Tacoma Landfill Superfund Site
Tacoma, Washington
Second Five-Year Review Report

I. INTRODUCTION

The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review Reports. In addition, Five-Year Review Reports identify issues found during the review, if any, and identify recommendations to address them.

The United States Environmental Protection Agency (EPA or Agency) is preparing this Five-Year Review Report pursuant to CERCLA Section 121(c), 42 USC Section 9621(c) and the National Contingency Plan (NCP). CERCLA Section 121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgement of the President that action is appropriate at such site in accordance with Section 9604(CERCLA §104) or Section 9606(CERCLA §106), the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The Agency interpreted this requirement further in the NCP; 40 CFR Section 300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

The United States Environmental Protection Agency (EPA) Region 10 conducted the five-year review of the remedy implemented at the Tacoma Landfill Superfund Site. The Tacoma Landfill is part of the Commencement Bay/South Tacoma Channel Site which was listed on the National Priorities List (NPL) on September 8, 1983. Other parts of the NPL site include Well 12A and the South Tacoma Field. Each part of the NPL listing is being treated as a separate site by EPA Region 10 for purposes of five-year reviews. The EPA Superfund Project Manager for the Tacoma Landfill conducted this review from June 2002 through November 2002. This report documents the results of the review.

This is the second five-year review for the Tacoma Landfill. The triggering action for this statutory review is the date of the first five-year review which was completed on September 27, 1997. This five-year review is required due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted

exposure.

The information used to conduct this review is contained in the Site File for the Tacoma Landfill site. The primary documents used in the review consist of the following:

1. Tacoma Landfill Consent Decree - May 1991.
2. Tacoma Landfill Operations and Closure Plan - revised January 1998.
3. Consent Decree 2001 Annual Report - May 2002.
4. Annual Summary of Inspections for the Tacoma Landfill Cap, Condensate Collection System and Central Area Leachate Collection System - May 2002.
5. Tacoma Landfill Biannual Gas System Evaluation Reports - July 1, 2001 through June 30, 2002.
6. Tacoma Landfill Odor Control Plan - September 30, 1998.
7. Tacoma Landfill Bird Management Plan - March 2002.
8. Tacoma Landfill Five Year Review Report - September 19, 1997.
9. Letter from EPA to Tacoma dated May 11, 1998, which extended landfilling activities at the site for 5 additional years.
10. Comment letters received from the public in response to the EPA fact sheet advertising the Review.
11. Correspondence from the Tacoma-Pierce County Health Department in response to EPA's request for information.

Additional information was obtained during a site inspection of the Landfill conducted on September 12, 2002.

II. SITE CHRONOLOGY

Event	Date
Tacoma Landfill begins operation	1960
Investigation detects hazardous substances in groundwater & soils near site	1983
Landfill placed on the National Priorities List	1983
Landfill gases cause small explosion at a neighboring business	1986
Tacoma begins RI/FS pursuant to Consent Order with the State	1986
RI/FS completed	1988
EPA issues ROD	1988
Consent Decree finalized between Tacoma, Washington State Dept. of Ecology (Ecology), and EPA	1991
Landfill cap & gas management system construction completed	1993
Groundwater pump & treat system construction completed	1995
First Five-Year Review completed	1997
Tacoma's request to extend waste disposal activities at site approved	1998
Groundwater treatment system turned off	1998
Extracted groundwater discharge diverted from sanitary sewer to storm sewer	2002

III. BACKGROUND

Physical Characteristics

The City of Tacoma Refuse Utility operates a solid waste disposal facility known as the Tacoma Landfill which is located within the City of Tacoma in Pierce County, Washington. Specifically, the landfill is situated in Sections 12 and 13 of Township 20 North, Range 2 East, near the western border of Tacoma. The landfill covers 240 acres and is bounded approximately by South 31st Street on the north, Tyler Street on the east, South 48th Street on the south, and Orchard Street on the west. See Figure 2.

Land and Resource Use

The Tacoma Landfill began operations in 1960, and has been operating as a sanitary landfill under a permit issued by the Tacoma-Pierce County Health Department. The wastes disposed at the landfill include garbage, rubbish, industrial wastes, construction and demolition wastes, street refuse, litter, and bulky waste. To date the landfill has received approximately 5 million tons of refuse. The landfill does not accept hazardous waste for disposal. However, the landfill received wastes in the 1960s and 1970s that have since been designated as hazardous wastes under state and federal law. Most of the site has already been filled. The last section of the site to be filled is called the Central Area which covers approximately 31 acres. This section was developed in 1987 and continues to be used for waste disposal. The Central Area was constructed with a flexible membrane bottom liner and leachate collection system. In addition to waste disposal, the site is the operations center for all solid waste management activities in the City of Tacoma. Solid wastes transported to the site are segregated, processed, and removed from the site with the exception of a small percentage of waste that is disposed in the Central Area. Figure 3 for a layout of the site.

The landfill is surrounded primarily by residential and commercial development with some open land and industrial development. The site is surrounded by a fence. Groundwater around the site is currently used as a drinking water aquifer. However, the City of Tacoma has replaced all wells affected by contamination from the site with municipal water and the drilling of new wells in the area affected by contamination from the site is currently prohibited by the cities of Tacoma, Fircrest, and University Place. The dominant groundwater flow is to the south and west and towards Leach Creek located approximately 1/2 mile west of the landfill. Leach Creek flows into Chambers Creek which enters into Puget Sound, approximately 5 miles southwest of the landfill.

History of Contamination and Initial Response

Groundwater contamination, primarily volatile organic compounds, was first detected in the early 1980s around the perimeter of the landfill and extended in a southwesterly direction toward Leach Creek. Because of the concern about public health effects of the contamination, particularly vinyl chloride, residents whose wells were impacted or threatened were hooked up to the Tacoma public water system in the mid-1980s. Landfill gases were found to be migrating from the landfill to residences and businesses adjacent to the site. The landfill gases contained methane, which can cause explosions at certain concentrations, and volatile organic compounds, which can cause negative health effects at elevated concentrations. Because of a concern over

the migration of landfill gases, the first stage of a landfill gas management system was constructed in 1986.

Basis for Taking Action

Monitoring at the site revealed that hazardous substances had been released from the landfill into the soils, groundwater, and air at the site. The hazardous substances released to groundwater include a variety of volatile and semi-volatile organic compounds and heavy metals, many of which were greater than State and Federal drinking water standards. Vinyl chloride was the most pervasive compound found in groundwater and represented the greatest health risk to human health. Landfill gases were found to contain a wide variety of volatile organic compounds as well as methane. The volatile organic compounds represent a risk to human health if the gases seep into neighboring homes and businesses. The methane in the gases represents the greatest risk to human health as it can cause explosions when it accumulates to certain concentrations. Accumulation of landfill gas in a utility vault at a company located adjacent to the landfill resulted in a small explosion in May 1986. Many of the same compounds found in groundwater and in landfill gases were also found in soils at the site.

The following are the chemicals of concern found in groundwater at the site:

1,1,1-Trichloroethane
1,1-Dichloroethane
1,2-Dichloroethane
1,2-Dichloroethenes (total)
Benzene
Chloroethane
Ethylbenzene
Methylene Chloride
Tetrachloroethene
Toluene
Trichloroethene
Vinyl Chloride
Xylenes (total)
Arsenic
Manganese

The following chemicals were found in landfill gases:

Methane
Benzene
Chlorobenzene
Chloroethane
1,1-Dichloroethene
1,2-Dichloroethane
Trans-1,2-Dichloroethene
1,2-Dichloropropane
Ethyl Benzene
Methylene Chloride
Tetrachloroethene
Toluene
1,1,1-Trichloroethane
Trichloroethene
Vinyl Chloride

IV. REMEDIAL ACTIONS

Remedy Selection

On March 31, 1988, EPA issued the Record of Decision (ROD) which selected the final remedial action for the site based on the RI/FS. On November 13, 1989, a Consent Decree between EPA, Ecology, and the City of Tacoma was lodged in federal court. The Decree

addressed implementation of the remedial actions specified in the ROD. This Decree was not accepted by the Court and was subsequently modified. The modified Decree was entered by the Court on May 17, 1991. The Consent Decree requires a review of the remedial actions conducted at the site at least every five years after the entry date of the Decree. This Five-Year Review satisfies both the Consent Decree requirement and the statutory requirement for 5-year reviews.

The ROD outlines the final remedial action for the site. The objectives for the remedial action are as follows:

Reduce the production of leachate by placing constraints on further site operations and by capping the landfill;

Eliminate off-site gas migration through the gas extraction system;

Prevent further migration of the contaminated plume via a groundwater extraction system;

Further protect public health and the environment via monitoring of groundwater, surface water, gas probes, and air emissions;

Provide an alternate water supply (Tacoma municipal water) to any residences deprived of their domestic supply due to demonstrated contamination from the landfill or due to the action of the extraction-treatment system;

Establish a closure plan for the landfill consistent with Washington State Minimal Functional Standards for Landfill Closure (WAC 173-304);

Establish institutional controls to assure that the remedial action will continue to protect human health and the environment.

Remedy Implementation, Operation, and Maintenance

The following remedial measures have been completed:

1. A landfill cover was installed over areas containing buried waste in two stages from 1990 to 1992 with the exception of the currently operating cell known as the Central Area. The cover was installed on approximately 125 acres of the 240 acre site. The purpose of the cover is to minimize rainwater and surface water infiltration into the landfill thereby reducing the production of leachate which is the source of groundwater contamination. The cover consists of two 60 mil HDPE liners separated by a leak detection and water collection layer with the exception of 4 acres which became part of an expanded operations area. The 4 acres were capped with a geomembrane layer and then covered by buildings or low permeable asphalt pavement. The permeability of the asphalt cover is regularly checked with lysimeters installed

in the cover. The asphalt cover is also regularly inspected and maintained in accordance with the Operations and Maintenance Plan. The capped areas are regularly inspected and maintained in accordance with the Operations and Maintenance Plan. The capped areas are inspected for evidence of erosion, settlement, ponding of water, improper or inadequate vegetation, burrowing animals, cracking, and other parameters as outlined in the Operations and Closure Plan.

Active land filling is still occurring in the Central Area which is the only portion of the site with a bottom liner. The Central Area cell was developed and first used in 1987 and then expanded to it's current 31 acres in 1990. The bottom liner is composed of two liners separated by a leak detection and water collection system. The side slopes in the Central Area consists of a single liner which separates the Central Area from the old landfill. As the Central Area is not covered, leachate is generated by the precipitation that falls onto this area. The Central Area was constructed with a leachate collection system which collects leachate and transports it to the sanitary sewer system for treatment and disposal. When the Central Area is eventually filled up, it will be covered with a cover similar to the one installed over the rest of the landfill.

While most of the cover has been performing as designed and is meeting performance standards, water has been found flowing in between the upper and lower landfill covers in an area on the west side of the landfill after periods of rain. It is not known when the leak in the upper landfill cover developed, but may have been present ever since the landfill cover system was installed. Since the water is collected prior to contacting garbage, it is treated as storm water and is discharged into a catch basin that is connected with the storm sewer system. No landfill cover can be completely impermeable and all allow some leakage. The amount of leakage in the upper cover in this area exceeds the original design criteria. The City has made several attempts to locate and fix the source of the leak over the past 10 years. These efforts are continuing.

Regular inspections of the landfill cover system by the City of Tacoma reveal evidence of minor damage such as local subsidence, erosion, ponded water, tears in the geomembrane liner accidentally caused by landfill operators, and cracks in the asphalt. These problems are normal at active landfills and are corrected by the City during routine maintenance activities.

A small amount of leachate is finding its way between the two bottom liners in the Central Area. This leachate is being collected by the leak detection/collection system and transported to the sanitary sewer for treatment and disposal. The amount of leachate is not considered to be significant and will likely decrease after the final cover system is installed over the Central Area.

2. A landfill gas management system was installed in several phases starting in 1986. The system currently consists of over 300 gas extraction well stations each consisting of 1 to 4 wells completed to various depths, piping for transferring the collected gas to a flare station where the gas is destroyed, and the flare station. See Figure 5 for the location of the gas extraction wells. The gas management system is being expanded into the Central Area as an areas get filled to final grade. The purpose of the landfill gas management system is to control the migration of landfill gases. Specifically, the system was designed to meet State of Washington Criteria for Municipal Solid Waste Landfills which require that methane concentrations must not exceed the lower explosive limit (5% methane by volume) at the property boundary of a landfill and not exceed 100 parts per million in off-site structures. The effectiveness of the landfill gas

management system is evaluated through regular monitoring of gas probes situated within and adjacent to for pressure (vacuum) and methane concentrations. The gas monitoring system includes approximately 75 gas monitoring probes around the perimeter of the landfill and an additional 55 probes up to 1,000 feet from the edge of the landfill, each probe consisting of 1 to 5 monitoring ports completed to various depths. See Figure 4 for the location of the gas monitoring probes. The landfill gas management system is a dynamic system affected by changes in the barometric pressure, pressure changes created by the development of landfill gas within the landfill and the vacuum applied by the gas collection system. Because of the dynamic nature of the system, some fluctuations of both the pressure and methane readings at the probe stations is normal. It is through these fluctuations that the need for adjustments to the gas system are identified. Changes in pressure alone do not trigger adjustments to the system, because they are generally temporary in nature and result from changes in the barometric pressure.

The City signed a contract in 1995 to lease the landfill gas field to a private company for the purpose of constructing an electrical generation facility at the landfill. This facility became operational in 1998 and is currently utilizing a portion of the collected landfill gases to generate electricity as opposed to destroying the gases in the existing flares. The flares are still utilized to destroy the gases produced by extraction wells that are not hooked up to the electrical generation facility. With the exception of the extraction wells hooked up to the electrical generation facility, the gas extraction system and the gas monitoring system are being operated in the same manner as previously employed.

In 1996 the City discovered that leachate was collecting in some landfill gas extraction wells and was impacting the effectiveness of the landfill gas management system. Further study found a fairly extensive zone of leachate in the south end of the capped landfill. The origin of this perched leachate is not known, but is believed to be residual leachate created prior to construction of the landfill cover. Based on these findings, the City conducted leachate pump tests through the existing gas probes and found that there is a substantial perched zone of leachate and that the leachate could be pumped out through the gas probes. The City has been periodically pumping out this leachate since 1996. The leachate is being pumped out mainly to increase the efficiency of the gas extraction wells in this area. The leachate is discharged into the City's sanitary sewer system for treatment.

Methane gas has been detected in a new gas probe installed after construction of a Home Depot Store on the northern portion of the site. This issue is discussed in greater detail in Section V.1.d. of this report.

3. In 1992 and 1993 a groundwater extraction and treatment system (GETS) was constructed. GETS consisted of 19 point-of-compliance (POC) wells (identified as W1 through W19 on Figure 1) and 9 edge-of-plume (EOP) wells (identified as W30 through 38 on Figure 1), pipelines to transport the extracted groundwater to a treatment facility, and a groundwater treatment system. The POC wells are located on the down gradient edge of the landfill and their purpose is to capture contaminated groundwater before it flows outside of the landfill boundary. The EOP wells are located along Leach Creek and their purpose is to cleanup the plume of contaminated groundwater at the edge of the plume and prevent the contamination from impacting Leach Creek and groundwater beyond the creek. Once extracted from the EOP and POC wells, groundwater was transported via pipelines to a treatment facility. The treatment

facility is equipped with: two air strippers to remove the volatile organic compounds; an acid wash system to periodically remove scale buildup from the internal packing material in the towers; and a control building where overall operations, control and monitoring of the groundwater extraction/treatment facilities are managed. The treated groundwater was then discharged to the sanitary sewer system for further treatment and disposal.

Based on groundwater monitoring and several years of experience in operating the groundwater extraction systems, improvements to the systems were made in 1995 through 1997. Monitoring of well yields indicated that some wells in the EOP system were not extracting at their designed flow rate and that flow from other wells were decreasing. In 1995 and 1996, a well rehabilitation program was conducted to increase the amount of groundwater being extracted from the EOP wells. Although the well rehabilitation program was successful in increasing flows from most wells, new wells were needed to increase total flow along the EOP system to design yields. In 1996 and 1997 4 new wells (identified as W40 through 43) were constructed along the EOP system, primarily in the extreme south end. The total number of EOP wells currently being pumped is 13. Enhancement of the POC system was prompted by groundwater monitoring data at a monitoring well near the City of Fircrest municipal well field. Groundwater quality data from this well indicated that vinyl chloride concentrations increased from 1991 through 1995 during the summer time when the municipal water needs are high. In response, the POC system was expanded by installing 3 new wells (identified as W 20, 21, & 22) to the north near the Fircrest well. The total number of POC wells currently being pumped is 22. Groundwater monitoring results from 1997 through 2001 are contained in and analyzed in the Consent Decree Annual Reports for those years.

Flows from the groundwater extraction wells gradually decrease over time due to growth of natural soil bacteria on the well screens. The City periodically treats the wells to remove the bacteria growth which then allows the wells to increase their extraction rates to design flows.

4. Operation of the EOP groundwater extraction system reduces the base flows in Leach Creek since it removes shallow groundwater that feeds the creek. Until 2002 the City maintained flows in Leach Creek using water from a well located northwest of the landfill. The augmentation well began operation on June 30, 1993 and was initially operated to maintain a minimum of 1.5 cubic feet per second (cfs) in Leach Creek as measured at the 40th Street gauging system. The minimum flow requirement was increased to 1.6 cfs when new EOP extraction wells began operation in 1997. The requirements for the Leach Creek augmentation system are contained in a 1996 amendment to the Consent Decree. The source of augmentation water was changed in 2002 as discussed in Section V.1.a. of this report. The flows and water quality in Leach Creek is sampled each quarter from one location upstream of the landfill and from 2 locations down stream. Monitoring indicates that the Landfill is not significantly impacting the water quality of Leach Creek and that minimal flow requirements are being met.

5. The City of Tacoma is required to provide an alternate water supply to all residents whose wells became or become contaminated by the landfill. The City has connected the affected residents to the Tacoma municipal water system. According to the criteria established for this

site, a well is considered contaminated when the concentration of a chemical exceeds 20% of it's drinking water standard or health-based level. Private wells still in use in the vicinity of the landfill, as well as monitoring wells between the landfill and the private wells, are monitored on a regular basis. Monitoring and contingency plans have been developed to track the contaminated plume and to respond to a potential expansion of the contaminated plume. See Figure 6 for a map of monitoring wells and groundwater flow direction. However, not all of the old wells have been abandoned; some may still be used for outdoor purposes such as lawn or garden watering. This 5-year review could not determine which residential wells were being used as sole domestic water supplies and which were being used only for outdoor purposes. Without this information, we could not verify that the system established to replace contaminated wells is being strictly adhered to. Subsequent to this 5-year review, EPA will require the City to obtain and supply us with the information needed to make this determination.

In 1995 Tacoma asked the neighboring City of Fircrest to limit the amount of water being pumped from their municipal well closest to the landfill, Fircrest Well # 5 because of the potential threat of pulling in landfill contaminants at higher pumping levels. In 1996 Tacoma drilled a new well to replace Fircrest Well #5. The old well has been temporarily closed. The Fircrest wells located closest to the landfill are regularly sampled by the City. Contaminants from the landfill have not been detected in these wells.

6. The City began recycling and household hazardous waste collection programs in the mid-1980s. The purposes of these programs are to reduce the total volume of waste going into the landfill and to minimize the amount of hazardous substances going into the landfill. Tacoma's recycling program includes curb side collection of a variety of materials including glass, cans, plastic bottles, newsprint and other waste paper, and yard waste. Drop off locations have been established for waste oil, household batteries, tires, appliances, and other items containing potentially hazardous substances. The City also provides assistance to businesses regarding recycling opportunities and proper procedures for disposing of wastes containing hazardous substances.

7. The City developed an Institutional Control Plan dated July 17, 1992 which outlines procedures to prohibit drilling of water supply wells within and adjacent to the landfill and to prohibit any activity that will negatively impact the remedies constructed at the landfill. The Plan was conditionally approved by EPA and Ecology on August 17, 1992. The Cities of Tacoma, Fircrest, and University Place have enacted ordinances which prohibit the drilling of private water supply wells within the plume of landfill contamination. The City of Tacoma has developed covenants which prohibit site activities that may threaten human health and the environment or may damage the remedies installed at the Landfill. The City has also developed a long-range plan for site use after closure of the Central Area cell. The long-range plan includes continued use of a portion of the site for solid waste transfer activities and recreational use of the rest of the site when no longer needed for remediation activities. The entire site is currently surrounded by a chain link fencing with gates that are locked when the landfill is closed.

V. PROGRESS SINCE LAST REVIEW

1. Previous Five-Year Review - The first 5-year review was completed in September 1997. The review concluded that the remedy selected for this site remains protective of human health and the environment. The following were recommendations made in the review:

a. Recommendation: Continue to operate the groundwater extraction and treatment system and make adjustments and improvements to the system as appropriate. The groundwater extraction system has been operating since 1993 and the groundwater monitoring program has shown a general improvement in water quality conditions in the contaminated plume outside the boundary of the landfill. New extraction wells were added to the EOP and POC system in 1996 and 1997. The EOP and POC wells need regular rehabilitation to remove deposits which reduce pumping capacity. Performance of the extraction wells should continue to be monitored through regular inspection and maintenance and through monitoring of groundwater around the landfill. Improvements and modifications should continue to be made as appropriate.
Evaluation of Progress: Because the combined water from all groundwater extraction wells met performance standards specified in the ROD for discharge into the sanitary sewer system for 6 consecutive quarters, the treatment system was mothballed in December 1998. The extracted groundwater was then discharged into the sanitary sewer system for treatment and disposal. Groundwater quality throughout the plume has continued to improve. By August 2002 the combined water from all groundwater extraction wells met performance standards specified by the ROD and by Ecology for discharge to surface water for 4 consecutive quarters. In response the City requested to temporarily change the discharge of extracted groundwater from the sanitary sewer system to Leach Creek. EPA and Ecology approved that request after being assured that the receiving storm sewer has adequate capacity to handle the additional flows. Since last August, the City has been periodically discharging all or a portion of extracted groundwater to Leach Creek to assist in design of a permanent discharge to the creek. The discharge of this water to Leach Creek has resulted in a decreased use of the augmentation well. However, Leach Creek continues to be augmented (through a combination of the discharge from the groundwater extraction system and the augmentation well) and monitored to assure that established minimum flow and water quality requirements for the creek are attained. A continuous and permanent discharge of extracted groundwater to Leach Creek should result in the shut down of the augmentation well.

The City is continuing the monitoring and treatment of groundwater extraction wells in order to keep extraction rates up to design goals.

b. Recommendation: Groundwater in the vicinity of the landfill should continue to be monitored and evaluated in accordance with the Groundwater Monitoring Plan - Tacoma Landfill, February 1996 and the Final Early Warning Values Plan, December 1996.
Evaluation of Progress: Groundwater monitoring indicates general improvement in the plume of contamination outside the boundary of the landfill. Only 5 COCs were detected at concentrations greater than performance standards in monitoring wells outside the boundary of the landfill last year. Vinyl chloride, the most mobile of the contaminants, continues to be the most widespread. The following is a list of those chemicals along with the highest concentrations detected during the year:

Chemical	Highest Level Detected	Number of Wells	Performance

	In Year 2001	With Concentrations Greater Than Std. in 2001	Standard
1,2-Dichloroethane	17 ug/L	2	5 ug/L
Tetrachloroethene	24 ug/L	1	5 ug/L
Trichloroethene	43 ug/L	2	5 ug/L
Vinyl Chloride	3 ug/L	4	2 ug/L
Arsenic	55 ug/L	1	50 ug/L*

* The MCL for arsenic was lowered to 10 ug/L in 2002. The impact of this change will be addressed in Section VII, Question B of this report.

Water quality monitoring data from Leach Creek indicates that the landfill is not impacting the water quality in Leach Creek. The latest sample results are contained in the Tacoma Landfill Consent Decree 2001 Annual Report.

c. Recommendation: Continue to monitor existing wells near the landfill that are used for private water supplies to insure that public health is protected from landfill contaminants. Continue to sample monitoring wells outside the boundary of the landfill to check for possible contaminant plume migration. Implement the New Plume Contingency Plan when necessary.
Evaluation of Progress: The City has continued monitoring private water supply wells and monitoring wells in accordance with approved plans. It has not been necessary to implement the New Plume Contingency Program over the past 5 years.

d. Recommendation: Continue to operate the landfill gas management system and the gas monitoring program.
Evaluation of Progress: The City has been operating and reporting on the landfill gas management system and monitoring program in accordance with approved plans.

When a Home Depot store was constructed adjacent to the Landfill in 2000, several groundwater and soil gas monitoring wells were removed and then replaced at the conclusion of construction. One of the newly constructed gas monitoring wells located in the Home Depot parking lot detected methane gas in excess of the lower explosive limit. The Home Depot store was reportedly constructed on old fill material not related the Landfill. Investigations by the City and Tacoma-Pierce County Health Department have confirmed elevated levels of methane gas on the Home Depot property; however, the investigations have not determined whether the methane is coming from the Landfill or the fill material under the store. One sampling event conducted by the City inside the Home Depot building indicated that methane gas was either not detected or detected at levels well below standards. Even though the origin of the methane at Home Depot was not established, the City of Tacoma agreed to take actions to reduce the potential for Landfill gas to migrate to the Home Depot property. At a meeting between the City, EPA, Ecology, and the Tacoma-Pierce County Health Department in early 2002, the City agreed to install additional gas extraction wells in the Landfill, to install additional soil gas monitoring wells, and to eliminate the potential for Landfill gas to migrate to the Home Depot property through a 42" storm sewer line. However, no schedule was established for this work and it has not been accomplished. EPA believes that this issue needs to be addressed and this 5-

year review will establish a milestone date for followup action in Section IX of this report. The Home Depot gas monitoring wells continue to be regularly monitored by the City.

A few additional gas extraction wells were installed in the Central Area to improve the efficiency of the landfill gas management system and improve odor control.

e. Recommendation: Continue the landfill cover inspection and maintenance program including the asphalt portion of the cover.
Evaluation of Progress: Based on visual observations during visits to the landfill and from information contained in the annual summary of inspections, the landfill cover system is being maintained as required by the Operations and Maintenance Plan for the Landfill Cap, Condensate Collection System and the Central Area Leachate Collection System with one exception. The September 12, 2002 site inspection found that parts of the landfill surface are partially obscured in some areas by vegetation growth and the storage of used garbage containers. The Operations and Maintenance Plan requires the landfill surface be free of obstructions and requires removal of vegetation growth that may damage the cover system.

In addition, there is excessive leakage through the upper cover on a portion of the landfill as previously mentioned. The City has located numerous small holes and tears in the cover and has made applicable repairs. The latest such investigation and repairs were conducted early in 2002 and included a large area on the west side of the landfill. The success of the latest repairs will be evaluated after the 2002/2003 rainy season. Preliminary evaluation of water flows through the upper landfill cover since the latest repairs have been made indicates a significant reduction in these flows with the possible exception of one small area. Flow data will continue to be collected during this rainy season and a decision regarding any additional investigation/repair work will be made this Spring.

f. Recommendation: Continue to operate the household hazardous waste collection program and the recycling program. The City should periodically evaluate the effectiveness of these programs and propose program adjustments and improvements to EPA and Ecology.
Evaluation of Progress: The City has operated successful household hazardous waste collection and recycling programs.

g. Recommendation: Continue efforts to complete the Institutional Control Plan and obtain EPA, Ecology, and Health Department approval of the Plan.
Evaluation of Progress: The City has put into place institutional controls needed to protect human health and the environment, including deed restrictions and the prohibition of new residential wells in the area of the plume of groundwater contamination. The City has submitted a draft Institutional Control Plan to EPA, Ecology, and the TPCHD for approval. The agencies need to complete their review of these documents and provide direction to the City.

2. Central Area Cell - The Consent Decree requires that the landfill be closed by December 31, 1999; but allows the City to request up to 3 five-year extensions to the closure date. The City requested a 5 year extension in September of 1997. EPA, Ecology, in conjunction with the Tacoma-Pierce County Health Department (TPCHD), approved this request in May 1998 subject to several conditions. The approval conditions have generally been complied with; however 3

conditions need additional attention and are discussed below:

a. Condition: Beginning May 30, 1998, the Central Area shall be filled and provided with interim impermeable covers in phases as outlined in Section 10.2 of the Operations and Closure Plan dated January 1998. The Operations and Closure Plan indicates that filling will generally proceed from south to north and that the southern half of the landfill will be filled to grade and covered by 2005.

Evaluation: The revised Operations and Closure Plan requires the Central Area to be sequentially filled to final grade from south to north and an interim cap be placed on those areas filled to grade. This revision was made to reduce the generation of leachate and assist in odor control. Inspections conducted by the TPCHD over the past 2 years indicate that filling in the Central Area was proceeding in an apparent haphazard manner and that impermeable cover was not being installed as needed. The inspection reports indicate that the haphazard filling and lack of the interim cover was contributing to leachate breakouts and odor problems. On November 18, 2002 the TPCHD informed EPA that the City has improved their filling practices in the Central Area; but that additional effort is needed before full compliance with the Operations and Closure Plan is achieved. On the September 12 inspection of the Landfill EPA observed that approximately 15 to 20 % of the Central Area had recently been filled to grade and appeared to be in the process of receiving a temporary plastic cover.

The City needs to make improvements in the manner in which the Central Area is being filled. This will be included in the lists of issues and recommendations contained in Sections 8 & 9.

b. Condition: the City shall continue to seek ways to reduce odor problems at the landfill by developing and putting into effect an Odor Control Plan. This plan shall be submitted to the TPCHD for approval by July 15, 1998.

Evaluation: The Odor Control Plan was submitted in July 1998 and received a conditional approval from the TPCHD in October 1998. The City has generally complied with the 1998 Odor Control Plan. The City stated that odor complaints have dropped over the last few years. The TPCHD indicates that the City has made significant improvements in odor control at the site; but has identified additional changes that could be made which would further reduce odor problems at the site. These recommendations are contained in the November 18 memo to EPA from the TPCHD.

In response to the public notice issued regarding the 5-year review, several citizens indicated that Landfill odors continue to be a problem. Landfill odors will be included in the lists of issues and recommendations contained in Sections 8 & 9.

c. Condition: The City shall comply with all terms and conditions of the Solid Waste Permit issued by the TPCHD.

Evaluation: Although the TPCHD considers the City to be in substantial compliance with their Permit, there are a number of compliance issues that need to be addressed and resolved. The issues include fill sequencing, odor and bird management, the presence of methane gas at Home Depot, and storage of containers on the landfill cap. Additional information can be found in the TPCHD November 6 issues paper. The approval to extend landfilling in the Central Area was

contingent upon the City complying with all terms and conditions of the Solid Waste Permit. EPA will require the City to respond and resolve all compliance issues raised in the November 6 paper within a short timeframe or to close the Central Area landfill. The compliance issues are discussed previously in this Section and are summarized in Sections VIII & IX.

With the exceptions discussed above, the City has satisfactorily complied with the landfill extension conditions under the oversight of EPA, Ecology, and the Tacoma-Pierce County Health Department over the past 5 years.

VI. FIVE-YEAR REVIEW PROCESS

This five-year review was conducted by Bob Kievit, the Remedial Project Manager for EPA and Lilibeth Serrano, the Community Involvement Coordinator for EPA, with technical assistance from Dave Bosch of the Tacoma-Pierce County Health Department. The five-year review process included a review of the documents listed in Section I of this report, interviews with City employees and local health department staff, analysis of public comments, and a site visit. A draft report was reviewed by other EPA employees from the Environmental Cleanup Office and Office of Regional Council, and by Christopher Maurer of the Washington State Department of Ecology.

Community Involvement

The Tacoma Landfill Five Year Review opened a public comment period to solicit input and suggestions for the review. The comment period lasted from June 3 to June 28, 2002. A fact sheet was mailed out to approx. 600 residents and businesses in the vicinity of the site announcing the comment period and explaining the objectives, process, and schedule for the Tacoma Landfill Five Year Review. The comment period was announced on EPA's home page and the fact sheet was posted on EPA's Commencement Bay web page for public review. Three sets of comments were received; all are summarized below.

1)Mr. & Mrs B Lawrence
They submitted comments dated June 21, 2002. Their comments pertained to both odors and noise. They are particularly concerned about noises caused by the operation of the landfill that cause birds to fly into the Lawrence's yard. The Lawrence family also pointed out their belief that methane gases are being checked regularly because he has seen the trucks and workers that perform the tests. Two requests were made; 1) to study odor control measures for garbage stored at the facility and 2) to cap the exposed central area of the landfill.

2)Mr. & Mrs. Weldon Fuller submitted comments dated June 22, 2002 and June 26, 2002. The main concern expressed was annoying odors that provoke negative physiological effects on visitors and themselves.

3) Juanita E Tindall provided comments dated June 26, 2002 urging EPA to take into consideration Mr and Mrs Fuller's problems with odors at their home.

Response: Although odor and noise problems are not considered to represent direct health threats, EPA required that the City prepare and submit an odor control plan for the landfill as a condition of receiving a 5 year extension for landfilling activities at the site. This plan was submitted and received conditional approval from the Tacoma-Pierce County Health Department (TPCHD) in 1998. Although implementation of this plan has improved odor control at the site, odor problems have not been eliminated. EPA has forwarded the odor complaints to and discussed them with the TPCHD and the City. Both entities have indicated that odor problems have been reduced over the last 5 years and that complaints from residents have dropped. The City has indicated that they believe most of the current odor problems are due to the delivery of restaurant wastes and residential yard wastes to the landfill during periods of stagnant weather. The TPCHD identified a number of things that can be done at the site to improve odor control; their recommendations are contained in the November 18 memo to EPA. The TPCHD and the City have agreed to look into ways that may further reduce odor and bird problems. EPA will require the existing Odor Control Plan be updated to further improve upon odor control efforts at the Landfill.

EPA did not notice any odor or bird problems during the site inspection; however, there was very little site activity occurring during the inspection.

Site Inspection

An inspection of the site was conducted on September 12, 2002, by the RPM, Dave Bosch of the Tacoma-Pierce County Health Dept., and Chris Maurer of the Washington Department of Ecology. The purpose of the inspection was to observe waste handling and disposal activities, to observe the remedial measures constructed at the site, to observe activities around the site, and to observe any odor, noise, or bird problems at the site. Cal Taylor, Gary Kato, and Jeff Geforos, all of the City of Tacoma were present at the inspection.

VII. TECHNICAL ASSESSMENT

Question A: Is the remedy functioning as intended by the decision documents?

The review indicates that the remedy is generally functioning as intended by the ROD.

Groundwater and landfill gas are being monitored as intended by the ROD. The landfill remedial actions are, in general, being inspected, monitored, and maintained as intended by the ROD. However, the need for improvements have been identified in the areas of odor and bird control, fill procedures in the Central Area, and general housekeeping.

Groundwater monitoring indicates that groundwater quality outside the boundary of the landfill continues to improve. In fact, the combined effluent from the groundwater extraction system has improved to the point where it meets ROD and state requirements for discharge to surface waters without any treatment. This is a strong indication that the remedial measures put into place for groundwater are working.

Gases generated by the Landfill are being successfully controlled by the landfill gas management system with the possible exception of the Home Depot area where methane gas has been detected above regulatory limits. Although the City, the TPCHD, and consultants for Home Depot have conducted monitoring and studies of the methane at Home Depot, it is unclear

that whether the methane gas is coming from the Landfill or from historic fill activities at that location unrelated to the municipal landfill. The City has made adjustments to the landfill gas extraction wells nearest to Home Depot, but they have not installed the additional extraction wells nor the sealing around the stormwater line as they indicated they would. This issue needs to be addressed by the City by either further investigation to determine that the gas is not originating from the landfill or by adjusting the landfill gas management system to eliminate the methane problem at Home Depot.

The City of Tacoma has put in place institutional controls designed to protect the remedy and to protect human health and the environment. The 5-year review did not reveal evidence to indicate there are any problems with the City's institutional controls at the site. However, the review did reveal that EPA and Ecology have not completed the review and approval process regarding the Institutional Control (IC) Plan drafted by the City. Without completing this process, EPA cannot verify that the City's IC Plan conforms to current regulatory and policy criteria. EPA and the Ecology need to review the City's institutional control plan in detail and to provide direction to the City.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

The groundwater cleanup level established in the ROD for arsenic was based on the Maximum Contaminant Level (MCL) in effect at that time which was 50 ug/L. In 2002 the (MCL) for arsenic was lowered down to 10 ug/L. As discussed in Item 5 on page 9, existing residential wells down gradient from the landfill are monitored and are hooked up to the municipal water system if levels of landfill contaminants exceed 20% of an MCL or health-based level. Since 20% of the old arsenic MCL equals the new arsenic MCL, the existing criteria for replacing contaminated wells is considered to be protective of human health. However, as stated in Item 5, this 5-year review could not determine which residential wells are still being used as sole domestic sources of water and which were only being used for outdoor watering. The City of Tacoma will be required to identify all existing residential wells located within and immediately down gradient of the plume of contamination. The City will also be required to identify all of the residences in that area that are not hooked up to a municipal water supply.

The groundwater cleanup level established in the ROD for trichloroethene (TCE) was also based on the MCL in effect at that time or 5ug/L. In 2002 EPA proposed a change in the Cancer Slope Factor (CSF) for TCE which reflects a greater cancer risk than the previous CSF. It is not known whether the proposed change to the CSF will be made final or whether a revised CSF will result in a change to the MCL. EPA believes it is premature reassess the TCE cleanup level in this 5-year review.

Although there has been some new development adjacent to the Landfill, the overall land use in the area has not changed. The detection of methane gas at the site of the new Home Depot store is an issue that must be addressed; however, it will not change cleanup levels or remedial action objectives specified in the ROD.

EPA is not aware of any other changes that would affect the exposure assumption, toxicity data, cleanup levels, or remedial action objectives.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

According to the reports reviewed, the site inspection, and information provided by citizens and government officials, the remedy is generally functioning as intended by the ROD and appears to be adequately protecting human health and the environment. However, several residents living near the landfill have complained about odor, noise, and bird problems associated with the landfill that were not specifically addressed by the ROD and are not considered to be threats to human health. Although these nuisance problems were not specifically addressed by the ROD, the ROD does require the City to be in full compliance with the permit issued by the Tacoma-Pierce County Health Dept. Since the landfill permit does address such nuisance problems, EPA believes that the 5-year review should also address these problems. The review also revealed several other issues regarding compliance with the Solid Waste Permit that need to be addressed by the City. These issues have been discussed in Sections V, VI, and VII and are summarized in Section VIII. One of the issues is the detection of methane gas at the Home Depot site adjacent to the Landfill. This is not considered an immediate health threat since the gas does not appear to be concentrating inside the store itself. However, the issue must be addressed and resolved.

VIII. ISSUES

Issue	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1. Detection of methane gas at Home Depot.	N	Y
2. Leakage of storm water through the upper landfill cover.	N	Y
3. Storage of garbage containers/maintenance of vegetation on landfill.	N	Y
4. Odor and bird problems.	N	N
5. Verify that all affected wells are replaced by city water.	N	Y

IX. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? Current	Future
1. Landfill	Enhance landfill gas	City of	TPCHD,	June 30, 2003	N	Y

gases at Home Depot.	extraction adjacent to Home Depot and conduct additional investigations.	Tacoma	EPA, Ecology			
2. Leakage of water through cap.	Monitor flows of water collected in leak detection system and report results. The agencies will determine the need for additional action based on these results	City of Tacoma	TPCHD, EPA, Ecology	July 15, 2003	N	Y
3. Odors.	a.Fill up to grade and place temporary cap in Central Area in compliance with Operations and Closure Plan.	City of Tacoma	TPCHD, EPA, Ecology	Continuous	N	N
	b.Revise & Implement Odor Control Plan.	City of Tacoma	TPCHD	June 30,2003	N	N
4. Birds.	Evaluate effectiveness of Bird Management Plan and adjust as necessary.	City of Tacoma	TPCHD	May 15, 2003	N	N
5. Garbage cans & vegetation.	Remove visual obstructions from landfill cover.	City of Tacoma	TPCHD	May 30, 2003	N	Y
6.Verify that all affected residents are hooked up to city water.	Identify all residences in the area potentially impacted by the landfill that are not hooked up to a city water supply.	City of Tacoma	EPA, Ecology, TPCHD	May 15, 2003	N	Y
	If any of the above have wells contam-inated by the landfill, extend city water to	City of Tacoma	EPA, Ecology, TPCHD	Sept. 30, 2003	N	Y

them.

X. PROTECTIVENESS STATEMENT

The remedy at this site is expected to be protective upon completion and, in the interim, exposure pathways that could result in unacceptable risks are being controlled by the operation of remedial controls such as the pump & treat systems and gas management systems and by institutional controls.

XI. NEXT REVIEW

The next five-year review for the Site should be conducted by September 2007.

Thomas Eaton for

Michael F. Gearheard, Director
Environmental Cleanup Office, Region 10
U.S. Environmental Protection Agency

5/14/03

Date

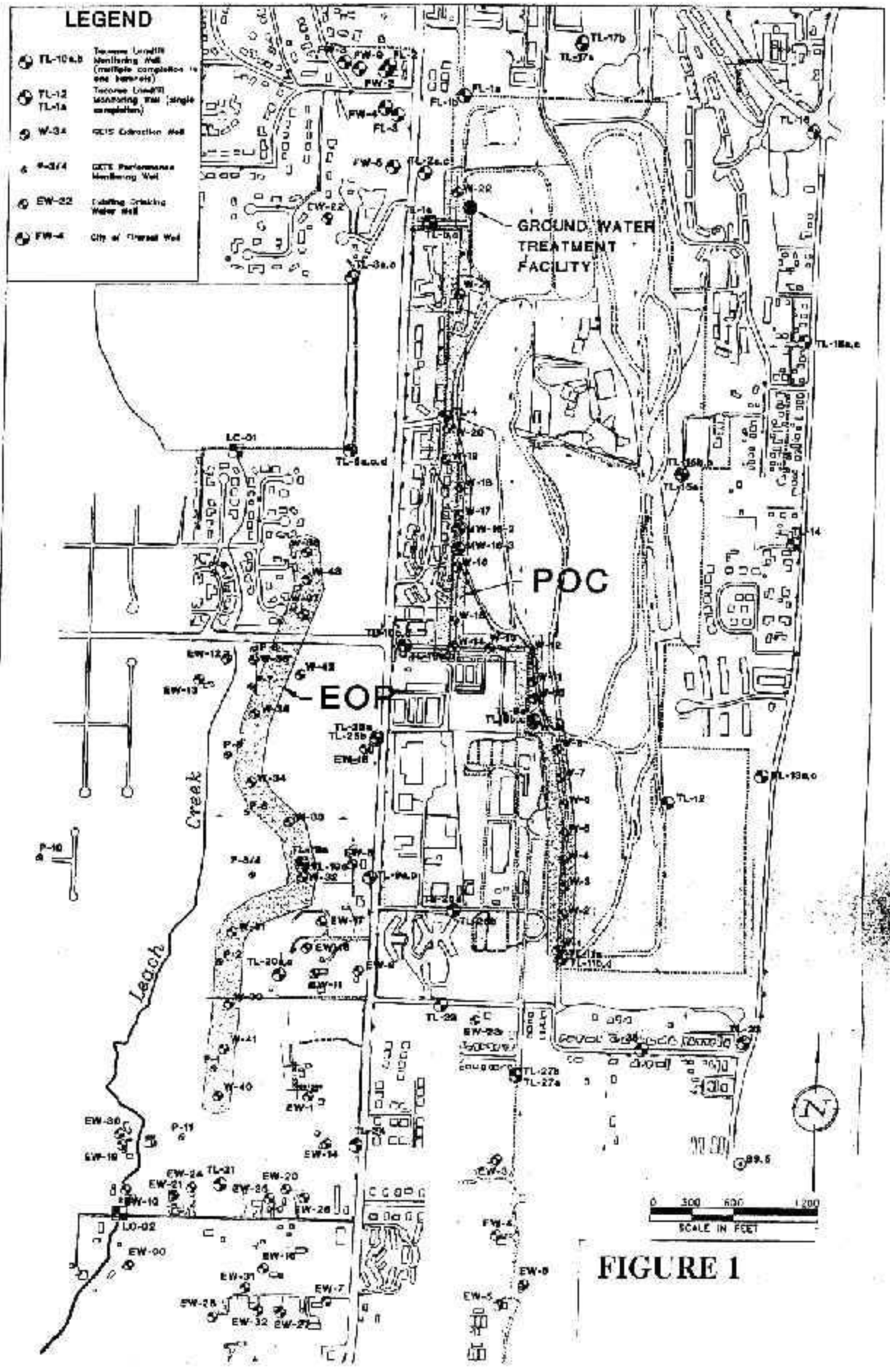

LEGEND
GROUND WATER TREATMENT FACILITY
POC
EOF
Leach Creek
SCALE IN FEET

FIGURE 1

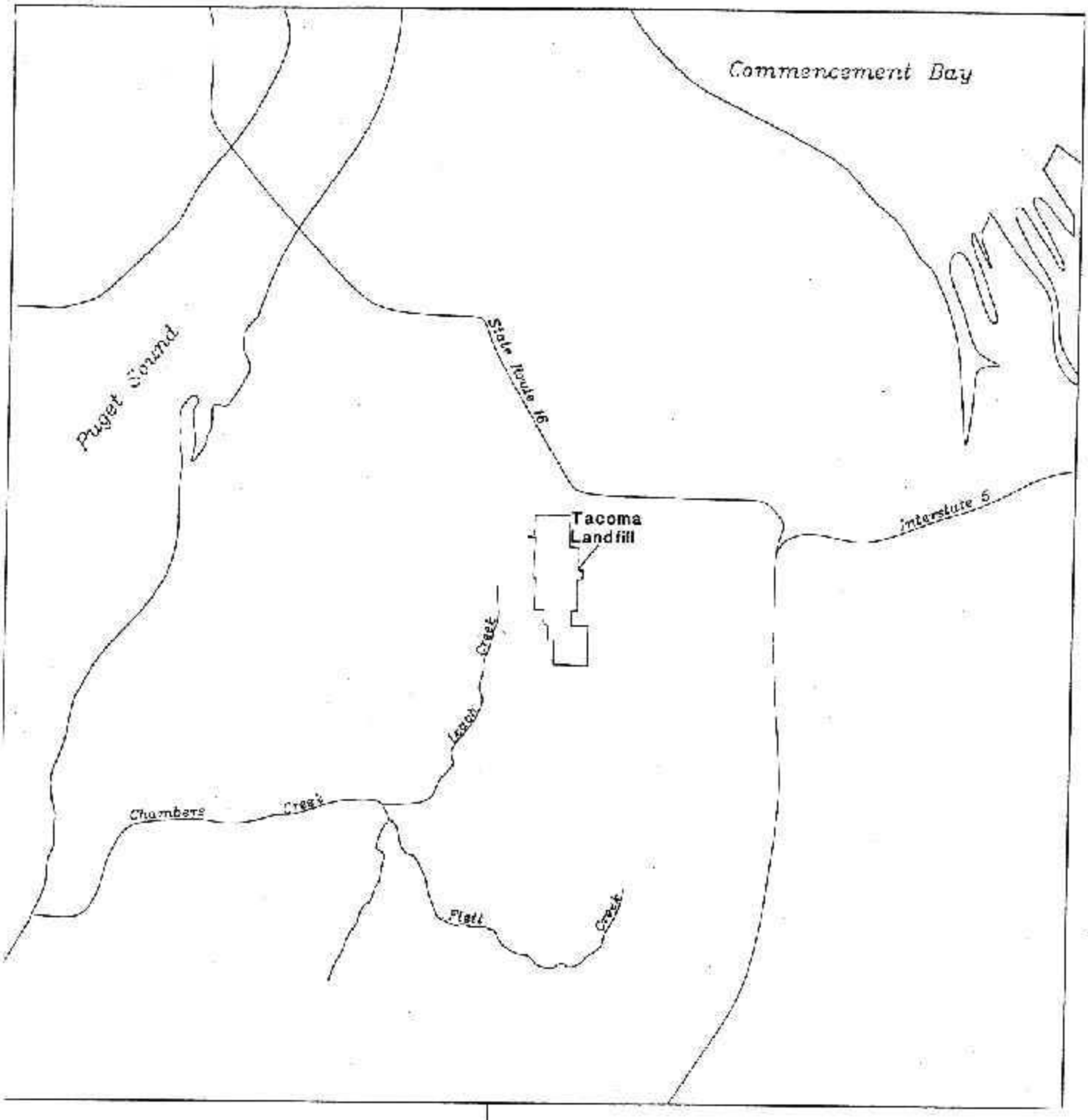
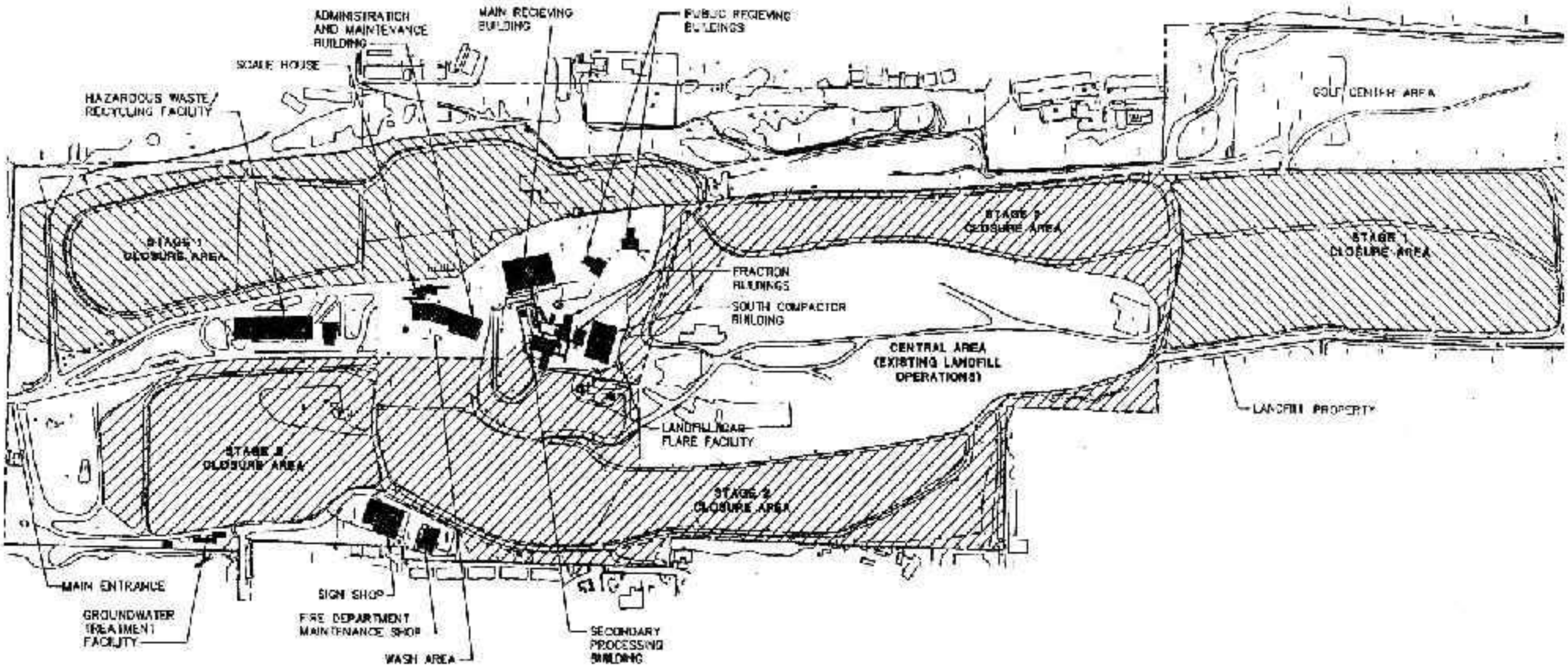

Commencement Bay
Puget Sound
State Route 16
Interstate 5
Tacoma
Landfill
Leach Creek
Chambers Creek
Flett Creek
0
3000
6000
SCALE IN FEET

FIGURE 2



FILE:
DATE: 03/04/99

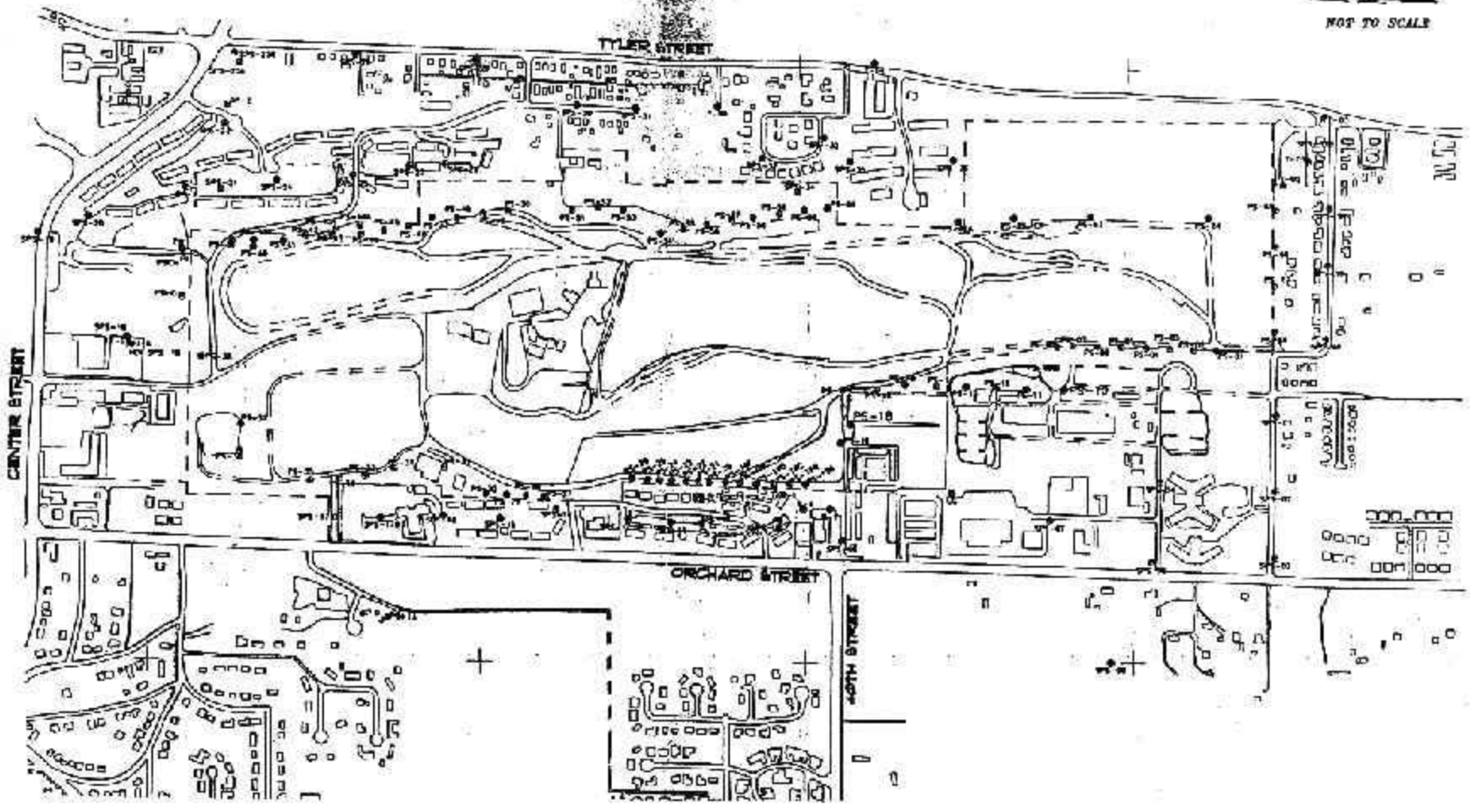
0 200 400
SCALE IN FEET

N

LEGEND:

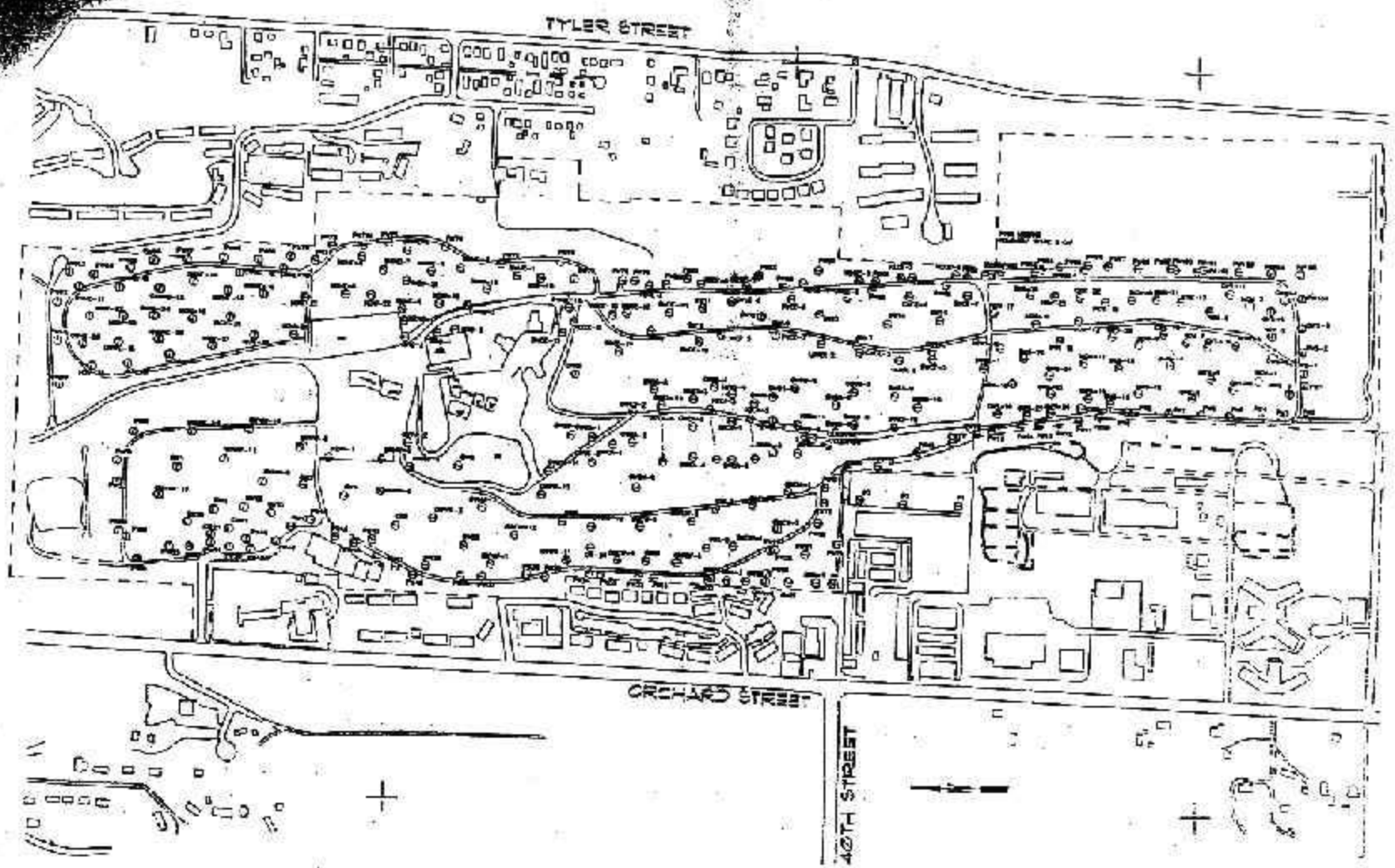
1 BUILDING WIRE BARRIER PHASING
LANDFILL PROPERTY
CLOSURE UNITS

FIGURE 3



CITY OF TACOMA – TACOMA LANDFILL
METHANE DETECTION PROBES

FIGURE 4



CITY OF TACOMA – TACOMA LANDFILL
METHANE EXTRACTION WELLS

FIGURE 5

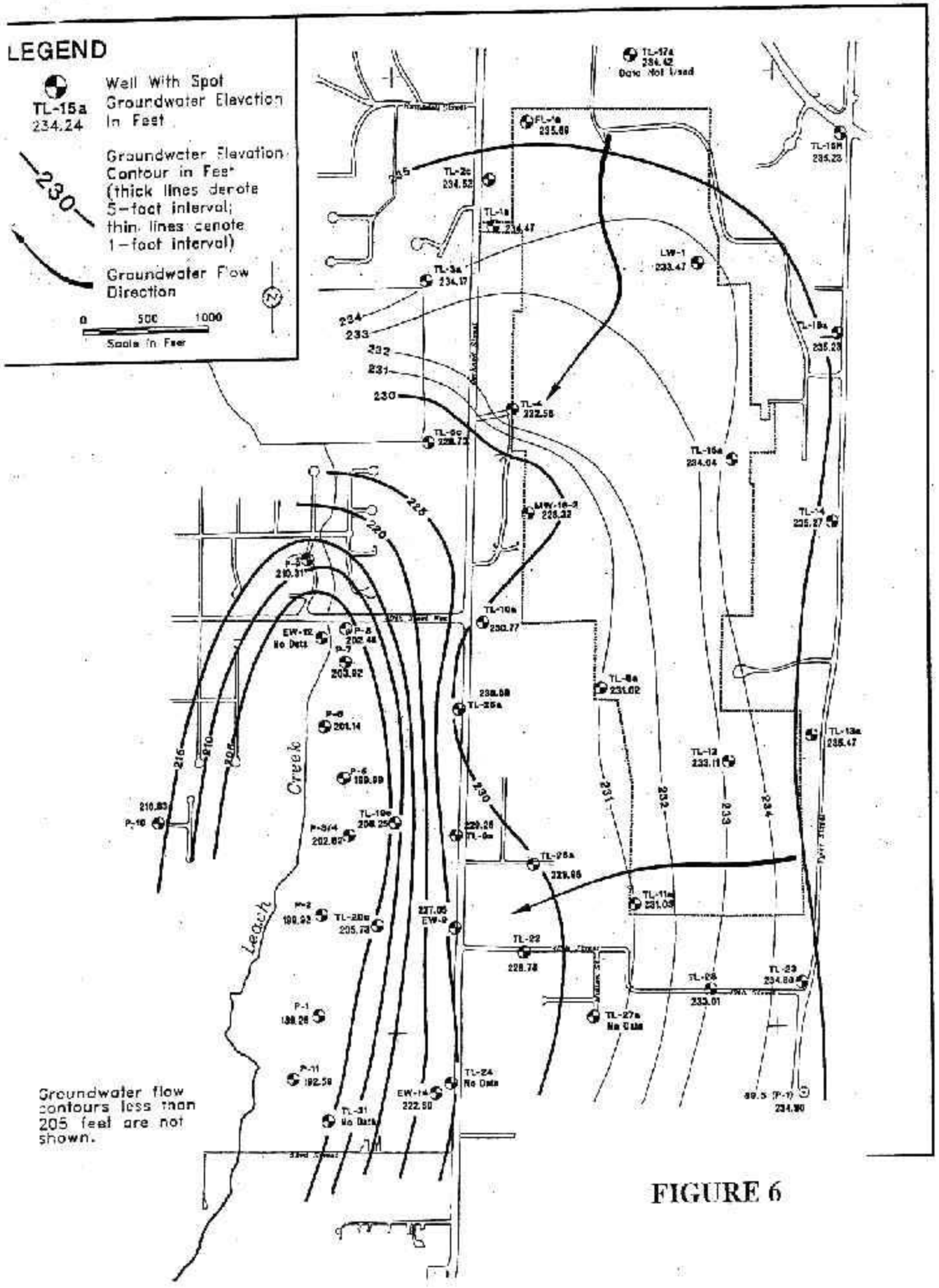

LEGEND
TL-15a
234.24
Well With Spot Groundwater Elevation In Feet
230
Groundwater Elevation Contour in Feet (thick lines denote 5-foot interval; thin lines denote 1-foot interval)
Groundwater Flow Direction
0
500
1000
Scale in Feet
Leach Creek
Groundwater flow contours less than 205 feet are not shown.

FIGURE 6