MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING

WEST BLUFF DRIVE / OCEAN DOCK ROAD AREA STORM DRAIN IMPROVEMENTS

ATTACHMENT D

1997 PORT OF ANCHORAGE DRAINAGE STUDY

Port of Anchorage Drainage Study, Final Report

DPW #95-17

PREPARED FOR

Department of
Public Works

Municipality of Anchorage

PREPARED BY

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March 1997

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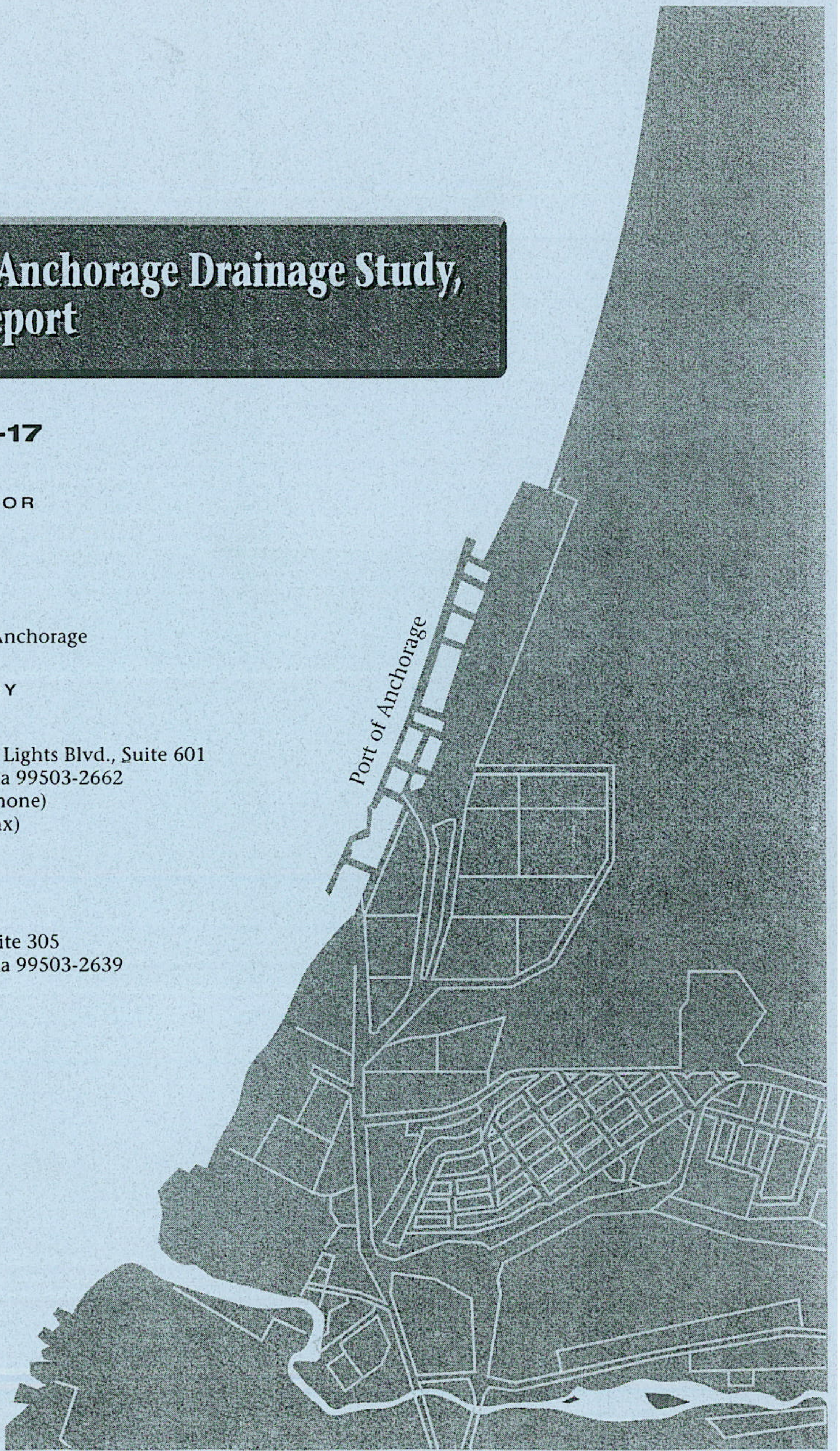

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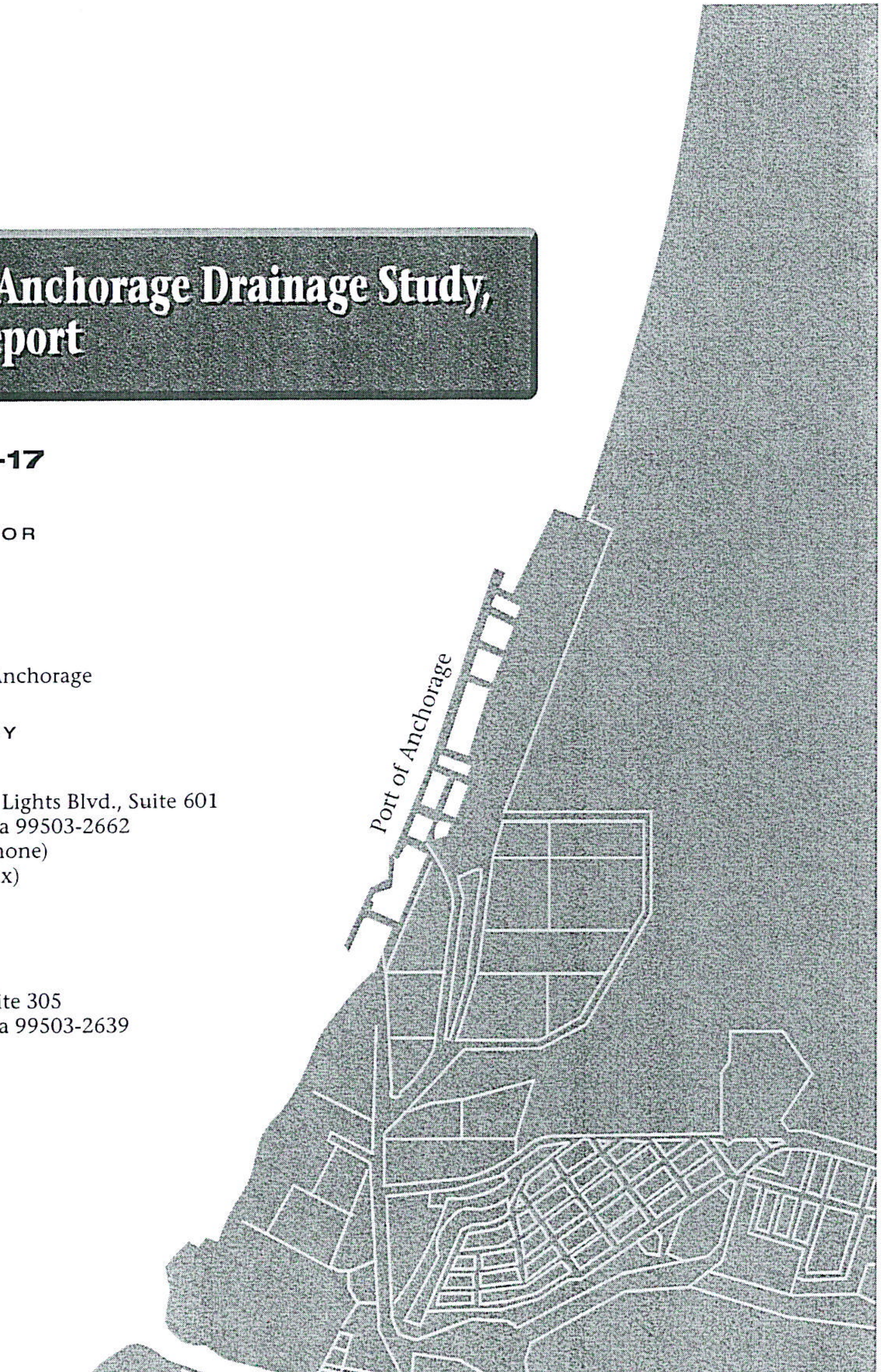

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Executive Summary

Purpose

The purpose of the Design Study is to assess and provide repair or rehabilitation recommendations for the six major storm drainage systems in the Port of Anchorage. The project area encompasses the Port of Anchorage and Alaska Railroad properties that are bounded by other Port of Anchorage property to the north, Elmendorf Air Force Base (EAFB) to the east, Cook Inlet to the west, and Ship Creek to the south.

Background

The Port has gone through several expansions since it was originally built. With each expansion, new underground utilities and storm systems were added to the Port property. However, there is no as-built information for many of these systems to verify their location, size, or whether they are still in use.

In recent years, the Port has been experiencing increased problems with their storm drainage systems. The collapse of the Sea-Land system in 1995, for example, created a sinkhole in the Sea-Land parking lot. Other systems have been experiencing a surcharging of their discharge.

Six major drainage systems are located within the project limits. These systems are referenced in the report as the North Tote, Tote, Sea-Land/Cherry Hill Ditch, Texaco, West Bluff, and North Star systems. Most of the systems were installed between 1967 and 1974. The two Tote systems are the most recent additions, installed in 1986. The North Star system could not be located during the field investigation for this report.

Assessment Process

Data relating to the existing storm systems, geotechnical information, and locations of utilities and easements were gathered to help assess the storm systems. The storm systems were inspected visually and by video for a general overview of their condition and to supplement the existing data. The inspection was limited to the manhole and a 10-foot section of the upstream and downstream pipe at each manhole. The Sea-Land system was an exception to this. It was videotaped along its entire length between Tidewater and Terminal roads. Preliminary hydraulic calculations were also performed to evaluate the flow capacities of the existing systems. Repair and rehabilitation alternatives were generated, evaluated, and presented in the preliminary draft version of this report. Copies of that report were sent out to the affected parties for comments. Review comments for that report have been incorporated into this report.

Summary

The repair alternatives provided in the preliminary report for the six storm drain systems were reviewed and comments provided. On the basis of those comments, the number of viable alternatives was reduced. The following is a brief discussion of the system condition and the recommended repair alternatives of for each system.

Tote and North Tote Systems

Because both systems were installed in 1986, the original repair alternative was to "do nothing." However, during the field inspection, the pipe leads adjacent to the manholes were found to be severely corroded. Heavy layers of sediment on the walls and bottoms of the manholes indicate the system is experiencing tidal surcharge. The condition of the manholes and the hydraulic capacity of both systems were both found to be satisfactory. The "do nothing" repair alternative is no longer appropriate for this systems. It is recommended the pipe in both systems be repaired either by sliplining or replacement with a suitable material. No specific repair costs have been generated for these systems. The price per lineal foot, however, should be similar to the $350 per lineal foot estimated for the West Bluff and Texaco systems.

Sea-Land System

The Sea-Land/Cherry Hill ditch system has a hydraulic capacity deficiency. Preliminary hydraulic analysis shows the existing Sea-Land system is unable to convey the runoff generated by the 10-year, 3-hour design storm event, as required by the Municipality of Anchorage's Design Criteria Manual. Most of the runoff is generated from EAFB property and is being conveyed to the Sea-Land system via the Cherry Hill Ditch. This study estimated flows from EAFB using unit runoff values from Anchorage International Airport Drainage Plan modeling. These flows should be refined further before design of recommended improvements.

The outfall of the Sea-Land system has deteriorated so severely that the discharge from this system is upstream of the berths. A large volume of sediment is being washed from the current discharge point of the system to underneath the berths. This erosion is working its way toward the parking area near the Port offices. Port personnel are concerned about the condition of the outfall and the transport of sediment.

The preliminary draft report identified seven repair alternatives for this system. On the basis of review comments, several alternatives were dismissed and the remaining refined into two repair alternatives for this report. It is recommended to replace the damaged sections, including the outfall, and slipline the entire system. This alternative would also construct a drainage swale to route the flow from the Cherry Hill Ditch to a new bypass system on the adjacent Tract 4A property. These repair recommendations would allow the 10-year, 3-hour event runoff to be conveyed without flooding Port property. The estimated construction cost of this alternative is $2,128,568. The estimated project cost including estimated project management and design costs is $2,573,439.

Texaco System

This system was generally in fair to poor condition. Several manholes showed signs of infiltration because of cracks in the barrel and missing mortar at the joints. The pipe leads at one manhole were severely corroded. The preliminary hydraulic model results indicate that several segments of the existing storm drain line are undersized for the 10-year, 3-hour rainfall event. No flooding has been reported, however, for this system. The preliminary draft report identified four repair alternatives: no-build, conduct spot repairs, combine with the Sea-Land system, and move the existing outfall. On the basis of review comments, the alternatives to combine with the Sea-Land system and move the existing outfall were dismissed.

It is recommended that spot repairs be conducted on the existing Texaco storm drain system. This would include grouting and sealing the deteriorated areas and sealing the manholes with a corrosion-resistant lining. Sliplining the existing pipe would also be installed after spots repairs to the defective pipe section have been completed. Construction of this alternative would, at minimal cost, extend the life of the system and eliminate most of the sediment transported within the system. The hydraulic capacity of the system would be unchanged. The estimated construction cost for this alternative is $170,161. The estimated project cost including estimated project management and design including costs is $231,249.

West Bluff Road System

The manholes and pipe leads at the manholes were generally in poor condition. Many of the pipes showed evidence of corrosion, and manhole defects such as missing mortar, cracking, and pitting were noted. Preliminary hydraulic model results indicate the downstream segment of this system may be undersized for the 10-year, 3-hour rainfall event. The outfall of the system is submerged at low tide, causing accumulation of sediment, which also reduces the capacity of the system.

Of the four repair alternatives identified in the preliminary draft report, only three were considered in this report: no-build, repair the existing outfall, and insertion line and repair manholes.

It is recommended to repair the outfall, slipline the pipe, and repair the manholes. As part of the outfall repair, the portion of the line downstream from Ocean Dock Road should be cleaned and inspected. The outfall inspection should be completed before other line repairs. Repairing manholes and lining the pipe would extend the life of the system. Repairing the outfall segment would increase the system capacity by reducing sedimentation within the system. Segments of the system would, however, remain undersized. Estimated construction cost would be approximately $542,958. The estimated project cost including estimated project management and design costs is $715,801.

North Star System

This is the southernmost system in the port drainage system. This system drains the North Star property and a portion of the Port Access Road area. No as-builts or records were found for this system. No aboveground features could be found for this system before or during the field investigation period. Consequently, only two alternatives are being considered in this report: do nothing and replace with new system. These are the only viable alternatives because the existing system could not be evaluated for system failure nor can it be maintained. It is therefore recommended that nothing be completed for this system, unless evidence is provided that shows a reasonable need to construct a new storm drain system.

SECTION 1

Introduction

SECTION 1

Introduction

Purpose

The purpose of this design study report is to assess the conditions of the six major storm drainage systems at the Port of Anchorage and recommend methods for rehabilitating, replacing, or doing nothing to the existing systems. The storm systems lie within property owned by the Port of Anchorage and the Alaska Railroad Corporation (ARR). The project limits are defined by the Port of Anchorage property to the north, Elmendorf Air Force Base (EAFB) to the east, Cook Inlet to the west, and Ship Creek to the south. The six storm drain systems will be referred to in this report as the North Tote, Tote, Sea-Land/Cherry Hill Ditch, Texaco, West Bluff, and North Star lines (see Figure 1-1). These systems total approximately 9,300 feet of pipe ranging in diameter from 16 inches in the West Bluff line to 72 inches in the Sea-Land line.

Scope of Work

This report has been divided into three distinct phases. The first, the preliminary draft design study phase, was primarily a data gathering phase. The data were used to evaluate up to 20 repair alternatives established before the data gathering process. Once the alternatives were evaluated, an order-of-magnitude cost estimate was prepared. The following is a list of the major tasks in Phase 1:

- Gather and review data about the existing storm pipe history, location, alignment, adjacent utilities, and easements, and prepare a base map.
- Collect existing recorded drainage easement records of the Cherry Hill Ditch, West Bluff, Texaco, and North Star storm drain alignments. Drainage easements will be researched and tabulated and easement gaps noted.
- Evaluate the Cherry Hill Ditch upstream of the existing storm drain for improvements to reduce downstream sediment accumulation. Develop alternative to reduce ditch erosion and sediment load into the port area.
- Collect available existing geotechnical information on the port area.
- Perform a Level 1 environmental assessment literature search analysis of the corridors of four existing and up to four new storm drain system alignments in the project area.
- Develop design flows and design capacity for the rehabilitated pipeline.
- Assess need for stormwater treatment.
- Inspect and evaluate existing pipeline manholes.

- Assess the remaining service life of the two newer existing storm drain systems installed by the Port of Anchorage.
- Develop up to 20 alternatives for repairing the Cherry Hill Ditch/Sea-Land, Texaco, West Bluff and North Star storm drain systems.
- Develop a synopsis of the agency permit constraints for construction of projects in this area.
- Assist Department of Public Works staff at the Government Hill Community Council meeting.
- Meet with Port Access Project Team, Port Users Group (PUG) and Terminal Users Group (TUG) once during the preliminary design report phase.

Phase 2, the draft design study phase, evaluates the alternatives selected after Phase 1 in more detail. Refining the cost estimates, confirming the selected utility corridors, resolving utility conflicts, and resolving construction issues are the major tasks in this phase. The goal of this phase is to describe and evaluate the selected repair alternative in enough detail to proceed to preliminary design. The following is a list of the major tasks in Phase 2:

- Conduct additional field investigations to refine surface flow patterns and drainage basins assumed for modeling.
- Evaluate in further detail up to eight alternatives selected from those developed in the preliminary design study phase. Rough order of magnitude cost estimates, with a 15 to 30 percent accuracy range, will be developed for each alternative.
- On the basis of existing and new data, evaluate and recommend the best alternative for repairing the storm drains, considering operation and maintenance, construction costs, hazardous materials issues, easement acquisition costs, utility conflicts, and water quality maintenance.
- Recommend an order of priority for making the storm pipe repairs based on life expectancy of the existing storm drain piping, potential for failure of the storm drain to impact Port operations, and coordination with other Port area development projects.
- Describe environmental permits required to implement the recommended alternatives.
- Meet with Port of Anchorage staff to present the project status and discuss current project issues and future plans for the project.
- Meet with the Port Access Project Team, PUG and TUG once during the draft design PUG, study phase.

Phase 3, the final design study phase, will finalize the report based on the comments received from Phase 2.

Background

The Port has gone through several expansions since it was originally built. Fill material used for the expansions is composed primarily of sand and gravel from nearby borrow pits

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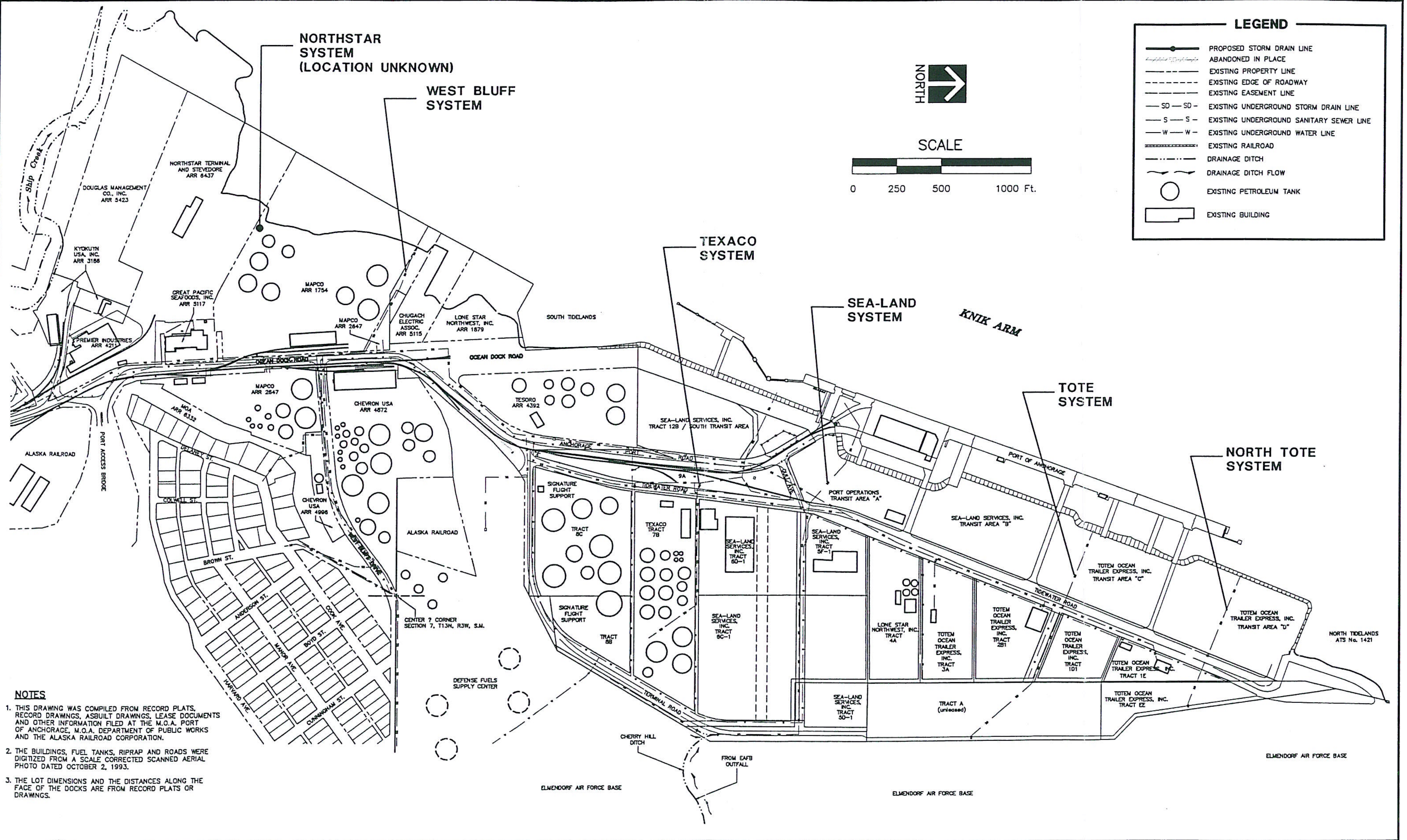

NOTES

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PORT OF ANCHORAGE DRAINAGE STUDY

PORT OF ANCHORAGE DRAINAGE STUDY

FIGURE 1–1
STORM DRAIN SYSTEM

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DATE FEB 1997
PROJ NO. 130330.A3.ZZ

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excavated in outwash deposits or landslide deposits from the 1964 earthquake. Based on existing test hole data, the groundwater depth ranges from 1 foot to 12 feet below the surface. A detailed discussion of the geotechnical information can be found in Section 3–Geotechnical Considerations.

With each expansion, new underground utilities and storm systems were added to the Port property. Many of these systems, however, have no as-built information to verify their location, size, or whether they are still in use. A list of the as-built information found is included in Section 2–Existing Storm Pipe System. It is known that sections of underground utilities were taken out of service during the expansions and abandoned. Encountering these systems during construction is likely.

During the past few years, the Port has been experiencing increased problems with its storm drainage systems. The collapse of the Sea-Land system in 1995, for example, created a sinkhole in the Sea-Land parking lot. Other systems have been experiencing tidal surcharging of their discharge. Heavy sedimentation deposits from the Sea-Land system have also been causing difficulties for the Port. The discharge, located near one of the berths, deposits enough sediment to adversely affect the vessels being moored.

The figure in Appendix E shows Port of Anchorage Drainage Study area, limits of Port and ARR land ownership, and leaseholders as of March 1996. Both ARR and Port lands are leased to a variety of entities. Tables 1 to 3 in Appendix E provide contacts for each lease holder, the Port, the ARR and key maintenance personnel. All streets within the study area, except Ocean Dock Road, are owned and maintained by the Municipality of Anchorage (MOA), Department of Public Works (DPW), Street Maintenance Division. Ocean Dock Road is owned by the Alaska Department of Transportation and Public Facilities (ADOT&PF) from Gull Avenue to the southern end of the study area.

SECTION 2

Existing Storm Pipe Systems

SECTION 2

Existing Storm Pipe Systems

General Description and Location

The Port of Anchorage Drainage Study contains seven distinct drainage basins. Six of these basins contain buried storm drain systems. One of the basins, the Ditch System, contains only open channels and short segments of culvert. There are no reported drainage problems within this basin and hydraulic model results indicate that the existing ditch system has adequate capacity to convey runoff from the design storm. It is assumed that the Ditch System basin is to remain an open ditch system and, therefore, it is not discussed further in this report. Figure 2-1 shows the drainage basins. Figure 2-2 shows an area of EAFB that contributes flow to the Sea-Land storm drain basin located within the Port of Anchorage Drainage Study area.

Evaluation Methodology

Information on each of the existing storm drain systems was collected and evaluated by collecting storm drain as-builts, conducting interviews, inspecting the existing storm drain systems, and modeling the existing drainage systems. The following paragraphs describe how each of the latter three methods was conducted.

Interviews

Eight individuals familiar with drainage at the Port of Anchorage were interviewed. Lengthy personal interviews were conducted with the MOA, DPW Street Maintenance Supervisor and the Port of Anchorage Operations Manager. Telephone interviews were conducted with representatives from the ARR, Chevron USA, Texaco, MAPCO, Signature Flight Support, and Tesoro.

The questions provided the respondent with the opportunity to share information on any perceived drainage problem areas at the Port, as well as provide project staff with suggested solutions. Responses specific to individual storm drain systems are summarized below. Appendix G, Public Participation Records and Interviews, fully documents the interview effort.

System Inspection

Five of the six buried storm drain systems were visually inspected and videotaped from March 12 to March 18, 1996. One of the systems, the North Star system, could not be located. The visual inspection was limited to the manholes and a 10-foot section of the upstream and downstream pipe at each manhole. In addition, most of the Sea-Land storm drain line was videotaped by close-circuit television (CCTV) because of pavement failure directly above the storm system in 1995. Results of the inspection effort specific to each of the five storm drain systems are summarized. Appendix C, Pipeline Inspection Results, fully documents the inspection effort.

Design Flow Modeling

The unsteady flow model, ILLUDAS, was used to evaluate the storm drain systems located within the seven drainage basins for the 10-year, 3-hour rainfall event. Use of ILLUDAS is called for in the MOA Design Criteria Manual for the design of municipal storm drainage systems. ILLUDAS routes hydrographs through a series of independent pipes under unpressurized flow conditions. ILLUDAS does not simulate the effects of surcharging or backwater, and no pipe has any influence on upstream pipes.

Results from the hydraulic models were used to identify drainage system deficiencies and evaluate alternatives. These models will also be used in the design of any new systems. Results of this modeling effort are summarized for each storm drain system. See Appendix F, ILLUDAS Modeling, for a more detailed description of the modeling effort.

Tote and North Tote Systems

General Discussion

The Tote storm drain systems service the northernmost area of land within the Port of Anchorage drainage study area. It is composed of two separate piped storm systems that were constructed in 1986. These systems are referenced in this report as the North Tote and Tote system. The combined systems contain approximately 2,000 feet of pipe ranging from 36-inch-diameter to 42-inch-diameter corrugated metal pipe (CMP). The systems collect the runoff from the Totem Ocean Trailer Express Inc., leases and convey it to Cook Inlet.

Two tracts of Port property (Tract A and Tract EE) at the boundary between EAFB and the Port were developed in 1994. A 12-inch-diameter, perforated pipe system was installed to collect groundwater and discharge it into both piped systems. The Tote storm drain system servicing this area freezes during the winter months. The tracts are reported to not have been leased because of ice accumulation.

The storm drain system services approximately 75 acres of land. Approximately one-half of this area is paved and is used by Totem Ocean Trailer Express, Inc., for parking. The remaining area within the basin is undeveloped, forested land owned by EAFB. The system was originally configured to be cathodically protected, but the cathode protection system was disconnected after approximately 1 year of service.

Summary of Inspection Results

Inspection of the storm drain system found the manholes to be in fair condition and the pipes to be in poor condition. The pipe leads adjacent to the manholes were found to be severely corroded. At some manholes, the pipe leads were completely corroded away. Heavy deposits of silt were observed on the crown of the pipes and on the manhole walls, indicating the system has been routinely surcharged with tide water. Twelve to 20 inches of silt was also observed in the bottom of the manholes. At the time of inspection, the perforated drainage system was frozen and the catch basins could not be inspected. Up to 3 feet of ice was noted to cover Tract A and Tract EE. The outfall was found but was not inspected. See Appendix C, Pipeline Inspection Results, for a detailed description of the inspection.

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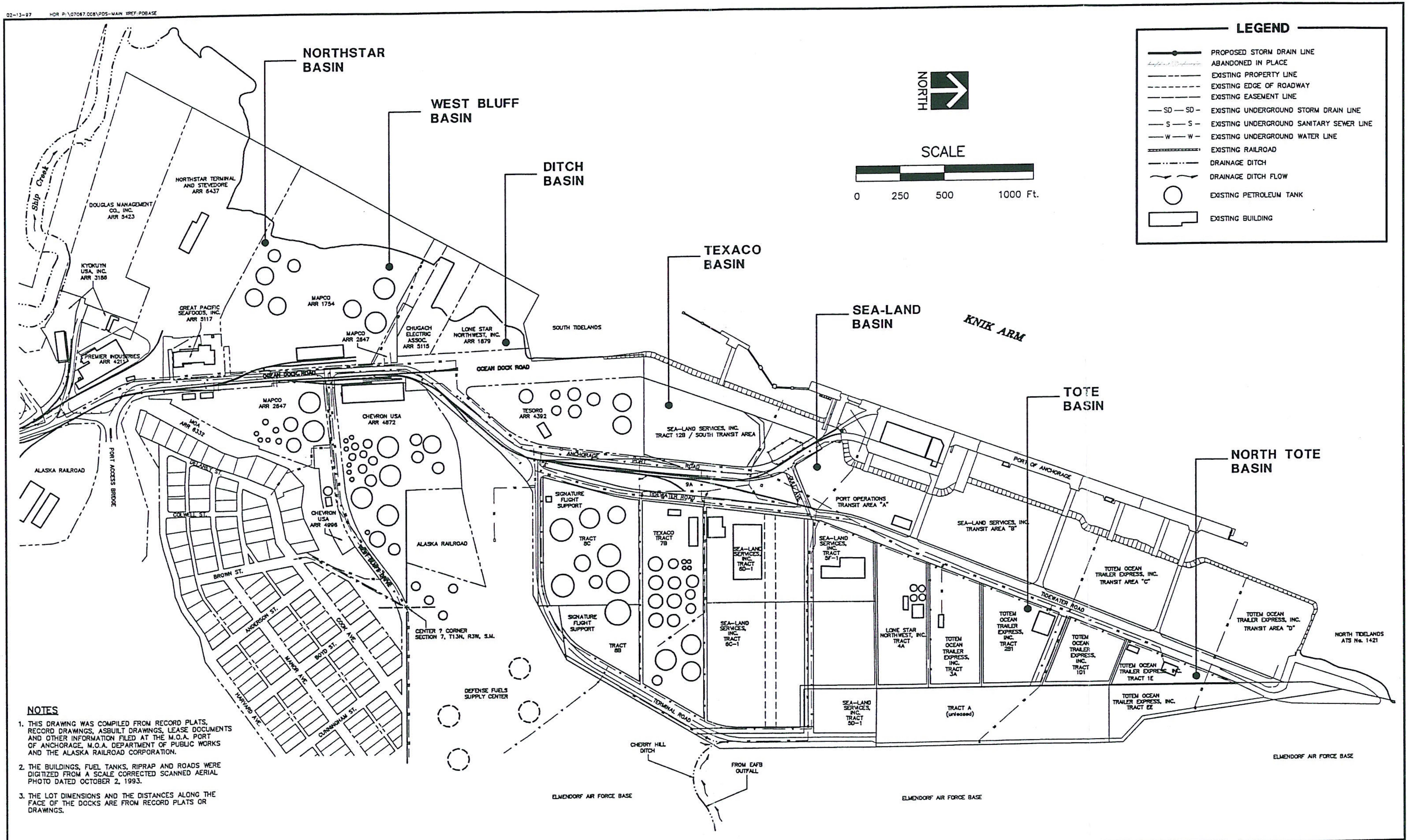

LEGEND

PROPOSED STORM DRAIN LINE
ABANDONED IN PLACE
EXISTING PROPERTY LINE
EXISTING EDGE OF ROADWAY
EXISTING EASEMENT LINE
— SD — SD — EXISTING UNDERGROUND STORM DRAIN LINE
— S — S — EXISTING UNDERGROUND SANITARY SEWER LINE
— W — W — EXISTING UNDERGROUND WATER LINE
EXISTING RAILROAD
DRAINAGE DITCH
DRAINAGE DITCH FLOW
○ EXISTING PETROLEUM TANK
EXISTING BUILDING

NOTES

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PORT OF ANCHORAGE DRAINAGE STUDY

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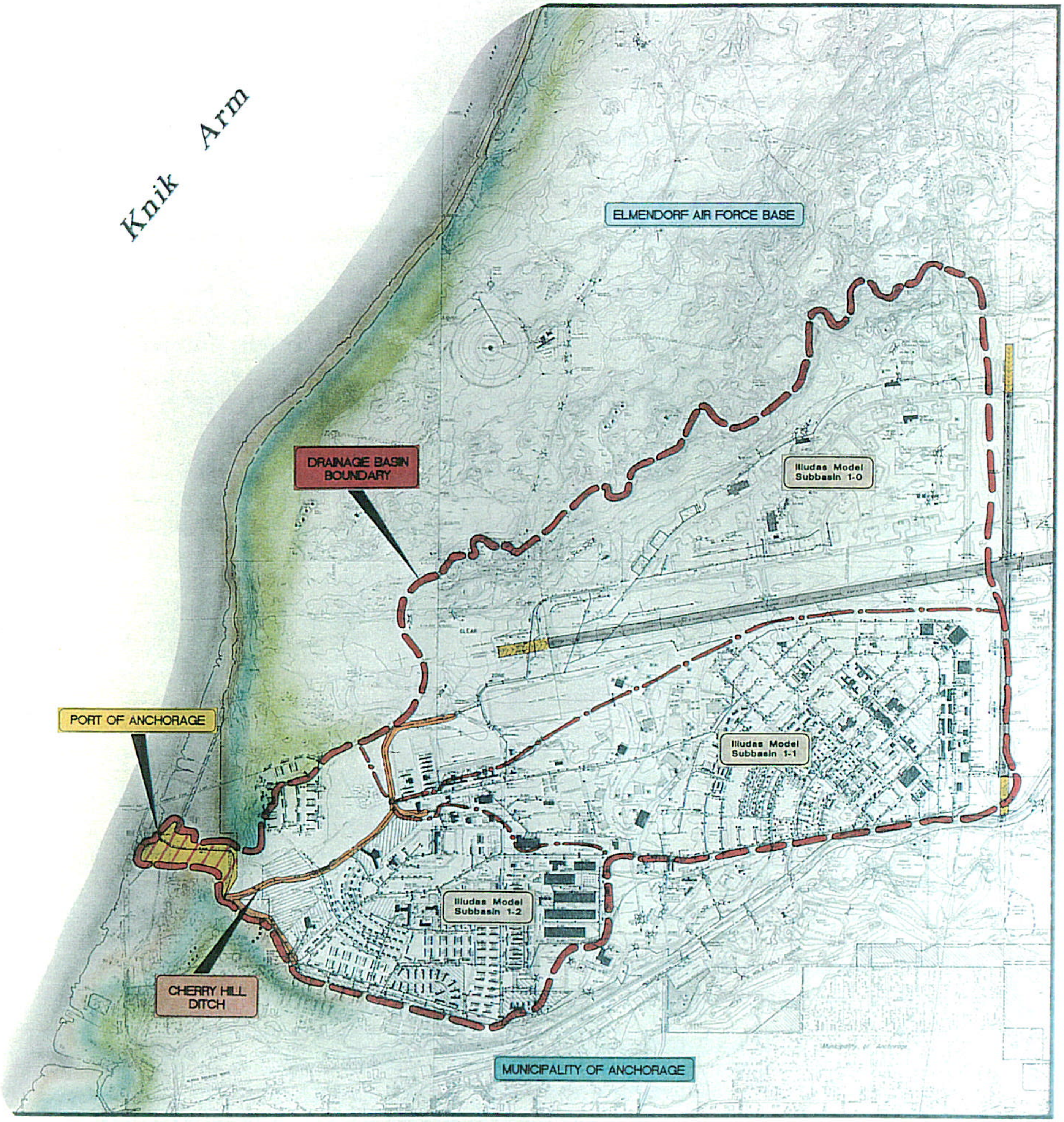

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NORTH

SCALE

Port of Anchorage Drainage Study
CHERRY HILL DITCH and SEA-LAND SYSTEM
DRAINAGE BASIN

Department of Public Works

FIGURE 2-2

Summary of Interviews

No people were interviewed about the Tote systems.

Summary of Hydraulic Model Results

Constraints of the hydraulic model required the storm drain system be modeled as two separate systems—North Tote and Tote—though they are connected by a segment of 12-inch-diameter pipe. Results of the North Tote hydraulic model indicate a peak flow of 4.4 cubic feet per second (cfs) would result from the 10-year, 3-hour rainfall event. This flow can be adequately routed in a 21-inch-diameter CMP placed at a slope of 0.3 percent. The existing pipe is a 36-inch-diameter CMP at 0.3 percent. Therefore, the existing storm drain system has adequate capacity to route runoff resulting from the 10-year, 3-hour design storm event.

Results of the Tote basin hydraulic model indicate that a peak flow of 9.4 cfs would result within the system from a 10-year, 3-hour rainfall event. This flow can be adequately routed in a 30-inch-diameter CMP placed at a slope of 0.3 percent. The existing 36-inch-diameter storm drain pipe, therefore, has adequate capacity to route runoff resulting from the 10-year, 3-hour design storm event.

Sea-Land System

General Discussion

The Sea-Land storm drain system contains approximately 1,800 feet of pipe ranging from 48-inch-diameter and 60-inch-diameter CMP to 72-inch by 44-inch arched CMP. Approximately 18 acres of the 2,250-acre drainage basin is located on Port of Anchorage property. The remaining drainage basin is located on EAFB as shown in Figure 2-2. An extensive piped storm drain system on EAFB (not analyzed as part of this study) collects and conveys the runoff on the base and routes it to a ditch known as Cherry Hill ditch. This ditch is located near the base of the steep hillside that separates the Port and EAFB property. Flow conveyed in Cherry Hill ditch enters the Sea-Land system next to Terminal Drive and is routed through Port of Anchorage property to its outfall near one of the Port's berths. This system also collects and routes the runoff from 18 acres of Port property.

The land on which the Sea-Land storm drain system is located originally belonged to the United States military. This land was purchased by the Port of Anchorage in 1961. In the land transfer documentation, the United States military agreed to maintain, operate, repair, or improve any utilities that were on the property that continued to be used by the military. The storm drain system conveying Cherry Hill ditch drainage through the Port appears to be one of these utilities. A copy of the transfer agreement is in Appendix N.

Summary of Inspection Results

The CCTV survey and inspection of the existing storm drain system found the manholes and pipes within the eastern portion of the storm drain system to be in fair condition. Most of the defects were found in the western, or the downstream, segment of the system. A segment east of Gull Avenue was particularly defective. An obstruction within this segment prevented the videotaping of approximately 230 feet of pipe. Corrosion was not excessive in most of the upstream segments of the Sea-Land system. Several protruding pipe laterals were observed throughout the system. Protruding laterals are considered defects for either slipline or insertion lining rehabilitation. Several manholes did have evidence of structural defects, such as cracks or missing mortar, and signs of infiltration. The last 100 to 150 feet of outfall pipe has separated at several joints and is exposed. Runoff discharging from the system is washing away the silts that previously covered the pipe and redepositing them underneath the berths. This erosion of the silt material is causing a gully to migrate toward a paved parking area (Transit Area A) east of the Port offices. See Appendix C, Pipeline Inspection Results, for a full summary of the CCTV survey and inspection of the existing Sea-Land storm drain system.

Summary of Interviews

During the interview process, Port of Anchorage personnel identified the Sea-Land system's outfall as a major drainage problem because of the sediment buildup at the outfall. This build up was reported to potentially affect ships moored at the Port dock. Another problem identified by Port personnel that was the collapse of a portion of this system caused the land to slump at a location near the Sea-Land office building during the summer of 1995.

Summary of Hydraulic Model Results

Hydraulic model results indicate that the majority of existing storm drain segments located within the Sea-Land drainage basin are undersized for the 10-year, 3-hour rainfall event. The 10-year storm event includes runoff from approximately 2,000 acres of EAFB. Those flows were estimated for this event by developing unit runoff values from similar modeling done for Anchorage International Airport. The estimated peak flows from EAFB appear conservative because of the method used. This study was not funded to do a more in-depth analysis of contributory flows from EAFB. Such a study should be done before constructing improvements to the Sea-Land system.

Table 2-1 presents model results, including modeled storm drain segment length, existing segment slope, existing pipe diameter, and required pipe diameter to convey the 10-year, 3-hour rainfall event runoff.

Texaco System

General Discussion

The Texaco storm drain system contains approximately 1,200 feet of 24-inch CMP that was originally installed in 1964. The system is located south of Gull Avenue and north of the intersection of Port Road and Tidewater Road. Its collects the runoff from the Texaco property and conveys it to Cook Inlet. Its drainage basin is 57 acres of industrial-use lands. Approximately 14.5 acres of the 57 acres contains diked tank farms that are operated by Texaco and Signature Flight Support.

TABLE 2-1
Sea-Land Storm Drain System
Hydraulic Model Results

Segment Length (feet)	Segment Slope (percent)	Existing Pipe Diameter (inches)	Required Pipe Diameter (inches)
2,060	0.5	ditch	60
2,060	0.5	ditch	84
2,060	0.5	ditch	84
450	0.3	48	96
248	0.51	60	84
712	0.3	60	96
322	0.19	72x44	108
365	0.26	60	96
383	4.81	60	54

Summary of Interviews

Individuals who were interviewed did not report any flooding problems within the drainage basin and stated that they believed the existing storm drain system was in good condition.

Summary of Inspection Results

The CCTV survey and inspection of the existing storm drain system found the existing storm drain system to be in fair to poor condition. The defects found in most of the manholes were missing mortar at joints and pipe penetrations, offset grade rings, and infiltration. The manhole furthest downstream also showed evidence of tidal surcharging. Several pipe leads at manholes were heavily corroded at their inverts. See Appendix C, Pipeline Inspection Results, for a full summary of the CCTV survey and inspection of the existing Texaco storm drain system.

Summary of Hydraulic Modeling Results

Hydraulic model results indicate that several existing storm drain segments may be too small to convey runoff from the 10-year, 3-hour rainfall event. Table 2-2 presents model results, including modeled storm drain segment length, existing segment slope, existing pipe diameter, and required pipe diameter to convey the 10-year, 3-hour rainfall event runoff.

TABLE 2-2
Texaco Storm Drain System
Hydraulic Model Results

Segment Length (feet)	Segment Slope (percent)	Existing Pipe Diameter (inches)	Required Pipe Diameter (inches)
420	0.3	24	24
20	0.3	12[a]	12[a]
1,000	0.3	24	27
20	0.3	12[a]	12[a]
332	0.3	18	21
248	0.3	36	30
550	0.3	30	36

[a] These reaches serve diked tank farm areas not included in the final design-mode ILLUDAS model. The 12-inch-diameter storm drains would be adequate to serve these areas.

West Bluff System

General Discussion

The West Bluff drainage system begins in Government Hill, but for purposes of this report, only the section located within the Port property will be discussed. The system contains approximately 1,700 feet of pipe ranging in size from 15-inch-diameter to 30-inch-diameter CMP. The West Bluff drainage basin is approximately 81 acres. Roughly half of the drainage basin is composed of residential land; the remainder is marine industrial land. Approximately 14 acres of the 81-acre basin contain diked, unlined tank farms that are operated by Chevron USA and MAPCO.

Summary of Interviews

In 1992 a storm drain manhole at the bottom of the Government Hill bluff surcharged, washed out a portion of West Bluff Road, and flooded a tank farm operated by Chevron. Chevron does not, however, perceive this as a current threat to their property. This incident is believed to be the result of flooding from a water main that broke in the fall of 1992 and not a result of a surcharged storm drain system. The break in the water main occurred in the West Bluff Roadway, approximately 200 feet from the crest of the hill above the Port of Anchorage. Flow from the break was reported to have washed a portion of the roadway away, creating a gully in the center of West Bluff Road, and deposited debris into the Chevron Tank farm. This would explain why the incident is not perceived by Chevron as a current threat to their facility.

A representative of Chevron did report that during the winter months and spring breakup the intersection of West Bluff Drive and Ocean Dock Road floods and glaciates. Chevron believes this has been and will continue to be a significant safety hazard.

The DPW cannot locate the storm drain manholes west of Ocean Dock Road and is unable to maintain this segment of the storm drain system. The DPW reports that petroleum product has been detected in the storm drain system and suggests that an oil-grit separator be constructed in-line before discharge to Cook Inlet. CH2M HILL also reported petroleum products visible in the storm drain system during their spring 1996 field reconnaissance.

Summary of Inspection Results

The CCTV survey and inspection of the existing storm drain system found the existing storm drain system to be in poor condition. Several manholes did have evidence of structural defects, such as cracks or missing mortar, and signs of infiltration. One of the manholes had significant pitting in the concrete wall. Surcharging by the tide water was evidenced by the sediment and muck buildup found in the lower sections of the system. The downstream segments of the storm drain system were found to be completely submerged at low tide. Many of the pipe leads at the manholes showed evidence of corrosion. The exact location of the outfall has not been identified, but a field inspection conducted at low tide identified water emerging from fill at the approximate location of the outfall. This indicates that the outfall is likely completely buried under fill, restricting outflow and probably causing sediment accumulation within the system.

Summary of Hydraulic Model Results

Hydraulic model results indicate that downstream segments of the existing storm drain system may be too small to convey runoff from the design rainfall event. Table 2-3 presents

TABLE 2-3
West Bluff Storm Drain System
Hydraulic Model Results

Segment Length (feet)	Segment Slope (percent)	Existing Pipe Diameter (inches)	Required Pipe Diameter (inches)
225	0.53	21	18
95	19.1	15	12
112	12.1	15	12
197	9.2	15	12
161	7.7	15	12
417	5.2	15	15
198	2.0	18	12
255	0.38	18	24
20	0.3	30	27
126	0.33	30	27
1,020	0.3	30	36

model results, including modeled storm drain segment length, existing segment slope, existing pipe diameter, and required pipe diameter to convey the 10-year, 3-hour rainfall event runoff.

North Star System

General Discussion

The North Star drainage system could not be found in the field. Information on the system alignment, outfall location, pipe size, pipe material, or invert slope also could not be located. The DPW is not able to maintain the system because of the lack of easements and location information. It is reported the North Star drainage basin is drained by a single-pipe storm system extending from Ocean Dock Road to an outfall into Cook Inlet.

The North Star drainage basin is a 23-acre marine industrial area at the southern end of the study area. A diked tank farm area operated by MAPCO occupies approximately 4.2 acres of the drainage basin. The tank farm area is currently diked and unlined and is not dewatered after rainfall events.

Summary of Interviews

There are no reported flooding problems within the North Star Basin.

Summary of Inspection Results

The system could not be located. No inspection was performed.

Summary of Hydraulic Model Results

The system was input into ILLUDAS as an 18-inch-diameter CMP set at 0.3 percent slope. These are assumed diameters and slopes and are used for modeling purposes only. Table 2-4 presents model results, including modeled storm drain segment length, existing segment slope, existing pipe diameter, and required pipe diameter to convey the 10-year, 3-hour rainfall event runoff.

TABLE 2-4
North Star Storm Drain System
Hydraulic Model Results

Segment Length (feet)	Segment Slope (percent)	Required Pipe Diameter (inches)
200	0.3	15
500	0.3	21
400	0.3	21
300	0.3	24

SECTION 3

Geotechnical Considerations

SECTION 3

Geotechnical Considerations

Review of Existing Information

This chapter presents the results of the geotechnical literature review and engineering assessment conducted in support of the storm drain repair study. The primary objective of these geotechnical services is to define subsurface conditions along the existing or proposed routes of the six storm drain lines considered in this study. Generalized recommendations regarding geotechnical-related repair issues are also addressed for each line. The geotechnical data referenced in this study was primarily obtained from the MOA DPW, the Port of Anchorage, CH2M HILL's project files, and published geologic data.

Area Geology and Hydrology

Area Geology

The majority of the project alignments are in areas that were originally low-lying tidal flats and tidal marshes (References 1 through 5 in Appendix A). These near-surface estuarine deposits consist primarily of soft to stiff fine-grained silts, although zones and layers of coarse-grained materials are also present in areas of higher-energy deposition. The tidal marsh deposits are distinguished from the tidal flat deposits primarily by the presence of organic material, including deposits of surficial peat. The tidal flat and tidal marsh materials are approximately 20 to 50 feet thick in the Port area and are underlain by thick deposits of the Bootlegger Cove formation. Bootlegger Cove soils typically consist of soft to hard clayey silt to silty clay with occasional sand and gravel lenses. The Bootlegger Cove formation ranges up to about 250 feet in thickness.

A 1992 study by Shannon & Wilson includes a map depicting location and time of fill placed in the port area, along with generalized cross-sections depicting east to west and north to south subsurface conditions in the Port area (Reference 5, Appendix A). The fill map and cross-sections are included in Appendix A, Attachment 1. The fill map indicates that fill has been placed over most of the tidal flat/tidal marsh areas in the Port during the last 50 years. The cross-sections indicate that the fill consists primarily of sand and gravel and is generally about 5 to 10 feet thick. The fill was primarily obtained from nearby borrow pits excavated in outwash deposits or landslide deposits after the 1964 earthquake. Accordingly, the fill consists primarily of sand and gravel soils. The near-surface organic materials in the tidal marsh areas were probably removed before fill placement in some areas, filled over in some areas, and left undisturbed in other areas where no fill has been placed.

Further east along the bluff line, colluvial deposits consisting primarily of landslide debris associated with the 1964 Good Friday Earthquake are also found. The landslide deposits are composed primarily of sand and gravel. The eastern portion of the upper West Bluff storm drain line on Government Hill is underlain by alluvial sand and gravel of the Anchorage coastal plain.

The 1964 Good Friday Earthquake caused extensive damage within the study area (Reference 6, Appendix A). Most of the damage induced by the earthquake was caused by ground displacement along fractures that ran parallel to the bluffs in a north-south direction. Most of these fractures were found east of Tidewater Road. The port is in an area of high seismicity, classified as Zone 4 on the Seismic Zone Map of the United States (Reference 7, Appendix A). The steeper side-slopes along the West Bluff Line are classified as having a high to very high susceptibility to seismically induced ground failure (Reference 4, Appendix A).

Regional Hydrology

Regional hydrology of the port area includes a deep confined aquifer that is separated from a shallow unconfined aquifer by fine deposits of the Bootlegger Cove formation (Reference 8, Appendix A). Direction of groundwater movement in the aquifers trends toward Cook Inlet. Surface waters throughout the area originally included open streams, ponds, marshes, and seeps and springs near the bluff. Development of the port area frequently included installation of subsurface drains to promote area drainage. Ship Creek, bordering the south end of the port area, is the primary stream with other minor spring-fed streams located throughout the area. Surface drainage is also towards the inlet.

North Tote Line

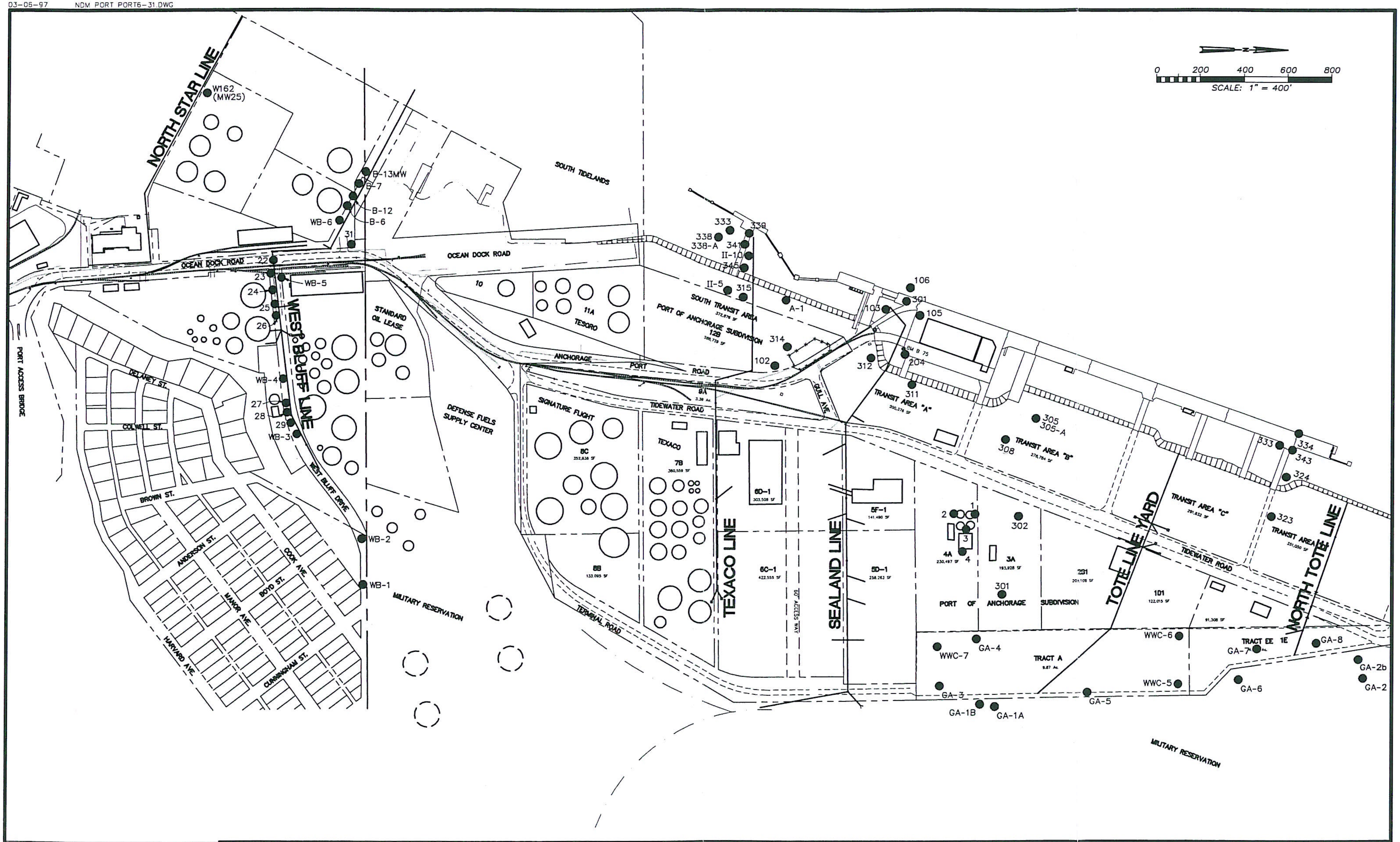
Logs from seven soil borings drilled near the storm drain alignment east of Tidewater Road were obtained from a 1990 USKH report (Reference 9, Appendix A). These include Golder Borings GA-2, GA-2b, GA-6, GA-7, and GA-8; and Woodward-Clyde Borings WWC 5 and WWC 6. Logs from soil borings drilled near the storm drain alignment west of Tidewater Road were obtained from a 1972 report prepared by Tippetts-Abbett-McCarthy-Stratton (TAMS) (Reference 10, Appendix A). These include Borings 323, 324, 333, 334, and 343. Boring locations from these studies are shown in Figure 3-1. Boring logs are included in Appendix A.

Site Conditions

Surface. The North Tote line consists of about 800 feet of 24- to 36-inch-diameter CMP. The storm drain easement runs westerly through Tract EE, Lot 1E, and then runs between the Port of Anchorage's Transit Areas C and D before outfalling beneath the existing docks. Most of the alignment lies in paved areas.

Soil. East of Tidewater Road, interlayered deposits of silt, clayey silt, clay, and sand were encountered in all borings, from original ground surface to termination depths ranging from 20.5 to 75 feet. Approximately 16.5 feet of granular fill or landslide debris was encountered above a 3-foot peat layer in Boring GA-6. Approximately 5 feet of sand fill was encountered over a compressed 1-foot-thick peat layer in Boring WWC 6. Based on blow counts during drilling, density of the granular soils ranged from loose to dense; the consistency of the fine-grained soils ranged from soft to stiff. Moisture contents ranged from about 5 to 20 percent in the sands, and from about 20 to 65 percent in the silts and clays.

West of Tidewater Road, the only available borings are from the 1972 TAMS study (Reference 10, Appendix A). These borings were drilled before fill was placed in the area; the Shannon & Wilson fill map indicates fill placement during 1984-1985 in this area. The



DSGN	K. KRUSHKE		
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CHK	M. STEPHL		
APVD	M. STEPHL		

NO.	DATE	REVISION	BY	APVD

REUSE OF DOCUMENTS

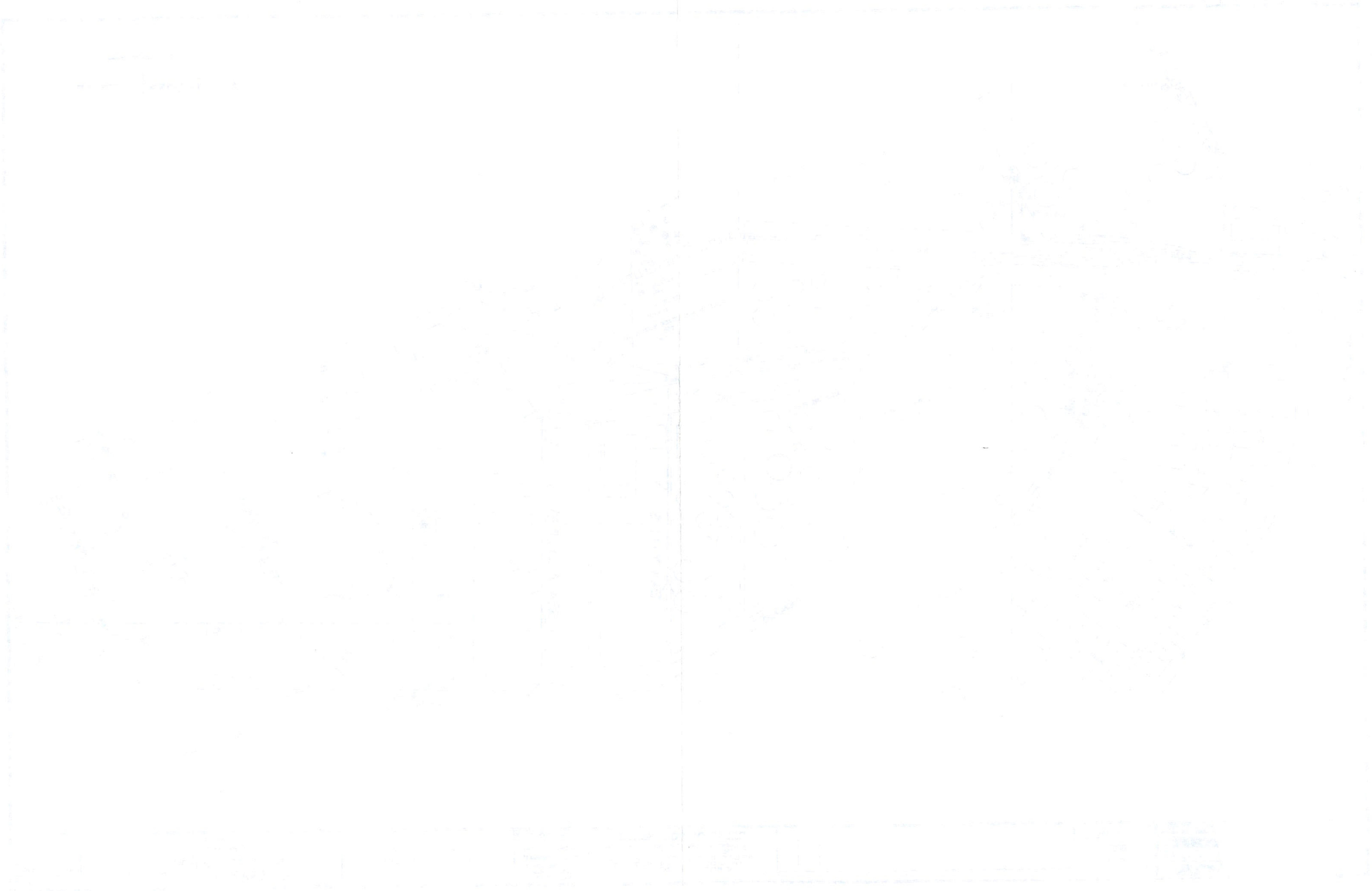
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

PORT OF ANCHORAGE
ANCHORAGE, ALASKA

PORT OF ANCHORAGE STORM DRAIN STUDY

FIGURE 3–1
PORT OF ANCHORAGE
STORM DRAIN SYSTEM SITE MAP

SHEET
DWG NO.
DATE OCT 1996
PROJ NO. 130330.A3.ZZ



TAMS borings were drilled to depths of 35 to 52 feet and encountered interlayered deposits of soft to hard fine-grained soils (sandy silt, silt, silty clay) and loose to dense granular soils (sand and silty sand with occasional gravelly layers). On the basis of the 1992 Shannon & Wilson cross sections (Attachment 1, Reference 5), it appears that fill thicknesses in the area are typically in the range of 5 to 10 feet, although greater fill thickness may be present in some areas, particularly near the inlet.

Groundwater. Groundwater was encountered in all eight borings drilled east of Tidewater Road. Groundwater level measurements during drilling operations are presented on the boring logs in Attachment 1. The depth to groundwater observed during drilling operations varied from about 3 to 22 feet. Groundwater measurements collected during drilling, however, may not reflect static groundwater levels. Subsequent groundwater measurements from monitoring wells in several of the borings, taken on January 3, 1990, indicated groundwater levels ranging from about 1 foot to 12 feet in depth.

Groundwater observations were apparently not recorded for the 1972 TAMS borings west of Tidewater Road. However, the generalized cross-sections from the 1992 Shannon & Wilson report (Reference 5, Appendix A) indicate groundwater depths ranging from about 1 foot to 10 feet.

It is expected that groundwater levels in the area are affected by tidal fluctuations, particularly west of Tidewater Road near the inlet, and will be higher in the spring and fall because of snowmelt, runoff, and seasonal precipitation. The variability of subsurface material is also expected to affect groundwater flow and level. Heaving sand in the augers was encountered at depths of 40 to 55 feet in GA-2A, and from 15 to 16.5 feet in GA-6. Heaving sand could be a problem during trench excavation if proper design and construction procedures are not followed.

Tote Line

Logs from eight soil borings drilled near the storm drain alignment east of Tidewater Road were available in the 1990 USKH and the 1972 TAMS reports (References 9 and 10, Appendix A). These borings include Golder Borings GA-1A, GA-1B, GA-3, GA-4, GA-5; Woodward Clyde Boring WWC-7; and TAMS Boring 301 and 302. Logs from four other borings (Nos. 1 through 4) drilled east of Tidewater Road were obtained from a 1968 North Pacific Test Lab report for the expansion of the Lonestar Cement Terminal (Reference 11, Appendix A). West of Tidewater Road the available data include TAMS Borings 305, 305-A, and 308. Locations for all available borings are shown in Figure 3-1 and boring logs are included in Appendix A.

Site Conditions

Surface. The Tote line consists of approximately 1,250 lf of CMP ranging in diameter from 30 to 42 inches. The storm drain line begins at the west boundary of Tract A where it connects with a perforated subdrain system placed within the Tract A fill. The line then runs westerly through Tote Alaska's paved industrial yard (Lot 3A), and then through Port of Anchorage Transit Area B before outfalling beneath the Port of Anchorage docks.

Soil. Significant deposits of organic materials (peat and organic silt) were encountered in 11 of the 12 available borings drilled east of Tidewater Road. In six of the 12 borings, organic materials were encountered at the ground surface to depths ranging from about 2 to

9 feet. In the other five borings where organic materials were encountered, they were present in compressed layers below granular fill. The compressed organic layers ranged in thickness from about 1 foot to 4 feet, with overlying fill thicknesses ranging from approximately 3 to 6 feet. Where not overlain by fill, the organic materials were typically very soft and highly compressible. Organic materials previously compressed by the weight of fill will have somewhat improved strength and compressibility characteristics. The areas traversed by the Tote line have all been filled; if organic materials are present along the route, they will be in the form of compressed layers below variable thicknesses of granular fill.

Interlayered sands, silty sands, silts, clayey silts, and silty clays are present below the organics in all borings east of Tidewater Road to the depths drilled, ranging from 21 to 140 feet. Gravel zones were encountered in many of the borings, typically increasing in frequency at deeper depths. Blow counts during drilling showed that density of the granular soils ranges from loose to dense; consistency of the silt and clay ranges from soft to hard. Moisture contents range from about 5 to 20 percent in the granular layers, and from about 20 to 45 percent in the fine-grained soils.

The TAMS borings east of Tidewater Road (Borings 305, 305-A, and 308) were drilled in 1971 before fill was placed in the area. The Shannon & Wilson fill map (see Attachment 1, Reference 5, Appendix A) indicates fill placement during 1973-1974 in this area. Typical area fill thicknesses are expected to be in the range of 5 to 10 feet. The TAMS borings were drilled to depths of 65 to 82 feet and encountered interlayered deposits of soft to hard sandy silt, silt, silty clay and medium dense to very dense sand and gravel soils.

Groundwater. East of Tidewater Road along the Tote alignment, groundwater was encountered in all the Golder and Woodward Clyde borings. Groundwater level measurements during drilling operations are presented in the boring logs in Attachment 1. In general, groundwater was encountered at or near the surface during drilling or rose to near the ground surface after drilling completion. Groundwater measurements were apparently not made in any of the TAMS or North Pacific Test Lab borings along the alignment. Accordingly, the only available information concerning groundwater levels west of Tidewater Road is from the generalized cross-sections from the 1992 Shannon & Wilson report (Reference 5, Appendix A), which indicate groundwater depths ranging from about 1 foot to 10 feet.

Sea-Land Line

Seven logs from borings drilled near the storm drain alignment west of Tidewater Road were available in the 1972 TAMS report (Reference 10, Appendix A) and a 1989 Tryck, Nyman & Hayes (TNH) geotechnical report (Reference 12, Appendix A); these borings were drilled during several different studies over the years and include Borings 103, 105, 106, 201, 204, 311, and 312. Boring locations are shown in Figure 3-1 and boring logs are included in Appendix A. Limited information concerning subsurface conditions east of Tidewater Road at the Sea-Land facility is available from the 1992 Shannon & Wilson summary site assessment report (Reference 5, Appendix A).

Site Conditions

Surface. The Sea-Land line is approximately 1,800 feet of CMP ranging in diameter from 48 inches to 72 inches. The storm drain line begins at the termination of the Cherry Hill ditch, which carries runoff from areas east of the bluff. The storm drain runs north for about 300 feet before turning west and crossing through a lighterage yard operated by Sea-Land, through the Port of Anchorage Transit Area A, and then outfalling beneath Port of Anchorage docks. The Sea-Land yard and the transit area are paved. The available borings were drilled in the transit area; the 1992 Shannon & Wilson site assessment report (Reference 5, Appendix A) briefly discusses site development in the Sea-Land yard area.

Soil. No borings are currently available in the Sea-Land yard east of Tidewater Road. The 1992 Shannon & Wilson report (Reference 5, Appendix A) indicates that filling of the site began in 1962 and was largely complete by 1972. Among the last areas filled were low marshy areas in the north and east sections of the property. On the basis of this information and knowledge of local geology, subsurface conditions in this area are expected to be generally similar to the Tote line just to the north, with granular fill overlying compressed organic layers. It is not known with certainty whether the organic materials were removed prior to filling, although it is likely that at least some of the organic materials remain below the fill. Two large buildings were constructed in the Sea-Land yard in 1968 and 1975.

The available borings west of Tidewater Road were all drilled before 1973, when fill placement in Transit Area A began. Interlayered silts, silty clays, sands, and silty sands with occasional gravel lenses were encountered in all borings throughout the depths drilled, ranging from about 47 to 160 feet below original ground surface. The density of the granular soils ranges from loose to dense, while consistency of the fine-grained soils ranges from soft to very stiff. These native soil conditions are generally similar to those observed elsewhere in the Port area. On the basis of the available soil cross-sections in the Port area (Reference 5, Appendix A), granular fill thicknesses over the native tidal flat deposits are expected to be in the range of 5 to 10 feet.

Groundwater. Groundwater level measurements were apparently not obtained from any of the available borings along the Sea-Land line. As noted previously, groundwater depths shown on the soil cross-sections in the 1992 Shannon & Wilson report range from about 1 foot to 10 feet below existing site grades in the filled tidal flat areas. It is expected that groundwater levels are affected by tidal fluctuations, snowmelt, seasonal precipitation, and runoff.

Texaco Line

The Texaco line is about 600 feet south of and parallel to the Sea-Land line. Three logs from soil borings drilled near the storm drain alignment west of Tidewater Road were available in the 1989 TNH report (Reference 12, Appendix A); these include Borings A-1, II-5 and II-10. The TNH report also contained an east-west cross-section of subsurface conditions in the area (Subsurface Profile C-C [Reference 12, Appendix A]). Nine logs from soil borings drilled near the storm drain alignment west of Tidewater Road were also available in the 1972 TAMS report (Reference 10, Appendix A); these include Borings 102, 314, 315, 333, 338, 338-A, 339, 341, and 345. Boring locations are shown in Figure 3-1 and boring logs and the east-west cross-section are included in Appendix A. Although no boring logs have been found near the alignment east of Tidewater Road, limited soils and groundwater information (but no boring logs) was obtained from the 1992 Shannon & Wilson summary site assessment report (Reference 5, Appendix A).

Site Conditions

Surface. The Texaco line consists of approximately 1,700 feet of 24-inch-diameter CMP. The storm drain easement runs westerly through a bulk fuel tank storage yard and terminal operated by Texaco and then through the Port of Anchorage South Transit Area before outfalling beneath Port of Anchorage docks. Most of the alignment is paved.

Soil. The Texaco terminal was constructed in 1964 following the Good Friday Earthquake. Eleven borings drilled during Shannon & Wilson's 1992 study showed that subsurface conditions at the terminal consist primarily of granular fill overlying silty clay (Reference 5, Appendix A, logs not currently available). The granular fill consists primarily of sandy gravel with a variable fines content (percent by weight of silt- and clay-sized particles). Silty clay with organics was encountered below the fill to the terminal depths of the borings (10 to 17.5 feet).

West of Ocean Dock Road in the Port Transit area, granular fill consisting of loose to dense, silty sandy gravel was found in Boring A-1 to a depth of about 18 feet (Reference 5, Appendix A). Boring A-1 was drilled in 1989. Other available borings were drilled before 1983-1984 when most of the fill in the area was placed. The native soils encountered in the borings include interlayered silts, silty clays, sands, and occasional gravel lenses throughout the depths drilled, ranging from 23 to 250 feet below grade. Granular material density ranges from loose to dense; consistency of the silt and clay ranges from soft to hard.

Groundwater. Groundwater level measurements made in the Texaco terminal facility indicated a perched groundwater condition at depths ranging from 3 to 8.5 feet below existing grade (Reference 5, Appendix A). No groundwater measurements were made in the transit area west of Ocean Dock Road, although the soil cross-sections in the 1992 Shannon & Wilson report indicate groundwater levels in the fill typically ranging from about 1 to 10 feet, as noted previously.

West Bluff Line

Subsurface information in the area of the West Bluff line was obtained from nine soil logs on file with the MOA that were drilled along or near the storm drain alignment, including Borings 3 and 22 through 29. These borings were included in a 1993 CH2M HILL design study report for the West Bluff storm drain (Reference 13, Appendix A). In addition to the MOA borings, CH2M HILL also drilled six borings along the storm drain alignment, Borings WB-1 through WB-6. Borings B-6, B-7, B-12, and B-13MW were completed near the alignment by Shannon & Wilson on MAPCO property in 1991 and 1992 (References 14 and 15, Appendix A). Boring locations are shown in Figure 3-1 and boring logs are included in Appendix A.

Site Conditions

Surface. The West Bluff line consists of approximately 2,700 feet of aluminum CMP ranging in diameter from 16 to 30 inches. For discussion purposes, the storm drain line can be divided into three distinct segments:

1. The first segment is an approximately 1,800-foot, east-west reach of 16- to 30-inch CMP along West Bluff Drive from near the top of Government Hill (east of Cunningham Street) to Ocean Dock Road. West Bluff Drive is paved with asphaltic concrete. Moderate to steep side slopes (15 to 45 percent) are present adjacent to the road along portions of this section.
2. The second segment is a 285-foot section of 30-inch CMP that runs north along Ocean Dock Road from West Bluff Drive to Union Way. The road surface in this area is flat and paved with asphaltic concrete.
3. The third segment is a 600-foot, east-west run of 30-inch CMP along the Union Way easement from Ocean Dock Road to an outfall on the water front. The Union Way easement is a flat, gravel-surfaced area that is paved only near its intersection with Ocean Dock Road.

Soil. The soils along the storm drain alignment can be grouped into two categories:

- Soils at higher (top of bluff) elevations along West Bluff Drive, represented by CH2M HILL Borings WB-1, WB-2 and WB-3.
- Soils at lower elevations in port area, represented by CH2M HILL Borings WB-4, WB-5 and WB-6 and the MOA and Shannon & Wilson borings.

As observed in WB-1 to WB-3, the bluff deposits consist primarily of granular material that includes medium to coarse sand and gravels with some silt to depths drilled of 8 to 16.5 feet. The material is relatively clean, with fines contents (percentage of silt and clay-sized particles) ranging from about 4 to 8 percent. Soils encountered below the roadway pavement include granular base course, granular fill, and native materials. Silts and silty clays found at lower elevations in the port area were not encountered in these borings. Based on blow counts during drilling, the granular materials are very loose to medium dense. Moisture contents in the granular materials averaged about 3 percent in the higher elevation borings.

Soils in the port area (represented by CH2M HILL Borings WB-4 to WB-6 and MOA and Shannon & Wilson borings) consist primarily of granular fill materials with some fines to depths ranging from 4 to 12 feet. These sands and gravels are typically in a loose to medium-dense condition. Most of these deposits were probably placed as part of the early tidelands development in the 1960s and early 1970s. The granular fill overlies interlayered silty clays, clayey silts, clay, and fine sands. These fines are typically soft to stiff in consistency and have low to moderate strength and moderate to high compressibility. Moisture contents in the fill ranged from 2 to 6 percent, and from about 23 to 31 percent in the silts, fine sands, and clays.

Groundwater. Groundwater was observed in Borings WB-2 and WB-3 along the bluff at depths of 7.5 and 15 feet, respectively, during drilling in June 1992.

Groundwater in the port area was observed in Borings WB-4 and WB-5 at depths of 5 and 6.5 feet during drilling, and at a depth of 13.5 feet in Boring B-12 during drilling in July 1992. Groundwater was not recorded in the MOA borings.

North Star Line

The North Star line is about 800 feet south of and parallel to the lower (western) West Bluff line. Soils information along the North Star alignment is available from a 1994 IT Corporation report to MAPCO (Reference 16) and in the 1992 Shannon & Wilson summary report (Reference 5). Both reports describe general subsurface conditions in the MAPCO facility. Logs of a soil boring (W162) and an associated monitoring well (MW 25) are available from the 1994 IT report.

Site Conditions

Surface. The North Star storm drain line is approximately 1,300 feet in length. The storm drain easement runs north for about 100 feet along Ocean Dock Road before heading west along the property boundaries between MAPCO and the North Star Terminal. The line eventually discharges at an outfall in the tidal flats. The alignment includes both paved and gravel-surfaced areas.

Soil. Subsurface conditions in the MAPCO Terminal area typically consist of 4 to 15 feet of granular fill overlying native deposits of soft to hard clayey silt, silty clay, and clay interlayered with medium dense to dense sand. The fill generally consists of gravelly sand and sandy gravel with somewhat variable fines contents. The fine-grained clay and silt deposits were encountered throughout the depths explored, ranging from 11 to 52 feet below existing grade. The fine-grained soils contain variable amounts of organics, with the greatest amounts typically present just below the fill. The conditions observed in Boring W162 are typical of the area, with 15 feet of silty gravel fill overlying interlayered sand, silt, and clay deposits.

Groundwater. Groundwater measurements in the borings drilled at the MAPCO Terminal indicated groundwater levels ranging from 2 to 25 feet, with an average of about 4 feet. Based on groundwater readings taken during both high and low tides, groundwater levels at this site did not seem to be influenced by tidal fluctuations (Reference 5, Appendix A).

Discussion and Recommendations

North Tote Line

On the basis of the conditions encountered in the borings described previously, the soils along the North Tote line are expected to include granular fill and landslide deposits, soft to hard silts and silty clays, and loose to dense sandy soils. Peat layers may also be encountered along the alignment, although any such layers would be expected to be relatively thin and compressed under the weight of overlying fills or landslide deposits. If a new pipe or pipe segments are installed, it is expected that the site soils will provide sufficient lateral support such that a properly designed flexible pipe can be installed in a conventional narrow trench (approximately 2D in width, where D is the pipe diameter). The flexible pipe will need to be designed using a reduced soil modulus (E′) that takes into account the possibility of soft fine-grained soils or compressed peat layers along the alignment. It is recommended that any assumptions made concerning soil conditions along the alignment be verified through site-specific soil borings or by onsite inspection of soil conditions during trench excavation by a qualified geotechnical engineer.

The expected soil conditions along the North Tote line are also expected to provide adequate vertical support for the storm drain pipe, given that suitable pipe bedding material (MASS Class B, 1-inch minus) is placed on the trench base. If any organic materials are encountered at the base of the trench, they should be excavated and replaced with compacted granular backfill.

Based on available measurements indicating groundwater depths ranging from 1 foot to 12 feet near the alignment, it is expected that groundwater will be encountered within the depth of excavation for the storm drain. Actual groundwater depths will depend on tidal fluctuations, seasonal precipitation, runoff, and related factors. The granular fill soils in the area are expected to be highly permeable, resulting in a relatively large water inflow into the trench. The native fine-grained soils have a low permeability and will allow less seepage into the trench. Groundwater levels should be lowered to at least 1 foot below the base of the trench to allow for pipe and backfill placement in the dry. In most cases, trench dewatering may be accomplished using only sump pumps, particularly in localized excavations for spot repairs or for placement of pipe segments. In extreme high water conditions, dewatering may require a series of well points. Tidal fluctuations may complicate dewatering, particularly near the inlet. Excess groundwater lowering of adjacent areas should be avoided to minimize the risk of inducing settlements of adjacent facilities.

Given the expected soil conditions, trench walls should be sloped no steeper than 1.5 to 1 (horizontal to vertical). Flatter slopes may be required in areas where seepage through the trench walls occurs. Alternatively, shoring or trench box construction methods could be used. The contractor should be assigned responsibility for excavation safety and provide adequate sloping or shoring as required. All trench excavations should conform to Occupational Safety and Health Administration regulations.

The granular fill and native materials encountered in excavations will generally be suitable for reuse as trench backfill unless they contain excessive fines, organics, or other deleterious inclusions. However, the native fine-grained silts and clays are not suitable for reuse as backfill. Additionally, the fine-grained soils will be very susceptible to strength loss when subjected to moisture and equipment or traffic disturbance.

The trench should be backfilled throughout the pipe zone (area extending up from the pipe bedding to a point 12 inches above the top of the pipe) with suitable pipe bedding material. In areas where the pipe will be below paved surfaces or other load-bearing facilities, the trench should be backfilled with MASS Type II material (8-inch minus, 2 to 6 percent fines content). The upper 6 inches below the roadway base course should be Mass Type IIa (3-inch minus). Trench backfill below load-bearing surfaces should be compacted in maximum 8-inch lifts to 95 percent of maximum dry density per AASHTO T-180-D criteria. In other areas, MASS Type IV material compacted to 90 percent maximum dry density is acceptable.

Tote Line

On the basis of the results of the borings described here, geotechnical considerations for the Tote storm drain line are as follows:

- The area in the vicinity of the eastern portion of the Tote alignment was originally underlain by surficial peat and organic soils, ranging in thickness from about 2 to 9 feet at the boring locations. In other borings in filled areas, 1- to 4-foot-thick compressed peat layers were present beneath 3 to 6 feet of granular fill. This fill-over-peat profile is expected to be representative of conditions along the eastern Tote line.
- In areas where thin, compressed organic layers are present below several feet of fill, a flexible pipe in a conventional narrow trench is expected to be feasible, given that the pipe is designed with an appropriate E' value selected to account for the organic presence.
- The remaining soils present along the storm drain alignment are expected to provide adequate lateral support for a properly designed flexible pipe. The soils will also provide adequate vertical support for the pipe, given that any unsuitable soils at the pipe base are removed and replaced with compacted granular backfill.
- Other design and construction considerations for the Tote line, including excavation, confirmation of assumed soil conditions, groundwater control, trench wall slopes, reuse of material, and backfilling, are as described previously for the North Tote line.

Sea-Land Line

On the basis of the available information described here, the soils along the Sea-Land storm drain alignment consist of variable thicknesses of granular fill overlying interlayered native deposits of fine-grained and coarse-grained soils. The native soils vary widely in consistency and density, ranging from soft and loose to very stiff and very dense. Compressed organic layers below the fill are likely present below the fill in at least the north and east portions of the Sea-Land property. Generally, the native soils and compressed organic layers below the fill should provide adequate lateral support for a properly designed flexible pipe such that a conventional narrow trench (2D width) will be feasible. As this conclusion is based only on very limited information, additional exploration as part of design is recommended. Alternatively, construction activities could include field confirmation that actual subsurface conditions correspond to the assumptions made. Thick layers of organic materials with little or no precompression would probably require a wide trench (5D width) for a flexible pipe, placement of the storm drain pipe below the organic material, or a rigid pipe in a narrow trench.

Other design and construction considerations for the Sea-Land line are similar to those described previously for the North Tote line.

Texaco Line

On the basis of the available information described here, the soils along the Texaco storm drain alignment consist of variable thicknesses of granular fill overlying interlayered native deposits of fine-grained and coarse-grained soils. There have been no reports of significant organic materials along the alignment, although such materials may be present below the fill in areas of the Texaco facility. The native soils vary widely in consistency and density, ranging from soft and loose to hard and very dense. Generally, the fill and native soils should provide adequate lateral support for a properly designed flexible pipe such that a conventional narrow trench (2D width) will be feasible. As this conclusion is based only on very limited information, construction activities could include field confirmation that actual subsurface conditions correspond to the assumptions made.

Other design and construction considerations for the Texaco line are similar to those described previously for the North Tote line.

West Bluff Line

Excavations along the lower portion of the West Bluff storm drain alignment will encounter 5 to 10 feet of loose to medium dense granular soil overlying thick deposits of soft to stiff fine-grained soils with some organics. Relatively competent granular soils will be encountered in excavations higher up along the alignment on Government Hill. Thick deposits of soft, highly compressible organic soils are not anticipated to be present. Generally, the fill and native soils should provide adequate lateral support for a properly designed flexible pipe such that a conventional narrow trench (2D width) will be feasible.

Other design and construction considerations for the West Bluff line are similar to those described previously for the North Tote.

North Star Line

On the basis of the available information described here, the soils along the North Star line consist of 4 to 15 feet of granular fill overlying interlayered native deposits of fine-grained and coarse-grained soils. The soils along the alignment vary widely in consistency and density, ranging from soft and loose to hard and dense. Generally, the fill and native soils should provide adequate lateral support for a properly designed flexible pipe such that a conventional narrow trench (2D width) will be feasible. As this conclusion is based only on limited information, construction activities could include field confirmation that actual subsurface conditions correspond to the assumptions made.

Other design and construction considerations for the North Star line are similar to those described previously for the North Tote line.

SECTION 4

Environmental Assessment and Contaminated Soils Handling

SECTION 4

Environmental Assessment and Contaminated Soils Handling

Environmental Assessment

A Level 1 environmental assessment literature search analysis was performed for the six existing storm drain corridors and adjacent areas that may be used for realignment of the existing storm drains. This memorandum addresses areas of possible contamination based on existing records. The accuracy of identifying areas of contamination is limited by the following:

- Soil and water quality data were collected in the past for purposes other than identifying conditions along the storm drain corridors.
- Most of the data were collected several years ago and site conditions may have changed.
- Most sample locations are distant from the storm drain corridor, requiring some interpolation.
- Various sampling techniques and analytic methods were used for the different projects and data results are not always directly comparable from one site to another.

Considering these data limitations, estimates are approximate as to the location and concentration of possible contamination. In addition, site conditions may have changed since samples were collected.

Each storm drain corridor is discussed below.

North Tote Line

No soil sample data were available for this corridor.

In the fall of 1995, a fuel pipeline was excavated across the storm drain corridor. Some petroleum contamination was found along the fuel pipe corridor, but soils near this storm drain corridor were not found to be contaminated. There are no fuel storage facilities immediately uphill or adjacent to this storm drain. The potential for encountering contaminated soil along this storm drain corridor is moderate to low.

Tote Line

This storm drain runs between Tracts 4A and 4B and through Transit Area B. A review of past literature did not identify any sample results in this corridor. There are no fuel storage facilities uphill or immediately adjacent to this storm drain corridor. The upgradient area was recently expanded into the hillside where no previous activity had been. The potential for contamination along this storm drain corridor is moderate to low.

Sea-Land/Cherry Hill Ditch Line

Drainage to this storm drain begins as an open ditch near the west end of the east-west runway on EAFB. The ditch was investigated under the Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA) program and was labeled site SD52, but is also referred to as the Cherry Hill ditch. Upper portions of the ditch were found to be contaminated with petroleum products and polychlorinated biphenyls, but contaminated soil was recently excavated and disposed of at an Environmental Protection Agency (EPA)-approved landfill outside of Alaska. Investigations at EAFB did not indicate that contamination was present in lower portions of the ditch, such as at the port region of the storm drain corridor.

The majority of land over this storm drain is paved and is used for vehicle and shipping container storage. A July 1992 report by Shannon & Wilson, Inc. indicated that the Sea-Land facility had a total of eight registered underground storage tanks (USTs) in the past, including two 25,000-gallon diesel tanks and one 10,000-gallon gasoline tank. Also, three of the eight USTs have been used for waste oil storage. It is unknown if any of these USTs have leaked in the past. Some of the USTs may have been removed after 1992. The potential for contamination of soil and groundwater in the upper (east) end of this storm drain corridor is low.

Petroleum contamination was found in 1995 near the intersection of Gull Road and Tidewater Road during the repair of the fuel pipeline from EAFB, according to project staff at Dames and Moore. Petroleum contamination of soil and groundwater west of Tidewater Road is highly probable.

Texaco Line

A fuel tank farm is located adjacent to this storm drain corridor. The aboveground tanks contain aviation gasoline, JP-4, automotive gasoline, and diesel fuel.

In 1991, ENSR drilled 11 borings within 100 feet of the storm drain corridor and sampled for benzene, toluene, ethylbenzene, and xylenes (BTEX), volatile petroleum hydrocarbons (VPH), and diesel. VPH-gas was found in concentrations exceeding the Alaska Department of Environmental Conservation (ADEC) cleanup level in boring B1 at a depth of 3 feet below ground surface. Location B1 is about 80 feet from the storm drain corridor.

The depth to groundwater is about 5 feet below the surface in summer months. There are four monitoring wells located along the storm drain corridor that were sampled in 1992. The groundwater was found to contain BTEX and lead. The concentration of BTEX was highest near Tidewater road, with benzene at 5,000 parts per million (ppm) and xylenes at 14,000 ppm.

No soil or groundwater samples have been reported to the west of Tidewater road. An area 400 feet to the south and west of Tidewater road has had floating petroleum product in the past.

The potential for contaminated soil and groundwater along this storm drain corridor is high. The western portions of the corridor may have the highest levels of contamination. Contamination may consist of gasoline, diesel, and lead. Excavations deeper than 5 feet may require dewatering.

West Bluff Road Line

Petroleum contamination has been found in soils and groundwater along several sections of this storm drain corridor. Soil samples taken at Defense Fuels, Chevron, and MAPCO have shown petroleum contamination in the past. There is a high probability that contaminated soil will be encountered along this storm drain corridor at various depths.

Groundwater has been found at a depth ranging from 1 to 14 feet below the ground surface, with the shallowest depth near the inlet. The depth is about 20 feet near the Chevron property and about 2 to 6 feet near the MAPCO property.

Samples taken in 1994 by Groundwater Technology at the Chevron Bulk Plant found benzene concentrations ranging from 10 ppm to 19,000 parts per billion (ppb) and gasoline-range organic (GRO) compounds at concentrations ranging from 900 to 28,000 ppb in groundwater. Samples collected by IT Corporation in 1993 near the storm drain corridor also found various concentrations of GRO.

Soils west of Ocean Dock Road have also been found to contain petroleum hydrocarbons. Gasoline, Turbine Oil #46, Jet A-50, and heating fuel spills occurred in the 1980s on MAPCO Alaska Petroleum Inc. (MAPI) property. Cleanup activities recovered most of the spilled material, but some residual may remain in the soil. The probability of encountering petroleum hydrocarbon contamination in soils west of Ocean Dock Road is high.

North Star Line

There are two monitoring wells within about 50 feet of this storm drain. No benzene contamination has been found. The corridor is near the MAPCO facility where soil and groundwater contamination has been found in the past. The probability of soil and groundwater contamination along this corridor is moderate.

Contaminated Soils Handling

Petroleum-contaminated soil will probably be encountered during the excavation and repair of storm drain systems. The ADEC will allow contaminated soil to be placed back into an excavated trench at the Port if the action will not increase pollution or contribute to the spread of contamination. The decision to allow the soil to go back into the trench will be a judgment call determined by the onsite engineer and ADEC staff. The ADEC staff person in charge of the Port area is Eileen Olson.

Factors that could result in additional pollution or the spread of contamination are discussed below, along with possible methods to prevent or minimize these effects.

- Soil with a high concentration of petroleum could contaminate other areas if the soil is placed back into an area of lower petroleum concentration. This situation applies to the vertical and horizontal placement of soil.

Prevention or Mitigation Measures

The construction specifications should require that contaminated soil removed from an excavation be placed back into the source location as closely as possible. For example, the last soil out should be the first soil back into the trench. The onsite engineer should verify that the contractor follows this requirement.

- Pipe bedding material may have a higher hydraulic conductivity than surrounding soils and may serve as a conduit along the length of pipe for the spread of contaminants.

Prevention or Mitigation Measures

Design plans should specify the placement of trench blocks consisting of low permeable material to minimize hydraulic transport of fluids along the length of pipe. Trench blocks should be placed on both the upper and lower end of an area containing contamination that is significantly higher than neighboring stations. The onsite engineer will determine what constitutes a significantly higher concentration of petroleum products than neighboring soils and the appropriate placement of trench blocks. Contaminated soil may be placed back into areas from which it was removed if trench blocks are installed. The engineer may also specify trench blocks in other locations with a potential for hydraulic flow in order to minimize erosion around the pipe, thereby preventing damage to the storm drain and the possible spread of contaminated soil.

- Soils saturated with petroleum may continue to disperse petroleum if placed back into a trench.

Prevention or Mitigation Measures

The engineer should evaluate the situation and specify the placement of a vertical barrier liner along the sides of the trench and/or trench blocks at both ends of the saturated zone, if necessary to minimize the spread of contamination. In addition, the pipe joints should be gasketed with oil-resistant rubber seals. Saturated soils may be placed back into a trench if engineering controls are in place to minimize the spread of petroleum product.

- The stockpiling of contaminated soils onto clean soil next to a trench could result in the spread of contamination.

Prevention or Mitigation Measures

The construction specifications should require that contaminated soil excavated from a trench be placed on a temporary liner to prevent the spread of contaminants to surrounding soils.

Disposal of Excess Contaminated Soil

Under some circumstances, it may not be possible to return all the contaminated soil back into a trench. The addition of pipe bedding material or installation of a larger pipe may result in excess contaminated soil that will not fit back into the trench. There are basically three practical disposal options for petroleum-contaminated soil generated at the Port.

1. Haul the contaminated soil to a thermal desorption facility. Disposal costs in Anchorage usually range from $30 to $40 per ton, depending on concentration, soil type, and quantity of soil.

2. Stockpile at an acceptable site at the Port until the petroleum concentration drops to a level suitable for landspreading or for use as fill material at the Port. Available space for this activity is limited. A site near the source of contaminated soil is preferred.
3. Haul to the Anchorage Regional Landfill and pay $45 per ton for disposal. This option is limited to soil with less than 1,000 milligrams per kilogram (mg/kg) of diesel-range organic (DRO) compounds and 50 mg/kg of BTEX. Soil containing characteristics of hazardous waste is not allowed.

The thermal desorption option appears to be the most practical because it is less expensive than landfilling, there are no limits on the concentration of petroleum, and the lack of suitable space at the Port makes stockpiling impractical unless the quantity is small in relation to the space available.

Contaminated soil for disposal must be tested to characterize the type and concentration of contamination before it will be accepted by a waste processor or disposal unit. Soil that meets the definition of a Resource Conservation and Recovery Act (RCRA) hazardous waste must be managed and disposed of as a hazardous waste. Most of the contaminated soil at the Port is expected to be contaminated with diesel-range and gasoline-range petroleum products, but other types of contaminants may be present. The final disposal option will depend on the type and concentration of contaminants.

It is recommended that a Memorandum of Agreement between the Port of Anchorage and ADEC be established to address the management of contaminated soil encountered during storm drain repair and renovation activities. The memorandum could be structured in a similar manner to the agreement between the Anchorage International Airport System, Alaska Department of Transportation, and ADEC regarding utility excavations.

Treatment and Disposal of Trench Water

During construction and repair of storm drains at the Port of Anchorage, it may be necessary to dewater the trench in some locations. Water may be allowed to drain into an existing or adjacent storm drain, but some treatment may be necessary if petroleum or chemical contamination is encountered.

There are four practical options for the disposal of groundwater from excavation trenches. They are as follows:

1. Discharge into the existing or adjacent storm drain
2. Discharge into a sanitary sewer
3. Discharge onto the ground surface
4. Discharge into an injection well

These options are discussed in the following section.

Permits and Plan Reviews

The ADEC requires applicants to obtain a general dewatering permit if the volume of water is expected to exceed 500,000 gallons. General permit number 9240-DB003 is also available for the disposal of wastewater produced from the treatment of hydrocarbon-contaminated groundwater. Permit applications should be submitted at least 90 days before field activities are planned. Also, if water treatment is necessary, the department requires the submittal of a treatment plan for non-domestic water. A system plan approval must be obtained from the department before the project can proceed. The desired methods of wastewater disposal should be addressed in the permit application. Remediated water must be discharged in a manner that does not result in the spread of contamination or violate water quality standards.

Discharge of trench water to an existing storm drain is regulated under the existing Port of Anchorage National Pollutant Discharge and Elimination System (NPDES) stormwater permit (AKS052426). Part II.B.7.b of the permit specifically allows the discharge of rising groundwaters, uncontaminated groundwater infiltration, uncontaminated pumped groundwater, uncontaminated foundation drains, springs, and remediated groundwaters. Pretreatment may be appropriate to meet the stormwater pollution prevention goals. Screening is recommended to prevent the discharge of gravel and sand to the drain. If petroleum hydrocarbons are present, treatment will be necessary to remediate the groundwater before discharge. The majority of floating product can be removed through an oil/water separator. Additional treatment through an activated carbon filter or other type of treatment system may be warranted to comply with the permitted discharge limits and environmental protection standards. A non-domestic wastewater treatment plan must be submitted to ADEC for review and approval before treatment and discharge of remediated groundwater is allowed. It is recommended that a plan be submitted at least 60 days before construction activities are scheduled to begin.

The Anchorage Water and Wastewater Utility (AWWU) requires that all options be explored for disposal of trench water. If no other alternatives are possible, AWWU will permit the discharge to a sanitary sewer. Authorization from AWWU must be obtained before discharge to a sanitary sewer. Pretreatment standards must be met and a fee will be charged per gallon of water discharged to the sewer. Pretreatment must remove gravel, floating products, and volatiles that could cause an explosive hazard in sewer lines and the treatment plant. The discharge rate will be limited to the capacity of the line to prevent surcharge. A single authorization can be obtained for the entire project from AWWU, if a single contractor is completing the entire project.

It is recommended that permit applications and treatment system plans be submitted to ADEC for review and approval as early as possible to avoid delays. Permits and approvals could take as long as 6 months to process. Discharge will adhere to the requirements of AMC 26.50.

SECTION 5

Stormwater Treatment Requirements

SECTION 5

Stormwater Treatment Requirements

The port area is characterized by industrial land uses, including bulk fuel transfer and storage, commodities transfer, and manufacturing and related uses. The land surface is primarily paved or gravel surfaced. Few vegetated areas are present.

Most of the industrial areas have individual stormwater quality maintenance requirements. For example, discharges from the Tote and Texaco systems are monitored by the Port of Anchorage under the requirements of their industrial water discharge permit. It can be argued that the discharges from the Sea-Land system are monitored by EAFB under their NPDES stormwater permit because almost all the stormwater and base flow in this system originates from EAFB. Finally, each of the bulk fuel handlers is covered under a separate industrial NPDES stormwater permit. Each of these permits requires stormwater quality to be maintained before discharge from the property. This would include discharge into any DPW storm drains in the project area.

Outside those areas in the municipality covered by industrial or other individual storm water discharge permits, DPW is embarking on a course of promoting non-structural controls to maintain stormwater quality.[1] Non-structural controls are actions that control pollution at its source, before it can come in contact with runoff before the runoff enters the storm drain. Source controls are generally less costly than treatment controls and include a broad combination of measures that do the following:

- Minimize pollutant contact with surfaces that come in contact with water (through practices such as storing materials under cover and preventing and cleaning up spills)
- Minimize contact of water with areas that are potential sources (such as excavated soils, overburden storage piles, and equipment maintenance areas)
- Promote substitution of materials that are less harmful to the environment (such as carefully selecting cleaners, paints, etc.)
- Encourage "good housekeeping" (such as cleaning up trash and debris and properly disposing of them)

These suggested management practices are aimed at raising the level of public awareness and knowledge regarding nonpoint pollutants. These suggestions can be implemented largely through educating the public and land owners and users about nonpoint pollution and the methods for reducing and minimizing it. The term "public" is used broadly here to include municipal employees responsible for street maintenance, general contractors, industrial and commercial land owners and operators, and anybody who performs activities that could affect local water quality. A program to educate these target groups about strategies to control pollution sources before pollutants can enter stormwater and

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[1] As of this writing the MOA has not been issued a NPDES storm water discharge permit by the EPA. The MOA application was submitted in May 1991. Until this permit is issued and the management of stormwater quality is transferred to the MOA, ADEC still reviews all storm drainage projects for compliance with State water quality standards. ADEC will then approve the plan for stormwater quality maintenance and issue the appropriate permit.

how these strategies benefit the general receiving water quality should be implemented on an areawide basis.

Discussions with several area property operators indicated such source control methods are already being implemented in the Port area. The bulk fuel operators contacted have source control measures in place to meet their permit requirements. EAFB has a stormwater permit in place and is planning to construct a sedimentation basin in the future to further maintain stormwater quality before it leaves their jurisdiction. The stormwater erosion of the bluff area on their property should be discussed with the Air Force, because it negatively impacts area stormwater quality and Port operations.

Discussions with ADEC as to what further treatment may be required were inconclusive. ADEC prefers to comment on each proposed project on a case-by-case basis. They did indicate that outfalls into Cook Inlet must meet appropriate State water quality standards. Treatment may be required to meet these criteria. For discharge into Cook Inlet, no visual sheens from oils or greases can be present; no floating residue or debris can be present; and sediment, road deicers, and other chemicals cannot impair the naturally occurring functions of Cook Inlet. This is based on State Water Quality Standards (18 AAC 70) and State Wastewater Disposal Regulations (18 AAC 72). These indicate that constructed treatment facilities may be minimal once the naturally occurring functions of Cook Inlet are determined for this area.

SECTION 6

Existing Utilities and Easements

SECTION 6

Existing Utilities and Easements

Existing Utilities

Many major utilities are located within the Port of Anchorage Drainage Study project area, including telephone lines operated by Anchorage Telephone Utility, natural gas lines operated by ENSTAR, power lines operated by Municipal Light and Power, and sanitary sewer and potable water lines operated by AWWU. In addition, numerous petroleum, oil, and lubricants (POL) lines exist that are operated by the U.S. Department of Defense, Defense Fuels; Signature Flight Support Services; and Texaco, Tesoro, and Chevron petroleum companies. Most of these utilities are aligned along Ocean Dock Road, Anchorage Port Road, and Tidewater Road, as shown in Figure J-1 (Appendix J).

Existing Easements

Approximate locations of existing storm sewer and drainage easements are shown in Figure K-1(Appendix K).[2] Existing easements do not fully cover any of the storm drain systems within the Port of Anchorage drainage study area. Easements are important because they secure the right to maintain and upgrade existing storm drainage structures. All new storm drain systems require the acquisition of easements. Section 7, Storm Drain Repair Alternatives, recommends the approximate length and width of easements that should be acquired to provide full coverage for each of the storm drain system alternatives.

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[2] Recorded easements on DPW plat maps.

SECTION 7

Storm Drain Repair Alternatives

SECTION 7

Storm Drain Repair Alternatives

General Repair Methods

Each storm system being analyzed in the study will encounter complications such as conflicts with buried utilities, contaminated soils, and groundwater during construction. The severity of the complications is related to the repair alternative selected.

Buried utilities are abundant and often not shown on any as-built drawings. Excavation within the Port area will, therefore, likely encounter unknown buried utilities, either abandoned or in service. Most of the soils within the project area contain some degree of hydrocarbon contamination.

Infiltration and inflow are primary concerns at the Port of Anchorage. To prevent or mitigate these problems, a comprehensive rehabilitation of the storm piping is necessary. Comprehensive rehabilitation includes repairing structurally damaged areas and reducing groundwater-dependent infiltration into the system. Because much of the Port's fill material has various levels of petroleum hydrocarbon contamination, infiltration into the storm drain system will carry contaminated groundwater to the outfall. Special handling and disposal will be required for the excavation soils. Much of the fill material used for the port facilities is very permeable. Those repair alternatives requiring trench excavation will require dewatering.

The concept of comprehensive rehabilitation is based on findings from documented infiltration and inflow studies, which show that infiltration will migrate to pipe defects along the main line within a zone of influence. This means that infiltration that can no longer enter a corrected defect will migrate through the soil or pipe trench to an unrepaired defect elsewhere in the system at a higher or lower elevation.

The cost-effectiveness of the various types of rehabilitation techniques has been assessed on the basis of the pipe condition documented by CCTV and manhole inspection. The recommended rehabilitation alternative provides the least costly effective alternative after careful consideration of the hydraulic capacity, constructability, and limitations of each rehabilitation alternative.

An order of magnitude cost estimate has been prepared for each of the pipeline repair alternatives. Capital costs for the alternatives were estimated in 1996 dollars and given an allowance for contingencies. This contingency factor is consistent with the level of effort required for planning and reflects the order of magnitude estimates and the level of risk associated with the alternative. A sliding scale allowance based on construction costs has been included for engineering, legal, and administrative costs. In addition, costs reflect the probability of encountering contaminated soils with each alternative. The costs are indicated with each alternative and are detailed in Appendix D, Cost Estimate Backup.

The rehabilitation alternatives considered for the Port of Anchorage storm drain system are as follows:

- Do nothing
- Spot-repair existing pipe
- Slipline or inversion-line existing pipe
- Place pipe in new alignment
- Replace pipe with open channel
- Replace pipe in same alignment

Any one or a combination of these alternatives may be chosen to rehabilitate the storm pipes at the Port of Anchorage. Appendix M contains discussions of these rehabilitation methods. Appendix J contains a lists the non-viable repair alternatives included in the preliminary draft report but not in the draft report.

Tote Systems

The original repair alternative, to "do nothing," is no longer appropriate for this line. This section describes the repair alternatives for the Tote Systems.

Alternative 1—Slipline Existing System

This alternative would slipline both of the existing Tote storm drain systems. Spot structural repair will be required to enclose the sections of pipe that are structurally damaged or have corroded away. This alternative will rehabilitate all of the manholes in both systems. Manholes with water infiltration will have chemical grout injected into the cracks. Once the grout has cured, the interior will be coated with an epoxy product to seal the concrete. Other rehabilitation work in the manhole will include frame mortaring, rung repair or replacement, and lifting holes patching. No costs were specifically estimated for this alternative. However, the price per lineal foot (lf) should be similar to the West Bluff and Texaco lines, approximately $350/lf.

Alternative 2—Replace in Same Alignment

This alternative would replace approximately 675 feet of the 36-inch-diameter precoated corrugated metal pipe (PCMP) for the North Tote system and 1,300 feet of the 36-inch-diameter PCMP for the Tote system. PCMP was used in this report for discussion purposes only. Once the design determines the cause of the rapid corrosion of these systems, an alternative pipe material may be required correct the heavy corrosion observed. This repair alternative would require the existing storm system pipe be removed and replace in the same pipe alignments. Bypass pumping of storm runoff and existing subdrain flow would be required as the replacement pipe is installed.

This alternative will also rehabilitate all of the manholes in both of the Tote systems. Manholes with water infiltration will have chemical grout injected into the cracks. Once the grout has cured, the interior will be coated with an epoxy product to seal the concrete. Other rehabilitation work in the manhole will include frame mortaring, rung repair or replacement, and lifting holes patching.

The soils excavated from the trench would be used as backfill except, possibly, around the pipe. Imported granular material would used as the pipe foundation and pipe zone material if the native material does not meet the material specification. The native soil displaced by the import material would have to be sampled and disposed of in a proper manner, as discussed in Section 4 of this report.

Traffic would be temporarily disrupted at Tidewater Road during installation of the pipe at the road crossing. Though disruption to traffic would primarily be to the Totem property, coordination of construction activities with the Port users would be necessary.

Because the pipe will be the same size and follow within the same alignment, additional utility conflicts are not anticipated. No costs were specifically estimated for this alternative. However, the price per lineal foot should be comparable to the North Star replacement alternative, approximately $400/lf.

TABLE 7-1
Comparison of Tote Systems Alternatives

Alternative	Estimated Construction Cost	Advantages	Disadvantages
Slipline existing system	Not estimated	No additional storm easements required Reduced dewatering Reduced excavation and contaminated soils Little or no disruption to traffic or to storage area Reduced potential for utility conflicts	Replacement of structural deficient sections still required
Replace pipe in same alignment	Not estimated	No additional storm easements required	Greater disruption to traffic or to storage area Increases potential for additional utility conflicts Increased excavation and contaminated soils

Recommended Alternative

It is recommended the pipe in both Tote systems be repaired by the sliplining method. No repair costs have been estimated for either system.

Sea-Land Line

This section describes the repair alternatives for the Sea-Land storm drain system. The two alternatives being evaluated in this report are (1) replace pipe in same alignment and (2) repair and bypass. Repair and replacement of the outfall is included in both alternatives.

A list of non-viable repair alternatives previously considered is included in Appendix J of the Technical Appendices. These alternatives were dismissed from further consideration after the review comments for the draft report of this study were reviewed.

The ILLUDAS model runs were used to determine the pipe sizes identified in this report. As discussed previously, the existing Sea-Land system is not adequately sized to handle the peak flow from the Cherry Hill ditch during the 10-year, 3-hour storm event. This apparent pipe size inadequacy of the existing system and the new pipe sizes discussed in the following repair alternatives are based on estimated peak flows from EAFB. This study estimated flows from EAFB using unit runoff values from Anchorage International Airport Drainage Plan modeling. The actual storm drain system on EAFB was not modeled because of the limited scope of this study. As a result, it is recommended that a refined analysis of the flows from EAFB be made during the design of this system. This analysis will allow the piping to be sized to the actual runoff flows being generated by EAFB. Further discussion of the modeling assumptions and methods used to calculate the runoff for this study is included in Appendix F of the Technical Appendices.

Alternative 1–Replace Pipe in Same Alignment

This alternative would upgrade the existing pipe to a pipe up to 96 inches in diameter to handle the design flow from the Cherry Hill ditch and the Sea-Land property. This size is based on a pipe roughness coefficient of 0.024 (PCMP) and the pipe laid at a 0.3 percent slope. This minimum slope was selected to reduce tidal influence and depth of excavation. Steeper slopes or smooth-walled pipe would reduce the required pipe size, but could increase construction costs.

Approximately 1,900 feet of open-cut trench would be excavation to depths to 16 feet. Trench side slopes would be no steeper than 1.5:1 (horizontal:vertical). A bottom trench width of two pipe diameters (2D) would be used in areas where good compactive fill or native material exists. In areas where the soils are highly organic or poorly compacted, a bottom trench width would be 5D. The anticipated trench width at the surface would vary from 46 feet to 86 feet without the use of shoring or a trench box.

The soils excavated from the trench would be used as backfill except, possibly, around the pipe. Imported granular material would be used as the pipe foundation and pipe zone material if the native material does not meet the material specification. The native soil displaced by the import material would have to be sampled and disposed of in a proper manner, as discussed in Section 4 of this report.

This alternative would require the existing storm system, manholes and pipe, be removed and replaced along with the existing pipeline piping. Bypass pumping of storm runoff and existing subdrain flow would be required as the replacement pipe is installed.

Traffic would be temporarily disrupted at the railroad spur, Tidewater Road, and Ocean Dock Road, with temporary traffic corridors necessary during construction. Coordination of construction activities with the Port users would be necessary.

The increased pipe diameter proposed for this alternative may cause additional conflicts with utilities. The system constructed in this alternative would convey the 10-year, 3-hour event runoff without flooding Port property. The estimated construction cost would be $2,093,314. The estimated project cost including estimated project management and design costs is $2,530,817.

Alternative 2—Repair and Bypass

This alternative would slipline the existing Sea-Land storm drain system and construct a bypass system on the adjacent property, Tract 4A. Spot structural repair (repair hole in crown of culvert, misaligned pipe segments, pipe lateral penetrations, etc.) to the existing pipe would be required before it could be sliplined. The six manholes in the Sea-Land system would also be rehabilitated. Manholes with water infiltration would have chemical grout injected into the cracks. Once the grout has cured, the interior would be coated with any epoxy product to seal the concrete. Other rehabilitation work in the manhole would include frame mortaring, rung repair or replacement, and patching of lifting holes.

An 800-foot open channel would be constructed from its present terminus on the east side of Tidewater Road at the inlet to the Sea-Land pipe system, north to Tract 4A. This property is reported to tentatively be scheduled for development in the summer of 1997. A new 1,800 foot bypass storm drain system will collect the flow from the new open channel and the Tract 4A property and route it through the Tract 4A property to Cook Inlet. Figure 7-1 shows the repairs proposed by this alternative.

The pipe size of the bypass and the existing Sea-Land system are directly related. The combined capacity of the two systems must be capable of conveying estimated runoff from the 10-year, 3-hour rainfall event. Three combinations of pipe sizes, shown below, are alternatives for sliplining the existing Sea-Land storm drain system and constructing the corresponding bypass system. For example, if the existing Sea-Land storm drain system is sliplined with a 54-inch-diameter pipe, then a 60-inch-diameter bypass system placed at 0.3 percent slope must be constructed. It also shows that before sliplining, 322 feet of 72-inch by 44-inch arch pipe and 301 feet of 48-inch-diameter pipe must be replaced in the existing Sea-Land storm drain system.

Existing Sea-Land System Sliplined		Bypass System		
Slipline Pipe Size (diameter in inches, n=0.014, slope varies)	Capacity[a] (cfs)	Pipe Size (diameter in inches, n = 0.014, slope 0.3%)	Capacity (cfs)	Combined System Capacity (cfs)
42	40	66-inch to 72-inch	170 to 215	210 to 255
48[b]	58	66-inch	170	228
54[c]	80	60-inch to 66-inch	132 to 170	212 to 250

[a] Existing Sea-Land system capacity is restricted by the minimum pipe segment slope of 0.19 percent.
[b] Requires 322 feet of 72-inch x 44-inch arch pipe be replaced.
[c] Requires 322 feet of 72-inch x 44-inch arch pipe and 301 feet of 48-inch CMP be replaced.

The systems constructed in this alternative would convey the 10-year, 3-hour event runoff without flooding Port property. The Sea-Land system's outfall also would be repaired. The estimated construction cost of this alternative is $2,128,568. The estimate project cost, which included estimated cost for project management and design, is $2,573.439

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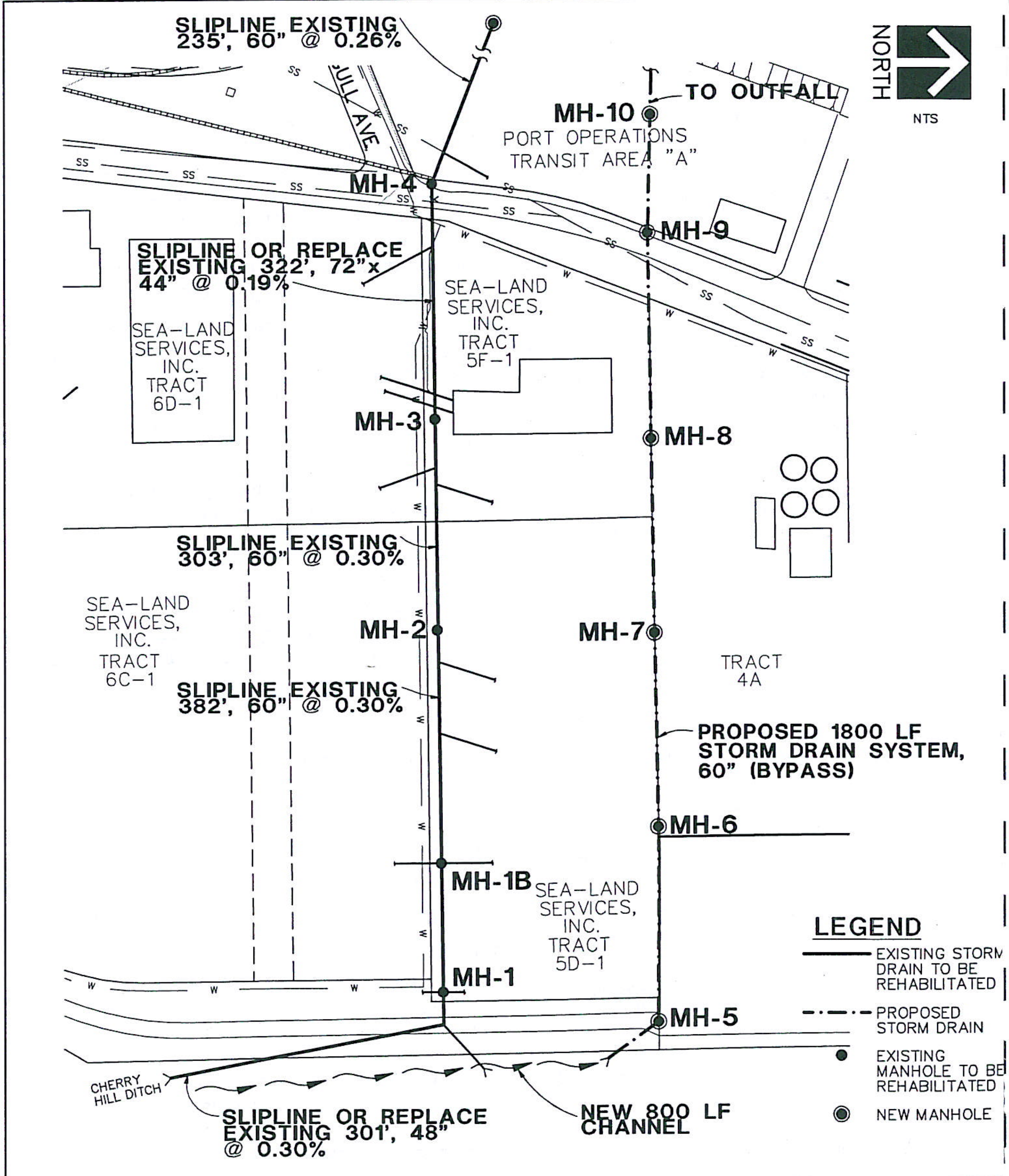

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Port of Anchorage Drainage Study

SEALAND/CHERRY HILL DITCH SYSTEM - REPAIR LINE AND BYPASS ALTERNATIVE

Date 2/97

Figure 7-1

CH2M HILL

Recommended Alternatives

It is recommended to slipline the existing system with a 54-inch pipe, construct an open channel bypass to route the Cherry Hill ditch flow to a new 60-inch storm drain system on Tract 4A and repair the outfall. In order to properly size the sliplining for the existing system and the pipe for the new bypass system, it is recommended that further modeling of the EAFB be conducted. This system would be able to convey the 10-year, 3-hour event runoff without flooding Port property. The estimated construction cost of this alternative is $2,128,568. This cost does not reflect any cost associated with the work that will be provided by the development of the Tract 4A property.

TABLE 7-2
Comparison of Sea-Land System Alternatives

Alternative	Estimated Construction Cost	Advantages	Disadvantages
Upgrade pipes in same alignment	$2,093,314 Dependent on soil conditions Shoreline protection work excluded from estimate	Hydraulic capacity deficiency resolved No additional storm easements required	Increased dewatering Increases potential for additional utility conflicts Creates road and railroad crossing conflicts Increased excavation and contaminated soils Alternative undesired by Port personnel
Repair pipe in same alignment and bypass	$2,128,568	Reduced excavation Little or no disruption to traffic Reduced dewatering Hydraulic capacity deficiency resolved No additional storm easements required A portion of construction cost offset by development of Lone Star property Alternative desired by Port personnel	Replacement of structurally deficient sections still required Lone Star property proposed to be developed in 1997

Texaco Storm Drain System

This section describes repair alternatives for the Texaco storm drain system. Two alternatives are considered: no-build and conduct spot repairs. Neither of these alternatives would provide system capacity to convey the MOA design storm event flows. Upgrading the system to provide this capacity, however, is not considered a viable alternative because no flooding has been reported within the basin; costs would be high to upgrade the system because of utility conflicts and contaminated soils; and any flooding would likely be minimal and temporary. It should also be noted that ILLUDAS does not consider the increase in flow capacity that occurs when the storm drain system manholes surcharge. This increase in capacity may be enough to adequately convey design flows.

Alternative T1—No-Build

The no-build alternative would leave the existing Texaco storm drain system in its current condition. Hydraulic modeling of the existing Texaco Basin storm drain system indicate that several segments of the system are undersized. There are, however, no reported flooding problems within the drainage basin and the existing storm drain system is reported to be in fair to poor condition.

Alternative T2—Conduct Spot Repairs

The manhole survey revealed that three manholes along the existing system have cracks, pitting, and mortar missing between joints, and that pipe inverts in one manhole were badly corroded. Segments of the existing storm drain line were reported to be corroded. This alternative would repair the three manholes and line approximately 465 feet of storm drain. Figure 7-2 shows the approximate locations of the manholes and corroded storm drain segments.

The manholes would be repaired by grouting and sealing the deteriorated areas and sealing the manholes with a corrosion-resistant lining. Manhole repairs would be conducted using traditional construction methods. High volumes of traffic at the port, many major buried utilities, contaminated soils, and groundwater and tides, however, make replacement of corroded storm drain by traditional trenching methods difficult and expensive. This alternative would use inversion lining, a trenchless technology, to place a smooth, corrosion-resistant liner within the existing storm drain.

As mentioned earlier, hydraulic model results indicate that several segments of the existing storm drain line are undersized for the 10-year, 3-hour rainfall event. A concern when lining an existing pipe is the loss of conveyance caused by the reduction in cross sectional area. In this case, however, the lining would have a much smoother surface than the existing corroded corrugated metal pipes. The new system would still be undersized, but existing capacity would not be reduced.

Insertion lining involves deforming high-density polyethylene (HDPE) pipe by applying heat, inserted the pipe with reduced cross section into the existing storm drain, and heating it back into a full circular cross section. Insertion lining uses existing manholes to insert the liners, and traffic interruptions would be minimal. Grouting between the lining and existing pipe is not needed, eliminating the need to excavate insertion holes.

This method would require the storm drain line to be cleaned and all segments television surveyed to locate restrictive defects and any pipe connections. All restrictive defects, areas that would restrict placement of lining, would need to be spot repaired before insertion lining. Spot repairs of these areas may require excavation to replace damaged segments. The system would need to be pumped dry during rehabilitation, requiring the outfall to be blocked to avoid tidal influence. Groundwater and buried utilities may influence the

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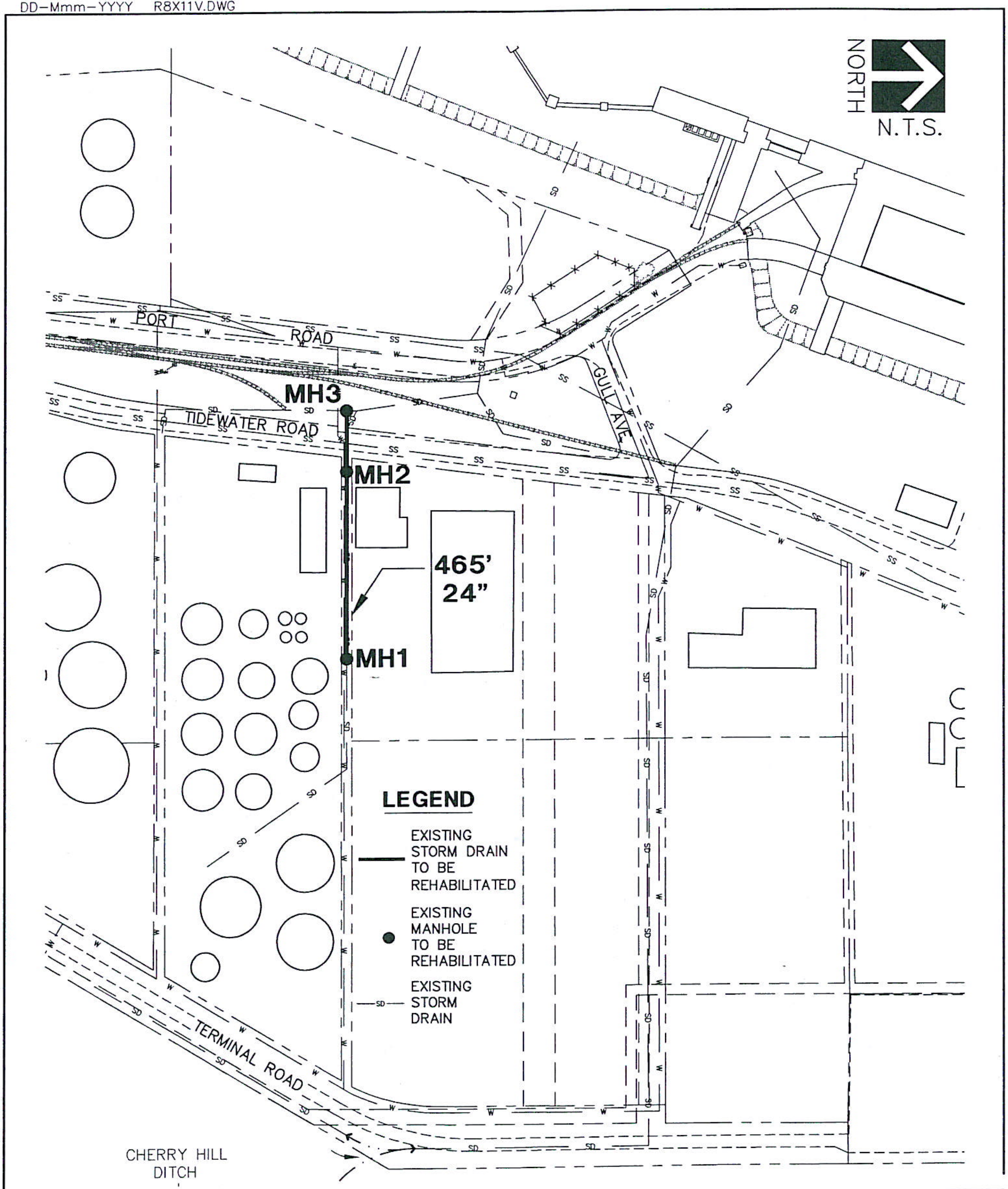

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Port of Anchorage Drainage Study

TEXACO STORM DRAIN SYSTEM
SPOT REPAIR ALTERNATIVE

Date
8/96

Figure
7-2

CH2M HILL

construction of spot repairs. No major trenching would be necessary to construct insertion or inversion lining. Robotics would be used to cut the newly inserted lining to reestablish pipe connections. Construction of this alternative would not likely require agency permits.

The estimated construction cost for rehabilitating the Texaco storm drain system using insertion lining is $170,161. These estimates are itemized in Appendix D, Cost Estimate Backup. The estimated construction cost including estimated project management and design costs is $231,249.

Table 7-3 presents cost estimates, disadvantages, and advantages for the Texaco storm drain system alternatives.

TABLE 7-3
Comparison of Texaco System Alternatives

Alternative	Estimated Construction Cost	Advantages	Disadvantages
T1 No-build	0	No immediate capital costs	Existing system would remain undersized
			System defects would continue to degrade until failure
T2 Conduct spot repairs	$170,161	Life of the storm drain system would be extended	Cost of construction
		Sediment eroded within the system would be eliminated	Segments of the system would still be undersized

Recommended Alternative

It is recommended that spot repairs be conducted on the existing Texaco storm drain system. Construction of this alternative would extend the life of the system and eliminate the majority of sediment transported within the system at minimal cost.

West Bluff Storm Drain System

This section describes the repair alternatives for the West Bluff storm drain system. Three alternatives are considered: no-build, repair the existing outfall, and insertion line and repair manholes. None of these alternatives would provide system capacity to convey the MOA design storm event flows. Upgrading the system to provide this capacity, however, is not considered a viable alternative because of the high costs associated with utility conflicts and contaminated soils. It is believed that the recommended alternative, though not providing full capacity for storm flows, would eliminate the potential for flood damage. Flooding, if any, would likely be minimal and temporary (surcharging of the manholes in a repaired storm drain system would likely increase the capacity to adequately convey design flows).

Alternative WB1—No-Build

The no-build alternative would leave the existing West Bluff storm drain system in its current condition. Hydraulic modeling of the existing storm drain system indicates that several segments of the system are undersized. In addition, survey of the storm drains showed that there is enough accumulated sediment in the lower reaches of the system to restrict flow and that pipes are corroded and manholes cracked. There are, however, no reported flooding problems within the drainage basin.

Alternative WB2—Repair the Existing Outfall

Water was found flowing from fill at low tide at a location that is assumed to be the outfall of the West Bluff storm drain system. The exact location of the existing outfall has not been located. The fill completely covering the outfall to the system is likely restricting flow and causing sediment to accumulate within the system. This alternative would replace the existing outfall by constructing a new outfall segment that allows storm water to flow free of fill material into Knik Arm. Class II riprap would be placed around the new outfall to protect the pipe against sea ice. The storm drain system would be flushed to remove sediment from within the system.

Construction of this alternative would not likely result in traffic closures or utility conflicts. Construction would require Department of the Army Section 404 and Section 10 permits and ADEC Section 401 Clean Water Act Certificate of Reasonable Assurance. The construction plans would also have to be found consistent with the Alaska and Anchorage Coastal Management Programs. Modifications will have to conform with any stipulations of the Port's NPDES stormwater discharge permit. The estimated cost of constructing this alternative is $82,968. The estimated construction cost including estimated project management and design costs is $112,754. These estimates are itemized in Appendix D, Cost Estimate Backup.

Alternative WB3—Insertion Line and Repair Manholes

The March CCTV survey of the existing storm drain line showed that pipes within the West Bluff system are corroded. In addition, the manholes were found to be cracked and mortar was missing between joints. This alternative would rehabilitate five manholes and line approximately 1,853 lf of pipe (1,020 feet of 30-inch-diameter, 255 feet of 18-inch-diameter, and 578 feet of 15-inch-diameter).

The five manholes to be rehabilitated under this alternative are shown in Figure 7-3. They would be repaired by grouting and sealing the deteriorated areas and sealing the manholes with a corrosion resistant lining. Manhole repairs would be conducted using traditional construction methods. In addition, as-builts show that there is approximately 610 feet of continuous existing storm drain line not containing manholes. A manhole would be constructed approximately 300 feet along this line to provide access for maintenance of the line.

The segments of storm drain line to be rehabilitated under this alternative are shown in Figure 7-3. High volumes of traffic at the port, many buried major utilities, contaminated soils, and groundwater and tides, however, make replacement of corroded storm drain by

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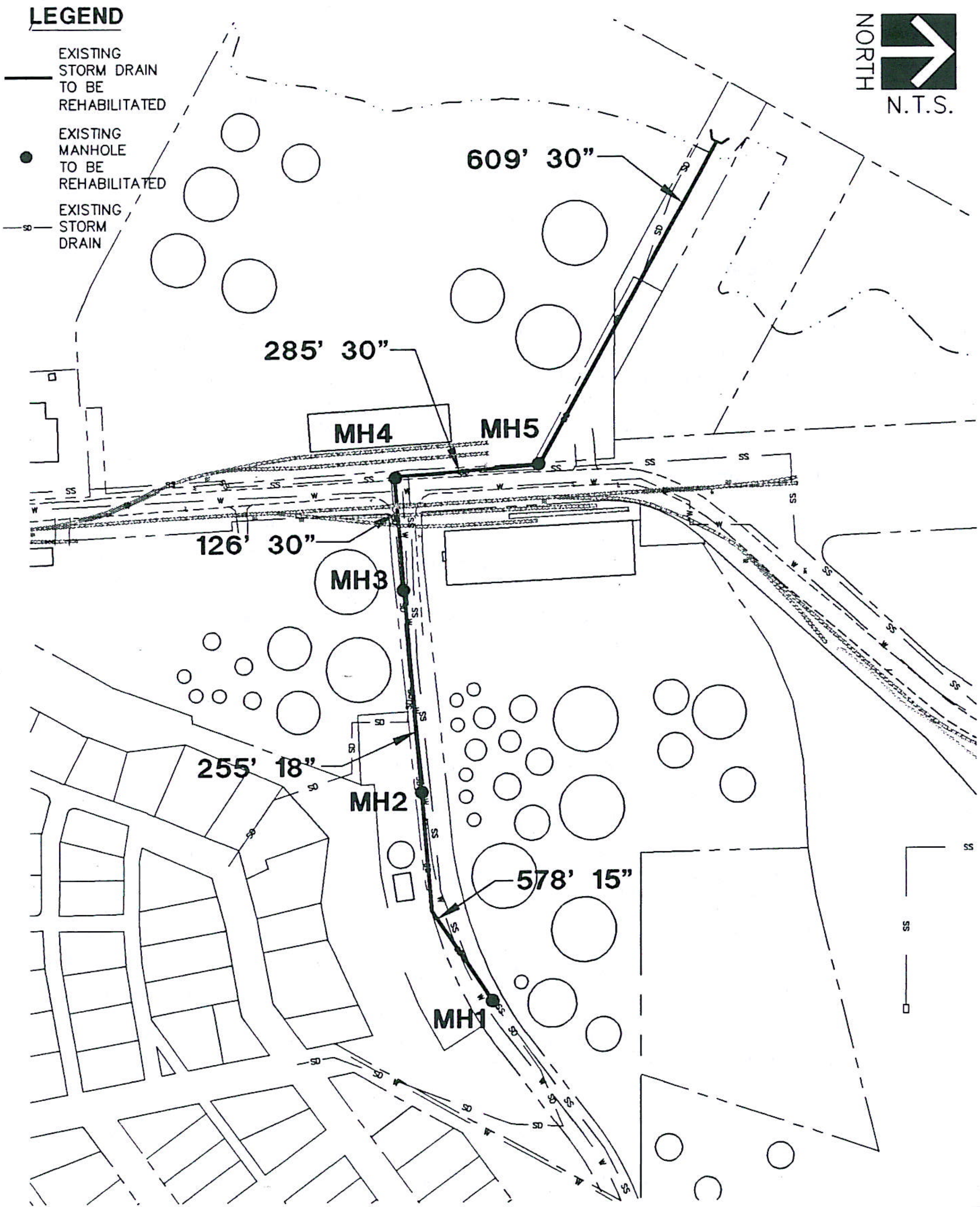


Port of Anchorage Drainage Study

WEST BLUFF SYSTEM STORM DRAIN LINING and MANHOLE REPAIR ALTERNATIVE

Date
8/96

Figure
7-3

traditional trenching methods difficult and expensive. This alternative would utilize insertion lining, a trenchless technology, to place a smooth, corrosion-resistant liner within the existing storm drain.

Insertion lining involves deforming HDPE pipe by applying heat, inserted the pipe with reduced cross section into the existing storm drain, and heating it back into a full circular cross section. Insertion lining uses existing manholes to insert the liners, and traffic interruptions would be minimal. Grouting between the lining and existing pipe is not needed, eliminating the need to excavate insertion holes.

It must be noted that hydraulic model results indicate that several segments of the existing storm drain line are undersized for the 10-year, 3-hour rainfall event (255 feet of 18-inch-diameter CMP should be replaced with 24-inch pipe, 1,020 feet of 30-inch CMP should be replaced with 36-inch pipe). A concern when lining an existing pipe is the loss of conveyance caused by the reduction in cross-sectional area. In this case, however, the lining would have a much smoother surface than the existing corroded CMP. The new system would still be undersized, but existing capacity would not be reduced.

This method would require the storm drain line to be cleaned and all segments CCTV surveyed to locate restrictive defects and any pipe connections. All restrictive defects, areas that would restrict placement of lining, would need to be spot repaired before insertion lining. Spot repairs of these areas may require excavation to replace damaged segments. The system would need to be pumped dry during rehabilitation, requiring the outfall to be blocked to avoid tidal influence. Groundwater and buried utilities may influence the construction of spot repairs. No major trenching would be necessary to construct insertion or inversion lining. Robotics would be used to cut the newly inserted lining to reestablish pipe connections. Construction of this alternative would not likely require agency permits.

The estimated construction cost for this alternative is $459,990. The estimated project cost including estimated project management and construction costs is $603,047. These estimates are itemized in Appendix D, Cost Estimate Backup.

Comparison of West Bluff Storm Drain System Alternatives

Table 7-4 presents cost estimates, disadvantages, and advantages for the West Bluff storm drain system alternatives.

Recommended Alternative

It is recommended that both WB2 and WB3 be constructed. The capacity of the existing system is restricted because of sediment accumulation within the system. System defects exist within the system and the outfall is not maintainable. Constructing WB2 by repairing the outfall segment would increase the system capacity by reducing the sedimentation within the system. WB2 should be constructed immediately and the accumulated sediment cleaned from the storm drain. After this project, WB3 should be reassessed to determine if the sediment-filled segments need to be relined. Constructing WB3 by repairing manholes and sliplining the system would extend the life of the system. Segments of the system would, however, remain undersized. Cost of constructing the two alternatives would be approximately $542,958. The estimated project cost including estimated project management and design costs is $715,801.

TABLE 7-4
Comparison of West Bluff System Alternatives

Alternative	Estimated Construction Cost	Advantages	Disadvantages
WB1 No-build	0	No immediate capital cost	Segments of the existing system would remain undersized System defects would continue to degrade until failure Sedimentation within the system would continue to restrict flow capacity
WB2 Repair the existing outfall	$82,968	Would increase flow capacity by reducing the sedimentation within the system Would allow the outfall to be maintained	Cost of construction Manhole and storm drain defects would continue to degrade until failure Segments of the system would remain undersized
WB3 Insertion line and repair manholes	$459,990	Life of the system would be extended	Cost of construction Segments of the system would remain undersized Outfall would remain unmaintainable and system Sedimentation within the system would continue to restrict flow capacity

North Star Storm Drain System

This section describes repair alternatives for the North Star storm drain system. Only two options, do nothing and replace with new system, are viable because the majority of the existing storm drain could not be located (see Section 2, Existing Storm Pipe Systems).

Alternative N1—No-build

The no-build alternative is an option if the existing conditions within the basin are acceptable. There are no reported flooding problems within the basin, but visual inspections have shown standing water at the Great Pacific Seafoods, Inc., building. The condition of the system is not known and the DPW is not able to maintain the system because of the lack of easements and location information.

Alternative N2—Replace with New System

A new system could be constructed to service the North Star drainage basin from Ocean Dock Road east to the inlet. The proposed alignment for the new storm drain system is between the Great Pacific Seafood lease and the Premier Industries Incorporated lease, south of the MAPCO tank farm, and under gravel lots leased by the North Star Terminal and Stevedoring group. The approximately 4.6 acres of undeveloped bluff on the east side of Ocean Dock Road would remain unserviced because of the high cost of constructing storm drain under the roadway, railroad lines, and buried utilities.

The new storm drain system would consist of approximately 880 lf of storm drain, 350 lf of 15-inch-diameter polyethylene (PE) pipe, and 530 lf of 21-inch PE pipe. Twin catch basins every 100 feet would collect runoff, and three Type I manholes would provide access to the system. The proposed storm drain would not cross Ocean Dock Road, and no utilities were found that would cross the alignment (see Figure 7-4).

The ARR owns all land that would contain the new storm drain system. Approximately 880 feet of temporary, 40-foot-wide construction easement would need to be secured from the ARR for construction of the storm drain system. Approximately 880 feet of permanent, 20-foot-wide storm drain easement would need to be acquired from the ARR to provide access for maintenance of the new system. Construction of a new storm drain system would require a Department of Army Section 404 and Section 10 permit and an ADEC Section 401 Clean Water Act Certificate of Reasonable Assurance. Construction would also need to be found consistent with the Port of Anchorage NPDES storm water discharge permit requirements and the Alaska and Anchorage Coastal Management Programs.

The approximate cost for this alternative is $356,547. The estimated project cost including estimated project management and design costs is $467,433. These estimates are itemized in Appendix D, Cost Estimate Backup.

Comparison of North Star Storm Drain System Alternatives

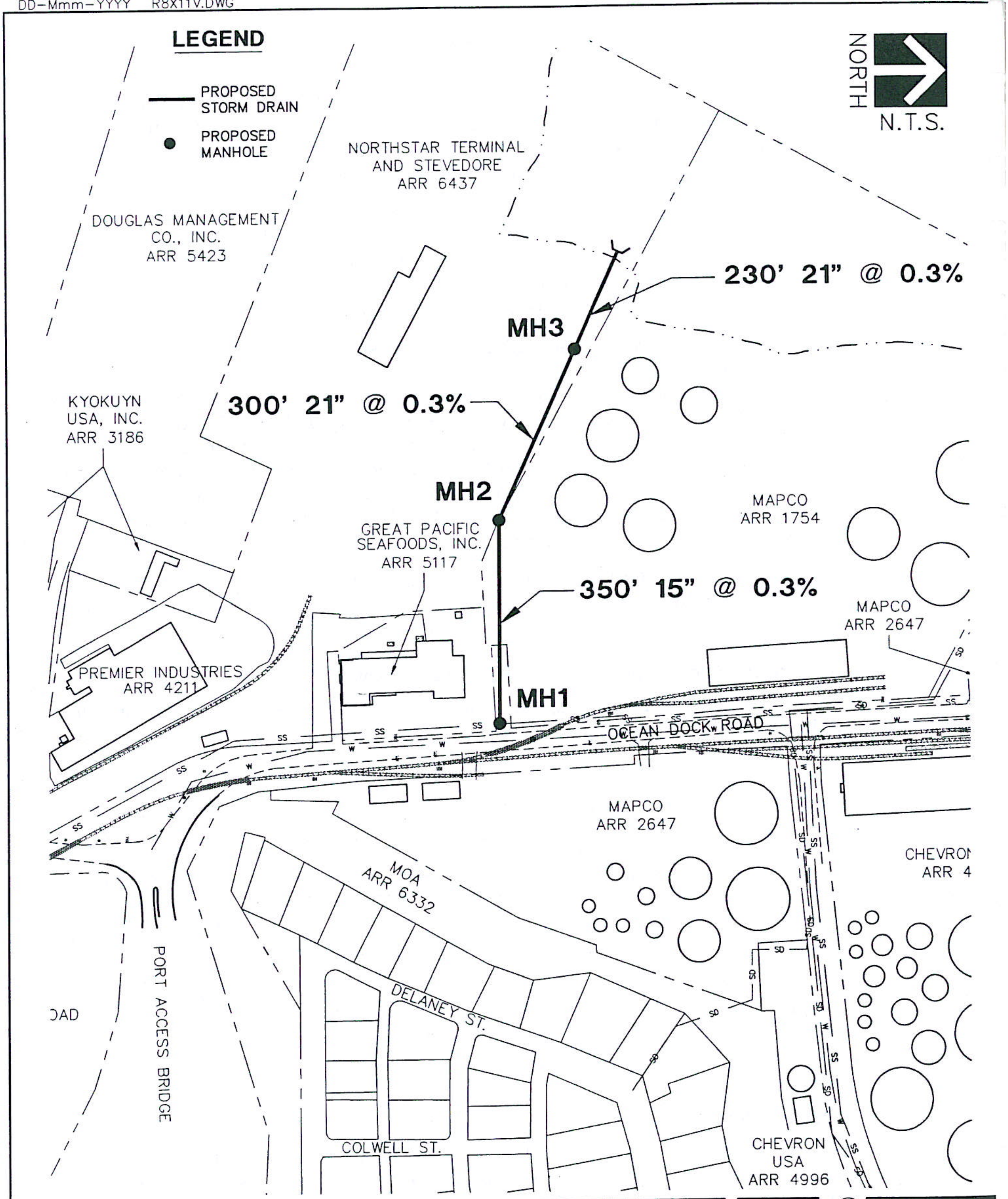
Table 7-5 presents cost estimates, disadvantages, and advantages for the North Star storm drain system alternatives.

TABLE 7-5
Comparison of North Star System Alternatives

Alternative	Estimated Construction Cost	Advantages	Disadvantages
N1 No-build	0	No upfront cost	Existing system is unmaintainable and will eventually fail
N2 Replace with new system	$356,547	Basin will be serviced by an MOA standard storm drain system that is maintainable	Cost of construction

Recommended Alternative

There are no lands or roads held by the Municipality of Anchorage within the North Star storm drain basin. Lands located within the basin are leased from the Alaska Railroad to private entities and the only road–Ocean Dock Road–is owned by the state. ADOT&PF is currently designing upgrades of Ocean Dock Road, including the segment within the North Star basin. It has not been determined by ADOT&PF how storm water runoff will be



HDR Alaska, Inc.

Port of Anchorage Drainage Study

NORTH STAR STORM DRAIN SYSTEM REPLACE WITH NEW SYSTEM ALTERNATIVE

Date
8/96

Figure
7-4

CH2M HILL

directed to final disposal. The existing storm drain system serving the North Star basin cannot be found, evaluated for system failure, or maintained. The system has no municipal easements for maintenance. It is therefore recommended that a new storm drain system be constructed and maintenance easements be secured to service this basin, particularly if runoff from the upgraded Ocean Dock Road is to affect the basin. This system should not, however, be constructed by the DPW because there are no lands or facilities held by the Municipality within the basin.

SECTION 8

Implementation Schedule

SECTION 8

Implementation Schedule

Recommended Plan and Implementation Schedule

Previous sections of this report discussed the repair alternatives, evaluated them, and provided recommendations for each of the storm systems. This section will prioritize those recommendations based on life expectancy of the existing system, potential impact to Port operation if the system fails, and coordination with other Port area development projects.

The following schedule show the plans for the design and repair construction of the six Port storm systems. Because this drainage study is the basis for the budgeting and planning of the recommended repair alternatives, little or no work is planned in 1997. There are, however, two exceptions. Funds will be available for the design of the West Bluff system in 1997. Funds were budgeted for this system following completion of a previous design study. The second exception is the Phase I portion of the Sea-Land system. The design of the Tract 4A property at the Port of Anchorage is currently under way, including a recommended bypass to be constructed for the Sea-Land system.

Phase II of the Sea-Land system, the outfall and open channel, is scheduled for construction in 1998. The existing outfall has come apart and is severely eroding the adjacent land. This problem is a major concern to Port personnel. An open channel between the existing Sea-Land system and the new Tract 4A system also will be constructed in Phase II to provide a bypass for the Cherry Hill ditch flow during the design storm event. Phase III, repair the existing piping, is scheduled to begin construction in 1998 and be completed in 1999.

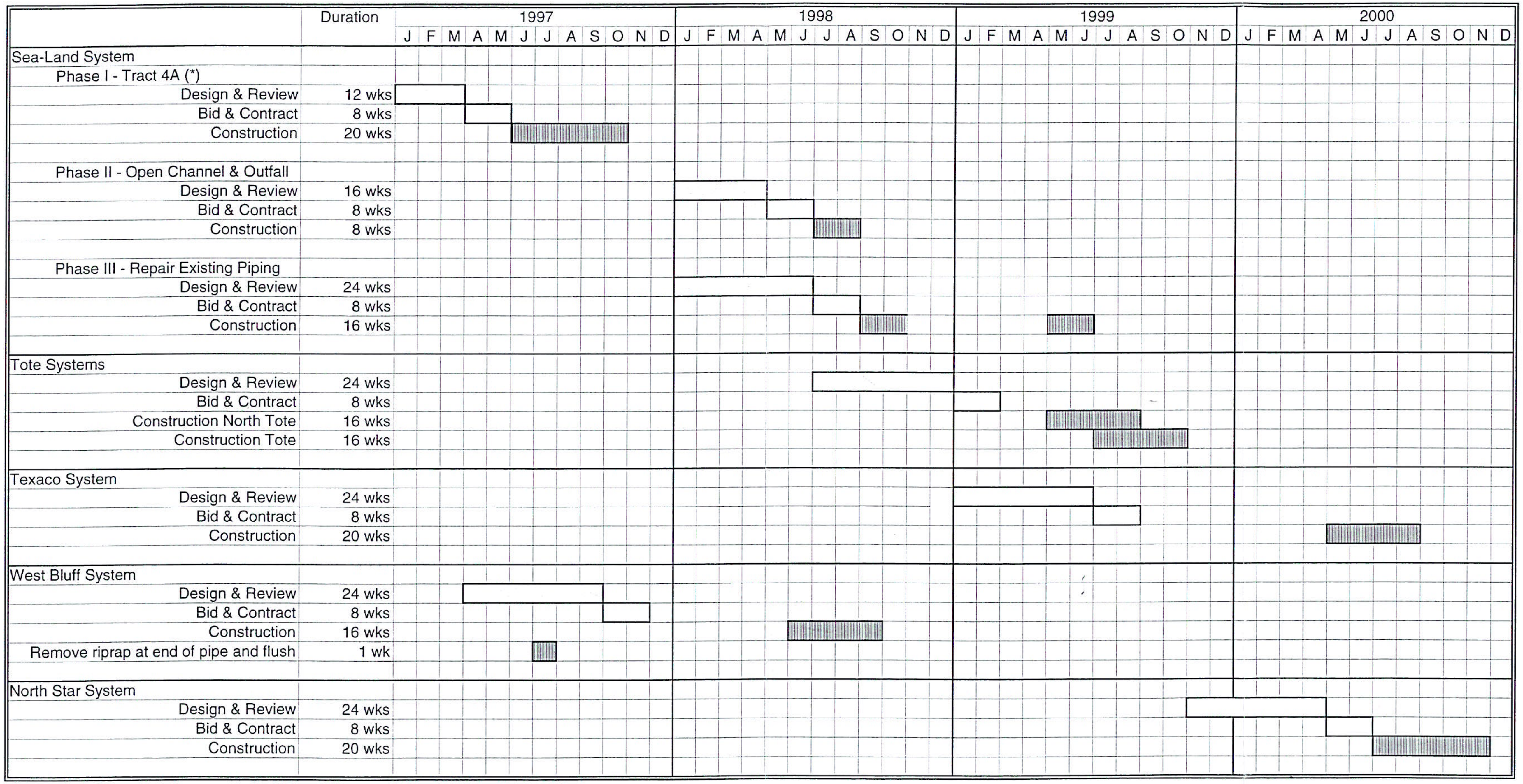
The two Tote systems are scheduled for construction in 1999. Construction schedules of these systems are staggered through the construction season to limit interference with Port operations.

The final two systems, Texaco and North Star, are recommended for construction in 2000. Because to the condition of the other systems and the assumed construction schedule of two system repairs per year, repair of the Texaco system is pushed out to the year 2000. The condition of the Texaco system, however, is poor and the system should be repaired by the year 2000 at the latest.

The North Star system is scheduled last because the existing system can not be found either in the field or from existing as-built information. There are no reported flooding problems within this basin.

Port of Anchorage Drainage Study - Final Report

Implementation Schedule



	Duration
Sea-Land System	
Phase I - Tract 4A (*)	
Design & Review	12 wks
Bid & Contract	8 wks
Construction	20 wks
Phase II - Open Channel & Outfall	
Design & Review	16 wks
Bid & Contract	8 wks
Construction	8 wks
Phase III - Repair Existing Piping	
Design & Review	24 wks
Bid & Contract	8 wks
Construction	16 wks
Tote Systems	
Design & Review	24 wks
Bid & Contract	8 wks
Construction North Tote	16 wks
Construction Tote	16 wks
Texaco System	
Design & Review	24 wks
Bid & Contract	8 wks
Construction	20 wks
West Bluff System	
Design & Review	24 wks
Bid & Contract	8 wks
Construction	16 wks
Remove riprap at end of pipe and flush	1 wk
North Star System	
Design & Review	24 wks
Bid & Contract	8 wks
Construction	20 wks

(*) RFP was advertised by the Port of Anchorage in September 1996 for the design of the Tract 4A property improvements

1. Bid & Contract assumes 1 week bid prep., 3 weeks bid, 2 weeks assembly approval, 2 weeks sign contract
2. Design & Review assumes 60 day preliminary design; 20 days review and response; 40 days final design