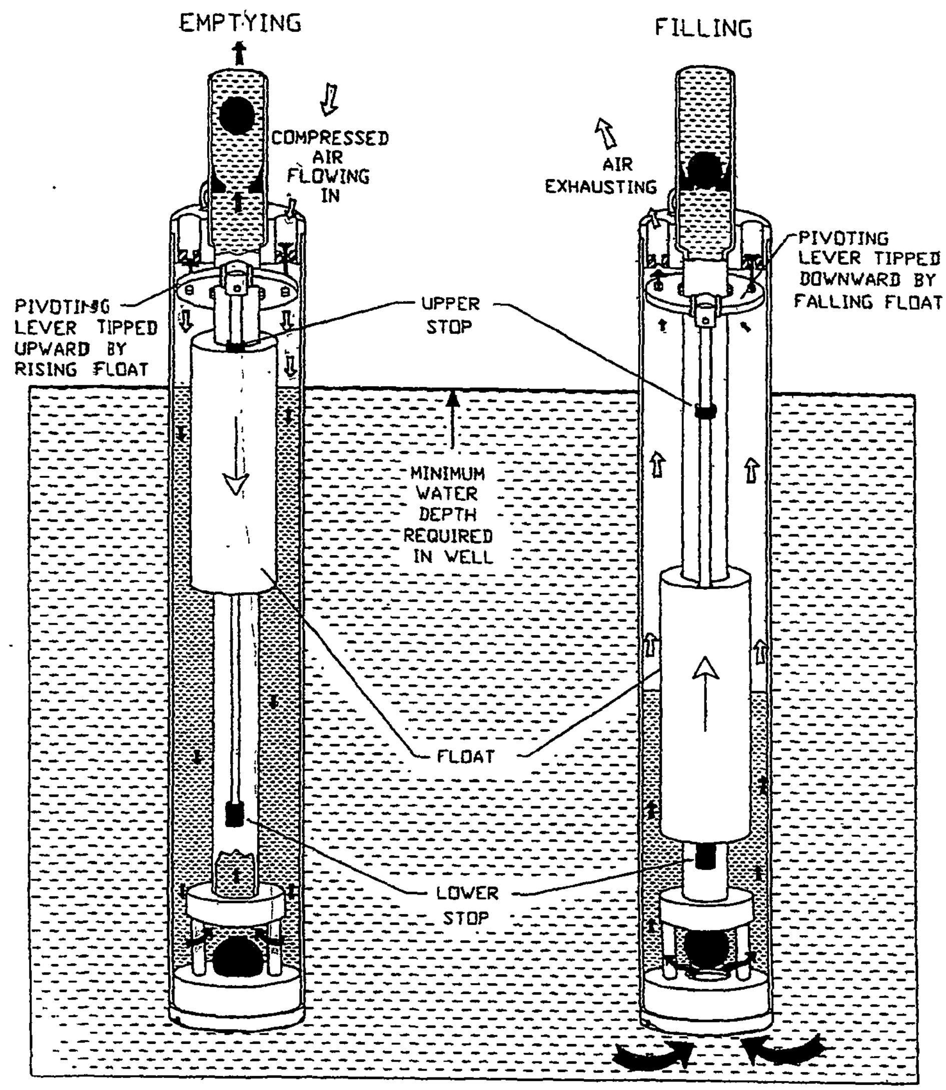


Figure 47 - Short AP-4 Air Consumption Curves: 3/4-inch I.D. Discharge U.S. UNITS (Includes Leachate Models)

Attachment 4



	To Empty Pump	To Fill Pump
Activation	Float Hits Upper Stop	Float Hits Lower Stop
Air Exhaust Valve	Closes	Opens
Air Inlet Valve	Opens	Closes
Intake Check Valve	Closes	Opens
Discharge Check Valve	Opens	Closes
Air Use	Yes	None

=Air Flow
=Water Flow
=Float Travel Direction

Figure . How it Works

ATTACHMENT O-6

GAS COLLECTION AND CONTROL SYSTEM CLOSURE PLAN CENTRAL LANDFILL, CITRUS COUNTY, FLORIDA

The active landfill gas collection and control system (GCCS) proposed for the Class I landfill is a voluntary system that is being installed to proactively reduce methane emissions to the atmosphere. The GCCS is not required by the Federal New Source Performance Standards (NSPS) for municipal solid waste landfills, nor is it being installed to mitigate landfill gas (LFG) migration or odors. Therefore, while Citrus County expects to operate the GCCS into the foreseeable future, if the County desires and if an engineering determination shows that the cessation of operation of the GCCS will not result in offsite LFG migration, odors, or excess gas pressure under a future final cover system, the County could choose to discontinue operation of the GCCS.

OPERATIONS AFTER CLOSURE

At landfill closure Citrus County will evaluate whether an active or passive GCCS is required in order to control offsite odors, subsurface LFG migration, and gas pressures in the landfill that could damage the final cover system. If a decision is made to decommission the active GCCS either prior to or after landfill closure, the County will notify the Florida Department of Environmental Protection (FDEP) in writing of their decision to discontinue operating the GCCS and submit an application to modify the operation or closure permit, as appropriate. The GCCS will be shut down and abandoned in place, and the LFG extraction wells will be converted to passive vents by removing the wellheads and installing "gooseneck" caps to allow venting of LFG.

GAS CONTROL DEVICES

The proposed active GCCS will be owned and operated by Citrus County. The candlestick flare station will be located south of the Class I landfill (Phase 1 and 1A, and Phase 2), near the leachate storage tanks.

CLOSURE REPORTING

As required by Rule 62-701.600(2)(a), F.A.C., a notification and closure schedule will be submitted to FDEP one year prior to the date when waste will no longer be accepted at the landfill.

SECTION P

LANDFILL CLOSURE REQUIREMENTS

P.1 THROUGH P.4.J

Not applicable.

P.4.K DESCRIPTION OF THE PROPOSED OR EXISTING GAS MANAGEMENT SYSTEM

Refer to Section L.9 of this application for a description of the proposed and existing gas management system

P.5 THROUGH P.6

Not applicable.

SECTION Q

CLOSURE PROCEDURES

Not applicable.

SECTION R

LONG-TERM CARE REQUIREMENTS

R.1 GAS SYSTEM MAINTENANCE

The gas collection and monitoring system will continue to be maintained and operated to minimize odors and prevent off site migration.

R.2 RIGHT OF PROPERTY ACCESS

This item is not applicable.

R.3 SUCCESSORS IN INTEREST

This item is not applicable.

R.4 REPLACEMENT OF MONITORING DEVICES

This item is not applicable.

R.5 COMPLETION OF LONG-TERM CARE

This item is not applicable.

SECTION S

FINANCIAL RESPONSIBILITY REQUIREMENTS

S.1 COST ESTIMATES FOR CLOSURE COST AND LONG-TERM CARE

Attachment S-1 contains the required FDEP financial assurance documentation. The long-term care cost associated with the GCCS has been added to the inflation adjusted Financial Assurance Report for 2009.

The closure cost construction estimates associated with the GCCS have not been included at this time as the system is a voluntary system and does not need to be constructed.

ATTACHMENT S-1

FINANCIAL ASSURANCE COST ESTIMATE

DEP Form #	62-701 900(28)
Form Title	Financial Assurance Cost Estimate Form
Effective Date	05-27-01
DEP Application No	(Filled by DEP)

Florida Department of Environmental Protection

Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, FL 32399-2400

FINANCIAL ASSURANCE COST ESTIMATE FORM

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
JUL 15 2009
SOUTHWEST DISTRICT TAMPA

Date: April 22, 2009 Date of FDEP Approval: ____________

I. GENERAL INFORMATION:

Facility Name: Citrus County Central Landfill WACS or GMSID #. SWD/53/49723
Permit / Application No.: ____________ Expiration Date: ____________
Facility Address: State Road 44, 3 miles east of Lecanto
Permittee: Citrus County Board of County Commissioners
Mailing Address: P.O. box 340 Lecanto, FL 34460

Latitude: 28 51'07" Longitude: 82 26'12" or UTM. ____________

Solid Waste Disposal Units Included in Estimate:

Phase / Cell	Acres	Date Unit Began Accepting Waste	Design Life of Unit From Date of Initial Receipt of Waste
3	6.65	N/A	N/A
2	6	Mid- 2005	10 years
1/1A	19.1	1991	14 years
Old LF	60	1975	Closed 1990

Total Landfill Acreage included in this estimate 31.75 Closure 91.2 Long-Term Care

Type of Landfill: X Class I ____ Class III ____ C&D Debris

II. TYPE OF FINANCIAL ASSURANCE DOCUMENT (Check Type)

____ Letter of Credit *
____ Performance Bond *
____ Guaranty Bond *
____ Insurance Certificate
X Escrow Account
____ Financial Test

*Indicates mechanisms that require use of a Standby Trust Fund Agreement

III. ESTIMATE ADJUSTMENT

40 CFR Part 264 Subpart H as adopted by reference in Rule 62-701.630, Florida Administrative Code sets forth the method of annual cost estimate adjustment. Cost estimates may be adjusted by using an inflation factor or by recalculating the maximum costs of closure in current dollars. Select on of the methods of cost estimate adjustment below.

(a) Inflation Factor Adjustment

Inflation adjustment using an inflation factor may only be made when a Department approved closure cost estimate exists and no changes have occurred in the facility operation which would necessitate modification to the closure plan. The inflation factor is derived from the most recent Implicit Price Deflator for Gross National Product published by the U.S. Department of Commerce in its survey of Current Business. The inflation factor is the result of dividing the latest published annual Deflator by the Deflator for the previous year. The inflation factor may also be obtained from the Solid Waste Financial Coordinator at (850)-488-0300.

This adjustment is based on the Department approved closure cost estimate dated: ____________

Latest Department Approved Closure Cost Estimate:		Current Year Inflation Factor		Inflation Adjusted Closure Cost Estimate:
____________	x	____________	=	____________

This adjustment is based on the Department approved long-term care cost estimate dated: ____________

Latest Department Approved Annual Long-Term Care Cost Estimate:		Current Year Inflation Factor		Inflation Adjusted Annual Long-Term Care Cost Estimate
____________	x	____________	=	____________
Number of Years of Long Term Care Remaining:			x	30
Inflation Adjusted Long-Term Care Cost Estimate:			=	____________

(b). Recalculate Estimates (see section V)

IV. CERTIFICATION BY ENGINEER

This is to certify that the Financial Assurance Cost Estimates pertaining to the engineering features of the this solid waste management facility have been examined by me and found to conform to engineering principals applicable to such facilities In my professional judgement, the cost Estimates are a true, correct and complete representation of the financial liabilities for closing and long-term care of the facility and comply with the requirements of Florida Administrative Code (F.A.C.), Rule 62-701.630 and all other Department of Environmental Protection rules, and statutes of the State of Florida. It is understood that the Financial Assurance Cost Estimates shall be submitted to the Department annually, revised or adjusted as required by Rule 62-701.630(4), F.A.C.

D. Bramlett 4/22/09
Signature of Engineer

Dominique H. Bramlett, P.E., Senior Project Engineer
Name & Title (please type)

61829
Florida Registration Number (affix seal)

SCS Engineers
4041 Park Oaks Blvd. Suite 100
Tampa, Florida 33610
Mailing Address

813-621-0080
Telephone Number

Susan J Metcalfe
Signature of Owner/Operator

Susan J. Metcalfe, Director, Div of Solid Waste Mgmt.
Name & Title (please type)

(352) 527-7671
Telephone Number

V. RECALCULATE ESTIMATED CLOSING COST

For the time period in the landfill operation when the extent and manner of its operation makes closing **most expensive**.

**** Third Party Estimate / Quote must be provided for each item**
**** Costs must be for a third party providing all material and labor**

DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
1. Proposed Monitoring Wells	(Do not include wells already in existence.)			
	EA	______	______	______
2. Slope and Fill (bedding layer between waste and barrier layer):				
Fine Grading	SY	______	______	______
Placement and Spreading	CY	______	______	______
Compaction	CY	______	______	______
Off Site Material (12")	CY	______	______	______
Delivery	CY	______	______	______
			Subtotal Slope and Fill:	______
3. Cover Material (Barrier Layer):				
Off-Site Clay	CY	______	______	______
Synthetics - 40 mil	SF	______	______	______
Synthetics - GCL	SY	______	______	______
Synthetics - Geonet (Geocomposite)	SF	______	______	______
Synthetics - Other	SY	______	______	______
			Subtotal Barrier Layer Cover:	______
4. Top Soil Cover: (18" protective soil + 6" topsoil)				
Off-Site Material	CY	______	______	______
Delivery +Spread	CY	______	______	______
Delivery +Spread	CY	______	______	______
			Subtotal Top Soil Cover	______

DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
5. Vegetative Layer				
Sodding	SY			
Hydroseeding	AC			
Fertilizer	AC			
Mulch	AC			
Other	SY			
			Subtotal Vegetative Layer:	
6. Stormwater Control System:				
Earthwork	CY			
Grading	SY			
Piping	LF			
Ditches	LF			
Berms	LF			
Control Structures	EA			
Other	LS			
			Subtotal Stormwater Controls:	
7. Gas Controls: Passive				
Vents (2 per acre)	EA			
Self -Igniter Flares	EA			
Monitoring Probes	EA			
NSPS/Title V requirements	LS			
			Subtotal Passive Gas Control·	

DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
8. Gas Control: Active Extraction				
Traps	EA			
Sump	EA			
Flare Assembly	EA			
Flame Arrestor	EA			
Mist Eliminator	EA			
Flow Meter	EA			
Blowers	EA			
Collection System	LF			
Other (describe)		19	$202.73	$3,852
		Subtotal Active Gas Extraction:		$3,852
9. Security System				
Fencing	LF			
Gate(s)	EA			
Sign(s)	EA			
		Subtotal Security System:		
10. Engineering:				
Closure Plan report	LS			
Certified Engineer	LS			
NSPS/Title V Air Permit	LS			
Final Survey	LS			
Certification of Closure	LS			
Other (detail)	LS			
		Subtotal Engineering:		

11. Professional Services

	Contract Management		Quality Assurance		
	Hours	LS	Hours	LS	TOTAL
P.E. Supervisor					
On-Site Engineer					
Office Engineer					
On-site Technician					
Administrative cost					
Reimbursables					

DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
Quality Assurance Testing	LS			

Subtotal Professional Services: ______

Subtotal of 1-11 Above: **$3,852**

12. Contingency 15 % of Total 15.00%

Closing Cost Subtotal: **$4,430**

13. Site Specific Costs (explain)

Mobilization (10% of Sub-Total 1-11) ______

Other (Bonds & Insurance 2% of Sub-Total 1-11) ______

Subtotal Site Specific Costs: ______

TOTAL CLOSING COSTS: **$4,430**

VI. ANNUAL COST FOR LONG-TERM CARE (Check Term Length)

_____ 5 years _____ 20 years __X__ 30 years _____ Other

See 62-701.600(1)a.1., 62-701.620(1), 62-701.630(3)a. and 62-701.730(11)b. F.A.C. for required term length. For landfills certified closed and Department accepted, enter the remaining long-term care length as "Other" and provide years remaining.

**** Third Party Estimate / Quote must be provided for each item**
**** Costs must be for a third party providing all material and labor**

All items must be addressed. Attach a detailed explanation for all items marked not applicable (N/A).

DESCRIPTION	Sampling Frequency (events/yr.)	Number of Wells	$/Well/Event	$ / Year
1. Groundwater Monitoring (62-701.510(6), and (8)(a))				
Monthly (Gradient)	12			
Quarterly	4			
Semi-Annual	2			
Annual	1			
		Subtotal Groundwater Monitoring:		
2. Surface Water Monitoring (62-701.510(4), and (8)(b))				
Monthly	12			
Quarterly	4			
Semi-Annual	2			
Annual	1			
		Subtotal Surface Water Monitoring:		
3. Gas Monitoring				
Monthly	12			
Quarterly	4			
Semi-Annual	2			
Annual	1			
		Subtotal Gas Monitoring:		

DESCRIPTION	Sampling Frequency (events/yr.)	Number of Wells	$/Well/Event	$ / Year
4. Leachate Monitoring (62-701.510(5), (6)(b) and 62-701.510(8)(c))				
Monthly	____	____	____	____
Quarterly	____	____	____	____
Semi-Annual	____	____	____	____
Annual	____	____	____	____
Weekly	____	____	____	____
		Subtotal Leachate Monitoring:		____

DESCRIPTION	UNIT	QUANTITY	UNIT COST	ANNUAL COST
5. Leachate Collection/Treatment Systems Maintenance				
Maintenance				
Collection Pipes	LS	____	____	____
Sumps, Traps	EA	____	____	____
Lift Stations	EA	____	____	____
Cleaning	LS	____	____	____
Tanks	EA	____	____	____
Impoundments				
Liner Repair	SY	____	____	____
Sludge Removal	CY	____	____	____
Treatment Systems	CY	____	____	____
Batch Plant	EA	____	____	____
Spray Aerators	EA	____	____	____
Disposal				
On-site Impoundment	1000 gallon	____	____	____

Sub-Total Leachate Collection /Treatment System Maintenance: ____

6. Leachate Collection/Treatment Systems Administrative·

Operation		Hours	$/Hour	Total
Ops Supervisor (1 day per month for reports)	HR			
On-Site Engineer	HR			
Office Engineer	HR			
On-site Technician (WWTP Operator 12 hrs./week)	HR			
Materials	LS			
Subtotal Leachate Collection/Treatment System Administrative:				

7 Maintenance of Groundwater Monitoring Wells

Monitoring Wells	EA			
Replacement	EA			
Abandonment	EA			
Subtotal Groundwater Monitoring Well Maintenance:				

DESCRIPTION	UNIT	QUANTITY	UNIT COST	ANNUAL COST
8 Gas System Maintenance				
Piping, Vents	LS	1	$420	$420
Blowers	EA			
Flaring Units	LS	1	$480	$480
Meters, Valves	EA			
Compressors	EA			
Flame Arrestors	EA			
Replace monitoring probes	EA			
			Subtotal Gas System	$900
9. Landscape				
Mowing	AC			
Fertilizer	AC			
			Subtotal Landscape Maintenance	

DESCRIPTION	UNIT	QUANTITY	UNIT COST	ANNUAL COST
10. Erosion Control & Cover Maintenance				
Sodding	SY			
Regrading	LS			
Liner Repair	LS			
Clay	CY			
		Subtotal Erosion Control and Cover Maintenance:		
11. Storm Water Management System Maintenance				
Conveyance Maintenance	LS			
		Subtotal Storm Water System Maintenance.		
12. Security System Maintenance				
Fences	LF	25	$13.08	$327
Gate(s)	EA			
Sign(s)	EA			
			Subtotal Security System·	$327
13 Utilities	LS			
14. Administrative				
Site Manager	HR			
On-Site Engineer	HR			
Office Engineer	HR			
Clerical	HR			
Other (consulting)				
			Subtotal Administrative:	
15. Contingency	% of Total	1,227	5%	$61
			Subtotal Contingency·	$61

16. Site Specific Costs (explain)

	UNIT COST	
	LS	
	LS	$0

ANNUAL LONG-TERM CARE COST ($/Year):	**$166,011**
NUMBER OF YEARS OF LONG-TERM CARE	30
TOTAL LONG-TERM CARE COST ($):	**$4,980,341**

SCS ENGINEERS

Final GCCS RAI No. 1

SHEET 1 OF 1

CLIENT CITRUS COUNTY	PROJECT ~~[illegible] CLOSED AREA [illegible]~~	JOB NO 09207049.03
SUBJECT FINANCIAL ASSURANCE COST ESTIMATE	BY VPB	DATE 6/24/09
GCCS Closure / Abandonment Costs	CHECKED D. Penoyer	DATE 7/1/09

OBJECTIVE TO CALCULATE COST TO REPLACE WELLHEADS WITH GOOSENECK VENT AS PART OF CLOSURE CONSTRUCTION. THERE ARE $\boxed{\text{19 WELLHEADS}}$ TO BE REPLACED. For closure, the extraction wells will be converted to passive vents.

CALCULATIONS:

MATERIAL COST

6" SCH 80 PVC PIPE : \$7.03/FT (1) (ATTACH. 1)
2 - 6" SCH 80 PVC 90-DEG. ELBOW : \$85.00 EA (ATTACH. 1)
4" HDPE END CAP (2) : \$10.00 EA (ATTACH. 2)

MATERIAL COST PER VENT:
(\$7.03/2) + \$85.00 + \$10.00 = \$98.52 ✓

LABOR COST: (SEE ATTACHMENT 3 FOR FEE SCHEDULE)
PER CONVERSATION WITH SCS FIELD SERVICES, IT WOULD TAKE APPROXIMATELY 2 (8 hour) DAYS FOR 2 TECHNICIANS TO FINISH THE WORK.

STANDARD FEE : \$50.00/HR (Technician)
TOTAL LABOR COST : 2 x 16 HOURS x \$50.00/HR = \$1,600 ✓
LABOR COST PER VENT : \$1,600/19 = \$84.21 EA ✓

EQUIPMENT COST:
35kW GENERATOR : \$135/DAY (ATTACHMENT 4)
4" FUSION MACHINE : \$55.00/DAY (ATTACHMENT 5)
EQUIPMENT COST PER VENT:
[(\$135/DAY x 2 DAYS) + (\$55/DAY x 2 DAYS)]/19 = \$20/VENT ✓

TOTAL COST PER VENT:
\$98.52 + \$84.21 + \$20 = $\boxed{\$202.73}$ ✓

TOTAL COST:
19 x \$202.73 = $\boxed{\$3,852}$ ✓

NOTES: (1) EACH VENT WOULD ONLY REQUIRE 6 INCHES TO CONNECT THE 2 90-DEGREE ELBOWS
(2) TO ABANDON THE HDPE LATERAL RISER

SCS ENGINEERS

CLIENT Citrus County	PROJECT Citrus Central LF GCCS Design	JOB NO 09207049.02
SUBJECT Financial Assurance - Long-Term Care Cost	BY JMM	DATE 4/1/09
	CHECKED DHB	DATE 4/2/09

Objective: To modify the FDEP Financial Assurance Cost Estimate Form DEP Form # 62-701.900(28) dated March 5, 2009 as approved by FDEP on April 1, 2009 (See Attachment 1) to reflect the long-term care costs for the proposed GCCS.

Method: Each item in the long-term care form will be addressed individually as it relates to the proposed GCCS.

Known: - The long-term care cost as approved on April 1, 2009 = $164,723.00 per year (See Attachment 1).

Section VI:

1. Groundwater Monitoring: Not applicable.
2. Surface Water Monitoring: Not applicable.
3. Gas Monitoring: Not applicable.
4. Leachate Monitoring: Not applicable.

SCS ENGINEERS

SHEET 2 OF 3

CLIENT Citrus County	PROJECT Citrus Central LF GCCS Design	JOB NO 09207049.02
SUBJECT Financial Assurance - Long Term Care Cost	BY IMM	DATE 4/1/09
	CHECKED DHB	DATE 4/2/09

5. Leachate Collection / Treatment Systems Maintenance: Not applicable.

6. Leachate Collection / Treatment Systems Administrative: Not applicable.

7. Maintenance of Groundwater Monitoring Wells: Not applicable.

8. Gas System Maintenance:

Piping/Vents – Assume that it takes 1 Technician app. 7 hrs. to check and make repairs to the piping system at \$60/hr (See Attachment 3)

Total = 7 hrs x \$60/hr = \$420

Flare/Blowers – Assume it takes 8 hours for 1 technician to check and resolve any maintenance issues.

Total = 8 hrs x \$60/hr = \$480

9. Landscape: Not applicable.

10. Erosion Control and Cover Maintenance: Not applicable.

11. Stormwater Management System Maintenance: Not applicable.

12. Security System Maintenance:

Fence – Assume 25 LF of fence will require repair or replacement

Unit cost = \$13.08/LF (See Attachment 4)

Total = 25 LF x \$13.08/LF = \$327

SCS ENGINEERS

SHEET 3 OF 3

CLIENT Citrus County	PROJECT Citrus Central LF GCCS Design	JOB NO 09207049.02
SUBJECT Financial Assurance - Long Term Care Cost	BY IMM	DATE 4/1/09
	CHECKED DHB	DATE 4/2/09

13: Utilities : Not applicable

14: Administrative : Not applicable

15: Contingency :

5% of total for items 1 → 14 = ~~$1,693~~ $1,227 × 5% = ~~$84.65~~ $61.35

16: Site Specific Costs : None:

Approved Annual Long-Term Care Cost = $164,723.00

∴ New total = $164,723.00 + ($1,227 × 5%) = $166,011 ✓

contingency

Number of years of long term care = 30 yrs.

Total Long-Term Care Costs = $4,980,341

ATTACHMENT 1

ISCO INDUSTRIES
ISCO Industries
926 Baxter Avenue
Louisville, KY 40204
800-345-4726

Quotation

QUOTE #	09004821
LOCATION	009
DATE	06/23/09
PAGE	1 OF 1

BILL TO
103705
SCS FIELD SERVICES, INC.
3900 KILROY AIRPORT WAY, STE. 1
LONG BEACH, CA 90806

SHIP TO
SCS FIELD SVCS
3211 WEST RUSTY PL
CITRUS SPRINGS, FL 34433

QUOTE DATE	EXPIRE DATE	REQUIRED DATE	REFERENCE NUMBER	PAYMENT TERMS
06/23/09	07/08/09			NET 30
WRITTEN BY: MARK V., Ext. 6739			CONTACT: JOYCE BELEN	SHIP VIA: BEST WAY
FREIGHT TERMS: PREPAID AND ADD			JOB NUMBER	SALES REP: MARK VANVAERENBERGH

PRODUCT/DESCRIPTION	QUANTITY	PRICE	U/M	EXTENSION
63060022 ~~6" SCH 80 SXS COUPLING #829-060~~ Not needed for well conversion	~~1~~	~~15.50~~	~~EA~~	~~15.50~~
63060013 6" SCH 80 PVC PIPE PE X BE	1	7.03	FT	7.03
63069999 6" SCH 80 PVC 180 DEGREE ELBOW (2 90 ELBOW)	1	85.00	EA	85.00

Sales tax will be charged based on the ship-to address at the time of invoice if there is no tax certificate on file. Freight will be charged based on terms agreed upon at the time the order is placed.

US $

MERCHANDISE TOTAL	HANDLING	MISC CHARGE	TAX	FREIGHT	QUOTE TOTAL
107.53	0.00	0.00	6.45	0.00	113.98

Accepted: By:____________________
Date:______________

Please contact your ISCO representative at 800-345-4726 to place your order.

ATTACHMENT 2

ISCO INDUSTRIES

Engineering Estimate - ISCO Industries, LLC

Quote #:	09-0423-001
Date:	April 23, 2009
Exp. Date:	May 8, 2009

Bill To:
SCS Engineers
Joyce Belene

Ship To:

Sales Contact	Payment Terms	Freight Terms	Ship Via
Mark Van Vaerenbergh	Net 30 days	PPD & Allowed	Best Way

Item #	Description	Qty	U/M	Unit Price	Extended Price
~~1~~	~~4" HDPE SDR 17 Pipe~~	~~1~~	~~Ft~~	~~$1.35~~	~~$1.35~~
~~2~~	~~4" HDPE SDR 17 Perforated Pipe~~	~~1~~	~~Ft~~	~~$2.03~~	~~$2.03~~
~~3~~	~~4" HDPE SDR 17 Tee~~	~~1~~	~~Ea~~	~~$18.75~~	~~$18.75~~
~~4~~	~~4" HDPE SDR 17 Cross~~	~~1~~	~~Ea~~	~~$83.75~~	~~$83.75~~
5	4" HDPE End Cap	1	Ea	$10.00	$10.00

Quote Total	$115.88
Sales Tax @ 6%	$6.95
Est. Freight	included
TOTAL	$122.83

Mark W. VanVaerenbergh

Mark Van Vaerenbergh
Ph: (813) 433-3384 / Fax: (866) 580-7009
mark.vanvaerenbergh@isco-pipe.com

Sales tax will be charged based on the ship-to addressat the time of invoice if there is not a tax-exempt certificate on file. Freight will be charged based on the terms agreed to at time order is placed. The pricing and freight terms set forth in this quote are based strictly on the quantities and delivery schedule if stated. If these varibles change per the customers request, ISCO reservies the to adjust the pricing and freight terms accordingly

PO Number:	______________	**By:**	______________
Job Name:	______________	**Date:**	______________

ATTACHMENT 3

Labor and Markup Rate Schedules

Code	Personnel	Standard	IESI	WMI PA	Multiplier	Bare Labor	Special	United	Lanchester
54	REGIONAL MANAGER	$195.00	$125.00	$140.00	$0.00	$50.00	$0.00	$110.00	$140.00
54	SR. PROJECT SUPERINTENTDENT	$110.00	$82.00	$80.00	$0.00	$40.00	$0.00	$72.00	$80.00
54	SR. PROJECT SUPERINTENTDENT OT	$165.00	$82.00	$80.00	$0.00	$40.00	$0.00	$72.00	$80.00
54	PROJECT SUPERINTENDENT	$95.00	$72.00	$72.00	$0.00	$30.00	$0.00	$56.00	$70.00
54	PROJECT SUPERINTENDENT (OT)	$142.50	$100.80	$100.80	$0.00	$42.00	$0.00	$78.40	$98.00
52	Project Forman	$72.00	$52.00	$44.00	$0.00	$22.00	$0.00	$42.00	$46.00
52	SENIOR TECHNICIAN (OT)	$108.00	$72.80	$61.60	$0.00	$30.80	$0.00	$58.80	$64.40
52	TECHNICIAN	$50.00	$40.00	$39.00	$0.00	$17.00	$0.00	$32.00	$40.00
52	TECHNICIAN (OT)	$70.00	$56.00	$54.60	$0.00	$23.80	$0.00	$44.80	$56.00
79	LABORER	$46.00	$34.00	$30.00	$0.00	$12.00	$0.00	$28.00	$30.00
79	LABORER (OT)	$66.00	$47.60	$42.00	$0.00	$16.80	$0.00	$39.20	$42.00
2	PROJ. ADMIN.	$65.00	$47.00	$44.00	$0.00	$21.00	$0.00	$42.00	$47.00
3	SECRETARY/ADMIN. ASST.	$45.00	$42.00	$42.00	$0.00	$15.38	$0.00	$36.00	$42.00
	OTHER DIRECT COST MARKUP	15%	12%	10%	15%	15%	15%	15%	15%
	LABOR MARKUP	100%	100%	100%	273%	230%	100%	100%	100%

Performance Bonding Cost: $25/$1K up to $100K, $15/$1K on next $400K

TRUCK MILEAGE: $ 100.00 per day

HELP

ATTACHMENT 4

(813) 626-7368

QUOTE

CONTACT	FAX
Joyce Belen	
SCS Engineers	

NEFF SALES REP
Patrick Sansotta
FAX
813 621 9284

Email
tamcounter@neffcorp.com

Approved By Neff (If Applicable)

QUANTITY	EQUIPMENT DESCRIPTION	SALE PRICE	DAILY RENTAL	WEEKLY RENTAL	4-WEEK RENTAL	TOTAL
1	30-40 KW Generator		135	250	685	

15% LDW unless Loss Coverage is provided. 1.5% Environmental fee may apply.

SUBTOTAL	
TAX	
DELIVERY	
PICK-UP	
PRICE	

6/24/09

Quote Expires 30 Days After This Date Unless Noted In the Comments Below

COMMENTS

ENVIRONMENTAL FEE $7.85

THE NEFF RENTAL COMMITMENT

QUALITY EQUIPMENT • ON-TIME DELIVERY

24/7 SERVICE • ACCURATE BILLING

NEFF RENTAL • WWW.NEFFRENTAL.COM • 888-709-NEFF

Belen, Joyce

From: Mark VanVaerenbergh [Mark.VanVaerenbergh@isco-pipe.com]
Sent: Wednesday, June 24, 2009 5.57 PM
To: Belen, Joyce
Subject: RE: 4" Fusion Machine

McElroy No 14 rents for $55.00/day. This unit will fuse HDPE pipe sizes 1" through 4". A 3-4 KW generator is needed to power the facer and heater. This is noemally supplied by the customer or you can rent it for $60.00 per day.

Mark Van Vaerenbergh
ISCO industries, LLC
mark.vanvaerenbergh@isco-pipe.com
(800) 345-4726 ext. 6739

From: Belen, Joyce [JBelen@scsengineers.com]
Sent: Wednesday, June 24, 2009 1:43 PM
To: Mark VanVaerenbergh
Subject: 4" Fusion Machine

Mark,
Can you also give me information about 4" fusion machine rental? Our field services crew told me that they also use ISCO Pipe for fusion machine rental.

Joyce Belen, E.I.
Staff Engineer
SCS ENGINEERS
4041 Park Oaks Blvd
Suite 100
Tampa, FL 33610
813-621-0080 (Office)
813-623-6757 (Fax)
jbelen@scsengineers.com
http://www.scsengineers.com

Attachment 1.

Florida Department of Environmental Protection

Southwest District Office
13051 North Telecom Parkway
Temple Terrace, Florida 33637-0926

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

Ms. Susan Metcalfe, P.G., Director
Citrus County Solid Waste Division
P.O. Box 340
Lecanto, Fl. 34460-0340

April 1, 2009

RE: Citrus County Central Class I Landfill Phase 3 Expansion
Financial Assurance Cost Estimates
Pending Permit No.: 21375-013-SC/01, Citrus County
WACS No.: SWD/09/39859

Dear Ms. Metcalfe:

This letter is to acknowledge receipt of the revised cost estimates dated and received December 10, 2008 and March 5, 2009 as Attachment S-1 of Citrus County Class I Central Landfill Phase 3 Expansion Construction Permit Application, prepared by SCS Engineers for closure and long-term care of the Citrus County Landfill (Phases 1, 1A, 2, & 3 and the old 60 acre landfill). The revised cost estimates received on December 10, 2008 and March 5, 2009 (total for closing $5,503,120.00 and [redacted] x 30 years= $4,941,676.00), are **APPROVED for 2009**. The approved estimates are for closing 31.2 acres (Phases 1, 1A, 2, & 3) and long-term care of 91.2 acres. The next annual update (revised or inflation-adjusted estimates) is due no later than **September 1, 2009**.

A copy of these estimates will be forwarded to Mr. Fred Wick, Solid Waste Section, FDEP, 2600 Blair Stone Road, Tallahassee, Florida 32399-2407. Please work with him directly to assess the facility's compliance with the funding mechanism requirements of Rule 62-701.630, F.A.C. Please note that approval of the proof of financial assurance funding shall be required prior to issuance of an operation permit for Phase 3. If you have any questions, you may contact me at (813) 632-7600 ext. 385.

Sincerely,

Steven G. Morgan
Solid Waste Section
Southwest District

sgm

cc. Carmen Bruno, carmen.bruno@bocc.citrus.fl.us
Dominique Bramlett, P.E., SCS Engineers, dbramlett@scsengineers.com
John Banks, P.E., SCS Engineers, jbanks@scsengineers.com
Patty Jefferson, Citrus County, patty.jefferson@bocc citrus.fl.us
Frank Hornbrook, FDEP, Tallahassee (e-mail)
John Morris, P G., FDEP Tampa (e-mail)
Susan Pelz, P E , FDEP Tampa (e-mail)

Attachment 2

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Tampa
6712 Benjamin Road
Suite 100
Tampa, FL 33634

Tel: (813) 885-7427
Fax: (813) 885-7049
www.testamericainc.com

May 30, 2008

Ms. Dominique Bramlett
SCS Engineers
4041 Park Oaks Blvd
Suite 100
Tampa, FL 33610
DBramlett@SCSEngineers.com

Subject: Request for Proposal
Citrus County Landfill
Quote Number: 66002177

Dear Ms. Dominique Bramlett,

On behalf of TestAmerica Laboratories, Inc., and its affiliates, I am pleased to submit pricing for the Citrus County Landfill. TestAmerica is eager to support this commitment by making our personnel and analytical laboratory resources available to you. As the largest environmental laboratory company in the world TestAmerica offers a full range of analytical services in one company

We thank you for choosing TestAmerica Laboratories, and we look forward to working with you for this project. The following quotation contains a detailed price breakdown, as well as any notes and clarifications pertaining to your project. This quotation is subject to TestAmerica's Standard Terms and Conditions, unless otherwise agreed upon in writing. Should you have any further questions or require additional information about our analytical services, please feel free to contact me at 813-885-7427 or via email at the address listed below

Sincerely,

Tina Fritz
Customer Service Manager
tina.fritz@testamericainc com
813-918-9088

TestAmerica Tampa
6712 Benjamin Road
Suite 100
Tampa, FL 33634

Prepared for:

Ms. Dominique Bramlett
SCS Engineers
4041 Park Oaks Blvd
Suite 100
Tampa, FL 33610
DBramlett@SCSEngineers.com

Prepared by Fritz, Tina
Date 5/30/2008
Expiration Date 8/29/2008
Est Start Date

Project: Citrus County Landfill	*Quote Number: 66002177 - 0*

Surface Water - Stormwater Discharge TAT: 10_Days (Business Days)

Matrix	Method	Test Description	Quantity	Unit Price	Extended Price
Water	365 4	Total Phosphorus	1	$ 25 00	$ 25.00
Water	353 2	Nitrogen, Nitrate	1	$ 25 00	$ 25 00
Water	SM 5310C	Total Organic Carbon	1	$ 40 00	$ 40 00
Water	351.2	Nitrogen, Total Kjeldahl	1	$ 30 00	$ 30.00
Water	Total Nitrogen	Total Nitrogen	1	$ 10 00	$ 10 00
Water	SM 5220D	Chemical Oxygen Demand	1	$ 25 00	$ 25.00
Water	SM 9222D	Fecal Coliform (6 hour hold time)	1	$ 40.00	$ 40 00
Water	SM 5210B	5 Day BOD test	1	$ 40 00	$ 40 00
Water	SM 2540C	Total Dissolved Solids	1	$ 18 00	$ 18 00
Water	SM 2540D	Total Suspended Solids	1	$ 18 00	$ 18.00
Water	200.7 Rev 4.4	Appendix 1 Metals + Iron	1	$ 100.00	$ 100 00
Water	8260B	8260 Appendix I Compounds	1	$ 90.00	$ 90.00
Water	8011	EDB and DBCP	1	$ 60 00	$ 60 00

Surface Water - Stormwater Discharge TAT: 10_Days (Business Days) (to be analyzed by Pensacola)

Matrix	Method	Test Description	Quantity	Unit Price	Extended Price
Water	1631E	Low Level Mercury and Field Blank	1	$ 180.00	$ 180 00
		Total Surface Water - Stormwater Discharge			**$ 741.00**

Leachate Influent TAT: 10_Days (Business Days)

Matrix	Method	Test Description	Quantity	Unit Price	Extended Price
Water	350 1	Ammonia	1	$ 20 00	$ 20 00
Water	353 2	Nitrogen, Nitrate	1	$ 25 00	$ 25 00
Water	SM 2540C	Total Dissolved Solids	1	$ 18.00	$ 18 00
Water	200 7 Rev 4 4	Appendix 1 Metals + Iron and Sodium	1	$ 100 00	$ 100 00
Water	8260B	8260 Appendix I Compounds	2	$ 90 00	$ 180 00
Water	8011	EDB and DBCP	1	$ 60.00	$ 60 00
Water	SM 2320B	Bicarbonate	1	$ 15 00	$ 15 00
Water	300 0	Chloride	1	$ 18 00	$ 18 00

Leachate Influent TAT: 10_Days (Business Days) (to be analyzed by Pensacola)

Matrix	Method	Test Description	Quantity	Unit Price	Extended Price

TestAmerica Tampa
6712 Benjamin Road
Suite 100
Tampa, FL 33634

Prepared for:

Ms. Dominique Bramlett
SCS Engineers
4041 Park Oaks Blvd
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DBramlett@SCSEngineers.com

Prepared by	Fritz, Tina
Date	5/30/2008
Expiration Date	8/29/2008
Est Start Date	

Project: Citrus County Landfill — *Quote Number: 66002177 - 0*

Leachate Influent **TAT: 10_Days (Business Days)** **(to be analyzed by Pensacola)**

Matrix	Method	Test Description	Quantity	Unit Price	Extended Price
Water	1631E	Low Level Mercury and Field Blank	1	$ 180 00	$ 180 00
		Total Leachate Influent			**$ 616.00**

Quote Other Charges

Description	Quantity	Unit Price	Extended Price
Compositing fee for Leachate Influent	1	$ 25 00	$ 25 00
Equipment - Decon - Daily	1	$ 50 00	$ 50 00
Services - Sampling (hourly)	1	$ 75.00	$ 75 00
Travel - Mileage (estimated per trip)	100	$ 0 50	$ 50 00
Total Other Charge			**$ 200.00**

Total Other Charges	**$ 200.00**
Total Analysis Charges	**$ 5,579.00**
Grand Total for Quote 66002177	**$ 5,779.00**

**Quoted charges do not include sales tax. Applicable sales tax will be added to invoices where required by law

Environmental Consultants
and Contractors

4041 Park Oaks Boulevard
Suite 100
Tampa, FL 33610

813 621-0080
FAX 813 623-6757
www scsengineers.com

SCS ENGINEERS

SCS ENGINEERS FEE SCHEDULE

(Effective July 1, 2008 through June 30, 2009)

	Rate/Hour ($)
Principal/Office Director	195
Project Director	185
Senior Project Advisor	145
Senior Project Manager	145
Project Manager	135
Senior Project Professional	112
Senior Superintendent	110
Project Professional	92
Designer	98
O&M Superintendent	95
Staff Professional	85
Senior Technician 2	85
Senior Technician 1	65
Associate Staff Professional	72
Draftsperson	70
Technician	60
Office Services Manager	75
Secretarial/Clerical	54

1. The hourly rates are effective through June 30, 2009. Work performed thereafter is subject to a new Fee Schedule issued for the period beginning July 1, 2009.

2. The above rates include salary, overhead, administration, and profit. Other direct expenses, such as analyses of air, water and soil samples, reproduction, travel, subsistence, subcontractors, computers, and other reimbursable fees, are billed in accordance with the attached reimbursables fee schedule or cost, plus 15 percent for administration.

3. For special situations, such as expert court testimony, hourly rates for principals of the firm will be on an individually-negotiated basis.

Florida Department of Transportation
Item Average Unit Cost
From 2007/01/01 to 2007/12/31

ontract Type: ('CC') STATEWIDE
isplaying: VALID ITEMS WITH HITS
rom: 0100 To: 1999999999

tem	No. of Conts	Weighted Average	Total Amount	Total Quantity	Unit Meas	Obs?	Description
550 10150	2	$11.57	$1,216,727.68	105,185.600	LF	N	FENCING, TYPE A, 8.1-10 0', STANDARD
550 10220	20	$13 08	$498,877.75	38,130 000	LF	N	FENCING, TYPE B, 5.1-6 0, STANDARD
550 10221	1	$18.25	$85,008 50	4,658 000	LF	N	FENCING, TYPE B, 5 1-6.0, W/ BARB ATTMT
550 10222	14	$16.46	$1,290,275 97	78,369 600	LF	N	FENCING, TYPE B, 5 1-6.0, W/ VINYL COAT
550 10228	3	$12 91	$13,413.00	1,039.000	LF	N	FENCING, TYPE B, 5.1-6 0, RESET EXISTING
550 10240	2	$32.62	$21,987.00	674 000	LF	N	FENCING, TYPE B, 7.1-8.0', STANDARD
550 10250	1	$19 50	$4,446.00	228.000	LF	N	FENCING, TYPE B, 8 1-10 0', STANDARD FEA
550 10343	1	$100 00	$156,000.00	1,560.000	LF	N	FENCING, TYPE R, 7 1-8 0, W/FULL ENCLOS
550 10353	2	$405 11	$195,262.46	482.000	LF	N	FENCING, TYPE R, 8 1-10', W/FULL ENCLOS
550 10918	1	$73 50	$1,470 00	20 000	LF	N	FENCING,SPECIAL TYP, 0 0-5.0', RESET EXI
550 10929	2	$29.23	$201,074 00	6,880 000	LF	N	FENCING, SPECIAL TYPE, 5 1-6 0', SPECIAL
550 60124	1	$1,100 00	$1,100.00	1 000	EA	N	FENCE GATE,TYP A, DBL, 18 1-20.' OPENING
550 60127	1	$2,500 00	$2,500.00	1 000	EA	N	FENCE GATE,TYP A,DBL, > THAN 30' OPENING
550 60211	2	$865 00	$1,730.00	2 000	EA	N	FENCE GATE,TYP B,SGL, 0- 6.0' OPENING
550 60212	1	$1,500.00	$4,500 00	3 000	EA	N	FENCE GATE,TYP B,SGL,6.1-12 0' OPENING
550 60222	3	$1,337.78	$12,040 00	9 000	EA	N	FENCE GATE,TYP B, DBL, 6.1-12 0' OPENING
550 60223	3	$2,023 36	$20,233.63	10.000	EA	N	FENCE GATE,TYP B, DBL,12 1-18.0' OPENING
550 60224	5	$1,295 18	$22,018.11	17.000	EA	N	FENCE GATE,TYP B, DBL,18 1-20 0' OPENING
550 60225	5	$2,356.67	$35,350.00	15 000	EA	N	FENCE GATE,TYP B, DBL, 20 1-24' OPENING
550 60227	1	$6,300.00	$6,300 00	1 000	EA	N	FENCE GATE,TYP B,DBL, > THAN 30' OPENING
550 60232	1	$1,200 00	$1,200 00	1 000	EA	N	FENCE GATE,TYP B,SLIDE/CANT,6 1-12'OPEN
550 60233	4	$3,037 50	$18,225 00	6 000	EA	N	FENCE GATE,TYP B,SLIDE/CANT,12 1-18'OPEN
550 60234	3	$2,334 00	$11,670 00	5 000	EA	N	FENCE GATE,TYP B,SLIDE/CANT,18 1-20'OPEN
550 60235	2	$4,250.00	$8,500 00	2 000	EA	N	FENCE GATE,TYP B,SLIDE/CANT,20 1-24'OPEN
550 60236	1	$3,700.00	$33,300 00	9 000	EA	N	FENCE GATE,TYP B,SLIDE/CANT,24 1-30'OPEN
550 60925	2	$3,295 20	$16,476 00	5.000	EA	N	GATE, SPECIAL, DOUBLE, 20 1-24' OPENING
550 60933	1	$6,558 00	$6,558.00	1 000	EA	N	GATE,SPECIAL,SLIDING/CANT, 12 1-18' OPEN
550 60934	1	$7,580 00	$15,160 00	2 000	EA	N	FENCE GATE,SPL,SLIDE/CANT,18.1-20'OPEN
550 60935	1	$7,500 00	$22,500 00	3 000	EA	N	FENCE GATE,SPL,SLIDE/CANT,20.1-24'OPEN
555 1 1	52	$20 67	$3,389,539 19	163,946.000	LF	N	DIRECTIONAL BORE, LESS THAN 6"
555 1 2	41	$24.95	$1,127,550.58	45,200 000	LF	N	DIRECTIONAL BORE, 6" TO < 12"
555 1 3	2	$131 96	$47,770 00	362 000	LF	N	DIRECTIONAL BORE, 12" TO < 18"
555 1 6	1	$802 00	$789,970.00	985 000	LF	N	DIRECTIONAL BORE, 36" TO < 48"
556 1 2	3	$251 65	$124,065 00	493 000	LF	N	JACK AND BORE, CASE DIA 6"TO<12"
556 1 4	4	$232 07	$381,760.70	1,645 000	LF	N	JACK AND BORE, CASE DIA 18"TO<24"

SCS ENGINEERS

SHEET ______ OF ______

CLIENT CITRUS COUNTY	PROJECT 7-ACRE CLOSED AREA RE-CLOSURE	JOB NO 09207049.03
SUBJECT FINANCIAL ASSURANCE COST ESTIMATE	BY JPB	DATE 6/24/09
	CHECKED D. Perwyer	DATE 7/1/09

OBJECTIVE TO CALCULATE COST TO REPLACE WELLHEADS WITH GOOSENECK VENT AS PART OF CLOSURE CONSTRUCTION. THERE ARE $\boxed{\text{19 WELLHEADS}}$ TO BE REPLACED. For closure, the extraction wells will be converted to passive vents.

CALCULATIONS

<u>MATERIAL COST</u>

6" SCH. 80 PVC PIPE : \$7.03/FT (1) (ATTACH. 1)
2 - 6" SCH 80 PVC 90-DEG. ELBOW : \$85.00 EA (ATTACH. 1)
4" HDPE END CAP (2) : \$10.00 EA (ATTACH. 2)

MATERIAL COST PER VENT
(\$7.03/2) + \$85.00 + \$10.00 = \$98.52 ✓

<u>LABOR COST</u> : (SEE ATTACHMENT 3 FOR FEE SCHEDULE)
PER CONVERSATION WITH SCS FIELD SERVICES, IT WOULD TAKE APPROXIMATELY 2 (8 hour) DAYS FOR 2 TECHNICIANS TO FINISH THE WORK.

STANDARD FEE : \$50.00/HR (Technician).
TOTAL LABOR COST : 2 × 16 HOURS × \$50.00/HR = \$1,600 ✓
LABOR COST PER VENT : \$1,600/19 = \$84.21 EA ✓

<u>EQUIPMENT COST</u> :
35KW GENERATOR : \$135/DAY (ATTACHMENT 4)
4" FUSION MACHINE : \$55.00/DAY (ATTACHMENT 5)
EQUIPMENT COST PER VENT:
[(\$135/DAY × 2 DAYS) + (\$55/DAY × 2 DAYS)]/19 = \$20/VENT ✓

TOTAL COST PER VENT:
\$98.52 + \$84.21 + \$20 = $\boxed{\$202.73}$ ✓

TOTAL COST :
19 × \$202.73 = $\boxed{\$3,852}$ ✓

NOTES : (1) EACH VENT WOULD ONLY REQUIRE 6 INCHES TO CONNECT THE 2 90-DEGREE ELBOWS
(2) TO ABANDON THE HDPE LATERAL RISER

ATTACHMENT 1

ISCO INDUSTRIES
ISCO Industries
926 Baxter Avenue
Louisville, KY 40204
800-345-4726

Quotation

QUOTE #	09004821
LOCATION	009
DATE	06/23/09
PAGE	1 OF 1

BILL TO
103705
SCS FIELD SERVICES, INC.
3900 KILROY AIRPORT WAY, STE. 1
LONG BEACH, CA 90806

SHIP TO
SCS FIELD SVCS
3211 WEST RUSTY PL
CITRUS SPRINGS, FL 34433

QUOTE DATE	EXPIRE DATE	REQUIRED DATE	REFERENCE NUMBER	PAYMENT TERMS
06/23/09	07/08/09			NET 30
WRITTEN BY: MARK V., Ext. 6739			CONTACT: JOYCE BELEN	SHIP VIA: BEST WAY
FREIGHT TERMS: PREPAID AND ADD			JOB NUMBER:	SALES REP: MARK VANVAERENBERGH

PRODUCT/DESCRIPTION	QUANTITY	PRICE	U/M	EXTENSION
63060022 ~~6" SCH 80 SXS COUPLING~~ ~~#829-060~~ Not needed for well conversion	~~1~~	~~15.50~~	~~EA~~	~~15.50~~
63060013 6" SCH 80 PVC PIPE PE X BE	1	7.03	FT	7.03
63069999 6" SCH 80 PVC 180 DEGREE ELBOW (2 90 ELBOW)	1	85.00	EA	85.00

Sales tax will be charged based on the ship-to address at the time of invoice if there is no tax certificate on file. Freight will be charged based on terms agreed upon at the time the order is placed.

US $

MERCHANDISE TOTAL	HANDLING	MISC CHARGE	TAX	FREIGHT	QUOTE TOTAL
107.53	0.00	0.00	6.45	0.00	113.98

Accepted: By: ____________________
Date: ______________

Please contact your ISCO representative at 800-345-4726 to place your order.

ATTACHMENT 2

ISCO INDUSTRIES

Engineering Estimate - ISCO Industries, LLC

Quote #:	09-0423-001
Date:	April 23, 2009
Exp. Date:	May 8, 2009

Bill To:
SCS Engineers
Joyce Belene

Ship To:

Sales Contact	Payment Terms	Freight Terms	Ship Via
Mark Van Vaerenbergh	Net 30 days	PPD & Allowed	Best Way

Item #	Description	Qty	U/M	Unit Price	Extended Price
~~1~~	~~4" HDPE SDR 17 Pipe~~	~~1~~	~~Ft~~	~~$1.35~~	~~$1.35~~
~~2~~	~~4" HDPE SDR 17 Perforated Pipe~~	~~1~~	~~Ft~~	~~$2.03~~	~~$2.03~~
~~3~~	~~4" HDPE SDR 17 Tee~~	~~1~~	~~Ea~~	~~$18.75~~	~~$18.75~~
~~4~~	~~4" HDPE SDR 17 Cross~~	~~1~~	~~Ea~~	~~$83.75~~	~~$83.75~~
5	4" HDPE End Cap	1	Ea	$10 00	$10.00

Quote Total	$115.88
Sales Tax @ 6%	$6.95
Est. Freight	included
TOTAL	$122.83

Mark W. VanVaerenbergh

Mark Van Vaerenbergh
Ph: (813) 433-3384 / Fax: (866) 580-7009
mark.vanvaerenbergh@isco-pipe.com

Sales tax will be charged based on the ship-to addressat the time of invoice if there is not a tax-exempt certificate on file. Freight will be charged based on the terms agreed to at time order is placed. The pricing and freight terms set forth in this quote are based strictly on the quantities and delivery schedule if stated. If these varibles change per the customers request, ISCO reservies the to adjust the pricing and freight terms accordingly

PO Number: ______________________ **By:** ______________________

Job Name: ______________________ **Date:** ______________________

ATTACHMENT 3

Labor and Markup Rate Schedules

Code	Personnel	Standard	IESI	WMI PA	Multiplier	Bare Labor	Special	United	Lanchester
54	REGIONAL MANAGER	$195.00	$125.00	$140.00	$0.00	$50.00	$0.00	$110.00	$140.00
54	SR PROJECT SUPERINTENTDENT	$110.00	$82.00	$80.00	$0.00	$40.00	$0.00	$72.00	$80.00
54	SR PROJECT SUPERINTENTDENT OT	$165.00	$82.00	$80.00	$0.00	$40.00	$0.00	$72.00	$80.00
54	PROJECT SUPERINTENDENT	$95.00	$72.00	$72.00	$0.00	$30.00	$0.00	$56.00	$70.00
54	PROJECT SUPERINTENDENT (OT)	$142.50	$100.80	$100.80	$0.00	$42.00	$0.00	$78.40	$98.00
52	Project Forman	$72.00	$52.00	$44.00	$0.00	$22.00	$0.00	$42.00	$46.00
52	SENIOR TECHNICIAN (OT)	$108.00	$72.80	$61.60	$0.00	$30.80	$0.00	$58.80	$64.40
52	TECHNICIAN	$50.00	$40.00	$39.00	$0.00	$17.00	$0.00	$32.00	$40.00
52	TECHNICIAN (OT)	$70.00	$56.00	$54.60	$0.00	$23.80	$0.00	$44.80	$56.00
79	LABORER	$46.00	$34.00	$30.00	$0.00	$12.00	$0.00	$28.00	$30.00
79	LABORER (OT)	$66.00	$47.60	$42.00	$0.00	$16.80	$0.00	$39.20	$42.00
2	PROJ ADMIN	$65.00	$47.00	$44.00	$0.00	$21.00	$0.00	$42.00	$47.00
3	SECRETARY/ADMIN ASST	$45.00	$42.00	$42.00	$0.00	$15.38	$0.00	$36.00	$42.00
	OTHER DIRECT COST MARKUP	15%	12%	10%	15%	15%	15%	15%	15%
	LABOR MARKUP	100%	100%	100%	273%	230%	100%	100%	100%

Performance Bonding Cost: $25/$1K up to $100K; $15/$1K on next $400K

TRUCK MILEAGE. $ 100.00 per day

HELP

ATTACHMENT 4

(813) 626-7368

QUOTE

CONTACT	FAX
Joyce Belen	
SCS Engineers	

NEFF SALES REP
Patrick Sansotta
FAX
813 621 9284

Email
tamcounter@neffcorp.com

Approved By Neff (If Applicable)

QUANTITY	EQUIPMENT DESCRIPTION	SALE PRICE	DAILY RENTAL	WEEKLY RENTAL	4-WEEK RENTAL	TOTAL
1	30-40 KW Generator		135	250	685	

15% LDW unless Loss Coverage is provided. 1.5% Environmental fee may apply.

SUBTOTAL	
TAX	
DELIVERY	
PICK-UP	
PRICE	

6/24/09

Quote Expires 30 Days After This Date Unless Noted In the Comments Below

COMMENTS

ENVIRONMENTAL FEE $7.85

THE NEFF RENTAL COMMITMENT

QUALITY EQUIPMENT • ON-TIME DELIVERY
24/7 SERVICE • ACCURATE BILLING

ATTACHMENT 5

Belen, Joyce

From: Mark VanVaerenbergh [Mark.VanVaerenbergh@isco-pipe.com]
Sent: Wednesday, June 24, 2009 5:57 PM
To: Belen, Joyce
Subject: RE: 4" Fusion Machine

McElroy No 14 rents for $55.00/day. This unit will fuse HDPE pipe sizes 1" through 4". A 3-4 KW generator is needed to power the facer and heater. This is noemally supplied by the customer or you can rent it for $60.00 per day.

Mark Van Vaerenbergh
ISCO industries, LLC
mark.vanvaerenbergh@isco-pipe.com
(800) 345-4726 ext. 6739

From: Belen, Joyce [JBelen@scsengineers.com]
Sent: Wednesday, June 24, 2009 1:43 PM
To: Mark VanVaerenbergh
Subject: 4" Fusion Machine

Mark,
Can you also give me information about 4" fusion machine rental? Our field services crew told me that they also use ISCO Pipe for fusion machine rental.

Joyce Belen, E.I.
Staff Engineer
SCS ENGINEERS
4041 Park Oaks Blvd
Suite 100
Tampa, FL 33610
813-621-0080 (Office)
813-623-6757 (Fax)
jbelen@scsengineers.com
http://www.scsengineers.com