DRAINAGE MASTER PLAN UPDATE

CITY OF FERNDALE

PREPARED FOR THE

CITY OF FERNDALE

BY

Spencer Engineering and Construction Management, Inc.
1585 Heartwood Dr., Suite F
McKinleyville, CA 95519

Adopted April 1, 2004

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
1.0 **INTRODUCTION** 4
1.1 Project Background 4
1.2 Purpose of the Drainage Master Plan Update 5
2.0 **DESIGN CONSIDERATIONS AND STUDY AREA CHARACTERISTICS** 5
2.1 Setting 5
2.2 Hydrology 5
2.2.1 Rational Method 5
2.2.2 Runoff Coefficients 9
2.2.3 Rainfall Intensity 10
2.2.4 Time of Concentration 12
2.3 Development Assumptions 13
3.0 **FRANCIS CREEK DRAINAGE WATERSHED** 14
3.1 Introduction 14
3.2 Completed Francis Creek Channel Improvements 14
3.3 Status of Francis Creek Improvements 16
4.0 **EAST SIDE DRAINAGE WATERSHED** 16
4.1 Introduction 16
4.2 East Side Drainage Watershed Existing Problem Areas and Recommended Solutions 18
5.0 **WEST SIDE DRAINAGE WATERSHED** 21
5.1 Introduction 21
5.2 West Side Drainage Watershed Existing Problem Areas and Recommended Solutions 22
6.0 **HYDRAULICS** 25
7.0 **FUTURE PROBLEM AREAS AND PROPOSED DRAINAGE PROJECTS** 28
8.0 **FUNDING** 29
8.1 General 29
8.2 Existing Development Drainage Fee Rate Structure 29
8.3 Estimated Revenue 29
9.0 **CONCLUSIONS AND RECOMMENDATIONS** 30
9.1 Conclusions 30
9.2 Recommendations 31
9.2.1 Recommended Drainage Improvement Projects 31
9.2.2 Project Implementation Schedule 32
9.2.3 Projects Outside City Limits – Downstream Improvements 34
10.0 **PROJECT ACTIVITIES AND TECHNIQUES** 34
10.1 Hydrology 34
10.2 Public Input 34
10.3 Field Investigations 35
10.4 References 35
APPENDIX A 36
APPENDIX B 38

LIST OF TABLES

Table i. Existing Problem Areas and Recommended Solutions ……1
Table 1. Rational Method Coefficients Based on Zoning..... 9
Table 2. Parameters and values used to evaluate the Rose Avenue Culvert (East Side Problem Area 1) 25
Table 3. Parameters and values used for the Grant Avenue drainage channel for evaluating the Washington Street Culvert. (East Side Problem Area 2)..... 26
Table 4. Watershed parameters and values used for evaluating the Herbert Street storm sewer system. (East Side Problem Area 4) 26
Table 5. Watershed parameters and values used for evaluating the Ambrosini Lane Culvert (East Side Problem Area 6)..... 27
Table 6. Watershed parameters and values used for evaluating the 5th Street Storm Drain. (West Side Problem Area 1)..... 27
Table 7. Recommended Project Priority List..... 31
Table 8. Recommended Future Improvement Projects..... 34

LIST OF FIGURES

Figure 1. Location Map..... 6
Figure 2. Area Map 7
Figure 3. Vicinity Map..... 8
Figure 4. Eureka NWS IDF Curves 11
Figure 5. SCS Velocity Upland Chart..... 13
Figure 6. Francis Creek Drainage Watershed..... 15
Figure 7. East Side Drainage Watershed 17
Figure 8. West Side Drainage Watershed..... 24
Figure 9. Locations of Proposed Projects 33

EXECUTIVE SUMMARY

The 2003 Drainage Master Plan Update is an update to the 1990 Drainage Master Plan. It addresses the current state of stormwater drainage in the City of Ferndale by identifying changes and improvements in stormwater drainage that have occurred since 1990, identifying current and future drainage problems, establishing a list of recommended drainage improvement projects, addressing drainage revenues and the drainage fee rate structure, and recommending changes to the City's drainage ordinance to better address the City's current needs.

Drainage problem areas were identified and a list of recommended improvement projects was created through public meetings and site visits. The recommended improvement projects and their estimated costs are listed below in Table i. The projects are listed in order of their priority.

Table i. Existing Problem Areas and Recommended Solutions

	Est. Cost
Note: Estimated costs include design, bidding, construction, and construction management in 2003 dollars.	
1. **Rose Avenue Culvert** - Replace existing Rose Avenue 12-inch storm drain with 470 feet of new 24-inch to 30-inch pipe. Will require obtaining easements, and working in narrow areas. Estimated cost does not include the cost to acquire easements.	$107,000
2. **Fifth Street Storm Drain** - Regrade and widen the channel west of 5th Street to improve flow conditions and replace the existing 6-inch by 24-inch storm drain crossing 5th Street with a new 2-foot by 4-foot storm drain.	$175,000
3. **Herbert Street Storm Drain System and Dewey Avenue** - Install a drop inlet and 510 feet of 48-inch pipe from Herbert Street down Dewey Avenue to the East Side Drainage Channel.	$164,000
4. **Intersection of Shaw Avenue and Berding Street** - Overlay 100 feet of roadway on Shaw Avenue west of the intersection and repair 200 feet of roadway on Berding Street south of the intersection to improve cross slopes.	$33,000
5. **Washington Street Culvert** - Replace existing 24-inch Washington Street culvert with a 4-foot wide by 2-foot high concrete box culvert or equivalent.	$100,000
6. **Market Street Culvert** - Abandon the culvert crossing Market Street just north of Highway 255 and redirect the flow to keep the water on the west	

side of Market Street. Will require upsizing several driveway culverts and increasing the capacity of the existing ditch. $77,000

7. **Ambrosini Lane Culvert** - Replace the existing 36-inch section of the Ambrosini Lane culvert with a new 48-inch section. $66,000

8. **Fairgrounds Storm Sewer Pipe** - Install a new storm sewer line through the Fairgrounds between Arlington Avenue and Van Ness Avenue. $306,000

Minimum Total $1,028,000

It is the recommendation of this report that these projects be implemented as drainage funds become available. Assuming a 20 year planning period, the City will have to spend $51,400 per year in 2003 dollars to complete all of the capital improvement projects.

The estimated cost to perform annual maintenance on Ferndale's existing drainage facilities is $10,000. Therefore, the estimated total annual drainage expense for capital improvement projects and annual maintenance will be $61,400.

There are currently 2 sources of funds for drainage improvements and maintenance: 1) Development Drainage Fees; and 2) Lytel Foundation contribution. In 1997, the voters approved the establishment of a Drainage Assessment District within the City Limits with the authority to assess each parcel a $25 annual drainage fee. The Lytel Foundation, a local non-profit organization, has contributed $25,000 per year to the City in-lieu of the City implementing the property drainage assessment.

The current Development Drainage Fee incorporates the following two-tier collection:

$1,500	for each new parcel in a subdivision or parcel map
$1,500	for each new building permit issued for a parcel

Assuming housing development occurs at a rate of 5 units per year, which is consistent with trends over the last 5-10 years, the Development Drainage Fee will generate $15,000 per year in revenue.

The annual Lytel Foundation contribution is currently used to make loan payments on a $300,000, 20-year loan taken out for the Francis Creek Hazard Mitigation Project. A balance of $265,917 in leftover monies from the loan was transferred into the Drainage Fund which had a balance of $340,000 at the beginning of the 2003 fiscal year. Approximately $236,000 was appropriated from the Drainage Fund for the 03/04 fiscal year, including $171,227 that will be used to help fix the City sewer system's inflow and infiltration (I&I) problem. The remaining balance of the Drainage Fund which could be used for drainage projects will be $150,000 after the 03/04 fiscal year.

Since the projected revenue for drainage improvement projects ($15,000 per year) is significantly less than the projected expenses ($61,400 per year), the eight drainage improvement projects on the priority list will not be completed within the 20 year planning period unless either the Development Drainage Fee rate structure is adjusted, other outside (state, federal) funds are obtained, a loan is taken, or bonds are sold.

1.0 INTRODUCTION

1.1 Project Background

The City of Ferndale is a small, historic dairy community located within the Eel River Valley, roughly 15 miles south of Eureka in Humboldt County. The City and surrounding area are within the Salt River watershed, which in turn flows into the Eel River near its mouth.

Ferndale and the surrounding areas have historically had problems with storm water and drainage. Storm runoff associated with heavy winter rains has caused chronic flooding and sedimentation problems in the relatively flat terrain in the City, and in the rural areas north of the City near the Salt River. The City of Ferndale has recognized that continued growth can only take place in or adjacent to those portions of the city experiencing chronic flooding, and that management of storm water runoff is in the public interest.

There are three storm drainage watersheds that contribute storm water through and adjacent to the City of Ferndale. These are:

- Francis Creek Watershed
- East Side Drainage Watershed
- West Side Drainage Watershed

And they in turn contribute additionally to:

- Salt River Watershed, and then to;
- Eel River Watershed

Sediment erosion in the upland areas south of Ferndale contributes to the flooding problem by filling local streams and the Salt River with silt, reducing their capacity to carry peak storm runoff. While flooding and sedimentation are natural processes, the frequency and rate of sediment deposition have increased because of land use activities in the Wildcat Hills (Salt River Watershed Local Implementation Plan, 1993).

The Federal Emergency Management Agency (FEMA) completed a Flood Insurance Rate Map (FIRM) for the City of Ferndale in January 1998 (Community Panel Number 060445 0001 C). Francis Creek is designated on the FIRM to be within a Zone AE (100-year floodplain, base flood elevations determined). A natural low-profile drainage swale east of the downtown area, known as the East Side Channel, is also designated to be within a Zone AE. Other sections of the downtown area and west side of the City are designated as Zone X (areas of 500-year flood; areas of 100-year flood with average depth less than 1 foot).

The City Council formed a Drainage Committee in 1989 to consider matters related to storm drainage within the City. In 1990 the City adopted a Drainage Master Plan which recognized the need to complete many major drainage improvements within the City limits. The Drainage Master Plan also recognized the limits imposed by both the Salt River and the Eel River estuary, in that these areas greatly influence drainage within the City.

1.2 Purpose of the Drainage Master Plan Update

The objective of the Drainage Master Plan Update is to bring the 1990 Storm Water and Drainage Master Plan current by:

- identifying improvement projects that have occurred since 1990;
- updating and developing relevant maps;
- identifying existing and future drainage problems;
- establishing an updated project list with recommended priorities and estimated project costs;
- reviewing funding methods and developing a new drainage fee rate structure;
- updating the drainage ordinance No. 94-01.

2.-1Design Considerations and Study Area Characteristics

2.1 Setting

The Ferndale soils consist of medium textured very dark greyish brown soils of recent alluvial origin. The sediments are derived from greywhacke, shale, and sandstone of the Franciscan formation in the North Coast Range Mountains (U.C. Davis, 1965).

Annual rainfall averages from 40 to 60 inches, winters are mild to wet, and summers are relatively dry with frequent fog. Average annual temperature is 52 degrees Fahrenheit, with the average in July being 56 degrees Fahrenheit, and 47 degrees Fahrenheit in January. The growing season is approximately 300 days.

Mixtures of permanent pasture have been produced on the Ferndale soils since the turn of the century. Excellent yields of high quality feed have marked them as the best soils in the County.

Ferndale soils occur at elevations from near sea level to about 100 feet. Drainage is generally good. In small local areas, drainage may be impeded, and only in rare instance is the slope of Ferndale soils greater than 3 percent.

2.2 Hydrology

2.2.1 Rational Method

Peak runoff estimates used in the Master Drainage Plan are computed using the Rational Method. The Rational Method is the most widely used method for estimating peak

Figure 1. Location Map

Figure 2. Area Map

Figure 3. Vicinity Map

runoff rates and is commonly used for designing drainage facilities in small urban watersheds.

The peak storm runoff flow is found from the following equation:

$$Q = CiA$$

where

Q = peak runoff rate in cubic feet per second

C = runoff coefficient

i = average rainfall intensity in inches per hour from the intensity - duration - frequency relationship for a specific return period and duration, t_c

t_c = time of concentration

A = size of the drainage area in acres

2.2.2 Runoff Coefficients

The runoff coefficient "C" values were assigned to the various land use zoning classifications as defined in Ferndale General Plan. The runoff coefficient values are based on the slope of the land surface, degree of imperviousness and the infiltration capacity of the land surface. The type of land use can greatly affect the amount of runoff. The quantity of runoff and peak flow rates are increased when the land is developed because the impervious surface area increases with the addition of roads, driveways, roofs, etc. The values of the runoff coefficient "C" for each land use classification are listed in Table 1.

Table 1. Rational Method Coefficients Based on Zoning

Land Use Designation		Dwelling Units Per Acre	Runoff Coefficient "c"
R-S	Residential Suburban	0-1	0.40
R-1	Residential One-Family	0-7	0.55
R-1-B-1	Residential One-Family Building Site Combining	0-5	0.50
R-1-B-2	Residential One-Family Building Site Combining	0-4	0.45
R-1-B-3	Residential One-Family Building Site Combining	0-2	0.40
R-2	Residential Two-Family	0-14	0.60
R-3	Residential Multiple-Family	0-21	0.70
R-4	Apartment-Professional	0-21	0.70
C-1	Neighborhood Commercial	na	0.85
C-2	Community Commercial	na	0.85
A-E	Agricultural Exclusive	na	0.25
P-F	Public Facility	na	.25 -.60
P	Pasture	na	0.20
F	Forest and Watershed	na	0.20

Drainage areas usually consist of several different subcatchments that have different runoff coefficients. A composite runoff coefficient "C" must be computed to take into account the various surface characteristics of the subcatchments. The composite runoff coefficient is found from the following equation:

$$C = \frac{C_1 A_1 + C_2 A_2 + \ldots C_n A_n}{A_1 + A_2 + \ldots A_n}$$

where *n* is the number of subcatchments in the watershed.

2.2.3 Rainfall Intensity

Rainfall intensities were selected from intensity-duration-frequency (IDF) curves developed for the Eureka NOAA Weather Station. The rainfall intensity is obtained from the IDF curve plot by computing the time of concentration, $t_{c,}$ and selecting the desired return period. The 25-year storm event was used in accordance with the adopted 1990 Stormwater and Drainage Master Plan recommendation as the basis for the evaluation of existing drainage facilities and the sizing of recommended improvement projects.

Figure 4. Eureka NWS IDF Curves

2.2.4 Time of Concentration

Runoff from a watershed usually reaches a peak when the entire watershed is contributing. The time of concentration is defined as the amount of time that it takes for water to flow from the most hydraulically remote point in the watershed to the point of interest. There are numerous methods for computing the time of concentration. The selection of a method for computing the time of concentration depends on the characteristics of the watershed being studied. The SCS velocity upland method was adopted for this report.

The time of concentration is found from the following equation:

$$t_c = \frac{1}{60} \sum \frac{L}{V}$$

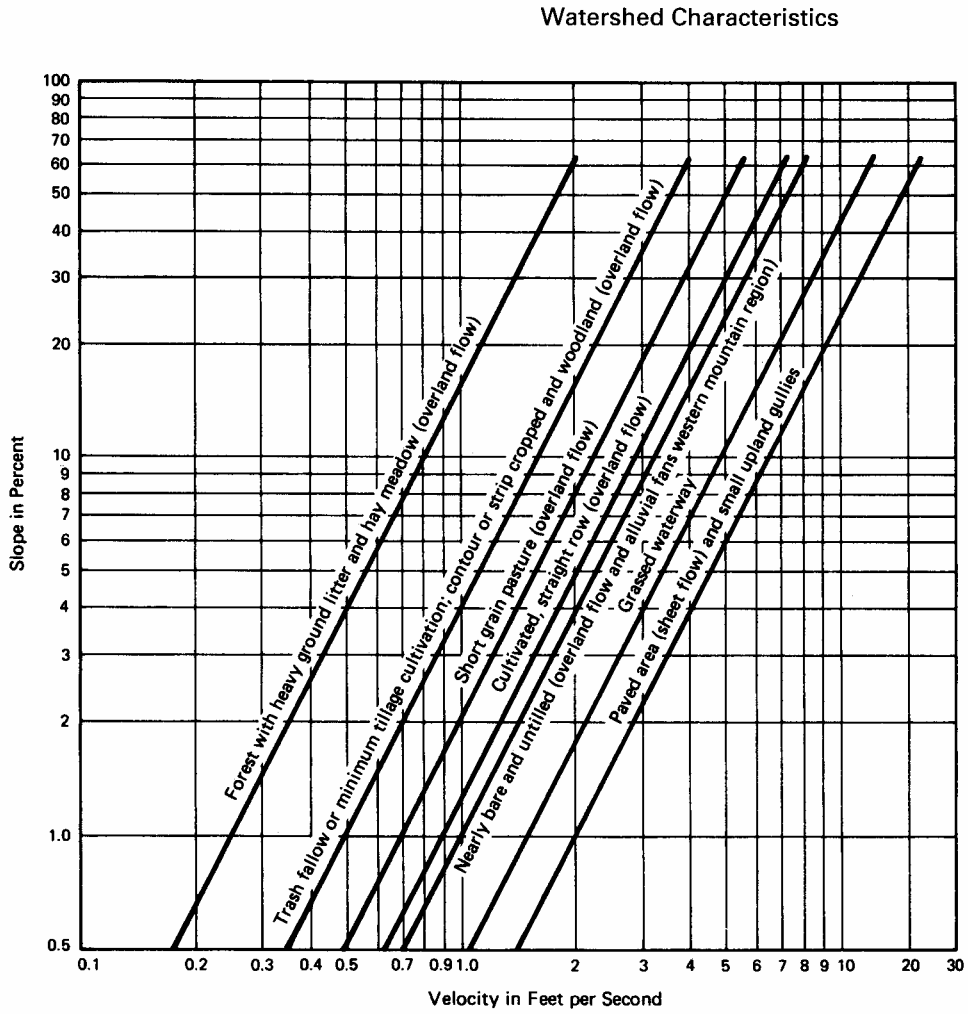
where

t_c = time of concentration in minutes

L = length of flow path in feet

V = average velocity in feet per second for various surfaces using Figure 2

For the purposes of this plan, a minimum t_c = 10 minutes was used.



Velocities for upland method of estimating t_c.

Figure 5. SCS Velocity Upland Chart

2.3 Development Assumptions

The Drainage Master Plan Update assumes maximum build-out based on the current zoning as described by the Ferndale General Plan. Estimated flow rates for various points in the drainage system were developed based on this assumption. All recommended projects are sized to accommodate these flows.

3.-1 FRANCIS CREEK DRAINAGE WATERSHED

3.1 Introduction

The Francis Creek Watershed has a drainage area of 1,958 acres. Francis Creek is normally a small, babbling brook which runs year round, winding through the very heart of the City. The Creek's flood carrying capacity was restricted by culverts, bridges, sediment build-up, and debris (Ferndale Drainage Master Plan, 1990). Flooding from Francis Creek has been historically documented at regular intervals, and varying intensities.

3.2 Completed Francis Creek Channel Improvements

Through the Governor's Office of Emergency Services (OES), the City of Ferndale applied for a FEMA Flood Hazard Mitigation Grant in January, 1996 to primarily increase the flow capacity of Francis Creek. Approval of funding to proceed with a Phase 1 study and report was received on October 31, 1997. The Phase 1 Report was completed in March, 1998.

The City received notification of funding approval for the project from OES in November 1999. In order to work effectively in Francis Creek during the relatively short construction season, the project was divided into three phases. Beginning in June, 2000 work began on the first phase of construction at the most downstream point. The City partnered with Caltrans to receive $764,000 towards completion of the first phase of work, at the most downstream portion of the project, part of which was within the Caltrans Highway 211 right-of-way. The first phase of work was substantially complete in December 2000.

Construction began on Phase 2 of the project in June 2001. The work included widening much of the middle section of the creek, and replacing two bridges. The City was successful in obtaining a California Department of Water Resources Urban Streams Restoration Grant of $270,000 to help fund a portion of the Phase 2 work. Phase 2 construction work was completed in November 2001.

The final phase of construction included the replacement of the two most upstream bridges of the project, and the installation of the east side drainage improvements. The work began in June 2002, and was substantially complete in September of the same year.

The design team employed several methods to complete the channel widening. In general, the lower portions for the creek bank were armored with large rock slope protection with interwoven plantings of native thimbleberry, ferns, and wild strawberries. Some of the upper sections of bank were lined with a biodegradable mesh fabric, with similar plantings. Larger bushes and trees were planted along the top of the bank to provide a future shade canopy. Habitat enhancing rock clusters were also placed at strategic locations in the creek channel.

Figure 6. Francis Creek Drainage Watershed

All of the new bridges included at least three feet of rock fill over foundation footings. This was intended to provide a channel bed of natural material.

3.3 Status of Francis Creek Improvements

The City was fortunate that the winters of 2000 and 2001 were relatively mild, with below normal rainfall. The new landscaping generally had time to develop and take hold on the creek banks that had been widened during the first two phases of work. The entire project was completed just before the extreme storm events of December 16 and 27, 2002. The December 16 storm produced peak flows in Francis Creek that were estimated to be at least 850 cfs. The December 27 storm was even greater; over 8 inches of rain fell on the Francis Creek watershed in a 24 hour period, producing flows in Francis Creek estimated to be at least 1,000 cfs, well above the design flow of 750 cfs for the 25-year storm event. Some estimates within Humboldt County indicate the December 27 event was roughly of a 100-year magnitude.

Francis Creek was able to handle the December 16 storm flow without any problems. At least one foot of clearance was reported at all creek banks and bridges.

The December 27 storm event produced some minor overtopping of Francis Creek; specifically, the Fern Avenue Bridge was overtopped and water was diverted into a nearby pasture. Minor overtopping was also reported at the Shaw Avenue bridge (which had not been replaced), but, again, this did not cause damage to any properties. In several places along Francis Creek the bank eroded or slumped. One of these areas of erosion occurred adjacent to an area that had been recently widened. Other bank problems occurred outside of the work zones, but may have been aggravated by the increased flow in Francis Creek.

4.-1 EAST SIDE DRAINAGE WATERSHED

4.1 Introduction

The East Side Drainage system consists of a network of street gutters, storm sewers, culverts, and drainage channels that convey runoff to a natural low profile drainage swale referred to as the East Side Channel. The East Side Channel lies about 2,000 feet east of Francis Creek and flows north to Market Street and Van Ness Street where it converges with a County maintained ditch.

In addition to draining the easterly portion of the City of Ferndale, the East Side Drainage Channel collects overflows (floodwaters) from both Francis Creek to the west and Williams Creek to the east. The recent flood mitigation projects completed on Francis Creek increased the capacity of the channel to allow it to contain the 25-year design storm. This should significantly reduce the frequency of Francis Creek overflows which will alleviate some of the previous flooding problems experienced in East Side Drainage Watershed.

Figure 7. East Side Drainage Watershed

To resolve the flooding issues in the East Side, a series of local improvements are proposed that will reduce present flooding conditions to a level below existing structures' finish floor by 1.0 foot. These improvements will allow the 25-year design flow to be accommodated without causing flows to exit the drainage system and create flooding conditions.

4.2 East Side Drainage Watershed Existing Problem Areas and Recommended Solutions

Five problem areas were identified in the East Side Drainage Watershed. The problem areas and recommended solutions are summarized in the following section.

Problem Area 1: Rose Avenue Culvert

The East Side Drainage Channel crosses McKinley Avenue and several adjacent properties through a series of culverts before emptying back into the natural drainage channel. Flow travels through the swale for a short distance before entering a 12-inch culvert located between Watson Avenue and Schley Avenue. The 12-inch culvert crosses several private lots and Rose Avenue before emptying back into the natural channel north of Rose Avenue.

The 12-inch culvert is undersized and does not have the required capacity to accommodate the surface runoff generated by a significant storm. This restriction created by the 12-inch culvert causes water to backup upstream of the inlet for some distance, creating a retention pond in the natural drainage channel. The property owners perceive the pond as a benefit and would like to see it remain. However, the channel does not have the required storage volume to contain the inflow associated with heavy precipitation events. The pond overflows as a result, causing flooding in several yards in the area between Watson Avenue and Schley Avenue. Houses on the south side of Rose Avenue are occasionally flooded during extreme storm events. The City Public Works Department assessed the culvert after a storm and reported that the outlet was flowing full which would indicate the culvert does not have any obstructions that would reduce its capacity. A hydraulic evaluation of the culvert indicates that it is substantially undersized to convey the 25-year design flow.

Recommended Solution: Replace the existing 12-inch culvert with a 24-inch to 30-inch drainage pipe that will have the required capacity to handle the 25-year design flow. This will require obtaining easements from the property owners and working in narrow areas. At a meeting held on May 21, 2003, the affected property owners acknowledged the severity of the problem and indicated that they would be willing to grant easements to allow for the culvert to be replaced.

The recommended solution involves day-lighting the East Side channel for approximately 70 feet beyond the present 12-inch culvert inlet. The flow will then enter a new culvert that will follow a similar path to the existing culvert which travels through a backyard, under a driveway, and across Rose Avenue out to a pasture before discharging into the natural swale.

Estimated Cost: $107,000

Problem Area 2: Washington Street Culvert

A drainage channel runs along the south side of Grant Avenue and collects runoff from the undeveloped area to the south and from the area on the north side of Grant Avenue. This drainage ditch meets at a confluence with street runoff from the southeastern portion of the downtown area at a 24-inch culvert on the south side of Washington Street. The flow enters the 24-inch culvert and crosses under Washington Street. After crossing Washington Street, the flow enters a junction box that connects with three 24-inch culverts that discharge into a drainage channel that begins approximately 50 feet north of Washington Street. The drainage channel then travels north to the intersection of Herbert Street and Rose Avenue.

The 24-inch culvert that crosses Washington Street is undersized which causes flooding conditions in the area. Storm flow backs up at the culvert entrance during heavy precipitation events which causing the drainage channel to overflow across Washington Street and into several yards. In addition, significant ponding occurs around the Washington Street drop inlet that is located above the culvert. Several yards and structures are periodically flooded during significant storm events.

Recommended Solution: Replace the 24-inch culvert with a 36-inch culvert or equivalent that will have the capacity to convey the 25-year design flow.

Estimated Cost: $100,000

Problem Area 3: Intersection of Shaw Avenue and Berding Street

A third flooding problem exists at the intersection of Shaw Avenue and Berding Street. This intersection lies at the upper end of the Berding Street storm sewer system and is subject to flooding during storm events. The accumulation of water in the travel lanes increases the risk of an accident occurring and can accelerate deterioration of the roadway. A hydraulic evaluation of the Berding Street storm sewer system indicates that it has the capacity to intercept and convey the flow from a 25-year storm event. However, only a fraction of the storm runoff is directed into the two grate inlets located on the west side of the intersection. A lack of cross slope on the pavement surface on both Shaw Avenue and Berding Street near the intersection results in the street runoff not being directed into the drainage inlets. Instead, the gutter flow traveling down Shaw Avenue and Berding Street spreads out into a sheet across the roadway prior to reaching the intersection and bypasses the storm sewer system. There is a small asphalt dike

constructed on the Berding Street grate inlet but it is not very effective. What is not intercepted by the 2 grate inlets on Berding Street travels in a northeast direction across the intersection. The flow then travels down Berding Street a short distance before flowing east down Rose Avenue. This carryover ends up creating flooding problems at the intersection of Rose Avenue and Herbert Street across from the Farm Shop where it enters the Herbert Street storm sewer system.

Potential Solution: Increase the cross slope of the pavement surface on Shaw Avenue and Berding Street near the intersection to limit the spread of water onto the roadway surface and to direct the storm flow into Berding Street storm sewer system.

Estimated Cost: $33,000

Problem Area 4: Herbert Street Storm Sewer System and Dewey Avenue

The drainage channel that flows north from Washington Street enters the Herbert Street storm sewer system at the intersection of Herbert Street and Rose Avenue. The Herbert Street storm sewer system runs along the west side of Herbert Street where it joins with the Berding Street storm sewer system at the intersection of Herbert Street, Berding Street, and Fern Avenue. Both of the storm sewer systems discharge into the East Side Drainage Channel through a 48-inch pipe just east of the intersection. An evaluation of the hydraulic behavior of the Herbert Street storm sewer system indicates that it does not have the required capacity to accommodate the runoff from the 25-year design storm. This is consistent with reports from residents of flooding along the west side of Herbert Street and at the intersection of Herbert Street and Rose Avenue across from the Farm Shop. Some of the flooding problems at the Herbert Street and Rose Avenue intersection should be alleviated by preventing runoff from bypassing the Berding Street storm sewer system as described in Problem Area 3. However, the 48-inch pipe downstream of the confluence of the Herbert Street and Berding Street storm sewer systems is undersized to accommodate the runoff from a significant storm causing the flow to backup in the Herbert Street system creating flooding conditions.

Another nearby flooding problem exists on the properties located on the north and south sides of Dewey Avenue. Significant ponding occurs on several of properties on the south side of the street near the roadway. In addition, a drainage swale exists on the lot situated at the southeast corner of Dewey and Herbert. The channel enters a 6-inch culvert that ties into the Herbert Street storm sewer system. This drainage channel is poorly constructed and has an adverse slope in some sections. Furthermore, the entrance to the 6-inch culvert is located too high to allow the channel to have a continuous positive gradient. Significant ponding occurs along the side adjacent to Dewey Avenue and in the backyard of this property.

During severe storm events, runoff flows across Dewey Avenue and ponds in the low lying areas of several properties situated north of Dewey Avenue. Ponding reaches depths of several feet in some instances and a house and several garages are subject to periodic flooding. The yards remain flooded until the water has a chance to infiltrate or flow to the East Side Drainage Channel through a 4-inch drainage pipe located on the

property situated on the northeast corner of the intersection of Herbert Street and Dewey Avenue.

Recommended Solution: Install two drop inlets on Dewey Avenue and a 48-inch drainage pipe from Herbert Street east on Dewey Avenue to the East Side Drainage Channel. This solution will also reduce loading and help alleviate problems at the existing junction where the Herbert Street and Berding Street storm sewer systems convene at intersection of Fern Avenue, Herbert Street, and Berding Street.

Estimated Cost: $164,000

Problem Area 5: Market Street Culvert

The culvert that crosses Market Street on the north side of Highway 211 has insufficient capacity to accommodate runoff from significant storm events, causing flooding on several nearby properties.

Recommended Solution: Abandon the undersized culvert and route the runoff on the west side of Market Street by increasing the size of the driveway culverts and increasing the capacity of the existing drainage ditch.

Estimated Cost: $77,000

Problem Area 6: Ambrosini Lane Culvert

The Ambrosini Lane culvert on the south side of Highway 211 conveys storm runoff from the East Side Channel across Ambrosini Lane. The culvert inlet is located just inside the city limits on private property approximately 300 feet south of Ambrosini Lane. The culvert outlet discharges a few feet beyond the north side of Ambrosini Lane into a County ditch that flows north towards Highway 211. The culvert is approximately 350 feet in length and is 36-inches in diameter at the inlet and 48-inches at the outlet. The culvert does not have the hydraulic capacity to convey storm water through the roadway without creating a significant amount of ponded water on the inlet side.

Recommended Solution: Replace the 36-inch section of the culvert with a new 48-inch pipe and higher capacity inlet that will have the capability to convey the 25-year flow without creating excessive ponding upstream of the culvert entrance.

Estimated Cost: $66,000

5.-1 WEST SIDE DRAINAGE WATERSHED

5.1 Introduction

The West Side Drainage Watershed drainage system consists of a network of street gutters, drainage channels, and culverts. The west side drainage area is absent of any

storm sewers except for the Coast Guard housing and a small internal drainage system at the County Fairgrounds. The remaining acreage contains a series of drainage channels all running northerly to Port Kenyon road where runoff ponds, percolates, or drains west in a small agricultural ditch.

The drainage channels are draining at maximum capacity and any increase in storm water will only contribute to additional unmanaged run-off. Furthermore, these drainage ditches are densely vegetated, especially during the spring months. This vegetation significantly decreases the hydraulic efficiency of the channels and their capacity to convey stormwater runoff.

5.2 West Side Drainage Watershed Existing Problem Areas and Recommended Solutions

Problem Area 1: 5th Street Storm Drain

A drainage problem occurs on the east side of 5th Street at the western end of the Coast Guard housing area. Excessive spread and accumulation of water on the travel lane occurs along the eastern side of 5th Street starting at the intersection with Fairview Drive and continuing south for some distance. The intersection is the low point of 5th Street and is situated in a low gradient area. A drainage inlet and 6-inch by 24-inch storm drain are located between the Fairview Drive intersections with 5th Street. Storm runoff ponds along the east side of 5th street while it is slowly conveyed through the storm drain across the roadway to a drainage channel that flows west before joining with a northerly flowing channel that travels parallel to Rasmussen Lane and out to Port Kenyon Road.

Recommended Solution: Regrade and widen the channel west of 5th Street to improve flow conditions and replace the existing 6-inch by 24-inch storm drain with a new 2-foot by 4-foot storm drain that will have the capacity to handle the 25-year design flow.

Estimated Cost: $175,000

Problem Area 2: Humboldt County Fairgrounds

The Humboldt County Fairground's storm sewer system collects runoff from the Fairgrounds property, and conveys runoff from portions of Arlington Avenue and 5th Street, and the undeveloped area south of Arlington Avenue. The Fairgrounds storm sewer system discharges into a roadside drainage ditch on the south side of Van Ness Avenue. Flooding commonly occurs around drainage inlets on the Fairgrounds property. The existing 12" conveyance culvert through the fairgrounds lacks the capacity to handle a 25 year storm event and frequently floods during smaller events. A hydraulic analysis of the existing culvert indicates that it is undersized. In addition to being undersized, the system appears to have lost capacity from sediment deposition in the pipelines.

Recommended Solution: Install a new storm sewer pipe between Arlington Avenue and Van Ness Avenue. The new storm sewer pipeline will consist of a combination of 24-

inch through 48-inch diameter pipes and will have the capacity to handle increased runoff from future development in the area south of Arlington Avenue. Furthermore, the new storm sewer should have the capacity to be expanded to collect surface runoff from the Fairgrounds.

Estimated Cost: $306,000.

Figure 8. West Side Drainage Watershed

6.-1 HYDRAULICS

The 25-year peak runoff flows (Q_{25}) were calculated for the drainage problem area locations identified in Sections 4.2 and 5.2. The watershed parameters and values used in the analysis of the problem areas are shown in the following tables.

Table 2. Parameters and values used to evaluate the Rose Avenue Culvert (East Side Problem Area 1)

Watershed Parameters	Value	
Watershed Area	51	Acres
Maximum Elevation	243	Feet
Minimum Elevation	46	Feet
Elevation Difference	197	Feet
Length of Flow Path	3684	Feet
Time of Concentration Estimate		
SCS Velocity Upland Method	48.8	Minutes
Rainfall Intensity (i_{25})	1.2	inches/hr
Composite Runoff Coefficient (C)*	0.27	
Peak Runoff Rate Estimate (Q_{25})	17	CFS

* See Appendix B for Composite "C" Computation

Table 3. Parameters and values used for the Grant Avenue drainage channel for evaluating the Washington Street Culvert. (East Side Problem Area 2)

Watershed Parameters	Value	
Watershed Area	134	Acres
Maximum Elevation	526	Feet
Minimum Elevation	62	Feet
Elevation Difference	464	Feet
Length of Flow Path	2950	Feet
Time of Concentration Estimate		
SCS Velocity Upland Method	15.0	Minutes
Rainfall Intensity (i_{25})	2.0	inches/hr
Composite Runoff Coefficient (C)*	0.32	
Peak Runoff Rate Estimate (Q_{25})	86	CFS

* See Appendix B for Composite "C" Computation

Table 4. Watershed parameters and values used for evaluating the Herbert Street storm sewer system. (East Side Problem Area 4)

Watershed Parameters	Value	
Watershed Area	156	Acres
Maximum Elevation	526	Feet
Minimum Elevation	46	Feet
Elevation Difference	480	Feet
Length of Flow Path	3500	Feet
Time of Concentration Estimate		
SCS Velocity Upland Method	21.0	Minutes
Rainfall Intensity (i_{25})	1.7	inches/hr
Composite Runoff Coefficient (C)*	0.36	
Peak Runoff Rate Estimate (Q_{25})	62	CFS

* See Appendix B for Composite "C" Computation

Table 5. Watershed parameters and values used for evaluating the Ambrosini Lane Culvert (East Side Problem Area 6)

Watershed Parameters	Value	
Watershed Area	393	Acres
Maximum Elevation	526	Feet
Minimum Elevation	26	Feet
Elevation Difference	500	Feet
Length of Flow Path	7900	Feet
Time of Concentration Estimates		
SCS Velocity Upland Method	73.0	Minutes
Rainfall Intensity (i_{25})	0.92	inches/hr
Rational Method (C)*	0.29	
Peak Runoff Rate Estimate (Q_{25})	105	CFS

*See Appendix B for Composite "C" Computation

Table 6. Watershed parameters and values used for evaluating the 5th Street Storm Drain. (West Side Problem Area 1)

Watershed Parameters	Value	
Watershed Area	40	Acres
Maximum Elevation	63.3	Feet
Minimum Elevation	38.1	Feet
Elevation Difference	25.2	Feet
Length of Flow Path	1800	Feet
Time of Concentration Estimate		
SCS Velocity Upland Method	13.3	Minutes
Rainfall Intensity (i_{25})	2.1	inches/hr
Composite Runoff Coefficient (C)*	0.56	
Peak Runoff Rate Estimate (Q_{25})	48	CFS

* See Appendix B for Composite “C” Computation

Table 7. Watershed parameters and values used for evaluating the Fairgrounds Storm Sewer System. (West Side Problem Area 2)

Fairgrounds Storm Sewer System Watershed Parameters	Value	
Watershed Area	63	Acres
Maximum Elevation	41	Feet
Minimum Elevation	31	Feet
Elevation Difference	10	Feet
Length of Flow Path	7900	Feet
Time of Concentration Estimates		
SCS Velocity Upland Method	16.0	Minutes
Rainfall Intensity (i_{25})	2.12	inches/hr
Rational Method (C)*	0.58	
Peak Runoff Rate Estimate (Q_{25})	78	CFS

*See Appendix B for Composite "C" Computation

7.-1 Future Problem Areas and Proposed Drainage Projects

Several future projects have been identified as being necessary to improve or maintain the City of Ferndale's stormwater management capabilities. The scope of these projects extends beyond the City limits and they are not part of the City's drainage plan. These projects would most likely have to be funded by others (federal, state, or county).

1. Dredge the Salt River to increase the capacity to contain peak storm runoff

2. The open ditches in the West Side Drainage Watershed don't have the capacity to handle any future increase in runoff. A review of the current zoning map indicates that about 50 acres of potential land exists for further development within the West Side Drainage Watershed. It is recommended that these channels be maintained by periodically cutting the weeds and brush along channel sides to prevent flow constriction.

3. The county ditches and culverts on the east side of Market Street also need to be upsized to handle any future increase in runoff from the East Side Drainage Watershed.

Because the City is reliant on, but has no control over drainage facilities outside the city limits, it is recommended that the City coordinate with, and strongly encourage, the County and others to correct downstream problems.

8.-1 FUNDING

8.1 General

The three basic means of obtaining funds for storm water maintenance and improvement projects are Property Assessment Districts, Development Fees, and grants. The City of Ferndale has created a Property Assessment District and Development Drainage Fees.

In 1994, the City adopted a Storm Drainage Fee Ordinance which established fees on new subdivisions and building permits. In the November 1997 election, the voters approved Measure V which established a Drainage Assessment District within the City Limits of Ferndale with the authority to assess each parcel a $25 annual drainage fee. The voters approved the passage of Measure V with the knowledge that the Lytel Foundation (a local non-profit organization) would pay $25,000 per year in lieu of the $25 per parcel annual fee.

8.2 Existing Development Drainage Fee Rate Structure

Development Drainage Fees are currently assessed at a rate of $1,500 for each new residential parcel created in a subdivision or parcel map. An additional $1,500 fee is required for the first building permit issued for any new parcel. The fee for constructing or relocating a residential structure on a parcel created prior to the 1994 ordinance is $2,500.

The fee for additions to existing parcels which result in increased ground coverage or additional floor area in excess of 100 square feet is $0.50 per square foot. New graveled roadways or parking areas in excess of 100 square feet are subject to a fee of $0.36 per square foot. The total fee for any one addition or improvement is not to exceed $500.

Commercial and industrial developments on existing parcels are charged a fee of $0.50 per square foot of impervious area created with a maximum fee of $15,000 per acre. The fee for new parcels created which are zoned commercial or industrial are pro rated at a rate of $15,000 per acre.

8.3 Estimated Revenue

The estimated cost to fix existing drainage problems in Ferndale is $1,028,000. Under the present zoning and existing development maps, it is estimated that there are approximately 100 acres of residential property in the city that can be further developed. However, it is believed no more than 50 acres may be developed in the next 20 years.

Assuming a 20 year planning period, the City will have to spend $51,400 per year in 2004 dollars to complete all of the capital improvement projects.

The estimated cost to perform annual maintenance on Ferndale's existing drainage facilities is $10,000. Therefore, the estimated total annual drainage expense for capital improvement projects and annual maintenance will be $61,400.

The funding to pay for these costs will be collected through Development Drainage Fees. The current Development Drainage Fee incorporates the following two tier collection:

$1,500	for each new parcel in a subdivision or parcel map
$1,500	for each new building permit issued for a parcel

Assuming housing development occurs at a rate of 5 units per year, which is consistent with trends over the last 5-10 years, the Development Drainage Fee will generate $15,000 per year in revenue.

The annual $25,000 in revenue collected from the Lytel Foundation is currently used to repay a $300,000, 20-year loan that was taken for the Francis Creek Flood Hazard Mitigation Project. A balance of $265,917 in leftover monies from the loan was transferred into the Drainage Fund following the completion of the Hazard Mitigation Project. There was $340,000 in the Drainage Fund at the beginning of the 2003 fiscal year. The City appropriated $236,060 from the Drainage Fund for the 03/04 fiscal year which included $171,227 for repairing the City sewer system's inflow and infiltration (I&I) problem. The Drainage Fund will have a remaining balance of $150,000 which could be used for drainage projects at the end of the 03/04 fiscal year.

Since the projected revenue for drainage improvement projects ($15,000 per year) is significantly less than the projected expenses ($61,400 per year), the drainage improvement projects will not be completed within the 20 year planning period unless either the Development Drainage Fee rate structure is adjusted, other outside (state, federal) funds are obtained, a loan is taken, or bonds are sold. Grant monies are available to fund storm water drainage projects but the availability of these funds is limited and it is uncertain whether the City of Ferndale will be able to obtain any capital through stormwater grants.

9.-1 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

The Ferndale Drainage Master Plan Update is a long-range planning tool that identifies deficiencies in the existing drainage system, provides a recommended course of action to reduce flood damage, supports the drainage fee ordinance, establishes a fee schedule for development, and provides guidance for the development of future drainage facilities.

9.2 Recommendations

It is recommended that this Drainage Master Plan Update be adopted by the City Council to better address the current state of storm water drainage in the City of Ferndale.

9.2.1 Recommended Drainage Improvement Projects

The eight projects in the project priority list (Table 8) should be implemented as drainage funds become available. The projects are listed in order of their priority. The factors considered in determining priority were the extent and frequency of flooding and the potential for property damage. The project descriptions and estimated costs are listed in Table 8 below. Any easements required for the projects should be acquired as soon as possible either through purchase, as a condition of development, or as condition of benefit resulting from the implementation of such projects. Funding methods and recommended drainage fee rate structures are described in Section 8.0 of this report. It is recommended that the existing Development Drainage Fee rate structure be maintained.

Table 8. Recommended Project Priority List

	Est. Cost
Note: Estimated costs include design, bidding, and construction management in 2003 dollars.	
1. Replace existing Rose Avenue 12-inch storm drain with 470 feet of new 24-inch to 30-inch pipe. Will require obtaining easements, and working in narrow areas. Estimated cost does not include the cost to acquire easements.	$107,000
2. Regrade and widen the channel west of 5th Street to improve flow conditions and replace existing 6-inch by 24-inch storm drain crossing 5th Street with a new 2-foot by 4-foot storm drain.	$175,000
3. Install a drop inlet and 510 feet of 48-inch pipe from Herbert Street down Dewey Avenue to the East Side Drainage Channel.	$164,000
4. Overlay 100 feet of roadway on Shaw Avenue west of the intersection and repair 200 feet of roadway on Berding Street south of the intersection to improve cross slopes.	$33,000
5. Replace existing 24-inch Washington Street culvert with a 4-foot wide by 2-foot high concrete box culvert or equivalent.	$100,000
6. Abandon the culvert and redirect the flow to keep the water on the west side of Market Street. Will require upsizing several driveway culverts and increasing the capacity of the existing ditch.	$77,000
7. Replace the existing 36-inch section of the Ambrosini lane culvert with a	

new 48-inch section. $66,000

8. Install a new storm sewer line through the Fairgrounds between Arlington Avenue and Van Ness Avenue. $306,000

Minimum Total $1,028,000

9.2.2 Project Implementation Schedule

Projects on the project priority list should be implemented as funds become available. Under the proposed drainage fee rate structure, an annual amount of about $15,000 would be available to fix existing problems. Assuming an average of 5 lots per year are developed and 5 building permits are issued, the following implementation schedule can be expected.

1. Upsize Rose Avenue Storm Drain – 2011
2. 5th Street Box Culvert and Channel Improvements – 2023
3. New Herbert Street and Dewey Avenue Storm Drain Pipe – 2034
4. Shaw Avenue and Berding Street Overlay – 2036
5. Upsize Washington Street Culvert – 2043
6. Market Street Improvements – 2048
7. Ambrosini Lane Culvert – 2052
8. Fairgrounds Storm Sewer Line –2073

Figure 9. Locations of Proposed Projects

9.2.3 Projects Outside City Limits – Downstream Improvements

Improvements within the City limits which increase the flow of storm water out of the City may have an adverse effect on downstream drainage facilities that may already be inadequately sized. The recommended improvement projects in Table 2 below have been identified as possibly being necessary to improve or maintain the downstream stormwater management capabilities outside the city limits. The scope of these projects extends beyond the city limits and would most likely have to be funded by outside sources.

Table 9. Recommended Future Improvement Projects

	Est. Cost
1. Dredge the Salt River	N/A
2. Increase the capacity of the west side drainage ditches to the Salt River	$277,000
3. Upsize county ditches and culverts on the East Side of Market Street	$264,000

Detailed descriptions of these projects can be found in Section 7.0, Future Problem Areas and Proposed Drainage Projects.

10.-1 PROJECT ACTIVITIES AND TECHNIQUES

10.1 Hydrology

For the East Side and West Side drainages, conventional civil engineering approaches to stormwater design and flood routing were employed to identify peak runoff rates produced by a storm with a 25-year return period. Design flows were developed using the Rational Method and the intensity-duration-frequency curve developed in 1976 for the NOAA weather station office in Eureka, California.

10.2 Public Input

A public meeting was held at the Ferndale City Hall on April 10, 2003 to gather information from the City of Ferndale residents about drainage problems in and around the city.

A meeting with the residents that will be potentially affected by the Rose Avenue replacement project was held on May 21, 2003 to assess the potential for obtaining drainage easements and evaluate potential culvert alignments.

Several public Drainage Committee meetings were held during the preparation of the report during which valuable feedback and recommendations were made.

10.3 Field Investigations

Several field investigations were conducted to verify and assess drainage problems identified at the public meetings. Field investigations were also conducted to gather information necessary to create the stormwater routing, storm sewer system, and watershed boundary maps.

10.4 References

The following existing reports were employed in developing the Master Plan Update:

Master Plan, Storm Water and Drainage Study, City of Ferndale. Spencer Engineering, McKinleyville, California, 1990.

McKinleyville Drainage Study. Winzler and Kelly, Eureka, California, 1982.

Salt River Watershed Local Implementation Plan. USDA, Davis and Eureka, California, 1993.

Soils of Western Humboldt County. U.C. Davis, Davis, California, 1965.

Storm Drainage System Report, Southeastern Ferndale. Winzler and Kelly, Eureka, California, 1982.

APPENDIX A

Cost Estimates

SHAW AVENUE ROADWAY GRADING ITEMS					
ITEM NO.	CONSTRUCTION ITEM	UNIT	QUANTITY	UNIT COST	EXTENDED COST
1	Cold Plane Asphalt Concrete - Shaw Avenue	SY	445	$5	$2,225
2	Asphalt Paving - Shaw Avenue	TON	74	$64	$4,736
3	Design, Bidding, and Construction Management	LS	1	$2,088	$2,088
4	20% Contingency	LS	1	$1,810	$1,810
	TOTAL SHAW AVENUE ROADWAY GRADING				**$10,859**
BERDING STREET ROADWAY GRADING ITEMS					
ITEM NO.	CONSTRUCTION ITEM	UNIT	QUANTITY	UNIT COST	EXTENDED COST
1	Cold Plane Ashpalt Concrete - Berding Street	SY	890	$5	$4,450
2	Asphalt Paving - Berding Street	TON	149	$64	$9,536
3	Design, Bidding, and Construction Management	LS	1	$4,196	$4,196
4	20% Contingency	LS	1	$3,636	$3,636
	TOTAL BERDING STREET ROADWAY GRADING				**$21,818**

ROSE AVENUE CULVERT ITEMS					
ITEM NO.	CONSTRUCTION ITEM	UNIT	QUANTITY	UNIT COST	EXTENDED COST
1	Grassed Waterway	LF	70	$80	$5,600
2	24" Drainage Pipe	LF	270	$100	$27,000
3	24" Drainage Pipe - Under Concrete/AC	LF	130	$120	$15,600
4	Added Cost for Excavating Near Houses	LS	1	$20,000	$20,000
5	Design, Bidding, and Construction Management	LS	1	$20,460	$20,460
6	20% Contingency	LS	1	$17,732	$17,732
	TOTAL ROSE AVENUE CULVERT				**$106,392**

HERBERT STREET STORM DRAIN ITEMS					
ITEM NO.	CONSTRUCTION ITEM	UNIT	QUANTITY	UNIT COST	EXTENDED COST
1	48" Drainage Pipe - Dewey Avenue	LF	510	$200	$102,000
2	Drainage Inlet	EACH	1	$2,500	$2,500
3	Design, Bidding, and Construction Management	LS	1	$31,350	$31,350
4	20% Contingency	LS	1	$27,170	$27,170
	TOTAL HERBERT STREET STORM DRAIN				**$163,020**

WASHINGTON STREET CULVERT ITEMS					
ITEM NO.	CONSTRUCTION ITEM	UNIT	QUANTITY	UNIT COST	EXTENDED COST
1	4'x2' Box Culvert	LF	64	$1,000	$64,000
2	Design, Bidding, and Construction Management	LS	1	$19,200	$19,200
3	20% Contingency	LS	1	$16,640	$16,640
	TOTAL WASHINGTON STREET CULVERT				**$99,840**

MARKET STREET CULVERT ITEMS					
ITEM NO.	CONSTRUCTION ITEM	UNIT	QUANTITY	UNIT COST	EXTENDED COST
1	Grassed Waterway	LF	500	$80	$40,000
2	Driveway Culverts	LS	3	$3,000	$9,000
3	Design, Bidding, and Construction Management	LS	1	$14,700	$14,700
4	20% Contingency	LS	1	$12,740	$12,740
	TOTAL MARKET STREET				**$76,440**

AMBROSINI LANE CULVERT ITEMS					
ITEM NO.	CONSTRUCTION ITEM	UNIT	QUANTITY	UNIT COST	EXTENDED COST
1	48" Culvert	LF	70	$600	$42,000
2	Design, Bidding, and Construction Management	LS	1	$12,600	$12,600
3	20% Contingency	LS	1	$10,920	$10,920
	TOTAL VAN NESS STREET				**$65,520**

FIFTH STREET CULVERT ITEMS					
ITEM NO.	CONSTRUCTION ITEM	UNIT	QUANTITY	UNIT COST	EXTENDED COST
1	Grassed Waterway	LF	900	$80	$72,000
2	4'x2' Box Culvert	LF	40	$1,000	$40,000
3	Design, Bidding, and Construction Management	LS	1	$33,600	$33,600
4	20% Contingency	LS	1	$29,120	$29,120
	TOTAL FIFTH STREET				**$174,720**

FAIRGROUNDS STORM SEWER ITEMS					
ITEM NO.	CONSTRUCTION ITEM	UNIT	QUANTITY	UNIT COST	EXTENDED COST
1	24" Drainage Pipe	LF	350	$75	$26,250
2	30" Drainage Pipe	LF	400	$120	$48,000
3	42" Drainage Pipe	LF	700	$155	$108,500
4	48" Drainge Pipe	LF	350	$175	$61,250
5	Remove and Replace Drainage Inlet	EACH	2	$1,400	$2,800
6	Design, Bidding, and Construction Management	LS	1	$7,404	$7,404
7	20% Contingency	LS	1	$50,841	$50,841
	TOTAL FAIRGROUNDS				**$305,045**

FRANCIS CREEK MAINTENANCE					
ITEM NO.	MAINTENANCE ITEM	UNIT	QUANTITY	UNIT COST	EXTENDED COST
1	Stream Channel Maintenance	HOUR	80	$25.00	$2,000.00
	TOTAL FRANCIS CREEK MAINTENANCE				**$2,000.00**
CITY OF FERNDALE STORMWATER FACILITIES					
ITEM NO.	MAINTENANCE ITEM	UNIT	QUANTITY	UNIT COST	EXTENDED COST
1	Drop Inlets - Jet/Vacuum	HOUR	80	$25.00	$2,000.00
2	Ditches - Cut Vegetation/Clear Debris	HOUR	80	$25.00	$2,000.00
3	Miscellaneous Maintenance	HOUR	160	$25.00	$4,000.00
	TOTAL FERNDALE STORMWATER MAINTENANCE				**$8,000.00**
	TOTAL COST				**$10,000.00**

APPENDIX B

Composite "C" Computations

ROSE AVENUE CULVERT			
Land Use Classification	**Density Range DU/Acre**	**Runoff Coefficient "C"**	**Representative Area (acres)**
R-1	0-7	0.55	8.0
R-1-B-2	0-4	0.45	3.0
Forest	na	0.20	14.0
Pasture	na	0.20	26.0
Total			51
Composite "C"	**0.27**		

WASHINGTON STREET CULVERT			
Land Use Classification	**Density Range DU/Acre**	**Runoff Coefficient "C"**	**Representative Area (acres)**
R-1	0-7	0.55	16.0
R-2	0-14	0.60	4.9
R-1-B-2	0-4	0.45	7.0
R-1-B-3	0-2	0.40	13.7
R-S-B-5	0-1	0.40	4.6
A-E	0.25	0.25	20.1
P-F	na	0.25	38.8
C-2-D	na	0.85	0.5
Forest	na	0.20	28.1
Total			133.7
Composite "C"	**0.32**		

FAIRGROUNDS STORM SEWER SYSTEM			
Land Use Classification	**Density Range DU/Acre**	**Runoff Coefficient "C"**	**Representative Area (acres)**
R-1	0-7	0.55	31.2
P-F	na	0.60	31.5
Total			62.8
Composite "C"	**0.58**		

HERBERT STREET STORM SEWER SYSTEM			
Land Use Classification	**Density Range DU/Acre**	**Runoff Coefficient "C"**	**Representative Area (acres)**
R-1	0-7	0.55	31.6
R-2	0-14	0.60	5.2
R-1-B-2	0-4	0.45	7.3
R-1-B-3	0-2	0.40	13.7
R-S-B-5	0-1	0.40	4.6
A-E	0.25	0.25	20.1
P-F	na	0.25	38.8
C-2-D	na	0.85	6.1
Forest	na	0.20	28.1
Total			155.6
Composite "C"	**0.36**		

5TH STREET STORM DRAIN			
Land Use Classification	**Density Range**	**Runoff Coefficient**	**Representative Area (acres)**
R-1	0-7	0.55	29.9
R-2	0-14	0.60	3.2
R-1-B-2	0-4	0.45	5.2
R-4-D	0-21	0.70	0.4
P-F	na	0.60	0.5
C-1	na	0.85	0.7
C-2-D	na	0.85	0.3
Total			40.4
Composite "C"	**0.57**		

AMBROSINI CATCHMENT

Land Use Classification	Density Range DU/Acre	Runoff Coefficient "C"	Representative Area (acres)
R-1	0-7	0.55	36.3
R-2	0-14	0.60	11.2
R-1-B-1	0-5	0.50	0.7
R-1-B-2	0-4	0.45	10.9
A-E	0.25	0.25	46.7
P-F	na	0.60	0.7
C-1-D-Q	na	0.85	4.9
Pasture	na	0.20	96.3
Total			207.6
Composite "C"		**0.32**	

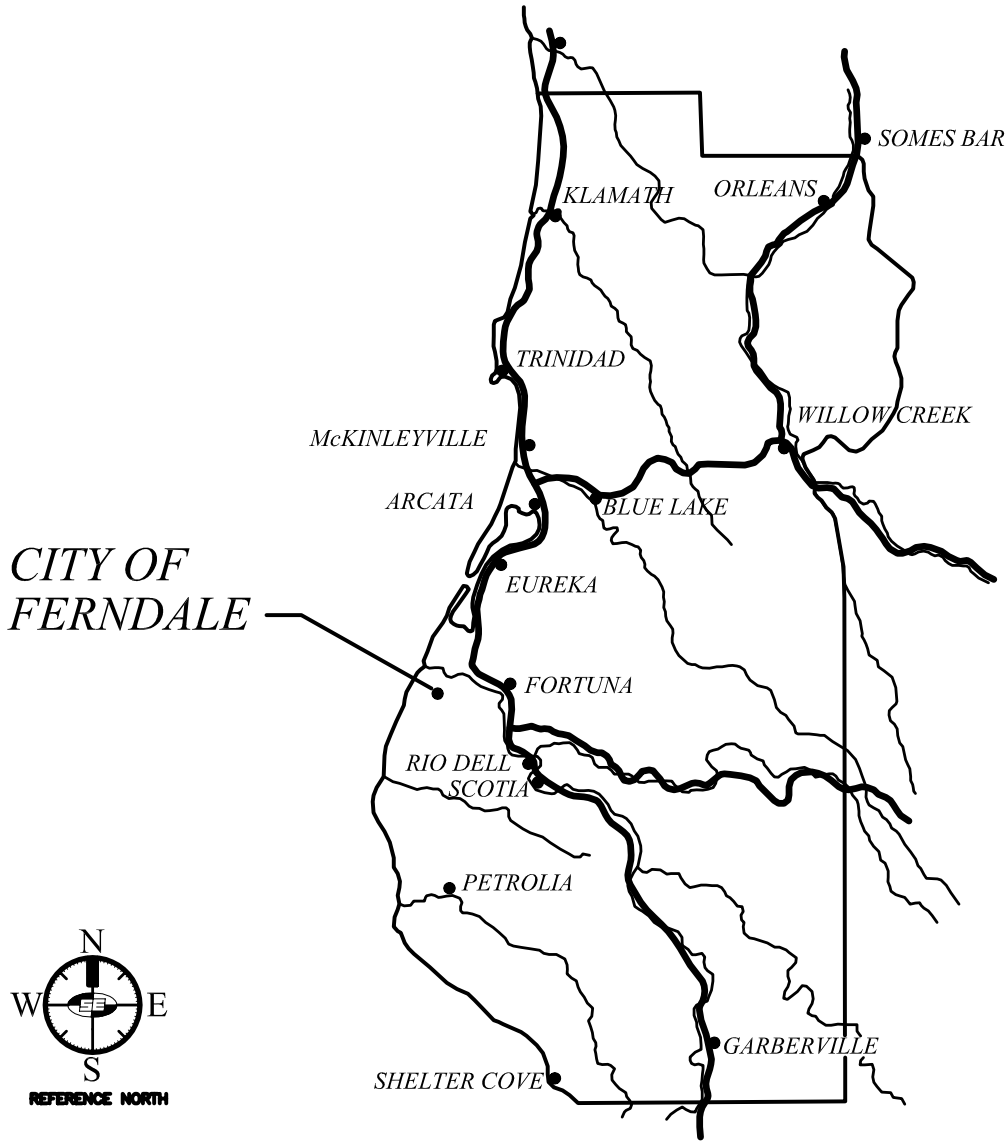
AMBROSINI LANE CULVERT
DRAINAGE BASIN SUBCATCHMENT SUMMARY

Subcatchment	Composite "C"	Drainage Area (acres)
AMBROSINI CATCHMENT	0.32	134
WASHINGTON STREET CULVERT	0.32	51
ROSE AVENUE CULVERT	0.27	208
Total		393
Composite "C"	**0.29**	

LOCATION MAP

DATE: 8/27/03	NTS	CITY OF FERNDALE	
		APPROVED BY T. S. KELLY DRAWN BY J. BAKER	FIGURE 1
MARK	DATE	REVISION	

AREA MAP



DATE: 8/27/03		NTS	CITY OF FERNDALE	
			APPROVED BY T. S. KELLY DRAWN BY J. BAKER	FIGURE 2
MARK	DATE	REVISION		

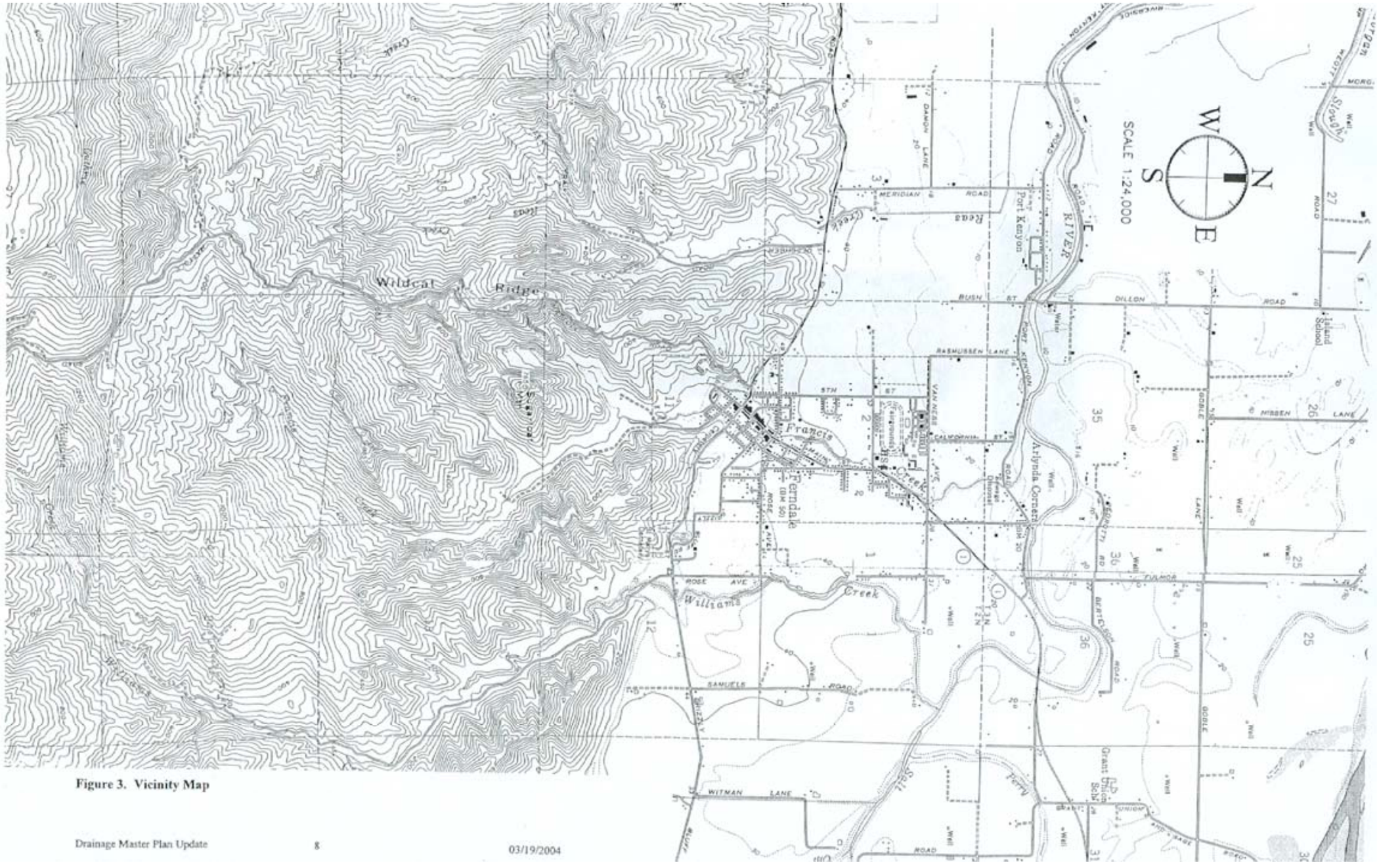
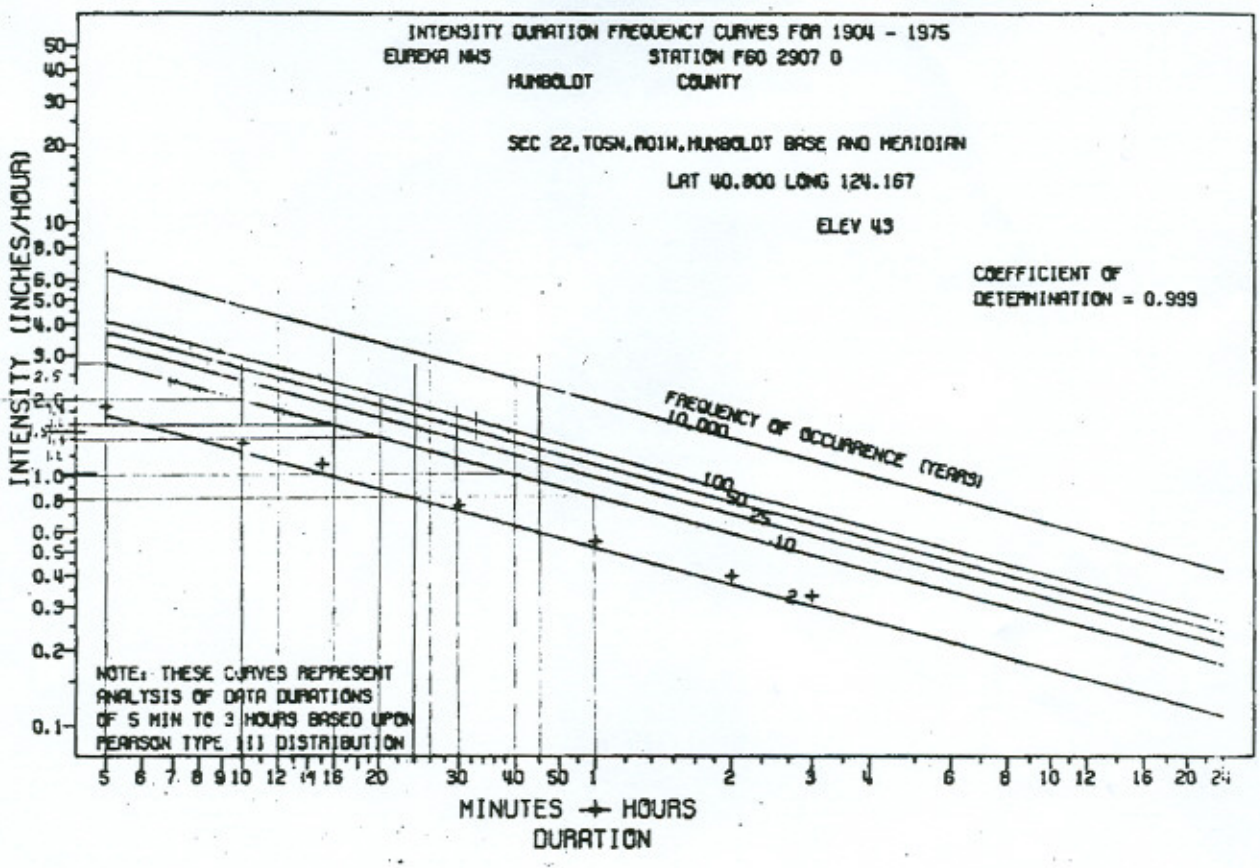
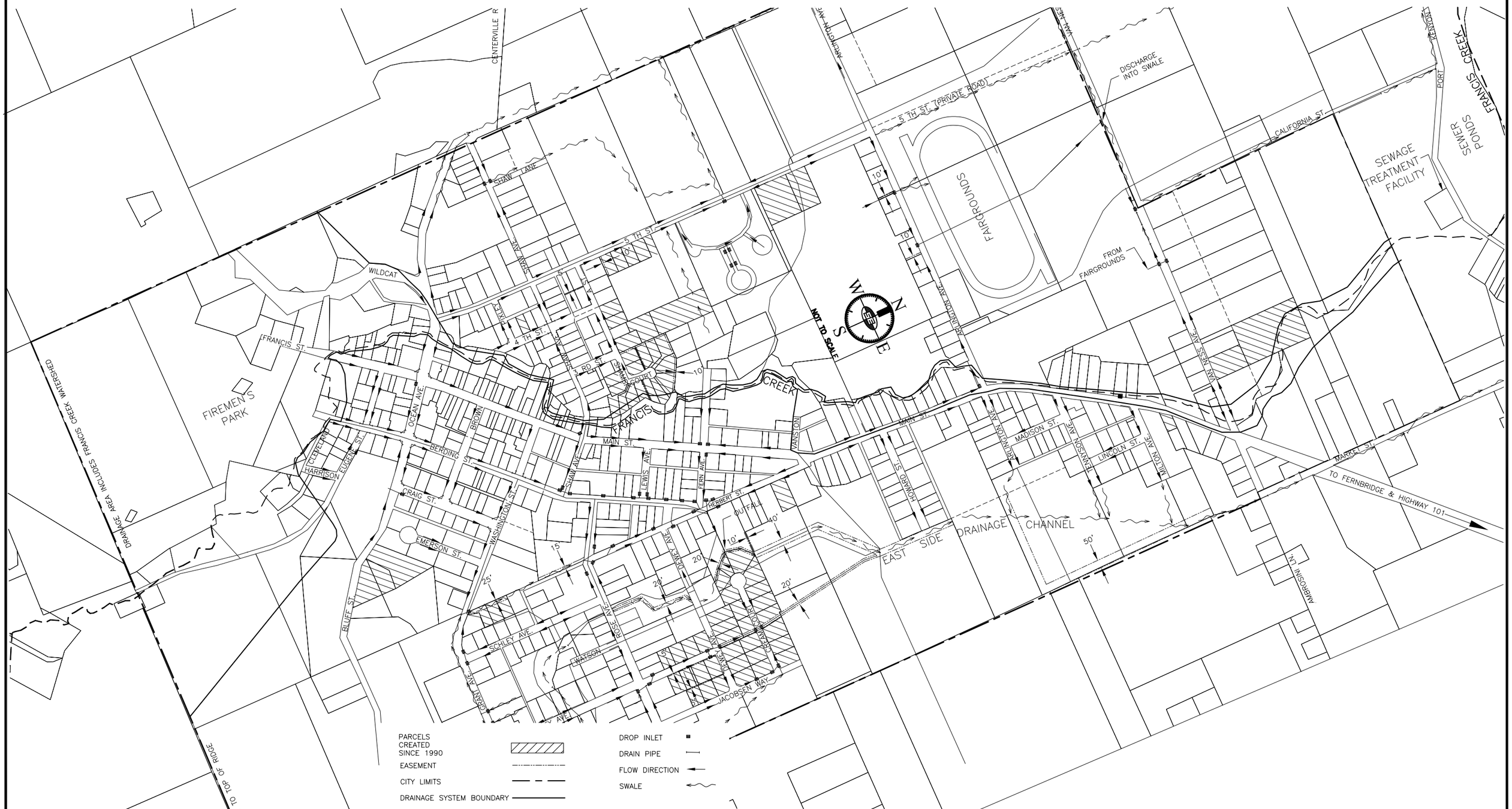


Figure 3. Vicinity Map



From: "Rainfall Analysis For Drawing Design Vol. I." Bulletin 195, Oct. 1976
California Department of Water Resources.

Figure 4. Eureka NWS IDF Curves



SPENCER ENGINEERING & CONSTRUCTION MANAGEMENT, INC.
1585 HEARTWOOD DRIVE, SUITE F • McKINLEYVILLE, CA 95519
TELEPHONE (707) 839-4339 • FAX (707) 839-4012

Designed: J. BROWN
Drawn: J. BAKER
Checked: T. S. KELLY

PREPARED FOR:
CITY OF FERNDALE

FIGURE 6. FRANCIS CREEK DRAINAGE
CITY OF FERNDALE

File Name: FRANCIS-1a
Date: 8/27/03

0 1"

Job No. 03106
Sheet No. 15

SPENCER ENGINEERING & CONSTRUCTION MANAGEMENT, INC.
1585 HEARTWOOD DRIVE, SUITE F • McKINLEYVILLE, CA 95519
TELEPHONE (707) 839-4338 • FAX (707) 839-4012

Designed: J. BROWN
Drawn: J. BAKER
Checked: T. S. KELLY

PREPARED FOR:
CITY OF FERNDALE

FIGURE 7. EAST SIDE DRAINAGE
CITY OF FERNDALE

File Name: EAST-1a
Date: 8/27/03

0 1"

Job No. 03106
Sheet No. 17

SPENCER ENGINEERING & CONSTRUCTION MANAGEMENT, INC.
1395 HEARTWOOD DRIVE, SUITE F • McKINLEYVILLE, CA 95519
TELEPHONE (707) 839-4338 • FAX (707) 839-4012

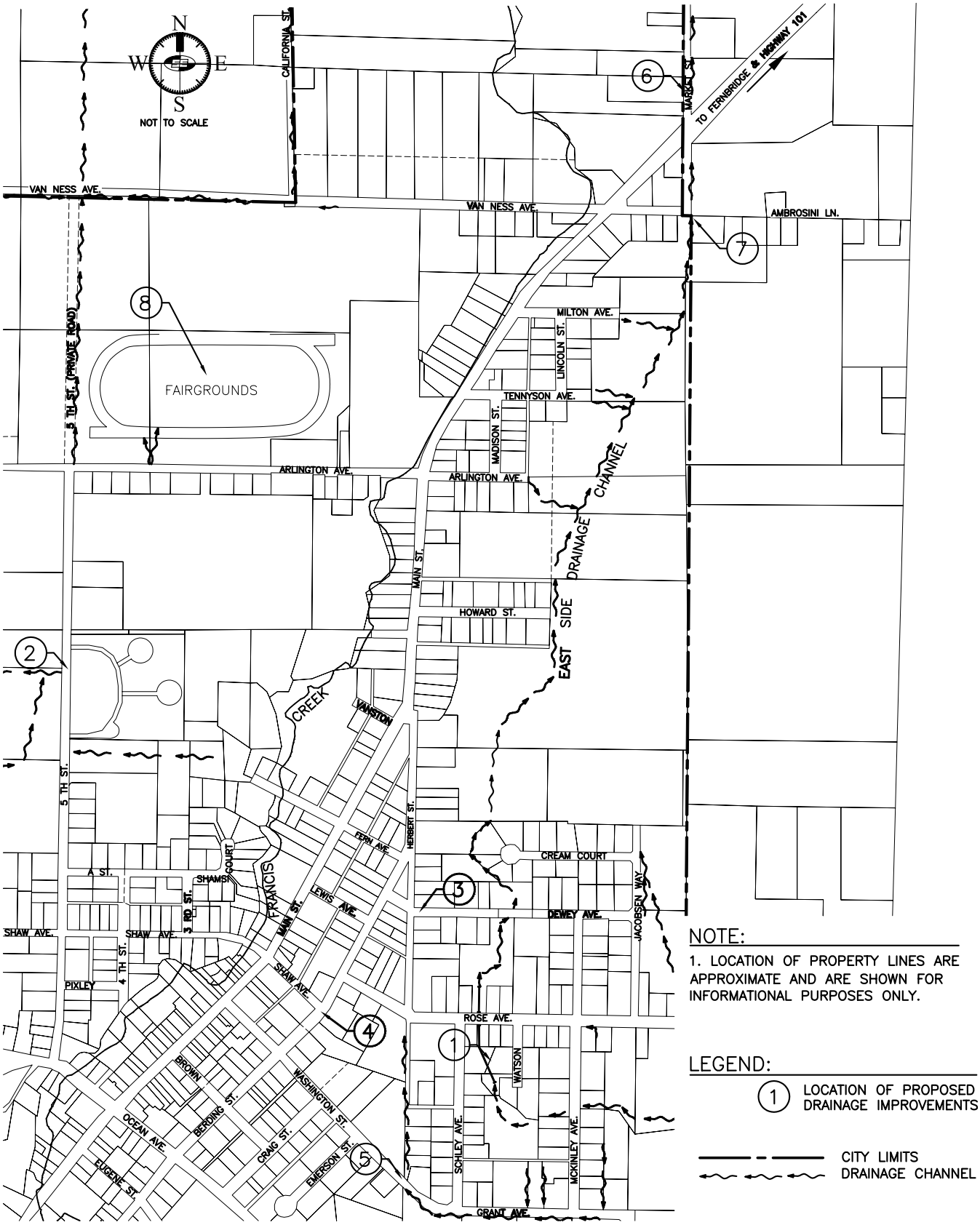
Designed:	J. BROWN
Drawn:	J. BAKER
Checked:	T. S. KELLY

PREPARED FOR:
CITY OF FERNDALE

FIGURE 8. WEST SIDE DRAINAGE
CITY OF FERNDALE

File Name:	WEST-1a
Date:	8/27/03
Job No.	03106
Sheet No.	24

0 1"



NOTE:

1. LOCATION OF PROPERTY LINES ARE APPROXIMATE AND ARE SHOWN FOR INFORMATIONAL PURPOSES ONLY.

LEGEND:

(1) LOCATION OF PROPOSED DRAINAGE IMPROVEMENTS

CITY LIMITS

DRAINAGE CHANNEL

DATE: 9/22/03	NTS	CITY OF FERNDALE
		APPROVED BY T. S. KELLY DRAWN BY J. BAKER
MARK	DATE	REVISION

FIGURE 9
PROPOSED DRAINAGE IMPROVEMENT SITES