NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

FINAL
Engineering Study

Prepared for

Town of Windsor
Windsor, CA

Prepared by

2235 Mercury Way, Suite 150
Santa Rosa, CA 95407
(707) 523-1010

March 2012

NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

Project No. 02283-10-003

Prepared for: Town of Windsor
8400 Windsor Road
P.O. Box 100
Windsor, CA 95492

Prepared by:

_____

Matthew J. Winkelman, P.E.
Project Manager, Civil Engineer

Reviewed by:

_____

Toni Bertolero, P.E.
Project Principal

Winzler & Kelly a GHD Company
2235 Mercury Way, Suite 150
Santa Rosa, CA 95407
(707) 523-1010

March 2012

TABLE OF CONTENTS

EXECUTIVE SUMMARY ES-1
ES-1 Study Area and Land Use ES-1
ES-2 Existing Conditions ES-2
ES-3 Proposed Improvements for Buildout Conditions ES-4
1.0 INTRODUCTION 1
1.1 Purpose 1
1.2 Background 1
1.3 Study Area Description 3
1.4 Land Use 3
2.0 EXISTING UTILITY INFRASTRUCTURE 6
2.1 Sanitary Sewer System 6
2.2 Potable Water System 7
2.3 Storm Drainage System 9
2.4 Recycled Water System 10
2.5 Overview of Other Utilities 10
3.0 DESIGN CRITERIA 12
3.1 Design Standards 12
3.2 Planning and Engineering Reports 12
3.3 Sanitary Sewer 12
3.4 Potable Water 16
3.5 Storm Drainage 17
3.6 Recycled Water 18
3.7 Utility Undergrounding 20
3.8 Crossing of Sotoyome Creek 20
4.0 UTILITY INFRASTRUCTURE ANALYSIS 27
4.1 Sanitary Sewer 27
4.2 Potable Water 38
4.3 Storm Drainage 41
4.4 Sotoyome Creek 46
4.5 Starr Creek 53
4.6 Recycled Water 58
4.7 Utility Undergrounding 59
5.0 PLANNING-LEVEL ESTIMATES OF PROBABLE CONSTRUCTION COSTS 62

5.1 Unit Construction Costs 62
5.2 Project Costs 63
6.0 RECOMMENDED NEXT STEPS 69
7.0 REFERENCES 71

TABLES

Table ES-1 Summary of existing utilities 3
Table ES-2 Summary of recommended improvements 5
Table 1 Sanitary Sewer System Summary of Alternatives 37
Table 2 North Old Redwood Highway Area Utility Infrastructure Study - Storm Drainage Watershed Info 50
Table 3 Storm Drainage Recommendations Summary 58
Table 4 Project Cost Summary for Overall Sanitary Sewer System Improvements Alternative 3 Modified – Public Option 63
Table 5 Project Cost Summary for Overall Sanitary Sewer System Improvements 64
Alternative 3 Modified (phase 1; minimum alternative) 64
Table 6 Project Cost Summary For Overall Potable Water Main Improvements 64
Table 7 Project Cost Summary For Phase 1 Potable Water Main Improvements (minimum alternative) 65
Table 8 Project Cost Summary For Watershed E-F Storm Drainage Improvements 66
Table 9 Project Cost Summary For Watershed G Storm Drainage Improvements 66
Table 10 Project Cost Summary For Watershed I Storm Drainage Improvements 67
Table 11 Project Cost Summary For Watershed J Storm Drainage Improvements 67
Table 12 Project Cost Summary For Watershed M Storm Drainage Improvements 68

FIGURES

Figure E-1 Study Area Map ES-1
Figure E-2 Existing Utilities ES-3
Figure E-3 Recommended Improvements ES-5
Figure 1 Study Area Map 2
Figure 2 – Study Area Property Owners 4
Figure 3 – Creek/Bridge Crossing 24
Figure 4 – Recommended Sanitary Sewer Improvements 29
Figure 5 – Conceptual Sewer Pump Station Site Layout 36
Figure 6 – Recommended Potable Water Improvements 39

Figure 7 – Recommended Storm Drain Improvements 42
Figure 8 – Sotoyome Creek And Starr Creek Watersheds 44
Figure 9 – Utility Undergrounding 60

APPENDICES

Appendix A	Town of Windsor General Plan Land Use Map (Brelje & Race)
Appendix B	Old Redwood Highway Vision Plan – Conceptual Land Use Plan (RBF Consulting)
Appendix C	Exhibit B from *Master Trunk Sewer Plan* (Brelje & Race)
Appendix D	*Utility Undergrounding Investigation – Rule 20A, B & C* (Coastland)
Appendix E	Sanitary Sewer Alternatives (Figures)
Appendix F	Sonoma County Water Agency Comment Letter (February 14, 2012)
Appendix G	Sotoyome Creek Cross Sections
Appendix H	Sotoyome Creek HEC-RAS Model Results
Appendix I	Plate 1 from *Sonoma County Airport Area Recycled Water Irrigation Project* (Kennedy/Jenks)
Appendix J	Planning-level Estimates of Probable Construction Costs

EXECUTIVE SUMMARY

The North Old Redwood Highway Area Utility Infrastructure Study (study) was embarked upon to provide both the Town and developers utility infrastructure information for proposed future development. The study includes the evaluation of existing utility infrastructure and analysis of land use and planning resources for proposed future utility infrastructure.

The following utilities are evaluated in the study:

- Sanitary sewer
- Potable water
- Storm drainage
- Recycled water

Other utilities, namely overhead utilities and underground gas facilities were briefly reviewed, but not a focus of the study.



ES-1 Study Area and Land Use

The study area is shown in Figure ES-1 and is bound to the east by Highway 101, to the west by the North Pacific Railroad right-of-way, to the north by the Gateway Commercial Area, and to the south by Arata Lane.

The study area has a total of approximately 78 acres, not including public rights-of-way within the study area boundary. Further discussion on the development of the study area boundary is found in Section 1.3 of the study.

The Town's current General Plan (adopted in 1996 and updated in 2005) is used for land use assumptions. New development or redevelopment is assumed for all parcels in the study area. A Vision Plan was prepared for the Old Redwood highway area overlapping the study area. Although the plan was not adopted by the Town Council, it was used for information purposes since it provided general guidance for land use assumptions and the layout of Old Redwood Highway and other secondary roads within the study area.

The planning horizon for the current General Plan is 2015. The planning horizon for the Water Master Plan and 2010 Urban Water Management Plan is 2035. For this study, the build-out condition of the study area is used and is not tied to a specific planning horizon date.

ES-2 Existing Conditions

A summary description of the utilities evaluated in the study is shown on Table ES-1 and illustrated in Figure ES-2. The storm drain in Figure ES-2 only includes storm drain pipes and not ditches or culverts.

Included in Table ES-1 is a summary of the key deficiencies and limitations pertaining to the utility, under existing conditions. A brief discussion of overhead and other underground utilities are included in Section 2 of the study.

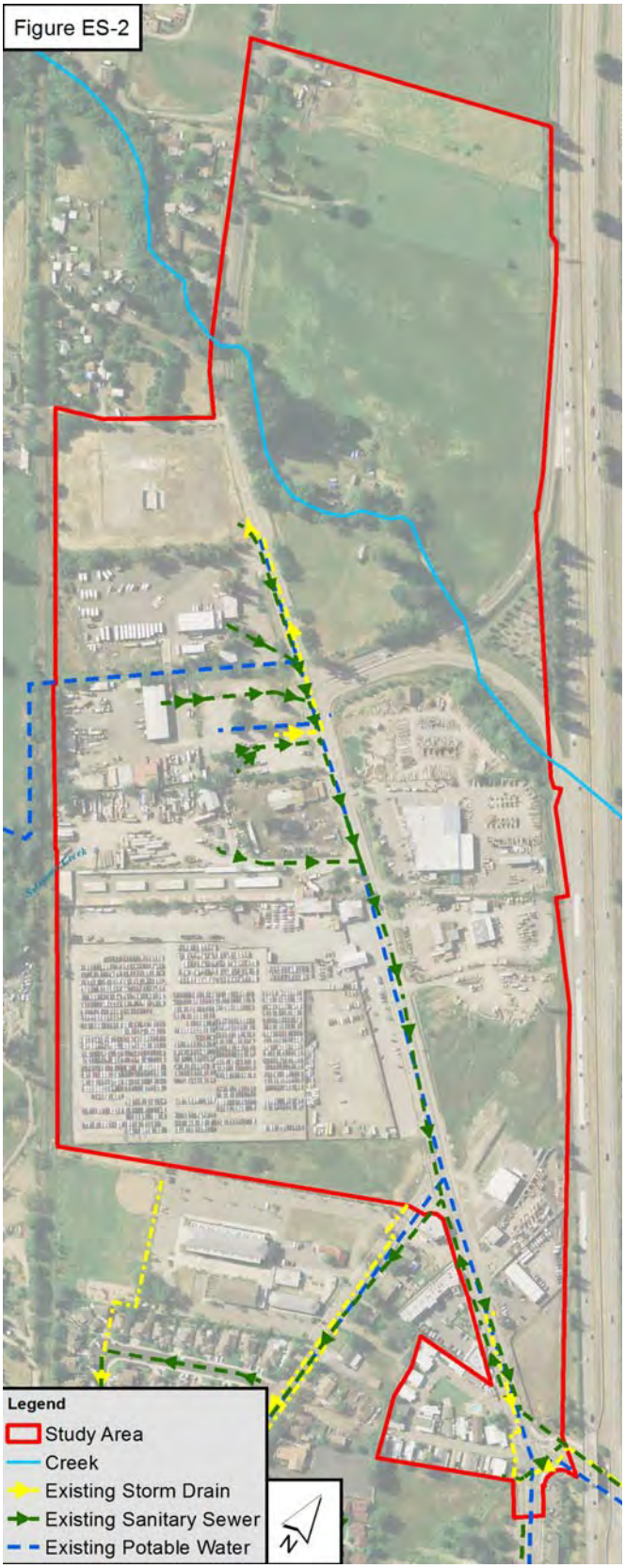


Table ES-1
Summary of Existing Utilities

Utility	Description	Comments
Sanitary Sewer	6-inch gravity main on Old Redwood Hwy discharges to 6-inch gravity main on Starr Road	No reserve capacity for Starr Road main to allow for additional flows from new development without expansion of system
	12-inch Los Amigos trunk gravity sewer that discharges to Arata Lane trunk gravity sewer	Los Amigos trunk planned to be the new sewer conveyance system for study area
	Private sewer pump stations and force mains connect some parcels to public system	Private sewer systems are the responsibility of individual parcels and tie into public system by permission (permit)
Potable Water	8- and 10-inch asbestos cement (AC) mains on Old Redwood Hwy that connect to 12-inch mains in Arata Lane, Starr Road, and 14-inch transmission main	Existing flow and capacity determined in Town *Water Master Plan* Existing 10-inch main is a hydraulic bottleneck between existing 12- and 14-inch transmission mains
Recycled Water	None.	Closest recycled water main is roughly a mile south of study area
Storm Drainage	18-inch storm drain on Old Redwood Hwy from Arata Lane on-ramp northerly to approximately 500 feet south of Sotoyome Creek	Minimal development in Sotoyome Creek watershed within study area; system does not have sufficient capacity for future development
	18-inch storm drain on Old Redwood Hwy from Arata Lane on-ramp southerly to Starr Road (to Starr Creek)	Starr Creek watershed is highly urbanized; system does not have sufficient capacity for future development
	Sotoyome Creek; drainage improvements consist of culverts and ditches that drain to creek	Parcels in the vicinity of the creek are in the 100-year flood plain; creek is unimproved and maintained by adjoining property owners

The existing utilities described in Table ES-1 are illustrated in Figure ES-2.

ES-3 Proposed Improvements for Buildout Conditions

A summary description of the recommended improvements for the utilities evaluated in the study is described on Table ES-2 and illustrated on Figure ES-3. A more detailed illustration of the recommended improvements is shown in Figure 4 (sewer), Figure 6 (water) and Figure 7 (storm drain).

The summary on Table ES-2 includes a public option and a private option for the sanitary sewer. The private option was the recommended alternative and includes private sewer pump stations for parcels in the northern portion of the study area. The private option was recommended due to having the lowest overall cost to the Town. The private option is also less dependent on the timing of development since each parcel is responsible for handling its own sewer service to an existing public sewer facility. However, the public option is recommended if there is sufficient development interest in the area, available right of way for a public pump station, and developer-financing of public improvements, combined with reimbursement agreements as future parcels develop.

Recycled water improvements are currently being investigated as the Town is embarking on a Town-wide Recycled Water Master Plan. Until the plan is completed, it is recommended that the recycled water main be extended along Old Redwood Highway to Windsor Road.

Potential funding sources identified in Table ES-2 include impact fees (paid by new development) and utility enterprise funds (paid through water and sewer rates).



Table ES-2
Summary of Recommended Improvements

Utility	Planning Level Cost Estimate	Description	Potential Funding Source(s)	Comments
Sanitary Sewer - Public Option	$2,973,000	Install new 8-inch gravity main from north end of study area to Sotoyome Creek	Sewer Enterprise Fund, Sewer Impact Fees	Impact fees are paid by new development
		Install new siphon structure at Sotoyome Creek crossing	Sewer Enterprise Fund, Sewer Impact Fees, Private Funding (Development)	Siphon proposed to avoid deep sewer main installation south of Sotoyome Creek
		Install new public pump station and 6-inch force main just south of Sotoyome Creek	Sewer Enterprise Fund, Sewer Impact Fees, Private Funding (Development)	Replaces existing private pump stations
		Install new 8-inch gravity main from Arata Lane off-ramp northerly to new public pump station	Sewer Enterprise Fund, Sewer Impact Fees, Private Funding (Development)	
		Replace existing 6-inch gravity main from Arata Lane off-ramp southerly to 12-inch Los Amigos Trunk Sewer with 12-inch main	Sewer Enterprise Fund, Sewer Impact Fees	Phase 1: Replace 250 feet of 6-inch gravity main at Starr Road intersection.
Sanitary Sewer - Private Option	$993,000	Install private pump stations and force mains to serve Parcel Nos. 8-15	Private Funding (Development)	
		Replace existing 6-inch gravity main from Arata Lane off-ramp southerly to 12-inch Los Amigos Trunk Sewer with 12-inch main	Sewer Enterprise Fund, Sewer Impact Fees	Phase 1: Replace 250 feet of 6-inch gravity main at Starr Road intersection.
Potable Water	$1,305,000	Install new 12-inch water main on Old Redwood Hwy from north end of study area to Starr Road	Water Enterprise Fund, Water Impact Fees	Phase 1: Install 1,100 feet of 12-inch water main on Old Redwood Highway from northern terminus of existing water main to Parcel No. 9 north property limit
Recycled Water	$1,750,000	Install new 12-inch recycled water main on Old Redwood Hwy and connect to existing main at Windsor Road	Sewer Impact Fees	Cost to extend recycled water main is $1.75 million; cost to connect individual parcels not developed at this time
Storm Drainage	$3,307,000	Replace portions of existing storm drain with new 18-inch storm drain on Old Redwood Hwy	Drainage Impact Fees	Minimal development in Sotoyome Creek watershed within study area
		Install new 42-inch main along study area boundary adjacent to railroad right-of-way	Drainage Impact Fees	Starr Creek watershed is highly urbanized
		Sotoyome Creek; drainage improvements consist of culverts and ditches that drain to creek	Drainage Impact Fees	Parcels in the vicinity of the creek are in the 100-year flood plain; creek is unimproved and maintained by adjoining property owners
Storm Drainage: Sotoyome Creek Bridge	$1,200,000	Replace existing bridge with new bridge structure capable of conveying projected peak flows	Drainage Impact Fees, Grant Funding	New bridge may be wider and have a greater span compared to existing bridge to facilitate road improvements

The planning-level costs are 2011 basis and includes construction, engineering, inspection and City administration costs. Refer to Section 5.2 for further details. Figure ES-2 illustrates the proposed improvements summarized in Table ES-2.

The proposed improvements shown in Table ES-2 could be phased depending on how, when and where development occurs within the study area. Refer to Section 6 of the study for a detailed discussion pertaining to phasing improvements.

To summarize, the recommended improvements are:

- Sewer. Replace existing 6-inch main to 12-inch main at south end of study area. (Note that these improvements are based on the private option which includes private property owner installation of private sewer pump stations to serve individual parcels.)

- Water. New 12-inch main from north end of study area to Starr Road.

- Recycled Water. Extend new 12-inch recycled water main on Old Redwood Highway to Windsor Road. (Note that recommended and proposed improvements will be determined by the Town's Recycled Water Master Plan currently underway. Town could require installation of "purple" pipe as a condition of approval as parcels develop in the study area.)

- Storm Drainage. New 18-inch storm drain on Old Redwood Highway; new 42-inch main along study area boundary adjacent to railroad right-of-way.

1.0 INTRODUCTION

1.1 Purpose

The purpose of this study is to provide both the Town and developers utility infrastructure information regarding potable water, sanitary sewer, storm drainage, recycled water, and overhead utilities for proposed future development and will provide the following guidance:

- Design criteria for utility planning for development in the study area;
- Utility information for Town-owned utility infrastructure in the study area;
- Capital improvement needs for "backbone" utilities for future development to tie into;
- Phasing of recommended capital improvements;
- Assessment of existing utilities in terms of adequacy to support future development in the study area, including limited evaluation of recycled water and utility undergrounding;
- Hydraulic modeling of storm drainage systems, including Sotoyome Creek; and
- Estimated cost splits between new development and existing users for capital improvements, as well as financing of the infrastructure improvements described in this study were not part of this study.

Recycled water assessment is substantially based on the *Sonoma County Airport Area Recycled Water Irrigation Project* prepared by Kennedy/Jenks Consultants. In addition, environmental documentation will need to be prepared prior to construction of any recommended infrastructure improvements.

The study area is bound to the east by Highway 101, to the west by the North Pacific Railroad right-of-way, to the north by the Gateway Commercial Area, and to the south by Arata Lane. The study area boundary is shown in Figure 1.

1.2 Background

The Town requested Winzler & Kelly prepare a utility infrastructure study of potable water, sanitary sewer, and storm drainage in the North Old Redwood Highway planning area to meet the intended purpose described above. The study includes the evaluation of existing utility infrastructure and analysis of land use and planning resources for proposed/future utility infrastructure. The planning horizon included in the Town's General Plan was used.

Based on previous utility studies and reports, the existing water, sewer, and storm drainage infrastructure within the study area is not adequate to support proposed development in the study area. It should be noted that the recommendations in this study are limited to within the study area and the existing utilities at the boundary of the study area, with the exception of the storm drainage system. Detailed study of the adequacy of existing downstream water and sewer utility infrastructure outside the study area is not included in this study but can be found in other utility master planning documents prepared for the Town. Limited study of downstream storm drainage systems is included, with study emphasis on the review of existing planning documents and limited hydraulic modeling analysis.



Town Boundary

Parcels

Study Area

N

0 250 500 Ft

1 inch = 500 feet printed at 8.5x11

WINZLER & KELLY

www.w-and-k.com

© Winzler & Kelly

Cartography: AF

Figure 1
Study Area Map

North Old Redwood Highway Area
Utility Infrastructure Study

TOWN OF WINDSOR

Town of Windsor

This study includes general information on the recycled water system in the study area. The information available at the time of the preparation of this study pertaining to the existing system as well as the recycled water master plan that is currently being conducted by others was provided to Winzler & Kelly for use in this study.

This study also includes general undergrounding information for overhead utilities along Old Redwood Highway in the study area, including a desktop evaluation of California Public Utilities Commission Rule 20 planning criteria, coordination with Pacific Gas and Electric Company (PG&E), and planning cost. The information gathered for this study was limited to information that was readily acquired by utilizing existing Town records, doing a summary site visit identifying visible overhead utilities, contacting PG&E, and the preparation of a summary figure for observations of existing overhead utilities (see Figure 9). This study did not include assessment of gas or other underground utilities not specifically mentioned herein.

The Town had been considering options for locating a new ballpark throughout various locations in the town limits as well as within the study area. However, this project did not materialize during the course of this study and therefore a qualitative analysis of the potential impacts on the utility infrastructure was not conducted.

1.3 Study Area Description

The study area boundary was discussed and verified with the Town as a preliminary step for this study. Based on that discussion, the study area was established to meet the following boundary conditions:

- Generally includes all parcels in the north Old Redwood Highway area designated for development or redevelopment;
- Contained within the Redevelopment Agency (RDA) boundary;
- Inclusion of the mobile home park parcel at the intersection of Arata Lane and Old Redwood Highway (Parcel No. 29); and
- Inclusion of the Old Redwood Highway right-of-way adjacent to Parcel Nos. 9-11.

The study area is shown in Figure 2, along with statistics for each parcel within the study area (i.e., parcel number, APN, property owner). The study area has a total acreage of 78.21 acres, which includes only parcel areas and not public rights-of-way within the study area boundary.

1.4 Land Use

General Plan

The land use that should be used as the basis of this study was also discussed and verified with Town staff as a preliminary step for this study. Consistent with other Town planning documents, this study uses the Town's current General Plan land use designations and assumes "Mixed Use" density of 16 Dwelling Units per Acre (DU/AC) for the parcels in the study area and the build-out condition. A copy of the Town's General Plan Land Use Map is provided in Appendix A. The land use basis in this study is consistent with the Town's Water Master Plan (June 2009; RMC) wherein land use density, for master planning purposes, is established to be 75 percent of the highest allowable use, or 12 DU/AC based on the following calculation:

Property ID	APN	Acreage	Property Owner
1	161-020-009	0.5	SSMP Properties LLC
2	161-020-008	0.9	SSMP Properties LLC
3	161-020-055	1.3	Jackson, Thomas L & Anita E
4	161-020-054	2.5	Sterling Savings Bank
5	161-030-045	0.5	Grill, Paul & Mark
6	086-170-038	3.7	Mascherini, Carole A
7	086-170-041	2.5	Mascherini, Carole A
8	086-170-044	3.4	Smith, Franklin Doyle & Marjorie Imogene
9	086-170-045	15.1	Smith, Franklin Doyle & Marjorie Imogene
10	086-170-016	10	Vandenbranden, Yves C
11	086-170-017	7.0	Sanderson Family Ltd
12	086-220-011	4.4	Nase, Werner JR
13	086-220-028	4.4	Windsor Unified School District
14	086-220-027	0.7	County of Sonoma
15	086-220-013	1.5	Crozat, Eugene A & Teri M
16	086-220-014	2.8	Martin, William T & Gaye L
17	086-220-015	0.7	Martin, Tom
18	086-220-016	0.9	Downer, Paul & Laraine
19	086-220-017	1.1	Von Arx, John W & Julie J
20	086-220-018	0.8	Downer Paul & Laraine
21	086-220-019	1.7	Von Arx, John W & Julie J
22	086-220-020	0.9	Faraudo Limited Partnership
23	086-220-021	1.2	Faraudo Limited Partnership
24	161-030-002	4.8	Castelli, Stephan Jr & Glenda
25	161-030-031	4.8	Castelli, Stephan Jr & Glenda
26	161-030-004	4.8	Castelli, Stephan Jr & Glenda
27	161-030-046	10	Zappelli, James J & Madeline
28	161-030-028	14	Zappelli, James J & Madeline
29	161-040-001	2.2	Nella, Helen & Roy

Town Boundary
Study Area
Creek

Highway 101
Highway 101 Off-Ramp
Highway 101 On-Ramp
Old Redwood Highway
Starr Road
North Pacific Railroad
Sotoyome Creek

0 200 400 ft

1 inch = 400 feet printed at 11x17

Sources: Santa Rosa GIS: Aerial 2009 1 foot resolution; Sonoma County GIS: Parcels; Winzler and Kelly GIS: Utilities.

WINZLER & KELLY
www.w-and-k.com

©Winzler & Kelly

Cartography	Date	Project #
AF	3/12/2012	0228310003

Figure 2
Study Area Property Owners

North Old Redwood Highway Area Utility Infrastructure Study

Town of Windsor

\\corp\wkprojects\sro\02283 - Town of Windsor\02283-10-003 North Old Rdwd Hwy Infra Study\GIS\Maps\Figures\Study Area Property Owners.mxd 9:28:30 AM

(16 DU/AC) x 75% = 12 DU/AC

- Land use density is assumed to be uniformly distributed throughout the study area;
- New development or Redevelopment is assumed for all parcels, including recently developed parcels (e.g., G&C Autobody; Parcel No. 15) and for anticipated development (e.g., Sanderson property; Parcel No. 11);
- The planning horizon for the current General Plan is 2015; the horizon for the Water Master Plan and Urban Water Management Plan is 2035. For this study, the build-out condition of the study area was used; and
- No new General Plan Amendments for the study area.

The application of land use is further discussed in the various analyses provided later in this study.

Vision Plan

A Vision Plan was prepared by RBF Consulting for the Old Redwood Highway area overlapping the study area. This plan was not adopted by the Town Council, but does provide some general guidance for land use assumptions and the layout of secondary roads within the study area. In the Vision Plan, secondary roads are shown within Parcel Nos. 12 to 26, which serves to demonstrate the need for access within these parcels for utilities and emergency access. Since the focus of this study is utility infrastructure within Old Redwood Highway, evaluation of utility routing and access within the parcels is not included. However, the watershed analysis for the storm drainage system does include recommendations for new pipelines within Parcel Nos. 24-26 and 28. For this reason, Figure 7 shows the approximate location of an access and utility corridor at the western boundary of those parcels.

A copy of the Vision Plan map is provided in Appendix B.

2.0 EXISTING UTILITY INFRASTRUCTURE

The description of the existing utility infrastructure provided herein is based on review of Town records, including record drawings from capital improvement projects and development projects, site walk to make initial assessment of existing utilities, limited site survey to verify the location of various existing utilities, and various field meetings with Public Works staff regarding sewer, water, and storm drainage utilities.

2.1 Sanitary Sewer System

Overview of Sanitary Sewer System

The following description of the Town's sanitary sewer system is based on the Town's April 2000 *Master Trunk Sewer Plan* (Brelje & Race):

Windsor's current wastewater collection system includes approximately 79 miles of public collection and trunk sewer, 1,400 manholes, 525 cleanouts, three Town-owned and operated lift stations, and a 7.2-million gallon per day (mgd) water reclamation facility. Existing pipelines range in diameter from 4- to 42-inches, and include two siphons. Approximately half of the existing collection system is comprised of 4- and 6-inch pipelines. The original collection system was put into service in 1964; the sewer system has expanded over time to provide service to new service developments and capacity for the overall system.

North Old Redwood Highway Area Existing Sanitary Sewer System

The existing sanitary sewer system within the study area consists of a 6-inch gravity sewer main that connects to the existing sewer system in Starr Road. The Starr Road sewer system generally flows to the south and is tributary to the North Trunk Sewer (see Exhibit B from the *Master Trunk Sewer Plan* provided in Appendix C). There are private pump stations and force mains for the northernmost connections to the sewer system in the vicinity of the Arata on/off ramps, including Parcel Nos. 13, 15, and 16. Parcel Nos. 8-11 are not connected to the Town sewer system; Parcel No. 11 has an abandoned private pump system is also not currently connected to the Town sewer system. These parcels require either extension of the public sewer system across Sotoyome Creek or private improvements to cross the creek to provide sewer service. Parcel No. 29 was connected to the 12-inch Los Amigos Trunk Sewer (also shown on Exhibit B) after 2000 with a new 6-inch pipe. The Town notes that the pipe was crushed by concrete construction over the top of the pipe. This is evident by the sag in the pipe.

The Los Amigos Trunk Sewer extends to Old Redwood Highway from Arata Lane. According to the *Master Trunk Sewer Plan*, the Los Amigos Trunk Sewer is planned to be the new downstream conveyance system for the study area.

Existing Sanitary Sewer Capacity

The existing 6-inch sewer within the study area has a hydraulic capacity of approximately 150 gallons per minute (gpm), or 0.22 million gallons per day (mgd). Flow into the sewer system comes from various commercial customers. Flow is primarily by gravity, though the northern portion of the study area that is connected to the sewer system utilizes private pump systems to convey flows. The Town has not reported any capacity issues with the existing 6-inch sewer

main in Old Redwood Highway; there have been no reported sanitary sewer overflows (SSOs) within the study area.

According to the Master Trunk Sewer Plan, the existing 6-inch sewer main in Starr Road has no reserve capacity. The capacity of the Los Amigos Trunk Sewer is approximately 1.13 mgd, which will be described in more detail in the utility infrastructure evaluation section of this study.

Existing Sanitary Sewer Demand
As stated in the December 2008 Technical Memorandum titled *Draft North Old Redwood Highway Sewer Capacity Study* prepared by Winzler & Kelly, the existing peak wet weather flow (PWWF) from the study area is approximately 167 gpm (0.24 mgd). As noted above, no capacity problems have been observed for the existing sewer system, so the demand exceeding the hydraulic capacity has not yet shown to be a problem in this portion of the Town's sewer system. The anticipated demand for redevelopment of the study area will exceed the capacity of the existing sewer system and will require the installation of a new sewer line within the study area.

2.2 Potable Water System

Overview of Potable Water System
The following description of the Town's potable water system is taken from the September 2011 *Water Master Plan Update* prepared by RMC (WMP):

The Town of Windsor's water service area includes all areas within the limits of the Town of Windsor. The Town's distribution system is comprised of approximately 136.6 miles of predominantly polyvinyl chloride (PVC) and the pipe diameters range from 4 to 18 inches. The majority of the Town's system has been installed within the last 12 years and is reportedly in good condition.

The Town owns and operations four storage tanks in the primary pressure zone (Zone 1), 12 storage tanks in smaller (and higher elevation) pressure zones, 5 river wells, and 3 off-river wells - two of which are designated for emergency use only. The water system storage capacity is approximately 5 million gallons (MG) located in the primary pressure zone and also serves three small pressure zones in the Shiloh Estates and Mayacama subdivisions located in the hills (east of the Town). The Shiloh and Mayacama area, along with the Airport area located in the southern portion of the town are served water through outside service agreements.

The Airport Service Area includes approximately 746 acres, according to the Specific Plan for the area. The Airport Service Area distribution system includes approximately 10.5 miles of mainly PVC pipeline with pipe diameters ranging from 6 to 12 inches. In the southern portion of the Airport Service Area, the 12-inch water main that runs along Laughlin Road connects to the Sonoma County Water Agency's (SCWA) 36-inch diameter Santa Rosa Aqueduct line (Brown and Caldwell, 2007). [Chapter 1]

The Water Master Plan includes recommendation for two future storage tanks for the water system: 1) New 3.0 MG storage tank on Chalk Hill Road (WMP Project ST-1); and 2) New 1.5 MG storage tank in Lakewood Hills (WMP Project ST-2).

North Old Redwood Highway Area Existing Potable Water System

The existing potable water system within the study area consists of a 10-inch asbestos cement (AC) water main that connects to water mains in Arata Lane and Starr Road. The existing 10-inch main also connects to a 14-inch water transmission main in the public easement between Parcel Nos. 14 and 15. The 14-inch main connects to the Town's well field. The existing system within the study area also includes an 8-inch AC dead-end main beyond the 10-inch main. Figure 6 shows the location and size of the existing water system. Town water is not currently available for Parcel Nos. 9, 10, and 11. Connection to Town water for these parcels would require the future water main to cross Sotoyome Creek.

Potable Water Supply

The Water Master Plan (WMP) states that there is adequate water supply on an average annual basis to meet existing demands until 2020. It also presents various options for new water supply development, including enhancement of existing sources, groundwater withdrawal beneath the Windsor-Fulton sedimentary unit, groundwater banking and withdrawal beneath the Windsor-Fulton unit, expanded use of recycled water, water transfers and regional water management, and water conservation and other demand management strategies. There are no proposed well sites within the North Old Redwood Highway Area study area. The nearest well is the North Area Well. According to the draft WMP, the nearest potential well field locations to the study area are the Hiram Lewis Park Area and Keiser Park Well Area (WMP Figure 3-4).

Potable Water Demand

The following information is based on Chapter 2 of the September 2011 WMP:

*With an assumed average household occupancy of 2.9 persons per household, the average household use is estimated to be 319 gpd/DU (110 gpd/capita * capita/DU).*

For the North Old Redwood Highway Area Study, the water demand factor used is 319 gpd/DU, consistent with the WMP. Table ES-1 in the Executive Summary from the WMP provides current and future demand for the potable water system:

Table ES- 1: Total Water Demands to be used in Model

Demand Scenario	Demand (mgd)
Current Conditions	
Average Day	3.98
Maximum Day	7.45
Maximum Day plus Fire Flow	7.45 + 1,500 gpm or 3,000 gpm
Peak Hour	11.18
Future Conditions	
Average Day	6.36
Maximum Day	12.08
Maximum Day plus Fire Flow	12.08 + 1,500 gpm or 3,000 gpm
Peak Hour	18.44

The WMP evaluates water supply and demand for the North Old Redwood Highway study area. Recommendations from the plan are described in the utility infrastructure analysis section later in this study.

2.3 Storm Drainage System

Overview of Storm Drainage System

The Town's existing storm drainage system is tributary to five major creeks that all eventually connect to the Russian River: 1) Windsor Creek; 2) East Windsor Creek; 3) Pool Creek; 4) Pruitt Creek; and 5) Starr Creek. The Town also has other minor creeks within its overall watershed, including Sotoyome Creek at the north end of the North Old Redwood Highway study area.

The urbanized portions of the Town's storm drainage system are comprised of a series of culverts, trunk pipelines, and open ditches that convey stormwater into the various creeks. The storm drainage system has been expanded and upgraded over time to provide adequate conveyance of stormwater through the Town. To protect and enhance the water quality of the creeks and waterways that flow through the town, the Town adopted Stormwater Quality Ordinance 2008-249. The ordinance focuses on activities that affect the water quality of the creeks and provides guidance for measures that are taken by the Town and its residents.

North Old Redwood Highway Area Existing Storm Drainage System

The existing storm drainage system in the Old Redwood Highway study area is comprised primarily of roadside culverts and ditches. The culverts range in size from 8- to 18-inches in diameter. There are also two trunk storm drain pipelines within the study area: 1) An 18-inch pipeline constructed by the G&C Autobody development (Parcel No. 15) that runs between the Arata on/off ramps and a tie-in point to the north in front of Parcel No. 13; and 2) A 15- to 24-inch pipeline constructed by the Estrella's Market development (southwest corner of Old Redwood Highway and Starr Road) that conveys runoff to the south. Figure 7 shows the location and size of the existing storm drainage system.

The study area is split into multiple sub-watersheds that are either tributary to Starr Creek (southern end of study area) or Sotoyome Creek (northern end of study area).

The Starr Creek watershed is highly urbanized where it overlaps with the study area, consisting of a mix of small to large pipelines and ditches/waterways. The watershed generally drains in a northeasterly to southwesterly direction, ultimately reaching Starr Creek.

Development within the Sotoyome Creek watershed is minimal and mostly consists of single family residences and various semi-rural parcels. This watershed generally drains in a east to west direction, collecting upstream stormwater runoff on the east side of Highway 101 where stormwater is conveyed in pipelines under the highway and ultimately to Sotoyome Creek. The creek passes under the Sonoma Marin Area Rail Transit (SMART) right-of-way at the western boundary of the study area. Within the study area, storm drainage improvements for the watershed consist of culverts and ditches that drain to the creek.

Existing Storm Drainage System Capacity
The Town has not reported any instances of flooding within the study area, though localized flooding may have occurred at some point in the past. Engineering analysis and plans for development within the Town (including the study area) are reviewed by the Sonoma County Water Agency (SCWA) to ensure proper hydraulic capacity within the new and existing storm drainage systems. Detention of stormwater is recommended where the downstream, existing storm drainage system would be impacted by upstream development. Previous and new recommendations for onsite detention will be described in the utility infrastructure analysis section of this study.

Existing Storm Drainage System Demand
Demand on the existing storm drainage system comes from the mix of commercial developments within the study area and stormwater flows from upstream watersheds. The June 1989 *Windsor Area Master Drainage Plan* (Sonoma County Water Agency) as well as the Program Report Windsor Cumulative Drainage Impact Mitigation Program Update (Boyle, 1999) were used to define major watershed boundaries and to define design flows. Improvements are based on the conveyance of stormwater both within and downstream of the study area. Off-site flows routed through the project watersheds were also taken from the SCWA Master Plan though flows were compared and matched closely with design flows from the Boyle Study. Analysis for redevelopment of the study area and the recommendations from the 1989 SCWA Plan and 1999 Boyle Study are described in the utility infrastructure analysis section of this study.

2.4 Recycled Water System

Overview of Recycled Water System
The Town's water reclamation facility produces Title 22-quality effluent that is suitable for reuse within the Town's water service area. The reclamation facility currently has five effluent storage ponds with a combined storage capacity of approximately 122 million gallons (MG) and an effluent pump station that has an approximate pumping capacity of 5,000 gpm (7.2 mgd). The Town currently uses recycled water for irrigating residential landscape, industrial and commercial landscape areas, parks and landscape strips, vineyards, pasture land, Windsor Golf Course, and Windsor High School fields.

The Town's recycled water system does not currently extend to the North Old Redwood Highway study area. The closest recycled water main is located approximately 4,500 feet south of the study area within Windsor Road. The Town's current (2010) planning effort for the recycled water system – *Sonoma County Airport Area Recycled Water Irrigation Project* (Kennedy/Jenks Consultants) identifies recycled water demands, including the eventual extension of a recycled water main into the North Old Redwood Highway study area. Further information is provided in the utility infrastructure evaluation section of the study.

2.5 Overview of Other Utilities

Overview of Overhead Utilities
The types of existing overhead utilities within the study area described herein are based on visual observation of the study area and not based on detailed coordination with utility providers. Observed overhead utility lines consist of low and high voltage (12 kV) power lines (PG&E) and communication lines (Comcast and AT&T). Overhead lines are supported by various utility

poles located on both sides of Old Redwood Highway within the study area. Dry utilities are located underground on the west side of Old Redwood Highway across from Parcel Nos. 2 and 3. Conduits for future undergrounding were also installed along the frontage of Parcel No. 15 (G&C Autobody).

Overview of Other Underground Utilities

There are other utility pipelines located within the study area. While these utilities are not a focus of this study, their presence within the study area is important to note, such that redevelopment of the study area will need to account for both the location of those utilities and potential extension/upgrade of the pipelines and associated facilities.

Based on site walk observations, there is an existing gas main located on the east side of Old Redwood Highway at or beyond the east side road shoulder. There is also some evidence of underground fiber optic lines along the west side of Old Redwood Highway, though the exact location was not determined in this study. There may also be other underground utility lines, of varying size and condition. A thorough investigation of both underground and overhead utilities should be conducted during future detailed design of utilities within the study area. Recommendations for new utilities should be checked based on future location and characterization of all utilities within the study area.

3.0 DESIGN CRITERIA

The purpose of providing design criteria in a utility infrastructure study is to provide the basis for this study's planning-level analysis and guidance for future detailed engineering analysis. Design criteria are provided in this section for potable water, sanitary sewer, and storm drainage utilities in the study area. Design criteria for recycled water, undergrounding of overhead utilities, and criteria applicable to other utilities (i.e., gas, underground communication lines) are not provided in this study.

There are two types of planning documents that are used for utility infrastructure planning for the Town and for the study area: 1) Design Standards; and 2) Planning Reports.

3.1 Design Standards

The Town's July 2009 *Design and Construction Standards* (and May 2010 revisions) and current City of Santa Rosa design standards provide requirements and guidance for the design and construction of underground utilities. The Town's standards focus on sanitary sewer, potable water, and storm drainage utilities. The Santa Rosa standards provide additional information for these utilities and for recycled water. The following section notes where Santa Rosa standards are referenced.

3.2 Planning and Engineering Reports

Various planning and engineering reports provide information and evaluation of the Town's utility infrastructure. These reports typically reference design criteria from the Town and other relevant standards (i.e., Caltrans, SCWA, Department of Health Services, etc.) and provide detailed evaluation for a particular utility. The planning and engineering reports that were referenced for the preparation of this study are provided below. This study provides a summary of the design criteria from these guidance documents.

- Potable Water System: *Draft Water Master Plan Update*, June 2009, RMC
- Potable Water System: *2005 Urban Water Management Plan*, June 2007, Brown and Caldwell
- Sanitary Sewer System: *Master Trunk Sewer Plan*, April 2000, Brelje & Race
- Sanitary Sewer System: *North Old Redwood Highway Sewer Capacity Study, Draft Technical Memorandum*, December 2008, Winzler & Kelly
- Storm Drainage System: *Windsor Area Master Drainage Plan*, June 1989, Sonoma County Water Agency
- Storm Drainage System: *Windsor Cumulative Drainage Impact Mitigation Program Update Report*, September 1999, Boyle Engineering
- Recycled Water System: *Sonoma County Airport Area Recycled Water Irrigation Project*, November 2010, Kennedy/Jenks Consultants

3.3 Sanitary Sewer

The following criteria are taken from the Town's *Design and Construction Standards*, *City of Santa Rosa Standards*, and/or *Master Trunk Sewer Plan* for the gravity and force main portions

of the sanitary sewer system. The "Alignment", "Pipe Material", and "Manholes and Cleanouts" sections describe the geometry of the sewer system. Other sections describe hydraulic design considerations.

Alignment

- In general, the State of California, Department of Health Services document entitled "Criteria for the Separation of Water and Sanitary Sewer Main" is followed;
- Horizontal separation from storm drains shall be minimum five feet clear;
- Horizontal separation from other utilities, such as gas, underground electric, underground television cable, etc., shall be a minimum of four feet clear between the pipes;
- Vertical separation at utility crossings (City of Santa Rosa): Generally provide a minimum of six inches of vertical separation from storm drains or other utilities, such as gas, underground electric, underground television cable, etc.;
- Vertical curves in gravity sewer mains are not allowed (City of Santa Rosa); and
- Depth of Cover: The minimum depth of cover is 24 inches. Minimum cover of 36 inches is recommended. Where cover is less than 36 inches, ductile iron pipe must be used.

Pipe Material (Gravity Sewer)

Gravity sewer mains shall be PVC SDR 35, Acrylonitrile-Butadiene-Styrene (ABS) SDR 35, or ductile iron pipe. Ductile iron pipe shall be polyethylene encased (for corrosion protection). Based on anticipated shallow depths of cover and vehicle "live loading" within Old Redwood Highway, a lower SDR (e.g., SDR 26) may be required for the use of PVC pipe. Detailed design may also find the need for a stronger plastic pipe (e.g., AWWA C900 pipe).

Manholes and Cleanouts

- A manhole is required at every horizontal or vertical change in alignment;
- The maximum distance between manholes shall be 300 feet and minimize the number of manholes. [The Town may consider increasing the spacing between manholes for the new trunk sewer. That effort should include coordination with operations and maintenance staff and specific review of manhole positioning];
- A manhole is required at the end of every main, except as otherwise specified below;
- Cleanouts may be installed in lieu of manholes at the end of a sewer main where the distance is less than 200 feet to the nearest manhole and the main size is 8 inches or less;
- Provide sufficient drop through the manhole to compensate for energy loss caused by change of alignment. A minimum drop of 0.10 feet is required for deflection angles greater than 30 degrees.

Pipe Material Coefficient (Manning's 'n')

Pipe capacities depend on many factors including slope, pipe roughness, and the pipe shape. The Continuity equation and the Manning equation for steady-state flow are used to calculate flow in a sewer pipe. The Manning coefficient 'n' is a friction coefficient and varies with respect to pipe material, size of pipe, depth of flow, smoothness of pipe and joints, and extent of root intrusion. For sewer pipes, the Manning coefficient typically ranges between 0.011 and 0.017.

The Town's current standard states: *Use n=0.011 for new pipe and n=0.015 for the existing system or manufacturer's recommendation, whichever is higher*. The *Master Trunk Sewer Plan*

utilizes a value of n=0.011, which is the design criterion used for evaluation of new sewer facilities for this study to provide consistency with the Town's existing master plan.

d/D Ratio

The design capacity of a pipeline is often determined by a set ratio of the design flow depth "d" to the pipeline diameter "D" or "d/D." When designing gravity sewer pipelines, it is common practice to set flow depth criteria by the size of the pipeline. Design d/D ratios typically range from 0.5 to 0.9. The maximum capacity of gravity sewers occurs at a d/D ratio of about 0.9, but using 0.7 provides a safety factor for the potential buildup of solids before scheduled maintenance can occur, regardless of the pipe diameter.

Although a d/D ratio of 0.7 may be appropriate for new and future sewers, applying this maximum ratio to existing sewers may lead to an increased number of improvements that may not necessarily be needed. For this reason, existing sewers should be considered adequate if they flow at a d/D of 0.9 (essentially full) or less and deficient if the flows exceed the 0.9 ratio. Exceeding the 0.9 ratio would indicate the pipeline is likely to surcharge. Capacity improvements identified for pipelines marginally exceeding the 0.9 ratio and in generally good structural condition should be considered a lower priority than projects where the d/D ratio exceeds 0.9 by a large margin.

The Town has established the use of the City of Santa Rosa's d/D ratio for its hydraulic analyses. The hydraulic evaluation for the West Trunk uses a d/D ratio of 0.75 for existing pipeline diameters less than or equal to 15 inches and a d/D ratio of 0.9 for existing pipeline diameters greater than 15 inches.

The Town's *Design and Construction Standards* and *Master Trunk Sewer Plan* do not provide specific guidance for the selection of a target d/D ratio, though both documents state that all gravity sewers shall be designed to achieve a minimum velocity of 2 feet per second (fps) when flowing full. This implies that the maximum d/D ratio should be 0.9, which is essentially the same as d/D=1.0. Evaluation of the Los Amigos Trunk Sewer within the *Master Trunk Sewer Plan* uses a d/D ratio of 1.0 in consideration of future tributary flows (from the study area).

Pipe Size and Design Velocities

The minimum diameter of a public sewer main shall be 8 inches. Evaluation provided herein for the sewer mains in the Old Redwood Highway study area range in size from 8- to 12-inches in diameter.

All gravity sewers shall be design to achieve a minimum velocity of 2 fps when flowing full and shall have a maximum velocity of 8 fps. The Town Engineer may allow for variation to the minimum and maximum velocities on a case-by-case basis.

Flow Peaking Factor

According to the *Master Trunk Sewer Plan*, the peaking factor for the Town could vary from 2.6 for the ultimate service area at build-out to 4.5 within small tributary areas. Given the small size of the study area (78 acres), a peaking factor of 4.5 is recommended, and used in the hydraulic

evaluation provided in this study. The peaking factor should be refined during the detailed design phase, or further evaluated as a part of the Town's future sewer master planning efforts.

Infiltration and Inflow (I/I) Flow Generation Factors

According to the *Master Trunk Sewer Plan*, hydraulic evaluation for the sanitary sewer system should use an infiltration rate of 400 gallons per acre per day (gpapd) and inflow rate of 1,500 gpapd for existing sewers. The Plan recommends a reduction of the inflow contribution in new areas (i.e., redevelopment of the study area) from 1,500 to 400 gpapd. The result of combining these flow generation factors is a combined I/I factor of 800 gpapd.

Pump Stations and Force Mains

The Town does not have current standards for pump stations and force mains. The following design criteria are presented as recommendations based on flow conditions for the study area.

Standby Power

Standby power is recommended for all public pump stations. This would be an engine generator with sub-base fuel tank and sound enclosure. The generator should be able to provide power for full load of the pump station for 24 hours.

Firm Capacity

Pump stations should be designed to a duty-standby configuration for pumps. This means that the peak flow anticipated for the pump station can be handled by one less than the total number of pumps. For example, two pumps would be in operation during peak demand and one additional pump would remain in standby, ready for operation in the event of a pump failure or greater than anticipated flows.

Pump Selection

Submersible pumps are recommended for use in the study area based on the anticipated size of the pump stations (420 gpm and less), especially for private pump stations where the maximum flow rate would be lower than 100 gpm. Private pump stations should consider the use of positive displacement grinder-style pumps due to anticipated low flow rates.

Force Mains

The minimum diameter for a force main should consider passing of a 3-inch diameter solid. As such, the minimum recommended diameter is 3 inches, though larger diameters are preferable for maintenance. Smaller diameter force mains (i.e., 2 inches for small, private pump stations) may be considered by the Town based on justification by the design engineer for system hydraulics. 4- to 6-inch diameter force mains are recommended in this study for the various sewer system alternatives.

The pipe material for force mains shall be consistent with the materials requirements for water mains:

- 6- to 12-inch water mains shall be PVC C900, Class 150 minimum, or ductile iron pipe, C151, Class 50 minimum.
- Ductile iron pipe must be polyethylene encased and have approved cathodic protection

- Where the normal main line static pressure exceeds 150 psi, ductile iron pipe or Class 200 PVC shall be used.

For trenchless crossing of Sotoyome Creek, horizontal directional drill (HDD) construction would likely utilize fusion-welded HDPE pipe.

3.4 Potable Water

The following criteria are taken from the Town's *Design and Construction Standards*, *City of Santa Rosa Standards*, and/or Appendix A – Performance and Design Criteria in the Town's *Water Master Plan* for the potable water system.

Alignment

- In general, the State of California, Department of Health Services document entitled "Criteria for the Separation of Water and Sanitary Sewer Main" is followed;
- Minimum horizontal separation from existing gas, electrical, and telephone lines shall be 3 feet between pipes;
- Minimum clear horizontal separation from a metallic pipeline with an induced current shall be 5 feet;
- Minimum clear horizontal separation from a storm drain shall be 5 feet;
- Minimum cover shall be 36 inches for 6- and 8-inch mains and 44 inches for 12-inch and larger mains. Where the minimum cover is greater than 30 inches, but less than the standard cover, Class 50 ductile iron pipe shall be required. The minimum cover shall not be less than 30 inches;
- Water main shall be installed above wastewater and storm drain lines with a minimum clearance of 12 inches;
- Where cover exceeds 8 feet, special permission from the Town Engineer is required; and
- Service laterals must have minimum cover of 3 feet at the property line and 18 inches for building sewers.

Pipe Material

- 6- to 12-inch water mains shall be PVC C900, Class 150 minimum, or ductile iron pipe, C151, Class 50 minimum.
- Ductile iron pipe must be polyethylene encased and have approved cathodic protection
- Where the normal main line static pressure exceeds 150 psi, ductile iron pipe or Class 200 PVC shall be used.

Size

- Water mains must be sized to meet minimum Fire Code requirements (see below)
- For residential/commercial installations, public and private mains shall be 8 inches minimum. 6-inch minimum is suitable where fire hydrants are not served
- For industrial installations, looped system shall be a minimum 8 inches in diameter, a dead end system requires a minimum 12-inch diameter pipe
- The Town Engineer may require increased pipe size for overall system benefit

Fire Hydrants

In commercial areas, fire hydrants shall be spaced every 300 feet or as approved by the Fire Chief. Hydrants shall be evenly distributed throughout a project area and no building may be more than 150 feet from the nearest hydrant.

Distribution System Design

The design considerations provided below should be followed for design of new potable water mains and associated distribution systems.

Fire Flow

The minimum fire flow required in commercial areas shall be 1,500 gpm with a 20-psi residual. Appendix I11-A of the *Uniform Fire Code* shall be considered for fire flow design, as its use may result in a larger fire flow requirement.

System Pressure

The maximum allowable main line pressure shall be 120 psi measured at a fire hydrant; the maximum allowable service pressure measured at a faucet shall be 80 psi. The minimum service pressure measured at a faucet shall be 35 psi, unless otherwise approved by the Town Engineer.

Peaking Factor

- Average Day Demand (ADD): DU x Water Demand Factor
- Maximum Day Demand (MDD): 1.9 x ADD
- Peak Hour Demand (PHD): 2.9 x ADD

Water Demand

- Persons per Household: 2.9
- Unit Water Demand Factors: 110 gallons/capita
- Water Demand Factor: 319 gpd/DU (2.9 persons per household * 110 gallons/capita)

Pipe Design

- The minimum pipe size for commercial installations (for both public and private mains) shall be 8 inches. The main size may be reduced to 6 inches where fire hydrants are not served.
- The maximum velocity shall be 10 fps;
- Design considerations for head loss, water meters, and other fire and system operating requirements are provided in the *Water Master Plan*.

3.5 Storm Drainage

Drainage facilities shall be constructed to meet Sonoma County Water Agency criteria.

Pipe Material

Storm drain conduits shall be reinforced concrete pipe (RCP) conforming to Caltrans Standard Specification Section 65. Cast-in-place concrete pipe (CIPP) and HDPE pipes are accepted alternates to Class III RCP within the public right-of-way. Ductile iron pipe (DIP) may be required when the storm drain pipe is very shallow. The Town's standards provide specific restrictions for the use of various pipe materials. Restrictions are noted below:

- Flexible pipes are generally not allowed in traveled ways;
- CIPP may not be used in existing roads; and
- HDPE may not be used in major streets or industrial subdivisions.

Calculations should be provided with the design to justify the selection of any pipe material, including RCP.

Manholes and Curb Inlets

Storm drain manholes shall consist of a precast or cast-in-place unit in conformance with Section 51 of the State Standard Specifications. Manholes shall be fitted with either an eccentric cone or a flat slab. The minimum inside diameter for a manhole shall be 48 inches.

Curb inlets shall be installed per Town standards and as directed by the Town Engineer.

Pipe Diameter

Storm drain pipes within roads maintained by the Town shall have a minimum diameter of 18 inches, except that laterals may be 15-inches in diameter. For this study, the anticipated range of trunk storm drain pipelines is from 18 to 42 inches in diameter.

Pipe Cover

The minimum cover over the pipe shall be 24 inches, though lesser cover may be allowed for storm drain pipes with the use of Class 5 (reinforced concrete) pipe and "D" load calculations. The design engineer may also consider the use of ductile iron pipe for shallow pipe installation.

The maximum allowable cover shall be limited to 11 feet for all pipe sizes.

Pipe Slope

Minimum pipe slopes are provided in the Town standards.

3.6 Recycled Water

The Town is currently in the process of developing standards for the design and installation of recycled water mains. The following design criteria highlights are taken from the City of Santa Rosa standards. Detailed standards, including fittings, valves, backflow devices, and other recycled water system facilities/features are not provided in this study document.

Pipe Material

Recycled water mains with pipe diameters between 4 and 12 inches shall be one of the following:

- Gasketed joint or fusible polyvinyl chloride (PVC) pipe, Pressure Class 150 minimum, per AWWA Standard C900;
- Ductile iron pipe (DIP) fittings, Pressure Class 350, per AWWA Standard C151
- Where normal static mainline pressure exceeds 100 psi, pipe, and fittings shall be rated for 200 psi minimum
- Ductile Iron Pipe (DIP) shall be used within delineated fault zones and extend to 100 feet outside each side of the delineated fault boundaries.

The design engineer should determine the presence of fault zones, if any, within the study area, in consideration of the use of DIP.

Horizontal Alignment

- Except for crossings, a minimum horizontal distance of 10 feet clear shall be maintained between potable water mains and the recycled water mains and service laterals. If a 10-foot horizontal separation is not feasible, a separation of at least 4 feet may be allowed subject to special construction conditions. (Designers should consult the [Town of Windsor] for specific design requirements.) In no case is horizontal separation of less than 4 feet or construction in the same trench as potable facilities allowed;
- The minimum horizontal separation from storm drains, gas, electrical, telephone and communications lines shall be 4 feet clear except at crossings;
- Recycled water mains shall be designed a minimum of 5 feet from all structures, such as manholes or drop inlets;
- Recycled water mains shall be designed a minimum of 3 feet clear from the lip of gutter and 5 feet clear from the edge of easements;
- In the event that it is not possible to maintain the required separations and relative positions between recycled water mains and service laterals, potable water lines and sanitary sewer lines, special design shall be required and approved by the [Town Engineer];
- Recycled water main crossings over or under other underground facilities will be designed as close to 90 degrees to the facility as possible; and
- Recycled water mains shall be designed with service laterals perpendicular to the main.

Vertical Alignment

- Recycled water mains shall be designed with the ability to generally drain to blow-offs. Consult with the [Town of Windsor] for specific design requirements;
- Provide a minimum of 6 inches vertical separation from storm drains or other underground utilities such as telephone, communication, gas, or electrical conduit; and
- Pothole and survey utilities or other structures critical to vertical alignment.

Depth of Cover

Depth of cover is defined as the distance from the top of the pipe to the final finished grade measured directly over the pipe. Minimum depth of cover shall be as follows:

- Service laterals shall have minimum cover as shown on [City of Santa Rosa] Standard Details
- Mains of 4-inch, 6-inch and 8-inch diameter shall have 36 inches of minimum cover
- Mains of 12-inch diameter shall have 42 inches of minimum cover
- When within 10 feet of separation from a potable water main, the depth of the recycled water pipe shall provide for 1 foot of vertical separation with the recycled water main beneath the potable water main.
- Where minimum cover is less than standard or greater than 8 feet, special permission from the [Town Engineer] is required. Show mains with non-standard cover in profile on the Improvement Plans or Encroachment Permit applications. Where cover is less than

the Standard, higher class pipe, ductile iron pipe, and use of controlled density fill may be required

Pipe Sizing

The Town does not have a current, adopted recycled water planning document. Recycled water mains will be sized based on development needs in coordination with the Town. Recycled water mains will be sized based on a peaking factor of 10 applied to the annual average demand rate, and a maximum velocity of 5 feet per second.

Recycled water mains shall be sized using equivalent criteria to potable water mains, where the minimum pipe diameter for commercial areas (such as the Study area) is 8 inches. The main size may be reduced based on the projected demand for a planning area. Guidance for pipe sizing is not provided in the Town's latest recycled water planning document: *Sonoma County Airport Area Recycled Water Planning Update* dated May 11, 2011 prepared by Kennedy/Jenks Consultants.

3.7 Utility Undergrounding

There are three different options for utility undergrounding provided by the California Public Utilities Commission. These options are described under Rule 20, which includes Sections A, B and C. Pacific Gas and Electric Company (PG&E) has an electric undergrounding program that places approximately 30 miles of overhead electric facilities underground each year within its service area. In general, if PG&E participates in utility undergrounding, other overhead utilities (i.e., AT&T, Comcast) will participate. The following is a summary of the three options for utility undergrounding:

- Rule 20A – The utility(ies) pay for a majority of the costs of the undergrounding project.
- Rule 20B – The majority of costs are paid for by the applicant, though some are paid by the utility(ies).
- Rule 20C – Applicant pays for all costs.

Rule 20A applies to areas mainly used by the general public (such as along Old Redwood Highway). Rule 20B mainly applies to larger developments or projects that do not fit the criteria for Rule 20A. Rule 20C is likely not applicable to the study area as it is typically used for smaller projects involving few property owners.

The Town's *Utility Undergrounding Investigation – Rule 20A, B & C* planning document (Coastland) provides a good summary of each option. This document is provided in Appendix D.

3.8 Crossing of Sotoyome Creek

All utilities discussed in this study are anticipated to cross Sotoyome Creek, with the potential exception for recycled water such that the Town's current planning document for recycled water shows the recycled water main within Old Redwood Highway ending just south of the creek.

This study provides two options for utility crossing of the creek/bridge: 1) Trenchless construction; and 2) Attach utilities to the bridge structure, which are described below.

Existing Bridge over Sotoyome Creek

The existing bridge was originally constructed in 1913 and widened in 1925. The latest Caltrans inspection for the bridge was completed on December 29, 2009 wherein the bridge received a Sufficiency Rating of 79.6 out of 100. The report does not appear to recommend structural improvements or rehabilitation. That is consistent with Caltrans Local Assistance Program Guidelines (LAPG) for its Highway Bridge Replacement and Rehabilitation Program (HBRRP), wherein a score above 80 does not qualify for rehabilitation funding and must be below 50 to be considered for replacement funding. The Caltrans rating is also consistent with visual inspection conducted by Winzler & Kelly and URS during the study.

Per the December 29, 2009 Caltrans Bridge Inspection Report, "the existing bridge is a reinforced concrete T-beam bridge with reinforced diaphragm abutments all founded on unknown foundation." Bridges of this type have a typical lifespan of 75 to 125 years, depending on a variety of factors that may include traffic loading, soil conditions, structural damage, and other environmental and construction-related factors. The dimensions of the existing bridge are provided below:

- Total Span: 21 feet with a 40-degree skew
- Culvert Span:16 feet for stormwater evaluation of Sotoyome Creek
- Width: 35.5 feet (total); 32-foot net width (between curbs)
- The bridge has one lane in each direction and no sidewalk or bicycle lanes

Based on discussions with the Town, Old Redwood Highway will likely be widened along with redevelopment within the study area. Road widening is anticipated to include up to two travel lanes, a bicycle lane, and a sidewalk on the east side, along with a vegetated center median. Road improvements are anticipated to be extended across Sotoyome Creek, though the road may narrow to the north of the Arata on/off ramps. For the purposes of this study, road widening of Old Redwood Highway to the north of the on/off ramps is anticipated to include a single travel lane in each direction, with bicycle lanes and sidewalks. To accommodate the wider deck, the entire existing structure may be removed, include abutments, wing walls, and the bridge deck.

In consideration of road improvements at the Sotoyome Creek crossing, there are two options for the existing bridge structure:

- Widen the existing bridge to accommodate the new road width and features
- Replace the existing bridge with a new bridge

Given the age of the existing structure and extent of widening, it appears that replacement of the bridge is warranted, although detailed analysis and recommendation for the bridge structure was not the focus of this study. Detailed geotechnical and structural evaluation for a new bridge structure is recommended as a part of future utility and/or road improvement projects. Bridge design should consider the following utility design factors:

- Number and position of crossing utilities;
- Recommended hydraulic improvements for Sotoyome Creek to adequately convey stormwater under the new bridge structure. The design should be able to pass the 25-

year storm event with adequate freeboard below bridge beams/supports and pass the 100-year storm event without flooding the bridge or surrounding area;
- Replacement bridge abutments should be positioned and aligned to improve the creek hydraulics; and
- Meet current design and safety standards.

For purposes of this study, the substructure for a new bridge is assumed to be comprised of diaphragm abutments supported by cast-in-drilled hole (CIDH) or cast-in-steel shell (CISS) concrete piles. The replacement bridge superstructure is assumed to be either cast-in-place reinforced concrete slab deck with support girders or precast, pre-stressed hollow core deck panels with cast-in-place topping slab.

Advantages and disadvantages of each bridge alternative, including bridge geometry, constructability, project cost, construction duration, and environmental impacts should be considered.

Options for utility crossing of the creek/bridge are described below. Trenchless construction methods are compared in the alternatives analysis for the sanitary sewer system. Hydraulic considerations for the bridge are provided in the storm drainage evaluation of the utility infrastructure section of the study below.

Tunneling of Utilities

Tunneling could be accomplished using one of a variety of construction methods that would be based on geotechnical recommendations for site soil and groundwater conditions. The anticipated length of trenchless crossing of Sotoyome Creek by tunneling method is approximately 100 feet. This distance is selected to remain clear of the existing and potential future bridge structure and the creek environment at and in the vicinity of the bridge. The following tunneling methods may be considered upon further geotechnical investigation and engineering analysis for the creek crossing: pilot tube guided auger boring, microtunneling (MTBM), tunneling (TBM), conventional auger bore and jack, and pipe ramming.

Tunneling requires deep sending and receiving shafts to provide sufficient depth below existing and future bridge abutments, which are anticipated to extend several feet below the existing channel bottom. Sending and receiving shafts typically require water-tight shoring (i.e., coffer dam, interlocking sheets) and dewatering. For gravity sewer, manholes would be installed on both ends of the tunnel, with either deep sewer construction on either side of the tunnel or the need for a siphon to provide for a shallower alignment.

The depth of cover under bridge footings should also be considered during the detailed design phase for the bridge in coordination with the structural engineer. The use of pile abutments may extend the bridge foundation to more than 30 feet deep, which would be well into the area anticipated for tunnel construction.

Tunneling will likely require the use of a steel casing to protect the carrier pipe from loads imposed from the bridge above. The casing is generally a few pipe sizes larger than the carrier pipe (i.e., a 12-inch pipe may require a 24-inch casing pipe). Pieces of the casing pipe are

typically welded together. Corrosion protection should be considered by the design engineer, though corrosion of the steel casing may not negatively affect the carrier pipe if the annular space between the two pipes is filled with grout, sand, or a similar material.

On a foot-by-foot basis, tunneling is generally more expensive compared to horizontal directional drilling (HDD) for small diameter pipelines. This is due in part to the need for deep sending and receiving pits and the casing pipe. The shorter length of trenchless crossing seems to result in a lower trenchless cost until the cost for remaining sewer pipeline is considered. Figure 3 provides a schematic representation of the difference between tunneling and HDD under Sotoyome Creek. Note that the tunnel crossing is approximately 100 feet whereas the HDD crossing is 350 feet.

Multiple creek crossings warrant further investigation for tunnel crossing of the creek. If permit agencies will allow for utilities to be bundled (i.e., reduction in standard utility separation requirements), the construction of a large tunnel to house multiple utilities may be less expensive compared to multiple HDD crossings.

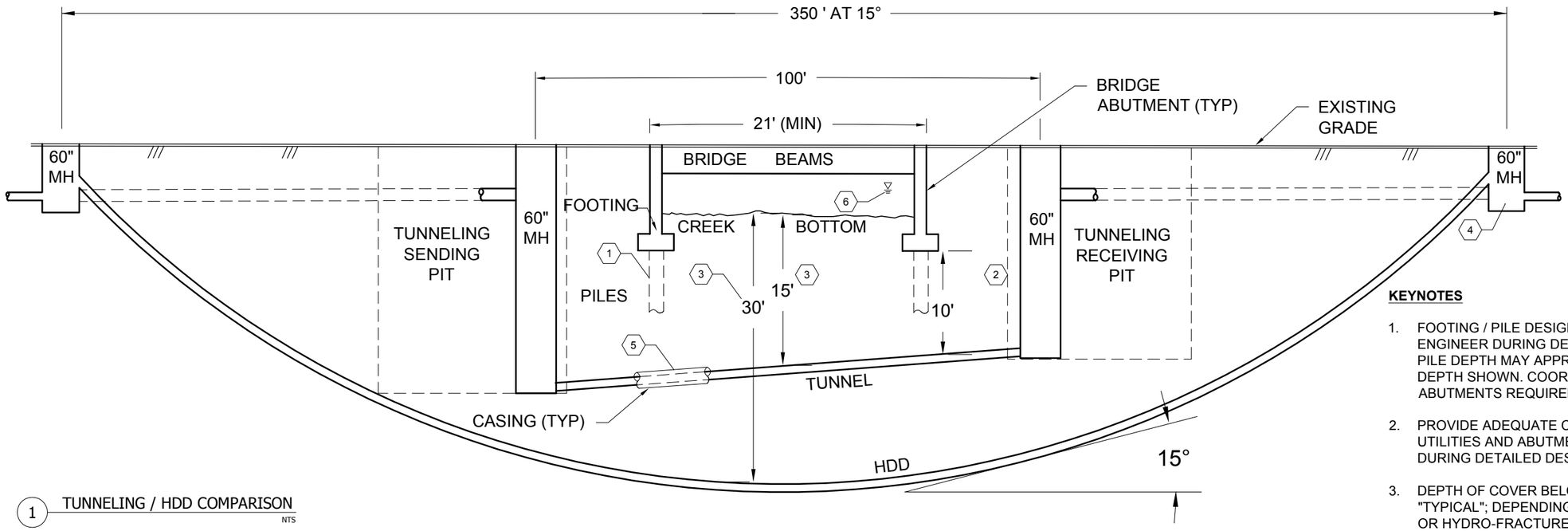
The design engineer should consider shifting the utilities crossing the creek to either the east or west sides of the bridge in order to avoid issues with the bridge abutment piles. The shift is anticipated to be on the east side since the west side is located outside of the Town limits and is not likely to develop, and there may not be sufficient right-of-way to accommodate the work.

Horizontal Directional Drilling (HDD)

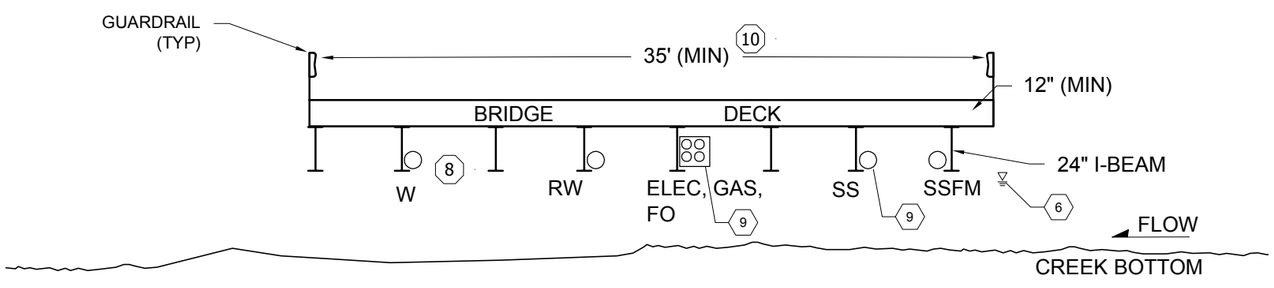
Horizontal directional drilling, or HDD, is a form of trenchless construction wherein a pilot hole is first drilled along the designed alignment. Then, the pilot string is removed and the hole enlarged by reaming to the diameter of the new pipeline. The new pipeline, which is recommended to be one continuous conduit (i.e., fusion-welded HDPE) is then pulled through the hole. Drilling mud (typically bentonite-based mud) is used to lubricate the drilling path. Many factors are important to consider for HDD work, including thorough geotechnical review of the site soils, proximity to other utilities, and worksite constraints such as the available work area and permit requirements.

HDD is generally less expensive compared to tunnel construction for small diameter utilities, especially where ample room is available to layout the pipe. As shown in Figure 3, HDD crossing of the creek would require about 3.5-times the horizontal distance compared to tunneling. This is due to the incline angle for construction (15 degrees is within the typical range for construction) and anticipated depth of cover between the natural channel above and the pipe. Figure 3 notes this vertical distance to be 30 feet, which upon advice from a geotechnical engineer, is a typical depth of cover to minimize the chance for hydrofracture caused by drilling into the creek. For this reason, a hydrofracture study is typically required by permit agencies when HDD trenchless construction is proposed under a natural channel.

The depth of cover under bridge footings should also be considered during the detailed design phase for the bridge in coordination with the structural engineer. The use of pile abutments may extend the bridge foundation to 30+ feet deep and into the area anticipated for HDD construction.



1 TUNNELING / HDD COMPARISON
NTS



2 CONCEPTUAL BRIDGE SECTION FOR ATTACHED UTILITIES
NTS

KEYNOTES

1. FOOTING / PILE DESIGN PER STRUCTURAL ENGINEER DURING DETAILED DESIGN PHASE. PILE DEPTH MAY APPROACH/ EXCEED TUNNEL DEPTH SHOWN. COORDINATION OF UTILITIES AND ABUTMENTS REQUIRED.
2. PROVIDE ADEQUATE CLEAR DISTANCE BETWEEN UTILITIES AND ABUTMENTS. TO BE DETERMINED DURING DETAILED DESIGN PHASE.
3. DEPTH OF COVER BELOW OPEN CHANNEL "TYPICAL"; DEPENDING ON TUNNELING METHOD OR HYDRO-FRACTURE STUDY RESULTS FOR HDD.
4. PROVIDE SUMP IN GRAVITY SEWER SIPHON MANHOLES.
5. PROVIDE STEEL CASING FOR TUNNEL CONSTRUCTION (E.G., 24" CASING FOR 12" UTILITY).
6. PROVIDE ADEQUATE FREEBOARD BETWEEN W.S. AND BRIDGE SUPPORTS / UTILITIES.
7. DUE TO MINIMAL COVER, GRAVITY SEWER CROSSING ATTACHED TO BRIDGE MAY NOT BE FEASIBLE.
8. STRUCTURAL SUPPORT DESIGN REQUIRED. UTILITY SEPARATION PER TOWN STANDARDS, OR AS RECOMMENDED BY ENGINEER WITH PROPER PIPE ENCASEMENT.
9. ENGINEER TO COORDINATE WITH DRY UTILITY COMPANIES ON PREFERRED / ALLOWED SUPPORT FOR DUCT BANK.
10. BRIDGE WIDTH TO BE DETERMINED BY TOWN IN CONSIDERATION OF FUTURE ROAD SECTION IN ADDITION TO APPROPRIATE UTILITY SEPARATION (IF APPLICABLE). EXISTING BRIDGE IS 35.5 FT WIDE WITH A 32-FT CLEAR WIDTH BETWEEN CURBS.

2/28/2011

WINZLER & KELLY
2235 MERCURY WAY, SUITE 150
SANTA ROSA, CA 95407
PH (707) 523-1010
FAX (707) 527-8679

TOWN OF WINDSOR

NORTH OLD REDWOOD HIGHWAY
AREA UTILITY INFRASTRUCTURE STUDY

CREEK / BRIDGE
CROSSING

FIGURE NO.
FIG 3

JOB # 0228310003

C:\Windsor-pumpstation\1219810001 FIG 3.dwg 3-02-11 01:46:38 PM TPatton

HDD pipelines are typically constructed with fusion-welded HDPE pipe (recommended), but can also be constructed using corrosion-wrapped ductile iron pipe. HDPE pipe is well-suited for pressure utility systems, including sanitary sewer force mains, potable and recycled water mains, and gas mains. HDPE can also be used to construct a smooth siphon for a gravity sewer system. Siphons are discussed in more detail in the following section.

The benefits for HDD construction for crossing of Sotoyome Creek are listed below:

- Facilitates shallow utility construction on either side of the bridge crossing without the need for abrupt vertical transition at tunneling pits;
- Facilitates creek crossing at a depth that is better-suited for permitting (minimize impacts to the creek)
- Anticipated lower unit cost per foot compared to tunneling.

Similar to the recommended future evaluation for tunneling methods, multiple creek crossings warrant further investigation for HDD crossing of the creek. If permit agencies will allow for utilities to be bundled (i.e., reduction in standard utility separation requirements), the construction of "bundled" utilities may be less expensive compared to multiple HDD crossings and/or compared to tunneling construction.

Siphon

An inverted siphon is a portion of a gravity pipe system that dips below the designed gradient of the gravity alignment to avoid an obstacle (i.e., Sotoyome Creek). An inverted siphon may have one, two, or more pipes and is typically designed with a minimum velocity of 3 feet per second (fps) to keep the pipe(s) clear of settleable solids. The siphon should have a manhole on either side to facilitate maintenance.

Siphons are generally not preferred for gravity systems since the low point of the pipeline tends to gather debris carried in the waste flow. Over time, if improperly maintained, the siphon pipeline could become blocked by debris causing a backup in flow and the potential for a sanitary sewer overflow (SSO).

The Town has two siphons in existing sanitary sewer collection system, with the more-recently constructed siphon performing better than the older siphon. The use of a siphon for trenchless crossing of the creek was discussed with the Town during the preparation of this study. While found not to be an ideal solution, the option for a siphon was generally preferred compared to deep gravity sewer construction and the greater construction costs for tunneling methods.

The following design criteria should be considered for trenchless crossing of Sotoyome Creek if utilizing a siphon for the sanitary sewer system:

- Provide a dedicated connection to the water system to assist the Town with siphon maintenance (flushing). Additional flushing of the pipeline may be required during early years of operation prior to greater build-out of the study area to augment low flows.

- The upstream manhole should be oversized and include a sump designed to catch debris and grit ahead of entering the siphon.
- Use welded HDPE pipe to provide a smooth transition under the creek.

Utilities Integral to Bridge Structure

One other alternative was evaluated for crossing of Sotoyome Creek with new utilities within Old Redwood Highway. As shown on Figure 3, utilities could be attached to a new bridge structure. With the new bridge structure anticipated to be wider than the existing structure, there should be adequate horizontal separation available between pipelines. With the anticipated requirement that utilities be encased and wrapped for protection from environmental factors, utility separation would be of an even lesser concern. The conceptual bridge section shown in Figure 3 notes the use of I-beam supports for the bridge span. The structural engineer for the bridge may consider other design alternatives that would provide for a "gap" between the top of the creek culvert and bridge pavement section. Note that in any case, the depth of cover between these utilities and the road surface would be less than minimum requirements. Strong and potentially encased pipelines should be anticipated to withstand vehicle live loading from the road above.

In coordination with the hydraulic evaluation for Sotoyome Creek, the bridge structure may be raised by approximately 1 foot to facilitate conveyance of storm flows within the creek under the bridge. Since the existing bridge is located in a vertical sag curve, construction of the bridge at a higher elevation to accommodate creek flows would likely provide a benefit for crossing utilities should that alternative be selected.

Based on phased construction for proposed utilities, reconstruction of the bridge with utility attachments may not capture all utilities. As shown in the utility infrastructure analysis provided in the following section, early phase construction for the potable water and sanitary sewer systems may necessitate trenchless crossing of the existing bridge. With attachment of permanent utilities not recommended for the existing bridge, those early phase utilities would likely remain in their deep, trenchless alignments upon future removal and replacement of the bridge. As such, attachment of utilities to the existing and/or new bridge is not recommended due to the timing and phasing of the anticipated utility extensions.

4.0 UTILITY INFRASTRUCTURE ANALYSIS

The analysis provided in this study is based on review of existing Town planning documents, coordination with Town staff, coordination with SCWA, hydraulic evaluation and/or confirmation of existing evaluations, and engineering judgment for a planning-level study. Not all aspects of utility design and analysis are considered in this study since the purpose of this study is to provide guidance and recommendations for utility improvements within the study area. In general, the design engineer for the various utilities considered in this study will need to review the recommendations provided in this study for use in the basis of design for each utility.

4.1 Sanitary Sewer

The following section provides an evaluation of the required size of the sanitary sewer mains within Old Redwood Highway for the limits of the study area. Recommendations for project phasing are also provided.

Flow Calculations – Existing Sewer System

The Town's April 2000 *Master Trunk Sewer Plan* (MTSP) states that the peak wet weather flow (PWWF) under existing conditions for the study area is 0.186 mgd (Table A-3; Basin N-22). According to the MTSP, the study area has an equivalent population of 470 people, which is calculated within the MTSP as the sum of mobile home park residents and population associated with the various commercial land uses within the study area.

Per the Town's December 2008 Technical Memorandum titled *Draft north Old Redwood Highway Sewer Capacity Study*, the existing peak wet weather flow (PWWF) from the study area is approximately 0.24 mgd. The capacity of the existing 6-inch sewer main (0.22 mgd), so current estimates note that the existing main is at its design capacity. The 12-inch diameter Los Amigos Trunk Sewer has a hydraulic capacity of 1.13 mgd when using the hydraulic design criteria from the *Master Trunk Sewer Plan* (d/D=1.0, n=0.011). Evaluation for the Los Amigos Trunk Sewer is also based on a pipe slope of 0.0017 ft/ft, which is understood to be the limiting pipe slope in the trunk sewer.

Study Area Flow Calculations

The calculation of sewer flows for the North Old Redwood Highway study area is summarized below:

- Total acreage: 78.21 acres
- Land Use Density: Assumed 12 du/acre (75% of highest allowable use; 75% x 16 du/ac = 12 du/acre)

The resulting number of dwelling units (du) for build-out of the study area is approximately 940 du (78.21x12=~938.52 du).

- Water demand: 319 gpd/du
- Irrigation Use: Assume 15 percent of land irrigated at an application rate of 3 acre-ft/acre/yr. This accounts for approximately 10-precent lower sewer flow compared to

water demand. The resulting sewer usage per dwelling unit was reviewed and found comparable to City of Santa Rosa Standards.

- Infiltration/Inflow (I/I) Factor: I/I Factor: 800 gpd/acre
- Peak Hour Factor: 4.5

Resulting sanitary sewer peak flow: 859 gpm (1.27 mgd)

The 1.27-mgd peak flow for the study area build-out condition is greater than the capacity of the existing 12-inch sewer main (1.13 mgd) using d/D=1.0 and n=0.011; however, the Los Amigos Trunk Sewer would not reach full capacity (d/D=1.0, which is the same as d/D=0.9) when using n=0.011 until approximately 836 dwelling units have been constructed:

$$\frac{940 \text{ du}}{X} = \frac{1.27 \text{ mgd}}{1.13 \text{ mgd}} \rightarrow X = 836 \text{ du}$$

Build-out within the study area should take several years to occur, as would the expected time to reach full I/I flow conditions. Also, the actual water usage for all 940 potential dwelling units is unknown at this time. The Town's current sewer master planning process should be used to further review sewer systems located downstream of the study area. These systems include the Los Amigos Trunk Sewer and Starr Road sewer system.

Recommendation for Trunk Sewer

Since the peak flow under build-out conditions for the study area may exceed the hydraulic capacity of the Los Amigos Trunk Sewer, some flow may need to be diverted to the Starr Road sewer system:

1.27 – 1.13 = 0.14 mgd < 0.186 mgd (capacity of Starr Road sewer system)

The comparison of potentially split flows to Starr Road (0.14) to the existing PWWF tributary to Starr Road (0.186) suggests that the flow split needed to achieve the hydraulic conditions noted in the *Trunk Sewer Master Plan* would work. Flows tributary to Starr Road would theoretically decrease. The Town had previously noted that additional flows should not be directed to Starr Road, as there are hydraulic problems in that collection system; however, in this scenario, flow in the Starr Road sewer system may actually decrease. The approach to split flows should be further evaluated during future Town sanitary sewer collection system master planning, including evaluation of planned flows tributary to the North and West Trunk Sewers. Master planning would also be the opportunity to revisit the hydraulic capacity of the Los Amigos Trunk Sewer.

Based on the hydraulics presented above, the sanitary sewer infrastructure for the study area should be constructed to convey the full 1.27 mgd into the Los Amigos Trunk Sewer. The new trunk sewer within Old Redwood Highway and upstream of the Los Amigos Trunk Sewer should be a 12-inch diameter pipe at a minimum slope of 0.0035 ft/ft. Figure 4 shows the recommended sanitary sewer improvements for the study area, wherein "public" and "private" options are shown, as discussed below following the alternatives analysis section.

For Private Option, replace improvements noted as "Public" with private pump stations similar to Alternative 1 and/or on-site septic systems for Parcels 9, 10, and 11.

Recommended sanitary sewer improvements are based on Alternative 3 Modified for the Public Option, including Phase 1 improvements. Private Option is based on Alternative 1, with the addition of private improvements in lieu of public improvements to benefit Parcels 9, 10, and 11.

New 8" Gravity Main (~8 ft deep) that serves Parcels 9, 10, and 11 (750 ft) **Public**

New 8" Gravity Main (~8 ft deep) that serves Parcels 9, 10, and 11 (300 ft) **Public**

***** New 8" Gravity Main (~8 ft deep) that serves Parcels 8, 12, 13, 14, and 15 (850 ft) **Public**

Replace Existing 6" Gravity Main with 12" to Existing 12" at the intersection with Starr Rd (1,700 ft)

New 12" Gravity Main to Divert Existing 6" Gravity Main to Existing 12" Los Amigos Trunk Sewer (250 ft) (Phase 1)

Existing 12" Los Amigos Trunk Gravity Sewer

Creek Crossing SS Gravity Main Siphon HDD (350 ft) **Public**

New Public Pump Station (~ 15 ft deep) that serves Parcels 8, 9, 10,11, 12, 13, 14, and 15 **Public**

***** New 6" Force Main that serves Parcels 8, 9, 10,11, 12, 13, 14, and 15 (750 ft) **Public**

Existing 6" Gravity Main

***** Existing sewers in ROW replaced by new sewers; private facilities not shown.

Highway 101

Highway 101 On-Ramp

Old Redwood Highway

Starr Road

Arata Lane

North Pacific Railroad

Sotoyome Creek

Town Boundary
Study Area
Creek
Existing SS Gravity Main
Existing SS Force Main
Proposed SS Gravity Main
Proposed SS Force Main
SS Pump Station

PROJECT PHASING

PHASE 1: Connect (E) 6" gravity main to Los Amigos Trunk Sewer; provide overflow connection to Starr Road Sewer System.

PHASE 2: Extend 12" gravity main in Old Redwood Highway to meet development needs; construct pump station(s) (public/private) to service Parcels 8-14.

Notes:
1. HDD = Horizontal Directional Drill

2. Preliminary construction costs do not include road overlay.

3. Costs include facilities within Old Redwood Highway only and pump station facilities as applicable.

0 200 400 ft

1 inch = 400 feet printed at 11x17

Sources: Santa Rosa GIS: Aerial 2009 1 foot resolution; Sonoma County GIS: Parcels; Winzler and Kelly GIS: Utilities.

WINZLER & KELLY
www.w-and-k.com

©Winzler & Kelly

Cartography	Date	Project #
AF	3/12/2012	0228310003

Figure 4 - Recommended Sanitary Sewer Improvements

North Old Redwood Highway Area Utility Infrastructure Study

Town of Windsor

\\corp\wkprojects\sro\02283 - Town of Windsor\022283-10-003 North Old Rdwd Hwy Infra Study\GIS\Maps\Figures\Sanitary Sewer Improvements.mxd 10:33:42 AM

Existing and future laterals along Old Redwood Highway should be connected to the new sewer main to alleviate downstream sewer problems in Starr Road.

Service elevations at the western end of Parcel Nos. 16-28 should be evaluated by the Town upon development of those parcels. Private pump systems (internal or external to buildings) may be required for service elevations below road grade for Old Redwood Highway.

Depending on the location of the first development within the Study Area, the Town may need to perform additional O&M cleaning of the new sewer lines. Low flows within the sewer main that is sized for build-out will likely need to be occasionally flushed. Force main(s) may also require additional O&M due to solids separation and odor concerns associated with low flows.

Alternatives Analysis

Winzler & Kelly conducted a workshop with various Town staff conducted on November 8, 2010 to evaluate alternatives for providing sanitary sewer service to the northern portion of the study area. The objective of the workshop was to identify the various advantages and disadvantages, including cost considerations, for several construction alternatives. All alternatives for the northern portion of the study area, including public and private options, would be tributary to the downstream trunk sewer in Old Redwood Highway, so the limits of the workshop discussion was the gravity breakpoint in the sewer system located in the vicinity of the Arata on/off ramps.

The northern portion of the study area requires pumping of sanitary sewer flows to reach the gravity breakpoint; Parcel Nos. 9-11 require crossing of Sotoyome Creek. Alternatives were selected to consider a range of scenarios for crossing of the creek and deep vs. shallow sewer construction. Initially, there were three alternatives, but upon further review in preparation for the workshop, Winzler & Kelly identified three additional alternatives that provided modification to the initial alternatives, each with the intent to enhance each alternative. Alternatives are described in Table 1. Figures E-1 through E-6 in Appendix E show the conceptual layout of each alternative. Preliminary opinions of probable construction cost and project cost are provided in Appendix J.

Alternatives were developed based primarily on the construction of a public sewer system, with the exception of Alternative 1 (Figure E-1) that includes private pump stations for Parcel Nos. 8 and 12-15. The private option for the recommended alternative (See Figure 4 and discussion following the alternatives analysis) includes private pump stations for Parcel Nos. 8-15.

Following review of each alternative, the top alternatives were ranked as follows:

1. Alternative 3 Modified (see Figure E-6 in Appendix E)

   This alternative includes one 420-gpm pump station at an approximate invert depth to the wet well of 15 feet. The pump station would be located within Parcel No. 12 and pump flow through a 6-inch force main to the gravity breakpoint. Parcels located on the north side of Sotoyome Creek (Parcel Nos. 9-11) would convey flow by gravity main in Old Redwood Highway under the creek with an inverted siphon (HDD construction).

Advantages of this alternative, as compared to the other top ranked alternatives include: 1) lowest overall construction cost (approximately the same cost as Alternative 1 Modified); 2) one public pump station; and 3) no private pump stations.

Disadvantages include: 1) Uncertainty of locating pump station within Parcel No. 12; and 2) Maintenance considerations for inverted siphon.

2. Alternative 1 Modified (see Figure E-2 in Appendix E)

   This alternative includes two pump stations, each with an approximate invert depth to the wet well of 15 feet. The pump stations would be located within Parcel Nos. 11 and 12 and pump flow through 6- and 4-inch force mains, respectively, to the gravity breakpoint. The Parcel No. 11 force main would convey flow under the creek with an inverted siphon (HDD construction). Parcels located on the south side of the creek (Parcel Nos. 8, 12-15) would convey flow to the Parcel No. 12 pump station.

   Advantages of this alternative, as compared to the other top ranked alternatives include: 1) strategy to have two pump stations provides phasing flexibility for serving each side of the creek; and 2) no private pump stations.

   Disadvantages include: 1) highest overall construction cost; 2) placement of a pump station within Parcel No. 11 may be difficult based on review of the Preliminary Grading and Utility Plan for that property (September 2005, Brelje & Race); 3) Uncertainty of locating pump station within Parcel No. 12; and 4) Maintenance considerations for inverted siphon and two public pump stations.

3. Alternative 2 Modified (see Figure E-4 in Appendix E)

   This alternative includes one 420-gpm pump station at an approximate invert depth to the wet well of 15 feet. The pump station would be located within Parcel No. 11 (Sanderson Property) and pump flow through a 6-inch force main to the gravity breakpoint. Parcels located on the south side of Sotoyome Creek (Parcel Nos. 8, 12-15) would convey flow by gravity main in Old Redwood Highway under the creek with an inverted siphon (HDD construction).

   Advantages of this alternative, as compared to the other top ranked alternatives include: 1) lowest overall construction cost (approximately the same cost as Alternative 3 Modified); 2) one public pump station; and 3) no private pump stations.

   Disadvantages include: 1) Placement of a pump station within Parcel No. 11 may be difficult based on review of the Preliminary Grading and Utility Plan for that property (September 2005, Brelje & Race); 2) Two trenchless creek crossings; and 3) Maintenance considerations for inverted siphons.

Winzler & Kelly recommended the modified alternatives, with Alternative 3 Modified as its top recommendation, followed by 2 Modified and 1 Modified. The reason for ranking 2 Modified ahead of 1 Modified was based on two pump stations in 1 Modified, which would result in higher long term maintenance costs. The Town ranked 2 Modified lower based on the longer pipelines and two creek crossings (gravity and force mains). Recommended Alternative 3 Modified is shown in Figure 4 along with other recommendations for the sanitary sewer system within Old Redwood Highway. A description of the "private" option is also provided in Figure 4.

During the workshop, Town staff noted that maintenance of a deep pump station is not of a significant concern for maintenance staff but did have concern with siphon maintenance. Nevertheless, the recommended alternative does include a siphon due to other benefits to the overall system. Maintenance procedures and sufficient operations and maintenance budget will need to be provided as part of the recommended alternative.

Septic System Option

One other alternative discussed with Town staff after the workshop should be considered for providing sewer service to Parcel Nos. 9-11. That alternative is to consider a strictly private sewer system for Parcel Nos. 9-11 because those parcels are on the north side of Sotoyome Creek. As shown in the preliminary cost estimates for the Alternatives 1-3 Modified, the capital costs for a sewer system to benefit those three parcels are very high due to the creek crossing. A private sewer system may be a better option for both the Town and the parcels and should be considered.

The following is taken from the Town's Municipal Code:

Section 12-4-120: Sewer Services Required; Water Connection Required

> No person owning or occupying or having under his/her control, any premises situated or being within three hundred (300') feet of a public sewer in the District, shall construct or maintain or suffer to be or remain upon such premises any privy, vault or cesspool or any sink, drain, or similar contrivance, except as in the manner provided in this ordinance. Any such person connecting to the POTW shall also connect to the District water system, if such system main is located within three hundred (300') feet of the premises.

Based on interpretation of this section of the Town's Municipal Code, Parcel Nos. 9-11 would not be required (but can do so voluntarily) to connect to the sanitary sewer system because the existing sewer line is well beyond 300 feet from the property (it is approximately 1,100 feet to the east of Parcel No. 9). Therefore, these properties may be able to use a septic system to provide sewer service for future development. Design and use of septic systems would need to meet the County's current PRMD septic requirements for this type of use.

A review at the PRMD regarding existing septic information on Parcel Nos. 9-11 shows that the existing soils are not conducive to onsite septic systems for potential expansion. There was not existing septic information for Parcel No. 11. Parcel No. 10 had abandoned portions of the existing septic system and installed new leach lines in June 2010 for the primary residence. There was no septic information available for Parcel No. 9. The existing lots on the west side of Old Redwood Highway do not have potential for septic system expansion.

Based on preliminary discussions with Sonoma County PRMD and review of available septic records, it appears that the property located to the north of Parcel No. 11 is a potential candidate for siting of a new septic system as an alternative to onsite septic systems. However, a septic system would likely not be permitted to take car wash effluent due to potential chemicals and detergents in that wastewater stream. At a minimum, pretreatment of this wastewater flow would be required, but still may not be sufficient to permit the septic system. Also, the groundwater is very high in this area (i.e., within 2 to 3 feet of the existing ground surface). This means that groundwater testing would be required by the applicant in addition to percolation testing of the area. If groundwater is present at 24 inches below grade or less, a septic system would not be permitted.

Coordination with PRMD also finds that septic systems shall be placed on lots abutting the parcel to be served. This means that Parcel Nos. 9 and 10 would not be able to use the lot located north of Parcel No. 11. Those lots would require onsite septic systems.

There are several planning and preliminary engineering tasks that would be required to permit a new septic system. These include: 1) Agreement with the abutting parcel for testing; 2) Seasonal groundwater and percolation testing; 3) Delineate existing wetlands; 4) Determine the location of existing wells; 5) Determine appropriate setbacks for wells, wetlands, and any drainageways; 6) 200-percent expansion capability for the new septic system (i.e., set-aside area approved for additional septic system in case of failure); and 7) Determine permit fees and construction costs.

It is difficult to determine the approximate cost of onsite septic systems for these properties. With the level of planning involved for this study, it appears that the construction of a septic system for Parcel No. 11 may not be feasible, and if it is, would likely be very costly. Onsite septic systems for Parcel Nos. 9 and 10 appear to be more feasible compared to Parcel No. 11, though many of the same planning and cost considerations for Parcel No. 11 also apply to these parcels.

The potential costs for testing, permitting, design, and construction would need to incorporate the following cost, which would be required for expansion of any of these parcels. The cost for easement or access requirements could vary significantly.

Description	Approximate Cost
Pre-Percolation Test	$7,000 - $10,000
Groundwater Tests	$2,500 - $5,000
Soils Testing	$500 - $1,000
Easements / Access	$10,000 - $70,000
Percolation Testing	$10,000 - $25,000
Design of System with Pre-Treatment	$20,000 - $50,000
Construction	$30,000 - $50,000
Total Construction Cost (Rounded)	**$80,000 - $211,000**

Recommendation for Northern Portion of Study Area

There are two recommended alternatives for the northern portion of the study area: the Public Option and the Private Option. The Private Option is recommended due to its significant cost savings for the Town and the uncertainty of development for Parcel Nos. 9-11.

1. The Public Option (see Figure 4): The public option is Alternative 3 Modified. Primary features of this alternative include the following:

   - One shallow pump station (15 feet; 420 gpm; 6-inch diameter force main) located on the south side of Sotoyome Creek;
   - Shallow gravity sewer main construction;
   - One creek crossing utilizing horizontal directional drill (HDD) construction;
   - Siphon for gravity main under the creek; and
   - No private pump stations.

   The advantages of this alternative include: 1) one public pump station; and 2) no private pump stations.

   Disadvantages include: 1) uncertainty of locating pump station within Parcel No. 12; 2) maintenance considerations for inverted siphon; and 3) higher construction and maintenance costs compared to the Private Option.

   Under the Public Option, the Town has more control regarding the operation and maintenance of the sewer system compared to the Private Option. However, the capital cost is significantly increased if private pump stations and force mains are funded by developers. The Town should consider the Public Option if there is enough concurrent development interest in the northern portion of the study area to justify the capital expenditure. Otherwise, the public sewer collection system could terminate on Old Redwood Highway at approximately the Arata Lane on/off ramps.

2. The Private Option (see Figure 4): The private option is comprised of the private pump stations from Alternative 1 for Parcel Nos. 8 and 12-15 and private system improvements for Parcel Nos. 9-11. Private improvements for Parcel Nos. 9-11 could include on-site or off-site septic systems or the construction of private pump stations and force mains that would discharge to the public system at approximately the intersection of Old Redwood Highway and the Arata Lane on/off ramps. Primary features of this alternative include the following:

   - Private pump stations and force mains in lieu of public infrastructure beyond the grade break in Old Redwood Highway at the Arata Lane on/off ramps;
   - Shallow, private force main construction; and
   - Creek crossings utilizing horizontal directional drill (HDD) construction for each private force main.

   The advantages of this alternative include: 1) no public pump station; and 2) limited commitment of public infrastructure funds.

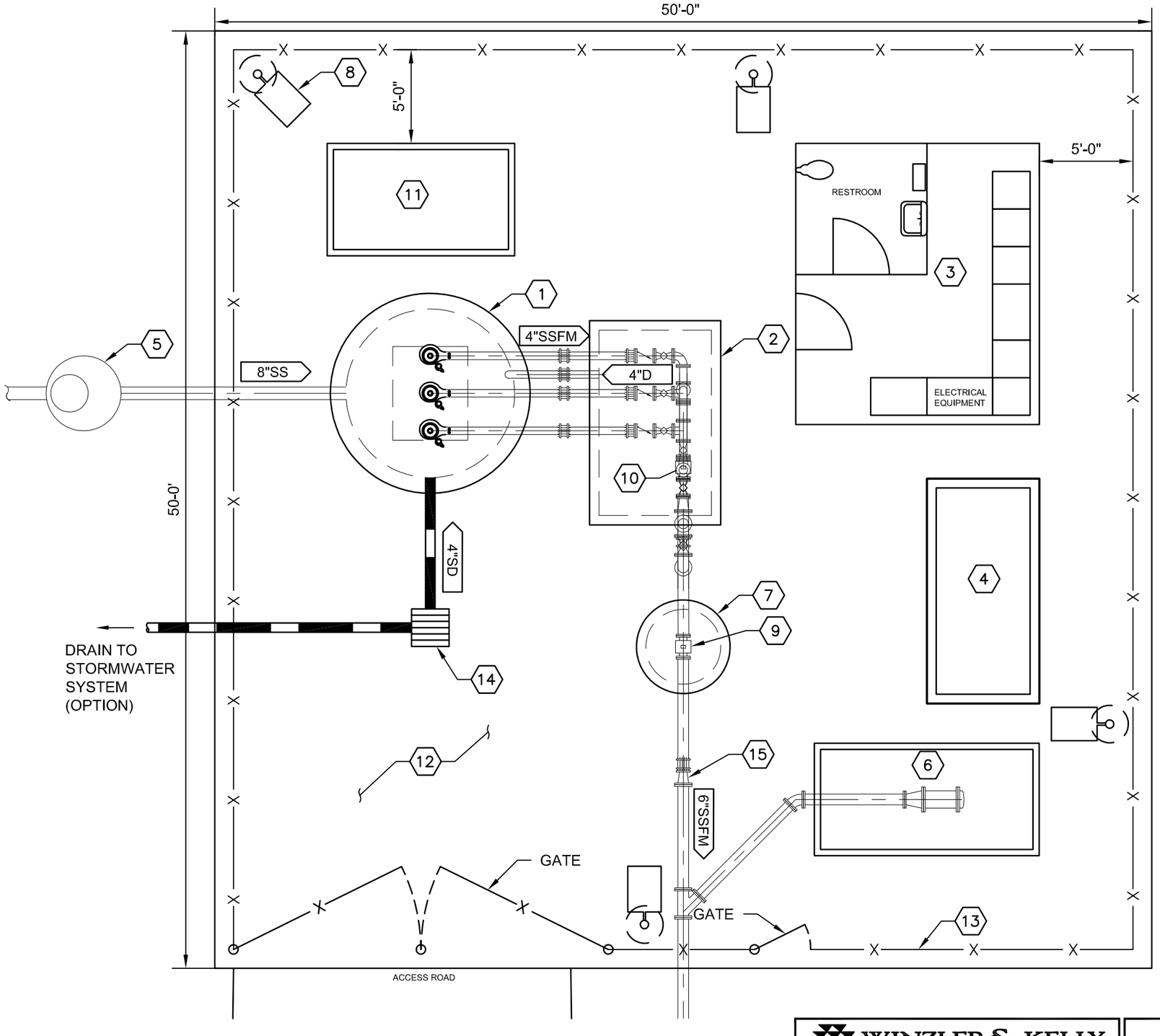
Disadvantages include: 1) without a public system that extends sewer service to these parcels, development could be delayed for a longer period of time; 2) risk that improper operation and maintenance of the private pump stations could lead to sanitary sewer overflows; and 3) multiple private force main pipelines could be located in a joint trench; however, that would require proper timing of the private improvements and multiple private utility crossings of Sotoyome Creek, either as HDD construction or integral to a new bridge structure. A license agreement for the private force main(s) would also be required if the pipelines are located within the right-of-way.

Under the Private Option, the Town would not fund a sewer extension to the northern portion of the study area. The analysis in this study finds that public sewer extension is costly for this area relative to the benefit provided to only three parcels. While public sewer service could eventually be provided to these parcels, deferment of public sewer system expansion to Parcel Nos. 9-11 is the recommended approach for the Town at this time. Should significant development interest arise for these parcels, the Town could consider a more detailed feasibility study by the developers to compare the costs and benefits of private and public options, wherein the developers fund the infrastructure improvements upfront and obtain a reimbursement agreement for fair share payment from future parcels connecting to the system.

Pump Stations

Considerations for a typical pump station layout are shown in Figure 5. Features include a wet well with submersible pumps, valve vault, electrical controls, and site features such as paving and a perimeter fence with gate. Other recommended features for the pump station site may be considered optional by the Town during the detailed design phase. These features include flow metering, emergency standby generator, odor control, pig launcher (for maintenance of the force main), and a building to house the electrical equipment.

The typical pump station figure shows two options for the collection and conveyance of onsite stormwater: 1) to the wet well; and 2) to an existing offsite stormwater system. The Town should consider its planned operations for the pump station(s) relative to spill control planning during the design phase. While it is not preferable to direct stormwater into the sanitary sewer system, doing so within the confines of the pump station site would provide a high level of spill control should sewage spill at the site.



KEYNOTES

1. WET WELL
2. VALVE VAULT
3. MCC BUILDING (OPTIONAL)
4. EMERGENCY GENERATOR ON CONCRETE PAD
5. INFLUENT SSMH
6. PIG LAUNCHER (OPTIONAL)
7. FLOWMETER VAULT
8. LIGHT FIXTURE (TYP)
9. FLOWMETER (OPTIONAL)
10. AIR / VACUUM RELEASE VALVE
11. ODOR CONTROL ON CONCRETE PAD (OPTIONAL)
12. AC PAVEMENT
13. PERIMETER FENCE
14. STORM DRAIN INLET
15. 4" x 6" INCREASER

2/23/2012

WINZLER & KELLY
2235 MERCURY WAY, SUITE 150
SANTA ROSA, CA 95407
PH (707) 523-1010
FAX (707) 527-8679

TOWN OF WINDSOR

NORTH OLD REDWOOD HIGHWAY
AREA UTILITY INFRASTRUCTURE STUDY

CONCEPTUAL SEWER PUMP STATION
SITE LAYOUT

FIGURE NO.
FIG 5

JOB # 0228310003

J:\02283 - Town of Windsor\02283-10-003 North Old Rdwd Hwy Infra Study\CAD\1219810001 FIG 11.dwg 2-22-12 01:34:57 PM CBach

NORTH OLD REDWOOD HIGHWAY UTILITY INFRASTRUCTURE STUDY
TABLE 1
SANITARY SEWER SYSTEM
SUMMARY OF ALTERNATIVES

Alternative 1	**Alternative 1 Modified**
New Gravity Main to new 260 gpm PS on Parcel 11; One Creek Crossing (HDD); Force Main; Private PS's necessary • Shallow 8" Gravity Main (8 feet) • 6" Force Main • 1 Shallow Public Pump Station (15 feet; 260 gpm) • 1 Creek Crossing (HDD) • Private Pump Stations for Parcels 8, 12, 13, 14, and 15 • Preliminary Construction Cost: $2.3 million	*Same as Alt. 1 but adds a new 160 gpm PS on Parcel 12 to eliminate the Private PS's* • Shallow 8" Gravity Main (8 feet) • 2 Force Mains (6" and 4") • 2 Shallow Public Pump Stations (15 feet; 260 gpm and 160 gpm) • 1 Creek Crossing (HDD) • No Private Pump Stations • Preliminary Construction Cost: $2.8 million
Alternative 2	**Alternative 2 Modified**
New Gravity Main to new deep 420 gpm PS on Parcel 11; Two Creek Crossings; Force Main • Deep Gravity Main (30+ feet) • 6" Force Main • 1 Deep Public Pump Station (30+ feet; 420 gpm) • 2 Creek Crossings (HDD and Tunneling) • No Private Pump Stations • Preliminary Construction Cost: $3.3 million	*Same as Alt. 2 but use HDD with Siphon in lieu of Tunneling for Gravity Main* • Shallow Gravity Main (8 feet) • 6" Force Main • 1 Shallow Public Pump Station (15 feet; 420 gpm) • 2 Creek Crossings (2 HDD) • Siphon for Gravity Main under Sotoyome Creek • No Private Pump Stations • Preliminary Construction Cost: $2.2 million
Alternative 3	**Alternative 3 Modified**
New Gravity Mains to new deep 420 gpm PS on Parcel 12; One Creek Crossing; Force Main • Deep Gravity Main (30+ feet) between Creek and PS • 6" Force Main • 1 Deep Public Pump Station (30+ feet; 420 gpm) • 1 Creek Crossing (Tunneling) • No Private Pump Stations • Preliminary Construction Cost: $2.8 million	*Same as Alt. 3 but use HDD with Siphon in lieu of Tunneling for Gravity Main* • Shallow Gravity Main (8 feet) • 6" Force Main • 1 Shallow Public Pump Station (15 feet; 420 gpm) • 1 Creek Crossing (HDD) • Siphon for Gravity Main under Sotoyome Creek • No Private Pump Stations • Preliminary Construction Cost: $2.2 million

Assumptions:

1. Sotoyome Bridge will not be modified for any alternatives.
2. No open-cut trench at creek crossings.
3. There is adequate land being dedicated on Parcel 11 for new pump station.
4. Costs do not include land acquisition costs.

The location for the pump station in Alternative 3 Modified is within Parcel No. 12; however, installation of a public pump station within this or any other private property should be evaluated as a preliminary step during the detailed design phase. The location of the pump station within Parcel No. 12 could vary depending on the development of the parcel. The pump station site should be located to facilitate ingress and egress for maintenance and delivery vehicles.

During the alternatives workshop, Town staff recommended providing a cost range for this alternative to reflect the potential variable location of the pump station. The pump station was relocated to an anticipated mid-point within the property to provide a mid-point cost. The contingency should be considered for variation in cost. Town staff also noted that PG&E has expressed development interest in Parcel No. 12 for a new substation. The Town will need to work with the property owner and other interested parties regarding the development of that parcel with a public pump station.

During the alternatives workshop, Town staff selected Alternative 3 Modified and this alternative is carried forward to the estimated costs summary. This alternative includes both a public and private option as described in this section.

4.2 Potable Water

The following section provides an evaluation of the required size of the potable water main within Old Redwood Highway for the limits of the study area. Figure 6 shows the existing and recommended potable water system. Recommendations for project phasing are also provided.

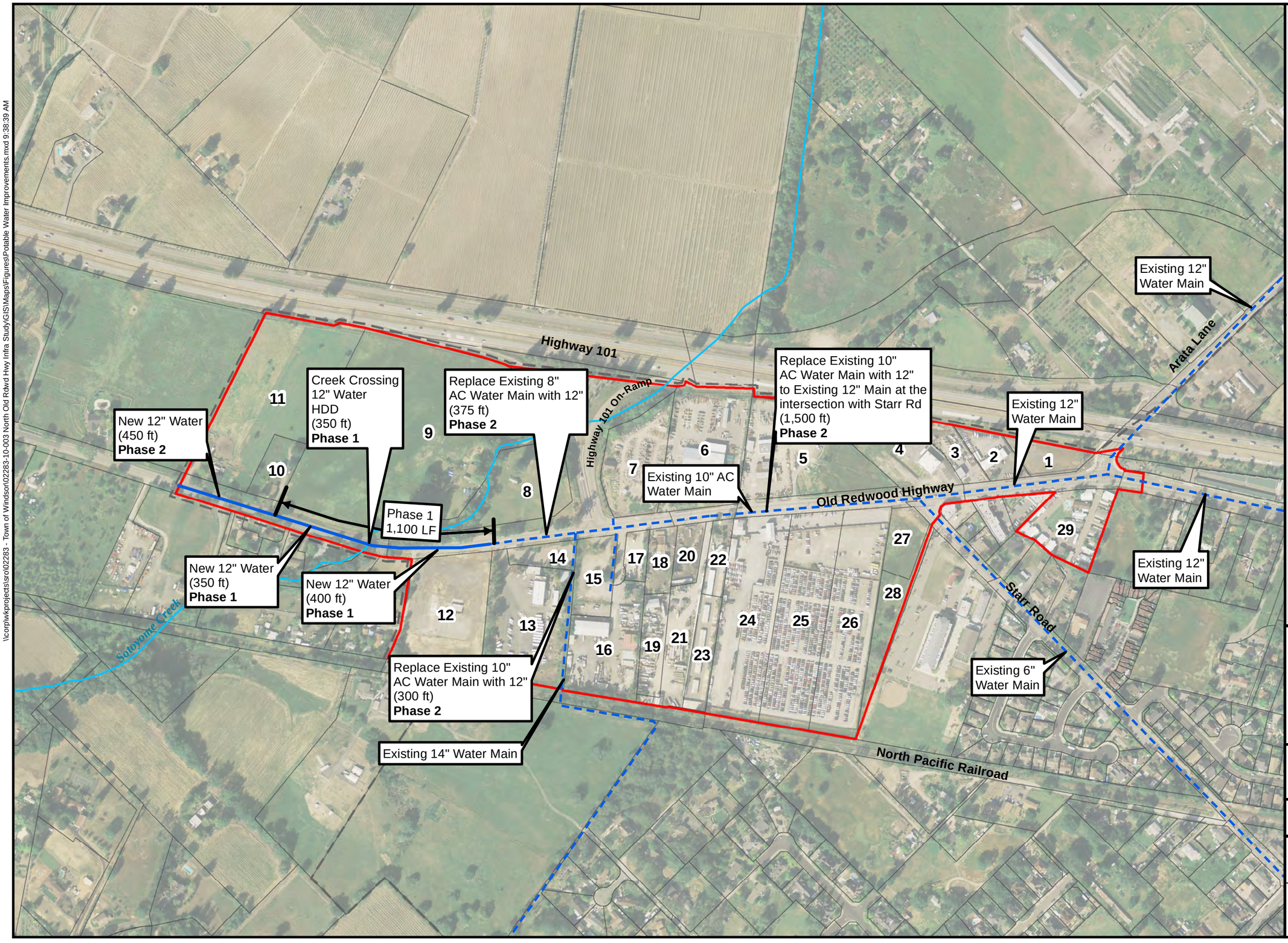
Flow Calculations

The North Old Redwood Highway study area overlaps with the planning area in the Town's Water Master Plan. The Town decided to keep land use assumptions for this study consistent with General Plan land use, which is also applied within the Water Master Plan. Further, this study assumes uniform density throughout the study area – an assumption that may not prove to be true upon actual redevelopment of the study area.

Land use density for the study area is calculated at 75 percent of the highest allowable use. This results in a net density of 12 dwelling units per acre (DU/AC) spread uniformly throughout the study area. With a total service area of 78.21 acres, there would in theory be a total of 938 dwelling units within the study area. Note: Recently developed properties, or those properties with current development plans are assumed to eventually redevelop to 12 DU/AC.

Based on this land use assumption and a water demand of 319 gallons per day per dwelling unit (gpd/DU), the average day demand (ADD) for the study area is approximately 0.3 mgd. Using the peaking factors provided in the Design Criteria section of the study, the ADD is peaked to 0.57 mgd for maximum day demand (MDD) and 0.87 mgd for peak hour demand (PHD).

Project WM-5 in the Water Master Plan considered these factors in its recommendation to replace the existing 10-inch asbestos cement (AC) water main between Starr Road and the public easement located north of Parcel No. 15 with a new 12-inch water main. The water main would connect to the existing 14-inch transmission main within the easement.



Town Boundary
Study Area
Creek
Proposed Water Main
Existing Water Main

PROJECT PHASING

PHASE 1: Extend 12" Water to northern portion of study area.

PHASE 2: Implement Project WM-5 from Water Master Plan; Extend water main from north beyond Phase 1 as necessary for development of Parcel No. 11.

Notes:
1. Preliminary construction costs do not include road overlay.

2. Costs include facilities within Old Redwood Highway and the portion of Phase 2 within the easement adjacent to Parcel No. 15.

0 200 400 ft

1 inch = 400 feet printed at 11x17

Sources: Santa Rosa GIS: Aerial 2009 1 foot resolution; Sonoma County GIS: Parcels; Winzler and Kelly GIS: Utilities.

WINZLER & KELLY
www.w-and-k.com

© Winzler & Kelly

Cartography	Date	Project #
AF	3/12/2012	0228310003

Figure 6
Recommended Potable Water Improvements

North Old Redwood Highway Area Utility Infrastructure Study

Town of Windsor

\\corpwkprojects\sro\02283 - Town of Windson\02283-10-003 North Old Rdwd Hwy Infra Study\GIS\Maps\Figures\Potable Water Improvements.mxd 9:38:39 AM

Pipe Sizing

Pipe sizing is generally based on the results of detailed analysis prepared within the Water Master Plan. However, the Water Master Plan does not make recommendations for the installation of a water main beyond the easement located north of Parcel No. 15.

Sizing of the water main beyond that point was discussed at a project workshop with the Town on November 8, 2010. At that workshop, Winzler & Kelly recommended an 8- to 10-inch water main for this portion of Old Redwood Highway due to decreased demand from the northern portion of the study area. The Town noted that users at the north end of the system may require a 12-inch main to achieve adequate fire flow. It was decided to keep a recommendation for a 12-inch diameter water main. The following points should be considered for sizing of the water main during the detailed design phase for the water main extension within Old Redwood Highway:

- Sizing shall follow the Town's *Design and Construction Standards* and *Water Master Plan* recommendations, including the design criteria brought forward in this study document. The pipe shall have a minimum diameter of 8 inches and be sized to meet minimum Fire Code requirements for commercial land use;
- Sizing of the water main shall consider other relevant planning documents, including the conditions of approval for the Sanderson Property (UP-05-34) dated July 24, 2007, wherein Condition of Approval No. 42 states: "The developer shall extend a 12-inch potable water line from the existing Town water system to and across the full project frontage [of the Sanderson Property] on Old Redwood Highway";
- The water main in Old Redwood Highway will be a dead-end main for at least some period of time, so an increased pipe diameter is also a feasible outcome from future detailed design; and
- The difference in construction cost between 8- and 12-inch-diameter water mains would be approximately $25,000 (the difference between 10- and 12-inch water mains would be less). This cost difference is for the 1,100 linear feet of water main extension beyond the 12-inch main recommended in the Water Master Plan. Note: Horizontal Directional Drilling (HDD) is recommended for crossing of Sotoyome Creek. Incremental upsizing of the water main from 8- to 12-inch diameter in the future would be less desirable for the HDD portion of the water main, as it would require a second HDD crossing. If water demand analysis for development of the Sanderson property suggests that an 8-inch water main is sufficient, the Town should still consider a 12-inch crossing of the creek.
- The Town should consider growth inducing impacts in the environmental documentation that will accompany further planning and design of the water main.

Recommended Potable Water System Improvements

Recommendations for overall water system improvements within the study area are summarized below and shown in Figure 6.

- Remove and replace approximately 1,825 linear feet of existing 10-inch AC water main with a new 12-inch water main between Starr Road and the easement located north of Parcel No. 15;

- Remove and replace approximately 375 linear feet of existing 8-inch AC water main with a new 12-inch water main between the easement and the northern terminus of the existing water system;
- Add approximately 1,100 linear feet of new 12-inch water main to a northern terminus at the property line between Parcel Nos. 9 and 10, inclusive of 300 linear feet of trenchless construction under Sotoyome Creek. Horizontal directional drilling (HDD) is recommended for this trenchless construction.

HDD is recommended in this study in lieu of hanging a new water main on the existing Sotoyome Creek Bridge. This approach is also preferred by the Town. A hung pipe would be vulnerable to environmental factors. Also, it is anticipated that the bridge will be modified at some point in the future, which would cause the need for the pipe to be relocated. The cost of HDD is higher compared to hanging pipe on bridge, which provides a more-conservative cost recommendation for this study. The Town may revisit hanging pipe on bridge when the bridge is being designed.

Recommended Potable Water System Phasing Option

Recommended improvements may be phased based on how the study area redevelops. The following provides one potential scenario for phasing of water system improvements:

- Phase 1: Extend approximately 1,100 linear feet of 12-inch water main beyond existing 8-inch dead-end main to serve northern study area. The pipe would end at the property line between Parcel Nos. 9 and 10.
- Phase 2: Implement Project WM-5 from the Water Master Plan.
- Phase 3: Install looped systems per review of future development plans.

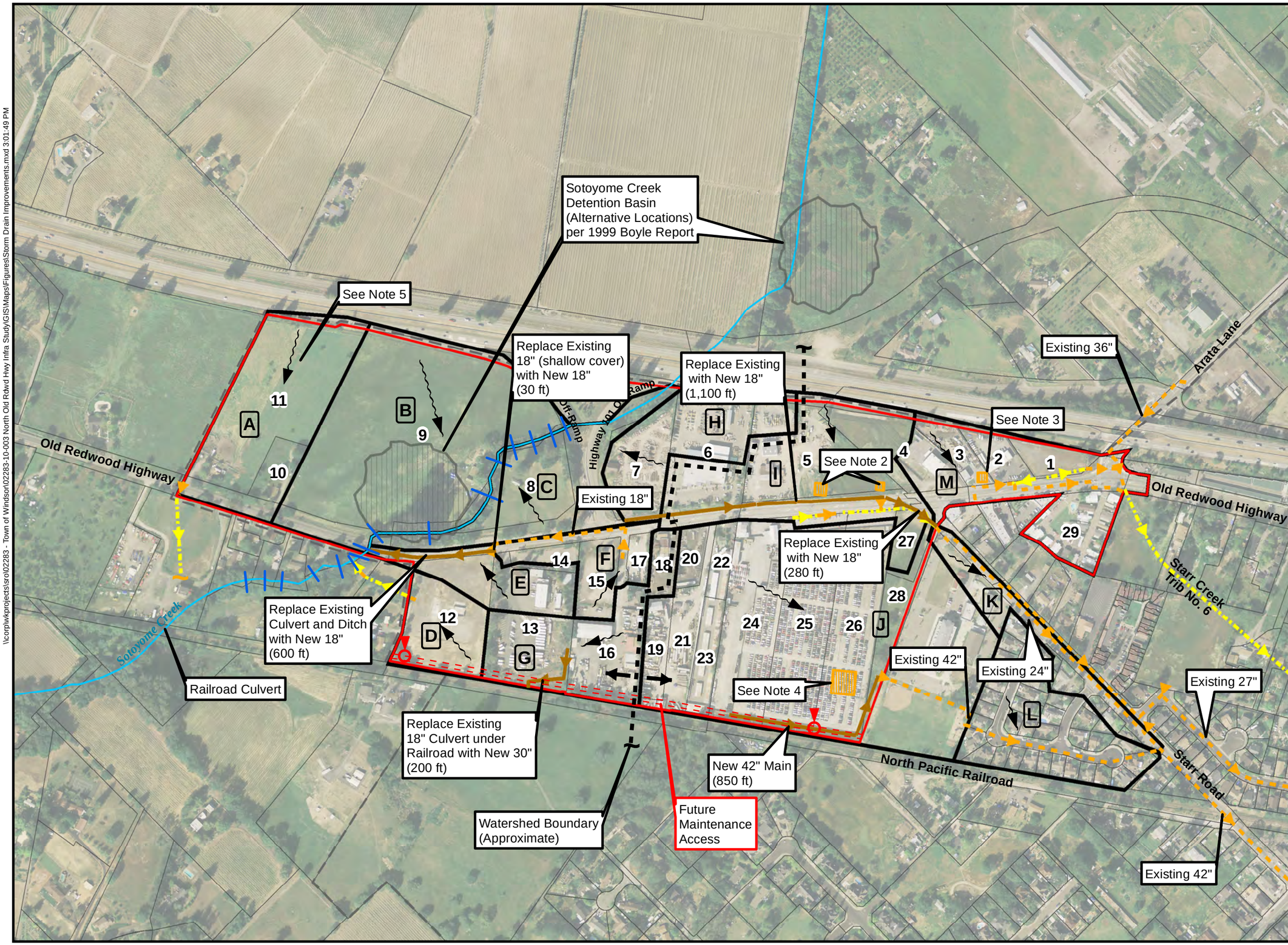
Looped water systems may be necessary upon Town review of future development submittals to provide system redundancy and reliability. A looped water system should be included within developed roadways, pathways, and easements. Looped systems may include 8- and 10-inch diameter pipelines; however, because the interior roadway systems are not yet known, it is not possible to identify where the looped systems will occur.

4.3 Storm Drainage

The following section provides an evaluation of the Sotoyome Creek and Starr Creek watersheds for storm drainage improvements in the study area. Each watershed is split into sub-watersheds in order to closely evaluate impacts to the existing storm drainage system from development. The required size of storm drainage mains and detention basins are provided in this section. Figure 7 shows the existing and recommended storm drainage system. Note: There are several potential scenarios for development within the study area. Construction of trunk storm drain pipelines within Old Redwood Highway, localized or regionalized detention schemes, and wholesale improvements to Sotoyome Creek should be further evaluated by the Town based on the location, number, and scale future development proposals.

Watershed Descriptions

The study area overlaps two major, separate watersheds. These watersheds eventually flow to the Russian River.



Town Boundary
Study Area
Project Watersheds
Potential Detention Site
Creek
Creek Cross-Section
Existing Ditch
Existing Pipe & Culvert
New Storm Drain
Overland Flow Direction
Public Utilities and Emergency Access Corridor (Based on Vision Plan)
Potential Access Location from Old Redwood Hwy.

Notes:

1. See table in study for detailed watershed information.

2. Provide onsite detention Watershed I (0.1 Ac-ft).

3. Provide onsite detention within Watershed M (0.04 Ac-ft).

4. Provide onsite detention within Watershed J (0.4 Ac-ft).

5. Watershed A required to handle increase in peak flows onsite to alleviate existing downstream capacity problem.

0 200 400 ft

1 inch = 400 feet printed at 11x17

Sources: Santa Rosa GIS: Aerial 2009 1 foot resolution; Sonoma County GIS: Parcels; Winzler and Kelly GIS: Utilities.

WINZLER & KELLY
www.w-and-k.com

©Winzler & Kelly

Cartography	Date	Project #
AF	2/23/2012	0228310003

Figure 7
Recommended Storm Drain Improvements

North Old Redwood Highway Area Utility Infrastructure Study

Town of Windsor

\\corp\wkprojects\sro\02283 - Town of Windsor\02283-10-003 North Old Rdwd Hwy Infra Study\GIS\Maps\Figures\Storm Drain Improvements.mxd 3:01:49 PM

- Starr Creek watershed in the south; and
- Sotoyome Creek watershed to the north.

Refer to Figures 7 and 8 for the approximate boundary between these two watersheds within the study area. Figure 7 shows the location of each sub-watershed. Figure 8 shows each overall watershed.

- Sotoyome Creek: Sub-watersheds A through H, where G is a small stand alone watershed that drains across the railroad
- Starr Creek: Sub-watersheds I through M.

Watershed Boundary Conditions

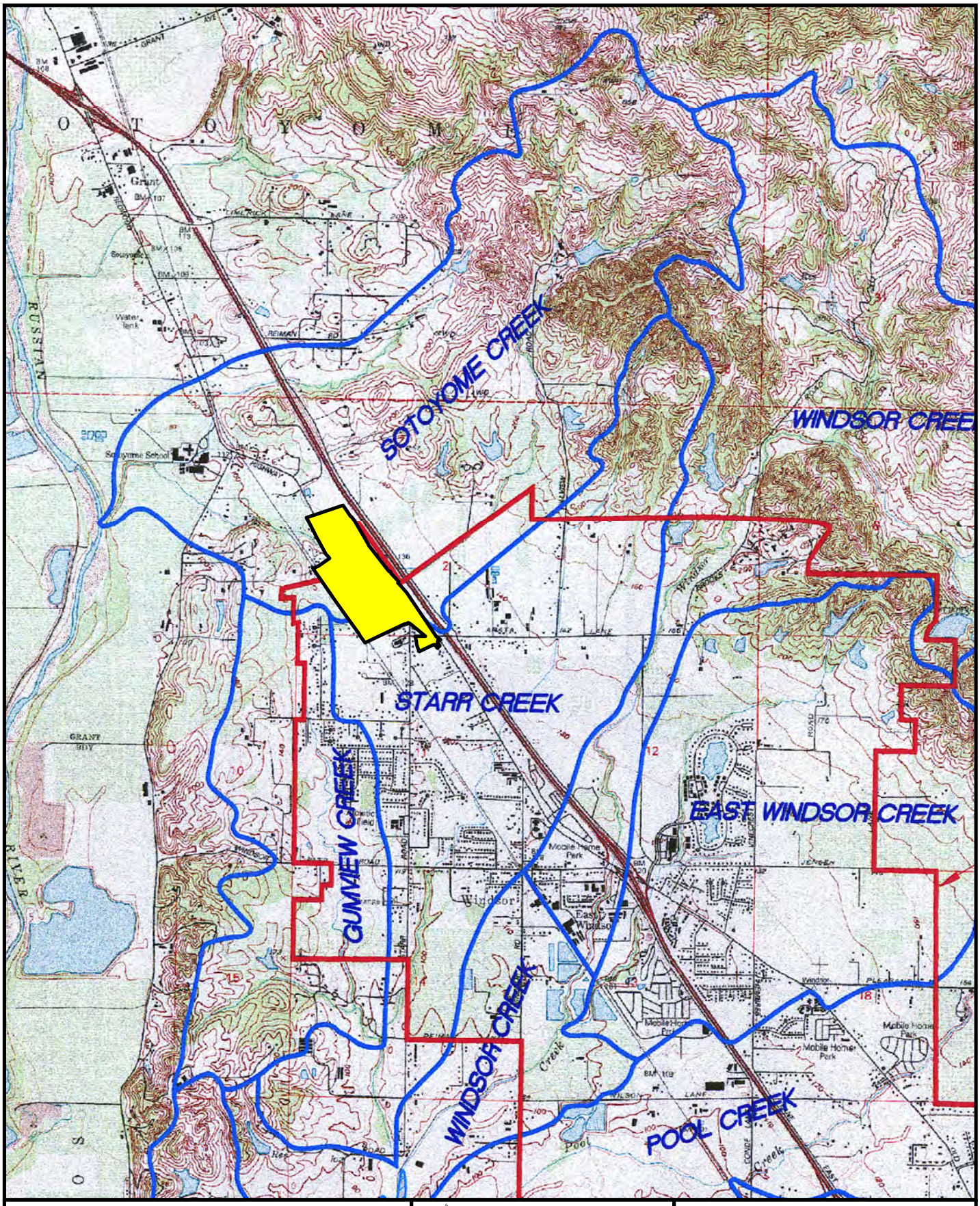
The downstream boundary condition for Sotoyome Creek watershed is assumed to occur at the railroad crossing where previous analysis for SMART provides a known water surface condition. Impacts of potential project development on the channel downstream of the railroad crossing are not analyzed as part of this study. In discussions with the Sonoma County Water Agency (Agency) regarding this issue, it was agreed that downstream impacts should be considered at the design phase and will likely be analyzed in more detail in the upcoming Storm Drain Master Plan being considered by the Town.

The downstream boundary condition for Starr Creek is at the confluence of the existing storm drain serving Watershed L with the existing storm drain on Starr Road. This is just downstream of the 27-inch storm drain tie-in location from the east on Entrada Lane.

The Windsor Watershed Master Drainage Plan (1989; Windsor Master Plan) prepared by the Agency as well as the Program Report Windsor Cumulative Drainage Impact Mitigation Program Update (Boyle, 1999) was used to define major watershed boundaries and to define design flows. Through coordination with Agency staff, we found that the Agency is more familiar with the 1989 Master Plan. The 1989 Master Plan was used as a beginning point for determining sub-watersheds. Sub-watersheds boundaries were refined based on field investigations, topographic mapping, and discussions with Agency staff. Off-site flows routed through the project watersheds were also taken from the 1989 Master Plan though flows were compared and matched closely with design flows from the Boyle Study.

Storm Drainage Analysis Approach

The approach for analysis of storm drainage facilities is similar to the other utilities considered in this study – the focus is on “backbone” utilities, most of which are located within Old Redwood Highway. In consideration of the layout of the various watersheds for the study area, some recommended drainage improvements are located within private properties. Improvements located within private properties include detention systems that are sized to capture increases in peak flows that would otherwise impact existing downstream drainage systems. Depending on the timing and scope of future development, detention systems could be combined into regional systems, which would result in fewer facilities to maintain and potentially a lower capital cost compared to the implementation of several small facilities.



Study Area

Source: Figure 1, Windsor Cumulative Drainage Impact Mitigation Program Update Program Report, September 15, 1999

N

0 1,500 3,000 Ft

1 inch = 3,000 feet printed at 8.5x11

WINZLER & KELLY

www.w-and-k.com

© Winzler & Kelly

Figure 8
Sotoyome Creek and Starr Creek Watersheds

North Old Redwood Highway Area Utility Infrastructure Study

Town of Windsor

Cartography: AF

Frontage improvements associated with parcel redevelopment will need to account for conveyance of gutter flow of stormwater. In general, redevelopment will result in the replacement of ditches with curb and gutter. Costs and analysis for frontage improvements are not included in this study.

Review of Planning Documents

The 1989 Windsor Master Plan was reviewed and watersheds and design flows were taken from this document including Map 16 – Starr Creek and Map 41 – Sotoyome Creek. Agency files were also reviewed for subdivisions and other developments for design flows and recommended sizing of drainage facilities. Planning documents also included Town Memorandum dated December 12, 2006 – *Hydraulic Analysis Requirements for Development Projects Along Creeks and Other Drainage Ways* as well as additional planning files for planned and recently-constructed developments, including the Sanderson property (Parcel No. 11), G&C Autobody (Parcel No. 15), and offsite developments such as Caitlyn Manor (Watershed L).

Coordination with SCWA

Several meetings were conducted with Agency staff to go through files, including the 1989 Windsor Master Plan and the 1999 Boyle Study, which provided background information on the identified sub-watersheds. Design concepts were also reviewed to ensure that they were in accordance with Agency design criteria. The Agency completed a cursory review of the Draft Study and indicated that the approach and methods used herein were found to be in general conformance with the Sonoma County Water Agency Flood Control Design Criteria. (Please refer to the Agency letter dated February 14, 2012 in Appendix F.)

Conveyance Improvements vs. Detention

Both full conveyance and detention were considered in developing drainage improvement alternatives. In certain cases, detention is required by the Town and Agency due to known downstream flooding issues. Table 2 provides a summary of the analysis for each watershed and recommended storm drain system improvements.

Runoff Coefficient and Soil Classifications

For comparing existing and developed conditions, it is assumed that at developed conditions the property will essentially be Service Commercial and/or Gateway Commercial per the Town of Windsor Zoning Map dated May 25, 2000 with final revisions dated November 1, 2005. It should be noted that we make no distinction between these types of commercial development when selecting the appropriate runoff coefficient assumed to be 0.9. The existing runoff coefficient varies between 0.38 and 0.80 as summarized in Table 2 and noted for each watershed. Existing coefficients are presented as weighted averages.

In addition to development, another impact to runoff is the underlying soil obtained from soil mapping that classifies soils into hydrologic soil groupings ranging from A (sandy well drained soils) to D (poorly draining clay soils). The soil classification used in the analysis for each watershed is noted.

4.4 Sotoyome Creek

The following section provides a summary of the analysis for each sub-watershed within the Sotoyome Creek watershed. Table 2 provides a summary of the analysis for each sub-watershed, including estimates of probable costs that are provided in detail in Appendix J. The existing and proposed storm drainage systems are also shown on Figure 7.

There are four sub-watersheds within the Sotoyome Creek watershed that are located to the east of Old Redwood Highway: Watersheds A, B, C, and H. The following analysis considers Watershed A as a stand-alone watershed due to previous Town planning decisions and the other sub-watersheds as combined since all flow is tributary to Sotoyome Creek.

Watershed A

Watershed A Description
Watershed A (see Figure 7) is a 9.1 acre site gently sloping towards the west and is located between Old Redwood Highway and US 101. The existing site consists of pasture land with a hydrologic soil classification of C; the existing runoff coefficient is 0.38. This is the future site for the Sanderson Development (Parcel No. 11). Due to downstream flooding, there is a condition of approval requiring detention to maintain peak flows for up to a 100-year event to pre-development levels. Hydrology analysis of the pre-development and post- development site indicates the following conditions:

- Pre-development 10-year runoff: 4.9 cfs
- Post-development 10-year runoff: 15.4 cfs
- Pre-development 100-year runoff: 6.9 cfs
- Post-development 100-year runoff: 21.8 cfs

Proposed Watershed A Improvements
As described above, onsite detention has been required as a condition of approval. A hydrologic analysis to determine the actual siting and type of detention is not provided in available Town planning documents. An estimated opinion of probable construction costs is not included for this site.

- Estimated storage requirements – 10-year design: 0.4 Ac-Ft
- Estimated storage requirements – 100-year design: 0.6 Ac-Ft

Watersheds B, C & H

Runoff from these three sub-watersheds combines and is tributary to Sotoyome Creek on the east side of Old Redwood Highway. A description of each sub-watershed is first provided, and then followed by an analysis for the combined flows and associated impacts and recommendations for the watershed. Pre-development and post-development runoff flow rates are used in the hydraulic modeling of Sotoyome Creek. Descriptions of sub-watersheds are also provided to show the basis for combined flows used in the hydraulic modeling.

Watershed B Description
Watershed B is a 17 acre site gently sloping towards the southwest and is located between Old Redwood Highway and US 101. It is bounded on its southern boundary by Sotoyome Creek. The existing site consists of pasture land with a hydrologic soil classification of C. It is assumed that under post-development conditions, the site will be developed as Commercial with a conservative overall runoff coefficient of 0.9; the existing runoff coefficient is 0.48. Hydrology analysis of the pre-development and post- development site indicates the following conditions:

- Pre-development 10-year runoff: 8.2 cfs
- Post-development 10-year runoff: 28.3 cfs

Watershed C Description
Watershed C is a 6.9 acre site sloping northerly from Old Redwood Highway to Sotoyome Creek. The existing site consists of pasture land with a hydrologic soil classification of D and also includes a portion of the US 101 on/off ramp. It is assumed that under post-development conditions, the site will be developed as Commercial with a conservative overall runoff coefficient of 0.9; the existing runoff coefficient is 0.48. Hydrology analysis of the pre-development and post- development site indicates the following conditions:

- Pre-development 10-year runoff: 5.8 cfs
- Post-development 10-year runoff: 13.2 cfs

Watershed H Description
Watershed H is a 5.8 acre site bounded on the east by US 101 sloping northwesterly to Sotoyome Creek. The existing site consists of urbanized graveled/paved conditions with a hydrologic soil classification of D with an estimated runoff coefficient of 0.8. It is assumed that under post-development conditions, the site will be developed as Commercial with a conservative overall runoff coefficient of 0.9; the existing runoff coefficient is 0.48. Hydrology analysis of the pre-development and post- development site indicates the following conditions:

- Pre-development 10-year runoff: 9.2 cfs
- Post-development 10-year runoff: 10.2 cfs

Watersheds C & H Combined Description
Both Watersheds C and H drain to Sotoyome Creek. Under pre-development conditions, their combined flows are governed by the longer time of concentration from Watershed C. Under post-development conditions, their combined flows are governed by the longer time of concentration from Watershed H. Combined hydrology analysis of the pre-development and post-development site indicates the following conditions:

- Pre-development 10-year runoff: 13.0 cfs
- Post-development 10-year runoff: 22.3 cfs

Watersheds B, C & H Combined Description
Combining Watershed B north of Sotoyome Creek and Watersheds C and H south of Sotoyome Creek result in the following runoffs:

- Pre-development 10-year runoff: 18.0 cfs
- Pre-development 100-year runoff: 25.0 cfs
- Post-development 10-year runoff: 38.0 cfs
- Post-development 100-year runoff: 53.0 cfs

Hydraulic Analysis for B, C, & H Combined
Watershed B (see Figure 7), located adjacent and northerly of Sotoyome Creek between US 101 and Old Redwood Highway and Watersheds C and H, adjacent and southerly of Sotoyome Creek between US 101 and Old Redwood Highway all drain directly to Sotoyome Creek upstream of its crossing of Old Redwood Highway. Discussions with Agency staff indicate that any improvements at these locations need to consider not only impacts to Sotoyome Creek but existing conditions on Sotoyome Creek. The Agency design criteria for the Sotoyome Creek watershed is that the design flows (in this case: 25-year storm) must be contained within the channel banks with 1.5 feet of freeboard. Further, the 100-year event cannot overtop its banks. Development on site needs to take these design considerations into account.

The 1999 Boyle Report also identifies the option for the detention of peak flows upstream of this sub-watershed, located east of US 101, wherein, the report states that 6 acre-feet of storage is required at a 1999 cost of $632,000. The option for regional detention that addresses existing flooding, flooding caused by development upstream of the watersheds within the Study area, and/or flooding caused by development within the Study area should be further investigated within the Town's upcoming Storm Drain Master Plan. That evaluation should consider the affect on detention sizing from onsite storage within the Study area.

Detention could also be implemented as a floodway within Parcel No. 9. The topography of Parcel No. 9 generally slopes downward from the creek top of bank towards Old Redwood Highway, so the land area required to adequately detain flows to prevent flooding would be significant. This land area dedicated to flood control would reduce the redevelopment potential on Parcel No. 9, whereas improvement in the creek conveyance system to "push" the flood waters to a downstream location may be preferable. The downstream location may be located beyond the railroad culvert (see Figure 7), which would be outside of the Town limits.

An existing HEC-2 model of Sotoyome Creek was obtained from the Agency. A field check of a number of cross sections was conducted and it appears that some stream degradation downstream of the US 101 on/off ramp has occurred causing bank erosion. More importantly, significant sedimentation at the Old Redwood Highway bridge crossing has occurred. The original Agency model indicates in the order of 8 feet clear under the bridge while the field surveys indicate this channel has filled in so there is only 3 to 4 feet of clearance from the soffit to flowline. A study prepared in support of development for the Sanderson property (Parcel No. 11) indicates that the Sotoyome Creek Bridge is not sufficient for hydraulic capacity. Stream cross sections provided by the Agency and collected as a part of this study are provided in Appendix G. The approximate locations of the cross sections are also shown on Figure 7.

A revised HEC-RAS model of the creek from just upstream of the railroad to just downstream of the culvert crossing of the freeway on/off ramp was developed for this study. The 1989 Windsor Master Plan flows for the 25-year storm were assumed for the model (Q25 – 634 cfs). 100-year

flows (Q100 – 934 cfs) were estimated from preliminary hydrology completed for SMART and scaled proportionally for AGENCY Q25 over SMART Q25. The model shows significant backwater caused by the bridge crossing of Old Redwood Highway. It is our recommendation that this bridge be replaced or at a minimum the channel cleaned out, removing much of the accumulated sediment at the bridge. This work would significantly reduce backwater impacts at the bridge and provide adequate freeboard in the channel upstream of the bridge negating the requirement of a bypass. Model results for existing conditions and for a new bridge configuration are provided in Appendix H.

The option of creating a floodway within Parcel No. 9 as a part of the strategy to reduce/manage flooding within Sotoyome Creek would provide some level of flow retention as flows are backed-up from the current hydraulic restriction at the bridge. However, the solution of creating a floodway as a stand-alone option will not solve the flooding potential for the creek upstream of the bridge without encumbering a significant area of land within Parcel No. 9. Improvement of the hydraulic capacity at the bridge is necessary, along with other capacity improvements for the creek (i.e., railroad culvert) to "push" flood waters to more open lands outside of the Town limits. This more regional evaluation should be conducted within the Town's Storm Drain Master Plan and in conjunction with Water Agency review since improvements could extend outside of the Town limits.

Proposed Watershed B, C, & H Combined Improvements

- Interim: Remove accumulated sediment to improve hydraulic capacity at bridge crossing; conduct regular maintenance for periodic cleaning of the channel. Consider ongoing cleaning even after the bridge is replaced to maintain hydraulic capacity at the bridge.
- Recommendation: New bridge on Old Redwood Highway at Sotoyome Creek crossing. See Section 5.2 for a description of bridge improvements.
- To be further investigated in addition to bridge replacement: Downstream floodway improvements, including the railroad culvert.

The increase in runoff from development of the site (Watersheds B, C and H) is estimated at 28 cfs for a 100-year event which is considered insignificant (approximately 3 percent increase) compared to the 100-year flow from the Sotoyome watershed. Drainage improvements to mitigate for peak flow increases may not be required within Watersheds B, C, and H if the bridge at Old Redwood highway is replaced. An estimate of probable construction costs for a new bridge is provided in Section 5.2.

Table 2
North Old Redwood Highway Area Utility Infrastructure Study - Storm Drainage Watershed Info

Basin	Included Parcels	Watershed	Area (ac)	C (exist) (1)	Q (exist) (cfs)	C (future)	Q (future) (cfs)	Q Delta (cfs)	Det. Vol (ac-ft)	Pipe Dia. (exist) (in)	Pipe Dia. (future) (in)	Est. of Probable Construction Cost ($)	Est. of Probable Total Cost ($)	Comments
A	10, 11	Sotoyome	9.1	0.38	4.78	0.90	16.57	11.79	0.7	n/a	n/a	n/a	n/a	Costs by others
Combined B/C/H	6, 7, 8, 9	Sotoyome	29.7	0.48	18.00	0.90	38.00	20	n/a	n/a	n/a	n/a	$1,200,000	Recommend new bridge at Old Redwood Hwy
D	12	Sotoyome	3.2	0.70	4.80	0.90	6.18	1.38	n/a	n/a	n/a	n/a	n/a	Costs by others
Combined E/F	12, 13, 14, 15	Sotoyome	6.9	0.76	5.12	0.90	6.42	1.3	n/a?	18"	Extend 18"	$332,000	$439,000	Site F reviewed by others as part of G&C project
G	13, 16, 17, 18	Sotoyome	6.6	0.80	10.99	0.90	12.36	1.37	n/a	18"	30"	$180,000	$231,000	
I	4, 5, 6, 27	Starr	11.0	0.70	15.47	0.90	19.72	4.25	0.1	18" to 24"	18"	$785,000	$1,034,000	Replace roadside ditch/culvert with 18" SD in Old Redwood Hwy; on-site detention
J[1]	19-26, 28	Starr	28.4	0.74	31.93	0.85	58.63	26.7	0.4	42"	42"	$1,143,000	$1,463,000	Extend 42" SD; on-site detention
K	n/a	Starr	3.3					0				n/a	n/a	
L	n/a	Starr	7.3					0				n/a	n/a	
M	1-3, 29	Starr	8.4	0.75	16.56	0.90	19.88	3.32	0.04	n/a	n/a	$109,000	$140,000	On-site detention

1 - Developed 10-year flows are contained in the (E) 42" on Starr Rd & Fulton Place but do not meet the 1' HGL to rim SCWA criteria

Notes:

(1) Weighted average

There are four sub-watersheds within the Sotoyome Creek watershed that are located to the west of Old Redwood Highway: Watersheds D, E, F, and G. The following analyses consider each watershed to be a stand-alone watershed, wherein storm drainage runoff from each sub-watershed is conveyed to either the trunk storm drain located within Old Redwood Highway or to an existing downstream culvert at the NWPRR crossing (Watershed G).

Watershed D

Watershed D Description
Watershed D is a 3.2 acre site gently sloping northerly to an overland swale that drains to Sotoyome Creek west of Old Redwood Highway. The site is bounded on the west by the NWPRR. The existing site consists of old concrete pavement and pasture land with a hydrologic soil classification of C/D. It is assumed that under post-development conditions, the site will be developed as Commercial with a conservative overall runoff coefficient of 0.9; the existing runoff coefficient is 0.70. Hydrology analysis of the pre-development and post-development site indicates the following conditions:

- Pre-development 10-year runoff: 4.8 cfs
- Post-development 10-year runoff: 6.2 cfs

Proposed Watershed D Improvements
It is assumed that drainage will be conveyed directly to Sotoyome Creek downstream of Old Redwood Highway. The actual onsite drainage layout is unknown and an estimated opinion of probable construction costs is not included for this site.

Watershed E

Watershed E Description
Watershed E is a 3.5 acre site sloping northerly to a roadside ditch along Old Redwood highway. The southern portion of the site is generally developed with pavement while the northerly portion of the site consists of pasture land with a hydrologic soil classification of D. It is assumed that under post-development conditions, the site will be developed as Commercial with a conservative overall runoff coefficient of 0.9; the existing runoff coefficient is 0.76. Hydrology analysis of the pre-development and post- development site indicates the following conditions:

- Pre-development 10-year runoff: 5.1 cfs
- Post-development 10-year runoff: 6.4 cfs

Proposed Watershed E Improvements

- 630 LF – 18” RCP

The analysis previously completed by others for the G&C Autobody site (Parcel No. 15) located in Watershed F below calls for onsite storage with onsite runoff directed to an 18-inch storm drain in Old Redwood Highway. It is recommended that this storm drain be extended to drain to Sotoyome Creek on the west side of the Old Redwood Highway Bridge, for a distance of

approximately 600 LF. Also, a portion of the 18-inch storm drain installed by the G&C Autobody development was installed with insufficient pipe cover as an interim solution. It is our understanding that this portion of the storm drain is located between the main pipeline in the road and the current discharge to the ditch on the west side of the road, or approximately 30 LF. This portion of the storm drain should also be replaced along with improvements in Old Redwood Highway, which results in a total storm drain improvement of 630 LF. The preliminary opinion of probable construction costs for improvements within Watersheds E/F is $343,000. Based on the cost considerations provided later in the study, the total project cost (including "soft costs") is approximately $439,000.

Watershed F

Watershed F Description
Watershed F is a 3.4 acre site sloping northeasterly to a roadside ditch/storm drain along Old Redwood Highway. The site is generally developed with a hydrologic soil classification of D. This is the site of G&C Autobody. The project has recently been reviewed by both the Agency and the Town of Windsor; a drainage report was prepared by Huffman Engineering and approved by the Agency. No net increase in runoff was the condition imposed on the project. The drainage system will be designed such that no increase in runoff will occur during a 10-year storm event.

Proposed Watershed F Improvements
Refer to the description of improvements for Watershed E above. Improvements include the construction of an 18-inch storm drain in Old Redwood Highway.

Watershed G

Watershed G Description
Watershed G is a 6.6-acre site that slopes northwesterly from Old Redwood Highway to an existing 18-inch culvert crossing of the NWPRR with a hydrologic soil classification of D. The existing site is generally developed, consisting of pavement and gravel. It is assumed that under post-development conditions, the site will be developed as Commercial with a conservative overall runoff coefficient of 0.9; the existing runoff coefficient is 0.80. Hydrology analysis of the pre-development and post- development site indicates the following conditions:

- Pre-development 10-year runoff: 11.0 cfs
- Post-development 10-year runoff: 12.4 cfs

The existing culvert is currently undersized with a capacity of approximately 6 cfs. However, SMART will likely replace culverts as part of the rail upgrade and will likely install a 30-inch or 36-inch culvert at this location, which will accommodate both the pre-development and post-development runoff.

Proposed Watershed G Improvements

- 200 LF – 30" RCP

An onsite storm drain should be constructed and tied to the culvert crossing of the railroad. Depending on slope, a 30-inch storm drain/culvert system should be adequate to handle the post-development flows. The cost for a new culvert crossing the railroad is not included in this study. The preliminary opinion of probable construction costs for improvements within Watershed G is $180,000. Based on the cost considerations provided later in the study, the total project cost (including "soft costs") is approximately $231,000.

4.5 Starr Creek

The following section provides a summary of the analysis for each sub-watershed within the Starr Creek watershed. Table 2 provides a summary of the analysis for each sub-watershed, including estimates of probable costs that are provided in detail in Appendix J. The existing and proposed storm drainage systems are also shown on Figure 7.

There are four sub-watersheds within the Starr Creek watershed that are tributary to the existing storm drainage system located within Starr Road and upstream of the railroad: Watersheds I, J, K, and L. The following analysis considers the sub-watersheds as combined since all flow is tributary to the same downstream boundary condition point. Note: Sub-watershed K is not evaluated in this study since it is located entirely outside of the study area and is not anticipated to redevelop, which would result in a higher storm drainage flow rate.

Combined Watershed I, J & L

Runoff from these three sub-watersheds combines and is tributary to Starr Creek within the piped conveyance system in Starr Road. A description of each sub-watershed is first provided, and then followed by an analysis for the combined flows and associated impacts and recommendations for the watershed. Pre-development and post-development runoff flow rates are used in the hydraulic modeling. Descriptions of sub-watersheds are also provided to show the basis for combined flows used in the hydraulic modeling.

Combined Watershed I, J, & L Description
Watershed I drains to Old Redwood Highway, tying to a storm drain on Starr Road. Watersheds J and L tie into the storm drain on Starr Road. Watershed L is the existing Caitlyn Manor subdivision that is routed to a 42-inch storm drain on Fulton Place the ties to the storm drain on Starr Road. Watershed J is a 28.4 acre site that is routed to the upstream limits of the existing 42-inch storm drain serving Caitlyn Manor and previous hydrologic analysis indicated that the 42-inch storm drain likely could not accommodate post-developed flows from this upper watershed without upstream detention. The following summarizes the individual and combined watershed runoff.

Watershed I

Watershed I Description
Watershed I is an 11-acre site that slopes southwesterly towards a roadside ditch with various storm drain culverts along the east side of Old Redwood Highway. This drainage system on Old Redwood highway ties to a 24-inch storm drain on Starr Road that becomes a 42-inch storm drain at the tie with the storm drain for Caitlyn Manor subdivision. The northerly portion of the

existing site is generally developed with the southerly portion consisting of poor pasture land with a hydrologic soil classification of D. It is assumed that under post-development conditions, the site will be developed as Commercial with a conservative overall runoff coefficient of 0.9; the existing runoff coefficient is 0.70. Hydrology analysis of the pre-development and post-development site indicates the following conditions:

- Pre-development 10-year runoff: 15.5 cfs
- Post-development 10-year runoff: 19.7 cfs

A Haestad StormCAD model of the 24-inch storm drain on Starr was developed and both the pre-development and post-development runoff routed through the model. The existing 24-inch storm drain will carry the post-development flows, but will not meet SCWA design criteria of maintaining at least one foot of freeboard.

Proposed Watershed I Improvements

- 1,380 LF – 18" RCP
- Estimated storage requirements – 10-year design: 0.1 Ac-Ft

The StormCAD model indicates that the two downstream sections of 24-inch pipe need to be upsized to 36-inch pipe (a length of 438 feet) in order to meet the SCWA design requirement. As an option, on-site detention at Watershed I to maintain peak flows to pre-development conditions would require approximately 0.1 acre-feet which would very likely be a much less costly improvement. Although open detention basins are an option, it is believed that an underground storage system, perhaps under a parking lot, likely is more feasible in a commercial area. It is estimated that an underground system consisting of a series of 48-inch diameter HDPE pipes tied to a common header and restricted outlet would require approximately 2,500 square feet of space. Approximately 400 LF of 48-inch diameter detention pipe would be required to achieve 0.1 acre feet of storage capacity.

The 1,380 LF of 18-inch diameter conveyance pipeline would be located in Old Redwood Highway, as shown on Figure 7, and would convey runoff from Watershed I to the existing 24-inch storm drain pipe in Starr Road.

The preliminary opinion of probable construction costs for pipeline improvements for Watershed I is $613,000; the cost for detention improvements within Watershed I is $195,000. The combined cost is $808,000. Based on the cost considerations provided later in the study, the total project cost (including "soft costs") for the pipeline and detention improvements is approximately $1,034,000. Please note that the detention system may be privately owned and maintained, so a portion of the soft costs included in the total project cost may not apply.

Watershed J

Watershed J Description

Watershed J is a 28.4-acre site that slopes to the southeast to the 42-inch storm drain serving the Caitlyn Manor subdivision. The site is generally developed consisting of pavement and gravel

with a hydrologic soil classification of D. It is assumed that under post-development conditions, the site will be developed as Commercial with a conservative overall runoff coefficient of 0.9; the existing runoff coefficient is 0.74. The site will likely be served by an extension of the existing 42-inch storm drain which significantly shortens the site's time of concentration and increasing the future runoff. Hydrology analysis of the pre-development and post- development site indicates the following conditions:

- Pre-development 10-year runoff: 31.9 cfs
- Post-development 10-year runoff: 58.6 cfs
- Estimated storage requirements: 0.4 ac-ft

Proposed Watershed J Improvements

- 850 LF – 42" RCP
- Estimated storage requirements – 10-year design: 0.4 Ac-Ft

Analysis indicates that the existing 42-inch storm drain with a proposed upstream extension will carry the pre-development runoff. However, the 42-inch storm drain cannot carry post-development flows which will surcharge the system. On-site detention of approximately 0.4 acre-feet will maintain runoff flows to pre-development levels. Although open detention basins are an option, it is believed that an underground storage system, perhaps under a parking lot, likely is more feasible in a commercial area. It is estimated that an underground system consisting of a series of 48-inch diameter HDPE pipes tied to a common header and restricted outlet would require approximately 10,000 square feet of space. Approximately 1,600 LF of 48-inch diameter detention pipe would be required to achieve 0.4 acre feet of storage capacity.

The preliminary opinion of probable construction costs for improvements within Watershed J is $1,143,000. Based on the cost considerations provided later in the study, the total project cost (including "soft costs") is approximately $1,463,000. Please note that the detention system may be privately owned and maintained, so a portion of the soft costs included in the total project cost may not apply.

Watershed L

Watershed L Description
This watershed is currently residential in nature (Caitlyn Manor subdivision) and is not assumed to change in the future. A 42-inch storm drain collects flows from the upstream watershed J and from the subdivision, tying to the 42-inch storm drain in Starr Road. A 24-inch storm drain also ties in at this junction running north on Starr, collecting runoff from Watershed I. As no change in runoff was anticipated from this site, hydrology analysis of the pre-development and post-development site was only done in combination with Watershed J.

Combined I, J & L Description
Combined hydrology analysis of the pre-development and post- development site indicates the following conditions:

- Pre-development 10-year runoff: 48.9 cfs
- Post-development 10-year runoff: 66.2 cfs
- Estimated storage requirements: 0.4 ac-ft

Hydraulic Analysis for I, J, & L Combined
A Haestad StormCAD model of the 42-inch storm drain on Fulton Place and Starr was developed and both the pre-development and post-development runoff routed through the model. The 42-inch storm drain is adequately sized to handle the pre-development flows but the post-development flows come very close to the rim elevation of a manhole in Fulton Place which does not meet the SCWA design criteria of maintaining at least one foot below the gutter/inlet. It is recommended that detention storage be required in Watershed J to reduce post-development flows from the site to match pre-development flows. This is a conservative approach as there is currently approximately 2.5-feet of freeboard at the manhole location. A more detailed description of the required storage is given under the Watershed J write-up above.

Discussions with Agency staff indicate that surcharging higher than the design criteria of one foot from gutter may be allowed in some instances and further discussions should be conducted prior to finalizing any design improvements. Please note that the detention system may be privately owned and maintained, so a portion of the soft costs included in the total project cost may not apply.

Watershed M

This watershed is a stand-alone watershed for the study area and is tributary to Starr Creek Tributary No. 6 as shown on Figure 7. The following section provides a description of the watershed and recommendations for onsite detention and offsite conveyance improvements.

Watershed M Description
Watershed M is an 8.4-acre site located just south of the intersection of Old Redwood Highway and Starr Road bounded by US 101 in the east. The site is generally developed with pavement and gravel and some residential. The site is tributary to Starr Creek Tributary No. 6 (see Figure 7), as also described in the Windsor Watershed Master Drainage Plan (Map No. 16). The 1989 Master Plan estimates a 10-year design flow for Tributary No. 5 of 43 cfs at the downstream boundary of Watershed M. To improve the hydraulic capacity for Tributary No. 5, the 1989 Master Plan recommends a new 36-inch storm drain to carry these flows, which are primarily generated for the Starr Creek Watershed to the east of US 101, to the south.

The current assumption is that the 43 cfs includes pre-development (existing conditions) flows from Watershed M. It is assumed that under post-development conditions, the site will be developed as Commercial with a conservative overall runoff coefficient of 0.9; the existing runoff coefficient is 0.75. Hydrology analysis of the pre-development and post- development site indicates the following conditions:

- Pre-development 10-year runoff: 16.6 cfs
- Post-development 10-year runoff: 19.9 cfs

Proposed Watershed M Improvements

- Estimated storage requirements – 10-year design: 0.04 Ac-Ft

This increase of 3.3 cfs is assumed to add directly to the 43 cfs for a post-development flow of 46.3 cfs. The actual route of a future storm drain system to serve the Starr Creek Tributary No. 6 watershed is unknown. If the pipe is routed south on Old Redwood Highway, where the existing street grade is estimated at 0.0038 ft/ft, a new 36-inch storm drain installed at the same slope would have a capacity of just under 46 cfs. Thus with minor surcharging, it would appear that the 1989 Master Plan recommendation of a new 36-inch storm drain would provide capacity for the post-development flows.

Hydraulic Analysis for Watershed M

Discussions with Agency staff indicate that improvements may be required all the way to the existing dual 54-inch storm drain on Chiquita Lane, which is located several hundred feet west of Old Redwood Highway. As an option, on-site detention could be used for Watershed M to maintain peak flows to pre-development conditions. This would require approximately 0.04 acre-feet of detention volume, which would very likely be a much less costly improvement compared to extensive offsite conveyance system improvements. Although open detention basins are an option, it is believed that an underground storage system, perhaps under a parking lot, likely is more feasible in a commercial area. It is estimated that an underground system consisting of a series of 48-inch diameter HDPE pipes tied to a common header and restricted outlet would require approximately 1,100 square feet of space. Approximately 160 LF of 48-inch diameter detention pipe would be required to achieve 0.04 acre feet of storage capacity.

The preliminary opinion of probable construction costs for improvements within Watershed M is $109,000. Based on the cost considerations provided later in the study, the total project cost (including “soft costs”) is approximately $140,000. Please note that the detention system may be privately owned and maintained, so a portion of the soft costs included in the total project cost may not apply.

Summary of Storm Drainage Recommendations

The following table provides a summary of the recommended storm drainage improvements for the study area. A breakdown of the preliminary opinion of probable total project costs is provided in Section 5.

Table 3
Storm Drainage Recommendations Summary

Sub-Watershed	Watershed	Included Parcels	Recommended Improvement	Prelim. Opinion of Probable Total Cost
A	Sotoyome	10, 11	Onsite detention (by developer as Condition of Approval)	n/a
Combined B, C, & H	Sotoyome	6, 7, 8, 9	New bridge at Old Redwood Hwy; remove sediment from channel	$1,200,000 [1]
D	Sotoyome	12	Onsite detention (by developer as Condition of Approval)	n/a
Combined E & F	Sotoyome	12, 13, 14, 15	Extend 18" SD in Old Redwood Hwy to Sotoyome Creek	$439,000
G	Sotoyome	13, 16, 17, 18	Replace (E) 18" SD with 30" SD	$231,000
I	Starr	4, 5, 6, 27	Replace roadside ditches and culverts with 18" SD in Old Redwood Hwy; onsite detention	$1,034,000
J	Starr	19-26, 28	Extend 42" SD; onsite detention (0.4 ac-ft)	$1,463,000
K	Starr	n/a	n/a (not in study area)	n/a
L	Starr	n/a	n/a (not in study area)	n/a
M	Starr	1-3, 29	Onsite detention (0.04 ac-ft)	$140,000

1 Cost does not include sediment removal.

4.6 Recycled Water

The following section provides a limited evaluation of the required size of the recycled water main within Old Redwood Highway for the limits of the study area. The Town is currently preparing a Recycled Water Master Plan (West Yost) that should be referenced for future improvements within the North Old Redwood Highway study area.

Review of Current Planning Document
The Town's most recent completed planning document for its recycled water system is the *Sonoma County Airport Area Recycled Water Irrigation Project* Kennedy/Jenks Analysis. Plate 1 of this current planning effort shows a "Phase 5" project extending a recycled water main north in Old Redwood Highway up to Sotoyome Creek Bridge, though the highlighted service area includes the properties to the north of Sotoyome Creek. A pipe diameter is not provided on the figure prepared by Kennedy/Jenks; however, for planning purposes, the recycled water pipeline is assumed to be 12 inches in diameter. This diameter is added to the figure for clarity.

On this figure dated November 2010, the "North RDA" area, which is coincident with the North Old Redwood Highway study area, is noted to have a recycled water demand of 48 acre-feet/year. Assuming full redevelopment of the 78-acre study area, the water demand would equate to approximately 0.61-acre-feet per year per acre (AF/yr/Ac). A typical planning number for recycled water irrigation is 3 AF/yr/Ac, which suggests that anticipated development within the study area will produce a lower than average demand for recycled water. Recent

redevelopment within the study area (i.e., G&C Autobody) does not include a significant area of "green space" that would be well-suited for higher recycled water usage.

No further analysis/planning information was available at the time this study was prepared. For planning purposes, a dead-end recycled water main for the study area is assumed to be a 12-inch diameter pipeline. Construction of this main is not recommended until there is sufficient demand within the study area; however, the Town may consider constructing all utility pipelines prior to road improvements in order to minimize future disturbance to the road.

Recommended Recycled Water Improvements
The Town should incorporate the findings and recommendations from the Kennedy/Jenks study into this study, or as a preferred option, the Town should use the conclusions and recommendations from the current RWMP effort. Future redevelopment of the study area may or may not result in a strong demand for recycled water, so the project cost and timing for an extension of a recycled water main approximately 4,500 feet to the north of the existing recycled water system should be further studies in the RWMP and other future recycled water planning studies. Plate 1 is provided in Appendix I.

4.7 Utility Undergrounding

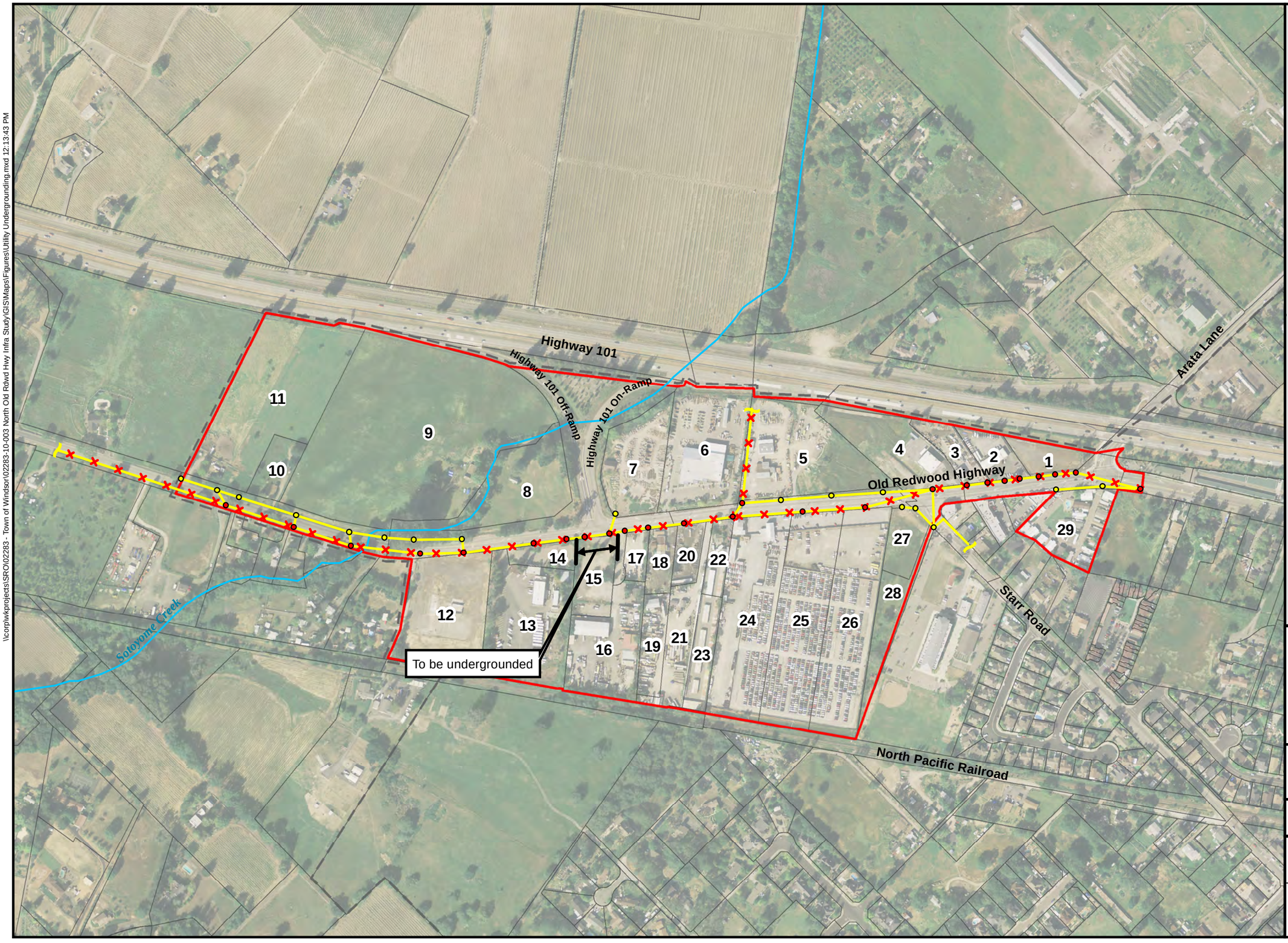
The North Old Redwood Highway Area study conducted a site evaluation of existing overhead utilities, review of available planning documents, and limited coordination with the Town and PG&E. The intent for this study was to provide the Town with general guidance regarding utility undergrounding within the study area. Per Town Municipal Code Section 16-2-190, all local overhead utilities are required to be undergrounded. The following section provides a summary of that analysis. Code Section 16-2-120 defines "local" electrical lines as 26 kV or less.

The following is taken from the Town's Municipal Code:

Section 16-2-190(b): Improvements Required

> Improvements on Streets. Said permittee shall provide for the improvement of said unimproved street by the installation, at the permittee's sole cost, including but not limited to all of the following improvements as required in the Town standards which said unimproved street shall lack: curbs, gutters, driveways, sidewalks, storm drains, complete paving to curb, street lighting, medians, traffic signals, signing and striping, bus stops, street trees, walkways, landscaping, sewer lines, water lines, undergrounding existing overhead and new utilities services.

Summary of Utility Undergrounding Analysis Site Visit
Winzler & Kelly staff conducted a site visit to make visual observations for existing overhead utilities within the study area. Since the determination for utilities was based on visual observation only, the accuracy of the findings is likely not comprehensive and should be verified as a preliminary step for future planning and design efforts. Staff noted the presence of low and high (12 kV) voltage electric lines, likely owned by PG&E throughout the study area. Overhead power lines were present on both sides of Old Redwood Highway and had various connection points through easements or rights-of-way to the east and west. Staff also noted the presence of other overhead utility lines, likely communication and data lines for cable (Comcast) and telephone (AT&T) service. Figure 9 provides a summary of the existing overhead utilities observed during the site visit.



Town Boundary
Study Area
Creek
High Voltage, 12 KV
Low Voltage, AT&T, Commcast, Fibre Optics
Joint Utility Pole 12 KV
Joint Utility Pole

0 200 400 ft

1 inch = 400 feet printed at 11x17

Sources: Santa Rosa GIS: Aerial 2009 1 foot resolution; Sonoma County GIS: Parcels; Winzler and Kelly GIS: Utilities.

WINZLER & KELLY
www.w-and-k.com

© Winzler & Kelly

Cartography	Date	Project #
AF	2/22/2012	0228310003

Figure 9
Utility Undergrounding

North Old Redwood Highway Area
Utility Infrastructure Study

Town of Windsor

\\corpwkprojects\SRO\02283 - Town of Windsor\02283-10-003 North Old Rdwd Hwy Infra Study\GIS\Maps\Figures\Utility Undergrounding.mxd 12:13:43 PM

Coordination with PG&E

Winzler & Kelly coordinated with PG&E to determine the amount of Rule 20A funds available to the Town. The following notes are based on communication with David Phillips and Lizette Burtis of PG&E and coordination with the Town.

- There is likely not an undergrounding assessment district for the study area. An assessment district would be formed through a Town resolution – such a resolution was not found during the preparation of this study.
- The Town's current Rule 20A allocation (through 2010) is $250,807, which is based on a yearly allocation of approximately $37,700. Annual allocation is based on the number of PG&E meters in the Town.
- Undergrounding projects typically have a heavy financial commitment required by the applicant (Town). At this time, most cities are deferring their 20A projects.
- A typical undergrounding project takes approximately 4 to 5 years to complete once all the stakeholders are identified. The Utility Undergrounding document provided in Appendix D notes that the overall process could take 10 years or more.
- Typical costs for the applicant include management of the project, providing base maps, permitting, and right-of-way and/or easement acquisition.
- Approximately 1 in every 10 projects includes gas in the joint trench.

Recommended Next Steps for Utility Undergrounding

Following the completion of this study, or as a parallel planning effort, the following steps should be taken by the Town to prepare a more comprehensive planning budget and project scope:

1. Determine what existing utilities are present within the study area. There could be a few or several. This task would include detailed gathering and review of utility records;
2. Confirm available Town funding for the project. This would lead to a preliminary decision to go with Rule 20A, B, or C;
3. Meet with the utilities. The Town will likely need to meet with each utility individually. Most of the time, utilities will follow PG&E's lead. Through the meetings with the utilities, you determine interest in the project; and
4. Once the Town has determined what the interest is for the project from the various utilities, the Town can prepare a more detailed preliminary cost evaluation. Project costs should be able to greatly refine the range of potential cost presented in this study. This task would likely include at least one more meeting with each utility. The overall construction cost is typically divided by percentage of volume within the joint trench, such that the total area of the conduits is divided by the area of each utility's conduit for cost sharing. The Town would be a part of this cost discussion if Rule 20B or if one of the utilities is a Town utility.

5.0 PLANNING-LEVEL ESTIMATES OF PROBABLE CONSTRUCTION COSTS

Construction costs developed in this study are based on a Class 5 (planning-level) estimate of probable construction cost as defined by the Association for the Advancement of Cost Engineering, International (AACE). Planning level estimates are based on limited "desktop" information and have an approximate accuracy range of +/- 50 percent.

The quantities applicable to each of the above utility evaluations and alternatives were determined from conceptual design. The estimate of most probable cost for each utility was determined by multiplying the unit cost estimates by the estimated quantities of each project component.

5.1 Unit Construction Costs

Estimated construction costs are indexed to the Engineering News Record Construction Cost Index (ENR CCI) of 10,208, which is for heavy construction in the San Francisco area in February 2012. Detailed summaries of the planning-level estimates of probable construction cost are provided in Appendix J. The following assumptions were made for the utility cost estimates:

- Estimates are based on evaluation of available planning documents, review of standard estimating data and reflect typical current costs and are subject to escalation;
- Estimates assume 3 feet of cover for water pipes, 3.5 feet for sewer force mains, 8 feet of cover for gravity sewer pipes, and approximately 5 feet for storm drain pipes. Some sanitary sewer alternative costs include very deep (30+ foot) trenching;
- Asphalt pavement thickness within Old Redwood Highway is assumed to be 5.4-inches thick;
- Trenching costs are escalated 50 percent for utility work within Old Redwood Highway to account for the presence of a continuous 20-foot-wide concrete slab under entire length Old Redwood Highway within study area;
- Assume 10 percent of all utility trenches have unstable trench conditions and require drain rock at the bottom of the trench;
- Trench backfill is assumed to be aggregate base material. The use of controlled low strength material (CLSM) would increase the cost. Also, native soils are assumed to be off-hauled and not reused.
- Assume Town Standard Trench Detail 115;
- Costs assume standard trench shoring, project dewatering, and general geotechnical considerations for soil conditions;
- Costs do not include road improvements for Old Redwood Highway, including, but not limited to road widening, resurfacing, streetscape, roundabouts, or other improvements;
- Costs do not include stub-outs, laterals, service connections, or any other utility extension outside of Old Redwood Highway, with the exception of recommended storm drainage improvements within private properties;
- All estimates include 17 percent for contractor's bonds, insurance, overhead, and profit;
- All estimates include a contingency of 25 percent;
- Construction cost estimates do not include "soft costs", which generally include design engineering, regulatory permitting, environmental work, hazardous materials abatement,

easement or right-of-way acquisition (if required), field engineering, construction management, or city administrative costs; and
- Total project costs include soft costs.

Estimates of probable construction costs are made on the basis of professional judgment and experience. Actual costs may vary due to availability of labor, equipment or materials, or market conditions.

5.2 Project Costs

Estimates of probable construction costs and total project costs are provided below.

Sanitary Sewer

The following table provides a summary of the planning-level estimate of probable construction cost for the construction of Public Option improvements provided in Figure 4, which is based on Alternative 3 Modified. The costs include HDD trenchless crossing of Sotoyome Creek for the gravity sewer main and a 420-gpm pump station located within Parcel No. 12. Right-of-way acquisition costs are not included for the pump station site and ingress/egress/utility easement(s).

Table 4
Project Cost Summary for Overall Sanitary Sewer System Improvements
Alternative 3 Modified – Public Option

Description	Total Cost
Construction Cost (Including Contingency)	$2,202,000
Engineering/Environmental/Permits (15%)	$330,300
Inspection/Construction Management (15%)	$330,300
City Administration (5%)	$110,100
Total Project Cost (Rounded)	**$2,973,000**

The total project cost for the Private Option would be approximately $2,000,000 less than the Public Option since Parcel Nos. 8-15 would be served by private system that would be funded by private development. The cost savings is found in the elimination of the 8-inch gravity sewer extension to Parcel Nos. 9-11, trenchless crossing of Sotoyome Creek, and public pump station.

Phase 1 of the recommended sanitary sewer system improvements includes the connection of the existing 6-inch gravity sewer main to the 12-inch-diameter Los Amigos Trunk Sewer within Old Redwood Highway. This connection would include approximately 250-linear feet of 12-inch gravity sewer main. The cost provided below represents a portion of the overall cost provided in Table 4 above.

Table 5
Project Cost Summary for Overall Sanitary Sewer System Improvements
Alternative 3 Modified (Phase 1; minimum alternative)

Description	Total Cost
Construction Cost (Including Contingency)	$109,000
Engineering/Environmental/Permits (15%)	$13,050
Inspection/Construction Management (15%)	$13,050
City Administration (5%)	$4,350
Total Project Cost (Rounded)	**$139,000**

Detailed costs for each of the various alternatives for the northern portion of the study area are provided in Appendix J, including the Public and Private Options for the recommended alternative.

Potable Water

Water Master Plan Project Costs
Water Master Plan provides a CIP cost of $652,000 for this project, though it notes a total project length of 2,245 linear feet whereas the actual footage is something closer to 1,800 linear feet. This cost equates to a unit price of approximately $360 per linear foot, which appears to be slightly lower compared to costs considered for this study. Also, it is unknown if the CIP cost considers the cost for trenching through concrete panels, which if not considered, may explain the relative difference in planning-level costs between the WMP and this study.

The following table provides a summary of the planning-level estimate of probable construction cost for 3,275-linear feet of 12-inch water main within Old Redwood Highway. The costs include HDD trenchless crossing of Sotoyome Creek.

Table 6
Project Cost Summary for Overall Potable Water Main Improvements

Description	Total Cost
Construction Cost (Including Contingency)	$967,000
Engineering/Environmental/Permits (15%)	$145,050
Inspection/Construction Management (15%)	$145,050
City Administration (5%)	$48,350
Total Project Cost (Rounded)	**$1,305,000**

Phase 1 of the recommended potable water improvements includes the extension of approximately 1,100-linear feet of 12-inch water main beyond the existing system (beyond the existing 8-inch dead-end main). 350 feet of this length is for HDD trenchless crossing of the

creek. The pipe ends at the property line between Parcel Nos. 9 and 10. The cost provided below represents a portion of the overall cost provided in Table 6 above.

Table 7
Project Cost Summary for Phase 1 Potable Water Main Improvements (minimum alternative)

Description	Total Cost
Construction Cost (Including Contingency)	$412,000
Engineering/Environmental/Permits (15%)	$61,800
Inspection/Construction Management (15%)	$61,800
City Administration (5%)	$20,600
Total Project Cost (Rounded)	**$556,000**

The reduction of the final run of 12-inch water main to an 8-inch main would save approximately $25,000. Given the uncertainty for actual water use for Parcel Nos. 9-11, final hydraulic design parameters for the dead-end water main, and need for trenchless crossing of Sotoyome Creek, this cost savings does not appear to justify a recommendation at this planning level for a smaller water main.

Storm Drainage – Sotoyome Creek Watershed

There are recommended improvements for only some of the watersheds within the study area.

Watershed A
In the storm drainage evaluation section, improvements for Watershed A are already covered through the conditions of approval for development of the Sanderson Property.

Watersheds B, C, & H
Evaluation for Watersheds B, C, and H identify the need for channel maintenance as an interim improvement or replacement of the Sotoyome Creek Bridge on Old Redwood Highway to adequate convey creek flows through the study area.

Watershed D
Improvements for Watershed D could vary depending on site development. The anticipated increase in peak flows is relatively small, so onsite detention may be the better option compared to offsite improvements that would be located outside of the study area (and Town limits).

Watersheds E and F
The following table provides a summary of the planning-level estimate of probable construction cost for Watersheds E and F. Improvements are described in the utility infrastructure evaluation section of this study, but generally include 630-linear feet of 18-inch storm drain pipe within Old Redwood Highway.

Table 8
Project Cost Summary for Watershed E-F Storm Drainage Improvements

Description	Total Cost
Construction Cost (Including Contingency)	$343,000
Engineering/Environmental/Permits (15%)	$41,100
Inspection/Construction Management (15%)	$41,100
City Administration (5%)	$13,700
Total Project Cost (Rounded)	**$439,000**

Watershed G

The following table provides a summary of the planning-level estimate of probable construction cost for Watershed G. Improvements are described in the utility infrastructure evaluation section of this study, but generally include 200-linear feet of 30-inch storm drain pipe located within Parcel No. 13 to convey runoff from the watershed to the downstream boundary culvert at the railroad right-of-way.

Table 9
Project Cost Summary for Watershed G Storm Drainage Improvements

Description	Total Cost
Construction Cost (Including Contingency)	$180,000
Engineering/Environmental/Permits (15%)	$21,600
Inspection/Construction Management (15%)	$21,600
City Administration (5%)	$7,200
Total Project Cost (Rounded)	**$231,000**

Sotoyome Creek Bridge Improvements

A range for the unit price to remove and replace the Sotoyome Creek Bridge is $550 to $600 per square foot, as based on the dimensions of the new bridge structure. Assuming a new bridge structure that has two 12-foot travel lanes, two 6-foot-wide bicycle lanes, one 5-foot-wide sidewalk on the east side of the bridge, and 1.5-feet on each side of the bridge for guardrails, the new bridge would be 46-feet wide. Based on the hydraulic evaluation for the creek, the bridge span may not require expansion; however, for the purpose of this cost analysis, the existing 21-foot clear span is assumed to be expanded to 25 feet. Add 5 feet to the overall bridge span to create a total span for the new bridge, for a total of 30 feet. Therefore, the new bridge would have approximately 1,380 square feet (46 * 30). This square footage results in a cost range of approximately $1.0 to $1.2-million. This cost range includes a 35-percent factor for soft costs, but does not include utility crossing of the creek. Costs for utility crossing are provided in separate cost estimates.

Storm Drainage – Starr Creek Watershed

There are recommended improvements for only some of the watersheds within the study area.

Watershed I
The following table provides a summary of the planning-level estimate of probable construction cost for Watershed I. Improvements are described in the utility infrastructure evaluation section of this study, but generally include 0.1-acre-feet of detention and 1,380-linear feet of 18-inch storm drain pipe within Old Redwood Highway.

Table 10
Project Cost Summary for Watershed I Storm Drainage Improvements

Description	Total Cost
Construction Cost (Including Contingency)	$808,000
Engineering/Environmental/Permits (15%)	$96,900
Inspection/Construction Management (15%)	$96,900
City Administration (5%)	$32,300
Total Project Cost (Rounded)	**$1,034,000**

Watershed J
The following table provides a summary of the planning-level estimate of probable construction cost for Watershed J. Improvements are described in the utility infrastructure evaluation section of this study, but generally include 0.1-acre-feet of detention and 850-linear feet of 42-inch storm drain pipe within Old Redwood Highway.

Table 11
Project Cost Summary for Watershed J Storm Drainage Improvements

Description	Total Cost
Construction Cost (Including Contingency)	$1,143,000
Engineering/Environmental/Permits (15%)	$137,100
Inspection/Construction Management (15%)	$137,100
City Administration (5%)	$45,700
Total Project Cost (Rounded)	**$1,463,000**

Watershed M
The following table provides a summary of the planning-level estimate of probable construction cost for Watershed M. Improvements are described in the utility infrastructure evaluation section of this study, but generally include 0.04-acre-feet of detention.

Table 12
Project Cost Summary for Watershed M Storm Drainage Improvements

Description	Total Cost
Construction Cost (Including Contingency)	$109,000
Engineering/Environmental/Permits (15%)	$13,050
Inspection/Construction Management (15%)	$13,050
City Administration (5%)	$4,350
Total Project Cost (Rounded)	**$140,000**

Recycled Water

Based on the linear footage cost for a potable water main provided in this study, a construction cost for a 12-inch diameter recycled water main is approximately $300 per LF, which includes only utility trench improvements within Old Redwood Highway. Based on this unit cost for construction, a new 4,300-foot recycled water main within the study area for Old Redwood Highway would be approximately $1.3-million. Add a soft cost of 35 percent to escalate the construction cost to a project cost of approximately $1.75 million. This cost represents only the cost of a recycled water main extension within the study area. The Town should derive a more accurate planning-level cost for the "Phase 5" project in the Kennedy/Jenks report from that report. The Town should also review and update that cost based on the analysis provided in the current Recycled Water Master Plan effort.

Utility Undergrounding

Per coordination with PG&E, the approximate construction cost for undergrounding of PG&E overhead facilities can range from $350 to $600 per foot. Note that this cost does not include the cost for undergrounding telephone and cable lines. The construction cost to add telephone and cable lines could be in the range of an additional $100 to $200 per foot.

The current PG&E allocation of $250,807 is not sufficient to fund a utility undergrounding project within the study area. Based on overall north-south length of 4,300 linear feet along Old Redwood Highway for the study area, and a construction cost of $450 to $800 per foot that includes typical underground for PG&E, cable, and telephone lines, the construction cost to underground anticipated overhead utilities is in the range of $2.0 to $3.5 million.

PG&E recommended that the Town verify if the County would be amicable in sharing a portion of the PG&E allocation since the northern portion of the study area (Sanderson annexation) was until recently County property.

6.0 RECOMMENDED NEXT STEPS

The recommendations and project costs provided in this study are intended to provide the Town with planning-level guidance for utility infrastructure within the study area. Recommendations should be considered by the Town and used as a basis for preliminary engineering of the various utilities. Unit costs and recommended construction methods should be evaluated based on the changing construction market. Also, geotechnical and Phase 1 hazardous materials investigations of the Old Redwood Highway corridor are recommended to determine subsurface conditions, including the presence of contaminated soils, groundwater, and concrete slabs under the existing paved surface.

Due to the recent changes to the use of redevelopment agency funds, this funding option is no longer available to the Town for construction of infrastructure in the study area. However, there other funding options such as developer financing, benefit assessment districts, water and wastewater enterprise funding. PG&E Rule 20 funds should also be considered for utility undergrounding.

Phasing of improvements will likely be necessary to provide sanitary sewer and potable water service to parcels that do not currently have access to frontage utility service (Parcel Nos. 9-11). The Town should consider the costs and benefits for extending utility service to these parcels. Phase 1 improvements for sanitary sewer and potable water utilities would have an approximate project cost of $695,000, which consists of $556,000 for potable water and $139,000 for sanitary sewer. Note that the sanitary sewer improvements for Phase 1 would only provide a connection between the existing 6-inch sewer main in Old Redwood Highway and the Los Amigos Trunk Sewer. Either private or public sewer system improvements would be required north of the Arata on/off ramps to provide sewer service to Parcel Nos. 9-11. The Town may consider the use of septic system designs to serve these parcels in lieu of a more expensive extension of public or private utilities within Old Redwood Highway.

Storm drainage improvements could also be phased as needed to support development within the various study area watersheds. Parcel No. 11 already has conditions of approval that require onsite detention of stormwater to known alleviate downstream flooding conditions, so anticipated offsite storm drainage improvements for that parcel should be minimal. This may not be the case for other parcels/watersheds, as presented in this study.

The project costs for recycled water and utility undergrounding improvements do not appear to be justified at this time, though the completion of all utility infrastructure improvements within Old Redwood Highway prior to a future road improvement project may provide a basis for those improvements. Recycled water is currently 4,500 feet south of the study area and based on anticipated land use within the study area, there may be limited demand for recycled water usage in the immediate future. However, because of the importance of recycled water to the Town's water supply portfolio, recycled water improvements are currently being investigated in the Town-wide Recycled Water Master Plan currently underway. Until the plan is completed to identify more specific improvements, it is recommended that the recycled water main be extended along Old Redwood Highway to Windsor Road.

.

The project cost for utility undergrounding improvements does not appear to be justified at this time, though the completion of all utility infrastructure improvements within Old Redwood Highway prior to a future road improvement project may provide a basis for those improvements.
The Town should meet with PG&E and other utility companies with overhead utilities to discuss the feasibility of a Rule 20A project.

Utility undergrounding is required by Town ordinance upon redevelopment of a property; however, there would likely be an overall cost benefit to the study area to create one assessment district or project and underground all remaining overhead utilities at one time. That project could have a very high cost if it does not proceed as a Rule 20A project (primarily utility funded).

Additional engineering study of the existing overhead utilities should be prepared by the Town prior to detailed coordination with the various utility companies.

CEQA review may be needed for some of the improvements recommended in this study. The Town should consider environmental review and permitting scheduling when considering potential projects.

7.0 REFERENCES

Draft Water Master Plan Update, June 2009, RMC

Master Trunk Sewer Plan, April 2000, Brelje & Race

North Old Redwood Highway Sewer Capacity Study, Draft Technical Memorandum, December 2008, Winzler & Kelly

Town Design and Construction Standards, July 2009, Town of Windsor

Conditions of Approval Sanderson UP 05-34, July 24, 2007, Town of Windsor

Preliminary Grading and Utility Plan, Sanderson Ford Site Plan, September 2005, Brelje & Race

Old Redwood Highway Vision Plan – Conceptual Land Use Plan, RBF Consulting

Windsor Area Master Drainage Plan, June 1989, Sonoma County Water Agency

Windsor Cumulative Drainage Impact Mitigation Program Update Report, September 1999, Boyle Engineering

Hydraulic Analysis Requirements for Development Projects Along Creeks and Other Drainage Ways, Memorandum, December 12, 2006, Town of Windsor

First Baptist Church of Windsor – 10285 Starr Road, Windsor, Letter from SCWA, January 7, 2002

Correspondence with Philip Wadsworth, SCWA

RE: North Old Redwood Highway Area Utility Infrastructure Study, Letter Correspondence from Sonoma County Water Agency, Philip Wadsworth, February 14, 2012

Improvement Plans G&C Autobody, September 7, 2010, Sheets 1-4, 7-10

RE: North ORH Utility Study - confirmation of approach for land use, Email Correspondence with Town of Windsor, David Lopez, September 23, 2010

City of Santa Rosa Aerial Image of the Town Limits

City of Santa Rosa Public Works Standards for potable water, sanitary sewer, and storm drainage

Potable Water, Sanitary Sewer, Reclaimed Water, Storm Drain, and Flooding Location Maps, Coastland Civil Engineering

Town Zoning Map

General Plan Map

Town of Windsor Streets Map

Section A-A and B-B Plan Sheet, Whitlock & Weinberger Transportation, Inc

Caltrans Inspection Report for Sotoyome Creek Bridge

Utility Undergrounding Investigation for the Town of Windsor, California, Rule 20A, B & C, Coastland

Utility Undergrounding Email Correspondence with PG&E

Plate 1, Recycled Water Study Current and Future RW Demands and Potential Pipeline Projects, November 2010, Kennedy/Jenks Consultants

Appendix A
Town of Windsor
General Plan Land Use Map (Brelje & Race)

General Plan Map

TOWN OF WINDSOR
Sonoma County, California

DATE:	May 25, 2000
REVISIONS:	
	JANUARY 21, 2002
	APRIL 30, 2003
	NOVEMBER 1, 2005

NORTH
0 625 1250 2500
SCALE: 1"=1250'

Land Use Categories

RESIDENTIAL

- CR — Compact Residential (12–32 dwelling units/acre)
- HDR — High Density Residential (12–16 dwelling units/acre)
- MHR — Medium–High Density Residential (8–12 dwelling units/acre)
- MHP — Mobile Home Park (8–12 dwelling units/acre)
- VR — Village Residential/Medium Density Residential (5–8 dwelling units/acre)
- SR — Surrounding Residential/Low–Medium Density Residential (3–6 dwelling units/acre)
- ER — Estate Residential/Low Density Residential (0.2–3 dwelling units/acre)
- RR — Rural Residential/Very Low Density Residential (0–0.2 dwelling units/acre)

MIXED USE

- BMU — Boulevard Mixed Use
- RMU — Regional Mixed Use
- NC — Neighborhood Center/Mixed Use
- TC — Town Center/Mixed Use

COMMERCIAL/INDUSTRIAL

- RC — Retail Commercial
- SC — Service Commercial
- GC — Gateway Commercial
- GB — General Business
- LI — Light Industrial
- HI — Heavy Industrial

PARKS/OPEN SPACE

- OS — Open Space
- P — Parks

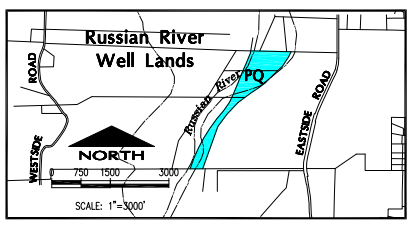
PUBLIC/QUASI–PUBLIC/INSTITUTIONAL

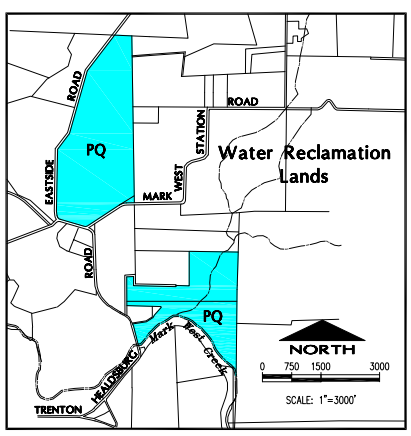
- PQ — Cemetery/School/Wastewater Treatment Plant

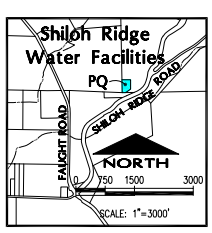
Map Legend

- Town Boundary
- Urban Growth Boundary
- Sphere of Influence
- Agricultural Buffer Area
- NC — Neighborhood Center Overlay
- SR — Surrounding Residential Overlay
- WWTP — Wastewater Treatment Plant
- Cemetery
- Hotel/Resort also Permitted
- Park
- School

Notes:
1. High Intensity Areas and Special Planning Areas are shown on Figure 4–2 of the General Plan.
2. Airport Referral Area Boundary is shown on the Zoning Map.







PREPARED BY:
BRELJE & RACE CONSULTING CIVIL ENGINEERS

1777\dwg\general plan.dwg xref:basemap-05-tow, annex-tow.dwg 11-01-05
18x26 use: 1777-half.ctb, 1777-DJ 18x26-color.pc3
36x52 use: 1777-full.ctb, 1777-DJ 36x60-color.pc3

Appendix B

Old Redwood Highway Vision Plan

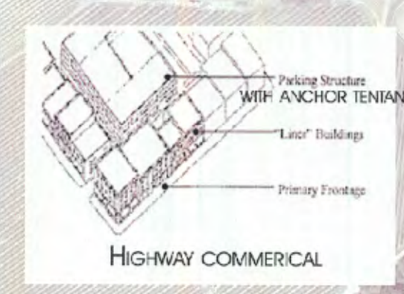
Conceptual Land Use Plan (RBF Consulting)

GATEWAY COMMERICAL

OPTIONAL SINGLE BAND OF MIXED USE ALONG THE FRONTAGE

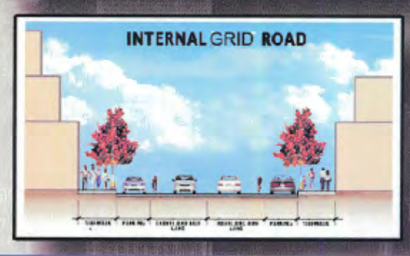
GATEWAY/HIGHWAY COMMERCIAL

Located adjacent to State Highway 101, the Gateway/Highway Commercial character area serves as a major entryway to the Town. While more auto-oriented in design, pedestrian and architectural details ensure that all new development contributes to the overall aesthetic environment. Landscaped setbacks buffer off-street parking areas from sidewalks and also help to reinforce the open, natural environment that is found just north of the corridor. New buildings are oriented toward Old Redwood Highway or to the internal grid street system provided in the area. Ample landscaping and attractive architecture create inviting views from the highway and from adjacent roadways and sidewalks. This area offers opportunities for larger commercial and office uses, such as a grocery store, employment center, restaurants, or other shopping destinations.



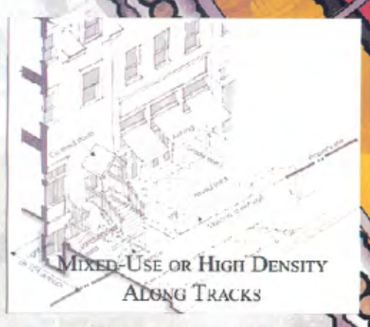
HIGHWAY COMMERICAL





OPEN SPACE

Future restoration area and public open space.


MIXED-USE OR HIGH DENSITY ALONG TRACKS

- Round-a-Bout
- Rail Trail
- Town Marker
- STREET TREES W/ TREE GRATES
- STREET TREES W/ TREE GRATES
- Pedestrian Crossing

GARRET'S

GRID STREET PATTERN

"T" INTERSECTIONS
EXACT STREET LOCATION TO BE DETERMINED

HIGH DENSITY RESIDENTIAL OR MIXED USE

GENERAL COMMERCIAL

PUBLIC

TRANSITIONAL COMMERCIAL

This area includes general commercial development transitioning into the more compact, pedestrian-oriented uses and street-adjacent development that occurs south of Arata. The transitional commercial character area provides attractive and convenient services to highway travelers, as well Windsor residents. This area may exhibit a variety of setbacks, but parking is primarily oriented behind or to the sides of buildings.

1/4 MILE WALKING CIRCLE

ROUNDABOUT

ARATA LANE

TRANSITIONAL COMMERCIAL

OLD REDWOOD HIGHWAY

HIGHWAY 101

MIXED USE

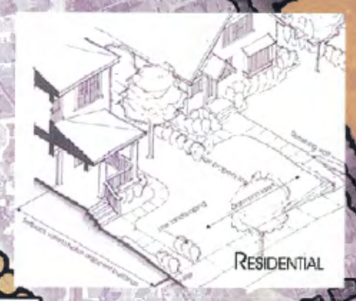
A two and three-story mixed-use neighborhood abuts the rail trail and the general commercial character area. Residents are able to take advantage of the rail-trail amenity and close proximity to the freeway, as well as the many neighborhood conveniences located within an easy walk or bike ride. Mixed-use buildings are oriented to an internal tree-lined grid street network and the rail-trail with little or no building setback.

GENERAL COMMERCIAL

General Commercial lines a portion of the west side of Old Redwood Highway north of Arata, taking advantage of the close proximity to State Highway 101 and of the adjacent mixed-use neighborhood. Landscaped setbacks help to transition from the wine country into a more urban fabric. The combination of one- and two-story regional and neighborhood commercial structures are oriented toward Old Redwood Highway or the interior roads that service the businesses and the mixed-use neighborhood behind them. Parking is located at the rear of buildings or in well-landscaped side-yard lots.

PUBLIC/CIVIC

School, church and other public uses predominate this area. Landscape features and architectural design tie the development to the rest of the corridor.


RESIDENTIAL

CROSSING

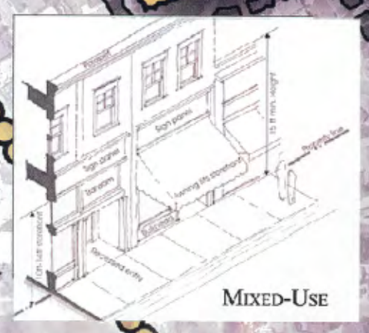
RESIDENTIAL

RESIDENTIAL

This area provides a combination of small single-family homes, as well as small multi-family courtyard apartments and townhomes. These residential options are supported by neighborhood shops, cafes, and other conveniences easily accessed on foot or bike. Parking areas and entrances to the multi-family units are located at the side of the parcel and small landscaped front yard setbacks help buffer residential units from the traffic noise along Old Redwood Highway and State Highway 101.

MIXED USE

This mixed-use character area provides an eclectic mix of small commercial, office, and neighborhood units, including opportunities for live-work units (e.g. lawyers, architects, dentists, etc.). Neighborhood services include local coffee shops, drycleaners, and other conveniences for residents living in the district. Setbacks are generally minimal with landscaping providing a buffer where building setbacks may exist.


MIXED-USE

MIXED USE

TRANSITIONAL MIXED USE

The transitional mixed-use area provides an important gateway to and from Old Downtown Windsor. In this area, building form, scale, and architectural design begins to more closely mimic that found in Downtown. A variety of different uses are found in the two and three-story located along the sidewalk-adjacent buildings, including not-for-profits, restaurants, shops, professional offices, and second story residential.


TRANSITIONAL MIXED USE





TRANSITIONAL MIXED-USE

WINDSOR LAND

D DOWNTOWN

GUIDING PRINCIPALS

1. BUILDING HEIGHT: SOUTH OF ARATA, BUILDING HEIGHTS SHOULD INCREASE CLOSER TO DOWNTOWN, NORTH OF ARATA, BUILDING HEIGHTS SHOULD VARY, BUT NEVER BE LESS THAN 1.5 STORIES.

2. BUILDING ORIENTATION: BUILDINGS THAT FACE BOTH OLD REDWOOD HIGHWAY AND HIGHWAY 101 SHALL CONTAIN ARCHITECHURAL FEATURES ON ALL SIDES. BACK ON ORIENTATION TO HIGHWAY 101 NOT ALLOWED.

3. BUILDING FACADES: FIRST FLOOR FACADE HEIGHTS SHOULD VARY FROM BUILDING TO BUILDING, BUT NEVER BE LOWER THAN 10 FEET.

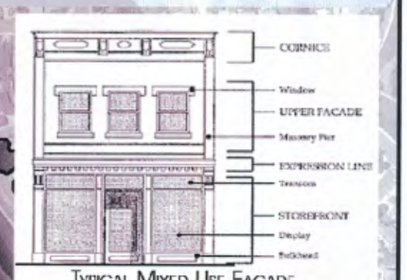
4. SETBACKS: IN COMMERCIAL PROJECTS, STAGGERED FRONT SETBACKS TO ARTICULATE THE STREETSCAPE ARE ENCOURAGED.

5. NEIGHBORHOOD CONFIGURATION: THE PLAN CONTAINS 1/4 MILE WALKING CIRCLES THAT COMPRISE NEIGHBORHOODS. WITHIN EACH CIRCLE, A MIX OF HOUSING, OPEN SPACE, DAILY NEEDS AND TRANIST STOPS ARE ENCOURAGED.

6. PARKING: CREATIVE PARKING SOLUTIONS ARE ENCOURAGED. PARKING LOTS ALONG OLD REDWOOD HIGHWAY OR HIGHWAY 101 IS NOT ALLOWED.

7. CIRCULATION: LARGER PARCELS NORTH OF ARATA WILL REQUIRE AN INTERNAL GRIDDED CIRCULATION PATTERN. "T" INTERSECTIONS CROSSING OLD REDWOOD HIGHWAY ARE REQUIRED.

8. OLD REDWOOD HIGHWAY NORTH OF ARATA SHOULD BE TWO LANES, IF LEVEL OF SERVICE DROPS BELOW D; TWO ADDITIONAL LANES SHOULD BE ADDED. IN EITHER CASE, THE ADEQUATE RIGHT-OF-WAY SHALL BE AQUIRED TO ACCOMMODATE 4 LANES, A BIKE LANE, SIDEWALK AND STREET PARKING.

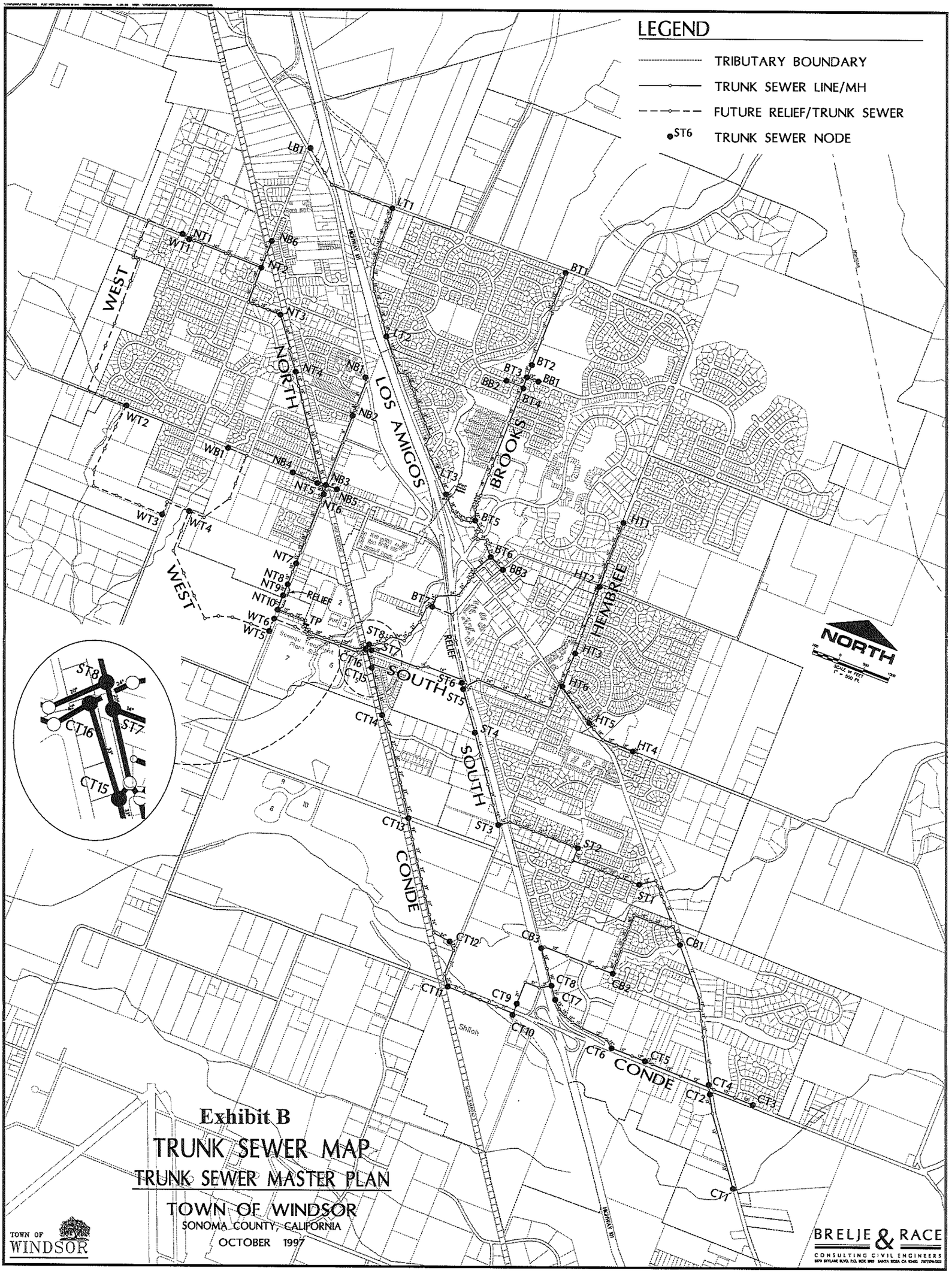


TYPICAL MIXED USE FACADE

Old Redwood Highway Vision Plan
CONCEPTUAL LAND USE PLAN
Town of Windsor, California

RBF CONSULTING

Appendix C
Exhibit B from
Master Trunk Sewer Plan, (Brelje & Race)


LEGEND
TRIBUTARY BOUNDARY
TRUNK SEWER LINE/MH
FUTURE RELIEF/TRUNK SEWER
ST6 TRUNK SEWER NODE
WEST
NORTH
LOS AMIGOS
BROOKS
HEMBREE
SOUTH
CONDE
RELIEF
NORTH
1" = 300 ft.
Exhibit B
TRUNK SEWER MAP
TRUNK SEWER MASTER PLAN
TOWN OF WINDSOR
SONOMA COUNTY, CALIFORNIA
OCTOBER 1997
TOWN OF WINDSOR
BRELJE & RACE
CONSULTING CIVIL ENGINEERS

Appendix D

Utility Undergrounding Investigation

Rule 20A, B & C (Coastland)

Coastland

Utility Undergrounding Investigation
For The
Town of Windsor, California
Rule 20A, B & C

Electric Undergrounding Program

Rule 20A is an electric tariff filed with the California Public Utilities Commission. Rule 20 also includes sections B and C. Sections A, B and C are determined by the type of area to be undergrounded and by who pays for the work. Under the provisions of this program, the Pacific Gas and Electric Company (PG&E) places approximately 30 miles of overhead electric facilities underground each year within its service area.

Rule 20A

Rule 20A projects are typically used for areas of a community that have the most general public use. These projects are paid for by customers through electric rates to PG&E, which are then allocated to government entities as credits. PG&E sends an annual memo to each agency that summarizes how much money the agency has in its fund.

To qualify, the following conditions must be met:

1. The governing body of a city or county must consult with PG&E and hold public hearings on the subject.
2. A determination must be made that the undergrounding is in the general public interest for one or more of the following reasons:
    - Undergrounding will avoid or eliminate an unusually heavy concentration of overhead electric facilities.
    - The street or road or right-of-way is extensively used by the general public and carries a heavy volume of pedestrian or vehicular traffic.
    - The street, road or right-of-way adjoins or passes through a civic area or public recreation area or an area of unusual scenic interest to the general public.
    - The street or road or right-of-way is considered an arterial street or major collector as defined in the Governor's Office of Planning and Research General Plan Guidelines.

3. An ordinance must be adopted creating an underground district in the designated area that specifies the following:

    - All existing overhead communication and electric distribution facilities in the district shall be removed
    - Each property served from electric overhead facilities shall have all electrical facilities on the premises changed to receive service from the underground facilities as soon as it is available
    - Authorization for PG&E to discontinue its overhead service

4. The undergrounding must extend for a minimum distance of one block or 600 feet, whichever is less.

Funding allocation credits are determined by PG&E based, in general, on a ratio of the total number of overhead meters in a city to the total system overhead meters.

Amounts allocated for undergrounding may exceed a city's credit by an amount up to five year's allocation when warranted (per PG&E) and when resources are available. That is, for certain high priority projects, PG&E can allow an agency to borrow up to 5 years of additional funds against their projected Rule 20A account. Agencies are also allowed to borrow funds from one another.

Upon request of the governing board, PG&E will use the existing allocation for the following:

- Installation of no more than 100 feet of each customer's underground electric service lateral (required due to undergrounding)
- The conversion of electric service panels to accept underground service, up to $1,500 per service entrance, excluding permit fees.

The governing body may establish a smaller footage allowance or may limit the amount of money expended on a single customer's electric service, or the total amount to be expended on all electric service installations in a particular project.

To our knowledge, the Town has used Rule 20A monies for two projects. The first project was the undergrounding of utilities along Windsor River Road from Conde Lane to Windsor Road, which included a short segment of Windsor Road. The tie over of services was funded by Redevelopment Agency Funds. The second project was the undergrounding of utilities northerly along Windsor Road.

Rule 20B

Rule 20B projects are usually done as a part of larger developments. They can also be requested by a group of homeowners. The majority of the costs are paid for by the developer or applicant. Undergrounding under Rule 20B is available for circumstances where the area to be undergrounded does not fit the Rule 20A criteria, but still involves both sides of the street for at

least 600 feet or 1 block (whichever is less). Under Rule 20B, the applicant is responsible for the installation of the conduit, substructures and boxes. The applicant then pays for the cost to complete installation of the underground electric system, less a credit for an equivalent overhead system, plus the Federal Income Tax Component of Contribution (ITCC tax), if applicable.

Specifically, the following conditions apply:

1. All property owners served from the overhead facilities first agree in writing to the following:
    - To have the wiring changes made on their premises
    - To be served from the underground distribution system in accordance with PG&E's rules
    - That PG&E may discontinue its overhead service upon completion of the underground facilities.
2. Suitable legislation is in effect requiring such necessary wiring changes to be made and authorizing PG&E to discontinue its overhead service.
3. The applicant has completed the following:
    - Furnished and installed the pads and vaults for transformers and associated equipment, conduits, ducts, boxes, pole bases and performed other work related to structures and substructures including breaking of pavement, trenching, backfilling, and repaving required in connection with the installation of the underground system, all in accordance with PG&E's specifications, or, in lieu thereof, paid PG&E to do so.
    - Transferred ownership of such facilities, in good condition to PG&E
    - Paid a nonrefundable sum equal to the excess, if any, of the estimated costs, of completing the underground system and building a new equivalent overhead system.
4. The area to be undergrounded includes both sides of a street for at least one block or 600 feet, whichever is less, and all existing overhead communication and electric distribution facilities within the area will be removed.

PG&E may, when requested by the government entity and mutually agreed upon by PG&E, initially fund any required engineering/design costs for conversion projects under this section. These costs are required to be refund upon proceeding of the project, or within two and one-half years upon demand by PG&E if the project has not proceeded. In the event payment is not received, PG&E shall reduce the government entities allocations provided under Rule 20A section.

The cost to remove overhead poles, lines and facilities will be paid by PG&E and shall not reduce Rule 20A allocations.

Rule 20C

Rule 20C projects are usually smaller projects involving a few property owners and the costs are almost entirely borne by the applicants.

Undergrounding under the provisions of Rule 20C is available where neither Rule 20A nor Rule 20B applies and when mutually agreed upon by PG&E and the applicant. Under Rule 20C, the applicant pays in advance, a non-refundable amount equal to the estimated cost of the underground facilities, less a credit for salvage.

Additional Funding Information

Rule 20B undergrounding districts are privately funded and are large enough for the applicants to avail themselves of the Municipal Improvement Act of 1913 and the Improvement Bond Act of 1915. Through these assessment district acts, the district can sell bonds for design and construction to facilitate the undergrounding districts. The bonds are paid off over time through property tax assessments. Rule 20C projects are smaller and are paid for without the use of assessment districts.

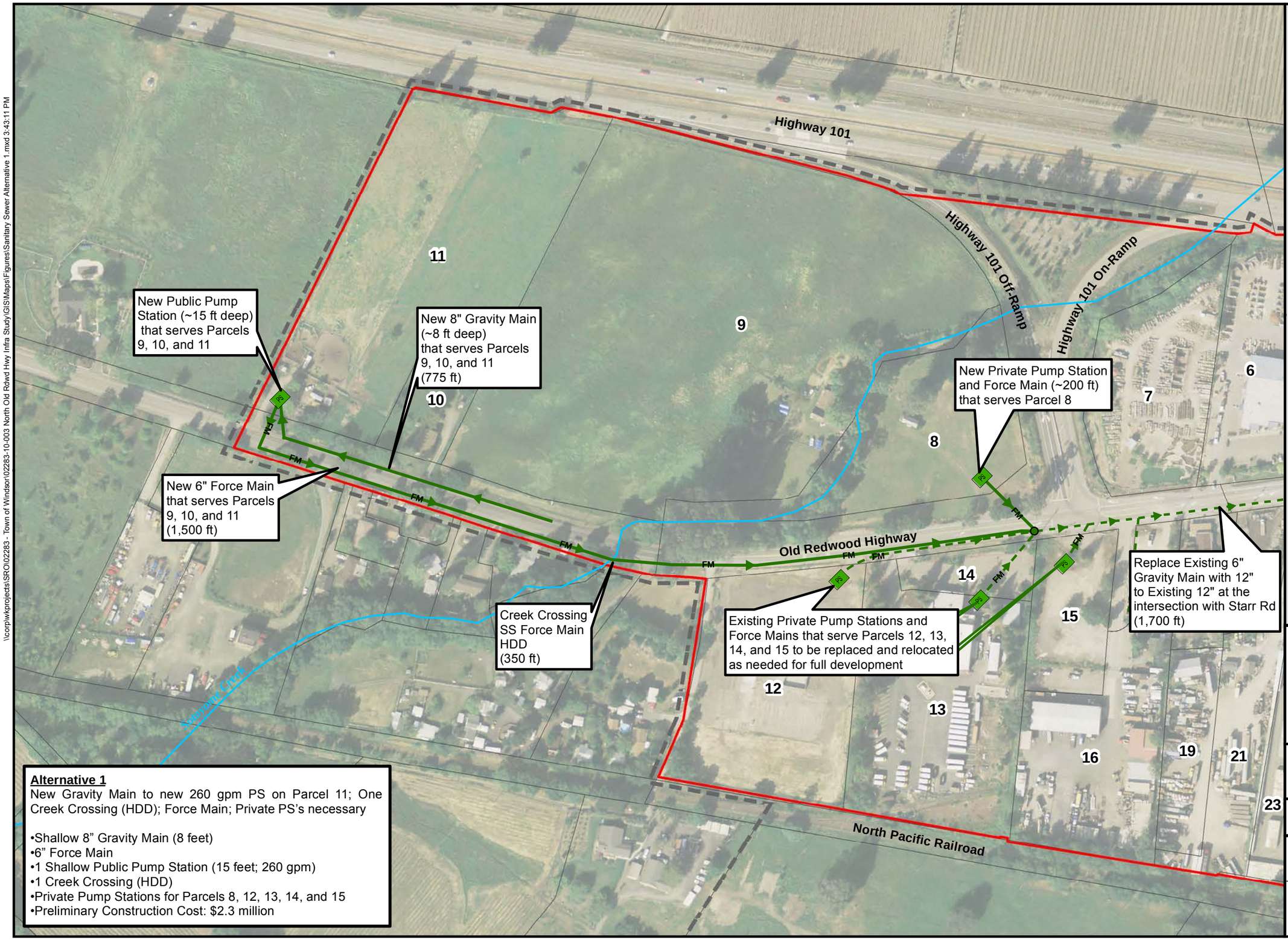
Funding for the AT&T and Comcast Cable portion of Rule 20A projects is provided by the company's shareholders. Neither the telephone companies nor cable companies have rate payer surcharges for undergrounding of overhead facilities. It has been our experience that once the project has begun construction, PG&E is fairly timely about getting their facilities underground and operational but AT&T in particular can be very slow to remove their facilities from the utility poles.

Other

Rule 20A districts are very time consuming. Our experience with these districts indicates that if everything goes smoothly, from inception to the beginning of construction will take a minimum of 5 years and it not unusual for a district to be on the books for 10 or more years. This time frame was verified with a PG&E representative.

PG&E indicated that the acquisition of right-of-way and easements is often a significant roadblock to getting a 20A district constructed. PG&E during the course of their design will perform a boundary survey and prepare deeds, descriptions and plats for their facilities but; it is the responsibility of the local agency to acquire right-of-way and easements. The cost of acquisition is not funded by Rule 20A funds.

Appendix E
Sanitary Sewer Alternatives



Alternative 1
New Gravity Main to new 260 gpm PS on Parcel 11; One Creek Crossing (HDD); Force Main; Private PS's necessary

- Shallow 8" Gravity Main (8 feet)
- 6" Force Main
- 1 Shallow Public Pump Station (15 feet; 260 gpm)
- 1 Creek Crossing (HDD)
- Private Pump Stations for Parcels 8, 12, 13, 14, and 15
- Preliminary Construction Cost: $2.3 million

Town Boundary
Study Area
Creek
Proposed SS Gravity Main
Proposed SS Force Main
Existing SS Gravity Main
Existing SS Force Main
SS Pump Station

Notes:
1. HDD = Horizontal Directional Drill

2. Preliminary construction costs do not include road overlay.

3. Costs include facilities within Old Redwood Highway only and pump station facilities as applicable.

0 100 200 ft

1 inch = 200 feet printed at 11x17

Sources: Santa Rosa GIS: Aerial 2009 1 foot resolution; Sonoma County GIS: Parcels; Winzler and Kelly GIS: Utilities.

WINZLER & KELLY
www.w-and-k.com
© Winzler & Kelly

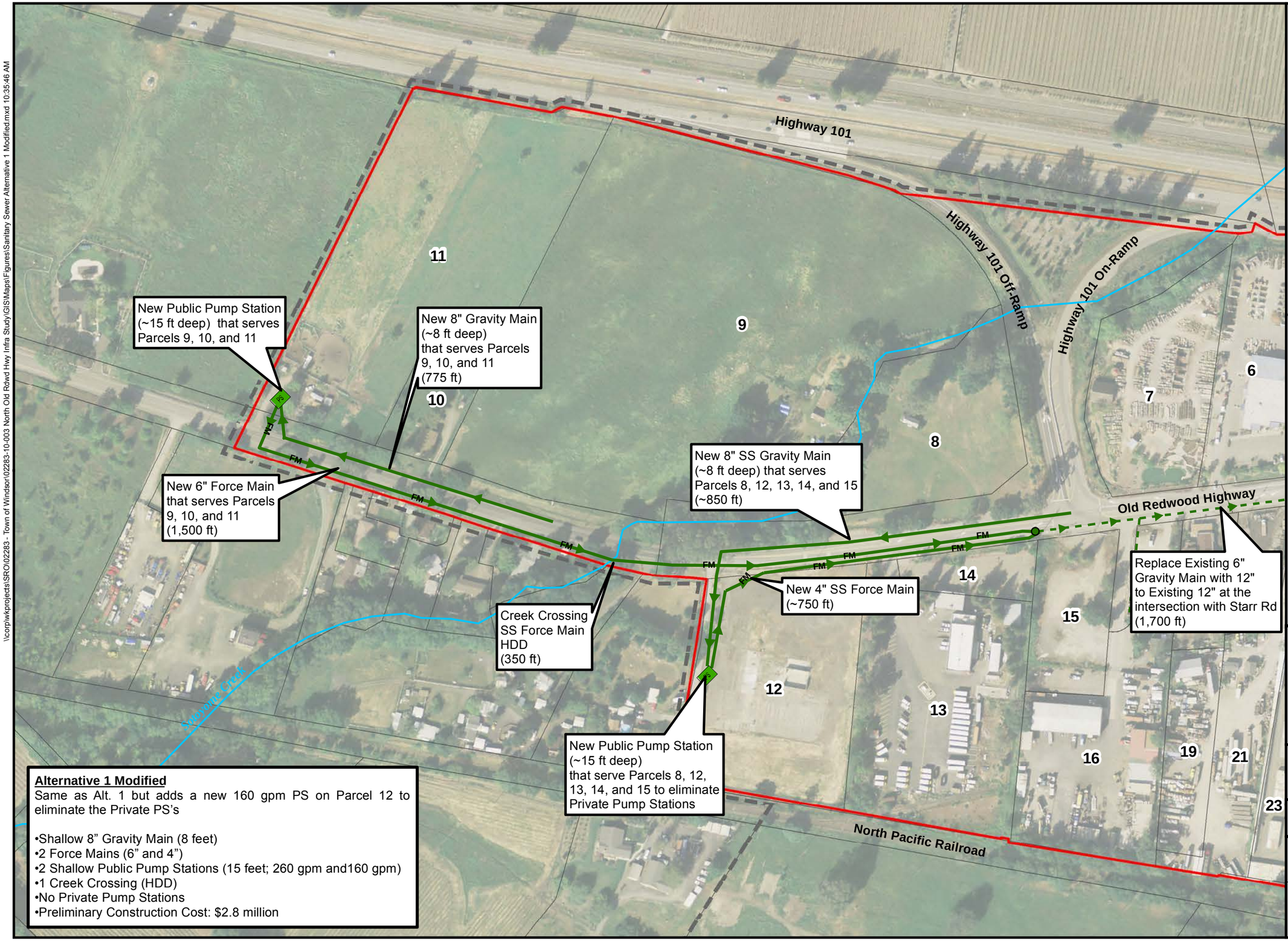
Cartography	Date	Project #
AF	2/22/2012	0228310003

Appendix E
Figure E-1
Sanitary Sewer Alternative 1

North Old Redwood Highway Area Utility Infrastructure Study

Town of Windsor

\\corp\wkprojects\SRO\02283 - Town of Windsor\02283-10-003 North Old Rdwd Hwy Infra Study\GIS\Maps\Figures\Sanitary Sewer Alternative 1.mxd 3:43:11 PM



Alternative 1 Modified
Same as Alt. 1 but adds a new 160 gpm PS on Parcel 12 to eliminate the Private PS's

- Shallow 8" Gravity Main (8 feet)
- 2 Force Mains (6" and 4")
- 2 Shallow Public Pump Stations (15 feet; 260 gpm and160 gpm)
- 1 Creek Crossing (HDD)
- No Private Pump Stations
- Preliminary Construction Cost: $2.8 million

Town Boundary
Study Area
Creek
Existing SS Gravity Main
Proposed SS Gravity Main
Proposed SS Force Main
SS Pump Station

Notes:
1. HDD = Horizontal Directional Drill

2. Preliminary construction costs do not include road overlay.

3. Costs include facilities within Old Redwood Highway only and pump station facilities as applicable.

0 100 200 ft
1 inch = 200 feet printed at 11x17

Sources: Santa Rosa GIS: Aerial 2009 1 foot resolution; Sonoma County GIS: Parcels; Winzler and Kelly GIS: Utilities.

WINZLER & KELLY
www.w-and-k.com

©Winzler & Kelly

Cartography	Date	Project #
AF	2/22/2012	0228310003

Appendix E
Figure E-2 - Sanitary Sewer Alternative 1 Modified

North Old Redwood Highway Area Utility Infrastructure Study

Town of Windsor

\\corp\wkprojects\SRO\02283 - Town of Windsor\02283-10-003 North Old Rdwd Hwy Infra Study\GIS\Maps\Figures\Sanitary Sewer Alternative 1 Modified.mxd 10:35:46 AM

\\corp\wkprojects\SRO\02283 - Town of Windsor\02283-10-003 North Old Rdwd Hwy Infra Study\GIS\Maps\Figures\Sanitary Sewer Alternative 2.mxd 9:42:09 AM

New Public Pump Station
(~30+ ft deep)
that serves Parcels 8, 9,
10, 11, 12, 13, 14, and 15

New 8" Gravity Main
(~30+ ft deep)
that serves Parcels
9, 10, and 11

New 6" Force Main that
serves Parcels 8, 9, 10,
11, 12, 13, 14, and 15
(1,500 ft)

Creek Crossing
SS Gravity Main
(~30 ft deep)
Tunnel
(100 ft)

New 8" Gravity Main
(~8 ft deep)
that serves Parcels
8, 12, 13, 14, and 15
(900 ft)

Creek Crossing
SS Force Main
HDD (350 ft)

Replace Existing 6"
Gravity Main with 12"
to Existing 12" at the
intersection with Starr Rd
(1,700 ft)

Highway 101

Highway 101 Off-Ramp

Highway 101 On-Ramp

Old Redwood Highway

North Pacific Railroad

Laguna de Santa Rosa

11 9 10 8 6 7 14 15 12 13 16 19 21 23

Alternative 2
New Gravity Main to new deep 420 gpm PS on Parcel 11; Two Creek Crossings; Force Main

- Deep Gravity Main (30+ feet)
- 6" Force Main
- 1 Deep Public Pump Station (30+ feet; 420 gpm)
- 2 Creek Crossings (HDD and Tunneling)
- No Private Pump Stations
- Preliminary Construction Cost: $3.3 million

Town Boundary
Study Area
Creek
Existing SS Gravity Main
SS Pump Station
Proposed SS Gravity Main
Proposed SS Force Main

Notes:
1. HDD = Horizontal Directional Drill

2. Preliminary construction costs do not include road overlay.

3. Costs include facilities within Old Redwood Highway only and pump station facilities as applicable.

0 100 200 ft

1 inch = 200 feet printed at 11x17

Sources: Santa Rosa GIS: Aerial 2009 1 foot resolution; Sonoma County GIS: Parcels; Winzler and Kelly GIS: Utilities.

WINZLER & KELLY
www.w-and-k.com

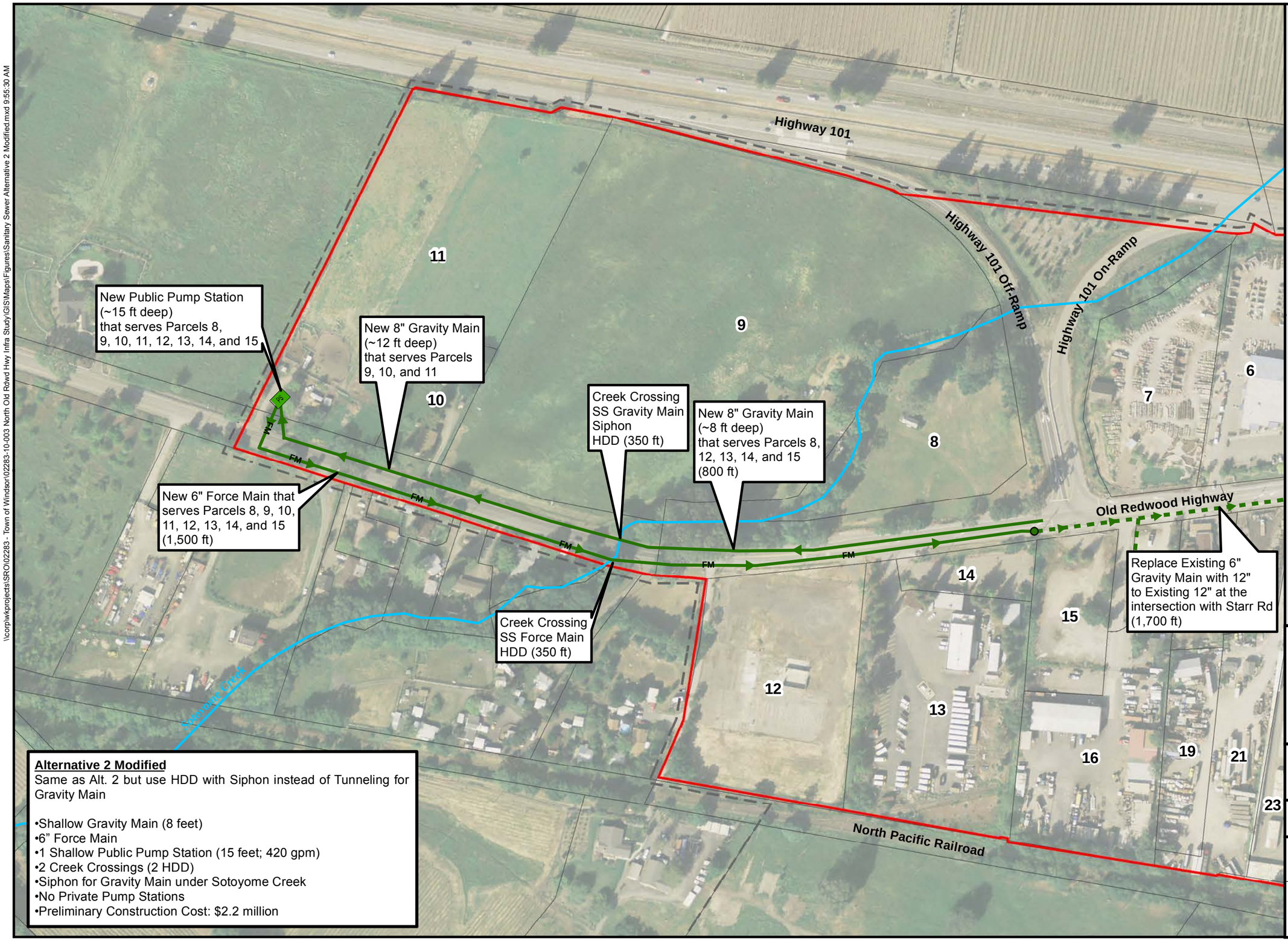
© Winzler & Kelly

Cartography	Date	Project #
AF	2/22/2012	0228310003

Appendix E
Figure E-3
Sanitary Sewer Alternative 2

North Old Redwood Highway Area
Utility Infrastructure Study

Town of Windsor



Alternative 2 Modified
Same as Alt. 2 but use HDD with Siphon instead of Tunneling for Gravity Main

- Shallow Gravity Main (8 feet)
- 6" Force Main
- 1 Shallow Public Pump Station (15 feet; 420 gpm)
- 2 Creek Crossings (2 HDD)
- Siphon for Gravity Main under Sotoyome Creek
- No Private Pump Stations
- Preliminary Construction Cost: $2.2 million

Town Boundary
Study Area
Creek
Existing SS Gravity Main
SS Pump Station
Proposed SS Gravity Main
Proposed SS Force Main

Notes:
1. HDD = Horizontal Directional Drill

2. Preliminary construction costs do not include road overlay.

3. Costs include facilities within Old Redwood Highway only and pump station facilities as applicable.

0 100 200 ft

1 inch = 200 feet printed at 11x17

Sources: Santa Rosa GIS: Aerial 2009 1 foot resolution; Sonoma County GIS: Parcels; Winzler and Kelly GIS: Utilities.

WINZLER & KELLY
www.w-and-k.com
© Winzler & Kelly

Cartography	Date	Project #
AF	2/22/2012	0228310003

Appendix E
Figure E-4 - Sanitary Sewer Alternative 2 Modified

North Old Redwood Highway Area Utility Infrastructure Study
Town of Windsor

\\corpwkprojects\SRO\02283 - Town of Windsor\02283-10-003 North Old Rdwd Hwy Infra Study\GIS\Maps\Figures\Sanitary Sewer Alternative 2 Modified.mxd 9:55:30 AM

\corp\wkprojects\SRO\02283 - Town of Windsor\02283-10-003 North Old Rdwd Hwy Infra Study\GIS\Maps\Figures\Sanitary Sewer Alternative 3.mxd 10:37:36 AM

Highway 101

Highway 101 Off-Ramp

Highway 101 On-Ramp

Old Redwood Highway

North Pacific Railroad

Mark West Creek

11

10

9

8

7

6

14

15

12

13

16

19

21

23

New 8" Gravity Main
(~8 ft deep)
that serves Parcels
9, 10, and 11
(750 ft)

New 8" Gravity Main
(~30+ ft deep)
that serves Parcels
9, 10, and 11
(200 ft)

New 8" Gravity Main
(~8 ft deep)
that serves Parcels 8,
12, 13, 14, and 15
(800 ft)

Creek Crossing
SS Gravity Main
(~30 ft deep)
Microtunnel
(100 ft)

New 6" Force Main
that serves Parcels
8, 9, 10,11, 12, 13, 14, and 15
(750 ft)

Replace Existing 6"
Gravity Main with 12"
to Existing 12" at the
intersection with Starr Rd
(1,700 ft)

New Public Pump Station
(~30+ ft deep)
that serves Parcels
8, 9, 10,11, 12, 13, 14, and 15

FM

PS

Alternative 3
New Gravity Mains to new deep 420 gpm PS on Parcel 12; One Creek Crossing; Force Main

- Deep Gravity Main (30+ feet) between Creek and PS
- 6" Force Main
- 1 Deep Public Pump Station (30+ feet; 420 gpm)
- 1 Creek Crossing (Tunneling)
- No Private Pump Stations
- Preliminary Construction Cost: $2.8 million

Town Boundary
Study Area
Creek
Existing SS Gravity Main
Proposed SS Gravity Main
Proposed SS Force Main
SS Pump Station

Notes:
1. HDD = Horizontal Directional Drill

2. Preliminary construction costs do not include road overlay.

3. Costs include facilities within Old Redwood Highway only and pump station facilities as applicable.

0 100 200 ft

1 inch = 200 feet printed at 11x17

Sources: Santa Rosa GIS: Aerial 2009 1 foot resolution; Sonoma County GIS: Parcels; Winzler and Kelly GIS: Utilities.

WINZLER & KELLY
www.w-and-k.com

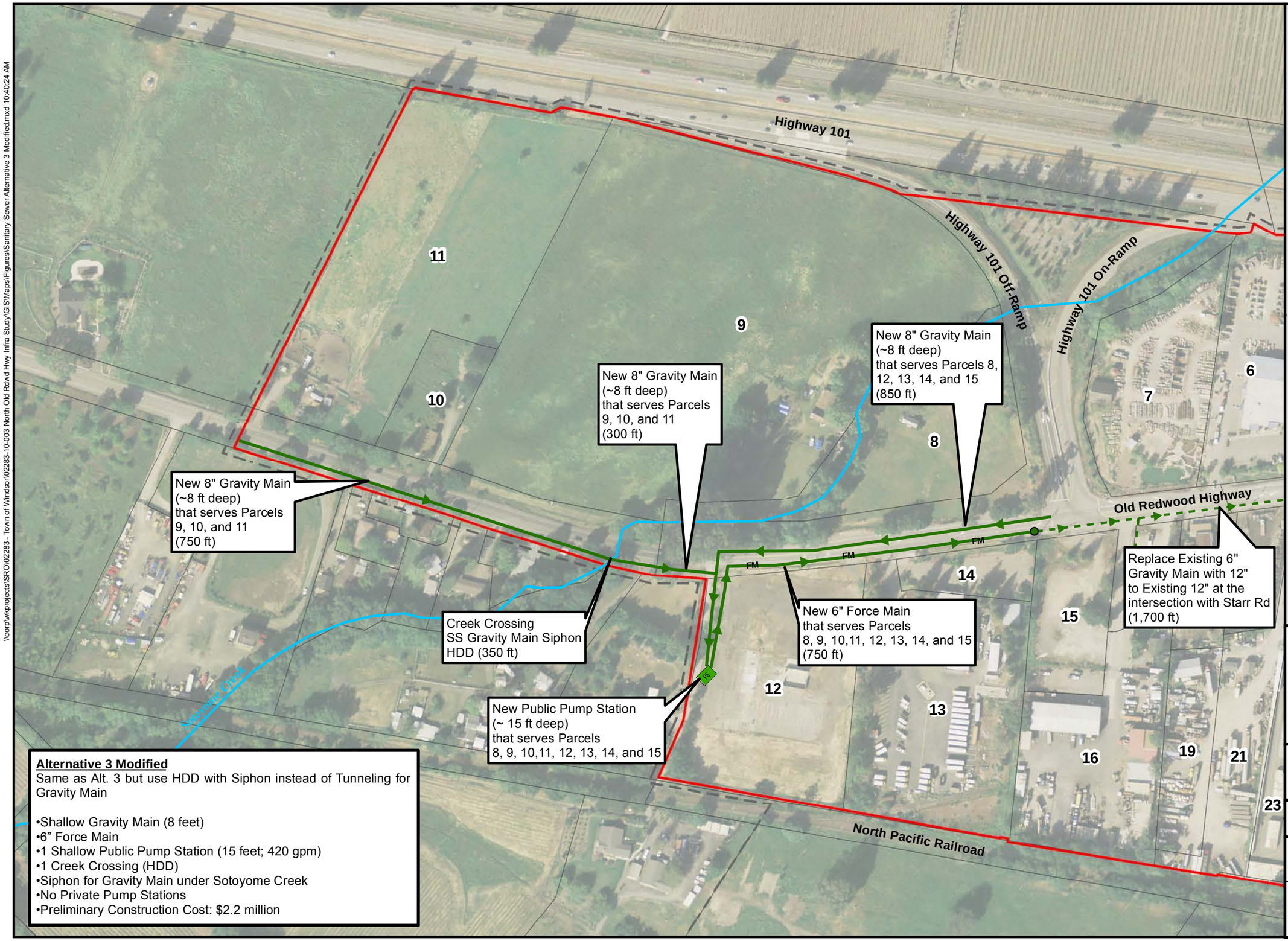
© Winzler & Kelly

Cartography	Date	Project #
AF	2/22/2012	0228310003

Appendix E
Figure E-5
Sanitary Sewer Alternative 3

North Old Redwood Highway Area
Utility Infrastructure Study

Town of Windsor



\\corp\wkprojects\SRO\02283 - Town of Windsor\02283-10-003 North Old Rdwd Hwy Infra Study\GIS\Maps\Figures\Sanitary Sewer Alternative 3 Modified.mxd 10:40:24 AM

Alternative 3 Modified
Same as Alt. 3 but use HDD with Siphon instead of Tunneling for Gravity Main

- Shallow Gravity Main (8 feet)
- 6" Force Main
- 1 Shallow Public Pump Station (15 feet; 420 gpm)
- 1 Creek Crossing (HDD)
- Siphon for Gravity Main under Sotoyome Creek
- No Private Pump Stations
- Preliminary Construction Cost: $2.2 million

Town Boundary
Study Area
Creek
Existing SS Gravity Main
Proposed SS Gravity Main
Proposed SS Force Main
SS Pump Station

Notes:
1. HDD = Horizontal Directional Drill

2. Preliminary construction costs do not include road overlay.

3. Costs include facilities within Old Redwood Highway only and pump station facilities as applicable.

0 100 200 ft
1 inch = 200 feet printed at 11x17

Sources: Santa Rosa GIS: Aerial 2009 1 foot resolution; Sonoma County GIS: Parcels; Winzler and Kelly GIS: Utilities.

WINZLER & KELLY
www.w-and-k.com
© Winzler & Kelly

Cartography	Date	Project #
AF	2/22/2012	0228310003

Appendix E
Figure E-6 - Sanitary Sewer Alternative 3 Modified

North Old Redwood Highway Area Utility Infrastructure Study
Town of Windsor

Appendix F
Sonoma County Water Agency Comment Letter (February 14, 2012)

SONOMA COUNTY WATER AGENCY

FILE:FDR\NORTH OLD REDWOOD HIGHWAY STUDY
8-9-2-8-7

February 14, 2012

Stewart Hayre
Town of Windsor
8400 Windsor Road
Windsor, CA 95492

RE: North Old Redwood Highway Area Utility Infrastructure Study

The draft engineering report for North Old Redwood Highway Area Utility Infrastructure Study dated March 3, 2011 prepared by Winzler & Kelly has been reviewed and the approach and methods used were found to be in general conformance with the Sonoma County Water Agency Flood Control Design Criteria with the following comments.

A detailed review of the calculations was not conducted under this review.

On page 33 of the report under section 4.3 "Storm Drain", "Sub-watersheds A through F" should read "sub-watersheds A through H" and "sub watersheds, G through M" should read "sub-watersheds, I through M".

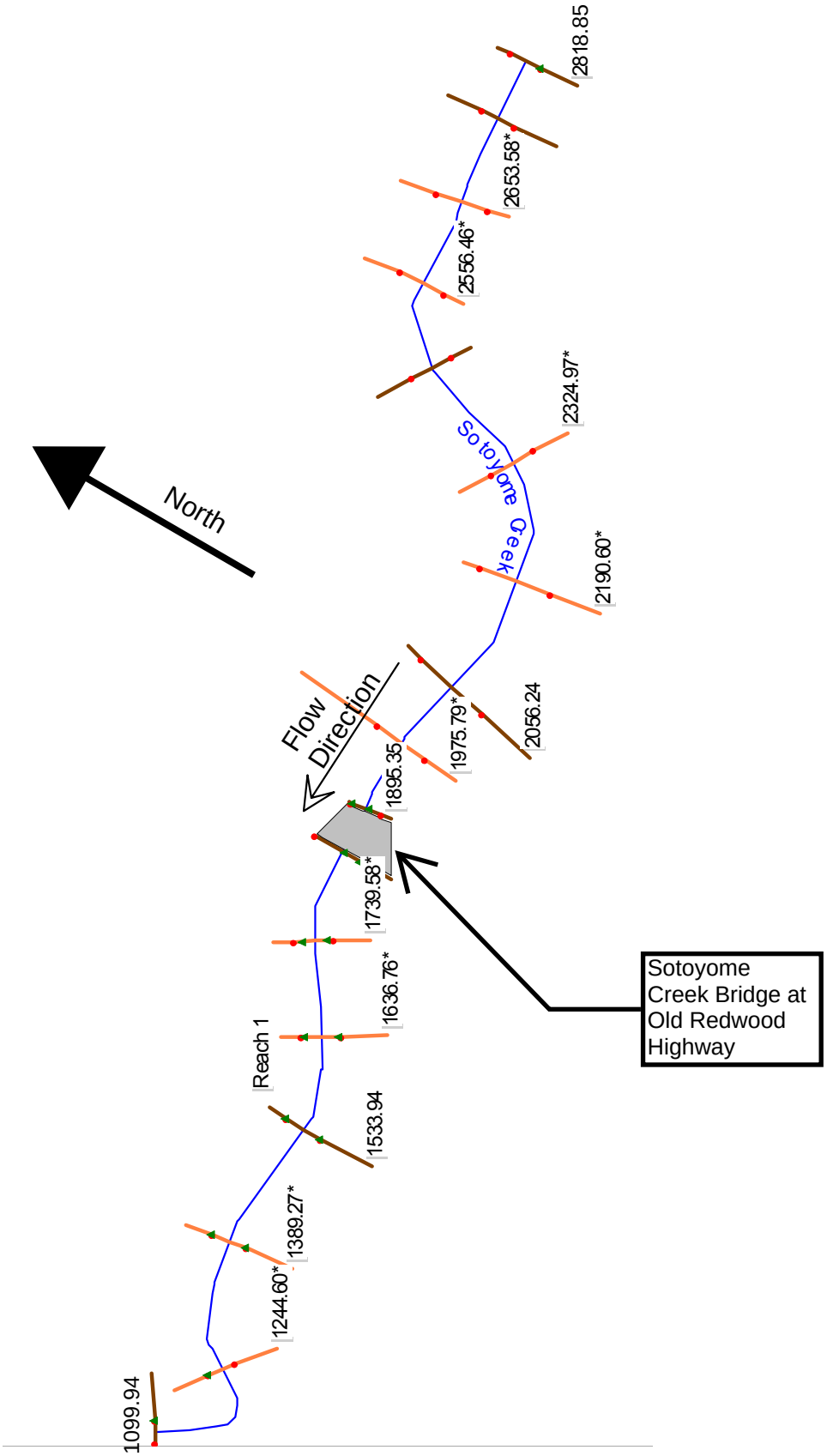
Philip E. Wadsworth

Philip E. Wadsworth
Water Agency Assistant Engineer

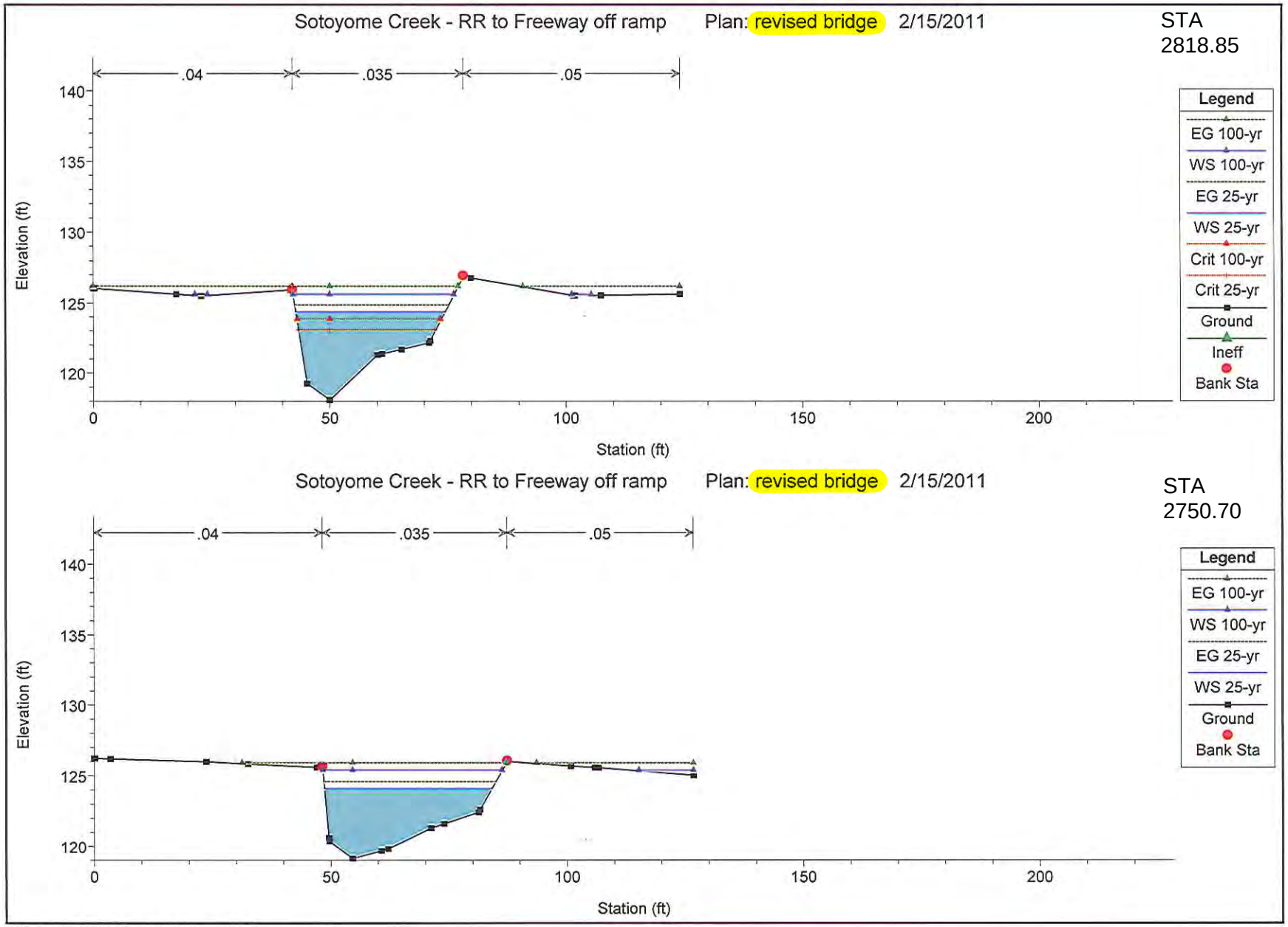
c GHD, Attn: Rick Jorgensen – 2235 Mercury Way, Suite 150, Santa Rosa, CA 95407

rs3\u\c\fdr\fdrrev

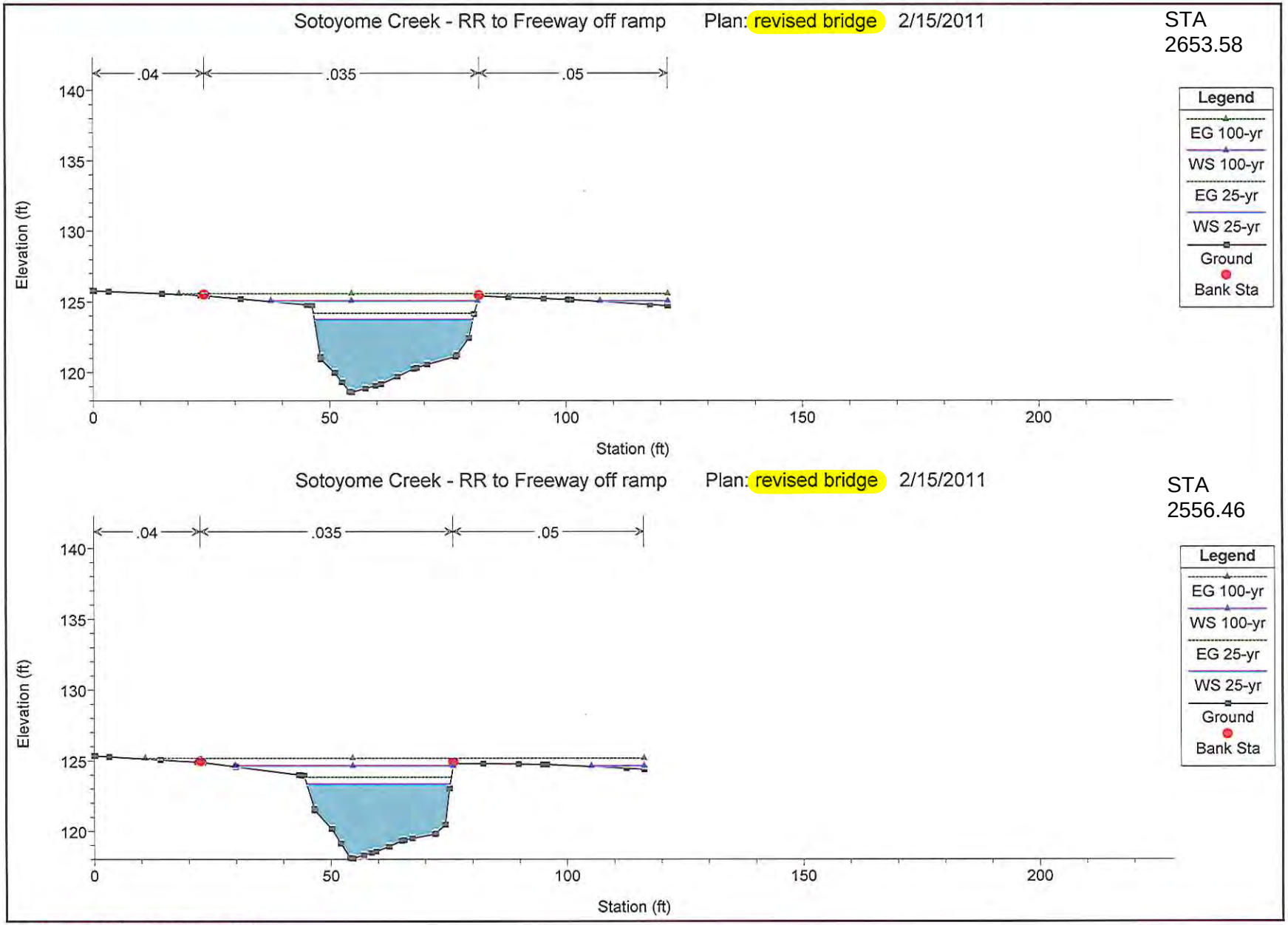
Appendix G
Sotoyome Creek Cross Sections

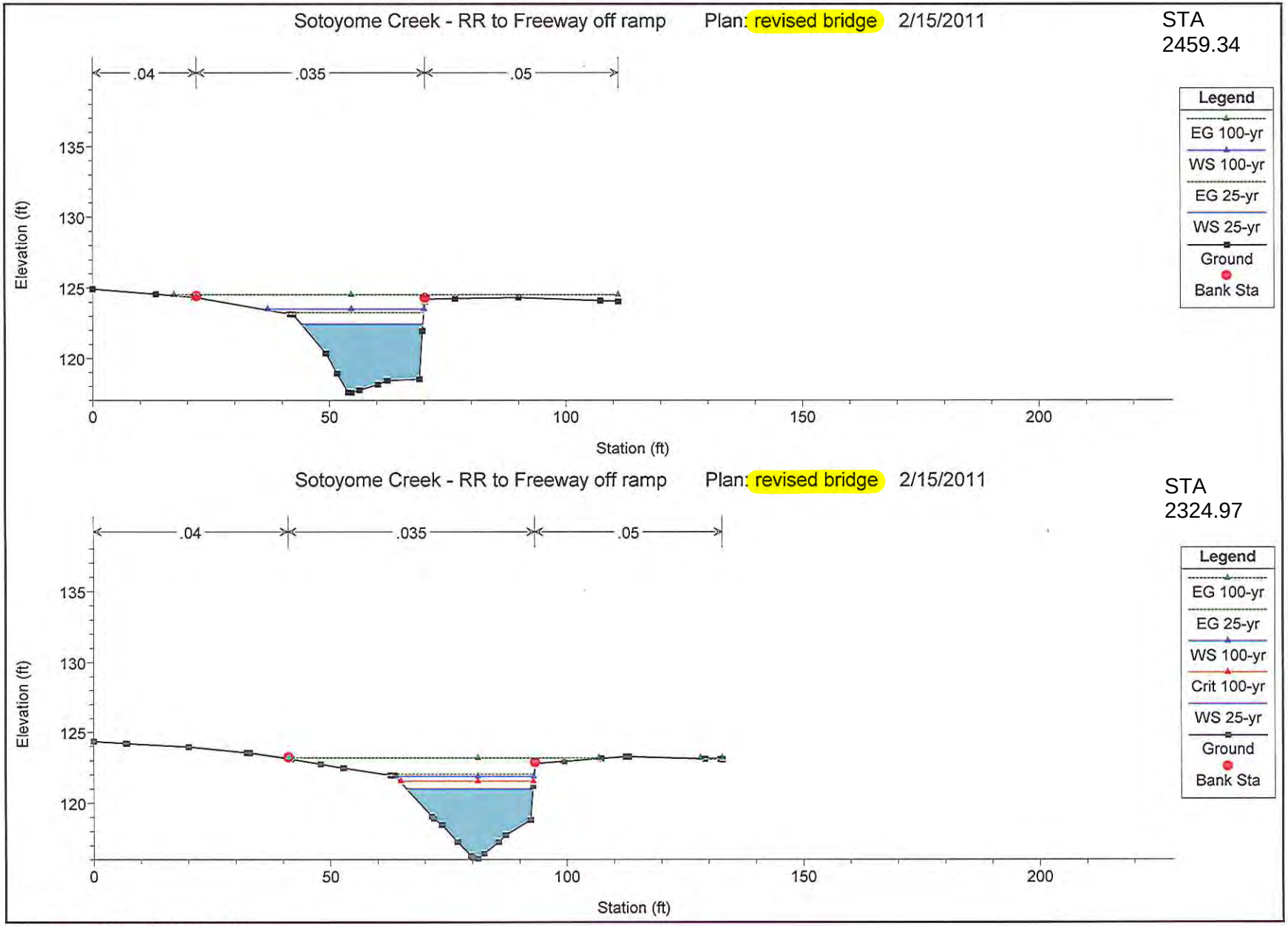


Sotoyome Creek Cross Sections

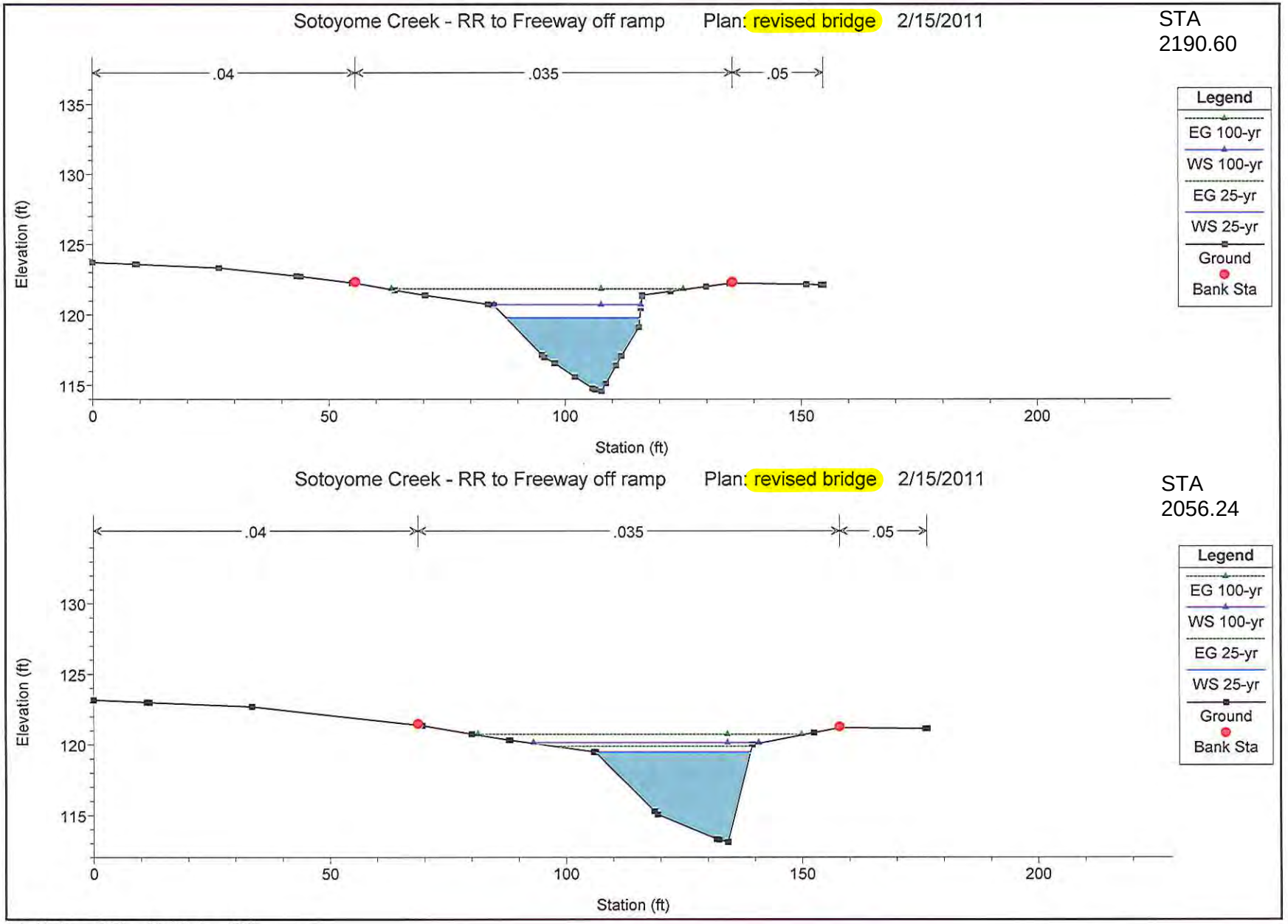


1 in Horiz. = 30 ft 1 in Vert. = 10 ft

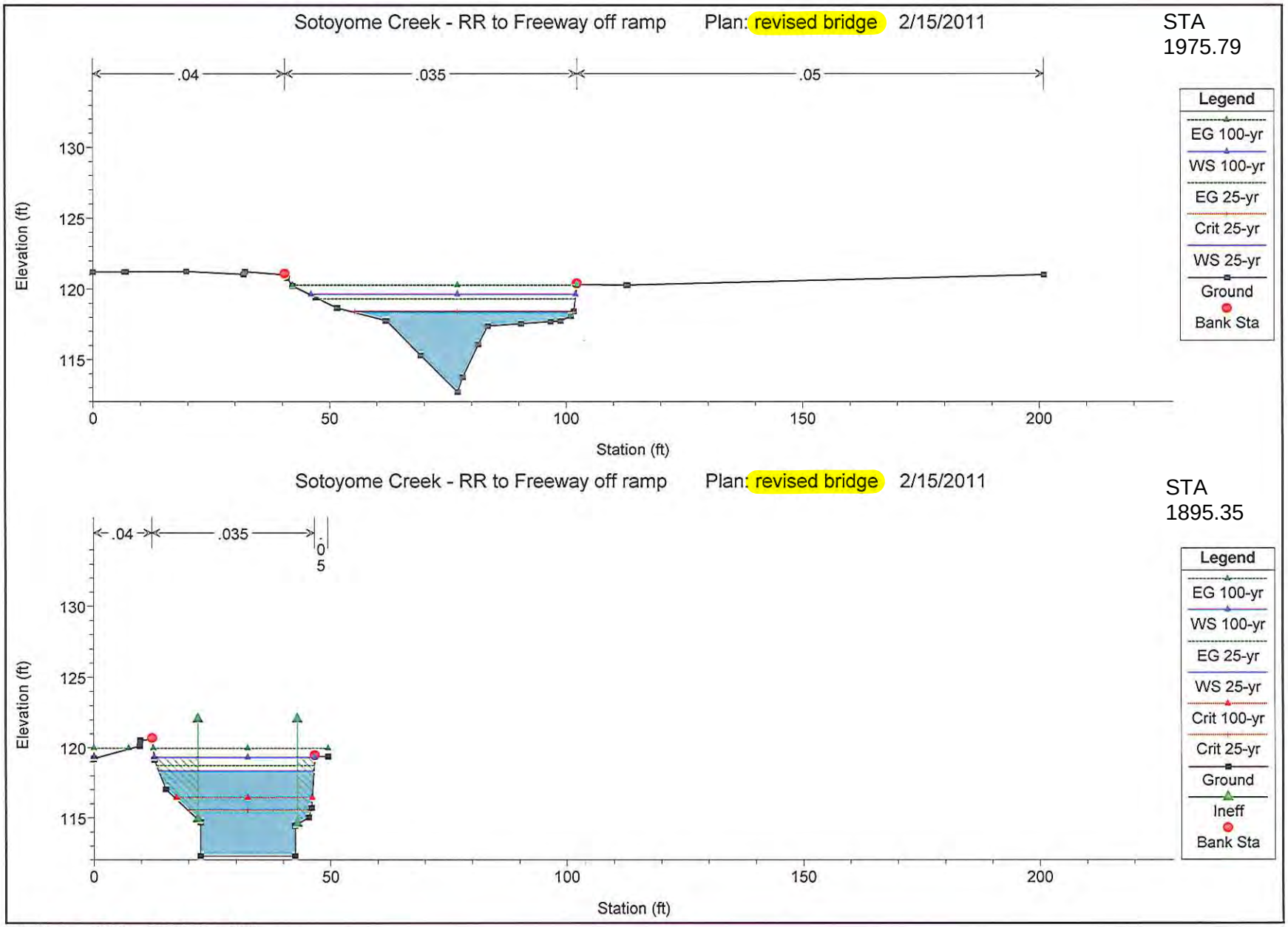

Sotoyome Creek - RR to Freeway off ramp
Plan: revised bridge 2/15/2011
STA 2653.58
.04
.035
.05
Legend
EG 100-yr
WS 100-yr
EG 25-yr
WS 25-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sotoyome Creek - RR to Freeway off ramp
Plan: revised bridge 2/15/2011
STA 2556.46
1 in Horiz. = 30 ft 1 in Vert. = 10 ft



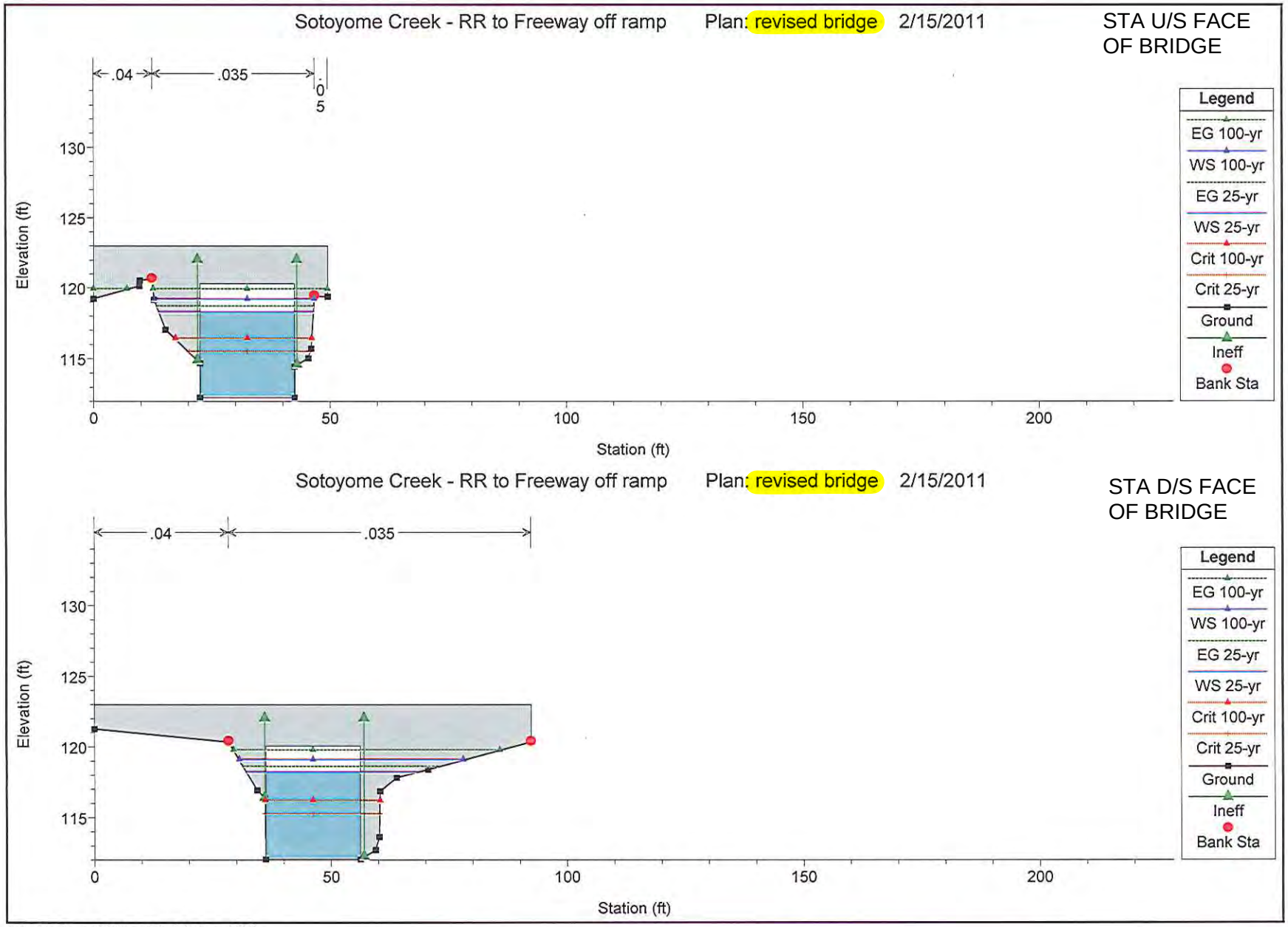
1 in Horiz. = 30 ft 1 in Vert. = 10 ft



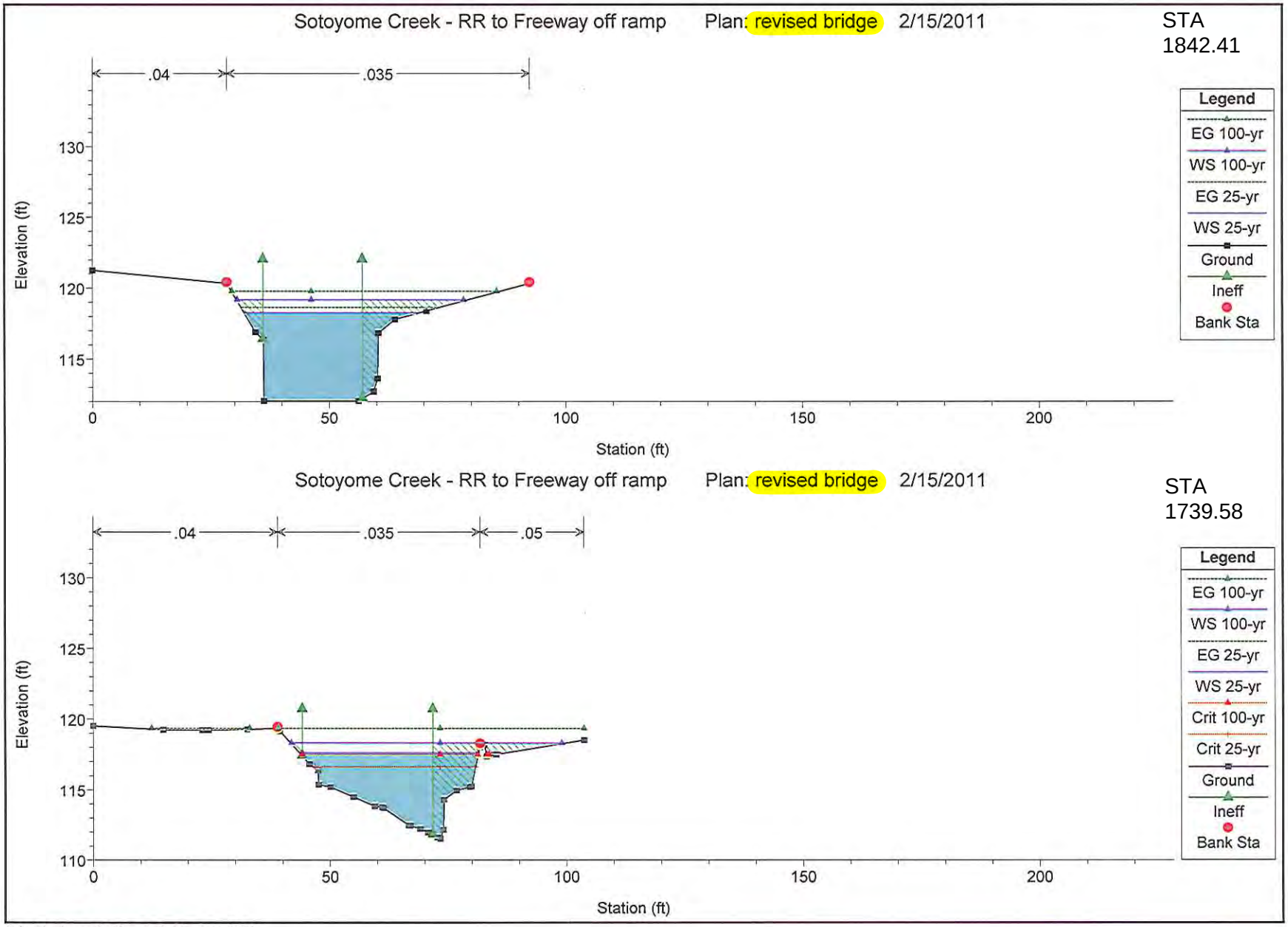
1 in Horiz. = 30 ft 1 in Vert. = 10 ft



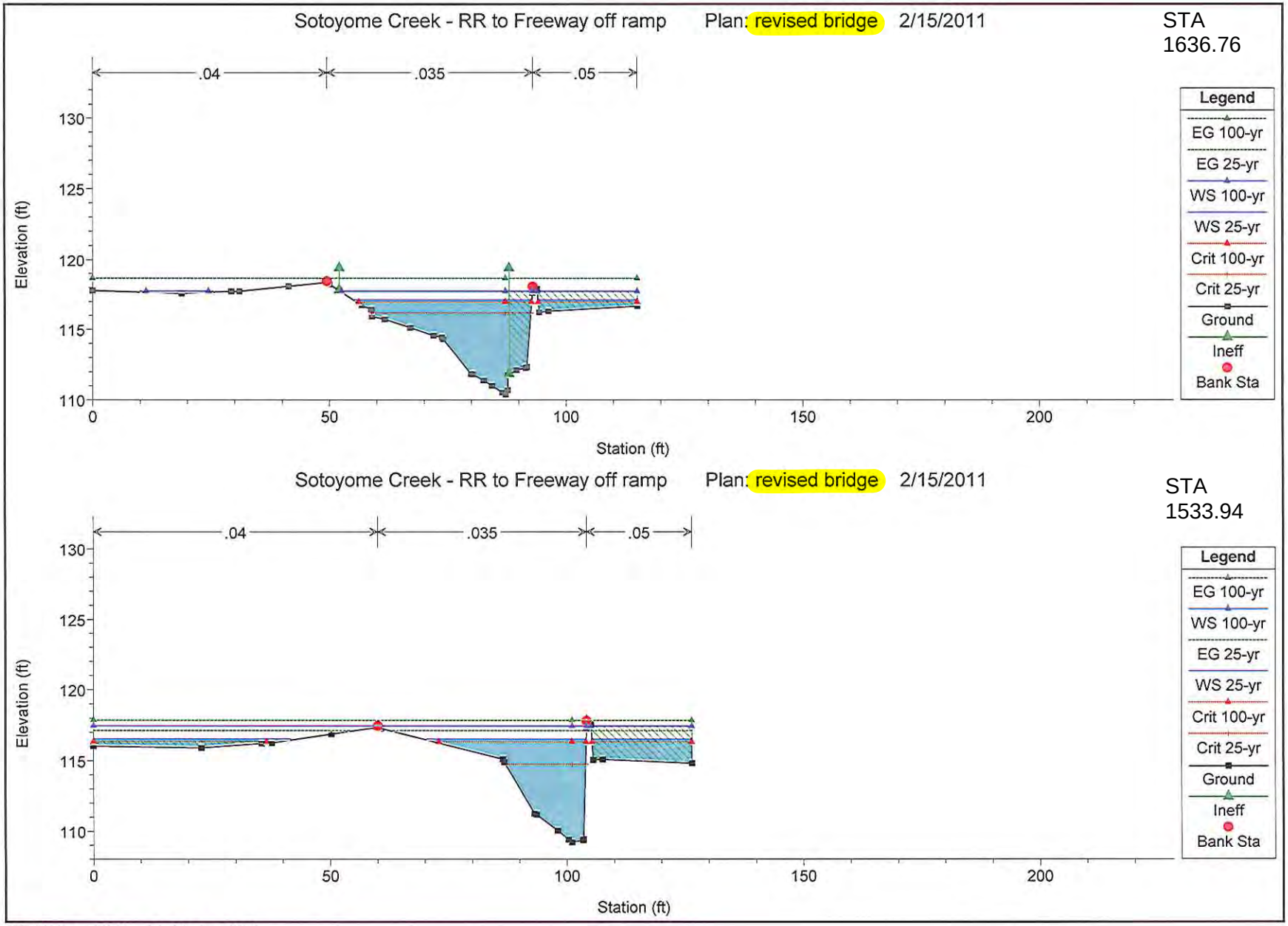
1 in Horiz. = 30 ft 1 in Vert. = 10 ft



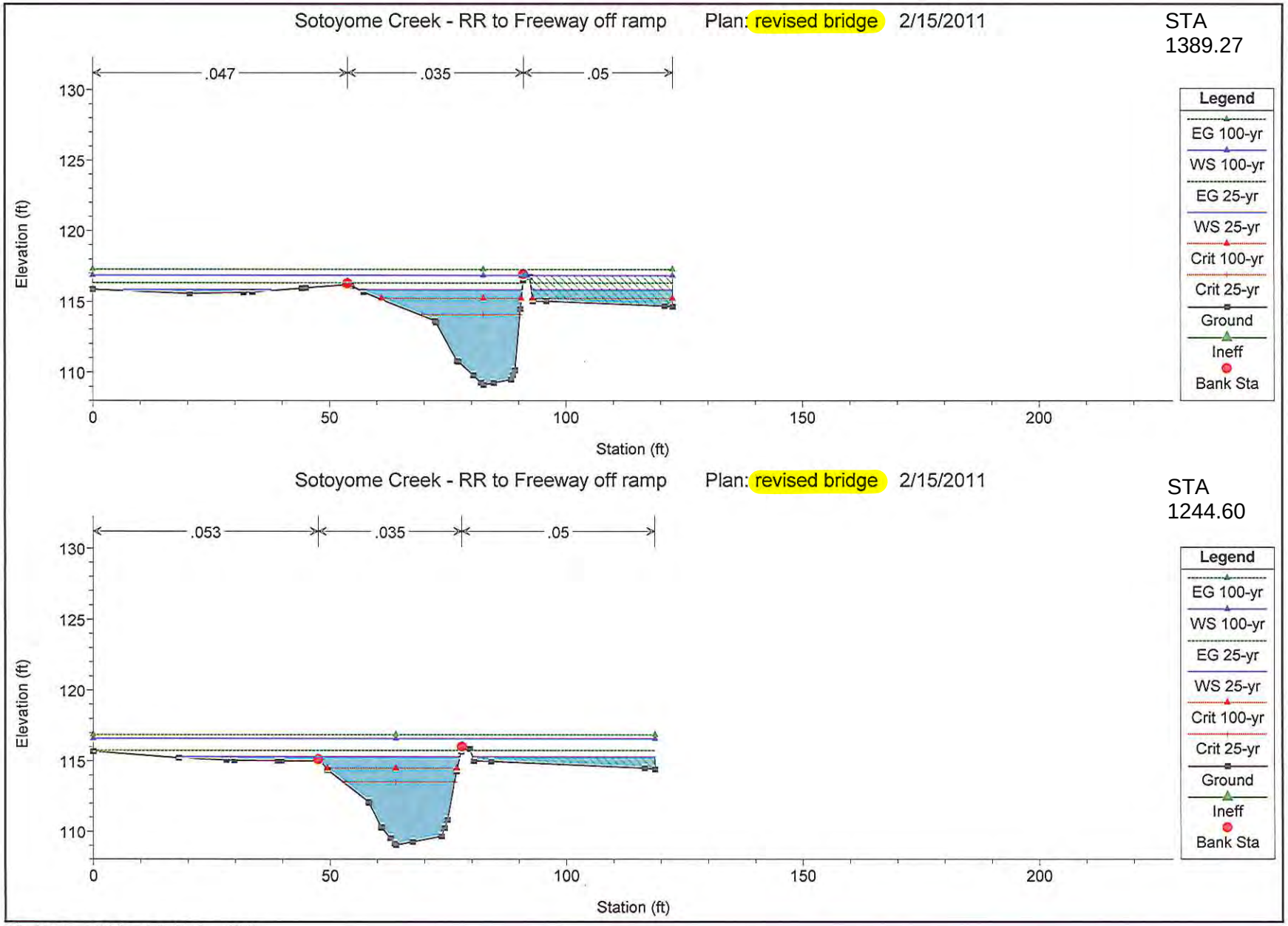
1 in Horiz. = 30 ft 1 in Vert. = 10 ft



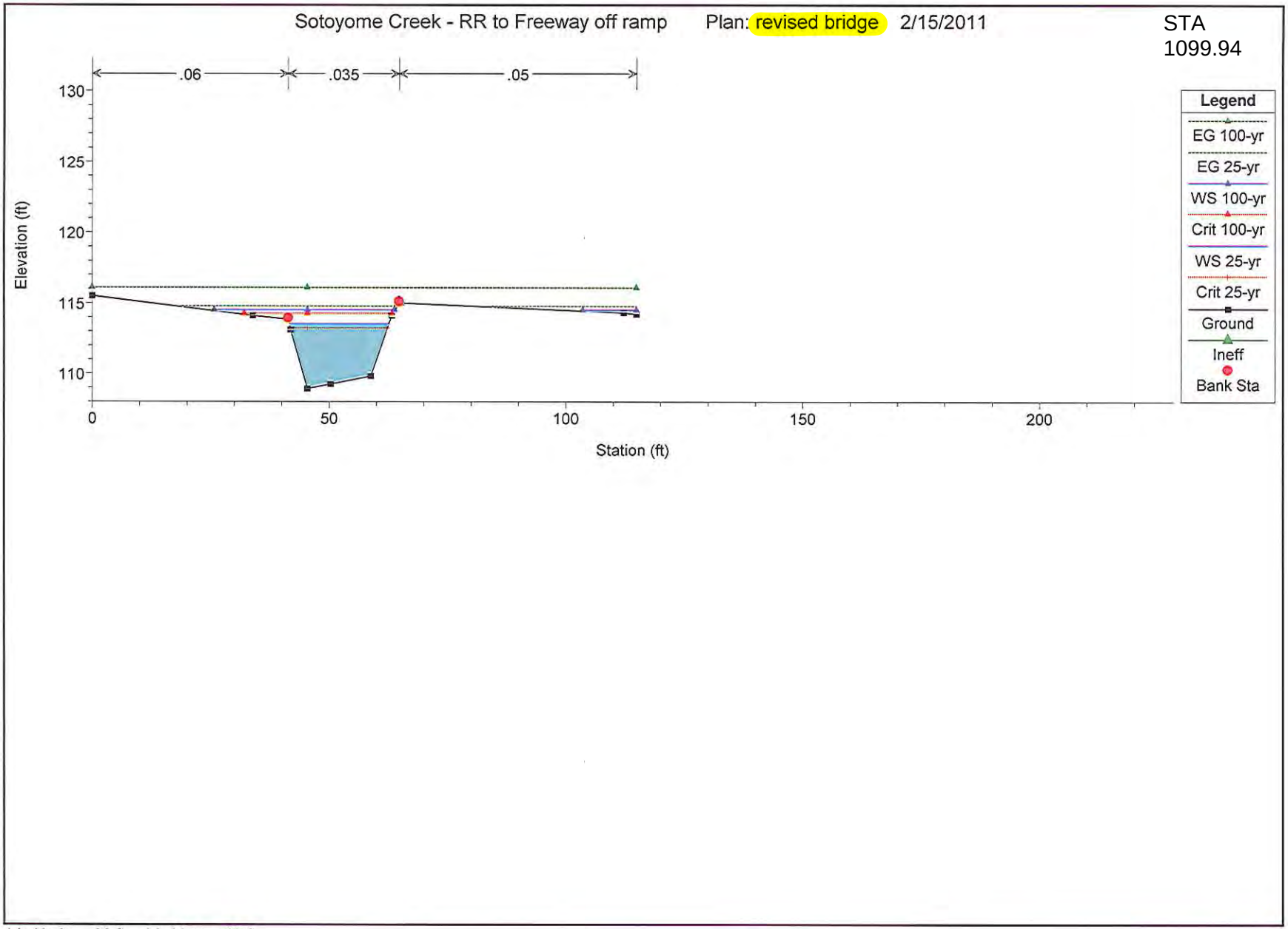
1 in Horiz. = 30 ft 1 in Vert. = 10 ft



1 in Horiz. = 30 ft 1 in Vert. = 10 ft



1 in Horiz. = 30 ft 1 in Vert. = 10 ft



1 in Horiz. = 30 ft 1 in Vert. = 10 ft

Appendix H
Sotoyome Creek HEC-RAS Model Results

HEC-RAS Plan: W&K SMART River: Sotoyome Creek Reach: Reach 1

EXIST CONDITIONS

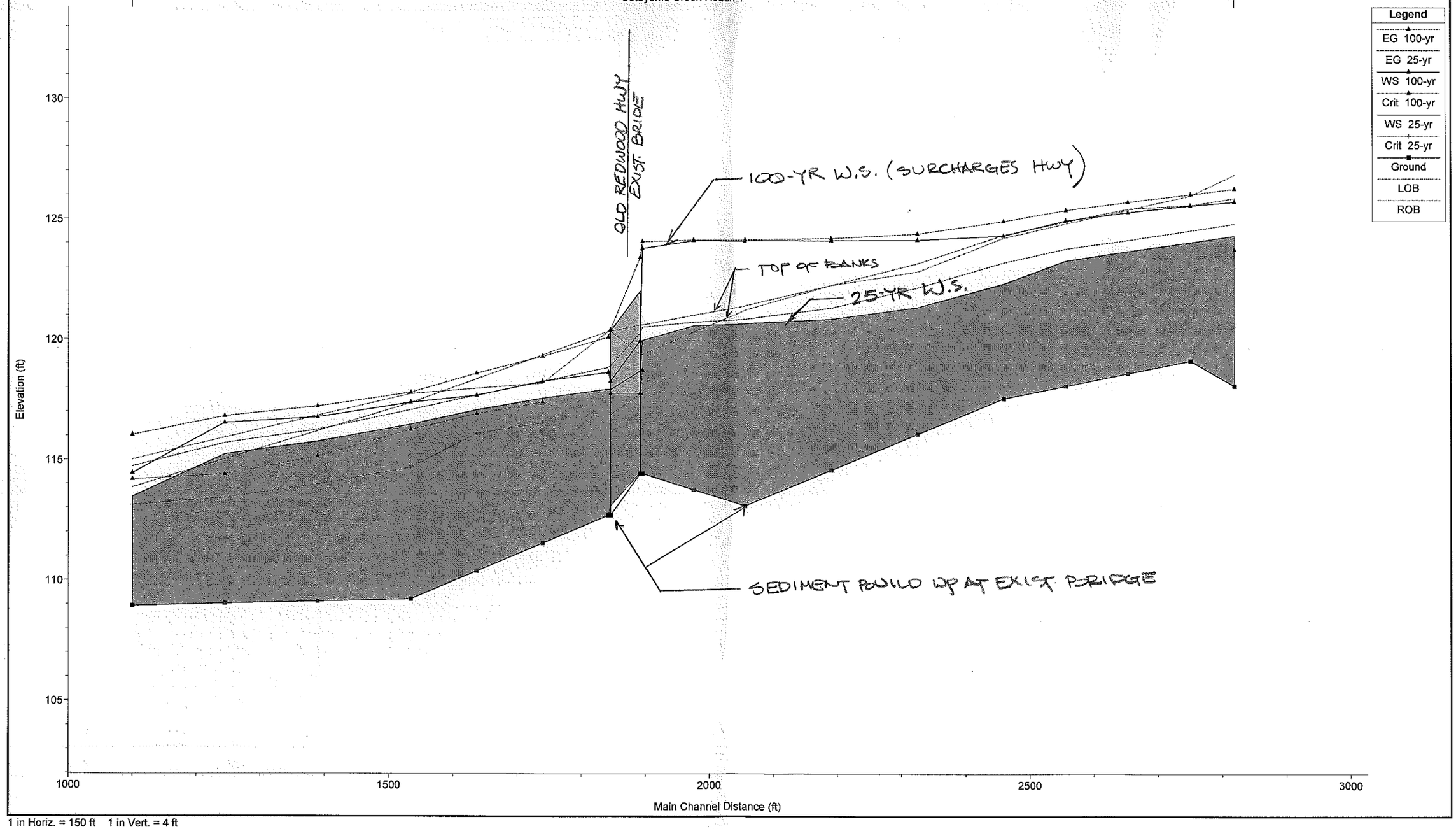
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	2818.85	25-yr	634.00	118.08	124.30	122.97	124.81	0.003985	5.69	111.43	31.51	0.53
Reach 1	2818.85	100-yr	934.00	118.08	125.72	123.73	126.26	0.003106	5.89	162.03	80.53	0.48
Reach 1	2750.70	25-yr	634.00	119.12	124.03		124.52	0.004259	5.63	112.63	35.27	0.56
Reach 1	2750.70	100-yr	934.00	119.12	125.56		126.03	0.002754	5.50	174.38	58.60	0.46
Reach 1	2653.58*	25-yr	634.00	118.60	123.67		124.13	0.003550	5.46	116.19	33.42	0.52
Reach 1	2653.58*	100-yr	934.00	118.60	125.29		125.72	0.003455	5.26	184.53	83.76	0.51
Reach 1	2556.46*	25-yr	634.00	118.07	123.27		123.77	0.003691	5.69	111.35	30.26	0.52
Reach 1	2556.46*	100-yr	934.00	118.07	124.94		125.37	0.003647	5.31	184.99	95.81	0.52
Reach 1	2459.34	25-yr	634.00	117.55	122.31		123.19	0.007843	7.54	84.11	25.30	0.73
Reach 1	2459.34	100-yr	934.00	117.55	124.31		124.91	0.005415	6.20	153.59	84.41	0.62
Reach 1	2324.97*	25-yr	634.00	116.07	121.32		122.15	0.007396	7.29	86.96	27.57	0.72
Reach 1	2324.97*	100-yr	934.00	116.07	124.12		124.39	0.001811	4.26	256.74	122.15	0.38
Reach 1	2190.60*	25-yr	634.00	114.58	120.84		121.31	0.003785	5.51	115.12	34.23	0.53
Reach 1	2190.60*	100-yr	934.00	114.58	124.10		124.20	0.000546	2.52	428.09	154.69	0.22
Reach 1	2056.24	25-yr	634.00	113.10	120.66		120.85	0.001935	3.48	182.22	67.33	0.37
Reach 1	2056.24	100-yr	934.00	113.10	124.10		124.14	0.000181	1.70	645.87	176.49	0.13
Reach 1	1975.79*	25-yr	634.00	113.76	120.56		120.71	0.001239	3.18	206.61	105.92	0.31
Reach 1	1975.79*	100-yr	934.00	113.76	124.09		124.12	0.000101	1.47	880.57	201.00	0.10
Reach 1	1895.35	25-yr	634.00	114.43	119.95	117.76	120.50	0.002128	5.96	106.34	44.81	0.46
Reach 1	1895.35	100-yr	934.00	114.43	123.77	118.71	124.05	0.001153	4.32	234.77	49.50	0.31
Reach 1	1868.88		Bridge									
Reach 1	1842.41	25-yr	634.00	112.70	117.93		118.84	0.004761	7.66	82.81	32.65	0.65
Reach 1	1842.41	100-yr	934.00	112.70	118.63		120.09	0.006227	9.69	96.40	41.77	0.77
Reach 1	1739.58*	25-yr	634.00	111.54	117.55	116.54	118.25	0.005121	6.69	94.75	40.68	0.64
Reach 1	1739.58*	100-yr	934.00	111.54	118.26	117.40	119.29	0.005971	8.18	114.17	57.18	0.71
Reach 1	1636.76*	25-yr	634.00	110.38	117.06	116.09	117.68	0.005326	6.28	100.88	58.35	0.63
Reach 1	1636.76*	100-yr	934.00	110.38	117.67	116.90	118.59	0.006939	7.70	121.30	74.57	0.73
Reach 1	1533.94	25-yr	634.00	109.22	116.46	114.68	117.07	0.006592	6.25	101.42	96.27	0.63
Reach 1	1533.94	100-yr	934.00	109.22	117.38	116.25	117.79	0.004844	5.59	200.68	125.41	0.56
Reach 1	1389.27*	25-yr	634.00	109.12	115.76	113.97	116.25	0.004385	5.62	112.72	95.09	0.55
Reach 1	1389.27*	100-yr	934.00	109.12	116.77	115.14	117.21	0.003377	5.60	203.21	121.85	0.49
Reach 1	1244.60*	25-yr	634.00	109.03	115.22	113.42	115.69	0.003375	5.53	118.72	98.15	0.50
Reach 1	1244.60*	100-yr	934.00	109.03	116.52	114.39	116.80	0.001724	4.74	286.48	118.73	0.37
Reach 1	1099.94	25-yr	634.00	108.93	113.47	113.12	114.73	0.011003	9.00	70.46	20.85	0.86
Reach 1	1099.94	100-yr	934.00	108.93	114.45	114.19	116.03	0.011011	10.14	96.40	49.33	0.88

EXIST. CONDITIONS

Sotoyome Creek - RR to Freeway off ramp Plan: W&K Run w SMART 2/14/2011 4:53:04 PM

Geom: W&K Sections with SMART Flow: SDMP Flows

Sotoyome Creek Reach 1



1 in Horiz. = 150 ft 1 in Vert. = 4 ft

HEC-RAS Plan: revise bridge River: Sotoyome Creek Reach: Reach 1

NEW BRIDGE

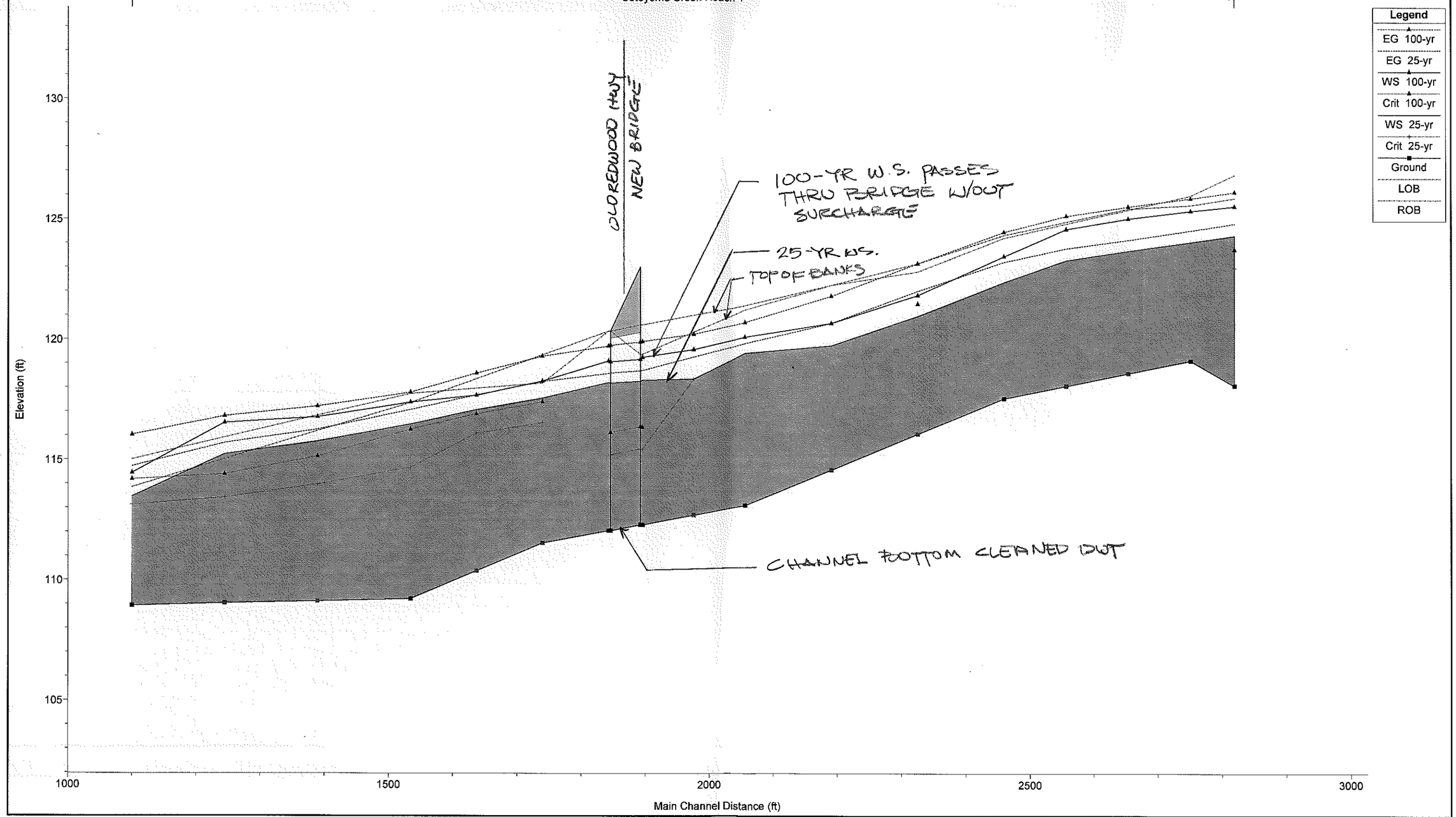
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	2818.85	25-yr	634.00	118.08	124.31	122.97	124.81	0.003971	5.68	111.56	31.52	0.53
Reach 1	2818.85	100-yr	934.00	118.08	125.53	123.73	126.12	0.003524	6.16	151.60	40.76	0.51
Reach 1	2750.70	25-yr	634.00	119.12	124.04		124.53	0.004236	5.62	112.83	35.28	0.55
Reach 1	2750.70	100-yr	934.00	119.12	125.34		125.86	0.003226	5.82	162.19	49.41	0.50
Reach 1	2653.58*	25-yr	634.00	118.60	123.68		124.14	0.003524	5.44	116.47	33.43	0.51
Reach 1	2653.58*	100-yr	934.00	118.60	125.02		125.53	0.003553	5.70	165.69	57.99	0.52
Reach 1	2556.46*	25-yr	634.00	118.07	123.28		123.78	0.003651	5.67	111.76	30.28	0.52
Reach 1	2556.46*	100-yr	934.00	118.07	124.58		125.13	0.004394	5.96	157.76	57.24	0.57
Reach 1	2459.34	25-yr	634.00	117.55	122.37		123.22	0.007470	7.41	85.60	25.47	0.71
Reach 1	2459.34	100-yr	934.00	117.55	123.45		124.47	0.008373	8.09	115.47	33.07	0.76
Reach 1	2324.97*	25-yr	634.00	116.07	120.96		122.01	0.010375	8.23	77.07	26.47	0.85
Reach 1	2324.97*	100-yr	934.00	116.07	121.83	121.47	123.15	0.010484	9.22	101.35	29.11	0.87
Reach 1	2190.60*	25-yr	634.00	114.58	119.74		120.67	0.008886	7.73	81.99	28.14	0.80
Reach 1	2190.60*	100-yr	934.00	114.58	120.67		121.80	0.008584	8.52	109.57	31.10	0.80
Reach 1	2056.24	25-yr	634.00	113.10	119.42		119.83	0.002928	5.16	122.95	32.58	0.47
Reach 1	2056.24	100-yr	934.00	113.10	120.09		120.70	0.005317	6.25	149.35	47.71	0.62
Reach 1	1975.79*	25-yr	634.00	112.70	118.34	118.34	119.26	0.016225	7.69	82.45	46.13	1.01
Reach 1	1975.79*	100-yr	934.00	112.70	119.58		120.21	0.006827	6.39	146.09	55.97	0.70
Reach 1	1895.35	25-yr	634.00	112.29	118.30	115.44	118.70	0.001783	5.12	123.77	32.72	0.37
Reach 1	1895.35	100-yr	934.00	112.29	119.25	116.34	119.90	0.002347	6.50	143.80	34.02	0.44
Reach 1	1868.86		Bridge									
Reach 1	1842.41	25-yr	634.00	112.05	118.20		118.58	0.001537	4.93	128.49	36.12	0.35
Reach 1	1842.41	100-yr	934.00	112.05	119.10		119.72	0.002113	6.34	147.36	47.81	0.42
Reach 1	1739.58*	25-yr	634.00	111.54	117.55	116.54	118.25	0.005121	6.69	94.75	40.68	0.64
Reach 1	1739.58*	100-yr	934.00	111.54	118.26	117.40	119.29	0.005971	8.18	114.17	57.18	0.71
Reach 1	1636.76*	25-yr	634.00	110.38	117.06	116.09	117.68	0.005326	6.28	100.88	58.35	0.63
Reach 1	1636.76*	100-yr	934.00	110.38	117.67	116.89	118.59	0.006939	7.70	121.30	74.57	0.73
Reach 1	1533.94	25-yr	634.00	109.22	116.46	114.67	117.07	0.006592	6.25	101.42	96.27	0.63
Reach 1	1533.94	100-yr	934.00	109.22	117.38	116.25	117.79	0.004844	5.59	200.68	125.41	0.56
Reach 1	1389.27*	25-yr	634.00	109.12	115.76	113.97	116.25	0.004385	5.62	112.72	95.09	0.55
Reach 1	1389.27*	100-yr	934.00	109.12	116.77	115.14	117.21	0.003377	5.60	203.21	121.85	0.49
Reach 1	1244.60*	25-yr	634.00	109.03	115.22	113.42	115.69	0.003375	5.53	118.72	98.15	0.50
Reach 1	1244.60*	100-yr	934.00	109.03	116.52	114.39	116.80	0.001724	4.74	286.48	118.73	0.37
Reach 1	1099.94	25-yr	634.00	108.93	113.47	113.12	114.73	0.011003	9.00	70.46	20.85	0.86
Reach 1	1099.94	100-yr	934.00	108.93	114.45	114.19	116.03	0.011011	10.14	96.40	49.33	0.88

NEW BRIDGE

Sotoyome Creek - RR to Freeway off ramp Plan: revised bridge 2/15/2011 3:08:58 PM

Geom: W&K Sections with SMART- revised bridge Flow: SDMP Flows

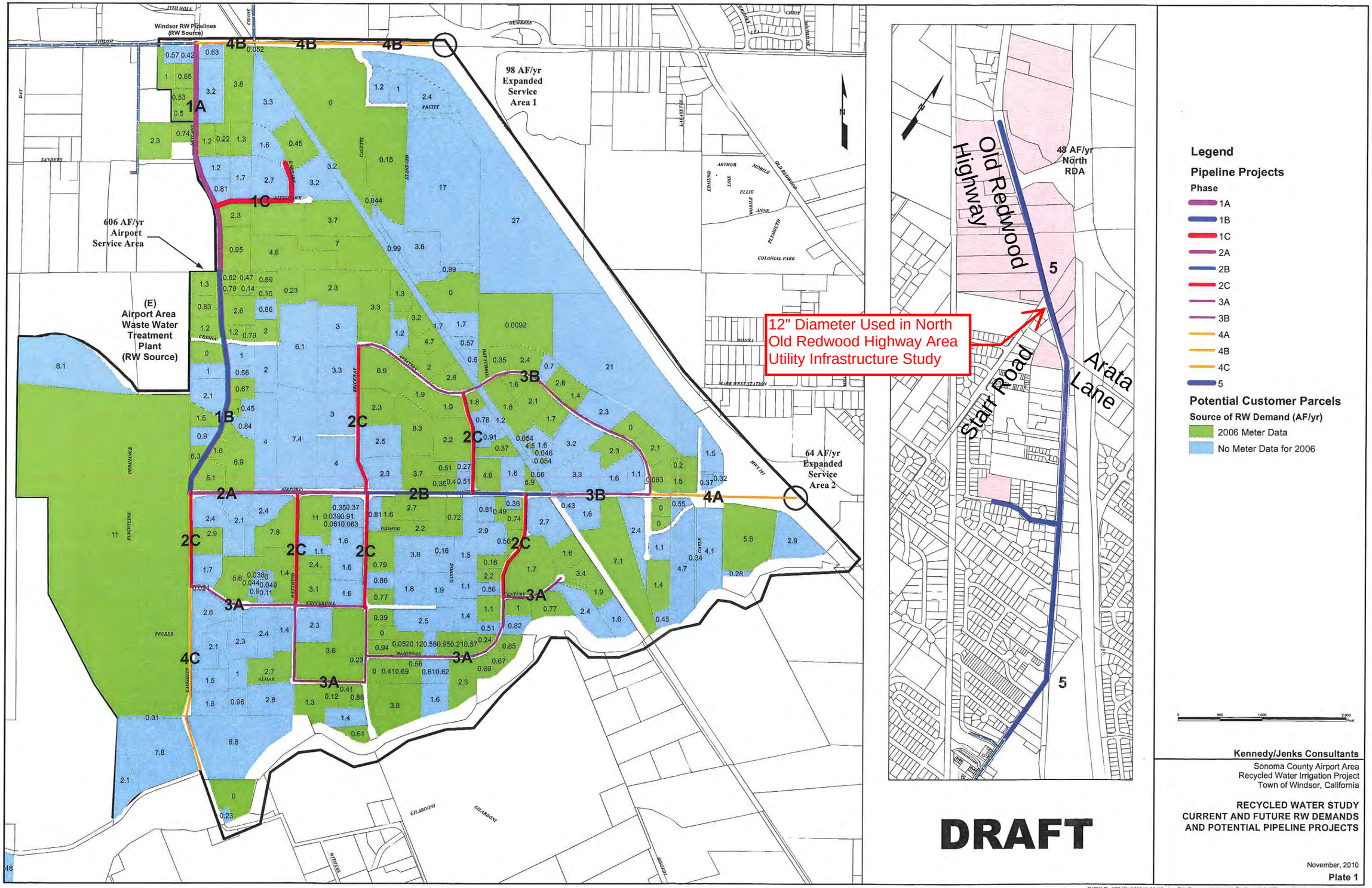
Sotoyome Creek Reach 1



1 in Horiz. = 150 ft 1 in Vert. = 4 ft

Appendix I

Plate 1 from *Sonoma County Airport Area Recycled Water Irrigation Project* (Kennedy/Jenks)



Legend

Pipeline Projects

Phase

- 1A
- 1B
- 1C
- 2A
- 2B
- 2C
- 3A
- 3B
- 4A
- 4B
- 4C
- 5

Potential Customer Parcels

Source of RW Demand (AF/yr)

- 2006 Meter Data
- No Meter Data for 2006

0 500 1,000 2,000 Feet

Kennedy/Jenks Consultants

Sonoma County Airport Area
Recycled Water Irrigation Project
Town of Windsor, California

RECYCLED WATER STUDY
CURRENT AND FUTURE RW DEMANDS AND POTENTIAL PIPELINE PROJECTS

November, 2010

Plate 1

P:\PW-Proj\2010\1068013.00 Windsor RW Planning Update\10-EngDesign\GIS\Figures\Projects.mxd Date: 11-22-10

Appendix J
Planning-level Estimates of Probable Construction Costs

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

WATER

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS		$5,000	$5,000	$5,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$32,000
01050	**Field Engineering**	1	LS		$5,000	$5,000	$5,000
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems	1	LS		$15,000	$15,000	$15,000
	Total Division 1						$57,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$10,000	$10,000	$10,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (12" W) - (3,275 LF)	1	LS			$10,000	$10,000
02300	**Earthwork (Pipeline Trenching - 12" W)**						
	Initial Sawcut	6,550	LF		$3.75	$4	$24,563
	Final Sawcut	6,550	LF		$3.75	$4	$24,563
	Pavement Removal and Disposal	400	CY		$15	$15	$6,000
	Trench Excavation	1,500	CY		$7.50	$8	$11,250
	Disposal of Excess Materials	1,500	CY		$15	$15	$22,500
	Overexcavation/ Trench Foundation	20	CY		$15	$15	$300
	Geotextile Fabric (for Overex / Foundation)	1,100	SF	$1	$0.75	$1.75	$1,925
	Drain Rock (for Overex / Foundation)	20	CY	$20	$15	$35	$700
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	750	CY	$30	$15	$45	$33,750
	Trench Zone Backfill (Class II Aggregate Base)	210	CY	$30	$15	$45	$9,450
	Final Zone Backfill (Class II Aggregate Base)	380	CY	$30	$15	$45	$17,100
	Bedding and Backfill Compaction	1,400	CY		$23	$23	$31,500
02400	**Tunnels, Bores and Jacks**						
	Horizontal Directional Drilling	350	LF			$330	$115,500
02532	**PVC Pipes**						
	12" PVC C900 DR 18 - W	3,275	LF	$20	$10	$30	$98,250
	Abandon Existing water line in place	1	LS			$5,000	$5,000
	Underground Tracer Wire (#10 AWG)	33	CLF	$1	$1	$2	$66
	Pipeline Testing (open-cut)	3,275	LF	$2	$3	$5	$16,375
	Tie-in to Existing Water System	2	EA	$5,000	$5,000	$10,000	$20,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving	720	TON	$113	$30	$143	$102,600
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping	3,275	LF	$1	$1	$2	$6,550
	Total Division 2						$567,941
	DIVISION 3 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL						
15200	Miscellaneous Valves and Fittings	1	LS	$30,000	$5,000	$35,000	$35,000
	Total Division 15						$35,000
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$660,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$113,000
	Construction Subtotal						$773,000
	Contingency (25%)	1	LS				$194,000
	Total Estimate of Probable Construction Cost *						**$967,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase for Pump Station	NA
Engineering/Environmental/Permits (15% of Construction)	$145,050
Inspection/CM (15% of Construction)	$145,050
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$290,100
City Administration (5% of Subtotal)	$48,350
Project Total	**$1,305,450**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

WATER - PHASE 1 WATER MAIN EXTENSION

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS		$3,000	$3,000	$3,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc...)(5%)	1	LS				$14,000
01050	**Field Engineering**	1	LS		$3,000	$3,000	$3,000
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems	1	LS		$7,500	$7,500	$7,500
	Total Division 1						$27,500
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$7,500	$7,500	$7,500
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (12" W) - (700 LF)	1	LS			$5,000	$5,000
02300	**Earthwork (Pipeline Trenching - 12" W)**						
	Initial Sawcut	1,300	LF		$3.75	$4	$4,875
	Final Sawcut	1,300	LF		$3.75	$4	$4,875
	Pavement Removal and Disposal	80	CY		$15	$15	$1,200
	Trench Excavation	300	CY		$7.50	$8	$2,250
	Disposal of Excess Materials	300	CY		$15	$15	$4,500
	Overexcavation/ Trench Foundation	10	CY		$15	$15	$150
	Geotextile Fabric (for Overex / Foundation)	300	SF	$1	$0.75	$1.75	$525
	Drain Rock (for Overex / Foundation)	10	CY	$20	$15	$35	$350
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	150	CY	$30	$15	$45	$6,750
	Trench Zone Backfill (Class II Aggregate Base)	50	CY	$30	$15	$45	$2,250
	Final Zone Backfill (Class II Aggregate Base)	80	CY	$30	$15	$45	$3,600
	Bedding and Backfill Compaction	300	CY		$23	$23	$6,750
02400	**Tunnels, Bores and Jacks**						
	Horizontal Directional Drilling	350	LF			$330	$115,500
02532	**PVC Pipes**						
	12" PVC C900 DR 18 - W	750	LF	$20	$10	$30	$22,500
	Abandon Existing water line in place	1	LS			$5,000	$5,000
	Underground Tracer Wire (#10 AWG)	8	CLF	$1	$1	$2	$15
	Pipeline Testing (open-cut)	750	LF	$2	$3	$5	$3,750
	Tie-in to Existing Water System	2	EA	$5,000	$5,000	$10,000	$20,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving	150	TON	$113	$30	$143	$21,375
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping	750	LF	$1	$1	$2	$1,500
	Total Division 2						$240,215
	DIVISION 3 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL						
15200	Miscellaneous Valves and Fittings	1	LS	$10,000	$2,500	$12,500	$12,500
	Total Division 15						$12,500
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$281,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$48,000
	Construction Subtotal						$329,000
	Contingency (25%)	1	LS				$83,000
	Total Estimate of Probable Construction Cost *						**$412,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase for Pump Station	NA
Engineering/Environmental/Permits (15% of Construction)	$61,800
Inspection/CM (15% of Construction)	$61,800
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$123,600
City Administration (5% of Subtotal)	$20,600
Project Total	**$556,200**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

SEWER - TIE-IN ONLY

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS		$1,000	$1,000	$1,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$4,000
01050	**Field Engineering**	1	LS		$2,500	$2,500	$2,500
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems	1	LS		$3,000	$3,000	$3,000
	Total Division 1						$10,500
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$1,000	$1,000	$1,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (12" SS) - (250 LF)	1	LS			$1,000	$1,000
02300	**Earthwork (Pipeline Trenching - 8" & 12" SS and 6" SSFM)**						
	Initial Sawcut	500	LF		$3.75	$3.75	$1,875
	Final Sawcut	500	LF		$3.75	$3.75	$1,875
	Pavement Removal and Disposal	31	CY		$15	$15	$465
	Trench Excavation	190	CY		$7.50	$8	$1,425
	Disposal of Excess Materials	190	CY		$15	$15	$2,850
	Overexcavation / Trench Foundation	2	CY		$15	$15	$30
	Geotextile Fabric (for Overex / Foundation)	80	SF	$1	$0.75	$1.75	$140
	Drain Rock (for Overex / Foundation)	2	CY	$20	$15	$35	$70
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	57	CY	$30	$15	$45	$2,565
	Trench Zone Backfill (Class II Aggregate Base)	95	CY	$30	$15	$45	$4,275
	Final Zone Backfill (Class II Aggregate Base)	29	CY	$30	$15	$45	$1,305
	Bedding and Backfill Compaction	180	CY		$23	$23	$4,050
02400	**Tunnels, Bores and Jacks**						
	Horizontal Directional Drill (6-inch SSFM)		LF			$175	
02532	**PVC Pipes**						
	6" PVC C900 DR 18 - SSFM		LF	$5	$5	$10	
	8" PVC SDR 35 - Gravity Sewer		LF	$12	$5	$17	
	12" PVC SDR 35 - Gravity Sewer	250	LF	$16	$5	$21	$5,250
	Underground Tracer Wire (#10 AWG)	3	CLF	$1	$1	$2	$5
	Pipeline Testing (open-cut)	250	LF	$2	$3	$5	$1,250
	Tie-in to Existing Gravity Sewer System	1	LS	$2,000	$5,000	$7,000	$7,000
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)	2	EA	$6,000	$3,000	$9,000	$18,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving	55	TON	$113	$30	$143	$7,838
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping	250	LF	$1	$1	$2	$500
	Total Division 2						$62,768
	DIVISION 3 THRU 10 - (NOT USED)						
	DIVISION 11 - MECHANICAL						
11310	Packaged Pump Station - Public (Shallow; 260 GPM, 50' x 50' property)		LS			$350,000	
11310	Private Pump Stations and Force Mains (16-60gpm)		LS			$75,000	
	Total Division 11						
	DIVISION 12 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL						
15200	Miscellaneous Valves and Fittings		LS	$5,000	$5,000	$10,000	
	Total Division 15						
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$74,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$13,000
	Construction Subtotal						$87,000
	Contingency (25%)	1	LS				$22,000
	Total Estimate of Probable Construction Cost *						**$109,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase for Pump Station (Approx. 2500 SF)	TBD
Engineering/Environmental (15% of Construction)	$13,050
Inspection/CM (15% of Construction)	$13,050
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$26,100
City Administration (5% of Subtotal)	$4,350
Project Total	**$139,450**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

SEWER - ALT 1

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS		$5,000	$5,000	$5,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$75,000
01050	**Field Engineering**	1	LS		$5,000	$5,000	$5,000
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems	1	LS		$30,000	$30,000	$30,000
	Total Division 1						$115,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$20,000	$20,000	$20,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (8" & 12" SS and 6" SSFM) - (4,025 LF)	1	LS			$30,000	$30,000
02300	**Earthwork (Pipeline Trenching - 8" & 12" SS and 6" SSFM)**						
	Initial Sawcut	7,950	LF		$3.75	$4	$29,813
	Final Sawcut	7,950	LF		$3.75	$4	$29,813
	Pavement Removal and Disposal	480	CY		$15	$15	$7,200
	Trench Excavation	3,200	CY		$7.50	$8	$24,000
	Disposal of Excess Materials	3,200	CY		$15	$15	$48,000
	Overexcavation/ Trench Foundation	30	CY		$15	$15	$450
	Geotextile Fabric (for Overex / Foundation)	1,300	SF	$1	$0.75	$1.75	$2,275
	Drain Rock (for Overex / Foundation)	30	CY	$20	$15	$35	$1,050
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	900	CY	$30	$15	$45	$40,500
	Trench Zone Backfill (Class II Aggregate Base)	1,800	CY	$30	$15	$45	$81,000
	Final Zone Backfill (Class II Aggregate Base)	460	CY	$30	$15	$45	$20,700
	Bedding and Backfill Compaction	3,100	CY		$23	$23	$69,750
02400	**Tunnels, Bores and Jacks**						
	Horizontal Directional Drill (6-inch SSFM)	350	LF			$175	$61,250
02532	**PVC Pipes**						
	6" PVC C900 DR 18 - SSFM	1,500	LF	$5	$5	$10	$15,000
	8" PVC SDR 35 - Gravity Sewer	775	LF	$12	$5	$17	$13,175
	12" PVC SDR 35 - Gravity Sewer	1,700	LF	$16	$5	$21	$35,700
	Underground Tracer Wire (#10 AWG)	40	CLF	$1	$1	$2	$80
	Pipeline Testing (open-cut)	3,975	LF	$2	$3	$5	$19,875
	Tie-in to Existing Gravity Sewer System	1	LS	$5,000	$5,000	$10,000	$10,000
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)	11	EA	$6,000	$3,000	$9,000	$99,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving	900	TON	$113	$30	$143	$128,250
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping	3,975	LF	$1	$1	$2	$7,950
	Total Division 2						$794,830
	DIVISION 3 THRU 10 - (NOT USED)						
	DIVISION 11 - MECHANICAL						
11310	Packaged Pump Station - Public (Shallow; 260 GPM, 50' x 50' property)	1	LS			$350,000	$350,000
11310	Private Pump Stations and Force Mains (16-60gpm)	4	LS			$75,000	$300,000
	Total Division 11						$650,000
	DIVISION 12 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL						
15200	Miscellaneous Valves and Fittings	1	LS	$5,000	$5,000	$10,000	$10,000
	Total Division 15						$10,000
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$1,570,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$267,000
	Construction Subtotal						$1,837,000
	Contingency (25%)	1	LS				$460,000
	Total Estimate of Probable Construction Cost *						**$2,297,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase for Pump Station (Approx. 2500 SF)	TBD
Engineering/Environmental (15% of Construction)	$275,550
Inspection/CM (15% of Construction)	$275,550
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$551,100
City Administration (5% of Subtotal)	$91,850
Project Total	**$2,939,950**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

SEWER - ALT 1 MOD

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS					$0	$0
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS	$0.00	$5,000	$5,000	$5,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$90,000
01050	**Field Engineering**	1	LS	$0.00	$5,000	$5,000	$5,000
01560	**Temporary Controls**						$0
	Temporary Traffic Controls Systems	1	LS	$0.00	$30,000	$30,000	$30,000
	Total Division 1						$130,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$20,000	$20,000	$20,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (8" & 12" SS and 6" SSFM) - (5,625 LF)	1	LS			$40,000	$40,000
02300	**Earthwork (Pipeline Trenching - 8" & 12" SS and 6" SSFM)**						
	Initial Sawcut	11,150	LF		$3.75	$3.75	$41,813
	Final Sawcut	11,150	LF		$3.75	$3.75	$41,813
	Pavement Removal and Disposal	670	CY		$15	$15	$10,050
	Trench Excavation	4,300	CY		$7.50	$8	$32,250
	Disposal of Excess Materials	4,300	CY		$15	$15	$64,500
	Overexcavation/ Trench Foundation	40	CY		$15	$15	$600
	Geotextile Fabric (for Overex / Foundation)	1,800	SF	$1	$0.75	$1.75	$3,150
	Drain Rock (for Overex / Foundation)	40	CY	$20	$15	$35	$1,400
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	1,200	CY	$30	$15	$45	$54,000
	Trench Zone Backfill (Class II Aggregate Base)	2,400	CY	$30	$15	$45	$108,000
	Final Zone Backfill (Class II Aggregate Base)	640	CY	$30	$15	$45	$28,800
	Bedding and Backfill Compaction	4,200	CY	$0	$23	$23	$94,500
02400	**Tunnels, Bores and Jacks**						
	Horizontal Directional Drill (6-inch SSFM)	350	LF			$175	$61,250
02532	**PVC Pipes**						$0
	4" PVC C900 DR 18 - SSFM	750	LF	$4	$5	$9	$6,750
	6" PVC C900 DR 18 - SSFM	1,500	LF	$5	$5	$10	$15,000
	8" PVC SDR 35 - Gravity Sewer	1,625	LF	$12	$5	$17	$27,625
	12" PVC SDR 35 - Gravity Sewer	1,700	LF	$16	$5	$21	$35,700
	Underground Tracer Wire (#10 AWG)	56	CLF	$1	$1	$2	$112
	Pipeline Testing (open-cut)	5,575	LF	$2	$3	$5	$27,875
	Tie-in to Existing Gravity Sewer System	1	LS	$5,000	$5,000	$10,000	$10,000
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)	14	EA	$6,000	$3,000	$9,000	$126,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving	1,300	TON	$113	$30	$143	$185,250
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping	5,575	LF	$1	$1	$2	$11,150
	Total Division 2						$1,047,587
	DIVISION 3 THRU 10 - (NOT USED)						
	DIVISION 11 - MECHANICAL						
11310	Packaged Pump Station - Public (Shallow; 260 GPM, 50' x 50' property)	1	LS			$350,000	$350,000
11310	Packaged Pump Station - Public (Shallow; 160 GPM, 50' x 50' property)	1	LS			$350,000	$350,000
	Total Division 11						$700,000
	DIVISION 12 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL						
15200	Miscellaneous Valves and Fittings	1	LS	$5,000	$5,000	$10,000	$10,000
	Total Division 15						$10,000
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$1,888,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$321,000
	Construction Subtotal						$2,209,000
	Contingency (25%)	1	LS				$553,000
	***Total Estimate of Probable Construction Cost** *						**$2,762,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase for Pump Station (Approx. 2500 SF)	TBD
Engineering/Environmental (15% of Construction)	$331,350
Inspection/CM (15% of Construction)	$331,350
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$662,700
City Administration (5% of Subtotal)	$110,450
Project Total	**$3,535,150**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

SEWER - ALT 2

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS	$0.00	$5,000	$5,000	$5,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$109,000
01050	**Field Engineering**	1	LS	$0.00	$5,000	$5,000	$5,000
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems	1	LS	$0.00	$30,000	$30,000	$30,000
	Total Division 1						$149,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$100,000	$100,000	$100,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (8" & 12" SS and 6" SSFM) - (4,850 LF)	1	LS			$100,000	$100,000
02300	**Earthwork (Pipeline Trenching - 8" & 12" SS and 6" SSFM)**						
	Initial Sawcut	9,800	LF		$3.75	$4	$36,750
	Final Sawcut	9,800	LF		$3.75	$4	$36,750
	Pavement Removal and Disposal	590	CY		$15	$15	$8,850
	Trench Excavation	6,300	CY	$0.00	$7.50	$8	$47,250
	Disposal of Excess Materials	6,300	CY		$15	$15	$94,500
	Overexcavation/ Trench Foundation	30	CY		$15	$15	$450
	Geotextile Fabric (for Overex / Foundation)	1,600	SF	$1	$0.75	$1.75	$2,800
	Drain Rock (for Overex / Foundation)	30	CY	$20	$15	$35	$1,050
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	1,100	CY	$30	$15	$45	$49,500
	Trench Zone Backfill (Class II Aggregate Base)	4,700	CY	$30	$15	$45	$211,500
	Final Zone Backfill (Class II Aggregate Base)	570	CY	$30	$15	$45	$25,650
	Bedding and Backfill Compaction	6,200	CY	$0	$23	$23	$139,500
02400	**Tunnels, Bores and Jacks**						
	Jack and Bore Pits (send and receive)	1	EA			$175,000	$175,000
	Casing Pipe	100	LF	$840		$840	$84,000
02532	**PVC Pipes**						
	6" PVC C900 DR 18 - SSFM	1,500	LF	$5	$5	$10	$15,000
	8" PVC SDR 35 - Gravity Sewer	1,700	LF	$12	$5	$17	$28,900
	12" PVC SDR 35 - Gravity Sewer	1,700	LF	$16	$5	$21	$35,700
	Underground Tracer Wire (#10 AWG)	49	CLF	$1	$1	$2	$98
	Pipeline Testing (open-cut)	4,900	LF	$2	$3	$5	$24,500
	Tie-in to Existing Gravity Sewer System	1	LS	$5,000	$5,000	$10,000	$10,000
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)	14	EA	$6,000	$3,000	$9,000	$126,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving	1,100	TON	$113	$30	$143	$156,750
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping	4,900	LF	$1	$1	$2	$9,800
	Total Division 2						$1,520,298
	DIVISION 3 THRU 10 - (NOT USED)						
	DIVISION 11 - MECHANICAL						
11310	Packaged Pump Station (Deep; 420 GPM, 50' x 50' property)	1	LS			$600,000	$600,000
	Total Division 11						$600,000
	DIVISION 12 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL						
15200	Miscellaneous Valves and Fittings	1	LS	$5,000	$5,000	$10,000	$10,000
	Total Division 15						$10,000
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$2,280,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$388,000
	Construction Subtotal						$2,668,000
	Contingency (25%)	1	LS				$667,000
	Total Estimate of Probable Construction Cost [1]						**$3,335,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase for Pump Station (Approx. 2500 SF)	TBD
Engineering/Environmental (15% of Construction)	$400,200
Inspection/CM (15% of Construction)	$400,200
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$800,400
City Administration (5% of Subtotal)	$133,400
Project Total	**$4,268,800**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

SEWER - ALT 2 MOD

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS	$0.00	$5,000	$5,000	$5,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$72,000
01050	**Field Engineering**	1	LS	$0.00	$5,000	$5,000	$5,000
01560	**Temporary Controls**						$0
	Temporary Traffic Controls Systems	1	LS	$0.00	$30,000	$30,000	$30,000
	Total Division 1						$112,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$20,000	$20,000	$20,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (8" & 12" SS and 6" SSFM) - (4,800 LF)	1	LS			$35,000	$35,000
02300	**Earthwork (Pipeline Trenching - 8" & 12" SS and 6" SSFM)**						
	Initial Sawcut	9,500	LF		$3.75	$4	$35,625
	Final Sawcut	9,500	LF		$3.75	$4	$35,625
	Pavement Removal and Disposal	580	CY		$15	$15	$8,700
	Trench Excavation	3,900	CY	$0.00	$7.50	$8	$29,250
	Disposal of Excess Materials	3,900	CY		$15	$15	$58,500
	Overexcavation/ Trench Foundation	30	CY		$15	$15	$450
	Geotextile Fabric (for Overex / Foundation)	1,500	SF	$1	$0.75	$1.75	$2,625
	Drain Rock (for Overex / Foundation)	30	CY	$20	$15	$35	$1,050
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	1,000	CY	$30	$15	$45	$45,000
	Trench Zone Backfill (Class II Aggregate Base)	2,300	CY	$30	$15	$45	$103,500
	Final Zone Backfill (Class II Aggregate Base)	550	CY	$30	$15	$45	$24,750
	Bedding and Backfill Compaction	3,800	CY	$0	$23	$23	$85,500
02400	**Tunnels, Bores and Jacks**						
	Horizontal Directional Drill (6-inch SSFM)	300	LF			$175	$52,500
02400	**Siphon**						
	Manholes and covers (both sides of the creek)	2	EA	$7,500	$3,500	$11,000	$22,000
	Siphon Pipe	350	LF	$200		$200	$70,000
02532	**PVC Pipes**						$0
	6" PVC C900 DR 18 - SSFM	1,500	LF	$5	$5	$10	$15,000
	8" PVC SDR 35 - Gravity Sewer	1,550	LF	$12	$5	$17	$26,350
	12" PVC SDR 35 - Gravity Sewer	1,700	LF	$16	$5	$21	$35,700
	Underground Tracer Wire (#10 AWG)	48	CLF	$1	$1	$2	$95
	Pipeline Testing (open-cut)	4,750	LF	$2	$3	$5	$23,750
	Tie-in to Existing Gravity Sewer System	1	LS	$5,000	$5,000	$10,000	$10,000
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)	13	EA	$6,000	$3,000	$9,000	$117,000
02700	**Asphalt Concrete Pavement**						$0
	Trench Paving	1,100	TON	$113	$30	$143	$156,750
02760	**Traffic Stripes and Pavement Markings**						$0
	Pavement Striping	4,750	LF	$1	$1	$2	$9,500
	Total Division 2						$1,024,220
	DIVISION 3 THRU 10 - (NOT USED)						
	DIVISION 11 - MECHANICAL						
11310	Packaged Pump Station (Shallow; 420 GPM, 50' x 50' property)	1	LS			$350,000	$350,000
	Total Division 11						$350,000
	DIVISION 12 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL						
15200	Miscellaneous Valves and Fittings	1	LS	$5,000	$5,000	$10,000	$10,000
	Total Division 15						$10,000
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$1,497,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$255,000
	Construction Subtotal						$1,752,000
	Contingency (25%)	1	LS				$438,000
	Total Estimate of Probable Construction Cost *						**$2,190,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase for Pump Station (Approx. 2500 SF)	TBD
Engineering/Environmental (15% of Construction)	$262,800
Inspection/CM (15% of Construction)	$262,800
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$525,600
City Administration (5% of Subtotal)	$87,600
Project Total	**$2,803,200**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

SEWER - ALT 3

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS	$0.00	$5,000	$5,000	$5,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$92,000
01050	**Field Engineering**	1	LS	$0.00	$5,000	$5,000	$5,000
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems	1	LS	$0.00	$30,000	$30,000	$30,000
	Total Division 1						$132,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$50,000	$50,000	$50,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (8" & 12" SS and 6" SSFM) - (3,900 LF)	1	LS			$50,000	$50,000
02300	**Earthwork (Pipeline Trenching - 8" & 12" SS and 6" SSFM)**						
	Initial Sawcut	8,800	LF		$3.75	$4	$33,000
	Final Sawcut	8,800	LF		$3.75	$4	$33,000
	Pavement Removal and Disposal	530	CY		$15	$15	$7,950
	Trench Excavation	4,500	CY	$0.00	$7.50	$8	$33,750
	Disposal of Excess Materials	4,500	CY		$15	$15	$67,500
	Overexcavation/ Trench Foundation	30	CY		$15	$15	$450
	Geotextile Fabric (for Overex / Foundation)	1,400	SF	$1	$0.75	$1.75	$2,450
	Drain Rock (for Overex / Foundation)	30	CY	$20	$15	$35	$1,050
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	1,000	CY	$30	$15	$45	$45,000
	Trench Zone Backfill (Class II Aggregate Base)	3,000	CY	$30	$15	$45	$135,000
	Final Zone Backfill (Class II Aggregate Base)	510	CY	$30	$15	$45	$22,950
	Bedding and Backfill Compaction	4,400	CY	$0	$23	$23	$99,000
02400	**Tunnels, Bores and Jacks**						
	Jack and Bore Pits (send and receive)	1	EA			$175,000	$175,000
	Casing Pipe	100	LF			$630	$63,000
02532	**PVC Pipes**						
	6" PVC C900 DR 18 - SSFM	750	LF	$5	$5	$10	$7,500
	8" PVC SDR 35 - Gravity Sewer	1,650	LF	$12	$5	$17	$28,050
	12" PVC SDR 35 - Gravity Sewer	1,500	LF	$16	$5	$21	$31,500
	Underground Tracer Wire (#10 AWG)	39	CLF	$1	$1	$2	$78
	Pipeline Testing (open-cut)	3,900	LF	$2	$3	$5	$19,500
	Tie-in to Existing Gravity Sewer System	1	LS	$5,000	$5,000	$10,000	$10,000
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)	13	EA	$6,000	$3,000	$9,000	$117,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving	1,000	TON	$113	$30	$143	$142,500
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping	3,900	LF	$1	$1	$2	$7,800
	Total Division 2						$1,183,028
	DIVISION 3 THRU 10 - (NOT USED)						
	DIVISION 11 - MECHANICAL						
11310	Packaged Pump Station (Deep; 420 GPM, 50' x 50' property)	1	LS			$600,000	$600,000
	Total Division 11						$600,000
	DIVISION 12 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL						
15200	Miscellaneous Valves and Fittings	1	LS	$5,000	$5,000	$10,000	$10,000
	Total Division 15						$10,000
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$1,926,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$328,000
	Construction Subtotal						$2,254,000
	Contingency (25%)	1	LS				$564,000
	Total Estimate of Probable Construction Cost [1]						**$2,818,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase for Pump Station (Approx. 2500 SF)	TBD
Engineering/Environmental (15% of Construction)	$338,100
Inspection/CM (15% of Construction)	$338,100
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$676,200
City Administration (5% of Subtotal)	$112,700
Project Total	**$3,606,900**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

SEWER - ALT 3 MOD (PUBLIC OPTION)

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS	$0.00	$5,000	$5,000	$5,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$72,000
01050	**Field Engineering**	1	LS	$0.00	$5,000	$5,000	$5,000
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems	1	LS	$0.00	$30,000	$30,000	$30,000
	Total Division 1						$112,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$50,000	$50,000	$50,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (8" & 12" SS and 6" SSFM) - (4,200 LF)	1	LS			$30,000	$30,000
02300	**Earthwork (Pipeline Trenching - 8" & 12" SS and 6" SSFM)**						
	Initial Sawcut	8,700	LF		$3.75	$4	$32,625
	Final Sawcut	8,700	LF		$3.75	$4	$32,625
	Pavement Removal and Disposal	530	CY		$15	$15	$7,950
	Trench Excavation	3,900	CY	$0.00	$7.50	$8	$29,250
	Disposal of Excess Materials	3,900	CY		$15	$15	$58,500
	Overexcavation/ Trench Foundation	30	CY		$15	$15	$450
	Geotextile Fabric (for Overex / Foundation)	1,400	SF	$1	$0.75	$1.75	$2,450
	Drain Rock (for Overex / Foundation)	30	CY	$20	$15	$35	$1,050
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	1,000	CY	$30	$15	$45	$45,000
	Trench Zone Backfill (Class II Aggregate Base)	2,400	CY	$30	$15	$45	$108,000
	Final Zone Backfill (Class II Aggregate Base)	500	CY	$30	$15	$45	$22,500
	Bedding and Backfill Compaction	3,800	CY	$0	$23	$23	$85,500
02400	**Siphon**						
	Manholes and covers (both sides of the creek)	2	EA	$7,500	$3,500	$11,000	$22,000
	Siphon Pipe	350	LF	$200		$200	$70,000
02532	**PVC Pipes**						
	6" PVC C900 DR 18 - SSFM	750	LF	$5	$5	$10	$7,500
	8" PVC SDR 35 - Gravity Sewer	1,900	LF	$12	$5	$17	$32,300
	12" PVC SDR 35 - Gravity Sewer	1,700	LF	$16	$5	$21	$35,700
	Underground Tracer Wire (#10 AWG)	44	CLF	$1	$1	$2	$87
	Pipeline Testing (open-cut)	4,350	LF	$2	$3	$5	$21,750
	Tie-in to Existing Gravity Sewer System	1	LS	$5,000	$5,000	$10,000	$10,000
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)	14	EA	$6,000	$3,000	$9,000	$126,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving	1,000	TON	$113	$30	$143	$142,500
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping	4,350	LF	$1	$1	$2	$8,700
	Total Division 2						$982,437
	DIVISION 3 THRU 10 - (NOT USED)						
	DIVISION 11 - MECHANICAL						
11310	Packaged Pump Station (Shallow; 420 GPM, 50' x 50' property)	1	LS			$400,000	$400,000
	Total Division 11						$400,000
	DIVISION 12 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL						
15200	Miscellaneous Valves and Fittings	1	LS	$5,000	$5,000	$10,000	$10,000
	Total Division 15						$10,000
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$1,505,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$256,000
	Construction Subtotal						$1,761,000
	Contingency (25%)	1	LS				$441,000
	Total Estimate of Probable Construction Cost *						**$2,202,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase for Pump Station (Approx. 2500 SF)	TBD
Engineering/Environmental/Phase 1 Study/Permits (15% of Construction)	$330,300
Inspection/CM (15% of Construction)	$330,300
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$660,600
City Administration (5% of Subtotal)	$110,100
Project Total	**$2,972,700**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

SEWER - ALT 3 MOD (PRIVATE OPTION)

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS	$0.00	$5,000	$5,000	$5,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$24,000
01050	**Field Engineering**	1	LS	$0.00	$5,000	$5,000	$5,000
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems	1	LS	$0.00	$25,000	$25,000	$25,000
	Total Division 1						$59,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$40,000	$40,000	$40,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (12" SS) - (1,700 LF)	1	LS			$30,000	$30,000
02300	**Earthwork (Pipeline Trenching - 12" SS)**						
	Initial Sawcut	3,400	LF		$3.75	$4	$12,750
	Final Sawcut	3,400	LF		$3.75	$4	$12,750
	Pavement Removal and Disposal	210	CY		$15	$15	$3,150
	Trench Excavation	1,800	CY	$0.00	$7.50	$8	$13,500
	Disposal of Excess Materials	1,800	CY		$15	$15	$27,000
	Overexcavation/ Trench Foundation	10	CY		$15	$15	$150
	Geotextile Fabric (for Overex / Foundation)	600	SF	$1	$0.75	$1.75	$1,050
	Drain Rock (for Overex / Foundation)	10	CY	$20	$15	$35	$350
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	400	CY	$30	$15	$45	$18,000
	Trench Zone Backfill (Class II Aggregate Base)	1,100	CY	$30	$15	$45	$49,500
	Final Zone Backfill (Class II Aggregate Base)	200	CY	$30	$15	$45	$9,000
	Bedding and Backfill Compaction	1,700	CY	$0	$23	$23	$38,250
02400	**Siphon**						
	Manholes and covers (both sides of the creek)	0	EA	$7,500	$3,500	$11,000	$0
	Siphon Pipe	0	LF	$200		$200	$0
02532	**PVC Pipes**						
	6" PVC C900 DR 18 - SSFM	0	LF	$5	$5	$10	$0
	8" PVC SDR 35 - Gravity Sewer	0	LF	$12	$5	$17	$0
	12" PVC SDR 35 - Gravity Sewer	1,700	LF	$16	$5	$21	$35,700
	Underground Tracer Wire (#10 AWG)	17	CLF	$1	$1	$2	$34
	Pipeline Testing (open-cut)	1,700	LF	$2	$3	$5	$8,500
	Tie-in to Existing Gravity Sewer System	1	LS	$5,000	$5,000	$10,000	$10,000
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)	8	EA	$6,000	$3,000	$9,000	$72,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving	400	TON	$113	$30	$143	$57,000
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping	1,700	LF	$1	$1	$2	$3,400
	Total Division 2						$442,084
	DIVISION 3 THRU 10 - (NOT USED)						
	DIVISION 11 - MECHANICAL						
11310	Packaged Pump Station (Shallow; 420 GPM, 50' x 50' property)	0	LS			$400,000	$0
	Total Division 11						$0
	DIVISION 12 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL						
15200	Miscellaneous Valves and Fittings	0	LS	$5,000	$5,000	$10,000	$0
	Total Division 15						$0
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$502,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$86,000
	Construction Subtotal						$588,000
	Contingency (25%)	1	LS				$147,000
	Total Estimate of Probable Construction Cost *						**$735,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase for Pump Station (Approx. 2500 SF)	TBD
Engineering/Environmental/Phase 1 Study/Permits (15% of Construction)	$110,250
Inspection/CM (15% of Construction)	$110,250
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$220,500
City Administration (5% of Subtotal)	$36,750
Project Total	**$992,250**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

STORM DRAINAGE - WATERSHEDS E & F

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS		$5,000	$5,000	$5,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$12,000
01050	**Field Engineering**	1	LS		$5,000	$5,000	$5,000
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems	1	LS		$10,000	$10,000	$10,000
	Total Division 1						$32,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$5,000	$5,000	$5,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (18" SD) - (630 LF)	1	LS		$5,000	$5,000	$5,000
02300	**Earthwork (Pipeline Trenching - 18" SD)**						
	Initial Sawcut	1,260	LF		$3.75	$4	$4,725
	Final Sawcut	1,260	LF		$3.75	$4	$4,725
	Pavement Removal and Disposal	90	CY		$15	$15	$1,350
	Trench Excavation	600	CY		$7.50	$8	$4,500
	Disposal of Excess Materials	600	CY		$15	$15	$9,000
	Overexcavation/ Trench Foundation	10	CY		$15	$15	$150
	Geotextile Fabric (for Overex / Foundation)	300	SF	$1	$0.75	$1.75	$525
	Drain Rock (for Overex / Foundation)	10	CY	$20	$15	$35	$350
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	200	CY	$30	$15	$45	$9,000
	Trench Zone Backfill (Class II Aggregate Base)	300	CY	$30	$15	$45	$13,500
	Final Zone Backfill (Class II Aggregate Base)	90	CY	$30	$15	$45	$4,050
	Bedding and Backfill Compaction	500	CY		$23	$23	$11,250
02400	**Tunnels, Bores and Jacks**						
	Horizontal Directional Drill (NA)		LF			$175	
02532	**RCP Pipes**						
	6" PVC C900 DR 18 - SSFM		LF	$5	$5	$10	
	18" RCP - Gravity Storm Sewer	630	LF	$44	$5	$49	$30,870
	12" PVC SDR 35 - Gravity Sewer		LF	$16	$5	$21	
	Underground Tracer Wire (#10 AWG)	6	CLF	$1	$1	$2	$13
	Pipeline Testing (open-cut)	630	LF	$2	$3	$5	$3,150
	Tie-in to Existing Gravity Sewer System	1	LS	$2,500	$2,500	$5,000	$5,000
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)	5	EA	$6,000	$3,000	$9,000	$45,000
	Catch Basins	5	EA	$2,000	$1,000	$3,000	$15,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving	200	TON	$113	$30	$143	$28,500
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping	630	LF	$1	$1	$2	$1,260
	Total Division 2						$201,918
	DIVISION 3 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL - (NOT USED)						
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$234,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$40,000
	Construction Subtotal						$274,000
	Contingency (25%)	1	LS				$69,000
	***Total Estimate of Probable Construction Cost** *						**$343,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase	TBD
Engineering/Environmental (15% of Construction)	$41,100
Inspection/CM (15% of Construction)	$41,100
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$82,200
City Administration (5% of Subtotal)	$13,700
Project Total	**$438,900**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

STORM DRAINAGE - WATERSHED G

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS		$5,000	$5,000	$5,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$6,000
01050	**Field Engineering**	1	LS		$5,000	$5,000	$5,000
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems		LS				
	Total Division 1						$16,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$5,000	$5,000	$5,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (30" SD) - (200 LF)	1	LS		$5,000	$5,000	$5,000
02300	**Earthwork (Pipeline Trenching - 30" SD)**						
	Initial Sawcut		LF		$2.50	$3	
	Final Sawcut		LF		$2.50	$3	
	Pavement Removal and Disposal		CY		$10	$10	
	Trench Excavation	300	CY		$5	$5	$1,500
	Disposal of Excess Materials	300	CY		$10	$10	$3,000
	Overexcavation/ Trench Foundation	10	CY		$10	$10	$100
	Geotextile Fabric (for Overex / Foundation)	200	SF	$1	$0.50	$1.50	$300
	Drain Rock (for Overex / Foundation)	10	CY	$20	$10	$30	$300
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	200	CY	$30	$10	$40	$8,000
	Trench Zone Backfill (Class II Aggregate Base)	200	CY	$30	$10	$40	$8,000
	Final Zone Backfill (Class II Aggregate Base)	40	CY	$30	$10	$40	$1,600
	Bedding and Backfill Compaction	300	CY		$15	$15	$4,500
02400	**Tunnels, Bores and Jacks**						
	Horizontal Directional Drill (NA)		LF			$175	
02532	**RCP Pipes**						
	6" PVC C900 DR 18 - SSFM		LF	$5	$5	$10	
	30" RCP - Gravity Storm Sewer	200	LF	$106	$5	$111	$22,200
	12" PVC SDR 35 - Gravity Sewer		LF	$16	$5	$21	
	Underground Tracer Wire (#10 AWG)	2	CLF	$1	$1	$2	$4
	Pipeline Testing (open-cut)	200	LF	$2	$3	$5	$1,000
	Tie-in to Existing Gravity System	1	LS	$5,000	$5,000	$10,000	$10,000
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)	3	EA	$6,000	$3,000	$9,000	$27,000
	Catch Basins	3	EA	$2,000	$1,000	$3,000	$9,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving		TON	$75	$30	$105	
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping		LF	$1	$1	$2	
	Total Division 2						$106,504
	DIVISION 3 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL - (NOT USED)						
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$123,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$21,000
	Construction Subtotal						$144,000
	Contingency (25%)	1	LS				$36,000
	***Total Estimate of Probable Construction Cost** *						**$180,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase	TBD
Engineering/Environmental (15% of Construction)	$21,600
Inspection/CM (15% of Construction)	$21,600
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$43,200
City Administration (5% of Subtotal)	$7,200
Project Total	**$230,400**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

STORM DRAINAGE - WATERSHED I - Detention

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures		LS		$5,000	$5,000	
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$7,000
01050	**Field Engineering**		LS		$5,000	$5,000	
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems		LS				
	Total Division 1						$7,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$5,000	$5,000	$5,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (48" SD) (400 LF)	1	LS		$5,000	$5,000	$5,000
02300	**Earthwork (Pipeline Trenching - 48" SD)**						
	Initial Sawcut		LF		$2.50	$3	
	Final Sawcut		LF		$2.50	$3	
	Pavement Removal and Disposal		CY		$10	$10	
	Trench Excavation	650	CY		$5	$5	$3,250
	Disposal of Excess Materials	650	CY		$10	$10	$6,500
	Overexcavation/ Trench Foundation	10	CY		$10	$10	$100
	Geotextile Fabric (for Overex / Foundation)	300	SF	$1	$0.50	$1.50	$450
	Drain Rock (for Overex / Foundation)	10	CY	$20	$10	$30	$300
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	400	CY	$30	$10	$40	$16,000
	Trench Zone Backfill (Class II Aggregate Base)	100	CY	$30	$10	$40	$4,000
	Final Zone Backfill (Class II Aggregate Base)	100	CY	$30	$10	$40	$4,000
	Bedding and Backfill Compaction	500	CY		$15	$15	$7,500
02400	**Tunnels, Bores and Jacks**						
	Horizontal Directional Drill (6-inch SSFM)		LF			$175	
02532	**RCP Pipes**						
	6" PVC C900 DR 18 - SSFM		LF	$5	$5	$10	
	42" RCP - Gravity Storm Sewer		LF	$150	$5	$155	
	48" HDPE	400	LF	$110	$5	$115	$46,000
	Underground Tracer Wire (#10 AWG)		CLF	$1	$1	$2	
	Pipeline Testing (open-cut)	400	LF	$2	$3	$5	$2,000
	Tie-in to Existing Gravity Sewer System		LS	$5,000	$5,000	$10,000	
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)		EA	$6,000	$3,000	$9,000	
	Concrete Vault	1	LS			$25,000	$25,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving		TON	$75	$30	$105	
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping		LF	$1	$1	$2	
	Total Division 2						$125,100
	DIVISION 3 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL - (NOT USED)						
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$133,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$23,000
	Construction Subtotal						$156,000
	Contingency (25%)	1	LS				$39,000
	***Total Estimate of Probable Construction Cost** *						**$195,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase	TBD
Engineering/Environmental (15% of Construction)	$23,400
Inspection/CM (15% of Construction)	$23,400
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$46,800
City Administration (5% of Subtotal)	$7,800
Project Total	**$249,600**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY
STORM DRAINAGE - WATERSHED I - Pipe in Old Redwood Hwy
ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures		LS		$5,000	$5,000	
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$20,000
01050	**Field Engineering**		LS		$5,000	$5,000	
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems	1	LS		$20,000	$20,000	$20,000
	Total Division 1						$40,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$15,000	$15,000	$15,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (18" SD) - (1,380 LF)	1	LS		$15,000.00	$15,000	$15,000
02300	**Earthwork (Pipeline Trenching - 18" SD)**						
	Initial Sawcut	2,760	LF		$3.75	$4	$10,350
	Final Sawcut	2,760	LF		$3.75	$4	$10,350
	Pavement Removal and Disposal	180	CY		$15	$15	$2,700
	Trench Excavation	650	CY		$7.50	$8	$4,875
	Disposal of Excess Materials	650	CY		$15	$15	$9,750
	Overexcavation/ Trench Foundation	10	CY		$15	$15	$150
	Geotextile Fabric (for Overex / Foundation)	500	SF	$1	$0.75	$1.75	$875
	Drain Rock (for Overex / Foundation)	10	CY	$20	$15	$35	$350
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	500	CY	$30	$15	$45	$22,500
	Trench Zone Backfill (Class II Aggregate Base)	500	CY	$30	$15	$45	$22,500
	Final Zone Backfill (Class II Aggregate Base)	190	CY	$30	$15	$45	$8,550
	Bedding and Backfill Compaction	1,100	CY		$23	$23	$24,750
02400	**Tunnels, Bores and Jacks**						
	Horizontal Directional Drill (6-inch SSFM)		LF			$175	
02532	**RCP Pipes**						
	6" PVC C900 DR 18 - SSFM		LF	$5	$5	$10	
	18" RCP - Gravity Storm Sewer	1,380	LF	$44	$5	$49	$67,620
	48" HDPE		LF	$110	$5	$115	
	Underground Tracer Wire (#10 AWG)	14	CLF	$1	$1	$2	$28
	Pipeline Testing (open-cut)	1,380	LF	$2	$3	$5	$6,900
	Tie-in to Existing Gravity Sewer System	1	LS	$2,500	$2,500	$5,000	$5,000
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)	6	EA	$6,000	$3,000	$9,000	$54,000
	Catch Basins (every 300 feet along gravity sewer + 2)	12	EA	$2,000	$1,000	$3,000	$36,000
	Concrete Vault		LS				
02700	**Asphalt Concrete Pavement**						
	Trench Paving	400	TON	$113	$30	$143	$57,000
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping	1,380	LF	$1	$1	$2	$2,760
	Total Division 2						$377,008
	DIVISION 3 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL - (NOT USED)						
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$418,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$72,000
	Construction Subtotal						$490,000
	Contingency (25%)	1	LS				$123,000
	Total Estimate of Probable Construction Cost *						**$613,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase	TBD
Engineering/Environmental (15% of Construction)	$73,500
Inspection/CM (15% of Construction)	$73,500
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$147,000
City Administration (5% of Subtotal)	$24,500
Project Total	**$784,500**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

STORM DRAINAGE - WATERSHED J

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS		$5,000	$5,000	$5,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$38,000
01050	**Field Engineering**	1	LS		$5,000	$5,000	$5,000
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems		LS				
	Total Division 1						$48,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$20,000	$20,000	$20,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (42" and 48" SD) - (2,450 LF)	1	LS		$20,000.00	$20,000	$20,000
02300	**Earthwork (Pipeline Trenching - 42" and 48" SD)**						
	Initial Sawcut		LF		$2.50	$3	
	Final Sawcut		LF		$2.50	$3	
	Pavement Removal and Disposal		CY		$10	$10	
	Trench Excavation	4,600	CY		$5	$5	$23,000
	Disposal of Excess Materials	4,600	CY		$10	$10	$46,000
	Overexcavation/ Trench Foundation	30	CY		$10	$10	$300
	Geotextile Fabric (for Overex / Foundation)	1,600	SF	$1	$0.50	$1.50	$2,400
	Drain Rock (for Overex / Foundation)	30	CY	$20	$10	$30	$900
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	2,000	CY	$30	$10	$40	$80,000
	Trench Zone Backfill (Class II Aggregate Base)	1,000	CY	$30	$10	$40	$40,000
	Final Zone Backfill (Class II Aggregate Base)	600	CY	$30	$10	$40	$24,000
	Bedding and Backfill Compaction	3,500	CY		$15	$15	$52,500
02400	**Tunnels, Bores and Jacks**						
	Horizontal Directional Drill (NA)		LF			$175	
02532	**RCP Pipes**						
	6" PVC C900 DR 18 - SSFM		LF	$5	$5	$10	
	42" RCP - Gravity Storm Sewer	850	LF	$150	$5	$155	$131,750
	48" HDPE	1,600	LF	$110	$5	$115	$184,000
	Underground Tracer Wire (#10 AWG)	9	CLF	$1	$1	$2	$17
	Pipeline Testing (open-cut)	2,450	LF	$2	$3	$5	$12,250
	Tie-in to Existing Gravity Sewer System	1	LS	$2,500	$2,500	$5,000	$5,000
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)	5	EA	$6,000	$3,000	$9,000	$45,000
	Catch Basins	10	EA	$2,000	$1,000	$3,000	$30,000
	Concrete Vault	1	LS			$15,000	$15,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving		TON	$75	$30	$105	
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping		LF	$1	$1	$2	
	Total Division 2						$732,117
	DIVISION 3 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL - (NOT USED)						
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$781,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$133,000
	Construction Subtotal						$914,000
	Contingency (25%)	1	LS				$229,000
	Total Estimate of Probable Construction Cost *						**$1,143,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase	TBD
Engineering/Environmental (15% of Construction)	$137,100
Inspection/CM (15% of Construction)	$137,100
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$274,200
City Administration (5% of Subtotal)	$45,700
Project Total	**$1,462,900**

TOWN OF WINDSOR
NORTH OLD REDWOOD HIGHWAY AREA UTILITY INFRASTRUCTURE STUDY

STORM DRAINAGE - WATERSHED M - Detention

ENGINEER'S PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
DETAILED ESTIMATE BY CSI SECTION

Client: Town of Windsor
Project: North Old Redwood Highway Area Utility Infrastructure Study 2/23/2012

CSI Section	Description	Quantity No	Quantity Unit	Cost Mat'l	Cost Labor	Total Unit Cost	Total Cost
	DIVISION 1 - GENERAL REQUIREMENTS						
01010	**Summary of Work**						
	Environmental Mitigation Measures	1	LS		$5,000	$5,000	$5,000
01025	**Measurement and Payment**						
	Mobilization and Demobilization (including salaries, trailer, permits, utilities, spill protection, etc…)(5%)	1	LS				$4,000
01050	**Field Engineering**		LS		$5,000	$5,000	
01560	**Temporary Controls**						
	Temporary Traffic Controls Systems		LS				
	Total Division 1						$9,000
	DIVISION 2 - SITEWORK						
02240	**Dewatering**						
	Trench Dewatering	1	LS		$2,000	$2,000	$2,000
02250	**Shoring and Trench Safety (Open Cut Construction)**						
	Trench Shoring (48" SD) - (160 LF)	1	LS		$2,000.00	$2,000	$2,000
02300	**Earthwork (Pipeline Trenching - 48" SD)**						
	Initial Sawcut		LF		$2.50	$3	
	Final Sawcut		LF		$2.50	$3	
	Pavement Removal and Disposal		CY		$10	$10	
	Trench Excavation	650	CY		$5	$5	$3,250
	Disposal of Excess Materials	650	CY		$10	$10	$6,500
	Overexcavation/ Trench Foundation	10	CY		$10	$10	$100
	Geotextile Fabric (for Overex / Foundation)	200	SF	$1	$0.50	$1.50	$300
	Drain Rock (for Overex / Foundation)	10	CY	$20	$10	$30	$300
	Pipeline Bedding / Pipe Zone (Class II Aggregate Base)	200	CY	$30	$10	$40	$8,000
	Trench Zone Backfill (Class II Aggregate Base)	100	CY	$30	$10	$40	$4,000
	Final Zone Backfill (Class II Aggregate Base)	50	CY	$30	$10	$40	$2,000
	Bedding and Backfill Compaction	300	CY		$15	$15	$4,500
02400	**Tunnels, Bores and Jacks**						
	Horizontal Directional Drill (NA)		LF			$175	
02532	**RCP Pipes**						
	6" PVC C900 DR 18 - SSFM		LF	$5	$5	$10	
	42" RCP - Gravity Storm Sewer		LF	$150	$5	$155	
	48" HDPE	160	LF	$110	$5	$115	$18,400
	Underground Tracer Wire (#10 AWG)		CLF	$1	$1	$2	
	Pipeline Testing (open-cut)	160	LF	$2	$3	$5	$800
	Tie-in to Existing Gravity Sewer System		LS	$5,000	$5,000	$10,000	
02537	**Precast Concrete Maintenance Holes**						
	Manholes and covers (every 300 feet along gravity sewer + 2)		EA	$6,000	$3,000	$9,000	
	Concrete Vault	1	LS			$12,000	$12,000
02700	**Asphalt Concrete Pavement**						
	Trench Paving		TON	$75	$30	$105	
02760	**Traffic Stripes and Pavement Markings**						
	Pavement Striping		LF	$1	$1	$2	
	Total Division 2						$64,150
	DIVISION 3 THRU 14 - (NOT USED)						
	DIVISION 15 - MECHANICAL - (NOT USED)						
	DIVISION 16 - ELECTRICAL (NOT USED)						
	TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST						
	Subtotal (Divisions 1 through 16; Rounded)	1	LS				$74,000
	Contractor's Bonds, Insurance, Overhead, and Profit (17%)	1	LS				$13,000
	Construction Subtotal						$87,000
	Contingency (25%)	1	LS				$22,000
	***Total Estimate of Probable Construction Cost** *						**$109,000**

* Does not include Engineering/Administration/Construction Management.

Right-of-Way Purchase	TBD
Engineering/Environmental (15% of Construction)	$13,050
Inspection/CM (15% of Construction)	$13,050
Subtotal (Construction + Engineering/Environmental/Inspection/CM)	$26,100
City Administration (5% of Subtotal)	$4,350
Project Total	**$139,450**