

**CITY OF SANTA FE
LANDFILL CLOSURE AND
POST CLOSURE PLAN**

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Prepared For:

City of Santa Fe

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1.0 INTRODUCTION

The closure of an active disposal site is currently regulated by both federal and state statutes. The federal legislation for solid waste management, including closure and post closure activity, is covered by the Resource Conservation and Recovery Act (RCRA), enacted in 1976. The United States Environmental Protection Agency (USEPA) issued the Subtitle "D" regulations in October 1991. Subtitle "D" establishes the criteria for municipal solid waste (MSW) landfills with respect to:

- Location restrictions;
- Facility design and operation;
- Groundwater monitoring requirements;
- Methane gas monitoring requirements;
- Closure requirements;
- Post-closure requirements.

The State of New Mexico solid waste management regulations (SWMR-4) present the general format for closure plans, and requirements for the long-term care and post-closure activities.

This document presents the city's plans for closure and post-closure of the City of Santa Fe Landfill.

2.0 HISTORICAL BACKGROUND

2.1 Age and Waste Inventory

The existing City of Santa Fe Landfill is owned and operated by the City and began receiving solid waste in 1969. It is located on approximately 110 acres of land in the northwest part of the city, bounded by the Arroyo de las Trampas to the north, Buckman Road to the east and Paseo de Las Vistas to the south. See Figure 2-1 for a location map. Since the landfill occupies a long and narrow parcel which slopes from Paseo de las Vistas down to the Arroyo de las Trampas, the method of operation has relied primarily on filling the wedge-shaped space between the road and the arroyo. Over the years of operation, solid waste has been placed in these "wedges" along the slope which results in a thick layer of waste near the arroyo, decreasing in thickness as it approaches the road. In the past few years, due to diminishing virgin land on which to place solid waste, the City has excavated deep waste disposal trenches. These pits have enabled the City to extend the life of the landfill until a new Regional landfill is opened. *drain arroyo?*

Recent subsurface work performed at the landfill, including a seismic refraction survey and borings through the solid waste, has indicated that the depth of solid waste in the landfill varies from 60 feet to 3 feet deep. The total volume of solid waste in the landfill is uncertain, since scales have only been used since 1989 to record incoming loads. Annual estimates of incoming waste prior to 1989 were made through a calculation of Santa Fe population and daily per capita waste generation rates. (See Table 2-1.) After the pre- and post-1989 figures were totaled, an in-place compaction of 1,000 pounds per cubic yard was assumed and a 10 percent volume addition for daily cover was included. The total waste inventory is approximately 5,621,000 cubic yards.

2.2 Subsurface Investigations

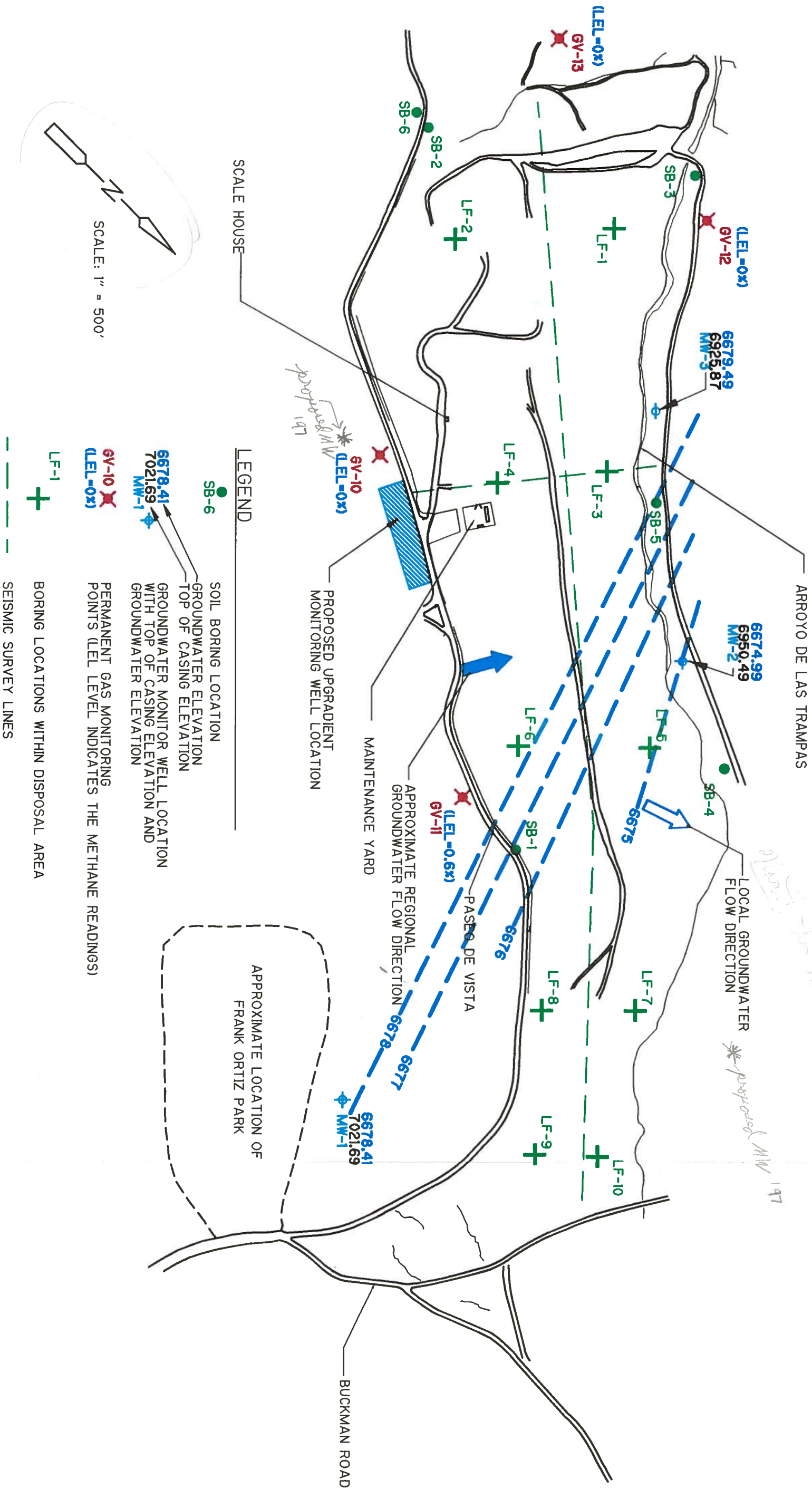
A subsurface investigation was performed at the existing landfill in the autumn of 1994. Holes were bored through the trash and samples recovered to determine the moisture content of the waste and of the soil for up to ten feet below the waste/soil interface. Such moisture content tests will indicate the extent of leachate accumulation in the waste and soil layers.

The soil beneath the waste was also tested for hydraulic conductivity, grain size distribution, and Atterberg limits. The native soil beneath the landfill was classified as a silty sand (SM) to a poorly graded sand (SP) with an average moisture content of approximately six (6) percent by weight. The hydraulic conductivities for this material ranged from 4.06×10^{-5} cm/sec to 5.3×10^{-5} cm/sec. The relatively low moisture content values measured where the native soil contacts the refuse is indicative of natural conditions and does not indicate large quantities of leachate accumulation.

There are currently three groundwater monitoring wells adjacent to the landfill. The depth to groundwater beneath the landfill ranges from 247 feet to 340 feet. The regional groundwater flow is in a north to northwesterly direction. The local groundwater flow is in a northerly direction. See Figure 2-2 for the location of various borings, vents, wells, and groundwater flow direction. *✓*

The soil at the base of the landfill was also analyzed for inorganic and organic constituents typically found in leachate. Indicators of leachate (nitrate, chloride, and ammonia) were minimal or not detected. A copy of the subsurface investigation report is included in Appendix A.

Table 2-1 Schedule of Landfill Receipts (Tons/Year)			
Year	Estimated Amount	Year	Estimated Amount
1968	0	1982	90,600
1969	73,000	1983	91,900
1970	74,400	1984	93,300
1971	75,700	1985	94,600
1972	77,000	1986	96,000
1973	78,400	1987	97,300
1974	79,800	1988	98,700
1975	81,000	1989	100,000
1976	82,500	1990	101,400
1977	83,800	1991	102,700
1978	85,200	1992	104,000
1979	86,500	1993	105,400
1980	87,900	1994	106,800
1981	89,200	1995	108,100
		TOTAL	2,445,200



3.0 CLOSURE

3.1 Introduction

A closure plan for an active disposal area is intended to ensure that the following criteria are met:

- That the landfill is closed according to applicable federal, state and local regulations.
- That the appropriate controls are in place for the minimization/management of leachate, landfill gases, and stormwater.
- That the approved final land use for the area is achieved.

These closure criteria are successfully met through the application of such design considerations as:

- Final cover contours
- Selection of appropriate cap system
- Design and construction of adequate stormwater collection and conveyance system
- Design and construction of gas mitigation and management system

The following sections present a discussion of these items, and provide the basis for the closure plan for the City of Santa Fe Municipal Solid Waste Landfill which will meet the criteria set forth in the New Mexico Solid Waste Regulations (SWMR-4), Part V: Closure and Post - Closure Requirements.

3.2 Final Cap

3.2.1 Cap System Design

The final cap is designed to protect the landfill from wind and water erosion. In addition, the final cap is designed to minimize infiltration of moisture through the solid waste layers. The final cap for the City of Santa Fe Landfill, designed to meet the New Mexico Solid Waste Regulation requirements, consists of the following (listed in order from bottom to top):

- A layer of daily cover soil consisting of native soils, varying in depth from six to twelve inches, to prepare the final lift of solid waste for capping.
- An 18-inch layer of soil with a permeability less than or equal to 1×10^{-5} cm/sec.;

show tests (X)

- A final 6-inch protective layer of native soil intermixed with chipped green waste, capable of sustaining plant growth;
- A layer of stones or cobbles, or other material, will be placed on the soil to protect against wind erosion;
- A seed mix of native species will be used to seed the top layer of soil prior to placement of the stones.

A profile of the cap design is shown in Figure 3-1.

The City will use soil from the north side of the Arroyo de las Trampas for the 18-inch layer of low permeability soil. This soil has been tested for permeability and meets the minimum regulatory requirements. See Appendix A for soil test results. The eighteen inches of 1×10^{-5} cm/sec. material will be transported with a scraper or belly dump truck and the material will be spread using a dozer. The material will then be compacted using a sheepsfoot roller. A water truck will provide water to achieve the specified compaction.

A vegetative cover is critical to maintaining the integrity of the final layer, protecting it from excessive wind and water erosion. Cover vegetation with a shallow root system is preferable to hold the final layer in place because the roots will not penetrate the infiltration layer below, thus violating the integrity of the cap. The six-inch vegetative cover will be a mixture of soil (4 parts), sludge (1 part), and wood chips (2 parts). The decontaminated sludge will be transported from the wastewater treatment plant to the landfill and placed in an area where it will be mixed with the soil and wood chips. The wood chips are generated from the Maxi-grinder machine at the landfill which chips all wood waste brought to the landfill. The six-inch vegetative cover will be placed using a dozer and evenly spread over the eighteen inches of low-permeability soil.

A mix of drought resistant vegetation will be established at the site and a layer of gravel will be placed over selected areas for wind and water erosion protection. A geosynthetic erosion control fabric consisting of curled wood excelsior sandwiched between biodegradable plastic mesh could be substituted for the gravel layer. After the six-inch vegetative cover soil has been placed, seeds will be drilled to a depth of 1/2 inch. The distance between the drilled furrows not be more than eight inches. All seeded areas will be mulched using hay at a rate of 2.5 tons per acre. The seed mix and planting rate to be used are as follows:

<u>Species</u>	<u>Pounds Pure Live Seed per Acre</u>
Blue Grama	2.0
Sideoats Grama	4.0
Galleta	3.0
Western Wheatgrass	4.0
Blue Flax	1.0
Firewheel	1.0
TOTAL	15.0

No fertilizer will be required. Seed will be planted July 1 through August 31. A dump truck will deliver the gravel to the site and a dozer will apply it evenly over the vegetative layer as an

erosion control measure. If the erosion control fabric is used in place of the gravel, it will be delivered to the site in rolls, unrolled across the vegetative layer, and secured using fasteners.

3.2.2 Final Cover Contours

An optimum final cover contour plan must balance the following factors: It must provide an adequate depth to final cover material while conforming to the existing topography wherever feasible to minimize soil volume requirements; it must employ cross- and side-slopes in accordance with regulatory requirements, minimizing erosion potential and maximizing stormwater runoff.

New Mexico solid waste regulations require final contours to have a minimum slope of 2 percent and a maximum slope of 25 percent. This range is used to promote surface water runoff while minimizing erosion. The slopes across the top of the closed City of Santa Fe Landfill have been designed between 2 and 5 percent. However, a portion of the existing sideslopes, particularly along the Arroyo de las Trampas exceed the maximum sideslope requirement of 25 percent. In a letter report to NMED dated July 18, 1995, three options were studied which address the violation of the sideslope criteria:

- (1) Relocation of the Arroyo de las Trampas;
- (2) Relocation of the waste material;
- (3) Existing slopes to remain, with erosion control measures

Due to the excessive engineering and construction expense of Options 1 and 2, and the potential health and safety dangers posed by option 2, the NMED was petitioned in the letter report to grant a variance on the sideslope requirement to allow for the implementation of option 3 (see Appendix B for letter report).

To date, no final cap has been placed over any part of the landfill. The proposed final contours are shown in Figure 3-2. The contours represent the top of the intermediate cover prior to installation of the 24-inch final cap. Should the regional landfill opening be delayed, an additional 10 foot lift would be placed across the southwest portion of the landfill (see Figure 3-2).

3.3 Stormwater Collection and Conveyance System

The AHYMO Method was used to determine the volume and peak stormwater flows generated from the drainage basins across the closed landfill site, and to analyze the flows in the Arroyo de las Trampas.

To minimize travel distance and velocity of stormwater across the closed landfill, and control erosion, the surface is divided into four smaller drainage areas. Each area slopes to swales which convey the stormwater to strategically-placed down-drain structures along the bank to the Arroyo de las Trampas. The arroyo will be armored with rip rap along the toe of the landfill to

minimize erosion, and special outlet structures will convey stormwater from the down-drains into the arroyo (see Figure 3-3).

3.4 Gas Control

Landfill gases are generated at most landfills in sufficient quantities to present a potential gas migration problem. If these gases are not managed properly, they could migrate laterally across subsurface soils until they reach the atmosphere. The gases could migrate harmfully close to populated areas, vegetative areas, or buildings. Methane gas, a common component of landfill gases, can destroy vegetation by displacing the oxygen from the plant's root zone. Landfill gases can also accumulate in underground pockets in quantities great enough to cause distortion, or worse, failure of the landfill capping system.

Four gas monitoring wells were installed along the perimeter of the site. See Figure 3-4 for a detail of the gas monitoring well. These wells and buildings within 500 feet of the limits of waste will be monitored regularly during the post-closure period as discussed in Section Four. All buildings on the landfill will be removed in conjunction with the closure.

3.5 Landfill Security

As of this date, the final land use planned for the closed landfill will be as open space. Surrounding the existing site is a 6-foot high chain link fence topped with barbed wire. A portion of this fence along Paseo de las Vistas will be replaced with a 4-foot high wood fence. The wood fence complements the residential nature of the neighborhood and still prevents vehicle access to the landfill. Limited access will be provided to hikers and for post closure inspection activities.

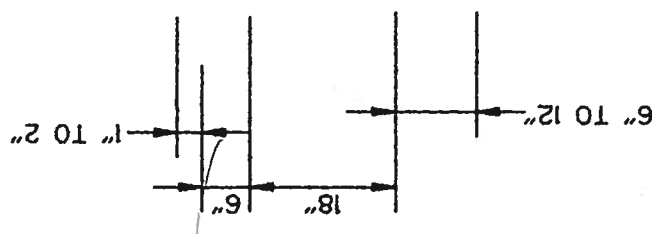
3.6 Schedule of Closure Activities

The City of Santa Fe plans to stop accepting solid waste by December 31, 1996, when the new Santa Fe regional landfill is scheduled to open. A schedule of closure activities is shown on Figure 3-5.

3.7 Final Land Use

The final land use, as approved by the City of Santa Fe Council, is open space. In the future, the council may approve alternative uses for the site. All future use plans will be submitted to NMED authorities for review, comment and approval.

"Stonehenge" Art



NATIVE GRASSES
EROSION PROTECTION LAYER (*Stone layer*)
VEGETATIVE LAYER
SOIL LAYER W/ 1×10^{-5} cm/sec PERMEABILITY
INTERMEDIATE COVER
REFUSE

CITY OF SANTA FE

LANDFILL CLOSURE SOIL CAP

DOWN DRAIN PIPE SECTION

SECTION 1

NOT TO SCALE

2

NOT TO SCALE

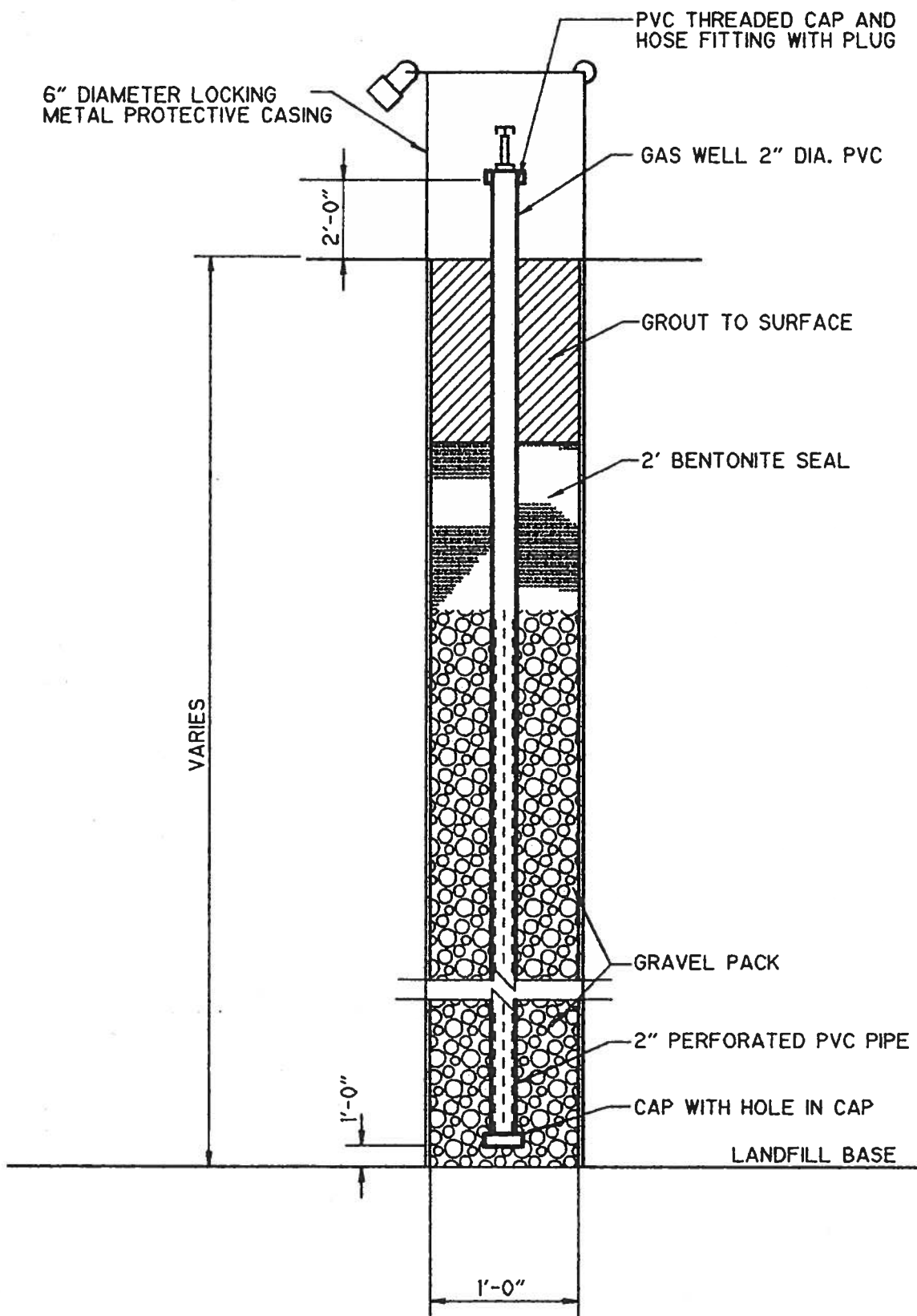
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FIG 3-4

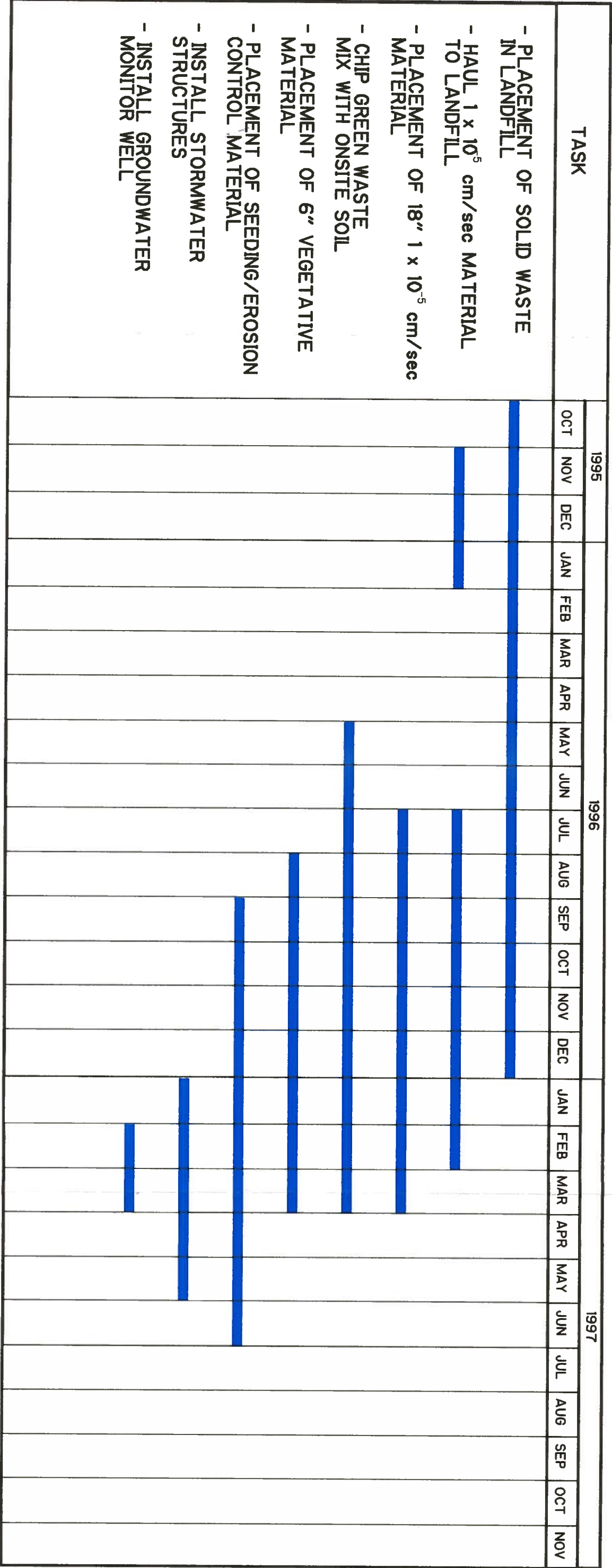
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CITY OF SANTA FE LANDFILL

TYPICAL GAS MONITORING WELL

CITY OF SANTA FE
LANDFILL CLOSURE
CONSTRUCTION SCHEDULE



4.0 POST-CLOSURE

4.1 Introduction

Post-closure care of the closed landfill is necessary to maintain the integrity of the final cap, to monitor the groundwater quality and to monitor methane generation. Post-closure care will be conducted for 30 years, unless reduced by the Secretary of the NMED.

The primary elements of this post-closure plan are:

- Inspection and maintenance of final cover
- Inspection and maintenance of stormwater control structures
- Adherence to gas monitoring program
- Adherence to a groundwater monitoring program

The following is a summary for each post-closure item.

4.2 Inspection and Maintenance of Final Cover

The entire site will be inspected quarterly for the 30-year post-closure period. Formal inspection records will be retained for examination. In particular, the final cover will be inspected for damage from settlement, wind and water erosion, or any other events. These inspections will be particularly critical following major storm events in the area, and will be conducted in addition to the regularly scheduled inspections. If damage is discovered, repairs such as regrading, stabilizing or revegetating will be made immediately to the affected area.

Fencing around the site will be maintained, and any trails through the site will be minimized. Trail inspection and repair will be included as a part of the inspection program.

4.3 Inspection and Maintenance of Stormwater Control Structures

Stormwater control structures will be inspected concurrently with the cover system. Stormwater control structures will be inspected for damage due to erosion, settlement and reduction in flow capacity due to the deposition of sediment and debris. Damaged areas will be identified, repaired as necessary, and noted on the inspection report.

4.4 Inspection and Maintenance of Leachate Collection System

The City of Santa Fe landfill does not have a leachate collection system. The results of the subsurface investigations, as shown in Appendix A, indicate that leachate generation is negligible. Therefore, no measures will be taken to collect leachate.

4.5 Groundwater Monitoring Program

The City of Santa Fe landfill has three groundwater monitoring wells at the site. Two existing groundwater monitoring wells are located downgradient (MW-2, MW-3) and will be used to detect groundwater problems at the site. Although an existing monitoring well (MW-1) is located upgradient to the existing landfill and has supplied background data for the facility in the past, it is too close to the old Frank Ortiz Landfill to be reliable and an additional up-gradient well will be installed. If contaminants are detected in the groundwater at the existing downgradient monitoring wells, an additional downgradient monitoring well be installed. Existing groundwater monitoring well locations are shown on the Final Grading Plan Drawing in Figure 3-2. A groundwater monitor well detail is shown in Figure 4-1. *location*

All monitoring and testing parameters will follow the requirements of Section 803, and 804 of Part VIII of the NMED Solid Waste Regulations (SWMR-4). Given the background data obtained from the existing monitoring well, the post-closure monitoring program will address the detection monitoring requirements of Section 804. The monitoring wells will be inspected as a part of the site inspections, and if maintenance of the monitoring wells is required, it will be carried out immediately.

4.6 Gas Monitoring Program

Methane gas generation and migration will be monitored on a quarterly basis for the first two years following closure, thereafter semi-annually (depending on test results) using a combustible gas meter. The four gas monitoring wells installed at the perimeter of the site will be monitored as part of the overall monitoring program. A complete record will be kept of all gas monitoring activity and results. The gas monitor wells will be inspected for damage and repaired as necessary. Damaged gas monitor wells and necessary repairs will be noted on the inspection report and repaired immediately.

If methane concentrations greater than twenty-five percent (25%) of the lower explosive limit (LEL) for the gases are detected within the facility, or if the concentrations of methane gas exceed the lower explosive limit for the gases at the facility boundary, the following measures will be taken: *? remove*

- Notify the Secretary of NMED and take immediate steps to ensure protection of public health, welfare and the environment;
- With seven (7) days of detection, record methane gas levels and submit description of steps taken to protect public health, welfare and the environment to the Secretary;

- Within 60 days of detection, implement a remediation plan for the methane gas releases and notify the Secretary that the plan has been implemented.

4.7 Final Land Use

It is proposed that the closed landfill be returned to open space status. By restricting landfill access to foot traffic, a final cap consisting of a 24-inch protective layer of soil and native vegetation which meets state regulations can be installed. If the City of Santa Fe selects another land use in the future, such as soccer or baseball fields, the proposal will be submitted to NMED authorities for review, comment, and approval. A future "active" use plan may require the installation of an irrigation system, or the strengthening of the final cover with additional soil layers, or the addition of a synthetic liner. All such revisions to the plan would be submitted to the NMED.

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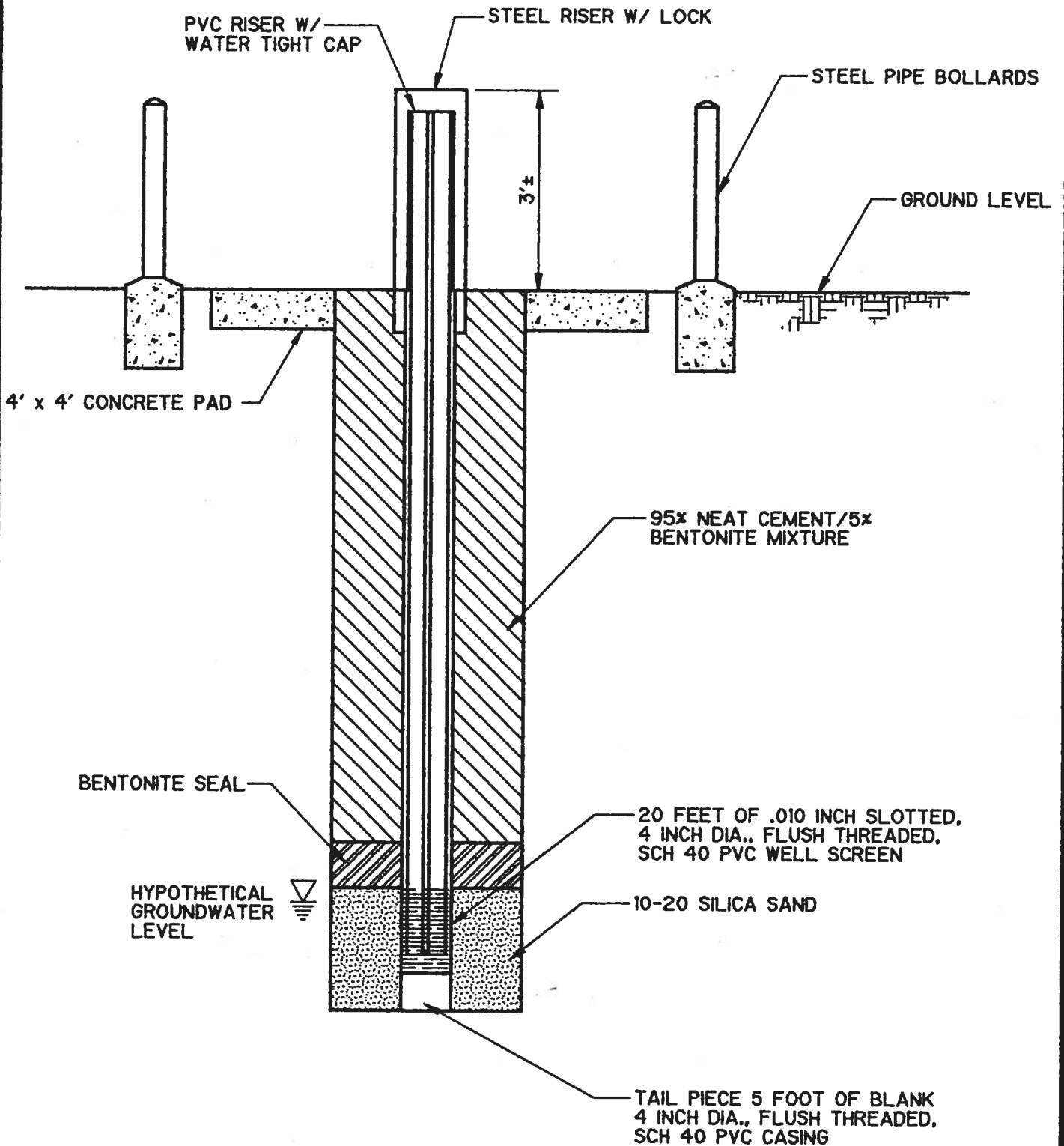
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FIG 4-1

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CITY OF SANTA FE LANDFILL

TYPICAL GROUNDWATER MONITORING WELL

CDM

environmental engineers, scientists,
planners, & management consultants

Figure No. 4-1