Templeton Drainage and Flood Control Study and Project 8 Addendum

FINAL REPORT

February 2014

Prepared By

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Civil Engineering • Land Surveying • Project Development

For

San Luis Obispo County Flood Control and Water Conservation District

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Abbreviations

ACOE	Army Corps of Engineers
APCD	San Luis Obispo Air Pollution Control District
BFE	100 year base water surface elevation
HEC	Hydraulic Engineering Center
Caltrans	California Department of Transportation
CDFG	California Department of Fish and Game
cfs	Cubic Feet per Second
CMP	Corrugated Metal Pipe
County	County of San Luis Obispo
County Standards	San Luis Obispo County Department of Public Works Public Improvement Standards & Public Improvement Drawings
CSA	County Service Area
CSD	Community Service District
District	San Luis Obispo County Flood Control and Water Conservation District
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
fps	Feet per Second
LAFCo	Local Agency Formation Commission
lf	Linear Feet
NPDES	National Pollution Discharge Elimination System
RWQCB	Regional Water Quality Control Board
UPRR	Union Pacific Railroad
WSEL	Water Surface Elevation

EXECUTIVE SUMMARY

North Coast Engineering, Inc. (NCE), working in conjunction with the San Luis Obispo County Flood Control and Water Conservation District (District), has prepared the Templeton Drainage and Flood Control Study for the Town of Templeton, CA (Study). This study identifies deficient drainage areas, proposes projects with engineered solutions to these deficiencies and identifies the tangible benefits of each project. It also provides a cost estimate of proposed projects and recommends a capital improvement program of priority projects. This study builds on a previous analysis performed by NCE and summarized in a report entitled "Templeton Master Drainage Study, Preliminary Hydrology and Field Reconnaissance", dated February 2009.

A draft copy of the Study was released for public review and comment in February 2011. In response to comments from the ad hoc Templeton Advisory Group (TAG) subcommittee, the District determined that two new projects (Projects 8A & 8B) should be added to the Study. NCE performed a feasibility analysis of the two proposed projects and the results of this analysis have been added to the Study as an addendum in Chapter 5.

Existing Drainage Problems

Twenty-six areas of deficiency were identified in the previous report and are shown on Exhibit B - Area of Interest Map. The District has identified eleven of these areas as having the highest impact to the community. These high impact areas are the focus of this report and are highlighted on Exhibit B. The primary areas of deficiency occur at the following locations:

- **Areas of Interest N, P, R** - Heavy vegetation and siltation in the Main Branch of Toad Creek east of Highway 101, along with restricted conveyance capacities of the bridges and culverts, causes flooding along the creek's channel. This flooding has the potential to cause property damage along the creek, and to cause road closures at Florence Street, Salinas Avenue, Eddy Street, Las Tablas Road, and Main Street.

- **Area of Interest A -** The regional detention basin at the Bethel Park recreational area, which is operated by the Templeton CSD, only has the capacity to detain the 10 year storm and does not operate as designed. Flooding occurs at this location during large storm events and has the potential to cause property damage and road closures along South Bethel Road and Godell Street.

- **Areas of Interest H, K, L -** The three major branches of Toad Creek are conveyed from the west side of Highway 101 in three major culverts. These culverts have restricted conveyance capacities which cause significant ponding on the west side of Highway 101 during 10-year and larger storm events. The areas upstream from these culverts act as de facto detention basins and attenuate the peak flows in Toad Creek east of Highway 101. Flooding in these areas has insignificant impacts on adjacent development and can actually be considered as potential benefit areas because of the detention effects at these locations.

- **Area of Interest S -** The Main Branch of Toad Creek converges with the "Unknown Creek" on the west side of Main Street. The box culverts at Main Street have restricted capacity and Main Street floods in the 10-year storm event. The receiving channel on the east side of Main Street does not have adequate capacity to convey 10-year storm events and flooding occurs in a wide flood plain on both sides of the channel. The inadequate capacity of the channel causes tail water effects at the culverts which contribute to their restricted capacities.

Proposed Projects

Potential projects that could mitigate existing flooding include vegetation removal and sedimentation removal from the Toad Creek Channel, and increased detention. A list of potential projects and estimated costs is summarized in Table 1- Project Summary. The locations of the proposed projects are shown on Exhibit A-Project Location Index.

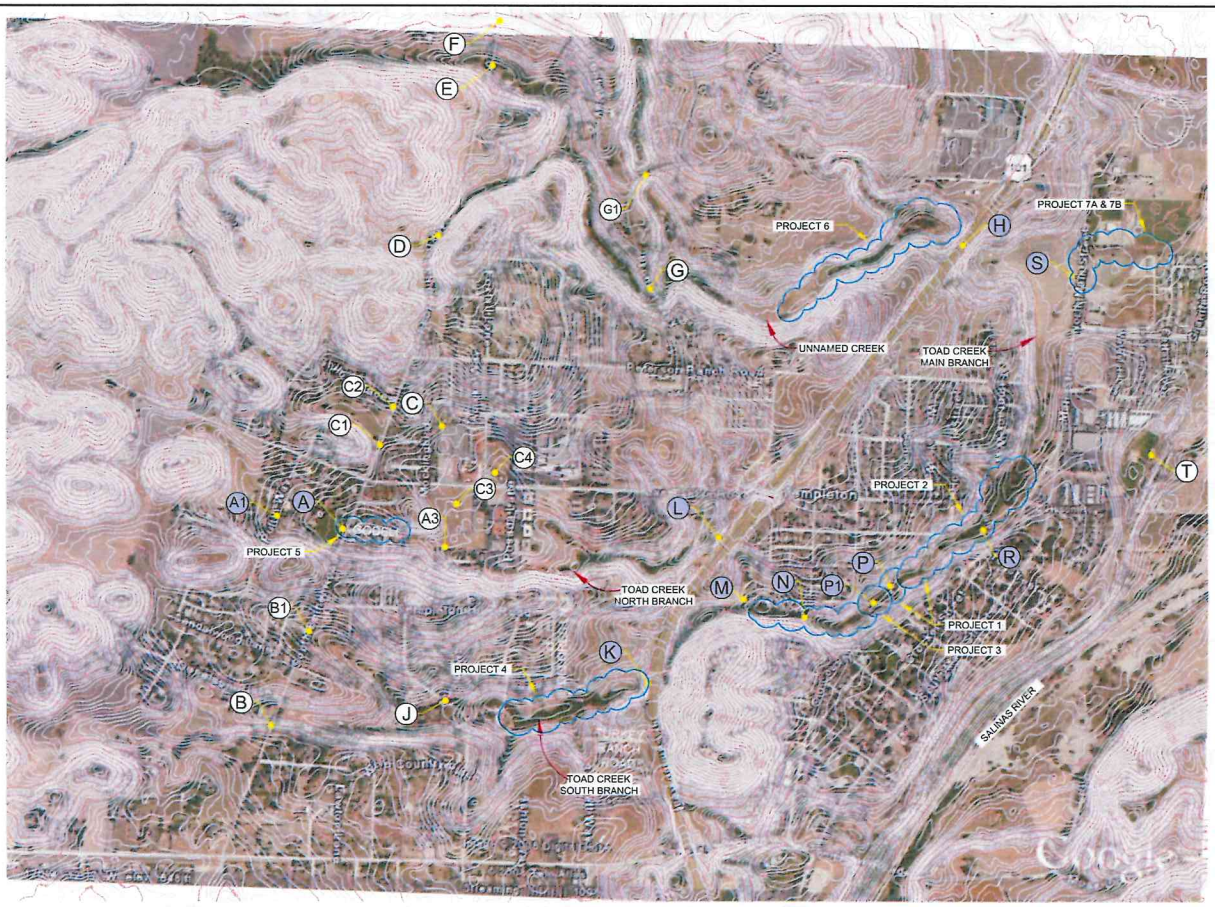
Table 1
Project Summary

Project	Project Location[1]	Proposed Mitigation	Benefit	Area of Benefit[2]	Capital Cost	Comment
1 Phase 1	Area of Interest R, channel from Main Street to Las Tablas Road	Vegetation Maintenance	Increased channel capacity, reduced WSEL	Properties adjacent to project and Las Tablas Road bridge	$ 28,000	
1 Phase 2	Area of Interest P, channel from Las Tablas Road to Eddy Street	Vegetation Maintenance	Increased channel capacity, reduced WSEL	Properties adjacent to project and Eddy Street bridge	$ 28,000	
1 Phase 3	Area of Interest N, channel from Eddy Street to Florence Street	Vegetation Maintenance	Increased channel capacity, reduced WSEL	Properties adjacent to project and Florence Street bridge	$ 42,000	
2 Phase1	Area of Interest R, channel from Main Street to Las Tablas Road	Sediment Removal	Increased channel capacity, reduced WSEL, reduce road closures and maintenance	Properties adjacent to project and Las Tablas Road bridge. Vehicle traffic using Las Tablas Bridge.	$ 78,400	Project has largest impact Toad Creek flooding. Conveyance capacity of upstream bridges increased to County standard (Q_{50})
2 Phase2	Area of Interest P, channel from Las Tablas Road to Eddy Street	Sediment Removal	Increased channel capacity, reduced WSEL, reduce road closures and maintenance	Properties adjacent to project and Las Tablas Road bridge. Vehicle traffic using bridges	$ 126,000	Project has largest impact Toad Creek flooding. Conveyance capacity of upstream bridges increased to County standard (Q_{50})
3	Area of Interest P1	Increase Culvert and Channel Capacity	Reduce street flooding, road closures, and maintenance	Salinas Avenue and properties adjacent to project	$ 337,400	Increase conveyance capacity of culvert and channel to County Standard (Q_{50})
4	Area of Interest K	Regional Detention Basin	Reduce downstream peak flows and WSEL	Properties adjacent to downstream Toad Creek and bridge crossings	$ 280,000	
5	Area of Interest A	Upsize culvert and add inlets	Reduce street flooding on South Bethel Road and Godell Street	Properties adjacent to project and vehicular traffic on South Bethel roads and Godell Street	$ 254,800	Increase conveyance capacity of culvert to County standard (Q_{50})
6	Area of Interest H	Regional Detention Basin	Reduce downstream peak flows and WSEL Reduce street flooding at Main Street bridge	Vehicular traffic on Main Street bridge and downstream properties	$ 420,000	Project should be used in conjunction with Projects 7A & 7B to reduce improvements required in these projects
7A	Area of Interest S	Increase Channel Capacity	Decrease WSEL and reduce road flooding and closures	Main Street Bridge and adjacent properties	$217,000	Channel capacity increased to County standard (Q_{100}) [3]
7B	Area of Interest S	Increase Culvert Capacity	Decrease WSEL and reduce road flooding and closures	Main Street Bridge and adjacent properties	$ 202,300	Requires completion of Project 7B. Increase culvert Capacity to County standard (Q_{100}) [3]

[1] Project locations are shown on Exhibit A, areas of interest are shown on Exhibit B.

[2] The area of benefit shown in this table are areas where the greatest impact is provided by each mitigation measure. Additional areas receive benefit from the mitigation measures but to a lesser degree.

[3] Tract 2294 improvements proposes widen Toad Creek channel east of Main St. to increase capacity and would reduce flooding, but the channel and bridges still won't convey the County standard 100 year design storm without flooding Main Street. For details of Tract 2294 drainage improvements and impacts of improvements see May 2010 Wallace Group report entitled "Flood study of Toad Creek for Tract 2294", this report is discussed in section 5.8.



LEGEND

- (A) AREA OF INTEREST (AS IDENTIFIED IN PREVIOUS REPORT)
- (B) AREA OF INTEREST (STUDIED IN DETAIL IN THIS REPORT)
- APPROXIMATE PROJECT BOUNDARY

0 500' 1000' 2000'

SCALE: 1"=1000'

EXHIBIT A
PROJECT
LOCATION INDEX

NOTE: SEE EXHIBITS C THRU H FOR A DETAILED VIEW OF EACH PROJECT.

CHAPTER 1 **INTRODUCTION**

Chapter Synopsis: This chapter presents a description of the study area, the objectives, purpose and scope of the Templeton Master Drainage Study, the identification of major drainage deficiencies, and an introduction to the proposed solutions.

1.1 Study Area Description

Templeton is located on State Highway 101 between Atascadero and Paso Robles in northern San Luis Obispo County. West of Highway 101, the town is comprised primarily of residential development, with medical service buildings, including Twin Cities Community Hospital, clustered along Las Tablas Road. East of Highway 101, the town is comprised primarily of residential development, with commercial properties concentrated near Main Street. The watershed west of Bethel Road, which extends to the northwest beyond Highway 46, is primarily used for agriculture, particularly vineyards and grazing, and has a scattering of low density residential development.

Three major streams convey runoff through town, namely the north and south branches of Toad Creek, and an unnamed creek (not to be confused with "Unnamed Creek no. 1" which is located west of Highway 101 in Paso Robles) which is a tributary of Toad Creek; this creek is referred to as "Unnamed Creek" in this report. These streams generally flow from west to east and cross Highway 101 in three separate culverts before converging on the west side of Main Street to form the main branch of Toad Creek. Toad Creek flows to the northeast crossing Main Street and the Union Pacific Rail Road (UPRR) tracks before joining with the Salinas River, which flows from south to north along the east side of town. The study area of this report focuses on the 7.2 square mile watershed of these three streams. The watershed is roughly bounded by Vineyard Drive to the south, the Salinas River to the east; the Main Street and Highway 101 interchange to the north east, and extends approximately three miles northwest of Highway 101 mile beyond state Highway 46. The location of Toad Creek, its tributaries, and the projects' watershed is shown on Exhibit A.

1.2 Scope and Objective of Report

This report has been prepared for the San Luis Obispo County Flood Control and Water Conservation District (District). The District's goal is to prepare a master drainage study for the Templeton area. Preparation of this study will be accomplished in three main phases. The primary goals of each phase are as follows:

- **Phase 1 –** Review existing drainage infrastructure, identify drainage deficiencies, and determine preliminary hydrology within the project's watershed.
- **Phase 2 –** Provide detailed hydrology calculations for the study area, perform hydraulic analyses of major drainage facilities, identify the causes of deficient drainage facilities, and identify potential solutions for deficient drainage.
- **Phase 3 -** Prioritize flooding problems caused by deficient drainage facilities, determine the feasibility of potential solutions, evaluate the benefits and costs of potential solutions, and determine the impacts and benefits of potential solutions.

The Phase 1 tasks were accomplished in the "Templeton Master Drainage Study – Preliminary Hydrology and Field Reconnaissance report by North Coast Engineering, dated February 2009. The Phase 2 and 3 tasks are accomplished in this report, which builds on the previous report. It should be noted that the hydrology analysis performed for the first report was refined based on a combination of additional topographical information and hydraulic analysis. The results presented in this report supersede the results from the previous report.

1.3 Methodology

Peak flow estimates for this report were calculated using the HEC-HMS computer program which employs TR-55 methodology. The hydraulic analysis of Toad Creek was completed using the HEC-RAS computer program. The analysis results used in this report were compared to a previous analysis of Toad Creek that was performed for the Federal Emergency Management Agency (FEMA) and published in the Flood Insurance Study for San Luis Obispo County, California and Unincorporated Area (FIS). The hydrological and hydraulic analyses methodology used in the FIS and in this report are the same. The FIS employed the HEC-1 and HEC-2 computer programs which are precursors to HEC-HMS and HEC-RAS; all of the mentioned computer software are by the Hydrologic Engineering Center (HEC) of the Army Corps of Engineers (ACOE) and are widely used and accepted for hydrologic and hydraulic calculations. The Toad

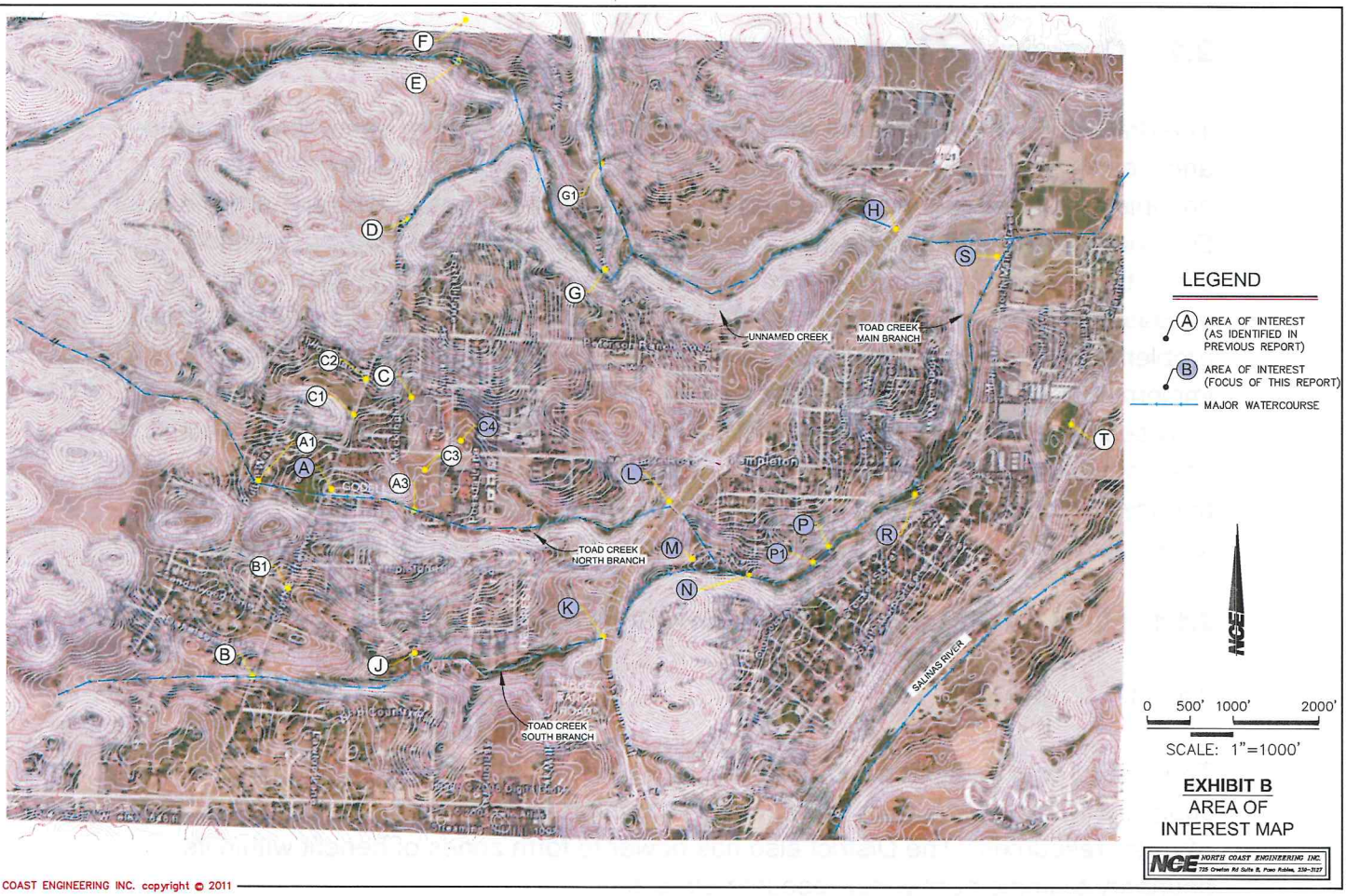
Creek watershed has a 7.4 square mile (4,700 acre) tributary area, which is too large for a rational method analysis; the rational method is generally limited to small watersheds of less than 200 acres. The watershed is shown on Exhibit I – Overall Drainage Map which is included in the Appendix.

1.4 Identification of Deficient Areas

A revised hydrologic and hydraulic analysis was performed that focused on areas of interest A, C3, C4, H, K, L, M, N, P1, P, and S, identified by the District as being deficient areas having the most impact on the community and/or solution areas with the greatest potential to alleviate drainage deficiencies. These areas will be discussed in greater detail in section 3.2 of this report. These areas of interest are shown on Exhibit B which is included at the end of this chapter.

1.5 Proposed Projects

The major drainage deficiencies identified in this report are primarily caused by restricted conveyance capacity of channels, bridges and culverts, and caused by insufficient storage capacities within existing detention basins. The proposed projects either increase the conveyance capacity of channels through vegetation removal or desiltation, or increase detention which will decrease downstream peak flows. The proposed projects are summarized in Table 1. The proposed projects were designed to meet County Standards where feasible.



CHAPTER 2 COUNTY POLICIES

Chapter Synopsis: This chapter presents an overview of the drainage and flood control responsibilities of the County of San Luis Obispo, as carried out by the San Luis Obispo County Flood Control and Water Conservation District, and of other public agencies, and private landowners.

2.1 Overview of Responsibilities

The drainage and flood control responsibilities of the County are determined by State and County statutes and by County policy. The responsibilities for drainage are administered through the County Public Works Department, the Development Services Division, and the San Luis Obispo County Flood Control and Water Conservation District. The Development Services Division's role is to "advise developers with mitigations" for private development. The District is responsible for identifying flooding problems, recommending solutions, and assisting unincorporated public areas implement solutions where no other agency has assumed an active role in such activities. The District has a regional role in the County and can work with individual cities or communities when requested. The sections below describe the limits of each agency's jurisdiction and drainage responsibilities, and how the District is administered to best leverage its powers by creating Zones of Benefit to administer specific projects.

2.1.1 Flood Control and Water Conservation District

2.1.1.1 History

The District was established in 1945 and has powers that include flood control, water supply, water conservation, water quality protection and the ability to study all aspects of water resources. The District also has power to form zones of benefit within its boundary to implement water resource projects.

The District is a special district that is governed by the County Board of Supervisors. The boundaries of the District are the same as the County boundaries, and the staff of the District is the same as the staff of the County. The District also includes all of the territory within the County's seven incorporated cities. The District budget is separate

and distinct from all other County budgets. It has its own funding sources, and its own expenditure plan.

2.1.1.2 Policy Direction: Resolution Number 68-223

The District is available to help communities deal with flood waters and to conserve, study, and develop water supplies. The District uses its general fund to identify water related issues, to determine solutions to those problems and to help those local areas implement recommended solutions. The District is not, however, responsible for paying for community-specific mitigation improvements. The specific property owners that benefit from these solutions must agree to pay for the construction and future maintenance of them. This policy (Resolution 68-223) was formally established by the Board of Supervisors in 1968, and was reviewed and reconfirmed in April 2001.

The policy was adopted because there is not sufficient funding available for the District to fund construction and operation of facilities. This approach provides the best leveraging of funds that are available on a county-wide basis.

The resolution also includes a provision for reimbursement to a developer (and a successor in interest), for constructing drainage facilities with excess capacities to accommodate runoff from adjacent properties. The normal period for reimbursement would be from five to ten years, and in no event would it exceed 20 years. Developer participation in recommended drainage projects is a central theme to this study.

2.1.1.3 Funding Sources

The primary funding source for the District which is the entire County is a pre-Proposition 13 general property tax allocation. In addition, the District receives interest income from current resources. Reserves from the County's General Fund, which is separate from District fund, are normally not used for the construction of projects protecting private property, unless there is a significant general or roadway benefit.

2.1.1.4 Countywide Activities

The District provides funding for flood control programming and planning of localized drainage issues.

2.1.2 Other Agencies with Drainage Responsibilities

2.1.2.1 Community Service Districts

Community Service Districts (CDS's) are locally controlled special districts that can also provide drainage and flood control services. Templeton CSD currently owns and operates the detention basins at Bethel Park and Gibson Park. They are not responsible for maintaining any other drainage facilities such as bridges, culverts, or private detention basins. Caltrans or the San Luis Obispo County Department of Public Works are responsible for maintaining drainage facilities located within the public right-of-way, and maintenance of drainage structures located on private property are the responsibility of the land owner.

2.1.2.2 County Service Areas

County Service Areas (CSA's) can focus the powers of the County to provide specific services to specific areas, including drainage and flood control services. These special districts are governed by the County Board of Supervisors and receive their funding through the collection of voter approved service charges or benefit assessments from the residents or property owners of the specific area served. The Local Agency Formation Commission (LAFCO) discourages the creation of CSA's within the boundaries of a CSD when the CSD is capable of performing the same service. Templeton CSD already provides drainage service in Templeton, so the creation of a separate CSA is strongly discouraged.

2.1.2.3 Cities

Incorporated cities within the County exercise control over drainage issues within their city limits.

2.1.2.4 U.S. Army Corps of Engineers

At the Federal level, the U.S. Army Corps of Engineers (Corps) provides flood protection throughout the nation; however, the Corps has done very little work in San Luis Obispo County and operates no facilities here.

2.1.2.5 California Department of Water Resources

The State of California also administers some flood control and drainage programs via the State Department of Water Resources' (DWR) flood control division. DWR has little presence in the County, and mainly gets involved in a consulting role during flood emergencies.

2.1.2.6 Caltrans

The California Department of Transportation (Caltrans) operates drainage facilities that are associated with the State Highway System. Toad Creek and its tributaries are conveyed under Highway 101 in three culverts which are owned and maintained by Caltrans. Any improvements to these facilities will require coordination and approval from Caltrans.

2.2 County Standards for Control of Drainage

The County's Planning Department establishes the land use policies and drainage ordinances for the County (the District has no land use ordinances). Section 22.52.080 et. seq., of the San Luis Obispo County Code contains the County's land use ordinance standards for the control of drainage and drainage facilities. These requirements apply to all projects and activities required to have land use permit approval. These standards aim to minimize the harmful effects of storm water runoff and to protect neighboring and downstream properties from drainage problems resulting from new development. They include:

- Requirements pertaining to the drainage and construction of drainage systems
- Requirements pertaining to the maintenance of offsite natural drainage patterns
- Restrictions on development in areas subject to flood hazards
- Requirements to conform with the County Standards

Conditions of development in flood hazard areas must, at a minimum, enforce the current Federal flood plain management regulations as defined in the National Flood Insurance Program. Projects that may be subject to or cause flood hazards are required to prepare a drainage plan that complies with the design requirements set forth in the County's Public Improvement Standards, and are subject to approval by the Director of Public Works and his or her designee.

In addition, the County's land use ordinances contain development standards for areas with the Flood Hazard (FH) designation. The standards state that drainage plans for development in FH areas must include a normal depth analysis that determines whether the proposed development is in the floodway or the flood fringe. In addition, development in FH areas would be subject to construction practices that would not limit floodway capacity or increase flood heights above an allowable limit.

2.3 Drainage in the County Right-of-Way

The County provides maintenance of existing drainage facilities within the County right-of-way (ROW) as well as some limited drainage improvements as a function of the Public Works Department Road Maintenance Division. It has numerous State statutes (primarily the Streets and Highways Code) that dictate how monies may legally be expended. The County maintained road system is funded through a combination of restricted revenue sources that are primarily derived through taxes on gasoline that are apportioned to cities and counties by the State, as well as contributions from the County General Fund. These funding sources can only be spent on solving problems that directly relate to County maintained roads.

As a function of operating the road system, the drainage issues related to the road system are addressed when such drainage work protects the County maintained road system in a cost beneficial way, or is directly related to County road improvement projects and is necessary to prevent property damage. This includes directing the flow of streams across the roads through culverts and bridges.

2.4 Flood Control Zone

The District has the power to form Zones of Benefit to implement and/or operate and maintain facilities. Each Zone must have its own funding source. Flood control zone 16 encompasses the entire County, including Templeton.

2.5 Funding Issues

The District is restricted in the way it can fund needed projects or increase revenues for existing operations. It is generally limited to obtaining grants, or forming a zone of benefit or assessment district to finance the construction of new projects.

Due to the changes enacted with the passage of Proposition 218, the District must now also have all new benefit assessments, and increases to existing benefit assessments for maintenance and operations, approved through an election of affected property owners.

The District provides a means of funding studies that define problems and recommend technical solutions to those problems. The critical next steps of constructing and maintaining drainage facilities can normally only be completed with local benefiting property owners being willing to vote to assess themselves for these costs.

2.6 Maintenance Responsibilities

Field investigations indicate that some road culverts are partially filled with sediment and excessive vegetal growth and that much of the Toad Creek channel between Highway 101 and Main Street is heavily vegetated and silted. These conditions reduce their conveyance capacity and inhibit their ability to convey runoff. Improved maintenance is needed; however, in many locations it is difficult to determine who is responsible for maintaining the facilities. If a property owner does not maintain drainage facilities such as swales located on private property, then these structures will go unattended because the District is not responsible for maintaining facilities on private property or on property within the jurisdiction of other public agencies (e.g., Caltrans and Highway 101).

CHAPTER 3 ENGINEERING ANALYSIS OF EXISTING CONDITIONS

Chapter Synopsis: This section summarizes the results of the hydrology and hydraulic analysis of the watershed and major drainage features affecting Templeton. This analysis considered the detention effects of the major culverts under Highway 101 as well as the regional detention basin at Bethel Park. A detail hydraulic analysis was performed for Toad Creek from Highway 101 to Main Street.

3.1 General Discussion of Watershed Characteristics

3.1.1 Land Use

Land use and ground cover of the watershed was determined from field reconnaissance and the inspection of aerial imagery of the watershed. It was found that the majority of the upper portion of the watershed is used for agriculture, primarily vineyards and small grain fields, or undeveloped rangeland with concentrations of tree cover along the major channels. The lower reaches of the watershed are dominated with medium density residential development with average lots of approximately ¼ acre, but have a high potential for future infill residential development. Commercial and office development is a lesser component and is generally concentrated along Las Tablas Road and Main Street.

3.1.2 Geography

The approximately 7.4 sq. mile Toad Creek watershed studied in this report is roughly bounded by Vineyard Drive on the south, the Salinas River to the east, and extends approximately 3.5 miles northwest of Templeton to beyond Highway 46. The landform within the watershed is generally rolling hills with elevations ranging from 1,400' in the hills located in the upper reaches of the watershed, to 750' at the Main Street Culverts. The hills north of Highway 46 have slopes greater than 30%, approaching 50% in some locations and the hills south of Highway 46 have gentler slopes, generally less than 30%.

The watershed contains well defined streams and creeks which generally flow from northwest to southeast towards Highway 101. These smaller water courses combine to form three major waterways; the North and South Branches of Toad Creek, and Unnamed Creek. These major creeks convey runoff from the west side of Highway 101 through three major culverts; the North and South Branches combine to form the Main Branch of Toad Creek on the east side of Highway 101 in the southern portion of the watershed. Unnamed Creek joins the Main Branch of Toad Creek on the west side of Main Street where runoff is conveyed under Main Street in two box culverts. The Main Branch of Toad Creek continues to the northeast crossing the Union Pacific Rail Road tracks before discharging into the Salinas River approximately one mile downstream from Main Street. See Exhibits I and J in Appendix I for an overview of the watershed limits.

3.1.3 Climate

Templeton is located in a semi-arid region of San Luis Obispo County with average annual rainfall of approximately 20 inches per year per County Standard Drawing H-1. The majority of this rainfall occurs during between December and March with little precipitation occurring from June to September.

3.1.4 Surface Soils

The surface soils within the watershed were determined from NRCS soil survey of San Luis Obispo County. The hydrologic soils groups of these soils determines the infiltration capabilities of the soils, and along with ground cover and land use, affects the surface runoff generated by the watershed. The hydrologic soils groups range from Type A with the highest potential for infiltration producing low runoff to Type D with very low infiltration rates and very high runoff potential. The soils found in the watershed are predominately Type B in the lower reaches and Type C within the upper reaches with moderate to high runoff potential respectively.

3.2 Deficient Drainage Areas

Deficient drainage areas were identified in the previous report and are shown on the Area of Interest Map- Exhibit B. Several of these areas were identified by the District to be studied in greater detail as discussed in section 1.3 of this report. These areas that were identified are discussed in section 3.2.1. The remaining areas of interest were deemed to be only minor nuisance flooding or impacting a very small portion of the community. The flooding problems in these areas are summarized in section 3.2.2; detailed information about these areas is available in the previous report.

3.2.1 Deficient Drainage Areas Studied in Detail

The following areas of interest were identified by the District as having flooding problems impacting the largest portion of the community or solution areas with the greatest potential to alleviate deficiencies.

- Area of interest A - The Bethel Park detention basin has a watershed of approximately 200 acres and lies on the North Branch of Toad Creek. This detention basin is operated by Templeton CSD as a regional detention and recreational facility. The design of this basin is summarized in a report by Twin Cities Engineering, Inc.", dated October 1987. The basin was designed per County Standards to detain the 50 year post-developed peak flow (277 cfs) and releasing at the 2 year pre-developed rate (58 cfs) with a design volume of 6 acre-feet. The outfall from the detention basin is conveyed in a 24" CMP pipe from an inlet on the east side of the park to an inlet on the west side of South Bethel Road. Stormwater from this inlet is conveyed in a 36" PVC pipe that runs east on Godell Street and discharges into a field east of the residences on Godell Street where it flows to a culvert at area of interest A3.

  A field survey of the basin shows that the basin has a maximum depth of approximately 4.3 feet and covers approximately 1.6acres and has a total volume of approximately 5.1acre-ft when completely full (elevation 864.3) and 3.6 acre-ft when the required 1' of freeboard is provided. A hydraulic analysis of the outfall structure revealed that its release capacity varies with depth ranging from 29 cfs when the basin is empty to 43 cfs when full. The basin is smaller than designed and release at a lower rate than allowed. The hydraulic analysis of the detention

basin shows that it only has capacity to store the 10 year runoff with no free board and that it overtops during larger events. In order to retain the 50 year design storm this basin would need to approximately double the existing capacity. There are two possible options to achieve the required volume increase. The first would be to lower the bottom of the basin by approximately 5' which would limit its use as a recreational field. The second option would be to expand the basin into the open space located to the south; this would require cuts of up to 20'. After a preliminary assessment it was determined that both options are not feasible considering the limited benefit.

County road maintenance staff has reported frequent flooding near the Inlet on South Bethel Road which affects the South Bethel Road, Godell Street and an adjacent property. A hydraulic analysis of the inlet shows that the inlet should have capacity and should not flood until the basin overtops during storms larger than 10 years. A possible cause of this flooding is that the storm drain pipe is partially clogged. Another possible cause is that or that other storm drain systems were connected to the 36" PVC pipe after its initial construction and that the capacity of this pipe has been exceeded causing water to back up into the South Bethel Road inlet. Even if this is the case the existing culvert and inlet do not have adequate capacity to convey runoff of storms greater than the 10 year storm due to the runoff that overtops the basin. The existing storm drain pipe and inlet would need to be upsized in order to reduce flooding in this location.

- Area of interest C3 – The watershed for the storm drain network located in Posada Lane has a tributary area of approximately 62 acres and includes Tracts 2389, 1668, and 1582, receives runoff from the storm drain system in Mocking Bird Lane, and is directly connected to the storm drains from the Templeton Medical Plaza, and Twin Cities Hospital detention basin located at area of interest C4. This storm drain network discharges into a natural swale on the south side of Tract 1582 which is a tributary to The North Branch of Toad Creek.

  The capacity of the storm drain was analyzed in a report by Russ Thompson Consulting, Inc. entitled "Drainage Analysis for the Existing Posada Lane Storm Drain Downstream of Templeton Medical Plaza", dated 4/14/04. A review of this report reveals that the storm drain network has adequate capacity for the ultimate development of the design watershed and meets County design standards and appears to have excess capacity for additional drainage areas outside the design

watershed. A detailed analysis of the storm drain must be made before any additional drainage areas are added, and all County design standards must be met including detention requirements.

- Area of interest C4 – The private detention basin at the Twin Cities Hospital has an approximate tributary area of 50 acres which includes runoff from the hospital and from the storm drain network in Celestial Way; the basin discharges to the storm drain network in Posada Lane at area of interest C3. The design of the detention basin is summarized in a drainage report by RRM Design Group entitled "Twin Cities Hospital Expansion Templeton, San Luis Obispo County Hydrology and Hydraulic Report – Addendum" dated September 11, 2002, revised April 15 2003. A visual inspection of the completed basin and a review of the report shows that basin was constructed to plan and that the basin design meets County design standards. The basin operates per County standards but has little or no excess capacity for additional runoff.

- Areas H and K – The culverts crossing Highway 101 at these locations have restricted capacities causing ponding on the west side of the highway in the 10-year and larger storm events. This ponding occurs within the highway's right-of way and on private property but adjacent development is well above the 100 year flood elevation. These areas have the potential to be used as regional detention basins.

- Area of interest L - The Highway 101 culvert located near the park & ride lot has restricted capacity which causes ponding on the west side of the highway. 100 year flood elevations are only 2'-3' below the adjacent street. Providing additional detention at this location would require major grading and could potentially impact existing development so this area is not considered a feasible solution area.

- Area of Interest M – Two 24" CMP culverts and a concrete Arizona Crossing convey runoff from the North branch of Toad Creek across the west end of Salinas Avenue. The culverts do not have adequate capacity to convey the large storm events and the road is overtopped frequently per eyewitness accounts of County maintenance personnel. Flooding of the road restricts access to two existing residences west of the culverts; but the undersized culverts do not contribute to flooding along Toad Creek. It is apparent that two or three existing

residences north of Salinas Avenue and adjacent to the North Branch of Toad Creek's channel are in peril of flooding, but this flooding is caused by the small size of the Creek's channel in this location and not by the Salinas Avenue culverts.

- Area of interest N, P, and R - The Florence Street, Eddy Street, and Las Tablas Road bridges all have restricted capacities and are overtopped by flood waters in 10 year storm events or greater; The Florence Street Bridge is overtopped in the 100 year storm. While the constricted conveyance capacities of the bridges contribute to their flooding, the inadequate conveyance capacity of the Toad Creek channel caused by sediment and heavy vegetation is the major reason these bridges flood.

- The Area P1 – The culverts at Salinas Avenue do not have capacity to handle even the two year storm and the downstream channel also has inadequate capacity. Flooding of the adjacent street occurs on a regular basis at this location, but the adjacent residences are well above the 100 year flood elevation. Increasing the size of the pipes to handle even the 10 year runoff is not possible without a major reconfiguration of Salinas Avenue.

- Area of Interest S – The box culverts at this location have restricted capacity and in their current condition can only convey between the five and 10-year storm before Main Street floods. The primary reason the road floods in this locations is that the receiving channel has inadequate capacity causing a tail water condition at the culverts. If the receiving channel was increased in size the bridges would have adequate capacity to pass the 10 year storm before the road floods. The culverts would need to be upsized in order to meet County standards and pass the 100 year storm. Proposed Tract 2294 improvements would widen the channel and would reduce flooding in this area but not all flooding would be mitigated.

- Areas of Interest M, N, P, P1, and R - The Toad Creek Channel between Highway 101 and Main Street is highly vegetated and silted in several locations which restrict the conveyance capacity of the channel. This conveyance restriction contributes to flooding along this section of the creek, particularly at the bridges.

3.2.2 Deficient Drainage Areas Not Studied in Detail

The district determined that potential flooding at the remaining areas of interest as discussed in the preliminary report "Templeton Master Drainage Study Preliminary Hydrology and Field Reconnaissance – DRAFT" do not pose significant threats to public safety or risks of property damage. Therefore these areas of interest were not studied in detail and were not considered for feasible candidates for upgrade projects beyond normal maintenance.

3.3 Summary of Hydrology Calculations

The hydrology analysis performed in the preliminary report was revised for this report using additional topographic information. The results of the hydrology calculations are summarized in Table 2 and detailed calculations are included in Appendix II.

3.3.1 Methodology Used for Hydrology Calculations

The TR-55 (NRCS) methodology used to calculate the hydrology for this analysis is the same as was used in the preliminary report. The preliminary analysis was performed using topographic information that was inadequate to accurately model the detention effects of the Bethel Park detention basin and of the undersized Highway 101 culverts. The preliminary analysis was revised in this report using additional survey data and provides more accurate peak flow estimates. A more detailed discussion of the methodology used in this analysis is included in the Appendix.

3.3.2 Summary of Results at all Areas of Interest

The subject watershed and sub-basins, and areas of interest are shown on Exhibits B, I, and J in Appendix I. Detailed results are included in the Appendix III. Results of significance are as follows:

- The analysis shows that the Bethel Park detention basin (area of interest A) does act to attenuate peak flow during large storm events, but that it only has adequate storage capacity for the 10 year event and that runoff from larger storms will spill out of the basin onto Bethel Park Road and Godell Street.

- Significant ponding occurs at the inlets of the Highway 101 culverts (areas of interest H, L and K) during the 10 year storm event and larger because of restricted culvert capacities. The restricted culvert capacities attenuate peak flows to the east side of Highway 101, which is consistent with the FEMA Flood Insurance Results.

The peak flows for each HEC-HMS model element (sub-basins, junctions, and reaches) are summarized in Tables 5, Appendix II. The peak flows at each area of interest are summarized in Table 6, Appendix II. The HEC-HMS model elements are shown schematically on Exhibits I and J, and directly correspond with the sub-basins shown on those exhibits. Because some of the areas of interest do not fall on the point of concentration of these sub-basins, the peak flows at these areas of interest were interpolated from the HEC-HMS results.

3.3.3 Summary of Detention Analysis

The hydrology calculations considered the detention effects of the Bethel Park detention basin in its current condition and three major Highway 101 culverts which restrict flow during large storm events. Peak flows into and out of these areas are summarized in Table 5, Appendix II.

3.3.4 Comparison of Results to FEMA FIS

The results of the hydrological analysis were compared to a detailed hydrologic and hydraulic analysis of Toad Creek completed in December of 1979 which is summarized in the FEMA Flood Insurance Study for San Luis Obispo County.

The hydrology analysis results were generally within 20% of the FEMA results. A considerable portion of the development on the west side of Highway 101 has occurred since the FEMA study was completed in 1979, and therefore not modeled in the FEMA analysis. This more recent development explains the differences in the FEMA peak flows and the peak flows calculated as a part of this analysis. See Table 9, Appendix III for a comparison of the hydrology calculated in this report and the FEMA results. The FEMA results are included for reference in Appendix VII.

3.4 Summary of Hydraulic Calculations

The Main Branch of Toad Creek downstream of Highway 101 was analyzed using the HEC-RAS computer program by the Army Corps of Engineers. The channel and bridge crossings were modeled using data collected from a field survey of the channel, and the Manning's n-values of the stream were determined from visual observation of the channel.

3.4.1 Summary of Hydraulic Results

The Toad Creek channel and bridges were analyzed from Highway 101 to Main Street. Detailed hydraulic results are presented in the Appendix and are summarized in Table 5; the locations of the cross sections used in the analysis are shown on Exhibit D in the Appendix. The analysis shows that the bridges at Florence Street, Eddy Street, Las Tablas Road and Main Street (areas of interest N, P, R, and S respectively) restrict flow during large storm events and contribute to flooding on Toad Creek, which is also caused in part by the heavy vegetation, siltation and debris in the Creek's channel and overbanks. The analysis shows that the Eddy Street, Las Tablas Road and Main Street bridges will be overtopped during the 10 year storm events.

3.4.2 Comparison of Hydraulic Results with FEMA Results

The results of the HEC-RAS hydraulic analysis of Toad Creek was compared to the FEMA results including the Flood Profiles and FIRM maps. It should be noted that the FEMA study was conducted using the NGVD29 vertical datum and the topographic information used in this report is on the NAVD 88 vertical datum. In order to compare the results of the two different studies the elevations listed in the FEMA report were adjusted to the NAVD88 datum by adding 3.0 feet.

When the channel profiles were compared they were found to be generally the same with similar channel elevations and profile grades, except 200 to 600 feet below the Eddy Street and Las Tablas Road bridges. Apparently, heavy vegetation and debris in the channels has slowed the velocities in the stream causing sediment to drop out of the flow resulting in extensive siltation in these areas since the FEMA analysis was performed. The channel elevations in these areas are 2'-4' higher than shown on the FEMA flood profiles. Generally, the base flood elevations and the 100 year normal depths from the current analysis are within 0.5' of the FEMA results except at the areas

below these bridges where the difference is up to 4'. The comparison of the HEC-RAS and FEMA results are summarized in Table 9, Appendix III.

The increased peak flows from the HEC-HMS analysis and the reduced hydraulic capacity of the channel caused by siltation and heavy vegetation growth explain the differences between the HEC-RAS and FEMA results, therefore the HEC-RAS results are considered to be reliable for the purposes of the final report.

Table 2 - Summary of Existing Conditions

Area of Interest [1]	Reach	Description	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)	Existing Capacity	Comments
A	Toad Creek North Branch	Regional detention basin and recreational area	156 in	187 in	228 in	279 in	10 year volume 45 cfs outfall when basin full	Basin designed to retain post – developed Q_{50} releasing at pre-developed Q_2 rate per County standard. Basin only has capacity for 10 year storm.
			45 out	99 out	168 out	247 out		
H	Un-named Creek	(4) 60" pipe culvert @ Highway 101	1,375 in	1,664 In	2,041 In	2,515 in	524 cfs outfall when pipes full	Culvert has restricted capacity causing runoff to be detained on the west side of the Highway 101. This area acts as a de facto detention basin reducing peak flows to the east side of Highway 101. Culvert invert ±35' below adjacent highway.
			978 out	1,127 out	1,217 out	1,333 Out		
K	Toad Creek South Branch	5' x 5' box culvert @ Highway 101	533 In	638 In	774 In	944 In	157 cfs outfall when culvert full	Culvert has restricted capacity causing runoff to be detained on the west side of the Highway 101. This area acts as a de facto detention basin reducing peak flows to the east side of Highway 101. Culvert invert ±25' below adjacent highway.
			364 Out	390 Out	419 Out	443 Out		
L	Toad Creek South Branch	5' x 5' box culvert @ Highway 101	344 In	396 In	463 In	556 In	157 cfs outfall when culvert full	Culvert has restricted capacity causing runoff to be detained on the west side of the Highway 101. This area acts as a detention basin reducing peak flows to the east side of Highway 101. Culvert invert ±25' below adjacent highway.
			290 Out	317 Out	347 Out	395 Out		
M	Toad Creek North Branch	Arizona Crossing of Salinas Ave with (2) 24" CMP culverts	290	317	347	395	20 cfs before overtopping road	Arizona crossing has two24" CMP pipes to convey low flow.
N	Toad Creek Main Branch	Florence Street Bridge	653	707	765	837	700 cfs [2] 850 cfs [3]	The bridge passes the 100 year storm without flooding meeting the secondary design requirements, but doesn't pass the 50 year storm with the primary design standard 1' of freeboard.

(1) Area of Interest locations are shown on Exhibit A

(2) Assuming clear receiving channel and 1' freeboard (Primary design storm requirements)

(3) Assuming clear receiving channel and no freeboard (Secondary design storm requirements)

Table 2 - Summary of Existing Conditions (continued)

Area of Interest (1)	Reach	Description	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)	Existing Capacity	Comments
P	Toad Creek Main Branch	Eddy Street Bridge	653	707	765	837	700 cfs (2) 850 cfs (3)	Because of the restricted capacity of the receiving channel this bridge floods during the 10 year storm. The bridge could potentially pass the 100 year storm without flooding meeting the secondary design requirements, but doesn't pass the 50 year storm with the primary design standard 1' of freeboard.
P	Toad Creek Main Branch	Channel between Eddy Street and Las Tablas Road bridges	653	707	765	837	N/A	Heavy siltation and sedimentation has restricted conveyance capacity of channel causing upstream flooding.
P1	Toad Creek Main Branch	(2) 36" pipe culvert @ Salinas Avenue	653	707	765	837	97 cfs before overtopping road	Culvert and receiving channel have restricted capacities causing flooding along Salinas Avenue.
R	Toad Creek Main Branch	Las Tablas Road Bridge	696	756	824	893	725cfs (2) 930 cfs (3)	Because of the restricted capacity of the receiving channel this bridge floods during the 10 year storm. The bridge could potentially pass the 100 year storm without flooding meeting the secondary design requirements, but doesn't pass the 50 year storm with the primary design standard 1' of freeboard.
R	Toad Creek Main Branch	Channel between Las Tablas Road and Main Street bridges	696	756	824	893	N/A	Heavy siltation and sedimentation has restricted conveyance capacity of channel causing upstream flooding.
S	Toad Creek Main Branch	Main Street Box culverts, (2) 4.5' x 10' and (3) 3.5' x 8'	1,746	1,909	2,159	2,390	1,200 cfs (2) 1,600 cfs (3)	Restricted capacity of receiving channel restricts capacity of culverts to 850 cfs before flooding the road, which is between the 5 year and 10 year storms.

(1) Area of Interest locations are shown on Exhibit A

(2) Assuming clear receiving channel and 1' freeboard (Primary design storm requirements)

(3) Assuming clear receiving channel and no freeboard (Secondary design storm requirements)

CHAPTER 4 ENGINEERING AND COST ANALYSIS OF PROPOSED CAPITAL IMPROVEMENT PROJECTS

Chapter Synopsis: This chapter identifies potential projects and methods to mitigate the deficient drainage problems and summarizes the hydraulic analyses of the modifications required for each project. This chapter also identifies the probable cost of implementing these projects.

4.1 Mitigation Methods

This section identifies methods which can be employed to mitigate the identified drainage deficiencies

4.1.1 Vegetation Maintenance

Removal of debris and vegetation within the channel will increase the conveyance capacity of the channel and will reduce flooding. Vegetation maintenance must be conducted on a regular basis in order to keep increased channel capacity.

4.1.2 Detention Basins Construction/Modification

Detention basins reduce flooding by attenuating the flows in Toad Creek. Detention at areas of interest K and L affect the peak flows in the Main Branch of the Creek downstream from Highway 101. Detention at area of interest H has the greatest impact on the Main Street culverts but will have no effect on the rest of the downtown areas. Increasing the capacity of the Bethel Park Basin at area of interest A reduces localized flooding and peak flows downstream on the North Branch of Toad Creek.

4.1.3 Sediment Removal

Sediment removal from the channel, particularly below the Eddy Street and Las Tablas Road bridges will increase the conveyance capacity of the channel, and will increase the conveyance capacity of the bridges by reducing tail water effects. Desiltation under the bridges will increase their conveyance capacity but a thorough structural and geotechnical analysis should be made to determine how much sediment is present and how deep the bridge opening can be made without compromising the integrity of the bridges. Sediment maintenance must be conducted on a regular basis in order to keep increased channel capacity.

4.1.4 Bridge/Culvert Upgrade

The Toad Creek bridges at Eddy Street and Las Tablas Road have restricted capacities primarily caused by heavy sedimentation and vegetation in the receiving channel. If the downstream channels were cleared and sediment removed from under the bridges they could pass the 50 year primary and the100 year secondary design storms without flooding the roadways, but they would not provide 1' of free board required during the primary design storm. Upsizing these bridges without clearing the receiving channel would only resolve the localized flooding at the bridges and would not address the underlying problem of inadequate conveyance capacity of the receiving channel caused by heavy vegetation and sedimentation. While the bridges can't meet the 1' free board requirement for the primary design storm, they can still safely pass the 100 year storm. Therefore we do not recommend that they be replaced at this time, but as these bridges reach the end of their service life they should be replaced by bridges that are designed with increased conveyance capacities to meet County standards.

The culverts at Main Street have restricted capacities caused primarily by the inadequate capacity of the receiving channel. The receiving channel must be improved for the culverts to convey their maximum capacities, but even then the culverts could not convey the 10 year storm much less the 100 year design storm required by County standards. These culverts need to be upsized in conjunction with increasing the capacity of the receiving channel to meet County standards; details are discussed in Section 4.2.8.

Several of the culverts in the community were identified in the previous report as having inadequate capacity (generally less than the 10 year peak) causing nuisance flooding of County maintained roads. They are located at areas of interest B, B1, C1,C2, D,E,F, and J. Upsizing of the culverts could decrease nuisance flooding of the streets but in most cases will require major road reconfiguration to handle the 10 year storm events or greater. It was determined that flooding in these areas is of short duration and has minimal impact to the community; therefore they were not studied in detail in this report.

4.1.5 Channel Modification

The Toad Creek channel on the east side of Main Street is undersized causing flooding on both sides of the channel in the 10 year storm and greater. It is obvious that the channel has been rerouted in the past and has 1'-2' levees on both sides. The levees

afford the adjacent properties some protection, but because they are less than one foot below the adjacent roadway they cause tailwater effects on the Main Street culverts drastically reducing their conveyance capacities. In order to reduce flooding of Main Street the channel must be increased in capacity to reduce the tailwater on the culverts thus increasing their capacities. Tract 2294 improvements propose widening Toad Creek in this location; see section 4.2.7 for a more detailed discussion of this project.

4.1.6 Discussion of Non-Engineering Alternatives

Future development should be encouraged to employ low impact design (LID) principles. LID principles minimize increased runoff caused by construction by promoting infiltration of runoff at the source and by minimizing the creation of impervious surfaces. These principles include the use of bio-swales and rain gardens, the disconnection of down spouts from storm drain systems promoting sheet flow, minimizing the use of paved surfaces, and the use of pervious pavements.

4.1.7 Private Residence Opportunities

Owner maintenance of culverts and swales located on private property will minimize localized flooding problems. Private owners cannot be forced to maintain their drainage facilities, but a public information campaign educating land owners of the benefits of maintenance should be considered.

4.2 ENGINEERING AND COST ANALYSIS OF PROPOSED CAPITAL IMPROVEMENT PROJECTS

Potential projects that increase detention can reduce downstream peak flows. The impact on flows at each potential project is summarized in this section in Table 3 and detailed analysis results are included in the Appendix.

4.2.1 Project 1 – Vegetation Maintenance

4.2.1.1 Project Description

This project proposes vegetation maintenance on the Main Branch of Toad Creek from the junction of the North and South Branches to approximately 500 feet downstream of the Las Tablas Road Bridge. This project can be phased as shown in Exhibit C but the phasing must go from downstream to upstream in order to have a regional effect on the flooding in Toad Creek. All vegetation and debris should be removed from the main

channel and the heavy vegetation (primarily willows and black berry bushes) should be thinned in the overbanks. No trees should be removed but low hanging branches should be trimmed. The main channel is generally 15' to 20' wide and the overbanks areas are between 50' and 75' wide in most areas. The n-value of the existing channel ranges from 0.04 to 0.06 and the existing overbanks range from 0.04 to 0.12. The proposed vegetation maintenance will reduce the n-value to 0.04 for the channel and overbanks.

4.2.1.2 Project Benefits

This project increases the conveyance capacity of the channel by reducing its n-value thus reducing flooding in Toad Creek along the length of the project. During the 10 year storm the water surface elevation is lowered by an average of 0.2' along the Creek; during the 100 year storm the water surface elevation is lowered by an average of 0.4'. While the implementation of this project will increase the conveyance capacity of the channel and reduce flooding at the bridges, the Las Tablas Road and Eddy Street bridges would still not be able to convey the County standard 50 year primary design storm without overtopping the bridges. Detailed hydraulic calculations for this project are included in Appendix VIII and a map of the project is shown on Exhibit C.

4.2.1.3 Project Costs

This project is divided in to 3 phases with an estimated cost of $28,000 per phase for phases 1 & 2 , and $42,000 for phase 3. Regular maintenance is necessary to maintain the conveyance capacity of the creek; the frequency and cost of this maintenance was not determined for this report. A detailed cost analysis for this project in included in Appendix XV.

4.2.2 Project 2 – Sediment Removal

4.2.2.1 Project Description

This project proposes removing excessive sedimentation from Toad Creek which reduces flooding by increasing the cross sectional area of the channel and restoring positive slope to the stream bed This project can be accomplished in two phases as shown on Exhibit D, but the phases must be completed from downstream to upstream to have more than local impacts. The runoff velocity of Toad Creek in this portion of the channel is lower than the rest of the creek because of the flatter slope and excess vegetation. The reduced velocity allows sediment to precipitate out of suspension and causes further sedimentation of the channel.

Phase one extends from Las Tablas Bridge to approximately 500' downstream of the bridge. A field survey of the stream shows that the sediment has raised the thalweg of the creek by approximately 3' in some locations when compared to the ground profile from the FEMA FIS and causes standing water of approximately 3' deep at the Las Tablas Road Bridge. A field observation was performed on 3/30/2010 at 10 a.m. and the water was approximately 3' deep at that time, which supports the field survey information. According to rain gauge data from the Atascadero Mutual Water #34 station, the last recorded rainfall was on 3/13/2010, two weeks before the observation. 0.06" of rainfall was recorded on 3/30/2010 but this occurred after the observation. The gauge data was obtained from the slocountywater.org website and is included for reference in Appendix VI.

Phase two extends from the Eddy Street Bridge to Las Tablas Road, and again the field survey showed excessive sedimentation and again was confirmed by a field observation of approximately 3' of standing water at the Eddy Street Bridge. Removal of the sediment should return the stream to its previous condition and should allow a consistent positive slope in the streambed.

4.2.2.2 Project Benefits

Employment of this project has significant impacts on the flooding at Eddy Street and Las Tablas Road and enables the bridges to pass the 100 year secondary design storm. Detailed calculations for this project are included in Appendix IX and a map of the project is shown of Exhibit D.

4.2.2.3 Project Costs

Implementation of these projects will require the removal of sedimentation and vegetation from the channel for an approximate width of 20'. The average depth of sediment is approximately 1' deep, with a maximum depth of approximately 3'. The estimated cost of phase1 and phase 2 is $78,400 and $126,000 respectively. Regular maintenance of the channel is necessary to maintain the conveyance capacity of the channel; the frequency and cost of this maintenance was not determined for this report. A detailed cost analysis for this project in included in Appendix XV.

4.2.3 Project 3 – Salinas Avenue Culvert Upgrade

4.2.3.1 Project Description

This project proposes the upgrade of an existing culvert crossing Salinas Avenue near Eddy Street. This culvert is comprised of two 36" CMP with approximately 1' of cover. This culvert has a 97 cfs capacity before flooding the road, which is less than a 2 year storm. This is evidenced by reports from County maintenance personnel that this road needs to be closed one or twice a year because of flooding. The restricted capacity of the culvert is primarily caused by its small size and shallow installation. The inadequate conveyance capacity of the receiving channel also contributes to the culverts restricted capacity.

4.2.3.2 Project Benefits

This project will increase the capacity of the culvert to 765 cfs with 1' of freeboard, which meets the County standard 50 year primary design storm. The current flooding problem does not threaten the adjacent homes and only has the potential to causes minor property damage, but the flooding does limit access which is a threat to public safety, and requires frequent maintenance by County personnel. This project will reduce road closures and required maintenance and improves access. Detailed calculations for this project are included in Appendix X and a map of the project is shown on Exhibit C.

4.2.3.3 Project Costs

This project proposes replacing the existing culvert with two 8' x 5' box culverts extending from the south side of Salinas Avenue to a point approximately 80' east on the north side of the street. The receiving channel should be improved to a 20' x 5' channel from the discharge of the culvert, to Eddy Street Bridge. Installation of the culvert will require Salinas Avenue to be raised by as much as two feet for approximately 200', and four adjacent driveways must be raised as well. The estimated cost of this project is $337,400. A detailed cost analysis for this project in included in Appendix XV.

4.2.4 Project 4 – Toad Creek, South Branch Detention Basin

4.2.4.1 Project Description

The South Branch of Toad Creek is conveyed under Highway 101 at area of interest K via a 5' x 5' box culvert. This culvert has restricted capacity and causes flooding in the channel on the west side of Highway 101 and causes this area to act as a de facto detention basin. The 100 year peak flow to the culverts is approximately 950 cfs and the maximum release is 450 cfs. The maximum storage is approximately 6 acre-ft with a maximum WSEL of 818.4' (approximately 15' deep); the adjacent Highway is at elevation 830'. All of the homes adjacent to Toad Creek are well above 830' in elevation with the exception of two homes located on Jordan Lane; these homes have an estimated finished floor elevation of approximately 825' to 830'.

This project proposes using this area as a regional detention basin by further restricting the flow out of the basin. To estimate the effects of increased detention the 5' x 5' box culvert was reduced to a 3' x 5' culvert in the hydraulic analysis. The results of this analysis show that the peak WSEL increased to 820.1 but that the peak discharge downstream was reduced by approximately 140 cfs. The resulting 2' increase in WSEL is at least 5' below the homes on Jordan Lane and approximately 10' below Highway 101.

4.2.4.2 Project Benefits

The reduction in peak flow downstream of the culvert reduces the depth of flow by an average of 0.4' in the South and Main Branches of Toad Creek to Main Street and results in a modest reduction of flooding at the Eddy street and Las Tablas Road bridges; specifically the Eddy Street bridge, in its current condition, would now be able to convey the 2 year storm without flooding the street but still won't pass the 50 year design storm. This project would be most effective if combined with projects 1 or 2. Detailed analysis results are included in Appendix XI and the project location is shown on Exhibit E.

4.2.4.3 Project Costs

In order to implement this project a restrictor plate will be bolted to the top of the existing concrete headwall. This restrictor plate will reduce the effective inlet area to 3' x 5'; by placing the restrictor plate to the top of the culvert low flows will be allowed to pass as before but during larger runoff events the capacity of the culvert will be restricted causing increased detention upstream of the culvert. This project will not require any

earthwork and uses the natural storage area already present. The land that would be covered by the detained runoff should be purchased by a public entity or covered by maintenance easement so that the continued operation of the detention basin can be controlled. The estimated cost of the project is $280,000. A detailed cost analysis for this project in included in Appendix XV.

4.2.5 Project 5 – Godell Street Storm Drain Upgrade

4.2.5.1 Project Description

County maintenance personnel have reported frequent flooding at a grate inlet on the west side of South Bethel Road between Godell and the Bethel Park detention basin/recreational facility. The grate inlet captures surface runoff from a watershed of approximately 1 acre on the west side of south Bethel Road and also receives piped runoff from a 24" CMP that serves as the discharge for the adjacent detention basin. Runoff to the inlet is conveyed in a 36" PVC pipe that runs eastward in Godell Street and discharging into an empty field at the end of Godell Street. A hydraulic analysis of the inlet shows that it should have adequate capacity to convey the surface runoff and the piped runoff from the detention basin without flooding the street, which contradicts numerous observations by County personnel.

One potential reason that the inlet floods is that the receiving pipe is partially clogged; which should be further explored. Another possible cause is that that adjacent development may have connected to the 36" PVC pipe in Godell Street exceeding its capacity and causing a tail water condition at the inlet; additional research must be done of the development plans of the adjacent project to confirm what exactly is attached to the 36" pipe.

Another possible cause of flooding considered was excess runoff from the detention basin. The design of the basin is summarized in the "Phase One Master Drainage Plan, Templeton Westside" by Twin Cities Engineering, Inc, for Templeton CSD, and dated October 1987. This report used the modified rational method to calculate the required storage volume of the detention basin.

The basin was designed to County standards to reduce the 50 year post developed runoff to the existing 2 year rate. Twin Cities peak flow calculations are similar to those generated in this report using the TR-55 methodology but the runoff volumes from the Twin cities report are approximately half of those calculated in this report. The Twin Cities report specified a design volume of 6 acre-ft, although it was unclear if that

included the required 1' of freeboard. A field survey of the basin shows that it only has a full capacity of approximately 5.1 acre-ft and with one foot of free board the volume is reduced to 3.6 acre-ft. The design release rate was calculated at 58 cfs but the Twin Cities report was unclear as how this was to be accomplished.

An analysis of the detention basin and its discharge rate was analyzed in this report using the TR-55 methodology. The maximum release rate through the 24" CMP pipe was calculated at 43 cfs which is less than what is allowed. When the basin was analyzed using the existing discharge structure and volume it was found that the basin only had capacity for the 10 year storm and does not meet the County standards. During the 50 year primary design storm the basin overtops and the maximum release rate is approximately 170 cfs which far exceeds the design maximum and the capacity of the inlet in Godell Street.

An analysis was performed to determine how the basin could be made to conform to the County standard using the hydrology calculated in this report. It was determined that the basin would require approximately 7 ac-ft of storage to contain the 50 year storm and with free board the basin would need to be at least 8 acre-ft in size. Two possible options could accomplish this goal. The first would be to lower the existing playing field by approximately 5' which severely limits its use as a recreational field. The second option would be to expand into the open space area to the south of the existing basin. This option would double the size of the park but would require an excessive amount of earthwork with maximum cut depths of approximately 20'. Both options are problematic and were not considered feasible projects.

A more feasible project that would reduce the flooding problem on South Bethel Road and Godell Street would be to upgrade the existing storm drain and add additional inlets in the intersection with adequate capacity to convey the 50 year primary design storm. A preliminary analysis of this option shows that a 48" HDPE pipe could convey the 50 year design storm.

4.2.5.2 Project Benefits

This project would reduce the flooding of Godell Street and the Godell Street and South Bethel Road Intersection. Detailed calculations are included in Appendix XII and a map of the project is shown on Exhibit F.

4.2.5.3 Project Costs

Implementation of this project would require the installation of two drain inlets at the South Bethel Road and Godell Street intersection, and increasing the size of the storm drain in Godell Street from a 36" to 48" pipe. The estimated cost of this project is approximately $420,000. A detailed cost analysis for this project in included in Appendix XV.

4.2.6 Project 6 – Unnamed Creek Detention Basin

4.2.6.1 Project Description

The Unnamed Creek, a tributary of Toad Creek, is conveyed under Highway 101 at area of interest H via four 60" HDPE pipes This culvert has restricted capacity and causes flooding in the channel on the west side of Highway 101 and causes this area to act as a de facto detention basin. The 100 year peak flow to the culverts is approximately 2,500 cfs and the maximum release is 1,500 cfs. The maximum storage is approximately 75 acre-ft with a maximum WSEL of 781 (approximately 16' deep); the adjacent Highway is at elevation 800'. The existing development on the west side of Highway 101 adjacent to the creek is higher than 800' in elevation. This project proposes using this area as a regional detention basin by further restricting the flow out of the basin.

4.2.6.2 Project Benefits

This project would increase the peak WSEL to 782.6' in the detention basin but the peak discharge downstream would be reduced by approximately 300 cfs during the 100 year storm. The resulting 2' increase in WSEL is still well below the highway and adjacent development. Because the detention basin would delay the peak flow through the 60" pipes the peak flow reduction at Main Street is approximately 500 cfs in the 100 year storm. The resulting decrease in peak flows are significant at Main Street, but the Main Street culverts will still flood in the 10 year storm, primarily because of the restricted capacity of the receiving channel downstream of the culverts. This project would be most effective if combined with projects 7A & 7B and would reduce the scope of the improvements needed in projects 7A and 7B. Detailed analysis results are included in Appendix XIII and the project location is shown on Exhibit G.

4.2.6.3 Project Costs

In order to implement this project, restrictor plates will be bolted to the existing concrete headwall, blocking the top ¼ of each 48" pipe. By placing the restrictor plates at the top of the pipes, low flows will be allowed to pass as before but during larger runoff events the capacity of the culverts will be restricted causing increased detention upstream of the culverts. This project will not require any earthwork and uses the natural storage area already present. The land that would be covered by the detained runoff should be purchased by a public entity or covered by a maintenance easement, so that the continued operation of the detention basin can be controlled. The estimated cost of the project is $483,000. A detailed cost analysis for this project in included in Appendix XV.

4.2.7 Project 7A – Toad Creek Main Branch Channel Widening at Main Street

4.2.7.1 Project Description

Unnamed Creek and Toad Creek merge together at Main Street, area of interest S, where the creek is conveyed under Main Street in two box culverts. The box culverts have a restricted a conveyance capacity which causes flooding in this area which has been observed by County maintenance personnel. The primary reason that the culvert has restricted capacity is that the receiving channel is undersized. It is obvious that the receiving channel is man-made has been rerouted at sometime in the past. The channel is approximately 10' wide and 3'-4' deep and has a 1'-2' levee on both sides. The levees have provided some protection to the adjacent properties, but the top of the levee is only 6" below the adjacent road. This causes a severe tail water effect on the Main Street Culverts causing the road to flood in large storm events.

The existing culverts are a double 10' x 4.5' box and a triple 8' x 3.5' box, they have a combined capacity of 1,600 cfs if the downstream channel had adequate capacity, but in its current configuration the culverts only have 840 cfs capacity before the road floods. The existing channel has a full capacity of approximately 500 cfs to 800 cfs before overtopping the adjacent levee. This project would increase the capacity of the channel below the Main Street culverts which would in turn increase the capacity of the Main Street culverts by reducing tail water effects.

4.2.7.2 Project Benefits

This project increases the capacity of the Toad Creek channel to meet the County standard 50 and 100 year design storms, reducing flooding to the north and south of Toad Creek, which has the potential for property damage to existing structures. This project would increase the conveyance capacity of the bridges before the street floods from 840 cfs to 1,600 cfs or approximately the 5 year to the 10 year storm. This project decreases flooding on Main Street but doesn't meet the County standard 50 year and 100 year requirements at the bridges. Flooding of the street is a potential public safety hazard because large floods can impede access of emergency vehicles on Main Street which is an arterial route for the community of Templeton. This project should be employed in conjunction with Project 7B. Detailed calculations are provided in Appendix XIII and the project is shown on Exhibit H.

4.2.7.3 Project Costs

This project proposes widening the receiving channel to receive the County standard 100 year design storm. The proposed section would widen the channel from approximately 25' wide to 75' wide at the top and 4' deep including a levee on the north side of the channel. Improvements for this project include earthwork and rock slope protection for the channel for approximately 800' of channel. The estimate cost of these improvements is $217,000. A detailed cost analysis for this project in included in Appendix XV.

4.2.7.4 Currently Proposed Projects

Tract 2294 improvements propose a medium density residential development on the 17 acre parcel east of Main Street and south of Toad Creek. This development would encroach on the FEMA 100 year flood plain, but the project proposes widening approximately 750' of the Toad Creek channel from Main Street to the eastern edge of the project. These proposed improvements are outlined in the "Flood Study of Toad Creek for Tract 2294" flood report prepared by Wallace Group, dated May 2010. These improvements would increase the conveyance capacity of the channel, and would reduce historic flooding across Main Street and on the Miller property to the north of Toad Creek, but were not intended to convey the entire 100 year storm and some flooding will still occur.

According to the Wallace report, the culverts, in the current condition, have an approximate capacity of 900 cfs before Main Street is flooded, which is consistent with the 840 cfs capacity that was calculated in this report. The Wallace report also calculated the capacity of the channel ranging from 512 cfs to 1,500 cfs, which is consistent with the capacities calculated in this report.

The Wallace report shows that during the 100 year storm approximately 410 cfs overtops the road in the existing condition which is reduced to 370 cfs after the channel is widened. While the proposed Tract 2294 improvements do reduce flooding at Main Street, they fall short of increasing the capacity of the channel and culverts to the County standard primary and secondary design storms.

It should be noted that the Wallace report used 1,790 cfs from the published FEMA flood study as the 100 year design storm. The 100 year design storm used in this report is 2,390 cfs; these results were calculated using SCS methodology The Wallace report also calculated the 100 year peak of 2,520 cfs using the SCS methodology, and 2,830 cfs using the Caltrans regional regression method. The model parameters, such as rainfall, curve number, drainage area, and time of concentration, used with the SCS methodology to calculate flow were nearly the same in both the Wallace and NCE analyses. The NCE analysis used 16 sub-basins within the watershed and modeled the detention effects of the Highway 101 culverts, where the Wallace analysis used 3 sub-basins, and did not appear to model detention at the Highway 101 culverts.

4.2.8 Project 7B – Main Street Culvert Upgrade

4.2.8.1 Project Description

This project should be used in conjunction with project 7A to increase the capacity of the Main Street culverts to the County standard 100 year design storm (2,400 cfs). The capacity of the existing culverts is only 840 cfs before Main Street floods.

4.2.8.2 Project Benefits

This project, when used in conjunction with Project 7A, would increases the capacity of the Toad Creek Main Street Culverts to meet the County standard 50 and 100 year design storms, reducing flooding to the north and south of Toad Creek, which has the potential for property damage to existing structures. This project would increase the conveyance capacity of the bridges before the street floods from 840 cfs to 2,400 cfs Flooding of the street is a potential public safety hazard because large floods can impede access of emergency vehicles on Main Street which is an arterial route for the

community of Templeton. This project should be employed in conjunction with Project 7B. Detailed calculations are provided in Appendix XIV and the project is shown on Exhibit H.

4.2.8.3 Project Costs

This project proposes widening the northern most culverts (double 10' x 4.5') by adding four 10' x 4' box culverts. Improvements for this project include culvert construction and the reconstruction of Main Street. The estimate cost of these improvements is $217,000. A detailed cost analysis for this project in included in Appendix XV.

The proposed Tract 2294 project doesn't include any improvements to the existing culverts. Detailed calculations are provided in Appendix XIII and the project is shown on Exhibit H. A detailed cost analysis for this project in included in Appendix XV.

4.2.9 Summary of Recent and Proposed Drainage Improvements by Private Development

At the time of the writing of this report, the following subdivisions were at various stages of development. Construction of these developments may contribute to the mitigation projects listed in this report, but the extent of these improvements are beyond the scope of this report.

Tract 2549

This tract is a 41 lot housing development located on Las Tablas Rd between Posada Lane and Heather Court. The storm drain improvements outlet to a detention basin near Toad Creek North Branch upstream of Area of Interest L.

Tract 2057

This tract is a lot housing development located on North Main Street between River Run Road and Hwy 101. The storm drain improvements outlet to a detention basin near Main Street upstream of Area of Interest S.

Tract 2348

This tract is a 62 lot housing development located on North Main Street between River Run Road and Creekside Ranch Road. The storm drain improvements outlet to Toad Creek east of Main Street near Area of Interest S.

Tract 2644

This tract is a 7 lot housing development located on the corner of Las Tablas Road and Old County Road. This development is near Area of Interest R.

Tract 2763

This tract is a 26 lot housing development located along east side of Highway 101 between Salinas Avenue and Forest Avenue. This development is near Area of Interest M.

Tract 2933

This is a proposed 6 lot development located on Eddy/Cayucos. Storm drainage will split flows. Approximately 0.6 ac flows to Eddy St, and flow north along Eddy and 0.8 ac will flow to Cayucos St and flow east along Cayucos. This development is near Area of Interest P.

Tract 2994

This tract is a 108 lot proposed housing development located north of Creekside Ranch Road. See Toad Creek Flood Study by Wallace Group. This is near Area of Interest S.

CO 05-0196

This is a proposed 4 parcel development located at 61 Main Street. This drainage is proposed to flow toward the Evers Sport Park retention basin.

CO 06-0011

This plan proposes a 3 parcel development located between Lincoln Avenue and Gough Avenue. This development is near Area of Interest N.

DRC05-00210

This is an approved multi-use development is approved located on 78 Main Street. The drainage flows to Main Street.

Table 3 - Quantitative Project Benefit Summary

Project[1]	Proposed Mitigation	Critical Area**	ΔQ_{10} (cfs)	$\Delta WSEL_{10}$ (ft)	ΔQ_{100} (cfs)	$\Delta WSEL_{100}$ (ft)	Comment
1 Phase 1	Vegetation Maintenance	Las Tablas Road Bridge, AOI R	0	-0.2	0	-0.5'	Existing Capacity: ± 5year Improved Capacity: < 10 year
1 Phase 2	Vegetation Maintenance	Eddy Street Bridge, AOI P	0	-0.4'	0	-0.4'	Existing Capacity: < 2 year Improved Capacity: ±5 year
1 Phase 3	Vegetation Maintenance	Florence Street Bridge, AOI N	0	-<0.1'	0	-<0.1'	Existing Capacity: ± 5year Improved Capacity: ±5 year
2 Phase1	Sediment Removal	Las Tablas Bridge, AOI R	0	-2.5	0	-2.1'	Existing Capacity: ± 5year Improved Capacity: 100 year
2 Phase2	Sediment Removal	Eddy Street Bridge, AOI P	0	-4.3'	0	-4.0'	Existing Capacity: < 2 year Improved Capacity: 100 year
3	Upsize Culvert	AOI P1	0	0	0	0	Existing Capacity: < 2 year Improved Capacity: 50 year
4	Regional Detention Basin	Area of Interest K	-100 dis-charge	+1.6'	-140 dis-charge	+1.9'	
4	Regional detention basin	Florence Street Bridge, AOI N	-100	-0.3'	-140	-0.4'	Existing Capacity: 100 year Improved Capacity: 100 year
4	Regional detention basin	Eddy Street Bridge, AOI P	-100	-0.3'	-140	-0.3'	Existing Capacity: < 2 year Improved Capacity: 2 year
4	Regional Detention Basin	Las Tablas Road Bridge (AOI R)	-100	-0.3'	-140	-0.5'	Existing Capacity: ± 5year Improved Capacity: ±5 year
5	Upsize storm Drain	AOI A, South Bethel Road and Godell Street	0	n/a	0	n/a	Existing Capacity: < 25 year Improved Capacity: 50 year
6	Regional detention basin	AOI H, Detention Basin	-175	+1.7'	-300	+1.9'	
6	Regional detention basin	AOI S, main Street Culverts	-205	<0.1'	-515	<0.1'	Existing Capacity: ± 5 year Improved Capacity: ± 5 year Detention does not have a significant impact on WSEL because receiving channel has a capacity of <10 years and causes the same tailwater effects on storms > 5 year. This project can be used in conjunction with projects 7A&B.
7A	Modify Channel	AOI S, Main Culverts	0	-1.0'	0	-0.5'	Existing Capacity: ± 5 year Improved Capacity: ±10 year
7B	Upsize Culverts	AOI S, Main Culverts	0	-1.5'	0	-2.0'	Existing Capacity: ± 5 year Improved Capacity: 100 year Project 7A must be completed before project 7B has any significant impact.

[1] Project locations are shown on Exhibit A.

[2] Results at the problem areas are representative for the area of benefit for each project; for results at other locations and storm events see the detailed calculations provided for reference in the appendices.

CHAPTER 5 **PROJECT 8 ADDENDUM**

Chapter Synopsis: This chapter adds two potential projects (8A & 8B) to the projects already identified in Chapter 4. This chapter also identifies potential methods to mitigate the deficient drainage problems, summarizes the hydraulic analyses of the modifications required for both projects, and identifies the probable cost of implementing these projects.

5.1 Purpose of Addendum

The purpose of this addendum is to determine the feasibility of adding two new projects (Project 8A & 8B) to the Templeton Drainage and Flood Control Study-Draft (Study) prepared by North Coast Engineering Inc (NCE) for the San Luis Obispo County Flood Control and Water Conservation District (District). The analysis used to prepare this addendum employed the same resources and analysis methodology used in the Study.

Over the past six months an ad hoc Templeton Advisory Group (TAG) subcommittee has been reviewing the Study and the projects outlined in it. The group has discussed these projects and the means of their implementation with the District. During these discussions TAG has requested that a different approach be made to achieve the objectives of the Study; primarily they would like to explore the options of using detention/retention in the areas that already experience flooding on the east and west side of Main Street. TAG has suggested using these areas, which are agricultural lands, to pond runoff which could reduce peak flows and promote ground water recharge at the Main Street Culverts and the UPRR trestle. See Exhibit X2 for a map of the proposed project area.

5.2 Scope and Limitations of Addendum

An order of magnitude analysis was performed for this addendum so that the effects of the proposed projects could be estimated. The advantages and disadvantages of the proposed projects are outlined in this addendum. Because the study area has been expanded to add the UPRR trestle two additional sub-basins (S-16A and S-16B) were added to the hydrology model (see Exhibit X1 for watershed locations). Sub-basin 16-A is a 330 acre watershed located west of Highway 101 that is conveyed east under Highway 101 in a 3' high by 9' wide

concrete box culvert that discharges into an agricultural field located west of the UPRR trestle. Sub-basin S16-B is a 170 acre watershed between Main Street and the UPRR tracks that discharges to the UPRR trestle. The existing hydrology analysis results are summarized in Table 1A.

This addendum employs the same 2' contour map used in the Study and provided by the District; the elevations on this map are on the NAVD 88 vertical datum. Note that the elevations from the FIRM and USGS maps are on the NGVD 29 vertical datum, which can be converted to the NAVD datum by adding approximately 3'

Table 1A- Existing Hydrology Summary for Project 8A & 8B

Area of Interest	Q_5 (cfs)	Vol_2 (ac-ft)	Q_{10} (cfs)	Vol_{10} (ac-ft)	Q_{25} (cfs)	Vol_{25} (ac-ft)	Q_{50} (cfs)	Vol_{50} (ac-ft)	Q_{100} (cfs)	Vol_{100} (ac-ft)
Main Street Culverts	723	284	1,746	662	1,909	776	2,159	924	2,390	1,108
UPRR Trestle	745	300	1,819	710	1,991	833	2,253	994	2,507	1,196

5.3 Project 8A – Detention/Retention West of Main Street

5.3.1 Description

It has already been determined in the Study that the Main Street culverts don't have adequate capacity to convey the 100 year storm and flooding occurs in the area west of Main Street, as evidenced by the FIRM map of the area. The capacity of the culverts is limited to 850 cfs before flooding Main Street, which is between the 5 year and 10 year storms. The low point in Main Street has an approximate elevation of 757' and the FIRM map shows a 100 year water surface elevation (WSEL) of 760' in the 100 year storm. The invert elevation of the culverts is at approximately 750'. As previously discussed in the Study the Main Street culverts' capacity is controlled by tail water from the downstream channel and could be

increased from 850 cfs to 1,600 cfs if the downstream channel were widened (See Project 7A).

Project 8A proposes to provide additional storage in the field on the west side of Main Street. The 25 year design storm was chosen to provide an order of magnitude storage estimate for this project. The aerial map shows that this field is at an approximate elevation of 756', which is only 1' below the roadway but based on visual observations it appears that the field is 3' to 4' lower than the road. Assuming that the field is an average of 3' below the road, the15 acre field already provides for approximately 45 ac-ft of storage. All of the existing storage capacity will be filled during the 10 year storm so in order reduce the 25 year peak flow additional storage must be provided. Assuming a peak outfall of 850 cfs through the Main Street culverts approximately 130 ac-ft of storage is required to reduce the 25 year peak to 850 cfs. This would require 85 ac-ft of additional storage or approximately 6' of cut over the 15 acre field (145,000 CY of export), assuming that it were level.

5.3.2 Advantages

Implementation of this project would reduce the peak flows to the Main Street culverts and allow the culverts to pass the 25 year peak flow and would provide increased public safety by keeping a major access route open for emergency vehicles for at least the 25 year storm. The detention/retention basin would retain approximately 1' to 2' of runoff and would promote ground water recharge.

5.3.3 Disadvantages

This project would require the acquisition of at least 15 acres of private agricultural land that would frequently be flooded, limiting its use. Construction of this project would require approximately 145,000 CY of earthwork.

5.4 Project 8B – Detention/Retention East of Main Street

5.4.1 Description

The Toad Creek channel east of Main Street to the UPRR trestle was not included in the Study. The hydrology analysis was revised to include the 330 acre watershed to the 3' x 9' concrete culvert located north of the Main Street and Highway 101 interchange, and the 170 acre watershed between Main Street and the UPRR tracks tributary to the UPRR trestle. This revised analysis provided peak flow estimates to the UPRR trestle as summarized in Table 1. The Toad Creek channel between Main Street and the UPRR trestle has a 1' to 2' high levee on the north side, is approximately 40' wide, and ranges from 5' to 7' deep including the levee. The UPRR trestle is approximately 26' wide with an average depth of 8' from the trestle's soffit to the creek bed; the channel invert has an approximate elevation of 741' and the tracks are at elevation 755'. The FEMA FIRM map of the area shows a broad flood plain during the 100 year storm with a WSEL ranging from 752' at the trestle to 757' just downstream from Main Street. A visual inspection located two Arizona crossings of Toad Creek approximately 50 yards and 150 yards downstream from the trestle. Scour holes were observed on the downstream side of both Arizona crossings. The channel downstream from the second Arizona crossing shows signs of erosion and has nearly vertical side walls for approximately 750' (See Exhibit X3). Beyond the eroded portion of the stream the channel sides flatten out to an approximate slope of 2:1 and the sides are covered in grasses and light weeds with no signs of erosion.

This project proposes to provide additional storage in the field upstream from the UPRR trestle in order to reduce the peak flows to the trestle. Without a soils report it is difficult determine what would be considered a non-erodible channel velocity design goal. The 25 year design storm and a design velocity reduction of 1 fps were used to determine order of magnitude storage estimates. To achieve a meaningful reduction in erosion, the channel velocities may need to be reduced by more than 1 fps.

One means of increasing storage would be to remove the levee on the north side of the channel to allow runoff to spill into the adjacent agricultural field sooner. The existing channel has an approximate capacity of 2,100 cfs which is less than the 50 year peak of 2,253 cfs. If the 2' levee were removed the channel capacity would be reduced to approximately 1,100 cfs which is between the 5 year and 10 year storms. Therefore, simply removing the levee would have no effect on storm with peak flows less than 1,100 cfs.

In order to reduce the 25 year velocity of 12.5 fps to 11.5 fps in the eroded portion of the channel the 25 year peak flow must be reduced from 1,991 cfs to approximately 1,100 cfs. To accomplish this, a portion of the levee must be removed and an additional storage volume of approximately 85 ac-ft must be provided. This additional storage would require approximately 145,000 CY of earthwork, which is equivalent to cutting down the entire 15 acre field by approximately 6', assuming that the field was level.

5.4.2 Advantages

This project will reduce erosion on an approximately 750' portion of Toad Creek which is adjacent to open agricultural land; there are no other public benefits.

5.4.3 Disadvantages

This project would require the acquisition of at least 15 acres of private agricultural land that would frequently be flooded limiting its use, and would reduce the existing flood protection to the adjacent property to the north of the channel. Construction of this project would require approximately 145,000 CY of earthwork assuming that the field is level.

Budget Cost Estimate

PROJECT NUMBER: 8A

PROJECT DESCRIPTION: Retention/Detention Pond
PROJECT LOCATION: Toad Creek West of Main Street

Work Item	Unit	Quantity	Unit Cost	Total Cost
Earthwork (Export)	CY	145,000	$15	$2,175,000
Land Acquisition	Acre	15	$20,000	$300,000
Erosion Control	LS	1	$5,000	$5,000
Revegetation	Acre	15	$5,000	$75,000
			Total Construction Items:	$2,555,000
			40% Contingencies:	$1,022,000
			Total	$3,577,000

Notes:

1: Budget cost estimate only includes major construction cost items. It does not include appurtenances that would typically be necessary to complete the project but are difficult to quantify until the project is designed. The cost of appurtenances are included in the 40% contingency.

2: Quantities are based on a planning level estimate which can be more accurately determined after project is design. This uncertainty is reflected in the 40% contingency.

3: Costs do not include Engineering, Testing, Staking, Permitting or other soft costs.

4: Unit costs are based on current estimated 2011construction costs and include the cost of materials and installation.

Budget Cost Estimate

PROJECT NUMBER: 8B

PROJECT DESCRIPTION: Retention/Detention Pond
PROJECT LOCATION: Toad Creek East of Main Street

Work Item	Unit	Quantity	Unit Cost	Total Cost
Earthwork (Export)	CY	145,000	$15	$2,175,000
Land Acquisition	Acre	15	$20,000	$300,000
Erosion Control	LS	1	$5,000	$5,000
Revegetation	Acre	15	$5,000	$75,000
			Total Construction Items:	$2,555,000
			40% Contingencies:	$1,022,000
			Total	$3,577,000

Notes:
1: Budget cost estimate only includes major construction cost items. It does not include appurtenances that would typically be necessary to complete the project but are difficult to quantify until the project is designed. The cost of appurtenances are included in the 40% contingency.
2: Quantities are based on a planning level estimate which can be more accurately determined after project is design. This uncertainty is reflected in the 40% contingency.
3: Costs do not include Engineering, Testing, Staking, Permitting or other soft costs.
4: Unit costs are based on current estimated 2011construction costs and include the cost of materials and installation.

Project: Addendum 8 revision

Simulation Run: 5 Junction: UPRR Trestle

Start of Run:	01Jan3000, 00:00	Basin Model:	Existing
End of Run:	02Jan3000, 12:00	Meteorologic Model:	5 year
Compute Time:	07Feb2014, 16:33:15	Control Specifications:	36 hour

Volume Units: AC-FT

Computed Results

Peak Outflow :	745 (CFS)	Date/Time of Peak Outflow :	01Jan3000, 10:59
Total Outflow :	300.48 (AC-FT)		

Project: Addendum 8 revision

Simulation Run: 5 Junction: J-9

Start of Run:	01Jan3000, 00:00	Basin Model:	Existing
End of Run:	02Jan3000, 12:00	Meteorologic Model:	5 year
Compute Time:	07Feb2014, 16:33:15	Control Specifications:	36 hour

Volume Units: AC-FT

Computed Results

Peak Outflow :	723 (CFS)	Date/Time of Peak Outflow :	01Jan3000, 10:54
Total Outflow :	283.87 (AC-FT)		

Project: Addendum 8 revision

Simulation Run: 10 Junction: UPRR Trestle

Start of Run:	01Jan3000, 00:00	Basin Model:	Existing
End of Run:	02Jan3000, 12:00	Meteorologic Model:	10 year
Compute Time:	07Feb2014, 16:29:52	Control Specifications:	36 hour

Volume Units: AC-FT

Computed Results

Peak Outflow :	1819 (CFS)	Date/Time of Peak Outflow :	01Jan3000, 11:04
Total Outflow :	709.69 (AC-FT)		

Project: Addendum 8 revision

Simulation Run: 10 Junction: J-9

Start of Run:	01Jan3000, 00:00	Basin Model:	Existing
End of Run:	02Jan3000, 12:00	Meteorologic Model:	10 year
Compute Time:	07Feb2014, 16:29:52	Control Specifications:	36 hour

Volume Units: AC-FT

Computed Results

Peak Outflow :	1746 (CFS)	Date/Time of Peak Outflow :	01Jan3000, 11:02
Total Outflow :	662.14 (AC-FT)		

Project: Addendum 8 revision

Simulation Run: 25 Junction: UPRR Trestle

Start of Run:	01Jan3000, 00:00	Basin Model:	Existing
End of Run:	02Jan3000, 12:00	Meteorologic Model:	25 year
Compute Time:	07Feb2014, 16:32:05	Control Specifications:	36 hour

Volume Units: AC-FT

Computed Results

Peak Outflow :	1991 (CFS)	Date/Time of Peak Outflow :	01Jan3000, 11:12
Total Outflow :	833.42 (AC-FT)		

Project: Addendum 8 revision

Simulation Run: 25 Junction: J-9

Start of Run:	01Jan3000, 00:00	Basin Model:	Existing
End of Run:	02Jan3000, 12:00	Meteorologic Model:	25 year
Compute Time:	07Feb2014, 16:32:05	Control Specifications:	36 hour

Volume Units: AC-FT

Computed Results

Peak Outflow :	1909 (CFS)	Date/Time of Peak Outflow :	01Jan3000, 11:08
Total Outflow :	775.99 (AC-FT)		

Project: Addendum 8 revision

Simulation Run: 50 Junction: UPRR Trestle

Start of Run:	01Jan3000, 00:00	Basin Model:	Existing
End of Run:	02Jan3000, 12:00	Meteorologic Model:	50 year
Compute Time:	07Feb2014, 16:32:37	Control Specifications:	36 hour

Volume Units: AC-FT

Computed Results

Peak Outflow :	2253 (CFS)	Date/Time of Peak Outflow :	01Jan3000, 11:20
Total Outflow :	994.43 (AC-FT)		

Project: Addendum 8 revision

Simulation Run: 50 Junction: J-9

Start of Run:	01Jan3000, 00:00	Basin Model:	Existing
End of Run:	02Jan3000, 12:00	Meteorologic Model:	50 year
Compute Time:	07Feb2014, 16:32:37	Control Specifications:	36 hour

Volume Units: AC-FT

Computed Results

Peak Outflow :	2159 (CFS)	Date/Time of Peak Outflow :	01Jan3000, 11:16
Total Outflow :	923.90 (AC-FT)		

Project: Addendum 8 revision

Simulation Run: 100 Junction: UPRR Trestle

Start of Run:	01Jan3000, 00:00	Basin Model:	Existing
End of Run:	02Jan3000, 12:00	Meteorologic Model:	100 year
Compute Time:	07Feb2014, 16:31:18	Control Specifications:	36 hour

Volume Units: AC-FT

Computed Results

Peak Outflow :	2507 (CFS)	Date/Time of Peak Outflow :	01Jan3000, 11:18
Total Outflow :	1195.51 (AC-FT)		

Project: Addendum 8 revision

Simulation Run: 100 Junction: J-9

Start of Run:	01Jan3000, 00:00	Basin Model:	Existing
End of Run:	02Jan3000, 12:00	Meteorologic Model:	100 year
Compute Time:	07Feb2014, 16:31:18	Control Specifications:	36 hour

Volume Units: AC-FT

Computed Results

Peak Outflow :	2390 (CFS)	Date/Time of Peak Outflow :	01Jan3000, 11:17
Total Outflow :	1108.33 (AC-FT)		

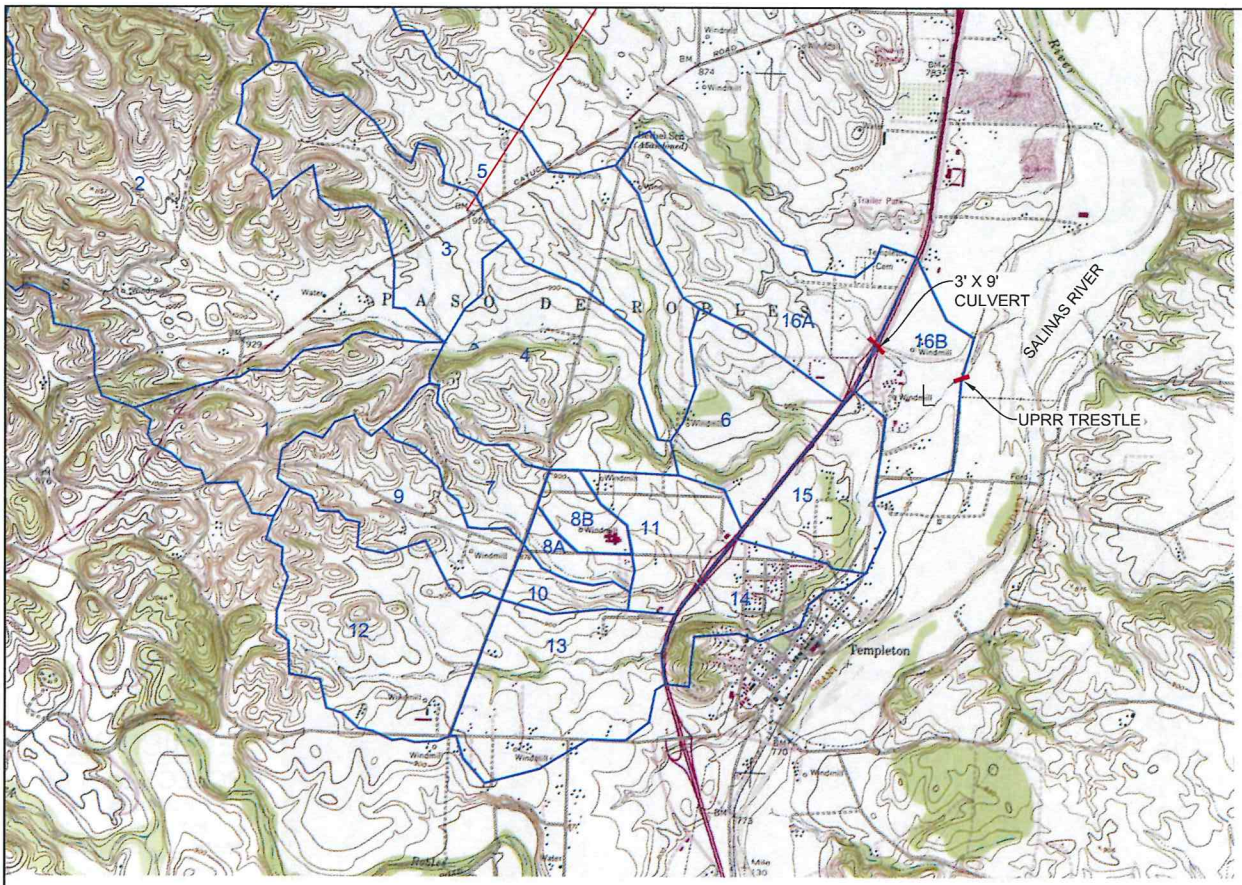


EXHIBIT X1

WATERSHED MAP

DATUM = NVGD29

0 1000' 2000' 4000'

SCALE: 1"=2000'

NORTH COAST ENGINEERING INC.
725 Crowton Rd. Suite B, Paso Robles, 230-3127

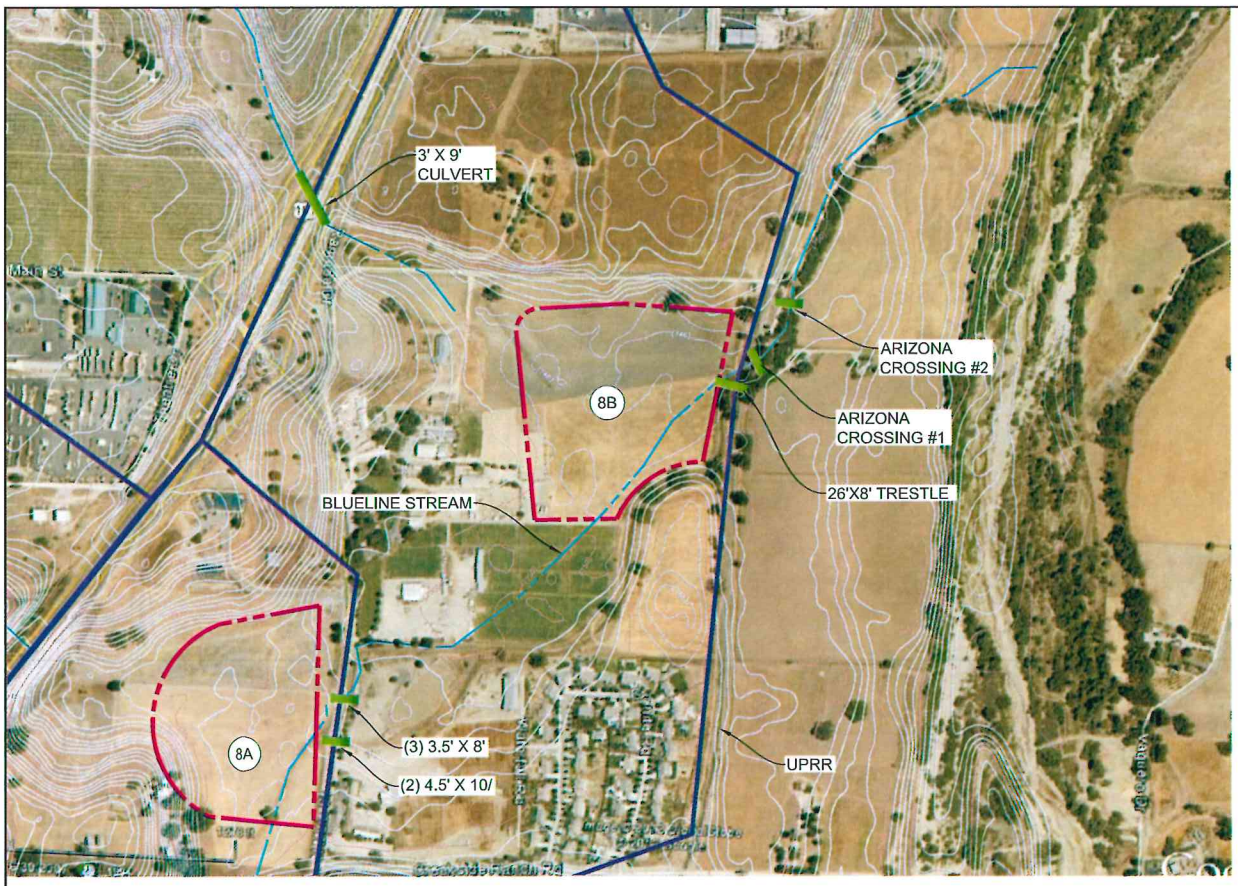


EXHIBIT X2

PROJECT 8A & 8B

2' CONTOURS

0 200' 400' 800'

SCALE: 1"=400'

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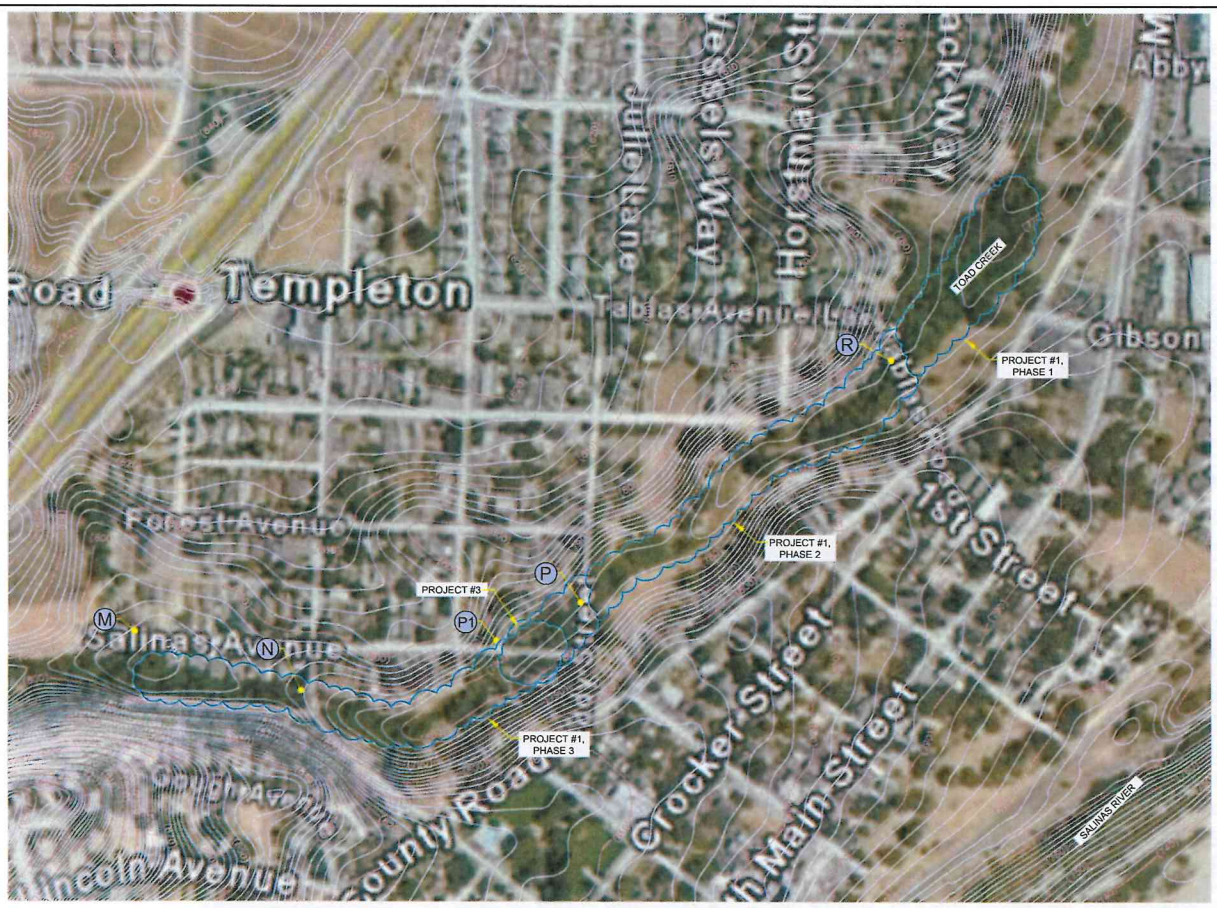
EXHIBIT X3

TOAD CREEK APPROXIMATELY 300 YARDS DOWNSTREAM FROM UPRR TRESTLE

Appendix I

Maps



LEGEND

- B — AREA OF INTEREST (STUDIED IN DETAIL IN THIS REPORT)
- APPROXIMATE PROJECT BOUNDRY

N

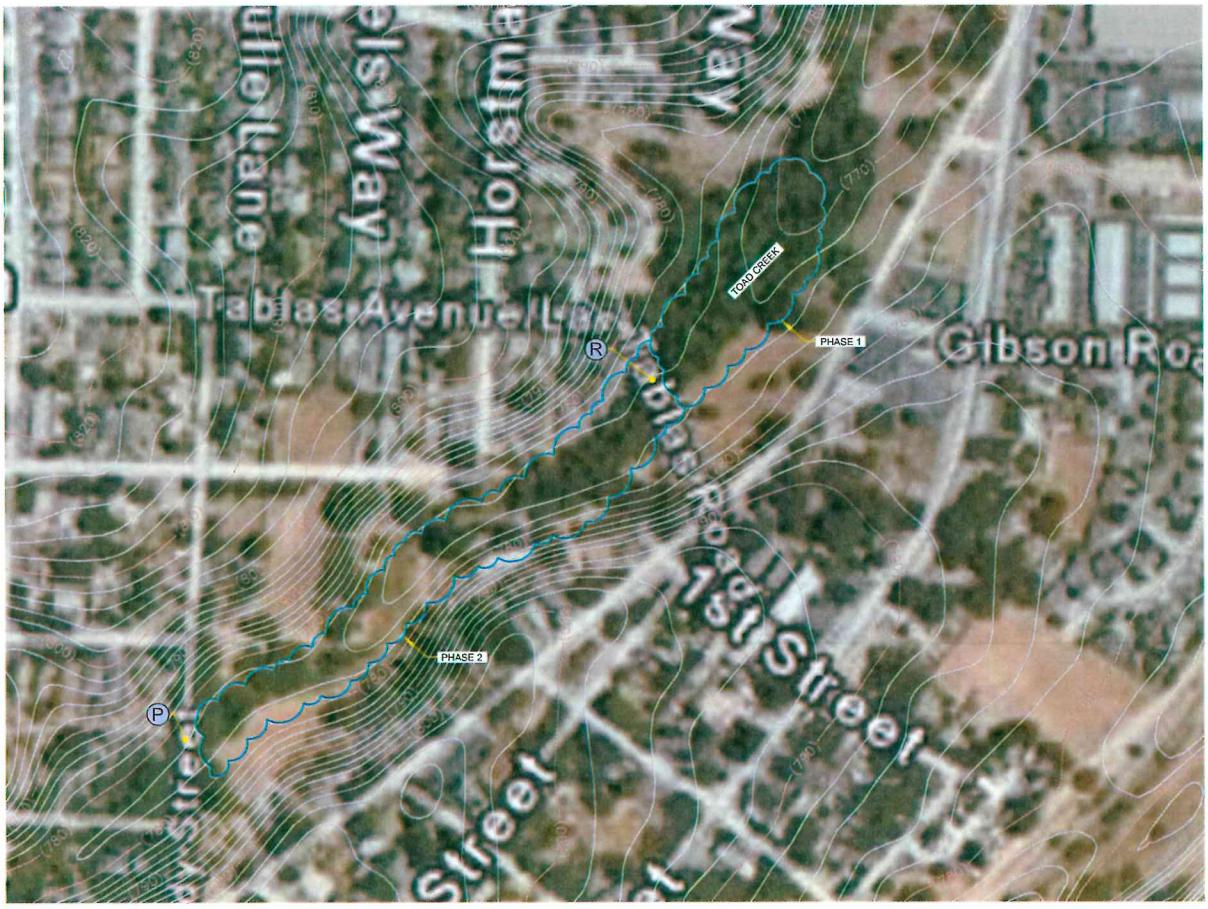
0 150' 300' 600'

SCALE: 1"=300'

EXHIBIT C

PROJECT #1 & #3
VEGETATION
MAINTENANCE AND
CULVERT UPGRADE

NCE NORTH COAST ENGINEERING INC.
725 Crowton Rd Suite B, Paso Robles, 239-3127



LEGEND

(B) AREA OF INTEREST (STUDIED IN DETAIL IN THIS REPORT)

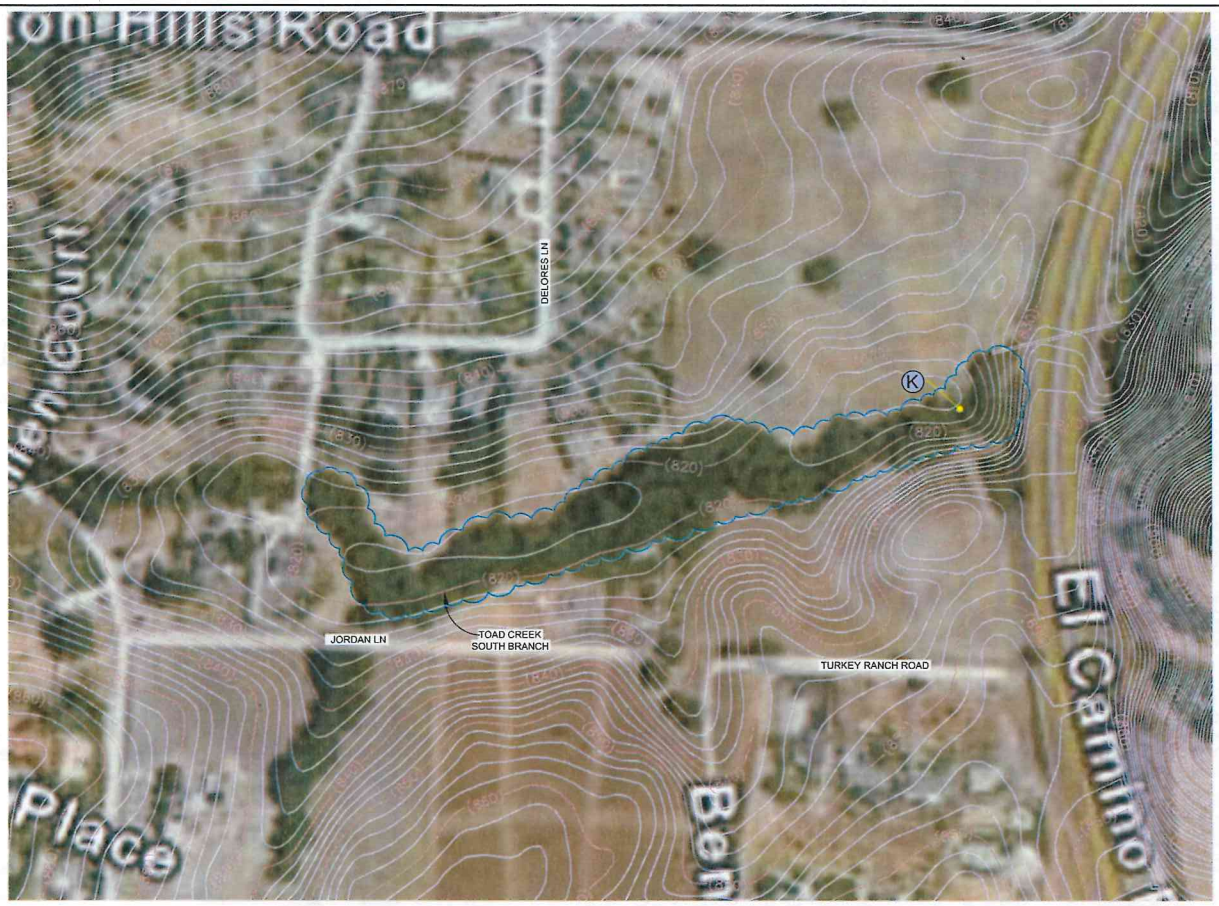
APPROXIMATE PROJECT BOUNDRY

0 100' 200' 400'

SCALE: 1"=200'

EXHIBIT D
PROJECT #2
SEDIMENT
REMOVAL

NCE NORTH COAST ENGINEERING INC.
725 Creston Rd Suite B, Paso Robles, 239-7127



LEGEND

B AREA OF INTEREST (STUDIED IN DETAIL IN THIS REPORT)

APPROXIMATE PROJECT BOUNDARY

0 100' 200' 400'

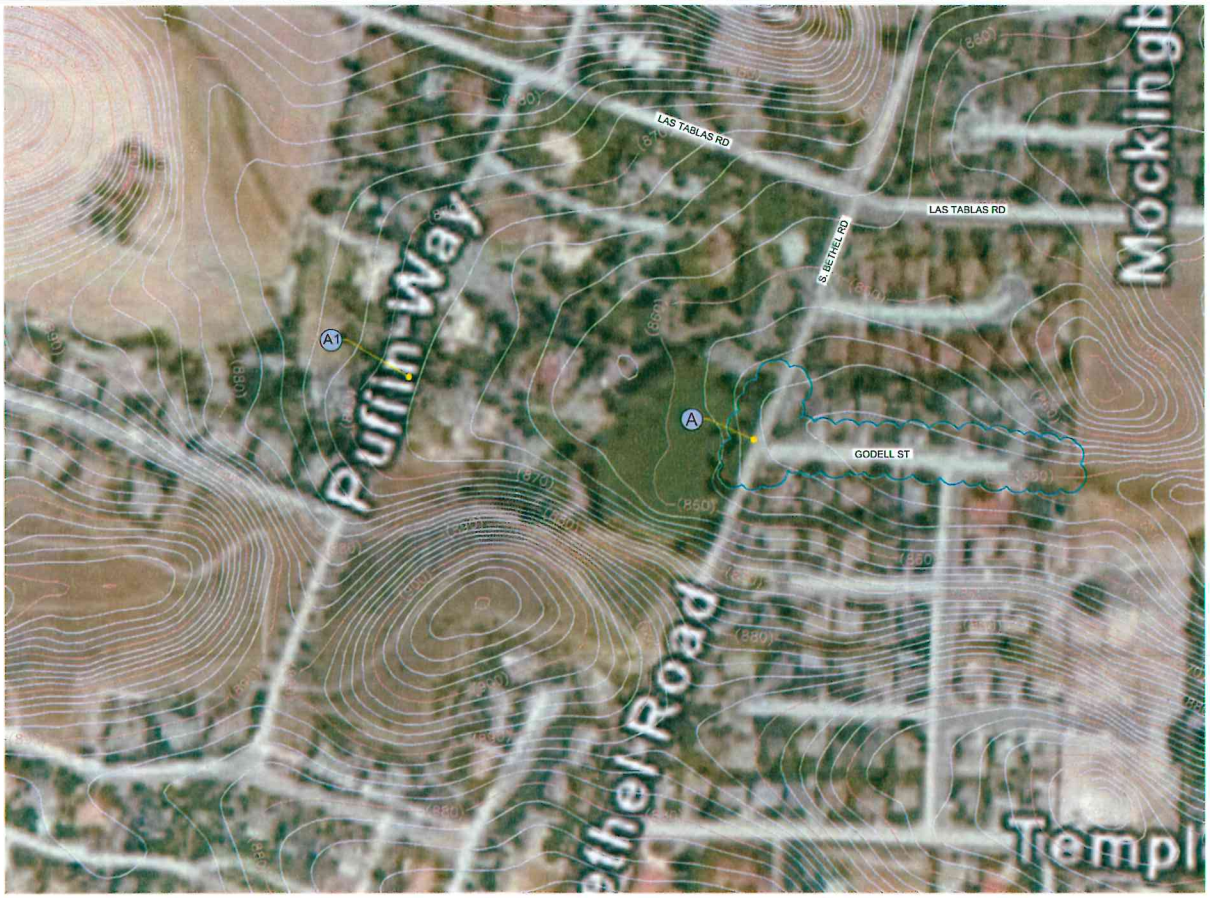
SCALE: 1"=200'

EXHIBIT E

PROJECT #4

DETENTION BASIN

NCE NORTH COAST ENGINEERING INC.
725 Crewton Rd Suite B, Paso Robles, 230-3127



LEGEND

B AREA OF INTEREST (STUDIED IN DETAIL IN THIS REPORT)

APPROXIMATE PROJECT BOUNDARY

0 100' 200' 400'

SCALE: 1"=200'

EXHIBIT F

PROJECT #5
DETENTION BASIN -
AREA OF INTEREST

NCE NORTH COAST ENGINEERING INC.
725 Crowton Rd Suite B, Paso Robles, 239-3127

LEGEND

B AREA OF INTEREST (STUDIED IN DETAIL IN THIS REPORT)

APPROXIMATE PROJECT BOUNDARY

N

0 100' 200' 400'

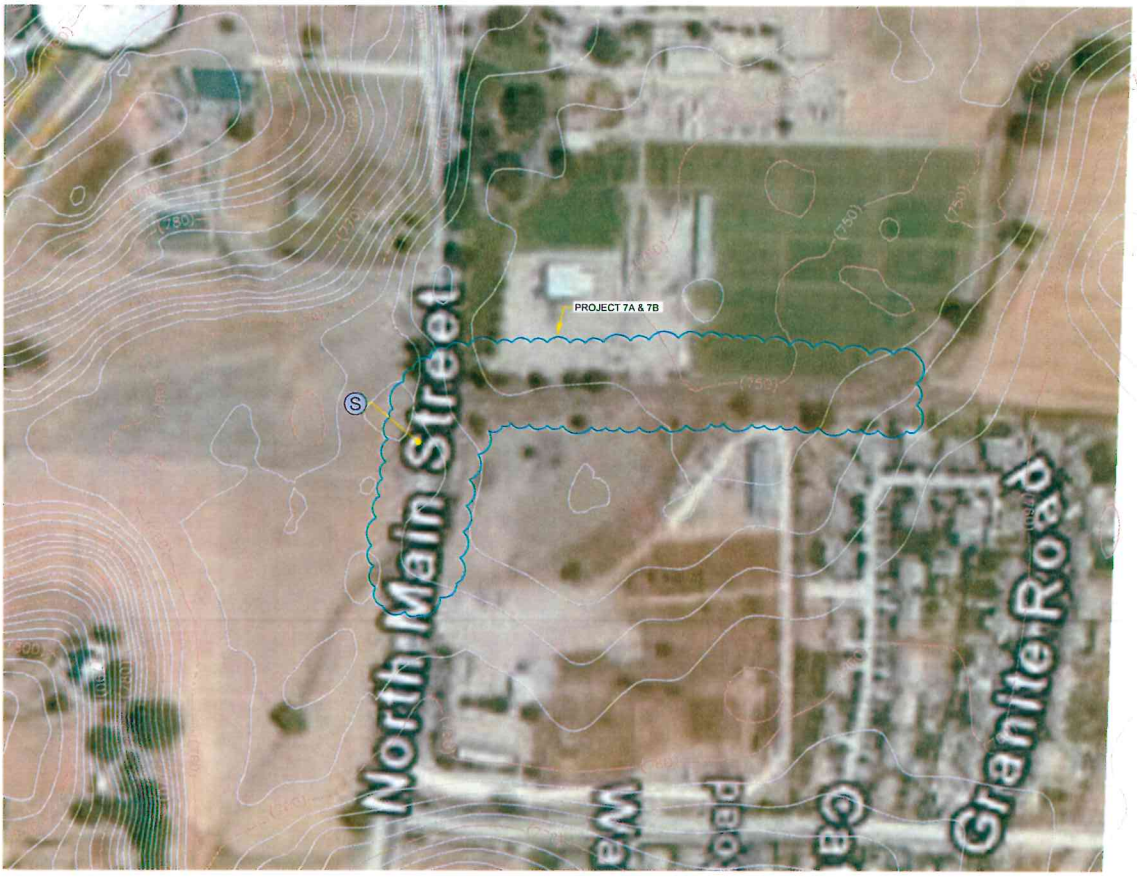
SCALE: 1"=200'

EXHIBIT G

PROJECT # 6

DETENTION BASIN

NCE NORTH COAST ENGINEERING INC. 725 Crowton Rd Suite B, Paso Robles, 230-3127



LEGEND

B AREA OF INTEREST (STUDIED IN DETAIL IN THIS REPORT)

APPROXIMATE PROJECT BOUNDARY

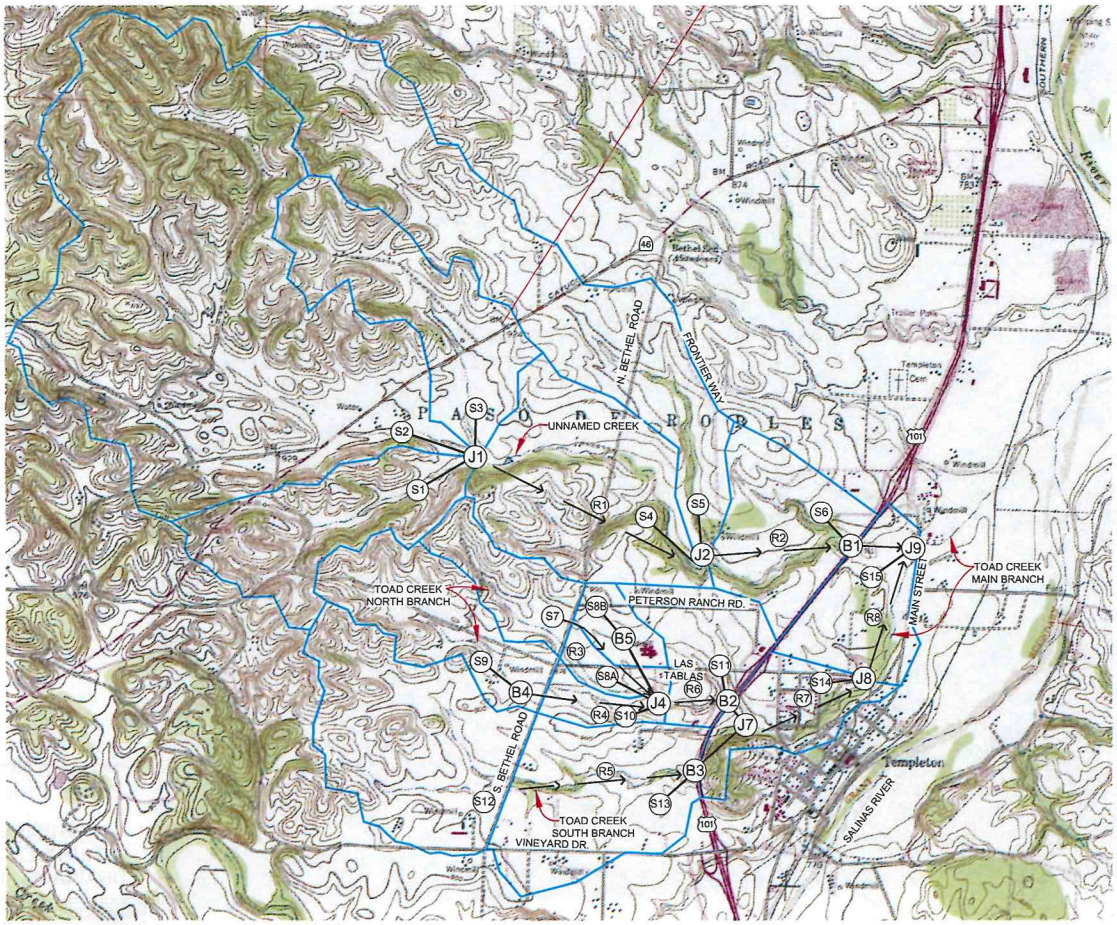
0 100' 200' 400'

SCALE: 1"=200'

EXHIBIT H

PROJECT # 7A & 7B
CHANNEL AND
CULVERT UPGRADE

NCE NORTH COAST ENGINEERING INC.
725 Crocker Rd Suite B, Paso Robles, 330-3127



DRAINAGE AREA SUMMARY

SUB BASIN #	AREA (IN AC)	CURVE NUMBER
1	270	69
2	1,360	70
3	310	70
4	380	67
5	645	71
6	215	62
7	110	77
8A	40	80
8B	50	81
9	210	71
10	45	78
11	150	72
12	375	71
13	295	71
14	135	70
15	160	62

LEGEND

ELEMENT CONNECTION
DIRECTION OF FLOW
SUB-BASIN BOUNDARY

HEC-HMS MODEL ELEMENTS

S1 SUB-BASIN
R1 REACH
J1 JUNCTION
B1 DETENTION BASIN

NOTE: SEE EXHIBIT B FOR ENLARGED VIEW OF DOWNTOWN AREA

0 1000' 2000' 4000'

SCALE: 1"=2000'

EXHIBIT I
OVERALL
DRAINAGE MAP

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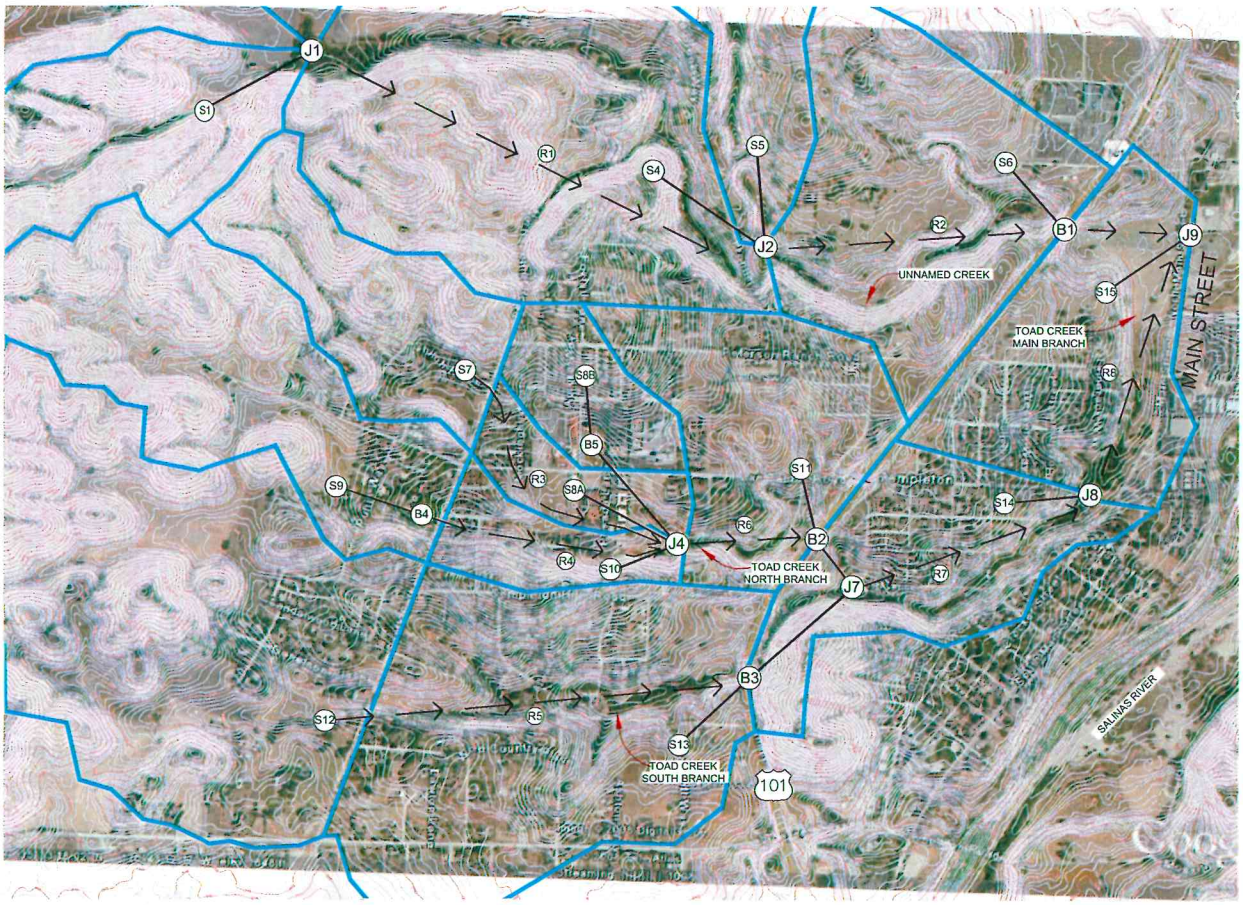
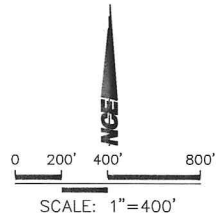


BASE FLOOD ELEVATIONS

SECTION	STATION*	BFE
		(FT)
A	5+90	761.3
B	15+90	763.3
C	20+70	769.7
D	26+90	773.8
LAS TABLAS (US)	29+35	776.9
E	32+30	779.3
F	37+00	780.4
G	38+40	780.5
H	41+30	780.7
I	42+40	782.7
J	43+90	784.2
EDDY (US)	44+60	784.7
K	45+20	784.9
L	46+40	785.5
SALINAS (US)	47+30	786.4
M	47+40	786.4
N	48+70	786.7
O	50+90	787.6
P	52+90	788.4
FLORENCE	54+73	792.7
Q	56+25	793.5
R	58+30	794.0
S	59+75	794.4
T	62+50	795.4
U	64+40	797.0
V	2+00	795.0
W	5+20	796.8

*NOTE: MAIN & SOUTH BRANCH STATIONING BEGINS AT MAIN STREET BRIDGE @ 1+00. NORTH BRANCH STATIONING BEGINS AT CONFLUENCE @ 0+00.



SCALE: 1"=400'

EXHIBIT K
TOAD CREEK
BASE FLOOD ELEVATIONS

NCE NORTH COAST ENGINEERING INC.
725 Crowton Rd Suite B, Paso Robles, 239-3127

Appendix II

Detailed HEC-HMS and Detention Calculations-Existing

TC - pages 1 &2 plus "wild creek"

djennings to: Debrish, Jeff, Greg O'Sullivan, Pelfrey, Bill, Ron Whisenand, Jim Wood, dflynn, jillian

02/15/2013 11:56 AM

From: djennings@tcsn.net

To: "Debrish, Jeff" <okdebrish@yahoo.com>, "Greg O'Sullivan" <gr8go@sbcglobal.net>, "Pelfrey, Bill" <wildbill-3@sbcglobal.net>, "Ron Whisenand" <kelpdiver@charter.net>, "Jim Wood" <jcw1942@tcsn.net>, dflynn@co.slo.ca.us, jillian@us-ltrcd.org

1 attachment

ToadCreekWatershedReport Feb 15 Pg1-2.doc

Hi everyone,

For those of you who were not there, yesterday we had a very productive meeting. However there is much yet to do. I've been revising the draft per that meeting. Please see attached - the first 2 pages for your consideration. Please send your comments to all.

Here is a suggestion for Recommendation #4 (page 10). What do you think?

new #4
Recognize that while Toad Creek is currently an unmanaged and uncontrolled creek any proposed creek management project in a revised study shall have as its highest priority to create and/or maintain a natural creek setting.

old #4
The draft study shall recognize that Toad Creek is a "wild creek" and recommended drainage improvements to that creek shall be consistent with the "wild creek" status.

Thank you in advance,
Dorothy