CITY OF VENETA
COYOTE CREEK TRIBUTARY
STORMWATER BASIN PLAN

May 2008

Prepared for:

City of Veneta
88184 Eighth Street
Veneta, Oregon 97487

Prepared by:

URS

111 S.W. Columbia, Suite 1500
Portland, Oregon 97201-5814
25696393

TABLE OF CONTENTS

List of Appendices

List of Tables

List of Figures

SECTION 1 – INTRODUCTION

1.1 Overview

This document is the Stormwater Basin Plan for the Coyote Creek tributary in the City of Veneta. This document presents the methods and results of the hydrologic and hydraulic modeling of the tributary drainage system in the southern portion of the City and identification of capital improvement project (CIP) alternatives to address flooding. When possible, water quality will also be addressed with implementation of the flood control CIPs. This section of the plan provides a summary of the need for the plan, a description of the approach for preparing the plan, and a summary of how this draft plan is organized.

1.2 Need for the Plan

The Coyote Creek tributary basin, specifically the drainage system along Oak Island Drive, was identified in the City of Veneta Drainage Master Plan (1999) as being deficient and requiring improvements to alleviate existing flooding conditions.

From 2003 to 2006, the City of Veneta attempted to obtain permits from the United States Army Corps of Engineers (USACE) in order to conduct channel widening and enhancement efforts on the downstream portion of the Coyote Creek tributary along Oak Island Drive and Cherry Street, in order to alleviate existing flooding conditions along the channel. As development has occurred within the Coyote Creek tributary drainage basin, downstream property adjacent to mainstem channel has continued to experience flooding during larger rain events.

In order to provide additional information to the USACE regarding the need such channel improvements, the City of Veneta initiated a project in 2006 to develop a stormwater basin plan for the tributary to Coyote Creek that runs through the southern portion of the City of Veneta along Oak Island Drive. The goals of this project are:

- To identify new and unanticipated alternatives to the proposed “in channel” excavations;
- To provide contributory documentation confirming that this channel was subject to flooding; and
- Document such actions that may be required to alleviate the flooding and risk to property owners in this area.

The purpose of this plan is to provide a guidance document to the City in order to plan for more comprehensive, efficient, and multi-objective management of the City’s stormwater resources along the Coyote Creek tributary. This document focuses on capacity and conveyance issues, and addresses water quality with respect to the selected flood control solutions.

1.3 Approach

The first steps in developing this basin plan included obtaining survey information for the open channel conveyance system, determining the overall contributing drainage area to the system, evaluating the City’s existing storm drainage infrastructure, and then evaluating future needs posed by anticipated growth and buildout of the Urban Services Area. To conduct these activities, information was initially acquired regarding the physical aspects of the existing storm drainage system in the area. As-built information was collected for use in delineating the drainage basin boundaries. A survey of the open channel system along Oak Island Drive was conducted to measure cross-sectional dimensions and channel bottom elevations with respect to a local datum. Initial efforts to delineate the contributing drainage basin resulted in the need for an additional survey of the area outside the City limits, to the southwest of the open channel system, which contributes flow but had no mapped topographic information to assist in the delineation.

Based on the compiled survey and hydraulic information, a hydrologic/hydraulic model was developed to evaluate the capacity of the City's storm drainage system. The XP-SWMM model was used due to model capabilities and staff familiarity with the model. The model study area covers approximately 350 acres of area both inside and outside the city limits. The study focused on the evaluation of flooding in the open channel system along Oak Island Drive and Cherry Lane inside of the City limits.

Flooding issues anticipated as a result of an estimated 25-year SCS design storm event were identified. Although both the 10-year and 25-year events were simulated, the City opted to use the most conservative storm event with which to base their capital improvement project design. There were 14 locations identified as flooding, although the magnitude of flooding varied significantly. Of the 14 locations, seven priority flooding locations were initially identified based on whether 1) roadway flooding was occurring at a culvert and 2) flooding was exceeding 0.5 feet in any open channel segment. Ten capital improvement project (CIP) alternatives were developed to address flooding throughout the system that focused on those seven priority locations. A workshop was then held with the City to refine the priority flooding locations and select four of the initial capital improvement projects for the development of CIP fact sheets and cost estimates. CIP options are described in Section 4.0 and the CIP fact sheets and cost estimates are provided in Section 5.0.

The conceptual designs for the top four high priority CIP project alternatives include water quality and natural resource considerations as described in the CIP fact sheets.

1.4 Document Organization

The remaining sections of this Stormwater Basin Plan are organized as follows:

- Section 2.0 includes a brief summary, including maps, of the characteristics of the study area.
- Section 3.0 describes the evaluation methods used to identify flooding locations in the Coyote Creek tributary system.
- Section 4.0 describes the approach and results of the initial Capital Improvement Project (CIP) development effort.
- Section 5.0 describes the selection of the preferred CIP alternatives and the associated CIP fact sheets and cost estimates.

In addition, the following appendices include more detailed additional information:

- Appendix A includes the overall hydrologic and hydraulic model results tables.
- Appendix B includes figures of all CIP alternatives.
- Appendix C includes the detailed hydraulic modeling results for each CIP alternative.
- Appendix D includes the unit cost estimates for CIPs.
- Appendix E includes photos and modeling results for the system verification.
- Appendix F includes figures and modeling results for the upgraded CIP options.

SECTION 2 – STUDY AREA CHARACTERISTICS

This section provides a summary of the study area characteristics relevant to the portion of the modeled storm drainage system.

2.1 Study Area Location

The City of Veneta is located in the southwest corner of the Willamette Valley in Lane County, Oregon (Figure 2-1). The city is approximately 12 miles west of the Eugene/ Springfield metropolitan area. The city itself is approximately 2.7 square miles, but for purposes of this Basin Plan, the study area comprises about 350 acres (0.55 square miles), which includes land both within and outside the city limits. Study area within the actual city limits is approximately 126 acres.

2.2 Rainfall

The average annual precipitation in the City of Veneta is approximately 55 inches. More information regarding design storm events and rainfall distributions are included in Section 3.

2.3 Topography

Topography in the City of Veneta, within the city limits is relatively flat. Particularly in the south/ southwest portion of the City associated with the study area there is limited grade and limited available topographic information. These topographic characteristics attribute to capacity constraints with regards to the city's drainage system and overall stormwater conveyance.

2.4 Land Use and Zoning

Development, specifically the conversion from undisturbed land to developed land uses can affect the quantity and quality of stormwater runoff. Stormwater runoff flows and volumes increase with increased impervious surface, and existing drainage infrastructure is often not sufficient to store and convey the increased runoff.

Existing condition land use information is not available for the City of Veneta, but the City does have citywide zoning information available. As a result, the existing condition (2006) land use for the study area is based on available zoning information and is shown in Figure 2-2. Land use categories are based on the zoning designations, except for the open space classification, which was determined as the appropriate land use category for the southwestern portion of the study area that is outside of the City UGB. The dominant existing land use category for the study area is open space, general residential, and single family residential. There is no commercial or industrial development in the study area.

Because most of the existing open space within the drainage area is located outside of the city limits, planning and future zoning of this area can not be projected or accounted for at this time. In addition, most of the land within the City's urban growth boundary (UGB) has already been developed. Therefore, only an existing land use scenario was simulated in the model. A summary of areas and imperviousness for each Subbasin and land use category is included in Section 3.0.

2.5 Soils

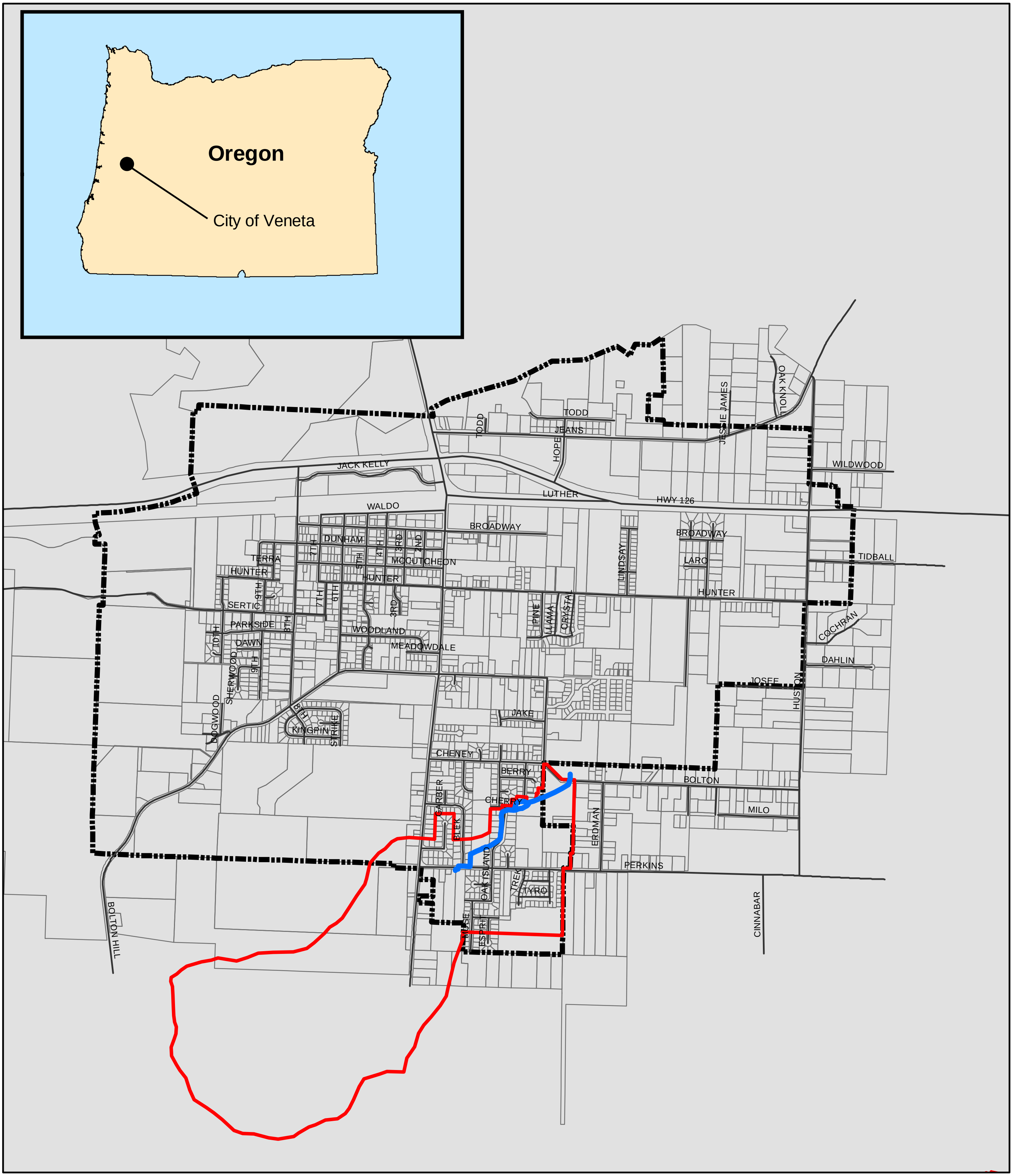
Soil classification is an important variable in determining the flow rate and volume of stormwater runoff generated from an area. The soil type and associated soil characteristics (permeability and runoff potential) control the rate of stormwater infiltration into pervious surfaces. As development increases and less pervious surface is present, the effects of soil type on the overall stormwater discharge flows and volumes is reduced.

The predominant soil types in the study area are the Noti soil complex and the Veneta soil complex. These soils are classified as hydrologic group D, which is the dominant hydrologic soil group for the study area, characterized by slow infiltration rates when thoroughly wetted and soils that are moderately fine to fine in texture. Additional information regarding infiltration characteristics of the soils is provided in Section 3.0.

2.6 Drainage System

The Coyote Creek tributary drainage area was initially delineated using available as-built information, available two-foot contours in the vicinity of the study area, and results of an additional survey of the area to the southwest of the city limits. The total basin area is approximately 357 acres. From this delineation, the basin was divided into nine subbasins for purposes of developing this Stormwater Basin Plan (Figures 2-2).

The modeled open channel drainage system starts at Perkins Road and flows north along Oak Island Drive, east along Cherry Lane, and northeast to the newly installed culverts at East Bolton Road (Figure 2-3). The total length of the modeled system is approximately 3100 feet. Although not included in the model, the system continues northeast from East Bolton Road to eventually discharge in Coyote Creek.



Map Features

🟥 Coyote Creek Tributary Drainage Basin

Modeled Coyote Creek Tributary

Roads

City of Veneta UGB Boundary

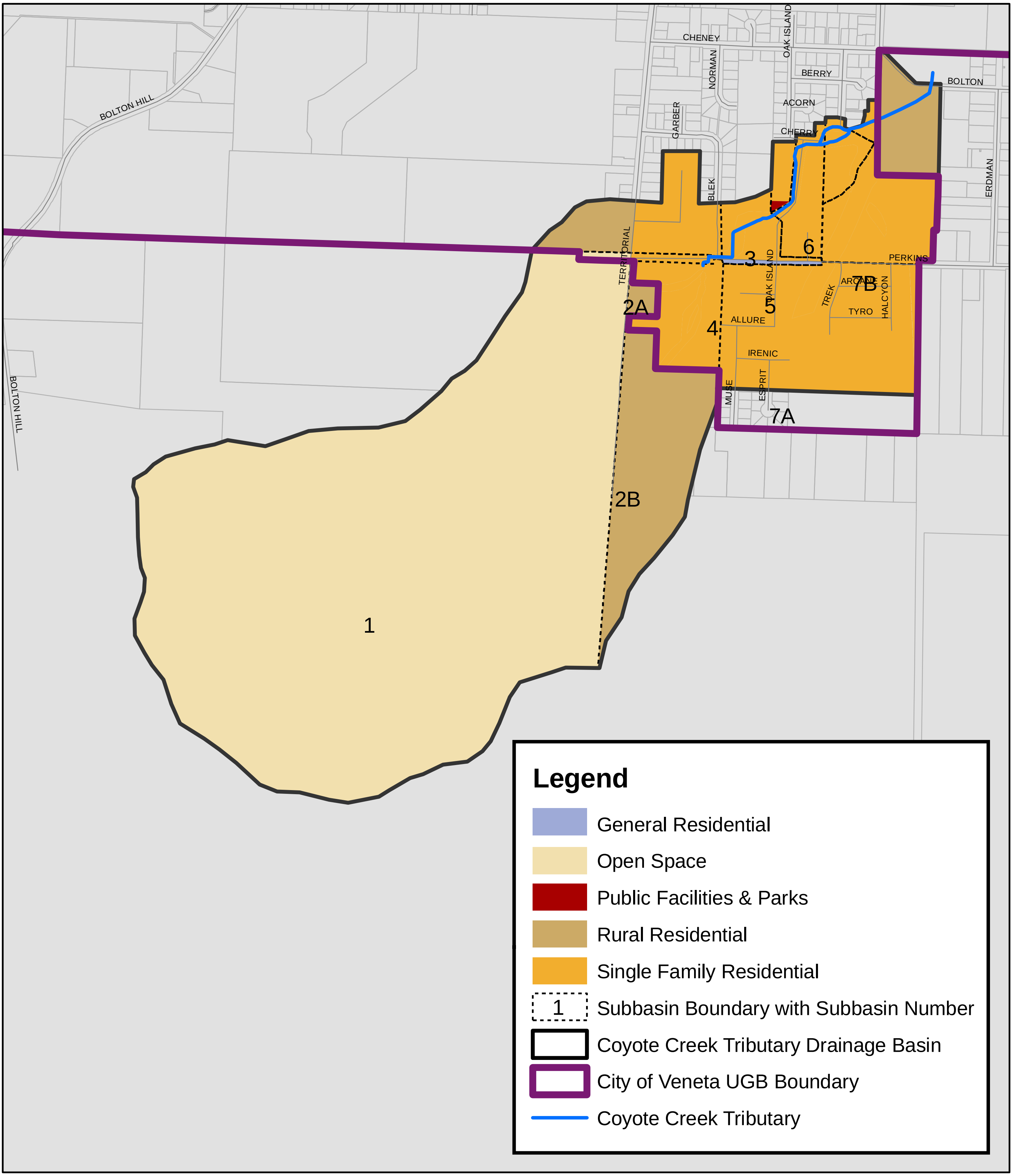
Figure 2-1
Vicinity Map

City of Veneta, Oregon

Map Date: February 18, 2008

URS

O:\25696393 Veneta Stormwater Master Plan\5000 Technical\GIS\Figures\Vicinitymap



O:\25696393 Veneta Stormwater Master Plan\5000 Technical\GIS\Figures\futureLanduse.mxd

Figure 2-2
Basin Land Use

City of Veneta, Oregon

Map Date: May 22, 2008

URS

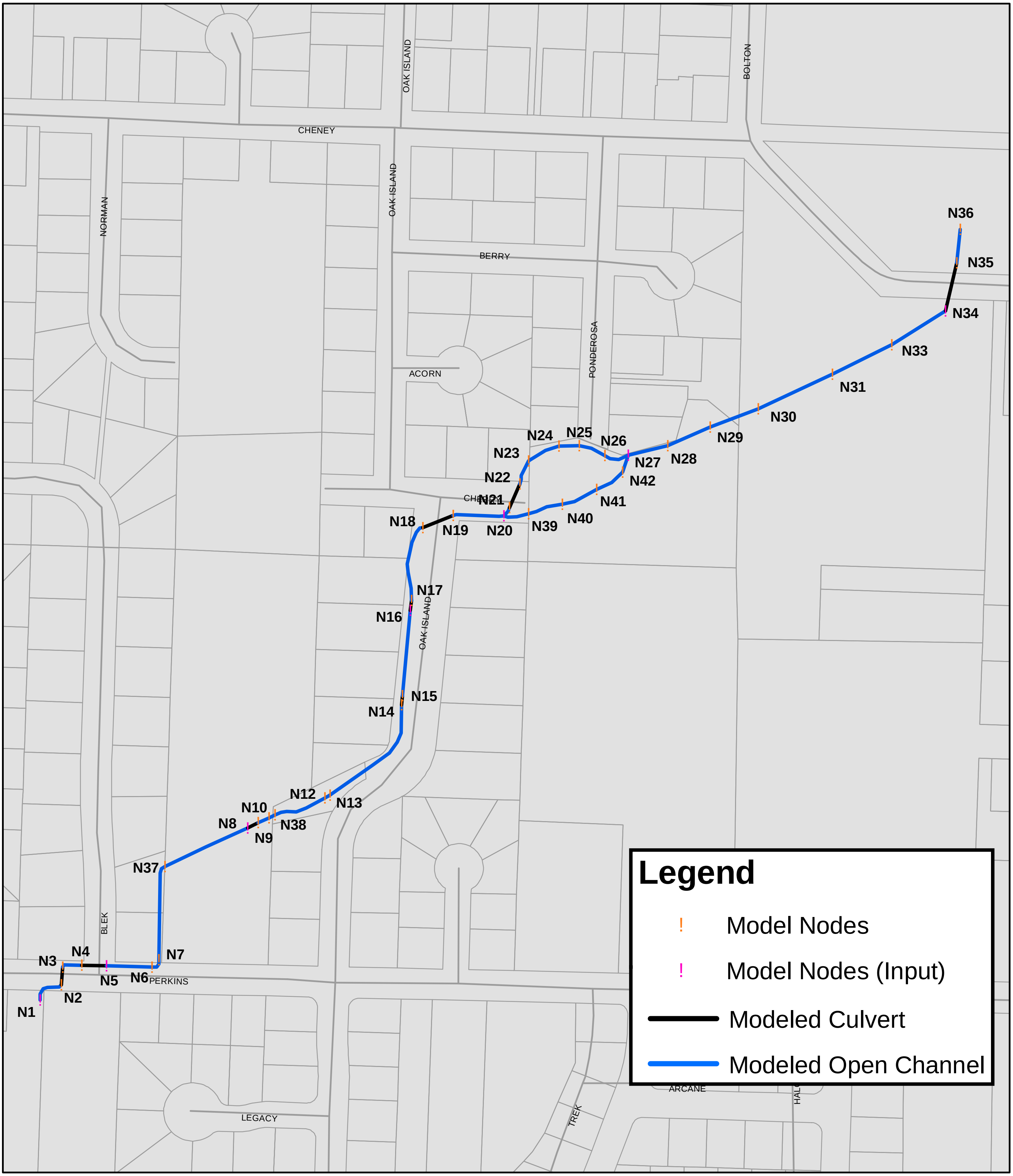


Figure 2-3
Modeled Drainage System Map

City of Veneta, Oregon

Map Date: May 22, 2008

URS

O:\25696393 Veneta Stormwater Master Plan\5000 Technical\GIS\Figures\Fig4_Drainage System.mxd

SECTION 3 – FLOOD CONTROL STUDY METHODS AND RESULTS

This section describes the study methods and results related to evaluating the Coyote Creek tributary system in the City of Veneta. Section 3.1 describes the hydrologic\hydraulic modeling methods and processes. Section 3.2 provides a description the model validation, and Section 3.3 provides a summary of the model results.

3.1 Hydrologic and Hydraulic Modeling Methods

To evaluate the capacity of the existing Coyote Creek tributary drainage system, a computer model was developed to simulate the hydrologic and hydraulic conditions of the system. The XP-SWMM model was selected to conduct these analyses. In order to develop the hydrologic and hydraulic components of the model, a number of input parameters were necessary. The information contained in this section describes the required input parameters and specifies methods for developing the data. Such input parameters and methods are categorized according to the following:

- Hydrologic Data
- Hydraulic Data

A description of the method or literature reference used to determine the value for each parameter is also provided.

3.1.1 Hydrologic Data

3.1.1.1 Subbasin Delineation

The basin area for the Coyote Creek tributary was not formally defined or delineated prior to the onset of this Basin Plan. Therefore, the basin area was delineated based on available topographic information (2-foot contours), provided by the City. During the delineation, it was determined that a large section of the southwestern portion of the basin area is located outside of the city limits and the urban growth boundary. Two-foot contour data was not available for this area, and use of USGS quadrangle maps did not allow for the resolution necessary to delineate this area. Therefore, the southwestern watershed boundary was separately surveyed and delineated for this project, for inclusion in the model.

Once the basin area was established, the basin was subdivided into smaller subbasins for modeling purposes. Subbasin boundaries were delineated based on available topographic information and the location of the existing drainage system, as provided in as-built drawings for new development areas. The subbasin boundaries were digitized into the GIS. A summary of the subbasin areas is provided in Table 3-1.

3.1.1.2 Model Input Parameters

In order for XP-SWMM to generate a stormwater runoff hydrograph from each subbasin, the following parameters must be specified in the model for each subbasin.

- Subbasin name or number.
- Area of subbasin (acres).
- Width of subbasin (feet).
- Impervious percentage (percent).
- Average ground slope (ft/ft).
- Manning’s roughness coefficient for impervious areas.
- Manning’s roughness coefficient for pervious areas.
- Depression storage for impervious areas (inches).
- Depression storage for pervious areas (inches).
- Green-Ampt soil infiltration parameters: average capillary suction (inches), saturated hydraulic conductivity (inches/hour), and initial moisture deficit (volume air/volume voids).

For each parameter, a summary is provided below describing the methods and resulting values used in XP-SWMM. For many of these parameters, GIS was used to generate area-weighted average values for each subbasin.

Subbasin Name
The nine delineated subbasins were numbered sequentially in accordance with where runoff from the area enters the open channel system. The furthest upstream subbasin was called subbasin 1, and the numbers increased in a downstream progression. In two locations, two subbasins enter the system at the same node (subbasins 2A and 2B and subbasins 7A and 7B). For these cases the basin was assigned a number and a letter naming convention. See Table 3-1.

Subbasin Area
Subbasin areas were calculated using GIS, based on the delineation described in Section 3.1.1.1. See Table 3-1.

Table 3-1: Subbasin Names and Areas

Subbasin Name	Node Number (in model)	Drainage Area (acres)
1	N1	231.4
2A	N5	14.1
2B	N5	37.7
3	N8	1.9
4	N16	5.5
5	N20	6.1
6	N27	3.6
7A	N34	34.2
7B	N34	22.7

Subbasin Impervious Percentage
Because the City of Veneta does not have existing condition land use information but has zoning for the basin area, the existing condition impervious area percentage calculated for each subbasin was based on the zoning. Zoning information was provided by the City of Veneta for most of the watershed area within the City boundary. The area to the southwest of the City (currently

outside the city limits) was characterized as open space/ pasture, based on field observations of the surveyor who delineated that portion of the watershed boundary. Per the City of Veneta Master Plan (June 1999), most zoning descriptions have an associated runoff coefficient ("C") that was used to calculate flow rates for the master plan. Runoff coefficients were converted to percent impervious values in accordance with the following equation:

$$C = 0.05 + 0.009*(\% \text{ impervious}) \text{ (Dreher and Price (1993))}$$

Per the City zoning classifications, the following percent impervious values were calculated (Table 3-2). Based on the calculated percent impervious for each zoning classification, a weighted average imperviousness was calculated for each subbasin.

Table 3-2: Zoning and Percent Impervious

Zoning Description (per City provided GIS)	Runoff Coefficient (C) (per City Master Plan – June 1999)	Calculated Impervious Area (%)
Single Family Residential	0.4 (1)	39
Open Space	0.25 (2)	22
Public Facilities and Parks	0.25 (2)	22
Rural Residential	0.3 (3)	28

Notes:

1. Runoff coefficient (C) from the Master Plan for low density residential was used for the Single Family Residential zoning characterization.
2. Runoff coefficient (C) from the Master Plan for open space was used for the Open Space and Public Facility and Parks zoning characterization.
3. Runoff coefficients for rural residential is not provided in the Master Plan. An average runoff coefficient of 0.3 was assumed based on observed land coverage.

A cumulative impervious percentage was calculated for each Subbasin for existing land use conditions, based on a weighted average of the associated impervious percentages for each zoning classification. Because the drainage area is currently fully developed, only the existing condition was simulated for the analysis. The cumulative impervious percentages calculated for each Subbasin is provided in Table 3-3.

Subbasin Slope

The subbasin slope is the average slope along the pathway of overland flow to the inlet of the drainage system. The subbasin slope was developed based on the digital topographic data contained in GIS. Subbasin specific slopes used in the XP-SWMM model are provided in Table 3-3. Table 3-3 is located at the end of Section 3.1.1.2.

Manning's Roughness Coefficient for Impervious Area

Manning's roughness coefficient provides a measure of the friction resistance to flow across a surface or channel. The Manning's roughness for impervious surfaces is based on local values presented in the recently completed City of Eugene Stormwater Drainage Master Plan and compared to those values cited in the XP-SWMM User's Manual. Based on the assumption that most, if not all, impervious surface is asphalt, the Manning's roughness coefficient for impervious area was set equal to 0.012.

Manning's Roughness Coefficient for Pervious Area
Using an aerial photograph and the zoning information in GIS for the subbasin areas, the average roughness coefficient for pervious areas in each subbasin was estimated based on the cover types. A summary of Manning's roughness coefficients for pervious areas are listed in Table 3-4. Subbasin specific coefficients are based on the zoning in the subbasin and an area weighted average for each subbasin is provided in Table 3-3.

Table 3-4: Manning's Roughness for Pervious Areas

Cover Type	Manning's n for pervious surface
Lawn or turf grass in urbanized areas	0.45
Pasture or cropland	0.20
Dense shrubs and/or forest	0.40

Depression Storage for Impervious Area
The depression storage is the volume of depression in the land surface that must be filled prior to the occurrence of runoff. Depression storage was set equal to 0.05 inches for all impervious areas based on local values presented in the recently completed City of Eugene Stormwater Drainage Master Plan.

Depression Storage for Pervious Area
The depression storage for pervious area was based on the USDA soil texture classification. Since the predominant soil type in the watershed area is silt loam, the depression storage was set equal to 0.15 inches. The depression storage was estimated based on values recommended in the XP-SWMM User's Manual.

Green-Ampt Infiltration Parameters (units vary)
The Green-Ampt infiltration method was used to estimate the infiltration losses associated with pervious areas. The Green-Ampt infiltration calculation requires estimation of three infiltration parameters: average capillary suction (inches), saturated hydraulic conductivity (inches per hour), and initial moisture deficit (dimensionless ratio). The values for each of these three infiltration parameters were based on the soil types in the Coyote Creek watershed area. The locations and specific information on the soils found in the watershed area available in GIS from the Natural Resources Conservation Service. Seven different soil series are present in the study area. The seven soil series were combined into three groups based on their USDA soil texture classification. The soil series, soil texture classifications, and the value for the Green-Ampt infiltration parameters, referenced from the City of Eugene River Road Santa Clara Stormwater Drainage Master Plan and Rawls, et. al. (1983), are summarized in Table 3-5.

Table 3-5: Green-Ampt Infiltration Parameters

USDA Soil Texture Classification	SCS Soil Numbers in Coyote Creek watershed area	Average Capillary Suction (in)	Saturated Hydraulic Conductivity (in/hr)	Initial Moisture Deficit
Loam	73, 98, 128B	3.5	0.3	0.43
Silt Loam	45C	6.6	0.5	0.49
Silty-Clay Loam	11C, 11D, 63C	10.7	0.08	0.43

Based on the values described in Tables 3-5, the area-weighted values for each subbasin were calculated using GIS and are summarized in Table 3-3.

Table 3-3: Hydrologic Input Parameters by Subbasin

Subbasin Name	% Impervious	Slope (ft/ft)	Subbasin Width (ft)	Manning's Coefficient		Depression Storage		Green-Ampt Infiltration Parameters		
				Imp.	Perv.	Imp.	Perv.	Avg. Capillary Suction (in)	Saturated Hydraulic Conductivity (in/hr)	Initial Moisture Deficit
1	22	.005	1884	.012	0.20	0.05	0.15	7.23	0.20	0.43
2A	35	.006	415	.012	0.45	0.05	0.15	3.5	0.3	0.43
2B	31	.009	485	.012	0.45	0.05	0.15	3.5	0.3	0.43
3	38	.009	241	.012	0.45	0.05	0.15	3.5	0.3	0.43
4	38	.013	1551	.012	0.45	0.05	0.15	3.5	0.3	0.43
5	39	.009	307	.012	0.45	0.05	0.15	3.5	0.3	0.43
6	39	.017	299	.012	0.45	0.05	0.15	3.5	0.3	0.43
7A	39	.010	1097	.012	0.45	0.05	0.15	3.5	0.3	0.43
7B	35	.007	577	.012	0.45	0.05	0.15	3.5	0.3	0.43

3.1.1.3 Design Storms

The City of Veneta currently has limited drainage design standards. Per the City of Veneta Master Plan (June 1999), the rational method with a 10-year frequency design storm intensity was used to estimate storm runoff.

For purposes of this basin plan, because a computer model was used to assess hydrologic and hydraulic flow conditions, the SCS method and not rational method was used to determine storm runoff. The goal of the basin plan is to assess flooding in the Coyote Creek tributary drainage system as a result of peak flow conditions. Therefore, the 10-year and 25-year, 24-hour storm events were simulated in XP-SWMM. The design storm distribution for those events was based on the 24-hour SCS Type 1-A distribution that applies to the Pacific Northwest. As there were no design storm volumes documented in the 1999 Master Plan, the 10 and 25-year design storm volumes were determined based on a review of the NOAA isopluvial maps for the region, in comparison with the City of Eugene’s calculated 24-hour storm events. Estimated storm volumes are listed below:

- 10-year, 24-hour design storm = 4.25 inches
- 25-year, 24-hour design storm = 5.0 inches

The SCS design storms are generally considered to be conservative when compared to real storm event data. CIP alternatives were developed for the SCS storm events, but results of a real storm event (November 2006) used for the model validation are also provided for each CIP alternative (Appendix C) so the City may compare the magnitude of flooding for each event.

3.1.2 Hydraulic Data

3.1.2.1 Survey

As part of this project, the Coyote Creek tributary channel was surveyed by WEST Consultants from Perkins Avenue to Cherry Street. A total of 28 cross sections were surveyed: 25 in the main channel and three in the overflow channel. Invert elevations for nine hydraulic structures in the main channel were surveyed, and four storm drain inlets located in Territorial Court were field verified. Cross sectional and invert elevation information as surveyed was included in the XP-SWMM model.

In order to obtain appropriate cross sectional data for the model, control for the project was set using the closest available National Geodetic Survey (NGS) monument located in Crow, Oregon (Point ID – AI1988). In order to bring control to the study area, five intermediate control points were established. The final project control point was set east of the intersection of Cherry Street and Oak Island Drive.

3.1.2.2 Existing HEC-RAS Model

Cross sectional survey information from an existing HEC-RAS model, originally prepared by Weber Elliott Engineers, P.C. to simulate open channel flow characteristics from the Cherry

Street system to the culvert under Bolton Road, was combined with the survey information collected and described in Section 3.1.2.1 in order to extend the modeled conveyance system outside of the City limits. Per the City's request, the cross sections from the existing HEC-RAS model were tied into the surveyed cross sectional data prepared by WEST Consultants. As the existing cross sectional data included in the HEC-RAS model were not tied to a benchmark, the elevations of the HEC-RAS cross sections were converted into the survey datum using the difference in elevations at a common surveyed location.

3.1.2.3 Model Input Parameters

The primary purpose of the XP-SWMM modeling effort was to conduct a hydraulic analysis of the open channel storm drainage system (aka: tributary to Coyote Creek). The evaluation of the storm drainage system included a hydraulic analysis of the open channel system and associated roadway crossings (culverts) that convey the flow from Perkins Road north to Cherry Lane, from Cherry Lane east to the channel bypass, and northeast to the culverts under East Bolton Road. It should be noted that the modeled system ends just downstream of the East Bolton Road culverts although the system actually continues to the northeast. Backwater conditions associated with the system downstream of the East Bolton Road culverts may affect the model results, specifically for the downstream portion of the modeled system.

The following parameters were required in XP-SWMM for the open channels and culverts:

- Segment name.
- Upstream node number.
- Downstream node number.
- Length of segment, graphical and measured.
- Invert elevation of the upstream node (feet).
- Ground surface elevation of the upstream node (feet).
- Invert elevation of the downstream node (feet).
- Ground surface elevation of the downstream node (feet).

Model input parameters were determined in accordance with the survey information described above in Sections 3.1.2.1 and 3.1.2.2.

3.2 Model Validation

Once the model was developed, based on the hydrologic and hydraulic parameters described in Section 3.1, a model validation was conducted based on a recent storm event and photo documentation of water surface elevations through culverts along Oak Island Drive. Specific measured flow data in the system for the storm event was not available so a detailed, site-specific calibration of the XP-SWMM model was not possible. Existing land use conditions were simulated during the model validation.

Photographs showing flow conditions for a storm event on 11-7-2006 at specific locations along the open channel system were obtained from the City of Veneta. Local rainfall records were unavailable so hourly rainfall records for the NOAA rain gage station at the Eugene Airport for the storm event period of record were obtained from the NOAA National Data Center. As rainfall began 11-1-2006 and continued (intermittently) until 11-7-2006, the entire rainfall period (11-1-2006 to 11-7-2006) was simulated in the model to accurately account for antecedent moisture conditions. In summary, the total rainfall volume for the modeled storm event was 6.46 inches; the average hourly rainfall was 0.04 inches; and the peak rainfall intensity for the storm event was 0.37 inches/hour.

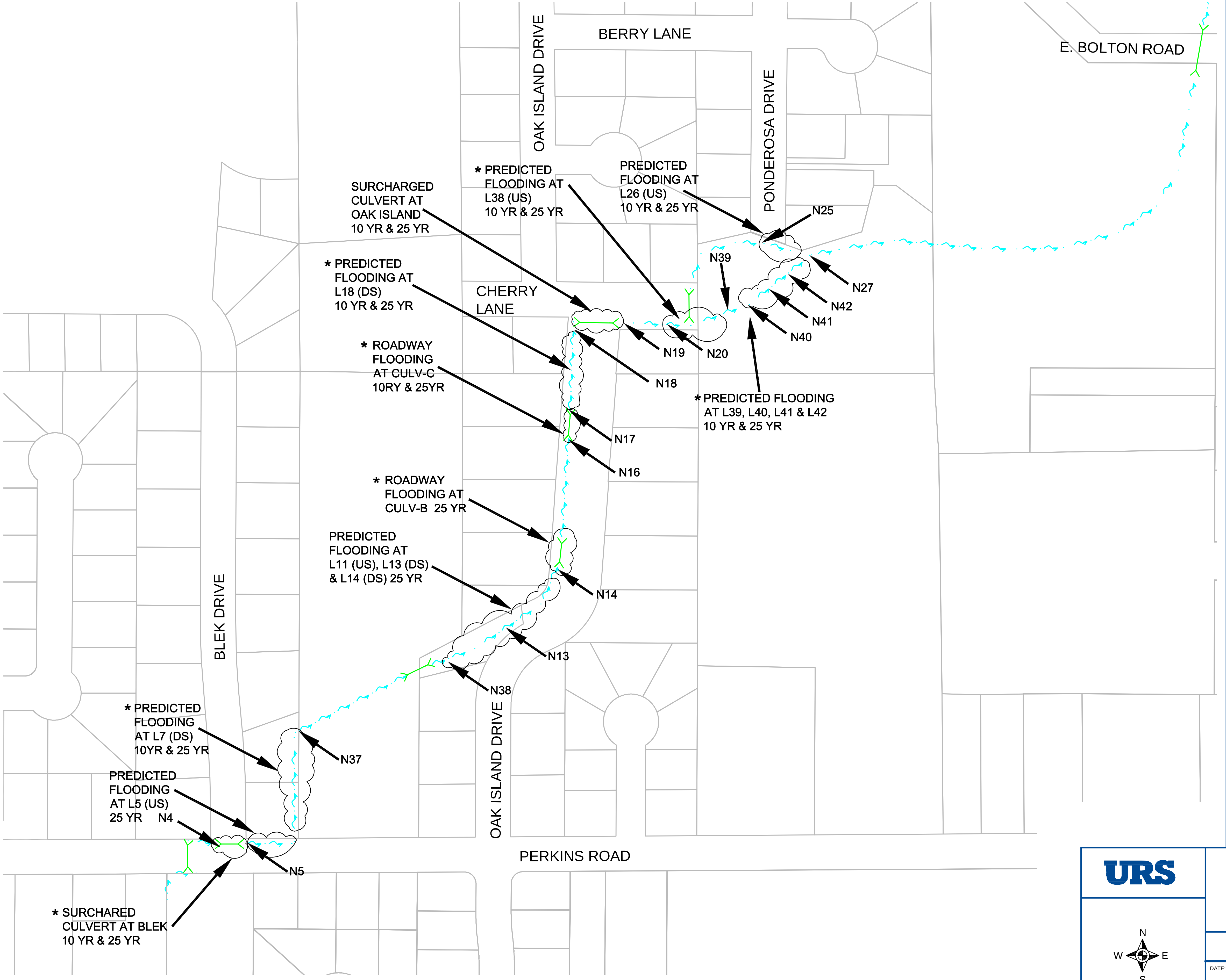
The modeled flow conditions at 2:00 pm, November 7, 2006 (i.e., the time the photos were taken) were compared with the photographs provided by the City to attempt to evaluate the accuracy of the model. Adjustments were made to the hydrologic input parameters (flow width and imperviousness) in order to see if significant improvement was made. It was determined that the unadjusted version of the model provided the closest resulting flows to those shown in the photos. The photos and resulting model comparisons are included in Appendix E.

3.3 Hydrologic and Hydraulic Model Results

Once the XP-SWMM model was developed and validated in accordance with methods described in Sections 3.1 and 3.2, the 10-year and 25-year, 24 hour design storm events were simulated for existing conditions. The hydrologic and hydraulic results tables (Tables A-1 and A-2) are provided in Appendix A.

Based on the hydraulic results in Table A-2, Table A-3 (Appendix A) and Figure 3-1 were developed to indicate those areas in the system experiencing surcharge, backwater, roadway flooding, or water overtopping the top of bank in open channels. In summary, three culvert locations showed surcharging conditions during the 10-year and 25-year events; two culvert locations showed surcharging and roadway flooding during the 10-year and 25-year events; and twelve open channel segments experienced some degree of flooding either in the upstream, downstream, or both nodes during the 10-year and/ or 25-year events. Roadway flooding occurs at Culverts B and C along Oak Island Drive, which is also where the City observes the most significant impacts of flooding along the channel corridor. Open channel flooding is shown to occur throughout the system, but to a greater extent along the main and bypass channel just east of Cherry Lane (Links 39, 40, 41, and 42) (Figure 3-1).

In characterizing the magnitude of flooding, surcharged culvert conditions were not identified as flooding issues. Water overtopping the roadway at the culvert locations is considered flooding. Water overtopping the top of bank elevation in the open channel systems was considered to be flooding, although the magnitude of “flooding” varied significantly throughout the system. Detail related to the development of capital improvement project options to address flooding locations is provided in Section 4.1.



LEGEND

EXISTING DITCH

EXISTING CULVERT

LOCATION OF PREDICTED FLOODING

NOTE

* IDENTIFIED AS A HIGH PRIORITY FLOODING LOCATION

NODE	MAGNITUDE OF FLOODING FOR 25 YR EVENT
N5	+ 0.20
N13	+ 0.16
N14	+ 0.07
N16	+ 0.84
N17	+ 0.94
N18	+ 1.10
N20	+ 1.29
N25	+ 0.29
N27	+2.02
N37	+ 0.47
N38	+ 0.08
N39	+ 0.78
N40	+ 0.03
N41	+ 0.34
N42	+ 0.91

URS

N W E S

STORMWATER BASIN PLAN
FOR THE CITY OF VENETA

EXISTING FLOODING WITH NO IMPROVEMENTS

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	3-1

City of Veneta Ex Flooding.dwg

SECTION 4 – CAPITAL IMPROVEMENT PROJECT DEVELOPMENT

Sections 2.0 and 3.0 of this plan provide a summary of data inputs and methods used to evaluate the Coyote Creek tributary drainage system with respect to flooding, and they provide the results of those evaluations. The purpose of this section is to describe the development of proposed conceptual capital improvement project (CIP) alternatives to address the flooding issues that were identified. Section 4.1 describes the overall approach for the development of the comprehensive CIP projects. Section 4.2 provides a summary of each of the CIP project alternatives. The overall prioritization and costs for select CIPs are provided in Section 5.0.

4.1 CIP Development

Per Section 3.3, flooding is observed throughout the Coyote Creek tributary system during the 10-year and 25-year storm events. In total, 14 locations are identified to be flooding; two are culverts where the water surface elevation exceeds the road elevation and 12 locations are segments or portions of the open channel conveyance system where the water surface elevation exceeds the top of bank elevation. There are also three culvert locations that experience surcharging during the 10 and/ or 25-year storm events. CIP development is based on a reduction in water surface elevation to an elevation where the system would not be considered flooding during the 25-year event.

As flooding occurs throughout the Coyote Creek tributary system, implementation of CIPs would reduce the water surface elevation but may not alleviate all flooding throughout the system. In addition, the magnitude of flooding that occurs throughout the system varies significantly. As a result, the 14 locations where flooding was initially identified during the 25-year simulation were assessed, and priority flooding locations were identified. Priority flooding locations were defined as 1) culverts where the roadway flooding occurs; or 2) open channels where the water surface elevation in either the upstream or downstream node exceeded 0.5'. As a result, seven priority flooding locations were initially identified. After meeting with the City of Veneta on February 7, 2008, two additional locations (the culvert at Blek Drive and the open channel segment L7) were also identified as priority locations due to the existing capacity issues and potential for roadway flooding.

Ten initial, comprehensive CIP alternatives were developed, ranging from open channel improvements to the installation of detention facilities. All ten alternatives are described in detail in Section 4.2. Figures associated with each described CIP alternative are provided in Appendix B and indicate the ground elevation (flood elevation), the existing water surface elevation for the 25-year storm event with no CIPs, and the associated water surface elevation for the CIP option. As the 25-year, 24-hour storm event is generally considered conservative from a design perspective, the November 2006 storm event was simulated for the CIP alternatives as well, and those water surface elevations are also provided on the Figures. The hydraulic modeling results for each CIP alternative are provided in Appendix C.

4.2 CIP Options

4.2.1 CIP Option 1

CIP Option 1 includes the widening and regrading of a short portion of the existing mainstem open channel system to the north of Cherry Lane between Cherry Lane and Ponderosa Drive (Node N22 to Node N27) and the removal of the Cherry Lane culverts. The existing invert (bottom) elevations were held at N21 and N27 and a constant slope was applied between the two locations. Widening of the channel increases the capacity of the mainstem channel, and the removal of the Cherry Lane culverts minimizes upstream pooling of water. Regrading is conducted on the channel to remove existing backslope along the channel bottom. As detailed on Figure 1 in Appendix B, the proposed improvement appears to reduce the water surface elevation in the mainstem open channel system north of Cherry Lane and immediately upstream of former Cherry Lane culvert location, but not enough necessary to eliminate flooding further upstream along Oak Island Drive.

Although this alternative does not eliminate flooding during the 25-year event, it does allow for some protection against flooding during more typical frequency events. As the City of Veneta has limited funding, this alternative may be considered as a temporary solution to address the immediate flooding issues witnessed by the local residents.

4.2.2 CIP Option 2

CIP Option 2 is the widening and regrading of the existing by-pass channel east of Cherry Lane, from N20 to N27, in addition to the proposed improvements to the main stem channel identified in Option 1. The intent of this alternative is to provide additional relief to the system upstream of the Cherry Lane culvert. Like Option 1, the modeling results indicate incremental benefits upstream of the Cherry Lane culvert, but also results in some predicted flooding within and downstream of the by-pass channel.

Although this alternative does not eliminate flooding during the 25-year event, this alternative does allow some diversion of flooding from the more critical areas to areas that appear to be less inhabited or areas where the increase in flooding would not appear to cause damage to private property.

4.2.3 CIP Option 3

CIP Option 3 attempts to eliminate flooding both upstream of the Cherry Lane culvert and throughout the bypass channel system by increasing the capacity of the mainstem channel all the way to the East Bolton Road culverts. Option 3 involves the widening and regrading of the mainstem channel from the Cherry Lane culverts to the East Bolton Road culverts (N21 to N34), in addition to the widening and regrading of the bypass channel system (N20 to N27). Based on the available survey information, the channel gradient significantly drops (approximately one foot) just upstream of the culvert crossing at Bolton (N34) to meet the culvert inverts. This alternative maintains that sharp drop in grade upstream of the East Bolton Road culverts;

regrading only involves the smoothing and establishment of a common slope in the channel and removal of backslope.

As shown on Figure 3 in Appendix B, Option 3 yields a reduced water surface elevation in the system upstream of the Cherry Lane culverts such that roadway flooding for the 25-year storm event is eliminated at Culverts B and C, but like options 1 and 2, fails to eliminate all flooding in the system.

4.2.4 CIP Option 3A

CIP Option 3A is a refined version of CIP Option 3 (Figure 3A, Appendix B). CIP Option 3A also involves the widening and regrading of the mainstem channel downstream of the Cherry Lane culvert (N22 to N34) and the widening and regrading of the bypass channel (N20 to N27). However, unlike Option 3, Option 3A eliminates the steep drop (approximately one foot) in the channel directly upstream of the East Bolton Road culverts. Regrading of the channel assumes a continuous slope from the inverts of the Bolton Road culverts upstream to node 20 (the node upstream of the Cherry Lane culverts).

By eliminating the steep drop, the cost of the open channel improvement is predicted to be higher, due to the increased depth of excavation. Option 3A is an improvement over Option 3 in that it further reduces ponding and flooding upstream of the Cherry Lane culverts and in the bypass channel. However, flooding during the 25-year event is still present in the bypass channel and immediately upstream of the Cherry Lane culverts.

4.2.5 CIP Option 4

Option 4 involves the widening and regrading of the bypass channel from the Cherry Lane culverts (N20 to N27) and the mainstem channel to the Bolton Road culverts (N27 to N34). The mainstem channel from the Cherry Lane culverts to N27 is not improved. Option 4 is similar to Option 3 in that the regrading of the channel involves the smoothing and establishment of a common slope in the channel and removal of backslope. The steep drop just upstream of the Bolton Road culverts is still present.

By only improving the bypass channel and not the mainstem channel downstream of the Cherry Lane culverts, this alternative increases the capacity in the bypass channel and reduces flow in the mainstem channel. In addition, there is less length of improvement as compared with Options 3 and 3A, which would result in less cost.

As compared with Options 3 and 3A, this alternative more significantly improves the capacity of the bypass channel and results in a significant reduction in water surface elevation along the bypass channel, which isn’t achieved in Options 3 or 3A. However, the reduction is not enough to completely eliminate flooding during the 25-year event.

4.2.6 CIP Option 4A

Like Option 3A, Option 4A is a refined version of Option 4, which involves the widening and regrading of the bypass channel downstream of the Cherry Lane culverts (N20 to N27) and the mainstem channel to the Bolton Road culverts (N27 to N34). Like Option 3A, the regrading of the mainstem channel involves the removal of the steep drop in the channel directly upstream of the Bolton Road culverts. Regrading of the channel assumes a continuous slope from the inverts of the East Bolton Road culverts (N34) upstream to N20 (the node upstream of the Cherry Lane culverts). This alternative results in increased capacity in the bypass channel.

As compared with Option 4, this alternative results in a more significant reduction in water surface elevations along the bypass channel and upstream of the Cherry Lane culverts. Flooding is alleviated for most of the bypass channel system. Flooding is almost entirely alleviated upstream of the Cherry Lane culverts. Like Option 3A, the cost of this option (4A) would be higher than Option 4 given the increased amount of excavation necessary. However, as compared with Option 3A, there is less length of total open channel improvements that would need to occur; resulting in less anticipated cost then Option 3A.

4.2.7 CIP Option 5

Option 5 involves the widening and regrading of the by-pass channel alone (N20 to N27). As a result of this improvement, small reductions in the maximum water surface elevation during the 25-year storm occurs, but the improvements proposed in this option are not to the level necessary to significantly reduce or eliminate flooding for the 25-year event in the priority flooding locations. The benefit of this option is that the cost of the improvement would be significantly lower than the other options. However, this option serves more as a temporary fix and not a long term solution to the existing flooding problems.

4.2.8 CIP Option 6

CIP Option 6 was developed to alleviate flooding and surcharge conditions in the culverts B and C along Oak Island Drive and reduce flow in the open channel system downstream of the Cherry Lane culvert. Option 6 involves the construction of a by-pass system that would convey some of the runoff generated in subbasins 1 and 2 east along Perkins Road and north to the open channel system downstream from Ponderosa Drive. This alternative would allow for potential new development to the south and west of the existing Coyote Creek tributary system, as a bypass system would be constructed to allow a portion of existing (and future projected) flows through the existing Coyote Creek tributary system and the remaining flow would be diverted through the bypass. The proposed bypass system would require a flow splitter bypass and sediment sump/ trash rack to be installed at the upstream end of the Coyote Creek tributary system at Perkins Road, a closed conduit conveyance system along Perkins Road, construction of an open channel system from Perkins north to the existing open channel downstream of Ponderosa Drive, and widening and regrading of the existing open channel system downstream of Ponderosa Drive to the culverts at Bolton Road (N31 to N34) (Figure 6, Appendix B).

This alternative could allow the City of Veneta to offset the CIP improvement costs by requiring developers that wish to discharge runoff from new development into the Coyote Creek tributary system to pay a portion of the construction costs. Although CIP Option 6 does provide reduced flows along Oak Island Drive, it does not eliminate all the flooding in the system during the 25 year storm event. Specifically, the mainstem and bypass open channel systems downstream of the Cherry Lane culvert still would experience water surface elevations that exceed the existing top of bank elevations.

4.2.9 CIP Option 7

CIP Option 7 proposes construction of a 1.0 acre detention pond west of Oak Island Drive at modeled node 8 (N8) to reduce flows in the downstream system. The average depth of the proposed detention pond is four feet. This conceptual CIP was originally developed in 1999 as part of a small project to qualitatively look at the Coyote Creek tributary system and propose potential CIP solutions. The proposed pond would provide temporary storage of flow in the system and would reduce surcharging and eliminate flooding conditions at culverts B and C on Oak Island Drive during the 25-year storm event. Similar to Option 6, a sediment sump would be installed just upstream of the pond inlet to prevent excessive sediment and trash and debris loads from entering the pond. An outlet control structure would be installed to regulate flows discharging from the pond into the Coyote Creek tributary system.

Although flooding would be reduced in portions of the system along Oak Island Drive, some flooding will continue to take place along the lower portion of the by-pass channel and just downstream of Perkins Road.

4.2.10 CIP Option 8

Like CIP Option 7, the concept for CIP Option 8 was originally developed as part of the qualitative look at potential CIPs in 1999. CIP option 8 involves construction of a meandering channel west of Oak Island Drive at modeled node 8 (N8), the same area where the detention pond in CIP Option 7 is proposed; the removal of culvert A and replacement with a bridge structure; and intermittent open channel improvements along Oak Island Drive downstream of the outlet of the meandering channel. The intent of this alternative is to provide additional storage along the proposed meandering channel.

Although the footprint of the meandering channel would be less than that of the detention pond in Option 7, the cost of this option would be expected to exceed the cost of Option 7 due to the added cost of a bridge and open channel improvements. In addition, flooding will continue to occur along a number of sections of the system during the 25 year storm event (Figure 8, Appendix B).

4.2.11 Upgraded CIP Options

Based on a review of the ten modeled CIP options described above, all options eliminated some flooding within the system, but none of the options completely eliminated flooding within the system during the 25-year storm event. Some options better reduced flows and associated water surface elevations than others. Options 3A, 4A, 6, and 7 appeared to best manage flooding within the system.

If the goal for the City is to completely eliminate all flooding in the modeled Coyote Creek tributary system during the 25-year storm event, then a more robust, costly CIP alternative than any of the ten original CIP alternatives described above would be needed. In order to provide the City with as many alternatives as possible, four additional CIP alternatives were simulated. These options are called the “Upgraded Options” and are based on the original CIP options 3A, 4A, 6, and 7 but include additional improvements in order to completely alleviate all flooding in the system.

Upgraded Option 3A and 4A includes additional open channel improvements (widening and regrading) and culvert replacement along Oak Island Drive to eliminate all flooding and surcharging conditions. Upgraded Option 6 includes additional open channel improvements upstream of the location where the new open channel system running north from Perkins Avenue ties into the existing open channel system discharging towards Bolton Road. Upgraded Option 7 includes additional open channel improvements from Blek Avenue to the proposed detention pond inlet and from the Cherry Lane culverts downstream along the mainstem and bypass open channels to the Bolton Road culverts.

Figures and hydraulic results tables related to the upgraded options are included in Appendix F.

SECTION 5 –CAPITAL IMPROVEMENT PROJECT PRIORITIZATION AND COST ESTIMATION

Section 4.0 of this plan summarizes the CIP alternatives developed to address flooding throughout the Coyote Creek tributary system. The purpose of this section is to describe the CIP prioritization process, based on the modeling results for the ten initial and four upgraded CIP alternatives described in Section 4.2 and the development of costs for selected CIP alternatives. Section 5.1 provides a summary of the CIP prioritization process and selection of four preferred CIP alternatives. Section 5.2 summarizes the cost tables that were used as the basis for estimating costs for the four preferred, conceptual CIP alternatives. Section 5.3 provides the resulting CIP fact sheets prepared for the preferred CIP alternatives.

5.1 CIP Option Prioritization Process

Each of the ten original CIP options described in Section 4.2.1 through 4.2.10 reduced flooding in some locations, but none of the original options eliminated all identified flooding locations in the system. In addition, not all of the 14 identified flooding locations experience significant (> 0.5') flooding or are in an area where flooding would be considered problematic. Therefore, it was necessary to determine how each of the original ten options addressed the priority flooding locations in the Coyote Creek tributary system.

Priority flooding locations were initially described in Section 4.1 and were established based on 1) roadway flooding at a culvert for the 25 year event; 2) the water surface elevation exceeding the top of bank elevation by 0.5' in the upstream and/ or downstream nodes of the open channel segment during the 25 year event; and 3) areas of concern as identified by the City of Veneta for the 25 year event. A total of nine priority flooding locations (segments) were identified (Figure 3-1).

Table A-4 in Appendix A was developed to compare the original water surface elevation as modeled for the 25 year design storm and the "flood elevation" for each priority flooding location with the resulting water surface elevations for each of the ten original, modeled CIP options. The "flood elevation" is either the road surface elevation or the top of bank elevation for an open channel system. Table A-4 identifies those CIP options that address flooding and/ or surcharging in each of the priority flooding locations. Each modeled segment is listed along with associated upstream and downstream nodes. Water surface elevations for each CIP alternative for the 25-year design storm event are listed and color coded according to whether the CIP alternative eliminates or significantly reduces flooding and surcharge conditions.

Table A-4 was provided to the City of Veneta to help the City determine which, if any, of the original ten CIP options seemed the most feasible from an economic perspective. The four upgraded CIP alternatives, which alleviate flooding in all locations in the system for the 25-year design storm, were also presented to the City. Due to project resources, CIP fact sheets would not be developed for each conceptual CIP alternative provided to the City. During a meeting with the City of Veneta on February 7, 2008, the City selected CIP options 3A, 4, 4A, and 7 as the most feasible from a practicability, performance, and economic perspective. Although the upgraded CIP alternatives would alleviate all flooding, the magnitude of proposed system modifications would be too expensive for the city considering that no structural damage is anticipated as a result of the 25-year storm event. CIP Option 6 alleviates flooding in a number of locations but was also considered to be too expensive. In addition, as a majority of undeveloped area in the Coyote Creek tributary basin is located outside of the City's urban growth boundary, it is uncertain how much development (and developers) may be available to help offset the construction costs of Option 6.

CIP fact sheets and cost estimates were prepared for the four selected CIP alternatives and are presented in Section 5.3.

5.2 Unit Cost Estimates for CIPs

Costs for the four selected CIP options were estimated using unit costs provided in Appendix D. Resulting cost estimates for the CIPs are provided in each of the individual CIP fact sheets in Section 5.3. The unit cost tables in Appendix D are based on updates to cost tables prepared for the City of Eugene basin planning project dated January 1999. Changes to the 1999 values are noted on the tables and generally include a 15% increase for inflation. The capital costs in the fact sheets were based on unit cost information provided in the unit cost tables plus a 25% contingency for engineering/design and administrative services.

5.3 CIP Fact Sheets for Select CIP Options

The following CIP fact sheets were developed for each of the four selected CIP options: Option 3A, Option 4, Option 4A, and Option 7. Each CIP fact sheet includes a description of the project location; a summary of the problems and/ or opportunities identified; a project description and summary of project elements; costs for construction, site acquisition (if applicable), engineering and administration, and maintenance; and a summary of objectives (flooding, water quality, natural resources) addressed. Costs were calculated for construction, engineering design and administrative services, and land acquisition (for Option 7 only). Land acquisition costs for open channel improvements (if applicable) and permitting costs were not estimated.

Water quality improvements or enhancements are a component of each CIP alternative. CIP Options 3A, 4, and 4A involve the widening and regrading of the existing open channel system. This activity could also include removal of non-native plant species and revegetation with native plants. Additional riparian vegetation would have a significant water quality benefit associated with reduced surface water temperature, erosion prevention, and sediment control. CIP Option 7 involves the installation of a detention pond west of Oak Island Drive to reduce flows in the Coyote Creek tributary system and installation of a trash rack upstream of the inlet to the pond. Assuming both facilities are properly maintained, each could be expected to have a water quality benefit due to removal of trash and debris, sediment, and other typical stormwater constituents. In addition, the detention pond could be upsized with an increased sump or internal baffles, which would increase the pond facility residence time and promote additional pollutant removal.

Construction and maintenance costs estimated on the fact sheets may vary significantly from actual values. Specifically, the unit costs used for open channel improvements assumes channel depth dimensions that are significantly larger than the depth of proposed improved open channels. In addition, the unit costs for open channel improvements do not vary in accordance with the projected depth of excavation but rather the projected width of the improved open channel. Therefore, there is no variance in open channel unit costs for Option 4 versus Option 4A because the same length and width of open channel improvement is proposed, although the projected depth of excavation would vary. The construction costs estimated for Options 3A, 4, and 4A are considered conservative estimates.

The CIP fact sheets and associated cost estimates serve as a tool the City of Veneta can use in order to determine which alternative would best meet the needs of the community while considering the City's budget for improvements. The City of Veneta may select an alternative(s) as presented and develop more detailed cost estimates or preliminary engineering in preparation for future construction. Table 5-1 summarizes the final developed costs for the four selected CIP alternatives.

Table 5-1: Summary of Select CIP Implementation Costs

CIP Option	CIP Implementation Cost
3A	$817,500
4	$744,400
4A	$744,400
7	$284,680

Capital Project Fact Sheet

Basin Name: Coyote Creek Tributary Basin

Project #: CIP Option 3A

Project Identifier	**CIP Option 3A**
Project Title	**Open Channel Improvements**

Project Location

CIP Option 3A involves the widening and regrading of the mainstem (N22 to N34) and bypass (N20 to N27) open channel system from the end of Cherry Street to the culverts at Bolton Avenue. This Option removes the steep drop in channel gradient just upstream of N34 and establishes a constant slope between N20 and the invert of N34.

Refer to Appendix B, CIP Option 3A for a figure.

Drainage Area Served by Capital Project	**357.3**	Acres
% Impervious (Existing Land Use)	**25.7**	
% Impervious (Future)	**26.8**	

Problems and/or Opportunities Identified

Problems

Roadway and property flooding occurs throughout the Coyote Creek tributary system that currently conveys runoff from approximately 350 acres of open space and residential property. The conveyance system itself is very flat and is affected by downstream constrictions (in the bypass channel downstream of Cherry Lane) and undersized culverts.

Opportunities

With significant improvements to the open channel conveyance system, there are opportunities to incorporate water quality during construction. Potential opportunities include revegetation and removal of non-native plants in the open channel system to promote water quality improvement.

Project Description to Address Identified Problems / Opportunities

Widen and regrade the existing mainstem channel from the Cherry Lane culvert to the culverts on Bolton Avenue (N22 to N34) (total length = 1412.5 feet), and widen and regrade the existing bypass channel from node N20 to node N27 (total length = 283.5 feet). The average channel depth in the mainstem system is to increase from an average of 2.5 feet to an average of 3.0 feet deep, and the average channel depth in the bypass channel is to increase from 0.5 feet to 2.0 feet deep to an average depth of approximately 3.0 feet. The backsloped segments of both channels and steep drop in channel gradient upstream of N34 would be removed.

Project Elements

1465 LF – Open Channel Improvements (Type 1)
231 LF – Open Channel Improvements (Type 2)

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Open Channel Improvements (Type 1)	Inspect sediment loading and vegetation, remove sediment and debris.
Open Channel Improvements (Type 2)	Inspect sediment loading and vegetation, remove sediment and debris.

Objectives Addressed by the Capital Project

Flood Control

The CIP addresses most modeled existing and projected future flooding problems associated with undersized and/or improperly graded portions of the existing stormwater system.

Water Quality

When the open channel conveyance system is widened and regraded, consideration should be given to improving and enhancing vegetation for water quality purposes.

Natural Resources

Open channel improvements should be constructed in accordance with riparian enhancements.

Other City Objectives Addressed by the Capital Project

To be Completed by the City

Costs

Cost Notes

Costs associated with permitting and land acquisition for the open channel improvements were not included at this time.

Construction Costs:	$681,300
Site Acquisition:	$0
Permitting:	TBD
Engineering / Administration:	$170,325
Capital Project Implementation Costs	**$817,500**
Annual Maintenance Costs	**$14,900**

Capital Project Fact Sheet

Basin Name: Coyote Creek Tributary Basin

Project #: CIP Option 4

Project Identifier	**CIP Option 4**
Project Title	**Open Channel Improvements**

Project Location

CIP Option 4 involves the widening of a portion of the mainstem (N27 to N34) and bypass (N20 to N27) open channel system from the end of Cherry Street to the culverts at Bolton Avenue. The steep drop in channel gradient just upstream of N34 is still maintained.

Refer to Appendix B, CIP Option 4 for a figure.

Drainage Area Served by Capital Project	**357.3**	Acres
% Impervious (Existing Land Use)	**25.7**	
% Impervious (Future)	**26.8**	

Problems and/or Opportunities Identified

Problems

Roadway and property flooding occur throughout the Coyote Creek tributary system that currently conveys runoff from approximately 350 acres of open space and residential property. The conveyance system itself is very flat and is affected by downstream constrictions (in the bypass channel downstream of Cherry Lane) and undersized culverts.

Opportunities

With significant improvements to the open channel conveyance system, there are opportunities to incorporate water quality during construction. Potential opportunities could include revegetation and removal of non-native plants in the open channel system to promote water quality improvement.

Project Description to Address Identified Problems / Opportunities

Widen the existing bypass channel from N20 to N27 (total length = 283.5 feet) to a width of approximately 15 feet, and widen the existing mainstem channel downstream of the bypass channel at N27 to the culverts on Bolton Avenue (N34) (total length = 1181.5 feet) to a width of approximately 10 - 12 feet. The backsloped segments of both channels would be removed, but the steep drop in channel gradient upstream of N34 would be maintained.

Project Elements

1181.5 LF – Open Channel Improvements (Type 1)
283.5 LF – Open Channel Improvements (Type 2)

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Open Channel Improvements (Type 1)	Inspect sediment loading and vegetation, remove sediment and debris.
Open Channel Improvements (Type 2)	Inspect sediment loading and vegetation, remove sediment and debris.

Objectives Addressed by the Capital Project

Flood Control

The CIP addresses most modeled existing and projected future flooding problems associated with undersized and/or improperly graded portions of the existing stormwater system. This CIP option results in more capacity and additional conveyance for the existing bypass channel.

Water Quality

When the open channel conveyance system is widened and regraded, consideration should be given to improving and enhancing vegetation for water quality purposes.

Natural Resources

Open channel improvements should be constructed in accordance with riparian enhancements.

Other City Objectives Addressed by the Capital Project

To be Completed by the City

Costs

Cost Notes

Costs associated with permitting and land acquisition for the open channel improvements were not included at this time.

Construction Costs:	$620,400
Site Acquisition:	$0
Permitting:	TBD
Engineering / Administration:	$155,100
Capital Project Implementation Costs	**$744,400**
Annual Maintenance Costs	**$12,700**

Draft February 28, 2008

Capital Project Fact Sheet

Basin Name: Coyote Creek Tributary Basin

Project #: CIP Option 4A

Project Identifier **CIP Option 4A**

Project Title **Open Channel Improvements**

Project Location

CIP Option 4A involves the widening and regrading of a portion of the mainstem (N27 to N34) and bypass open channel system from the end of Cherry Street to the culverts at Bolton Avenue (N20 to N27) . This Option removes the steep drop in channel gradient just upstream of N34 and establishes a constant slope between N20 and the invert of N34.

Refer to Appendix B, CIP Option 4A for a figure.

Drainage Area Served by Capital Project **357.3** Acres

% Impervious (Existing Land Use) **25.7**

% Impervious (Future) **26.8**

Problems and/or Opportunities Identified

Problems

Roadway and property flooding occur throughout the Coyote Creek tributary system that currently conveys runoff from approximately 350 acres of open space and residential property. The conveyance system itself is very flat and is affected by downstream constrictions (in the bypass channel downstream of Cherry Lane) and undersized culverts.

Opportunities

With significant improvements to the open channel conveyance system, there are opportunities to incorporate water quality during construction. Potential opportunities could include revegetation and removal of non-native plants in the open channel system to promote water quality improvement.

Project Description to Address Identified Problems / Opportunities

Widen and regrade the existing bypass channel from node N20 to node N27 (total length = 283.5 feet) and widen and regrade the existing mainstem channel downstream of the bypass channel (Node N27) to the culverts on Bolton Avenue (total length = 1181.5 feet). Widening to be consistent with characteristics described in CIP Option 4, and regrade to be consistent with characteristics described in CIP Option 3A.

Project Elements

1181.5 LF – Open Channel Improvements (Type 1)

283.5 LF – Open Channel Improvements (Type 2)

Maintenance Requirements

Facility Type	***Annual Maintenance Activities***
Open Channel Improvements (Type 1)	Inspect sediment loading and vegetation, remove sediment and debris.
Open Channel Improvements (Type 2)	Inspect sediment loading and vegetation, remove sediment and debris.

Objectives Addressed by the Capital Project

Flood Control

The CIP addresses most modeled existing and projected future flooding problems associated with undersized and/or improperly graded portions of the existing stormwater system. This CIP option results in more capacity and additional conveyance for the existing bypass channel.

Water Quality

When the open channel conveyance system is widened and regraded, consideration should be given to improving and enhancing vegetation for water quality purposes.

Natural Resources

Open channel improvements should be constructed in accordance with riparian enhancements.

Other City Objectives Addressed by the Capital Project

To be Completed by the City

Costs

Cost Notes

Costs associated with permitting and land acquisition for the open channel improvements were not included at this time.

Construction Costs:	$620,400
Site Acquisition:	$0
Permitting:	TBD
Engineering / Administration:	$155,100
Capital Project Implementation Costs	**$744,400**
Annual Maintenance Costs	**$12,700**

Draft February 28, 2008

Capital Project Fact Sheet

Basin Name: Coyote Creek Tributary Basin

Project #: CIP Option 7

Project Identifier	**CIP Option 7**
Project Title	**Install Detention**

Project Location

CIP Option 7 involves the installation of a 1-acre detention pond in the current vacant parcel north of culvert A along Oak Island Drive and installation of associated inlet and outlet components to the pond.

Refer to Appendix B, CIP Option 7 for a figure.

Drainage Area Served by Capital Project	**285.2**	Acres
% Impervious (Existing Land Use)	**24.0**	
% Impervious (Future)	**24.0**	

Problems and/or Opportunities Identified

Problems

Roadway and property flooding occur throughout the Coyote Creek tributary system that currently conveys runoff from approximately 350 acres of open space and residential property. The conveyance system itself is very flat and is affected by downstream constrictions (in the bypass channel downstream of Cherry Lane) and undersized culverts. Detention would minimize roadway flooding along Oak Island Drive and reduce volumes in the downstream open channel system.

Opportunities

With installation of a detention pond, there are opportunities to incorporate water quality during construction. The pond facility could be constructed with a larger sump for sediment collection or an upsized footprint to increase detention time. Vegetation along the banks and bottom of the pond would promote water quality as well.

Project Description to Address Identified Problems / Opportunities

Install a one-acre detention pond (1.5 acre including construction and safety buffer) and associated inlet and outlet controls at culvert A along Oak Island Drive. Include a sediment trap or trash rack upstream to minimize trash and debris discharged to the pond facility.

Project Elements

1 Ea – Trash Rack Inlet (Type 2)
1.5 Ac-Ft – Dry Extended Detention Pond
20 Ft – 18" CSP (5-10 ft. cover)
20 Ft – 36" CSP (5-10 ft. cover)

Maintenance Requirements

Facility Type	***Annual Maintenance Activities***
Trash Rack Inlet (Type 2)	Inspect and clean inlet, inspect vegetation and slope protection, remove debris.
Dry Extended Detention Pond	Inspect and clean inlet and outlet, maintain vegetation, inspect sediment loading, remove sediment, remove debris, inspect separation berm.
18" CSP (5-10 ft. cover)	N/A
36" CSP (5-10 ft. cover)	N/A

Objectives Addressed by the Capital Project

Flood Control

The CIP addresses most modeled existing and projected future flooding problems associated with undersized and/or improperly graded portions of the existing stormwater system. This CIP option reduces surcharge in culverts B and C along Oak Island Drive

Water Quality

When the detention pond is designed, increased sump or detention time would result in an increase potential for water quality improvement.

Natural Resources

Installation of bankside vegetation with construction of of the detention pond should be completed.

Other City Objectives Addressed by the Capital Project

To be Completed by the City.

Costs

Cost Notes

Costs associated with permitting are not included at this time. Site acquisition costs assume a total area of 1.5 acres and a cost of $2.00/square foot.

Construction Costs:	$106,600
Site Acquisition:	$130,680
Permitting:	TBD
Engineering / Administration:	$59,320
Capital Project Implementation Costs	**$284,680**
Annual Maintenance Costs	**$9,500**

Appendix A

Hydrologic and Hydraulic Model Results Tables

Table A-1
Hydrologic Performance of the Coyote Creek Tributary Drainage Area

Subbasin Name	Inlet Node	Area (acre)	Impervious Percentage	Slope (ft/ft)	Width (ft)	10-Year	25-Year
						Flow (cfs)	Flow (cfs)
1	N1	231.41	22.1	0.005	1884	45.30	54.19
2A	N5	14.12	34.8	0.006	415	4.76	5.65
2B	N5	37.74	31.1	0.009	485	10.92	12.98
3	N8	1.88	37.7	0.009	241	0.72	0.85
4	N16	5.52	37.9	0.013	1551	2.15	2.53
5	N20	6.09	39.0	0.009	307	2.38	2.82
6	N27	3.60	39.0	0.017	299	1.43	1.69
7A	N34	34.21	39.0	0.010	1097	13.14	15.58
7B	N34	22.73	35.0	0.007	577	7.65	9.10

Table A-2

Hydraulic Performance of the Coyote Creek Tributary System under Existing and Future Conditions

Segment ID	Node ID		Segment Length (ft)	Invert Elevation (ft)		Diameter (Height)	10-Year Conditions			25-Year Conditions		
	US	DS		US	DS		Max Flow (ft^3/s)	US Maximum Water Elevation (ft)	DS Maximum Water Elevation (ft)	Max Flow (ft^3/s)	US Maximum Water Elevation (ft)	DS Maximum Water Elevation (ft)
Blek1	N4	N5	43.5	426.25	426.39	2.5	22.80	429.20	429.05	26.59	429.51	429.30
Blek2	N4	N5	43.5	426.52	426.53	2.5	22.45	429.20	429.05	27.45	429.51	429.30
BlekRD	N4	N5	43.5	430.01	430.01	0.5	0.00	429.05	429.05	0.00	429.30	429.30
Cherry1	N21	N22	57.0	421.11	420.95	3.3	17.80	424.23	423.89	20.19	424.40	423.96
Cherry2	N21	N22	57.1	421.11	420.99	3.3	17.78	424.23	423.89	20.17	424.40	423.96
Cherry-RD	N21	N22	57.0	425.06	425.06	0.5	0.00	423.89	423.89	0.00	423.96	423.96
Concrete	N34	N35	35.0	414.68	414.65	4.0	23.59	416.89	416.80	27.04	417.02	416.91
County	N34	N35	35.0	414.68	414.65	4.0	23.59	416.89	416.73	27.04	417.02	416.85
RD	N34	N35	35.0	420.37	420.37	0.5	0.00	416.73	416.73	0.00	416.85	416.85
CulvA1	N8	N9	20.8	424.00	423.60	2.5	31.63	426.59	426.49	34.17	427.09	426.91
CulvA2	N8	N9	20.8	423.78	423.67	2.5	28.44	426.59	426.49	36.70	427.09	426.91
CulvA-RD	N8	N9	20.8	428.88	428.88	0.5	0.00	426.49	426.49	0.00	426.91	426.91
CulvB1	N14	N15	12.2	423.27	423.20	2.0	19.23	426.14	425.86	22.57	426.48	426.08
CulvB2	N14	N15	12.2	423.30	423.21	2.0	19.23	426.14	425.86	22.57	426.48	426.08
CulvB3	N14	N15	12.2	423.27	423.27	2.0	19.23	426.14	425.86	22.56	426.48	426.08
CulvB-RD	N14	N15	12.2	426.46	426.46	0.5	0.00	425.86	425.86	0.08	426.48	426.46
CulvC1	N16	N17	12.7	422.92	422.70	2.0	18.82	425.44	425.20	19.98	425.73	425.64
CulvC2	N16	N17	12.7	422.89	422.87	2.0	19.36	425.44	425.20	20.77	425.73	425.64
CulvC3	N16	N17	12.7	422.89	422.83	2.0	19.24	425.44	425.20	20.68	425.73	425.64
CulvC-RD	N16	N17	12.7	425.36	425.36	0.5	1.63	425.44	425.41	30.43	425.73	425.68
L1	N1	N2	20.0	427.59	427.59	2.6	45.28	429.54	429.47	54.09	429.89	429.78
L10	N9	N10	23.4	423.66	424.14	3.5	59.96	426.49	426.47	70.54	426.91	426.89
L11	N38	N12	105.5	424.03	423.89	2.8	59.38	426.46	426.35	69.15	426.88	426.66
L13	N12	N13	10.5	423.89	423.72	2.8	58.81	426.35	426.35	68.33	426.66	426.65
L14	N13	N14	132.5	423.72	423.46	3.0	58.22	426.35	426.14	68.03	426.65	426.48
L16	N15	N16	165.0	423.37	423.10	2.8	56.80	425.86	425.44	67.04	426.08	425.73
L18	N17	N18	150.0	422.88	421.55	3.0	54.75	425.20	425.16	62.76	425.64	425.62
L20	N19	N20	99.0	421.38	421.10	4.0	52.41	424.34	424.24	60.53	424.52	424.41
L21	N20	N21	11.5	421.10	421.10	4.0	35.58	424.24	424.23	40.37	424.41	424.40
L23	N22	N23	24.0	420.95	420.92	3.7	35.58	423.89	423.82	40.37	423.96	423.88
L24	N23	N24	25.0	420.92	420.56	3.6	35.56	423.82	423.80	40.36	423.88	423.86
L25	N24	N25	99.0	420.56	420.95	3.6	35.48	423.80	423.74	40.35	423.86	423.79
L26	N25	N26	25.0	420.95	421.50	2.6	35.47	423.74	423.72	40.35	423.79	423.75
L27	N26	N27	58.0	421.50	421.13	2.4	35.46	423.72	423.55	40.35	423.75	423.55
L28	N27	N28	115.0	421.13	421.02	2.4	37.59	423.55	423.16	37.99	423.55	423.16
L29	N28	N29	93.0	421.02	420.71	2.5	37.40	423.16	422.92	37.43	423.16	422.92
L3	N3	N4	39.5	427.18	426.92	3.2	45.24	429.24	429.20	53.98	429.55	429.51
L30	N29	N30	80.0	420.71	420.42	2.6	37.36	422.92	422.57	37.38	422.92	422.58
L31	N30	N31	45.0	420.42	420.06	2.5	37.33	422.57	422.27	37.36	422.58	422.28
L32	N31	N33	422.0	420.06	419.76	2.5	37.05	422.27	421.69	37.32	422.28	421.70
L33	N33	N34	426.5	419.76	417.37	2.8	36.45	421.69	418.39	37.23	421.70	418.40
L35	N35	N36	50.0	414.65	414.65	6.0	46.75	416.73	415.92	53.79	416.85	416.01
L36	N37	N8	177.0	423.89	423.70	4.4	59.93	426.89	426.59	70.54	427.31	427.09
L37	N10	N38	12.0	424.14	424.03	3.0	59.85	426.47	426.46	70.36	426.89	426.88
L38	N20	N39	13.0	421.10	422.64	2.0	18.14	424.24	424.23	21.62	424.41	424.40
L39	N39	N40	64.5	422.67	423.08	1.0	18.09	424.23	423.83	21.55	424.40	423.85
L40	N40	N41	79.0	423.08	423.05	0.7	18.10	423.83	423.79	21.55	423.85	423.79
L41	N41	N42	77.0	423.05	422.24	0.4	2.62	423.79	423.55	2.57	423.79	423.55
L42	N42	N27	50.0	422.24	421.13	0.4	2.63	423.55	423.55	-3.72	423.55	423.55
L5	N5	N6	88.5	426.64	426.91	2.5	60.77	429.05	428.70	72.35	429.30	428.87
L6	N6	N7	23.0	426.91	426.24	2.5	60.74	428.70	428.46	72.31	428.87	428.66
L7	N7	N37	183.0	426.24	423.89	3.0	60.66	428.46	426.89	72.15	428.66	427.31
Oak1	N18	N19	63.0	421.64	421.23	3.3	26.22	425.16	424.34	30.28	425.62	424.52
Oak2	N18	N19	63.0	421.50	421.37	3.3	26.21	425.16	424.34	30.28	425.62	424.52
Oak-RD	N18	N19	63.0	425.86	425.86	0.5	0.00	424.34	424.34	0.00	424.52	424.52
Perkins1	N2	N3	34.9	428.05	427.80	2.0	14.62	429.47	429.24	18.19	429.78	429.55
Perkins2	N2	N3	34.9	427.81	427.75	2.0	14.96	429.47	429.24	17.13	429.78	429.55
Perkins3	N2	N3	34.9	427.98	427.71	2.0	15.66	429.47	429.24	18.72	429.78	429.55
PerkinsRD	N2	N3	34.9	432.36	432.36	0.5	0.00	429.24	429.24	0.00	429.55	429.55

Table A-3
Summary of Flooding Areas during the 10 and 25 Year Events

						10 YR					25 YR						
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation	Downstream Invert Elevation	Diameter (Height)	Max Flow (ft^3/s, m^3/s)	Maximum Water Elevation (US) (ft, m)	Calculated Top of Bank (US)	Maximum Water Elevation (DS) (ft, m)	Calculated Top of Bank (DS)	Max Flow (ft^3/s, m^3/s)	Maximum Water Elevation (US) (ft, m)	Calculated Top of Bank (US)	Maximum Water Elevation (DS) (ft, m)	Calculated Top of Bank (DS)	Observed Flooding Problem?	Priority?
Blek1	N4	N5	426.25	426.394	2.5	22.8	429.20	428.75	429.05	428.89	26.6	429.51	428.75	429.30	428.89		
Blek2	N4	N5	426.518	426.532	2.5	22.5	429.20	429.02	429.05	429.03	27.5	429.51	429.02	429.30	429.03		
BlekRD	N4	N5	430.01	430.01	0.5	0.0	429.05	430.51	429.05	430.51	0.0	429.30	430.51	429.30	430.51	N - No roadway flooding	No
Cherry1	N21	N22	421.108	420.952	3.3	17.8	424.23	424.41	423.89	424.25	20.2	424.40	424.41	423.96	424.25		
Cherry2	N21	N22	421.114	420.994	3.3	17.8	424.23	424.41	423.89	424.29	20.2	424.40	424.41	423.96	424.29		
Cherry-RD	N21	N22	425.06	425.06	0.5	0.0	423.89	425.56	423.89	425.56	0.0	423.96	425.56	423.96	425.56	No	No
Concrete	N34	N35	414.684	414.654	4	23.6	416.89	418.68	416.80	418.65	27.0	417.02	418.68	416.91	418.65		
County	N34	N35	414.684	414.654	4	23.6	416.89	418.68	416.73	418.65	27.0	417.02	418.68	416.85	418.65	No	No
RD	N34	N35	420.37	420.37	0.5	0.0	416.73	420.87	416.73	420.87	0.0	416.85	420.87	416.85	420.87	No	No
CulvA1	N8	N9	423.998	423.602	2.5	31.6	426.59	426.50	426.49	426.10	34.2	427.09	426.50	426.91	426.10		
CulvA2	N8	N9	423.778	423.672	2.5	28.4	426.59	426.28	426.49	426.17	36.7	427.09	426.28	426.91	426.17		
CulvA-RD	N8	N9	428.884	428.884	0.5	0.0	426.49	429.38	426.49	429.38	0.0	426.91	429.38	426.91	429.38	N - No roadway flooding	No
CulvB1	N14	N15	423.266	423.202	2	19.2	426.14	425.27	425.86	425.20	22.6	426.48	425.27	426.08	425.20		
CulvB2	N14	N15	423.302	423.206	2	19.2	426.14	425.30	425.86	425.21	22.6	426.48	425.30	426.08	425.21		
CulvB3	N14	N15	423.274	423.272	2	19.2	426.14	425.27	425.86	425.27	22.6	426.48	425.27	426.08	425.27		
CulvB-RD	N14	N15	426.46	426.46	0.5	0.0	425.86	426.96	425.86	426.96	0.1	426.48	426.96	426.46	426.96	Y - 25 yr	Yes
CulvC1	N16	N17	422.918	422.698	2	18.8	425.44	424.92	425.20	424.70	20.0	425.73	424.92	425.64	424.70		
CulvC2	N16	N17	422.89	422.874	2	19.4	425.44	424.89	425.20	424.87	20.8	425.73	424.89	425.64	424.87		
CulvC3	N16	N17	422.89	422.83	2	19.2	425.44	424.89	425.20	424.83	20.7	425.73	424.89	425.64	424.83	Backwater from Oak Dr.system	
CulvC-RD	N16	N17	425.36	425.36	0.5	1.6	425.44	425.86	425.41	425.86	30.4	425.73	425.86	425.68	425.86	Y - 10/ 25 yr	Yes
L1	N1	N2	427.59	427.59	2.59	45.3	429.54	430.18	429.47	430.18	54.1	429.89	430.18	429.78	430.18	No	No
L10	N9	N10	423.66	424.14	3.5	60.0	426.49	427.16	426.47	427.64	70.5	426.91	427.16	426.89	427.64	No	No
L11	N38	N12	424.03	423.89	2.77	59.4	426.46	426.80	426.35	426.66	69.2	426.88	426.80	426.66	426.66	Minor - US 25 yr	No
L13	N12	N13	423.89	423.72	2.77	58.8	426.35	426.66	426.35	426.49	68.3	426.66	426.66	426.65	426.49	Minor - DS 25 yr	No
L14	N13	N14	423.72	423.46	2.95	58.2	426.35	426.67	426.14	426.41	68.0	426.65	426.67	426.48	426.41	Minor - DS 25 yr	No
L16	N15	N16	423.37	423.1	2.76	56.8	425.86	426.13	425.44	425.86	67.0	426.08	426.13	425.73	425.86	No	No
L18	N17	N18	422.88	421.55	2.97	54.8	425.20	425.85	425.16	424.52	62.8	425.64	425.85	425.62	424.52	Slight - DS 10/ 25 yr	Yes
L20	N19	N20	421.38	421.1	4	52.4	424.34	425.38	424.24	425.10	60.5	424.52	425.38	424.41	425.10	No	No
L21	N20	N21	421.1	421.1	4	35.6	424.24	425.10	424.23	425.10	40.4	424.41	425.10	424.40	425.10	No	No
L23	N22	N23	420.952	420.92	3.69	35.6	423.89	424.64	423.82	424.61	40.4	423.96	424.64	423.88	424.61	No	No
L24	N23	N24	420.92	420.56	3.61	35.6	423.82	424.53	423.80	424.17	40.4	423.88	424.53	423.86	424.17	No	No
L25	N24	N25	420.56	420.95	3.55	35.5	423.80	424.11	423.74	424.50	40.4	423.86	424.11	423.79	424.50	No	No
L26	N25	N26	420.95	421.5	2.55	35.5	423.74	423.50	423.72	424.05	40.4	423.79	423.50	423.75	424.05	Slight - US 10/ 25 yr	Yes
L27	N26	N27	421.5	421.13	2.43	35.5	423.72	423.93	423.55	423.56	40.4	423.75	423.93	423.55	423.56	No	No
L28	N27	N28	421.13	421.02	2.43	37.6	423.55	423.56	423.16	423.45	38.0	423.55	423.56	423.16	423.45	No	No
L29	N28	N29	421.02	420.71	2.54	37.4	423.16	423.56	422.92	423.25	37.4	423.16	423.56	422.92	423.25	No	No
L3	N3	N4	427.18	426.92	3.16	45.2	429.24	430.34	429.20	430.08	54.0	429.55	430.34	429.51	430.08	No	No
L30	N29	N30	420.71	420.42	2.55	37.4	422.92	423.26	422.57	422.97	37.4	422.92	423.26	422.58	422.97	No	No
L31	N30	N31	420.42	420.06	2.5	37.3	422.57	422.92	422.27	422.56	37.4	422.58	422.92	422.28	422.56	No	No
L32	N31	N33	420.06	419.76	2.5	37.1	422.27	422.56	421.69	422.26	37.3	422.28	422.56	421.70	422.26	No	No
L33	N33	N34	419.76	417.37	2.8	36.5	421.69	422.56	418.39	420.17	37.2	421.70	422.56	418.40	420.17	No	No
L35	N35	N36	414.654	414.65	6	46.8	416.73	420.65	415.92	420.65	53.8	416.85	420.65	416.01	420.65	No	No
L36	N37	N8	423.89	423.7	4.35	59.9	426.89	428.24	426.59	428.05	70.5	427.31	428.24	427.09	428.05	No	No
L37	N10	N38	424.14	424.03	3	59.9	426.47	427.14	426.46	427.03	70.4	426.89	427.14	426.88	427.03	No	No

Table A-3
Summary of Flooding Areas during the 10 and 25 Year Events

						10 YR					25 YR						
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation	Downstream Invert Elevation	Diameter (Height)	Max Flow (ft^3/s, m^3/s)	Maximum Water Elevation (US) (ft, m)	Calculated Top of Bank (US)	Maximum Water Elevation (DS) (ft, m)	Calculated Top of Bank (DS)	Max Flow (ft^3/s, m^3/s)	Maximum Water Elevation (US) (ft, m)	Calculated Top of Bank (US)	Maximum Water Elevation (DS) (ft, m)	Calculated Top of Bank (DS)	Observed Flooding Problem?	Priority?
L38	N20	N39	421.1	422.64	2.02	18.1	424.24	423.12	424.23	424.66	21.6	424.41	423.12	424.40	424.66	Y - US 10/ 25 yr	Yes
L39	N39	N40	422.67	423.08	0.95	18.1	424.23	423.62	423.83	424.03	21.6	424.40	423.62	423.85	424.03	Y - US 10/ 25 yr	Yes
L40	N40	N41	423.08	423.05	0.74	18.1	423.83	423.82	423.79	423.79	21.6	423.85	423.82	423.79	423.79	Slight - US 10/ 25 yr	Yes
L41	N41	N42	423.05	422.24	0.4	2.6	423.79	423.45	423.55	422.64	2.6	423.79	423.45	423.55	422.64	Y - 10/ 25 yr	Yes
L42	N42	N27	422.24	421.13	0.4	2.6	423.55	422.64	423.55	421.53	-3.7	423.55	422.64	423.55	421.53	Y - 10/ 25 yr	Yes
L5	N5	N6	426.64	426.91	2.46	60.8	429.05	429.10	428.70	429.37	72.4	429.30	429.10	428.87	429.37	Minor - US 25 yr	No
L6	N6	N7	426.91	426.24	2.46	60.7	428.70	429.37	428.46	428.70	72.3	428.87	429.37	428.66	428.70	No	No
L7	N7	N37	426.24	423.89	2.95	60.7	428.46	429.19	426.89	426.84	72.2	428.66	429.19	427.31	426.84	Slight - DS 10/ 25 yr	No
Oak1	N18	N19	421.638	421.234	3.3	26.2	425.16	424.94	424.34	424.53	30.3	425.62	424.94	424.52	424.53		
Oak2	N18	N19	421.498	421.368	3.3	26.2	425.16	424.80	424.34	424.67	30.3	425.62	424.80	424.52	424.67		
Oak-RD	N18	N19	425.86	425.86	0.5	0.0	424.34	426.36	424.34	426.36	0.0	424.52	426.36	424.52	426.36	No roadway flooding	No
Perkins1	N2	N3	428.046	427.798	2	14.6	429.47	430.05	429.24	429.80	18.2	429.78	430.05	429.55	429.80	No	No
Perkins2	N2	N3	427.808	427.748	2	15.0	429.47	429.81	429.24	429.75	17.1	429.78	429.81	429.55	429.75	No	No
Perkins3	N2	N3	427.982	427.71	2	15.7	429.47	429.98	429.24	429.71	18.7	429.78	429.98	429.55	429.71	No	No
PerkinsRD	N2	N3	432.356	432.356	0.5	0.0	429.24	432.86	429.24	432.86	0.0	429.55	432.86	429.55	432.86	No	No

🟥 : Surcharging culvert or water surface elevation exceeding top of bank
🟦 : Roadway flooding

Table A-4
Summary of CIP Alternatives with Respect to Priority Flooding Locations

			25-yr	25-yr											
Flooding Link	**Nodes Associated with High Priority Locations**		**No CIP**	**Surcharge Elevation**	**Flood Elevation**	**Option 1**	**Option 2**	**Option 3**	**Option 3A**	**Option 4**	**Option 4A**	**Option 5**	**Option 6**	**Option 7**	**Option 8**
Name	Name		Max WSE	Max WSE	Max WSE	Max WSE	Max WSE	Max WSE	Max WSE	Max WSE	Max WSE	Max WSE	Max WSE	Max WSE	Max WSE
Culvert Blek Rd.	US	N4	429.51	428.75	430.01	429.51	429.51	429.51	429.44	429.51	429.44	429.51	429.36	429.52	429.59
	DS	N5	429.3	428.89	430.01	429.3	429.3	429.3	429.23	429.3	429.23	429.3	429.15	429.23	429.38
L7	US	N7	428.66	N/A	429.19	No Existing flooding									
	DS	N37	427.31	N/A	426.84	427.28	427.26	427.20	427.22	427.22	427.23	427.30	425.09	426.86	428.10
Culvert B	US	N14	426.48	425.27	426.46	426.44	426.42	426.37	426.36	426.40	426.39	426.47	425.10	425.48	426.02
	DS	N15	426.08	425.2	426.46	426.04	426.03	425.93	425.95	425.98	425.99	426.06	424.21	424.88	425.79
Culvert C	US	N16	425.73	424.89	425.36	425.60	425.56	425.33	425.36	425.46	425.46	425.67	423.64	425.00	425.40
	DS	N17	425.68	424.7	425.36	425.55	425.51	424.92	424.94	425.42	425.42	425.62	423.57	424.21	425.38
L18	US	N17	425.64	N/A	425.85	No Existing flooding									
	DS	N18	425.62	N/A	424.52	425.31	425.24	424.65	424.61	425.01	424.97	425.49	423	424.07	425.07
L38	US	N20	424.41	N/A	423.12	423.90	423.86	423.87	423.75	423.23	422.89	424.26	423.84	424.01	424.20
	DS	N39	424.4	N/A	424.66	No Existing flooding									
L39	US	N39	424.4	N/A	423.62	423.90	423.86	423.85	423.75	423.21	422.85	424.17	423.83	424.42	424.19
	DS	N40	423.85	N/A	424.03	No Existing flooding									
L41	US	N41	423.79	N/A	423.45	423.79	423.83	423.56	423.41	423.01	422.40	424.11	423.05	424.37	423.79
	DS	N42	423.55	N/A	422.64	423.55	423.80	423.37	423.17	422.92	422.23	424.08	422.64	423.72	423.55
L42	US	N42	423.55	N/A	422.64	423.55	423.80	423.37	423.17	422.92	422.23	424.08	422.64	423.95	423.55
	DS	N27	423.55	N/A	421.53	423.56	423.78	423.22	422.95	422.82	422.04	424.06	422.64	423.35	423.52

Notes:

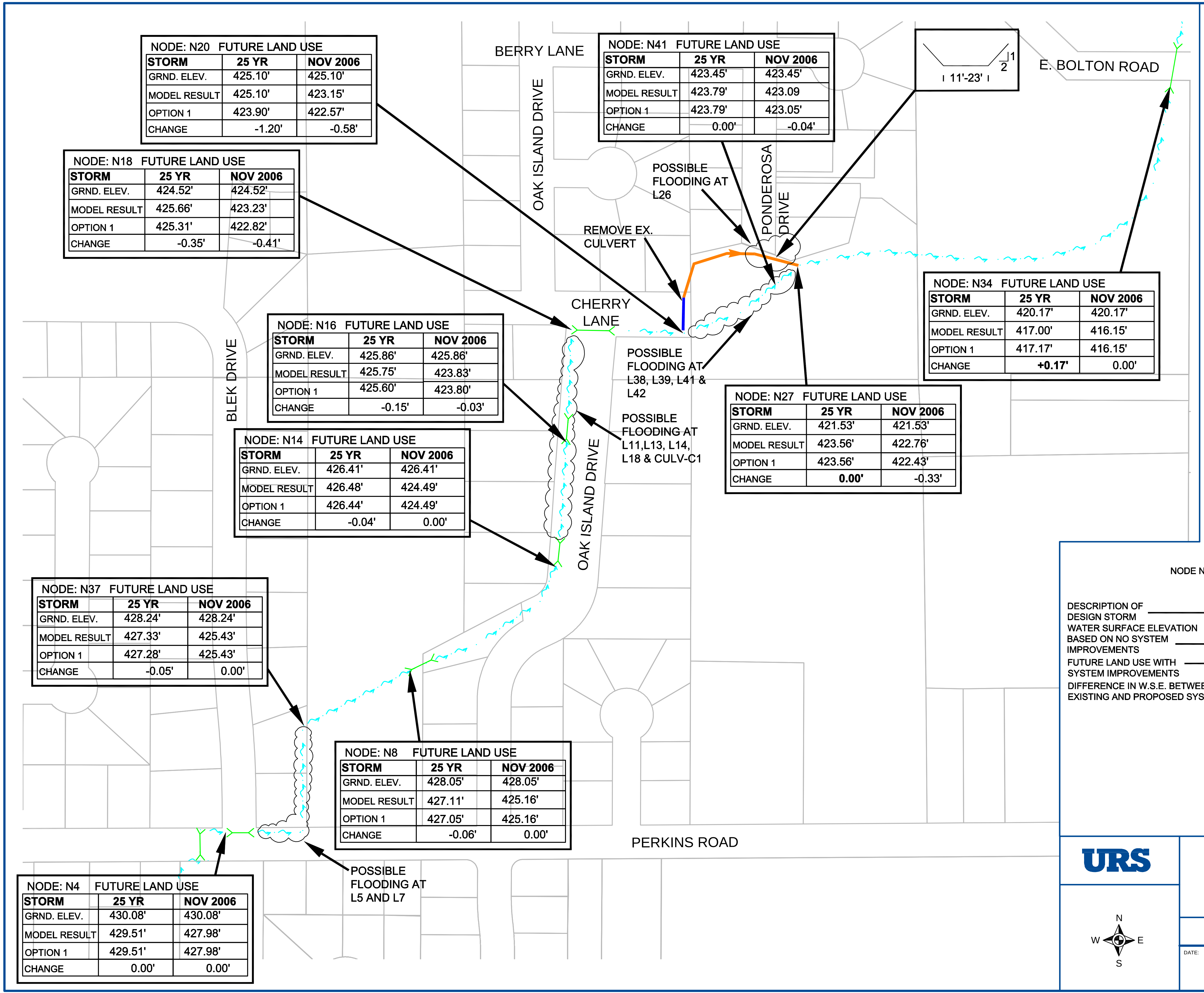
1) Surcharge Elevations only apply to culvert locations. Ideally surcharge would be alleviated with improvements.

Key:

⬜	No flooding or flooding alleviated (to within 0.1')
🟨	Alleviates flooding and surcharging (to within 0.1')
🟦	Significant improvement made but not to magnitude needed to resolve flooding.
🟪	Flooding not alleviated with CIP alternative.

Appendix B

CIP Alternatives Figures



NODE: N20 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.10'	425.10'
MODEL RESULT	425.10'	423.15'
OPTION 1	423.90'	422.57'
CHANGE	-1.20'	-0.58'

NODE: N41 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	423.45'	423.45'
MODEL RESULT	423.79'	423.09
OPTION 1	423.79'	423.05'
CHANGE	0.00'	-0.04'

NODE: N18 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	424.52'	424.52'
MODEL RESULT	425.66'	423.23'
OPTION 1	425.31'	422.82'
CHANGE	-0.35'	-0.41'

NODE: N16 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.86'	425.86'
MODEL RESULT	425.75'	423.83'
OPTION 1	425.60'	423.80'
CHANGE	-0.15'	-0.03'

NODE: N34 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	420.17'	420.17'
MODEL RESULT	417.00'	416.15'
OPTION 1	417.17'	416.15'
CHANGE	**+0.17'**	0.00'

NODE: N27 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	421.53'	421.53'
MODEL RESULT	423.56'	422.76'
OPTION 1	423.56'	422.43'
CHANGE	**0.00'**	-0.33'

NODE: N14 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	426.41'	426.41'
MODEL RESULT	426.48'	424.49'
OPTION 1	426.44'	424.49'
CHANGE	-0.04'	0.00'

NODE: N37 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.24'	428.24'
MODEL RESULT	427.33'	425.43'
OPTION 1	427.28'	425.43'
CHANGE	-0.05'	0.00'

NODE: N8 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.05'	428.05'
MODEL RESULT	427.11'	425.16'
OPTION 1	427.05'	425.16'
CHANGE	-0.06'	0.00'

NODE: N4 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	430.08'	430.08'
MODEL RESULT	429.51'	427.98'
OPTION 1	429.51'	427.98'
CHANGE	0.00'	0.00'

LEGEND

⋯	EXISTING DITCH
≻—≺	EXISTING CULVERT
→	WIDEN AND REGRADE CHANNEL
≻—≺	NEW CULVERT
→	NEW CHANNEL
☁	LOCATION OF PREDICTED FLOODING

NODE NAME

GENERAL DESCRIPTION

NODE: NXX FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	XX.XX'	XX.XX'
MODEL RESULT	XX.XX'	XX.XX'
OPTION X	XX.XX'	XX.XX'
CHANGE	-XX.XX'	+XX.XX'

DESCRIPTION OF DESIGN STORM

WATER SURFACE ELEVATION BASED ON NO SYSTEM IMPROVEMENTS

FUTURE LAND USE WITH SYSTEM IMPROVEMENTS

DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS
(- INDICATES A DECREASE IN WSE AND
+ INDICATES AN INCREASE IN WSE)

URS

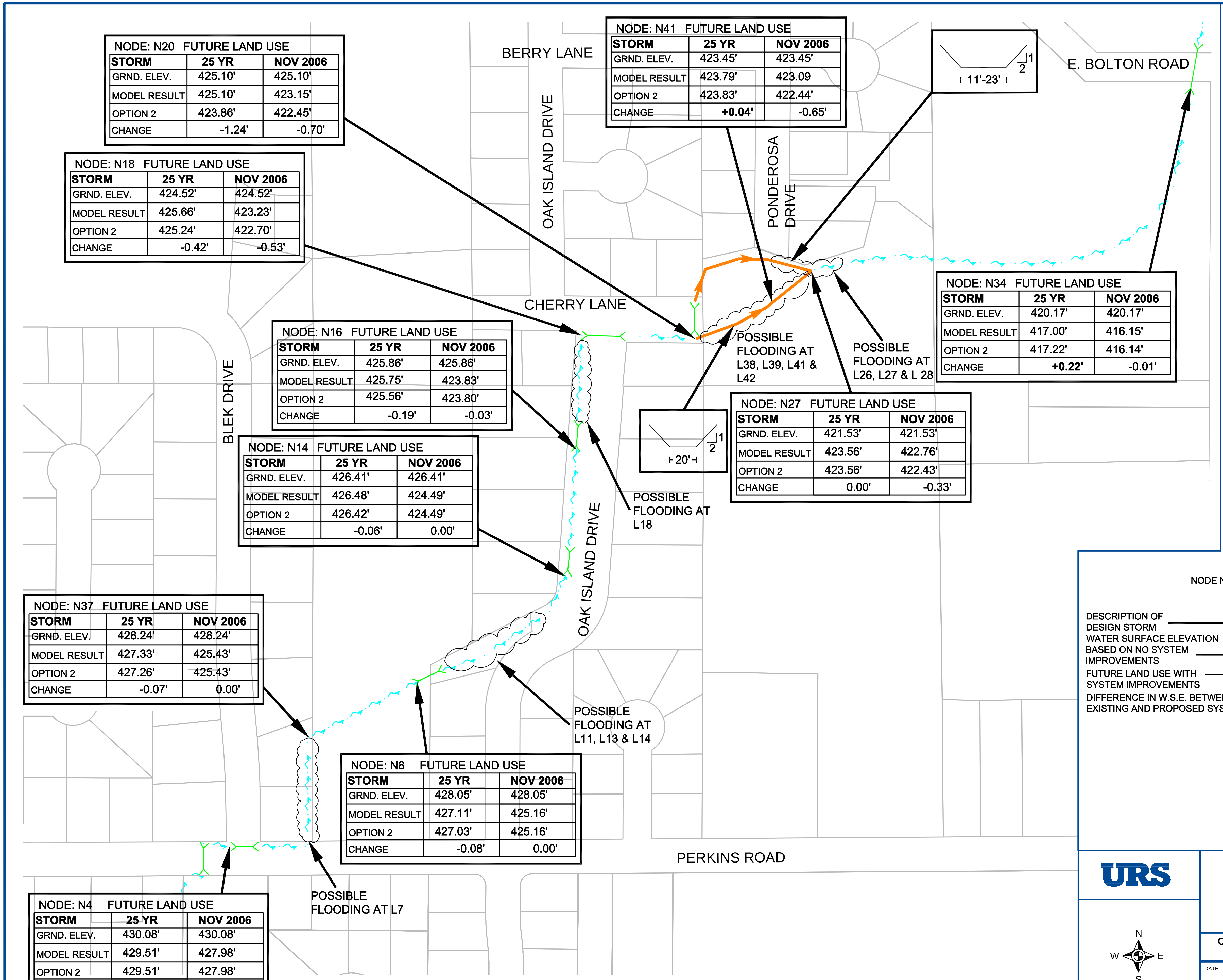
N
W E
S

STORMWATER BASIN PLAN FOR THE CITY OF VENETA

OPTION 1: WIDENING AND REGRADING OF MAINSTEM CHANNEL AT BY-PASS

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	1

20071686.184 CMBC Civil Engineering.Figure 1.dwg



NODE: N20 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.10'	425.10'
MODEL RESULT	425.10'	423.15'
OPTION 2	423.86'	422.45'
CHANGE	-1.24'	-0.70'

NODE: N18 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	424.52'	424.52'
MODEL RESULT	425.66'	423.23'
OPTION 2	425.24'	422.70'
CHANGE	-0.42'	-0.53'

NODE: N41 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	423.45'	423.45'
MODEL RESULT	423.79'	423.09
OPTION 2	423.83'	422.44'
CHANGE	**+0.04'**	-0.65'

NODE: N34 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	420.17'	420.17'
MODEL RESULT	417.00'	416.15'
OPTION 2	417.22'	416.14'
CHANGE	**+0.22'**	-0.01'

NODE: N16 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.86'	425.86'
MODEL RESULT	425.75'	423.83'
OPTION 2	425.56'	423.80'
CHANGE	-0.19'	-0.03'

NODE: N27 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	421.53'	421.53'
MODEL RESULT	423.56'	422.76'
OPTION 2	423.56'	422.43'
CHANGE	0.00'	-0.33'

NODE: N14 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	426.41'	426.41'
MODEL RESULT	426.48'	424.49'
OPTION 2	426.42'	424.49'
CHANGE	-0.06'	0.00'

NODE: N37 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.24'	428.24'
MODEL RESULT	427.33'	425.43'
OPTION 2	427.26'	425.43'
CHANGE	-0.07'	0.00'

NODE: N8 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.05'	428.05'
MODEL RESULT	427.11'	425.16'
OPTION 2	427.03'	425.16'
CHANGE	-0.08'	0.00'

NODE: N4 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	430.08'	430.08'
MODEL RESULT	429.51'	427.98'
OPTION 2	429.51'	427.98'
CHANGE	0.00'	0.00'

LEGEND

~	EXISTING DITCH
≻—≺	EXISTING CULVERT
➝	WIDEN AND REGRADE CHANNEL
≻—≺	NEW CULVERT
➝	NEW CHANNEL
☁	LOCATION OF PREDICTED FLOODING

NODE NAME

GENERAL DESCRIPTION

DESCRIPTION OF DESIGN STORM

WATER SURFACE ELEVATION BASED ON NO SYSTEM IMPROVEMENTS

FUTURE LAND USE WITH SYSTEM IMPROVEMENTS

DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS

NODE: NXX FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	XX.XX'	XX.XX'
MODEL RESULT	XX.XX'	XX.XX'
OPTION X	XX.XX'	XX.XX'
CHANGE	-XX.XX'	+XX.XX'

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS
(- INDICATES A DECREASE IN WSE AND
+ INDICATES AN INCREASE IN WSE)

URS

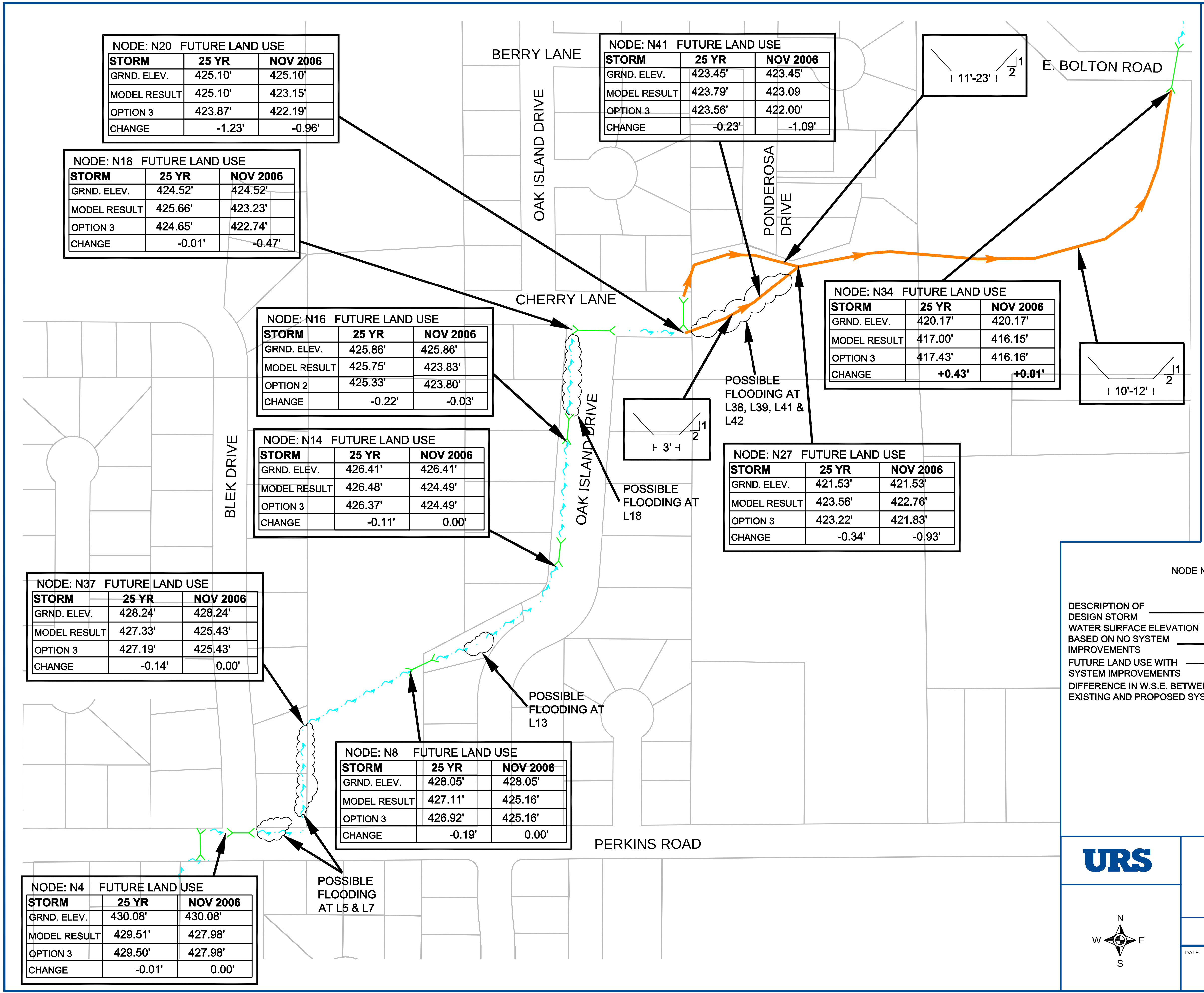
N
W E
S

STORMWATER BASIN PLAN
FOR THE CITY OF VENETA

OPTION 2: WIDENING AND REGRADING OF MAINSTEM AND BY-PASS CHANNEL AT BY-PASS

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	2

25696393.00003 Option 2.dwg



NODE: N20 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.10'	425.10'
MODEL RESULT	425.10'	423.15'
OPTION 3	423.87'	422.19'
CHANGE	-1.23'	-0.96'

NODE: N18 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	424.52'	424.52'
MODEL RESULT	425.66'	423.23'
OPTION 3	424.65'	422.74'
CHANGE	-0.01'	-0.47'

NODE: N41 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	423.45'	423.45'
MODEL RESULT	423.79'	423.09
OPTION 3	423.56'	422.00'
CHANGE	-0.23'	-1.09'

NODE: N16 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.86'	425.86'
MODEL RESULT	425.75'	423.83'
OPTION 2	425.33'	423.80'
CHANGE	-0.22'	-0.03'

NODE: N14 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	426.41'	426.41'
MODEL RESULT	426.48'	424.49'
OPTION 3	426.37'	424.49'
CHANGE	-0.11'	0.00'

NODE: N34 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	420.17'	420.17'
MODEL RESULT	417.00'	416.15'
OPTION 3	417.43'	416.16'
CHANGE	**+0.43'**	**+0.01'**

NODE: N27 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	421.53'	421.53'
MODEL RESULT	423.56'	422.76'
OPTION 3	423.22'	421.83'
CHANGE	-0.34'	-0.93'

NODE: N37 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.24'	428.24'
MODEL RESULT	427.33'	425.43'
OPTION 3	427.19'	425.43'
CHANGE	-0.14'	0.00'

NODE: N8 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.05'	428.05'
MODEL RESULT	427.11'	425.16'
OPTION 3	426.92'	425.16'
CHANGE	-0.19'	0.00'

NODE: N4 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	430.08'	430.08'
MODEL RESULT	429.51'	427.98'
OPTION 3	429.50'	427.98'
CHANGE	-0.01'	0.00'

LEGEND

⁓	EXISTING DITCH
⟷	EXISTING CULVERT
→	WIDEN AND REGRADE CHANNEL
⟷	NEW CULVERT
→	NEW CHANNEL
☁	LOCATION OF PREDICTED FLOODING

NODE NAME

GENERAL DESCRIPTION

DESCRIPTION OF DESIGN STORM

WATER SURFACE ELEVATION BASED ON NO SYSTEM IMPROVEMENTS

FUTURE LAND USE WITH SYSTEM IMPROVEMENTS

DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS

NODE: NXX FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	XX.XX'	XX.XX'
MODEL RESULT	XX.XX'	XX.XX'
OPTION X	XX.XX'	XX.XX'
CHANGE	-XX.XX'	+XX.XX'

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS
(- INDICATES A DECREASE IN WSE AND
+ INDICATES AN INCREASE IN WSE)

URS

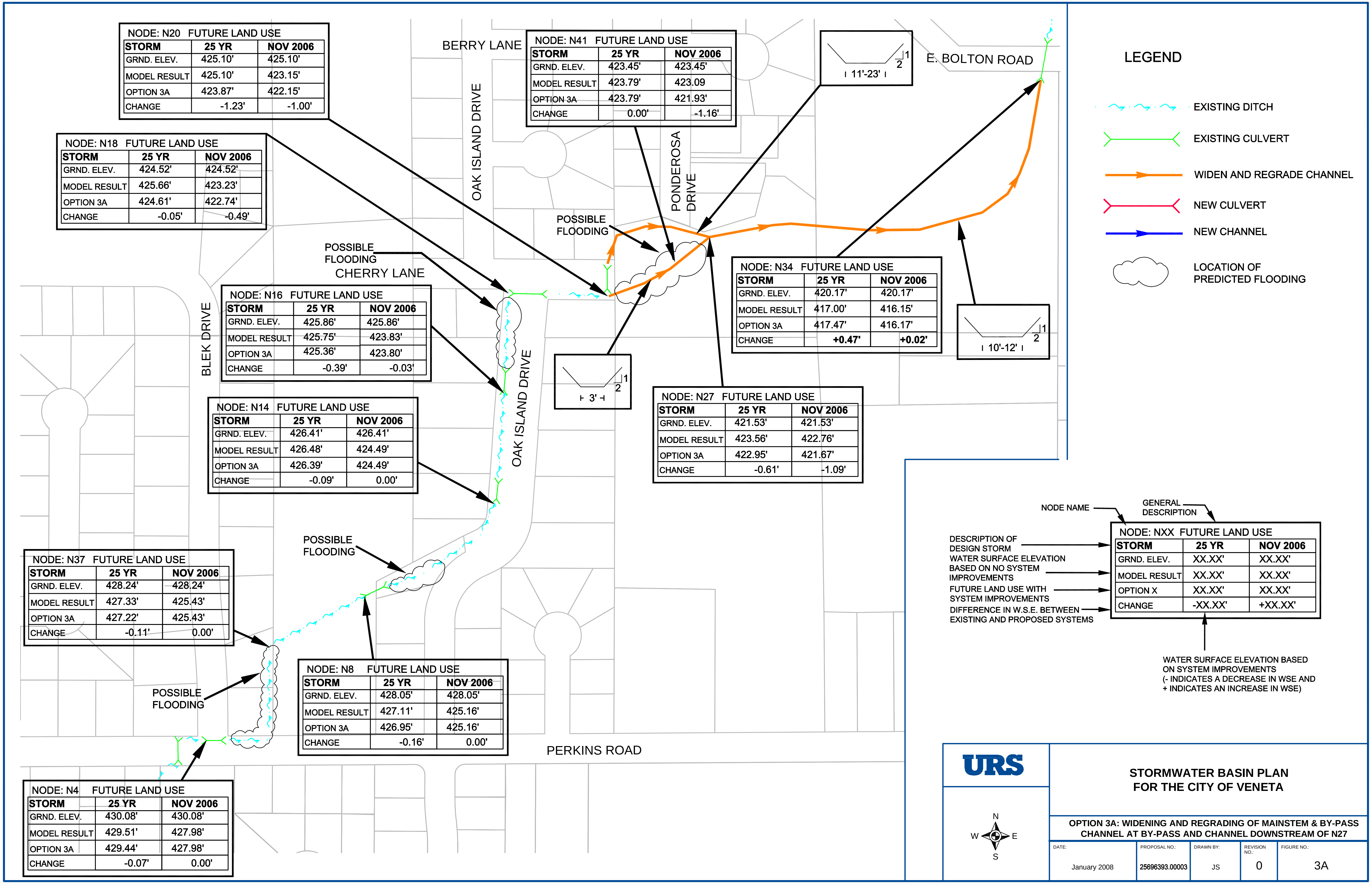
N
W E
S

STORMWATER BASIN PLAN FOR THE CITY OF VENETA

OPTION 3: WIDENING AND REGRADING OF MAINSTEM & BY-PASS CHANNEL AT BY-PASS AND CHANNEL DOWNSTREAM OF N27

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	3

25696393.00003 Option 3.dwg



NODE: N20 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.10'	425.10'
MODEL RESULT	425.10'	423.15'
OPTION 3A	423.87'	422.15'
CHANGE	-1.23'	-1.00'

NODE: N41 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	423.45'	423.45'
MODEL RESULT	423.79'	423.09
OPTION 3A	423.79'	421.93'
CHANGE	0.00'	-1.16'

NODE: N18 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	424.52'	424.52'
MODEL RESULT	425.66'	423.23'
OPTION 3A	424.61'	422.74'
CHANGE	-0.05'	-0.49'

NODE: N34 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	420.17'	420.17'
MODEL RESULT	417.00'	416.15'
OPTION 3A	417.47'	416.17'
CHANGE	**+0.47'**	**+0.02'**

NODE: N16 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.86'	425.86'
MODEL RESULT	425.75'	423.83'
OPTION 3A	425.36'	423.80'
CHANGE	-0.39'	-0.03'

NODE: N27 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	421.53'	421.53'
MODEL RESULT	423.56'	422.76'
OPTION 3A	422.95'	421.67'
CHANGE	-0.61'	-1.09'

NODE: N14 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	426.41'	426.41'
MODEL RESULT	426.48'	424.49'
OPTION 3A	426.39'	424.49'
CHANGE	-0.09'	0.00'

NODE: N37 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.24'	428.24'
MODEL RESULT	427.33'	425.43'
OPTION 3A	427.22'	425.43'
CHANGE	-0.11'	0.00'

NODE: N8 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.05'	428.05'
MODEL RESULT	427.11'	425.16'
OPTION 3A	426.95'	425.16'
CHANGE	-0.16'	0.00'

NODE: N4 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	430.08'	430.08'
MODEL RESULT	429.51'	427.98'
OPTION 3A	429.44'	427.98'
CHANGE	-0.07'	0.00'

NODE: NXX FUTURE LAND USE

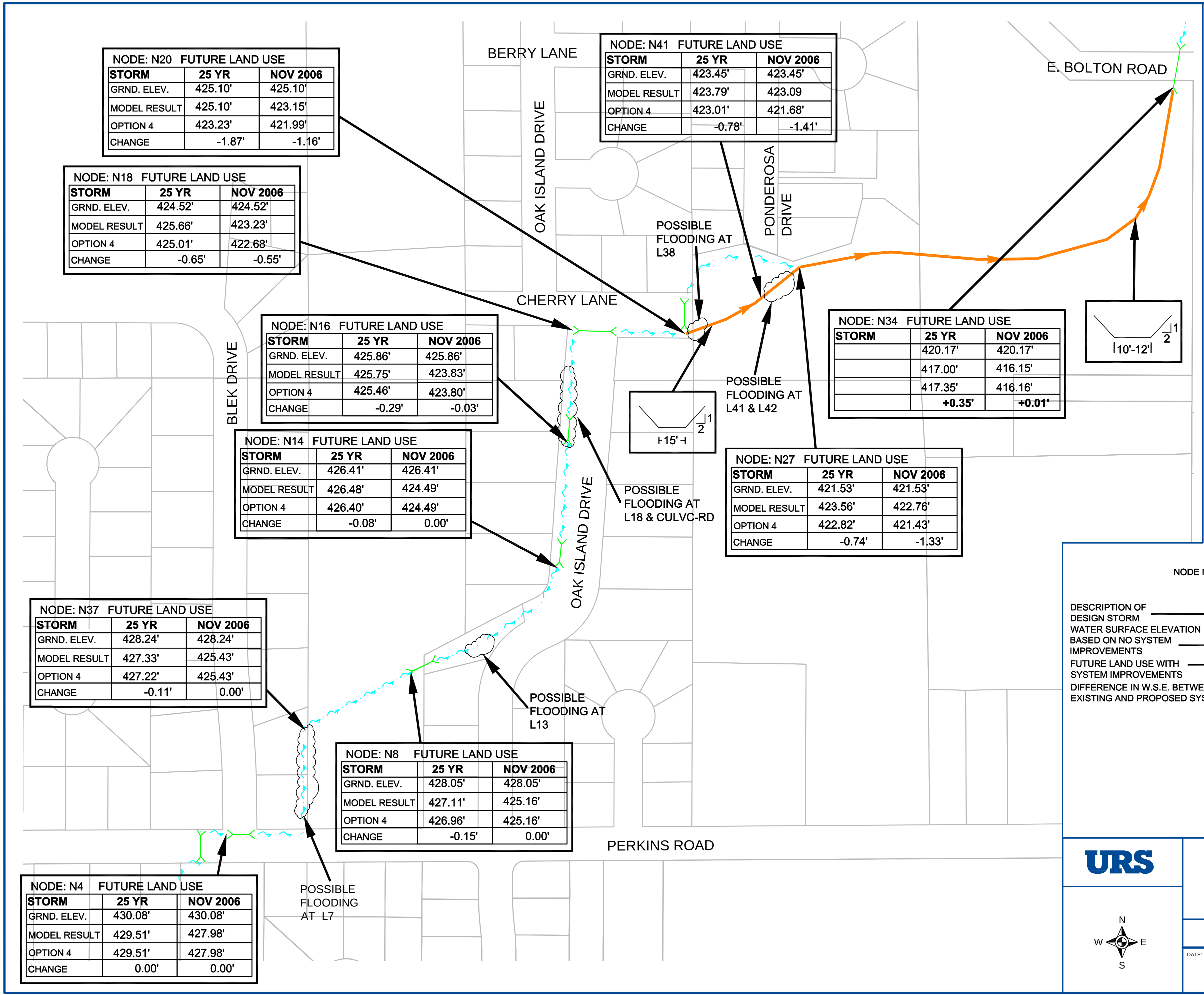
STORM	25 YR	NOV 2006
GRND. ELEV.	XX.XX'	XX.XX'
MODEL RESULT	XX.XX'	XX.XX'
OPTION X	XX.XX'	XX.XX'
CHANGE	-XX.XX'	+XX.XX'

URS

STORMWATER BASIN PLAN
FOR THE CITY OF VENETA

OPTION 3A: WIDENING AND REGRADING OF MAINSTEM & BY-PASS
CHANNEL AT BY-PASS AND CHANNEL DOWNSTREAM OF N27

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	3A



NODE: N20 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.10'	425.10'
MODEL RESULT	425.10'	423.15'
OPTION 4	423.23'	421.99'
CHANGE	-1.87'	-1.16'

NODE: N18 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	424.52'	424.52'
MODEL RESULT	425.66'	423.23'
OPTION 4	425.01'	422.68'
CHANGE	-0.65'	-0.55'

NODE: N41 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	423.45'	423.45'
MODEL RESULT	423.79'	423.09
OPTION 4	423.01'	421.68'
CHANGE	-0.78'	-1.41'

NODE: N16 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.86'	425.86'
MODEL RESULT	425.75'	423.83'
OPTION 4	425.46'	423.80'
CHANGE	-0.29'	-0.03'

NODE: N34 FUTURE LAND USE

STORM	25 YR	NOV 2006
	420.17'	420.17'
	417.00'	416.15'
	417.35'	416.16'
	+0.35'	+0.01'

NODE: N14 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	426.41'	426.41'
MODEL RESULT	426.48'	424.49'
OPTION 4	426.40'	424.49'
CHANGE	-0.08'	0.00'

NODE: N27 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	421.53'	421.53'
MODEL RESULT	423.56'	422.76'
OPTION 4	422.82'	421.43'
CHANGE	-0.74'	-1.33'

NODE: N37 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.24'	428.24'
MODEL RESULT	427.33'	425.43'
OPTION 4	427.22'	425.43'
CHANGE	-0.11'	0.00'

NODE: N8 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.05'	428.05'
MODEL RESULT	427.11'	425.16'
OPTION 4	426.96'	425.16'
CHANGE	-0.15'	0.00'

NODE: N4 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	430.08'	430.08'
MODEL RESULT	429.51'	427.98'
OPTION 4	429.51'	427.98'
CHANGE	0.00'	0.00'

LEGEND

- EXISTING DITCH
- EXISTING CULVERT
- WIDEN AND REGRADE CHANNEL
- NEW CULVERT
- NEW CHANNEL
- LOCATION OF PREDICTED FLOODING

NODE NAME

GENERAL DESCRIPTION

DESCRIPTION OF DESIGN STORM

WATER SURFACE ELEVATION BASED ON NO SYSTEM IMPROVEMENTS

FUTURE LAND USE WITH SYSTEM IMPROVEMENTS

DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS

NODE: NXX FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	XX.XX'	XX.XX'
MODEL RESULT	XX.XX'	XX.XX'
OPTION X	XX.XX'	XX.XX'
CHANGE	-XX.XX'	+XX.XX'

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS
(- INDICATES A DECREASE IN WSE AND
+ INDICATES AN INCREASE IN WSE)

URS

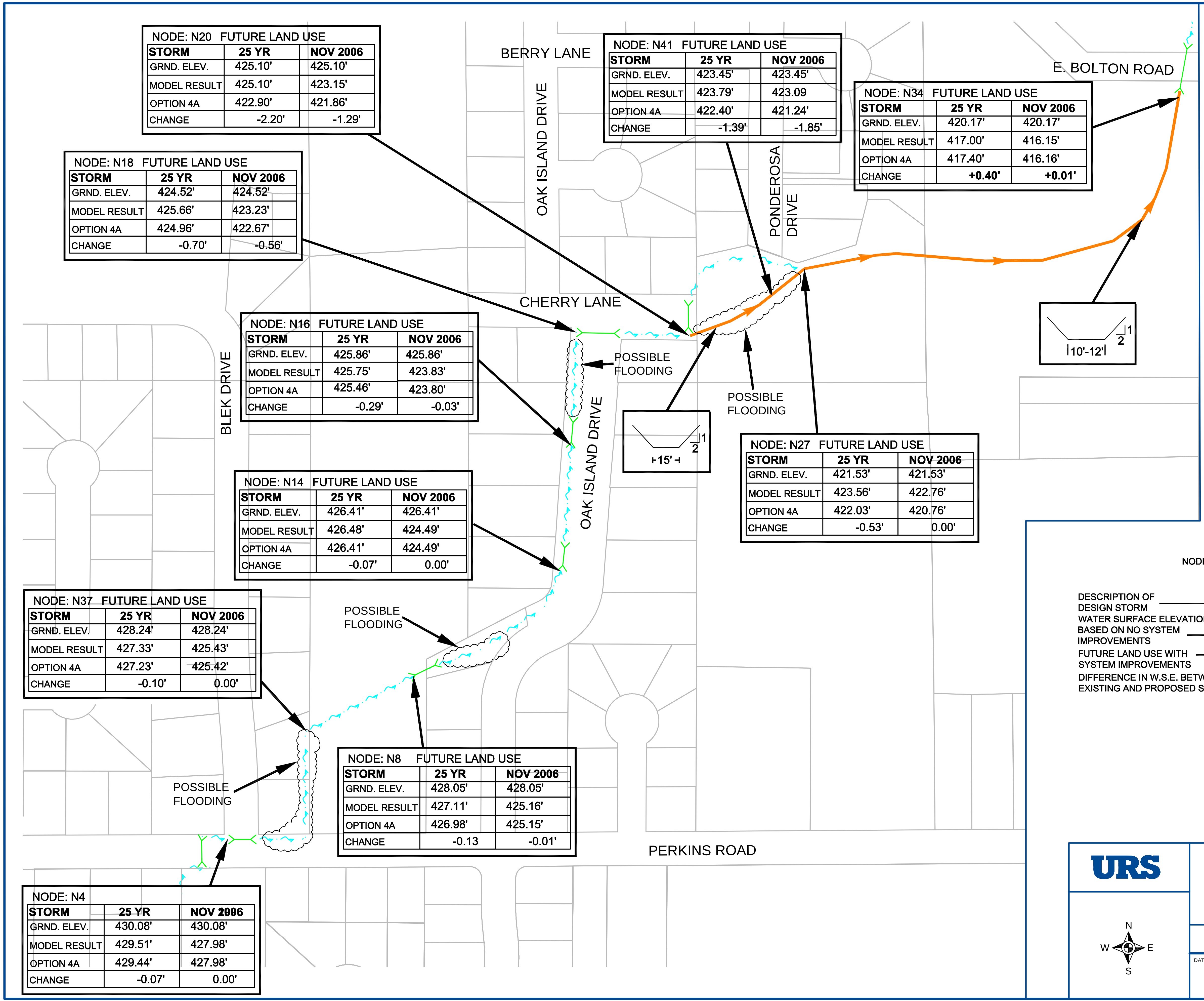
N
W E
S

**STORMWATER BASIN PLAN
FOR THE CITY OF VENETA**

**OPTION 4: WIDENING AND REGRADING OF BY-PASS CHANNEL
AND CHANNEL DOWNSTREAM OF N27**

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	4

25696393.00003 Option 4.dwg



NODE: N20 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.10'	425.10'
MODEL RESULT	425.10'	423.15'
OPTION 4A	422.90'	421.86'
CHANGE	-2.20'	-1.29'

NODE: N18 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	424.52'	424.52'
MODEL RESULT	425.66'	423.23'
OPTION 4A	424.96'	422.67'
CHANGE	-0.70'	-0.56'

NODE: N41 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	423.45'	423.45'
MODEL RESULT	423.79'	423.09
OPTION 4A	422.40'	421.24'
CHANGE	-1.39'	-1.85'

NODE: N34 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	420.17'	420.17'
MODEL RESULT	417.00'	416.15'
OPTION 4A	417.40'	416.16'
CHANGE	**+0.40'**	**+0.01'**

NODE: N16 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.86'	425.86'
MODEL RESULT	425.75'	423.83'
OPTION 4A	425.46'	423.80'
CHANGE	-0.29'	-0.03'

NODE: N27 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	421.53'	421.53'
MODEL RESULT	423.56'	422.76'
OPTION 4A	422.03'	420.76'
CHANGE	-0.53'	0.00'

NODE: N14 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	426.41'	426.41'
MODEL RESULT	426.48'	424.49'
OPTION 4A	426.41'	424.49'
CHANGE	-0.07'	0.00'

NODE: N37 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.24'	428.24'
MODEL RESULT	427.33'	425.43'
OPTION 4A	427.23'	425.42'
CHANGE	-0.10'	0.00'

NODE: N8 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.05'	428.05'
MODEL RESULT	427.11'	425.16'
OPTION 4A	426.98'	425.15'
CHANGE	-0.13	-0.01'

NODE: N4

STORM	25 YR	NOV 2006
GRND. ELEV.	430.08'	430.08'
MODEL RESULT	429.51'	427.98'
OPTION 4A	429.44'	427.98'
CHANGE	-0.07'	0.00'

LEGEND

-·-·-	EXISTING DITCH
>——<	EXISTING CULVERT
——▶	WIDEN AND REGRADE CHANNEL
>——<	NEW CULVERT
——▶	NEW CHANNEL
☁	LOCATION OF PREDICTED FLOODING

NODE NAME
GENERAL DESCRIPTION

NODE: NXX FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	XX.XX'	XX.XX'
MODEL RESULT	XX.XX'	XX.XX'
OPTION X	XX.XX'	XX.XX'
CHANGE	-XX.XX'	+XX.XX'

DESCRIPTION OF DESIGN STORM

WATER SURFACE ELEVATION BASED ON NO SYSTEM IMPROVEMENTS

FUTURE LAND USE WITH SYSTEM IMPROVEMENTS

DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS
(- INDICATES A DECREASE IN WSE AND
+ INDICATES AN INCREASE IN WSE)

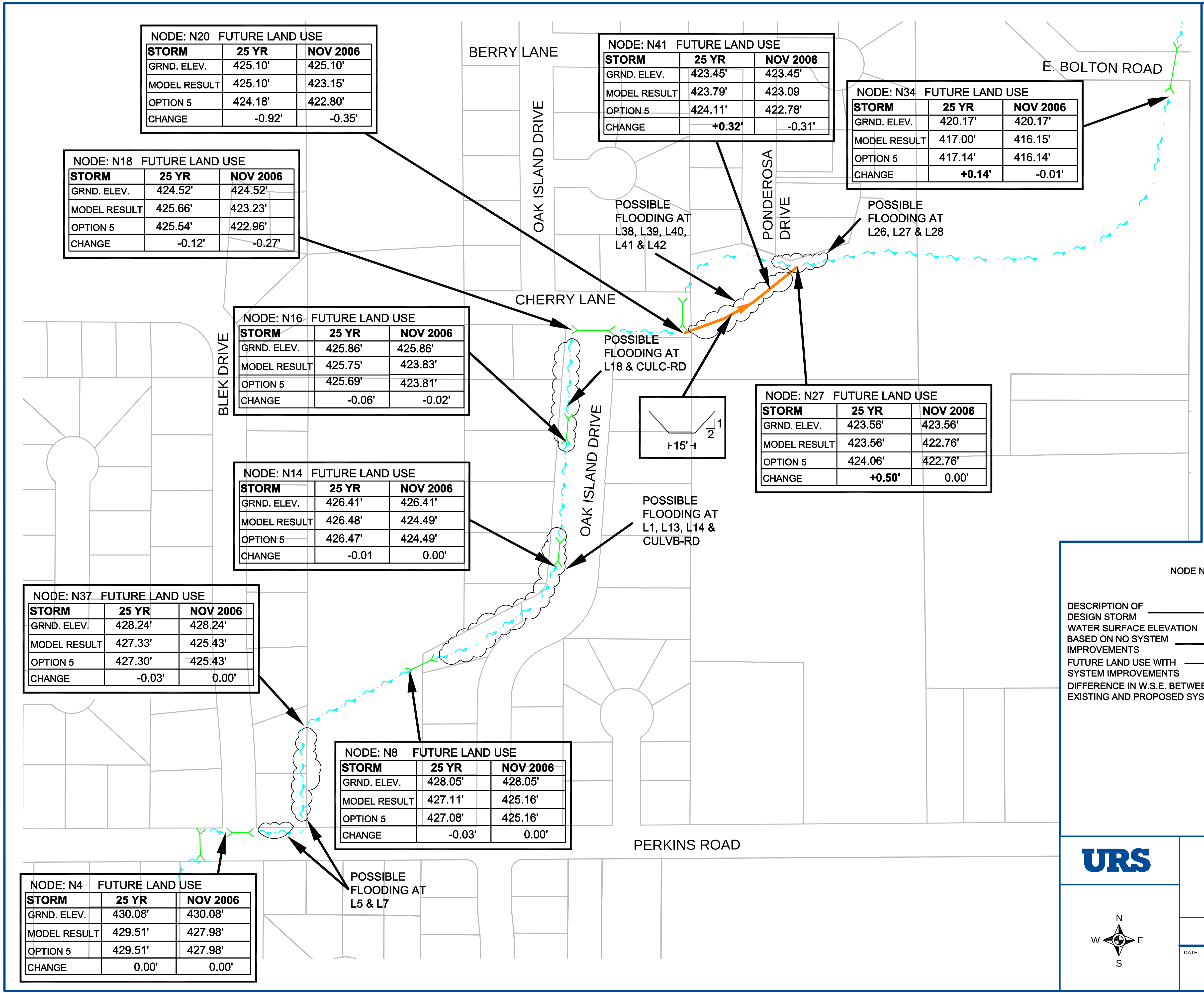
URS

N
W E
S

STORMWATER BASIN PLAN FOR THE CITY OF VENETA

OPTION 4A: WIDENING AND REGRADING OF BY-PASS CHANNEL AND CHANNEL DOWNSTREAM OF N27

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	4A



NODE: N20 FUTURE LAND USE

STORM	**25 YR**	**NOV 2006**
GRND. ELEV.	425.10'	425.10'
MODEL RESULT	425.10'	423.15'
OPTION 5	424.18'	422.80'
CHANGE	-0.92'	-0.35'

NODE: N18 FUTURE LAND USE

STORM	**25 YR**	**NOV 2006**
GRND. ELEV.	424.52'	424.52'
MODEL RESULT	425.66'	423.23'
OPTION 5	425.54'	422.96'
CHANGE	-0.12'	-0.27'

NODE: N41 FUTURE LAND USE

STORM	**25 YR**	**NOV 2006**
GRND. ELEV.	423.45'	423.45'
MODEL RESULT	423.79'	423.09
OPTION 5	424.11'	422.78'
CHANGE	**+0.32'**	-0.31'

NODE: N34 FUTURE LAND USE

STORM	**25 YR**	**NOV 2006**
GRND. ELEV.	420.17'	420.17'
MODEL RESULT	417.00'	416.15'
OPTION 5	417.14'	416.14'
CHANGE	**+0.14'**	-0.01'

NODE: N16 FUTURE LAND USE

STORM	**25 YR**	**NOV 2006**
GRND. ELEV.	425.86'	425.86'
MODEL RESULT	425.75'	423.83'
OPTION 5	425.69'	423.81'
CHANGE	-0.06'	-0.02'

NODE: N27 FUTURE LAND USE

STORM	**25 YR**	**NOV 2006**
GRND. ELEV.	423.56'	423.56'
MODEL RESULT	423.56'	422.76'
OPTION 5	424.06'	422.76'
CHANGE	**+0.50'**	0.00'

NODE: N14 FUTURE LAND USE

STORM	**25 YR**	**NOV 2006**
GRND. ELEV.	426.41'	426.41'
MODEL RESULT	426.48'	424.49'
OPTION 5	426.47'	424.49'
CHANGE	-0.01	0.00'

NODE: N37 FUTURE LAND USE

STORM	**25 YR**	**NOV 2006**
GRND. ELEV.	428.24'	428.24'
MODEL RESULT	427.33'	425.43'
OPTION 5	427.30'	425.43'
CHANGE	-0.03'	0.00'

NODE: N8 FUTURE LAND USE

STORM	**25 YR**	**NOV 2006**
GRND. ELEV.	428.05'	428.05'
MODEL RESULT	427.11'	425.16'
OPTION 5	427.08'	425.16'
CHANGE	-0.03'	0.00'

NODE: N4 FUTURE LAND USE

STORM	**25 YR**	**NOV 2006**
GRND. ELEV.	430.08'	430.08'
MODEL RESULT	429.51'	427.98'
OPTION 5	429.51'	427.98'
CHANGE	0.00'	0.00'

LEGEND

⋯	EXISTING DITCH
≻—≺	EXISTING CULVERT
→	WIDEN AND REGRADE CHANNEL
≻—≺	NEW CULVERT
→	NEW CHANNEL
☁	LOCATION OF PREDICTED FLOODING

NODE NAME

GENERAL DESCRIPTION

DESCRIPTION OF DESIGN STORM

WATER SURFACE ELEVATION BASED ON NO SYSTEM IMPROVEMENTS

FUTURE LAND USE WITH SYSTEM IMPROVEMENTS

DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS

NODE: NXX FUTURE LAND USE

STORM	**25 YR**	**NOV 2006**
GRND. ELEV.	XX.XX'	XX.XX'
MODEL RESULT	XX.XX'	XX.XX'
OPTION X	XX.XX'	XX.XX'
CHANGE	-XX.XX'	+XX.XX'

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS
(- INDICATES A DECREASE IN WSE AND
+ INDICATES AN INCREASE IN WSE)

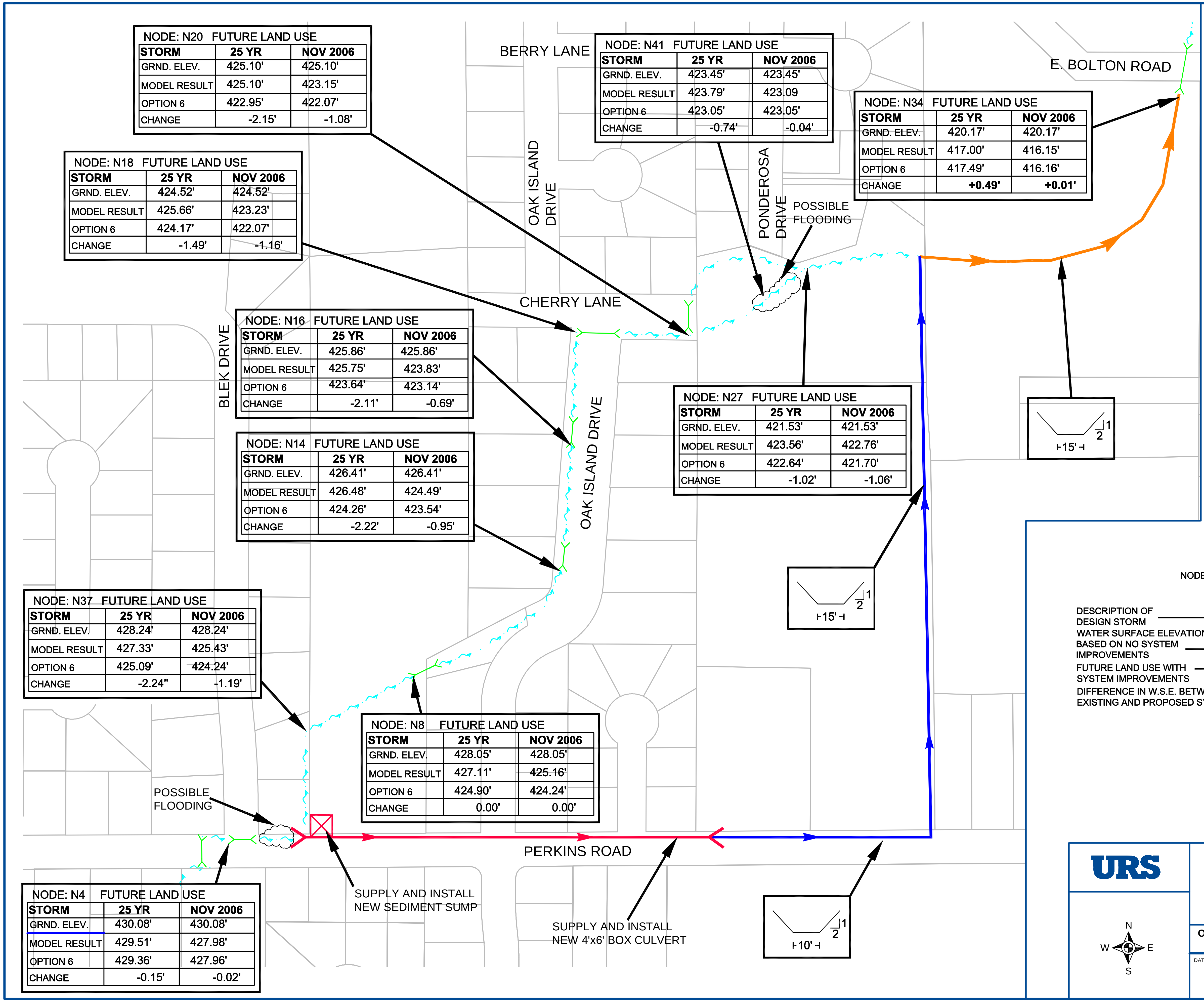
URS

STORMWATER BASIN PLAN FOR THE CITY OF VENETA

OPTION 5: WIDENING AND REGRADING OF BY-PASS CHANNEL

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	5

25696393.00003 Option 5.dwg



NODE: N20 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.10'	425.10'
MODEL RESULT	425.10'	423.15'
OPTION 6	422.95'	422.07'
CHANGE	-2.15'	-1.08'

NODE: N41 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	423.45'	423.45'
MODEL RESULT	423.79'	423.09
OPTION 6	423.05'	423.05'
CHANGE	-0.74'	-0.04'

NODE: N34 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	420.17'	420.17'
MODEL RESULT	417.00'	416.15'
OPTION 6	417.49'	416.16'
CHANGE	**+0.49'**	**+0.01'**

NODE: N18 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	424.52'	424.52'
MODEL RESULT	425.66'	423.23'
OPTION 6	424.17'	422.07'
CHANGE	-1.49'	-1.16'

NODE: N16 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.86'	425.86'
MODEL RESULT	425.75'	423.83'
OPTION 6	423.64'	423.14'
CHANGE	-2.11'	-0.69'

NODE: N14 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	426.41'	426.41'
MODEL RESULT	426.48'	424.49'
OPTION 6	424.26'	423.54'
CHANGE	-2.22'	-0.95'

NODE: N27 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	421.53'	421.53'
MODEL RESULT	423.56'	422.76'
OPTION 6	422.64'	421.70'
CHANGE	-1.02'	-1.06'

NODE: N37 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.24'	428.24'
MODEL RESULT	427.33'	425.43'
OPTION 6	425.09'	424.24'
CHANGE	-2.24"	-1.19'

NODE: N8 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.05'	428.05'
MODEL RESULT	427.11'	425.16'
OPTION 6	424.90'	424.24'
CHANGE	0.00'	0.00'

NODE: N4 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	430.08'	430.08'
MODEL RESULT	429.51'	427.98'
OPTION 6	429.36'	427.96'
CHANGE	-0.15'	-0.02'

LEGEND

~·~·~	EXISTING DITCH
>——<	EXISTING CULVERT
——►	WIDEN AND REGRADE CHANNEL
>——<	NEW CULVERT
——►	NEW CHANNEL
☁	LOCATION OF PREDICTED FLOODING

NODE NAME

GENERAL DESCRIPTION

NODE: NXX FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	XX.XX'	XX.XX'
MODEL RESULT	XX.XX'	XX.XX'
OPTION X	XX.XX'	XX.XX'
CHANGE	-XX.XX'	+XX.XX'

DESCRIPTION OF DESIGN STORM

WATER SURFACE ELEVATION BASED ON NO SYSTEM IMPROVEMENTS

FUTURE LAND USE WITH SYSTEM IMPROVEMENTS

DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS
(- INDICATES A DECREASE IN WSE AND
+ INDICATES AN INCREASE IN WSE)

URS

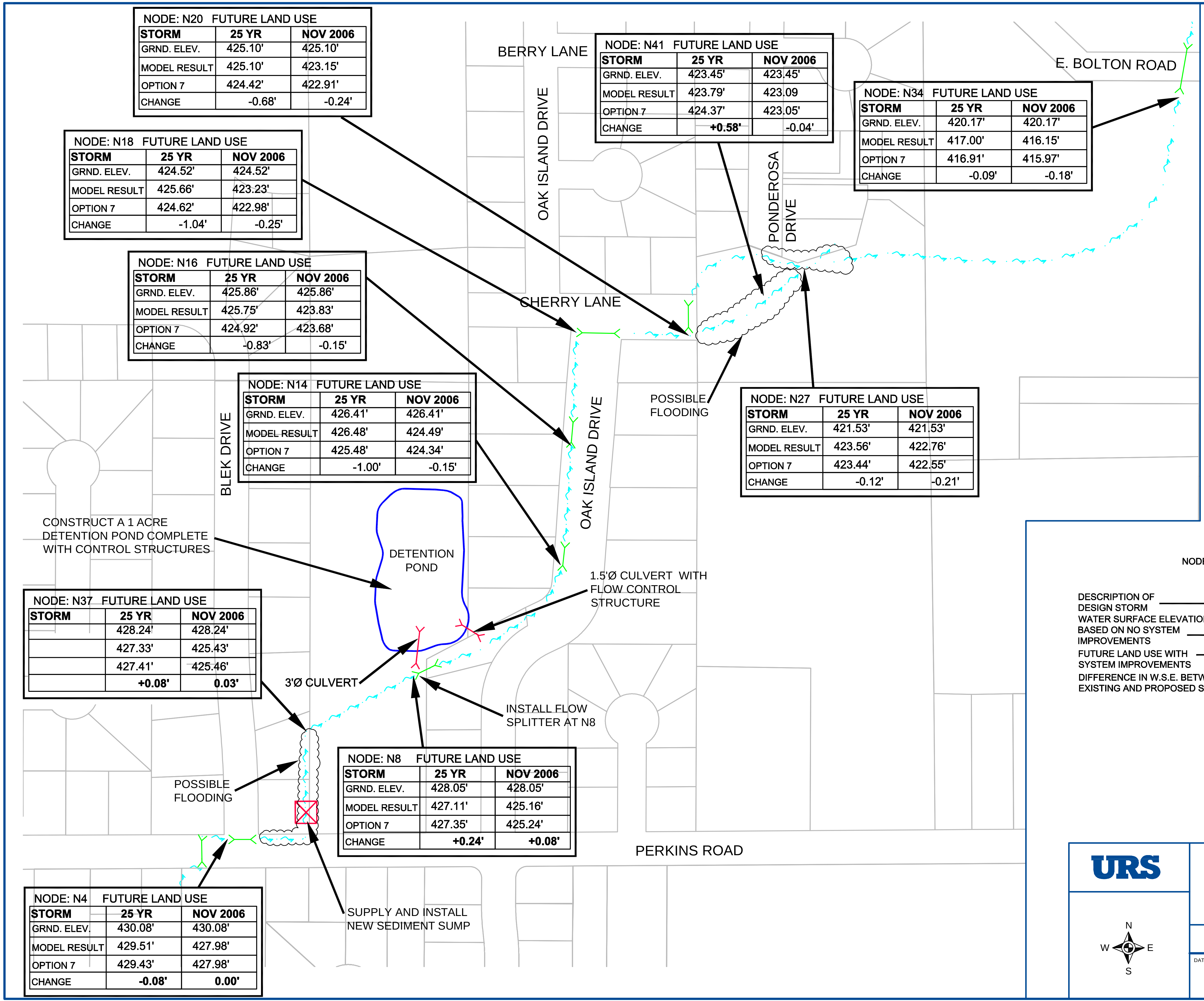
N
W E
S

STORMWATER BASIN PLAN FOR THE CITY OF VENETA

OPTION 6: REGRADE AND WIDEN EXISTING DOWNSTREAM CHANNEL AND INSTALL NEW BY-PASS CHANNEL DOWN PERKINS AVE.

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	6

25696393.00003 Option 6.dwg



NODE: N20 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.10'	425.10'
MODEL RESULT	425.10'	423.15'
OPTION 7	424.42'	422.91'
CHANGE	-0.68'	-0.24'

NODE: N18 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	424.52'	424.52'
MODEL RESULT	425.66'	423.23'
OPTION 7	424.62'	422.98'
CHANGE	-1.04'	-0.25'

NODE: N16 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.86'	425.86'
MODEL RESULT	425.75'	423.83'
OPTION 7	424.92'	423.68'
CHANGE	-0.83'	-0.15'

NODE: N14 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	426.41'	426.41'
MODEL RESULT	426.48'	424.49'
OPTION 7	425.48'	424.34'
CHANGE	-1.00'	-0.15'

NODE: N41 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	423.45'	423.45'
MODEL RESULT	423.79'	423.09
OPTION 7	424.37'	423.05'
CHANGE	+0.58'	-0.04'

NODE: N34 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	420.17'	420.17'
MODEL RESULT	417.00'	416.15'
OPTION 7	416.91'	415.97'
CHANGE	-0.09'	-0.18'

NODE: N27 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	421.53'	421.53'
MODEL RESULT	423.56'	422.76'
OPTION 7	423.44'	422.55'
CHANGE	-0.12'	-0.21'

NODE: N37 FUTURE LAND USE

STORM	25 YR	NOV 2006
	428.24'	428.24'
	427.33'	425.43'
	427.41'	425.46'
	+0.08'	0.03'

NODE: N8 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.05'	428.05'
MODEL RESULT	427.11'	425.16'
OPTION 7	427.35'	425.24'
CHANGE	+0.24'	+0.08'

NODE: N4 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	430.08'	430.08'
MODEL RESULT	429.51'	427.98'
OPTION 7	429.43'	427.98'
CHANGE	-0.08'	0.00'

LEGEND

⋯	EXISTING DITCH
>—<	EXISTING CULVERT
→	WIDEN AND REGRADE CHANNEL
>—<	NEW CULVERT
→	NEW CHANNEL
☁	LOCATION OF PREDICTED FLOODING

NODE NAME

GENERAL DESCRIPTION

DESCRIPTION OF DESIGN STORM

WATER SURFACE ELEVATION BASED ON NO SYSTEM IMPROVEMENTS

FUTURE LAND USE WITH SYSTEM IMPROVEMENTS

DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS

NODE: NXX FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	XX.XX'	XX.XX'
MODEL RESULT	XX.XX'	XX.XX'
OPTION X	XX.XX'	XX.XX'
CHANGE	-XX.XX'	+XX.XX'

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS
(- INDICATES A DECREASE IN WSE AND
+ INDICATES AN INCREASE IN WSE)

URS

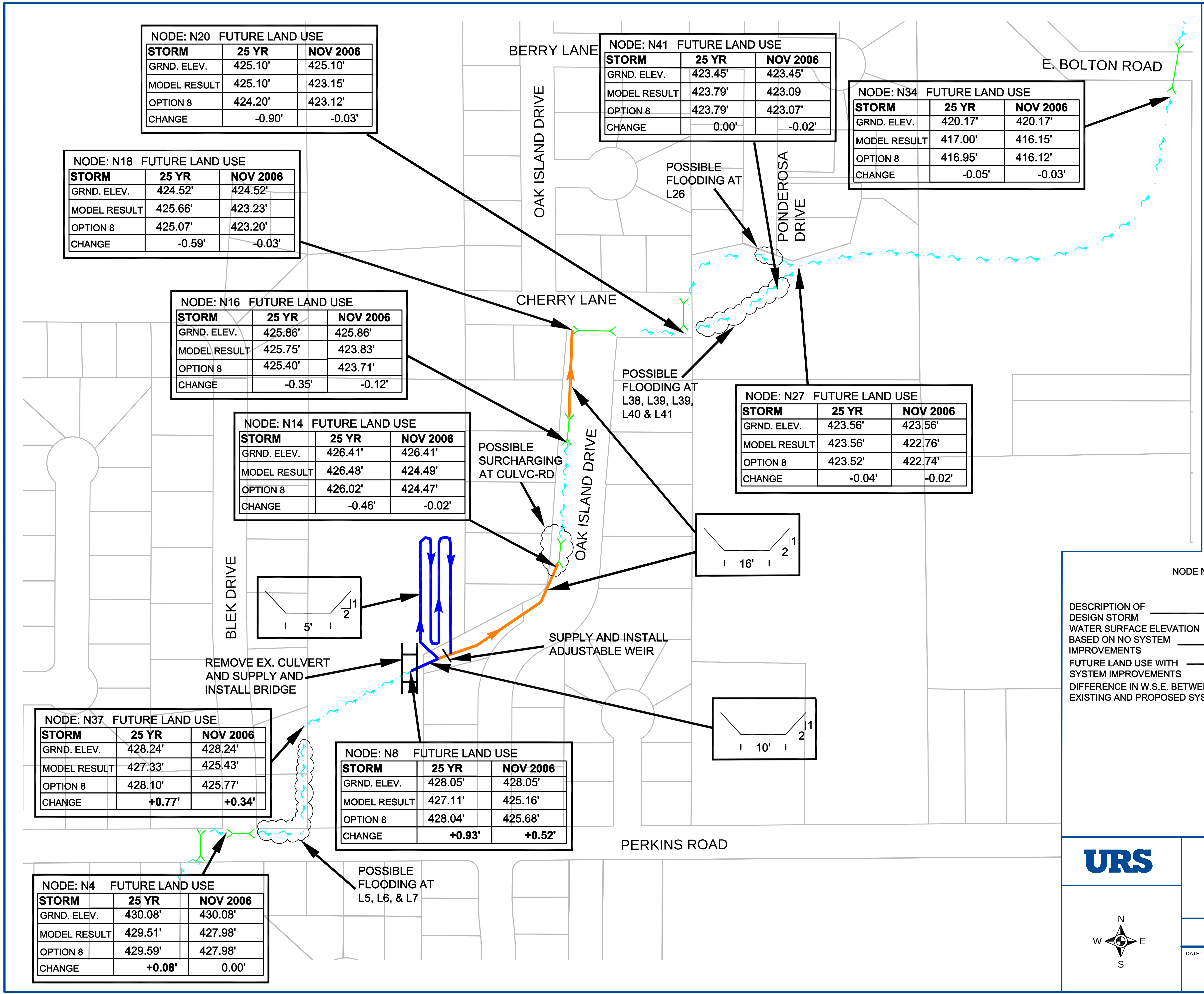
N
W E
S

STORMWATER BASIN PLAN
FOR THE CITY OF VENETA

OPTION 7: INSTALL NEW 1 ACRE DETENTION POND

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	7

20071686.184 Veneta Civil Engineering.Figure 7.dwg



NODE: N20 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.10'	425.10'
MODEL RESULT	425.10'	423.15'
OPTION 8	424.20'	423.12'
CHANGE	-0.90'	-0.03'

NODE: N41 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	423.45'	423.45'
MODEL RESULT	423.79'	423.09
OPTION 8	423.79'	423.07'
CHANGE	0.00'	-0.02'

NODE: N34 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	420.17'	420.17'
MODEL RESULT	417.00'	416.15'
OPTION 8	416.95'	416.12'
CHANGE	-0.05'	-0.03'

NODE: N18 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	424.52'	424.52'
MODEL RESULT	425.66'	423.23'
OPTION 8	425.07'	423.20'
CHANGE	-0.59'	-0.03'

NODE: N16 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	425.86'	425.86'
MODEL RESULT	425.75'	423.83'
OPTION 8	425.40'	423.71'
CHANGE	-0.35'	-0.12'

NODE: N27 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	423.56'	423.56'
MODEL RESULT	423.56'	422.76'
OPTION 8	423.52'	422.74'
CHANGE	-0.04'	-0.02'

NODE: N14 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	426.41'	426.41'
MODEL RESULT	426.48'	424.49'
OPTION 8	426.02'	424.47'
CHANGE	-0.46'	-0.02'

NODE: N37 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.24'	428.24'
MODEL RESULT	427.33'	425.43'
OPTION 8	428.10'	425.77'
CHANGE	**+0.77'**	**+0.34'**

NODE: N8 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	428.05'	428.05'
MODEL RESULT	427.11'	425.16'
OPTION 8	428.04'	425.68'
CHANGE	**+0.93'**	**+0.52'**

NODE: N4 FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	430.08'	430.08'
MODEL RESULT	429.51'	427.98'
OPTION 8	429.59'	427.98'
CHANGE	**+0.08'**	0.00'

LEGEND

🟦	EXISTING DITCH
🟩	EXISTING CULVERT
🟧	WIDEN AND REGRADE CHANNEL
🟥	NEW CULVERT
🟦	NEW CHANNEL
☁	LOCATION OF PREDICTED FLOODING

NODE NAME

GENERAL DESCRIPTION

NODE: NXX FUTURE LAND USE

STORM	25 YR	NOV 2006
GRND. ELEV.	XX.XX'	XX.XX'
MODEL RESULT	XX.XX'	XX.XX'
OPTION X	XX.XX'	XX.XX'
CHANGE	-XX.XX'	+XX.XX'

DESCRIPTION OF DESIGN STORM

WATER SURFACE ELEVATION BASED ON NO SYSTEM IMPROVEMENTS

FUTURE LAND USE WITH SYSTEM IMPROVEMENTS

DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS
(- INDICATES A DECREASE IN WSE AND
+ INDICATES AN INCREASE IN WSE)

URS

N
W E
S

STORMWATER BASIN PLAN
FOR THE CITY OF VENETA

OPTION 8: INSTALL NEW SIDE CHANNEL

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	8

20071686.184 Veneta Civil Engineering.Figure 8.dwg

Appendix C

Detailed Hydraulic Modeling Results for each CIP Alternative

OPTION 1

						NOVEMBER 2006 FUTURE					25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.25	426.394	2.5	5.47	427.98	428.75	427.97	428.89	26.6	429.51	428.75	429.3	428.89
Blek2	N4	N5	426.518	426.532	2.5	4.43	427.98	429.02	427.97	429.03	27.45	429.51	429.02	429.3	429.03
BlekRD	N4	N5	430.01	430.01	0.5	0.00	427.97	430.51	427.97	430.51	0	429.3	430.51	429.3	430.51
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Link44	N21	N22	421.1	420.952	3.6	14.04	422.57	424.41	422.54	424.29	55.97	423.888	424.41	423.845	424.29
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete	N34	N35	414.684	414.654	4	8.89	416.15	418.68	416.09	418.65	32.9	417.172	418.68	417.02	418.65
County	N34	N35	414.684	414.654	4	8.89	416.15	418.68	416.09	418.65	32.9	417.172	418.68	417.02	418.65
RD	N34	N35	420.37	420.37	0.5	0.00	416.09	420.87	416.09	420.87	0	417.02	420.87	417.02	420.87
CulvA1	N8	N9	423.998	423.602	2.5	13.18	425.16	426.50	425.16	426.10	34.45	427.049	426.50	426.866	426.10
CulvA2	N8	N9	423.778	423.672	2.5	-1.62	425.16	426.28	425.16	426.17	36.94	427.049	426.28	426.866	426.17
CulvA-RD	N8	N9	428.884	428.884	0.5	0.00	425.16	429.38	425.16	429.38	0	426.866	429.38	426.866	429.38
CulvB1	N14	N15	423.266	423.202	2	4.57	424.49	425.27	424.46	425.20	22.71	426.442	425.27	426.039	425.20
CulvB2	N14	N15	423.302	423.206	2	4.69	424.49	425.30	424.46	425.21	22.71	426.442	425.30	426.039	425.21
CulvB3	N14	N15	423.274	423.272	2	3.99	424.49	425.27	424.46	425.27	22.71	426.442	425.27	426.039	425.27
CulvB-RD	N14	N15	426.46	426.46	0.5	0.00	424.46	426.96	424.46	426.96	0	426.039	426.96	426.039	426.96
CulvC1	N16	N17	422.918	422.698	2	5.41	423.80	424.92	423.70	424.70	21.67	425.596	424.92	425.352	424.70
CulvC2	N16	N17	422.89	422.874	2	3.94	423.80	424.89	423.70	424.87	22.13	425.596	424.89	425.352	424.87
CulvC3	N16	N17	422.89	422.83	2	4.29	423.80	424.89	423.70	424.83	22.11	425.596	424.89	425.352	424.83
CulvC-RD	N16	N17	425.36	425.36	0.5	0.00	423.70	425.86	423.70	425.86	13.82	425.596	425.86	425.547	425.86
L1	N1	N2	427.59	427.59	2.59	9.90	428.63	430.18	428.58	430.18	54.1	429.884	430.18	429.781	430.18
L10	N9	N10	423.66	424.14	3.5	13.26	425.16	427.16	425.15	427.64	70.72	426.866	427.16	426.844	427.64
L11	N38	N12	424.03	423.89	2.77	13.26	425.14	426.80	424.91	426.66	69.86	426.839	426.80	426.628	426.66
L13	N12	N13	423.89	423.72	2.77	13.25	424.91	426.66	424.89	426.49	69.36	426.628	426.66	426.619	426.49
L14	N13	N14	423.72	423.46	2.95	13.25	424.89	426.67	424.49	426.41	68.76	426.619	426.67	426.442	426.41
L16	N15	N16	423.37	423.1	2.76	13.25	424.46	426.13	423.80	425.86	66.93	426.039	426.13	425.596	425.86
L18	N17	N18	422.88	421.55	2.97	13.63	423.70	425.85	422.82	424.52	64.86	425.352	425.85	425.311	424.52
L20	N19	N20	421.38	421.1	4	13.61	422.75	425.38	422.57	425.10	63.32	424.104	425.38	423.902	425.10
L21	N20	N21	421.1	421.1	4	14.05	422.57	425.10	422.57	425.10	55.97	423.902	425.10	423.888	425.10
L23	N22	N23	420.952	420.94	3.69	14.03	422.54	424.64	422.52	424.61	55.96	423.845	424.64	423.812	424.61
L24	N23	N24	420.94	420.92	3.25	14.02	422.52	424.53	422.51	424.17	55.96	423.812	424.53	423.782	424.17
L25	N24	N25	420.92	420.87	3.25	14.00	422.51	424.11	422.48	424.50	55.96	423.782	424.11	423.73	424.50
L26	N25	N26	420.87	420.86	2.2	13.99	422.48	423.50	422.48	424.05	55.96	423.73	423.50	423.709	424.05
L27	N26	N27	420.86	420.82	2.43	13.99	422.48	423.93	422.43	423.56	55.96	423.709	423.93	423.56	423.56
L28	N27	N28	420.82	420.76	2.43	14.19	422.43	423.56	422.37	423.45	54.5	423.56	423.56	423.356	423.45
L29	N28	N29	420.76	420.71	2.54	14.17	422.37	423.56	422.32	423.25	54.41	423.356	423.56	423.188	423.25
L3	N3	N4	427.18	426.92	3.16	9.89	428.07	430.34	427.98	430.08	53.99	429.544	430.34	429.51	430.08
L30	N29	N30	420.71	420.42	2.55	14.16	422.32	423.26	421.97	422.97	54.34	423.188	423.26	422.82	422.97
L31	N30	N31	420.42	420.06	2.5	14.15	421.97	422.92	421.73	422.56	54.19	422.82	422.92	422.538	422.56
L32	N31	N33	420.06	419.76	2.5	14.03	421.73	422.56	421.07	422.26	53.81	422.538	422.56	422.023	422.26
L33	N33	N34	419.76	417.37	2.8	13.90	421.07	422.56	418.02	420.17	53.36	422.023	422.56	418.582	420.17
L35	N35	N36	414.654	414.65	6	17.78	416.09	420.65	415.43	420.65	65.79	417.02	420.65	416.145	420.65
L36	N37	N8	423.89	423.7	4.35	13.14	425.43	428.24	425.16	428.05	70.89	427.278	428.24	427.049	428.05
L37	N10	N38	424.14	424.03	3	13.26	425.15	427.14	425.14	427.03	70.58	426.844	427.14	426.839	427.03
L38	N20	N39	421.1	422.64	2.02	0.00	422.57	423.12	422.64	424.66	8.91	423.902	423.12	423.902	424.66
L39	N39	N40	422.67	423.08	0.95	0.00	422.64	423.62	422.64	424.03	8.89	423.902	423.62	423.8	424.03
L40	N40	N41	423.08	423.05	0.74	0.00	423.05	423.82	423.05	423.79	8.9	423.8	423.82	423.79	423.79
L41	N41	N42	423.05	422.24	0.4	0.00	423.05	423.45	422.43	422.64	1.85	423.79	423.45	423.55	422.64
L42	N42	N27	422.24	420.82	0.4	0.04	422.43	422.64	422.43	421.53	1.54	423.55	422.64	423.56	421.53
L5	N5	N6	426.64	426.91	2.46	13.15	427.97	429.10	427.78	429.37	72.37	429.3	429.10	428.868	429.37
L6	N6	N7	426.91	426.24	2.46	13.15	427.78	429.37	427.53	428.70	72.34	428.868	429.37	428.657	428.70
L7	N7	N37	426.24	423.89	2.95	13.14	427.53	429.19	425.43	426.84	72.2	428.657	429.19	427.278	426.84
Oak1	N18	N19	421.638	421.234	3.3	6.89	422.82	424.94	422.75	424.53	31.66	425.311	424.94	424.104	424.53
Oak2	N18	N19	421.498	421.368	3.3	6.73	422.82	424.80	422.75	424.67	31.66	425.311	424.80	424.104	424.67
Oak-RD	N18	N19	425.86	425.86	0.5	0.00	422.75	426.36	422.75	426.36	0	424.104	426.36	424.104	426.36
Perkins1	N2	N3	428.046	427.798	2	2.71	428.58	430.05	428.33	429.80	18.19	429.781	430.05	429.544	429.80
Perkins2	N2	N3	427.808	427.748	2	3.63	428.58	429.81	428.41	429.75	17.14	429.781	429.81	429.544	429.75
Perkins3	N2	N3	427.982	427.71	2	3.55	428.58	429.98	428.30	429.71	18.72	429.781	429.98	429.544	429.71
PerkinsRD	N2	N3	432.356	432.356	0.5	0.00	428.07	432.86	428.07	432.86	0	429.544	432.86	429.544	432.86

🟥	Surcharging or Flooding of Conduit for CIP Option

OPTION 2

						NOVEMBER 2006 FUTURE					25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.25	426.39	2.50	5.47	427.98	428.75	427.97	428.89	26.60	429.51	428.75	429.30	428.89
Blek2	N4	N5	426.52	426.53	2.50	4.43	427.98	429.02	427.97	429.03	27.46	429.51	429.02	429.30	429.03
BlekRD	N4	N5	430.01	430.01	0.50	0.00	427.97	430.51	427.97	430.51	0.00	429.30	430.51	429.30	430.51
Cherry1	N21	N22	421.11	420.95	3.30	2.60	422.45	424.41	422.45	424.25	7.83	423.86	424.41	423.80	424.25
Cherry2	N21	N22	421.11	420.99	3.30	2.52	422.45	424.41	422.45	424.29	7.82	423.86	424.41	423.80	424.29
Cherry-RD	N21	N22	425.06	425.06	0.50	0.00	422.45	425.56	422.45	425.56	0.00	423.80	425.56	423.80	425.56
Concrete	N34	N35	414.68	414.65	4.00	8.81	416.15	418.68	416.09	418.65	34.37	417.22	418.68	417.06	418.65
County	N34	N35	414.68	414.65	4.00	8.81	416.15	418.68	416.09	418.65	34.37	417.22	418.68	417.06	418.65
RD	N34	N35	420.37	420.37	0.50	0.00	416.09	420.87	416.09	420.87	0.00	417.06	420.87	417.06	420.87
CulvA1	N8	N9	424.00	423.60	2.50	13.18	425.16	426.50	425.16	426.10	34.59	427.03	426.50	426.84	426.10
CulvA2	N8	N9	423.78	423.67	2.50	-1.62	425.16	426.28	425.16	426.17	37.07	427.03	426.28	426.84	426.17
CulvA-RD	N8	N9	428.88	428.88	0.50	0.00	425.16	429.38	425.16	429.38	0.00	426.84	429.38	426.84	429.38
CulvB1	N14	N15	423.27	423.20	2.00	4.57	424.49	425.27	424.46	425.20	22.85	426.42	425.27	426.03	425.20
CulvB2	N14	N15	423.30	423.21	2.00	4.69	424.49	425.30	424.46	425.21	22.85	426.42	425.30	426.03	425.21
CulvB3	N14	N15	423.27	423.27	2.00	3.99	424.49	425.27	424.46	425.27	22.84	426.42	425.27	426.03	425.27
CulvB-RD	N14	N15	426.46	426.46	0.50	0.00	424.46	426.96	424.46	426.96	0.00	426.03	426.96	426.03	426.96
CulvC1	N16	N17	422.92	422.70	2.00	5.40	423.80	424.92	423.70	424.70	22.13	425.56	424.92	425.29	424.70
CulvC2	N16	N17	422.89	422.87	2.00	3.94	423.80	424.89	423.70	424.87	22.46	425.56	424.89	425.29	424.87
CulvC3	N16	N17	422.89	422.83	2.00	4.29	423.80	424.89	423.70	424.83	22.47	425.56	424.89	425.29	424.83
CulvC-RD	N16	N17	425.36	425.36	0.50	0.00	423.70	425.86	423.70	425.86	10.35	425.56	425.86	425.51	425.86
L1	N1	N2	427.59	427.59	2.59	9.90	428.63	430.18	428.58	430.18	54.10	429.88	430.18	429.78	430.18
L10	N9	N10	423.66	424.14	3.50	13.26	425.16	427.16	425.15	427.64	71.01	426.84	427.16	426.82	427.64
L11	N38	N12	424.03	423.89	2.77	13.26	425.14	426.80	424.91	426.66	70.15	426.82	426.80	426.61	426.66
L13	N12	N13	423.89	423.72	2.77	13.25	424.91	426.66	424.89	426.49	69.72	426.61	426.66	426.60	426.49
L14	N13	N14	423.72	423.46	2.95	13.25	424.89	426.67	424.49	426.41	69.11	426.60	426.67	426.42	426.41
L16	N15	N16	423.37	423.10	2.76	13.25	424.46	426.13	423.80	425.86	67.33	426.03	426.13	425.56	425.86
L18	N17	N18	422.88	421.55	2.97	13.63	423.70	425.85	422.77	424.52	64.66	425.29	425.85	425.24	424.52
L20	N19	N20	421.38	421.10	4.00	13.61	422.68	425.38	422.45	425.10	62.52	424.07	425.38	423.86	425.10
L21	N20	N21	421.10	421.10	4.00	5.13	422.45	425.10	422.45	425.10	15.66	423.86	425.10	423.86	425.10
L23	N22	N23	420.95	420.94	3.69	5.12	422.45	424.64	422.44	424.61	15.63	423.80	424.64	423.80	424.61
L24	N23	N24	420.94	420.92	3.25	5.11	422.44	424.53	422.44	424.17	15.59	423.80	424.53	423.79	424.17
L25	N24	N25	420.92	420.87	3.25	5.09	422.44	424.11	422.44	424.50	15.51	423.79	424.11	423.79	424.50
L26	N25	N26	420.87	420.86	2.20	5.07	422.44	423.50	422.44	424.05	15.53	423.79	423.50	423.79	424.05
L27	N26	N27	420.86	420.82	2.43	5.07	422.44	423.93	422.43	423.56	15.57	423.79	423.93	423.78	423.56
L28	N27	N28	420.82	420.76	2.43	14.08	422.43	423.56	422.37	423.45	64.14	423.78	423.56	423.49	423.45
L29	N28	N29	420.76	420.71	2.54	14.06	422.37	423.56	422.31	423.25	64.14	423.49	423.56	423.26	423.25
L3	N3	N4	427.18	426.92	3.16	9.89	428.07	430.34	427.98	430.08	53.99	429.54	430.34	429.51	430.08
L30	N29	N30	420.71	420.42	2.55	14.05	422.31	423.26	421.96	422.97	60.29	423.26	423.26	422.87	422.97
L31	N30	N31	420.42	420.06	2.50	14.04	421.96	422.92	421.72	422.56	60.22	422.87	422.92	422.56	422.56
L32	N31	N33	420.06	419.76	2.50	13.93	421.72	422.56	421.07	422.26	57.12	422.56	422.56	422.05	422.26
L33	N33	N34	419.76	417.37	2.80	13.78	421.07	422.56	418.02	420.17	55.07	422.05	422.56	418.60	420.17
L35	N35	N36	414.65	414.65	6.00	17.60	416.09	420.65	415.43	420.65	68.74	417.06	420.65	416.18	420.65
L36	N37	N8	423.89	423.70	4.35	13.14	425.43	428.24	425.16	428.05	71.02	427.26	428.24	427.03	428.05
L37	N10	N38	424.14	424.03	3.00	13.26	425.15	427.14	425.14	427.03	70.81	426.82	427.14	426.82	427.03
L38	N20	N39	421.10	421.09	3.50	8.92	422.45	423.12	422.45	424.66	48.36	423.86	423.12	423.86	424.66
L39	N39	N40	421.09	421.02	3.00	8.91	422.45	423.62	422.45	424.03	48.32	423.86	423.62	423.85	424.03
L40	N40	N41	421.02	420.94	2.85	8.89	422.45	423.82	422.44	423.79	48.19	423.85	423.82	423.83	423.79
L41	N41	N42	420.94	420.86	2.65	8.85	422.44	423.45	422.43	422.64	48.02	423.83	423.45	423.80	422.64
L42	N42	N27	420.86	420.82	2.65	8.83	422.43	422.64	422.43	421.53	47.94	423.80	422.64	423.78	421.53
L5	N5	N6	426.64	426.91	2.46	13.15	427.97	429.10	427.78	429.37	72.38	429.30	429.10	428.87	429.37
L6	N6	N7	426.91	426.24	2.46	13.15	427.78	429.37	427.53	428.70	72.34	428.87	429.37	428.66	428.70
L7	N7	N37	426.24	423.89	2.95	13.14	427.53	429.19	425.43	426.84	72.23	428.66	429.19	427.26	426.84
Oak1	N18	N19	421.64	421.23	3.30	6.86	422.77	424.94	422.68	424.53	31.29	425.24	424.94	424.07	424.53
Oak2	N18	N19	421.50	421.37	3.30	6.75	422.77	424.80	422.68	424.67	31.29	425.24	424.80	424.07	424.67
Oak-RD	N18	N19	425.86	425.86	0.50	0.00	422.68	426.36	422.68	426.36	0.00	424.07	426.36	424.07	426.36
Perkins1	N2	N3	428.05	427.80	2.00	2.71	428.58	430.05	428.33	429.80	18.18	429.78	430.05	429.54	429.80
Perkins2	N2	N3	427.81	427.75	2.00	3.63	428.58	429.81	428.41	429.75	17.14	429.78	429.81	429.54	429.75
Perkins3	N2	N3	427.98	427.71	2.00	3.55	428.58	429.98	428.30	429.71	18.72	429.78	429.98	429.54	429.71
PerkinsRD	N2	N3	432.36	432.36	0.50	0.00	428.07	432.86	428.07	432.86	0.00	429.54	432.86	429.54	432.86

🟥 Surcharging or Flooding of Conduit for CIP Option

OPTION 3

						NOVEMBER 2006 FUTURE					25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.25	426.394	2.5	5.47	427.98	428.75	427.97	428.89	26.6	429.51	428.75	429.30	428.89
Blek2	N4	N5	426.518	426.532	2.5	4.43	427.98	429.02	427.97	429.03	27.46	429.51	429.02	429.30	429.03
BlekRD	N4	N5	430.01	430.01	0.5	0.00	427.97	430.51	427.97	430.51	0	429.30	430.51	429.30	430.51
Cherry1	N21	N22	421.108	420.952	3.3	5.54	422.18	424.41	422.08	424.25	20.39	423.87	424.41	423.42	424.25
Cherry2	N21	N22	421.114	420.994	3.3	5.29	422.18	424.41	422.08	424.29	20.37	423.87	424.41	423.42	424.29
Cherry-RD	N21	N22	425.06	425.06	0.5	0.00	422.08	425.56	422.08	425.56	0	423.42	425.56	423.42	425.56
Concrete	N34	N35	414.684	414.654	4	9.10	416.16	418.68	416.10	418.65	41.57	417.43	418.68	417.24	418.65
County	N34	N35	414.684	414.654	4	9.10	416.16	418.68	416.10	418.65	41.57	417.43	418.68	417.24	418.65
RD	N34	N35	420.37	420.37	0.5	0.00	416.10	420.87	416.10	420.87	0	417.24	420.87	417.24	420.87
CulvA1	N8	N9	423.998	423.602	2.5	13.18	425.16	426.50	425.16	426.10	34.88	426.92	426.50	426.74	426.10
CulvA2	N8	N9	423.778	423.672	2.5	-1.62	425.16	426.28	425.16	426.17	37.48	426.92	426.28	426.74	426.17
CulvA-RD	N8	N9	428.884	428.884	0.5	0.00	425.16	429.38	425.16	429.38	0	426.74	429.38	426.74	429.38
CulvB1	N14	N15	423.266	423.202	2	4.57	424.49	425.27	424.46	425.20	23.43	426.37	425.27	425.93	425.20
CulvB2	N14	N15	423.302	423.206	2	4.69	424.49	425.30	424.46	425.21	23.43	426.37	425.30	425.93	425.21
CulvB3	N14	N15	423.274	423.272	2	3.99	424.49	425.27	424.46	425.27	23.42	426.37	425.27	425.93	425.27
CulvB-RD	N14	N15	426.46	426.46	0.5	0.00	424.46	426.96	424.46	426.96	0	425.93	426.96	425.93	426.96
CulvC1	N16	N17	422.918	422.698	2	5.40	423.80	424.92	423.70	424.70	23.78	425.33	424.92	424.92	424.70
CulvC2	N16	N17	422.89	422.874	2	3.94	423.80	424.89	423.70	424.87	23.51	425.33	424.89	424.92	424.87
CulvC3	N16	N17	422.89	422.83	2	4.29	423.80	424.89	423.70	424.83	23.57	425.33	424.89	424.92	424.83
CulvC-RD	N16	N17	425.36	425.36	0.5	0.00	423.70	425.86	423.70	425.86	0	424.92	425.86	424.92	425.86
L1	N1	N2	427.59	427.59	2.59	9.90	428.63	430.18	428.58	430.18	54.1	429.88	430.18	429.78	430.18
L10	N9	N10	423.66	424.14	3.5	13.26	425.16	427.16	425.15	427.64	71.82	426.74	427.16	426.72	427.64
L11	N38	N12	424.03	423.89	2.77	13.26	425.14	426.80	424.91	426.66	71.26	426.71	426.80	426.58	426.66
L13	N12	N13	423.89	423.72	2.77	13.25	424.91	426.66	424.89	426.49	70.98	426.58	426.66	426.58	426.49
L14	N13	N14	423.72	423.46	2.95	13.25	424.89	426.67	424.49	426.41	70.61	426.58	426.67	426.37	426.41
L16	N15	N16	423.37	423.1	2.76	13.25	424.46	426.13	423.80	425.86	69.81	425.93	426.13	425.33	425.86
L18	N17	N18	422.88	421.55	2.97	13.63	423.70	425.85	422.74	424.52	69.54	424.92	425.85	424.65	424.52
L20	N19	N20	421.38	421.1	4	13.62	422.59	425.38	422.19	425.10	67.58	424.11	425.38	423.87	425.10
L21	N20	N21	421.1	421.1	4	10.84	422.19	425.10	422.18	425.10	40.76	423.87	425.10	423.87	425.10
L23	N22	N23	420.952	420.94	3.69	10.83	422.08	424.64	422.04	424.61	40.73	423.42	424.64	423.39	424.61
L24	N23	N24	420.94	420.92	3.25	10.83	422.04	424.53	422.01	424.17	40.67	423.39	424.53	423.36	424.17
L25	N24	N25	420.92	420.87	3.25	10.81	422.01	424.11	421.95	424.50	40.5	423.36	424.11	423.31	424.50
L26	N25	N26	420.87	420.86	2.2	10.81	421.95	423.50	421.94	424.05	40.38	423.31	423.50	423.30	424.05
L27	N26	N27	420.86	420.82	2.43	10.81	421.94	423.93	421.83	423.56	40.35	423.30	423.93	423.22	423.56
L28	N27	N28	420.82	420.484	2.43	14.24	421.83	423.56	421.52	423.45	69.44	423.22	423.56	422.86	423.45
L29	N28	N29	420.484	420.213	2.54	14.23	421.52	423.56	421.24	423.25	69.38	422.86	423.56	422.50	423.25
L3	N3	N4	427.18	426.92	3.16	9.89	428.07	430.34	427.98	430.08	54	429.54	430.34	429.51	430.08
L30	N29	N30	420.213	419.979	2.55	14.23	421.24	423.26	420.90	422.97	69.35	422.50	423.26	422.03	422.97
L31	N30	N31	419.979	419.848	2.5	14.22	420.90	422.92	420.59	422.56	69.32	422.03	422.92	421.60	422.56
L32	N31	N33	419.848	418.615	2.5	14.20	420.59	422.56	419.06	422.26	69.18	421.60	422.56	419.70	422.26
L33	N33	N34	418.615	417.37	2.8	14.17	419.06	422.56	417.75	420.17	69.08	419.70	422.56	418.43	420.17
L35	N35	N36	414.654	414.65	6	18.19	416.10	420.65	415.44	420.65	83.14	417.24	420.65	416.33	420.65
L36	N37	N8	423.89	423.7	4.35	13.14	425.43	428.24	425.16	428.05	71.62	427.20	428.24	426.92	428.05
L37	N10	N38	424.14	424.03	3	13.26	425.15	427.14	425.14	427.03	71.73	426.72	427.14	426.71	427.03
L38	N20	N39	421.1	421.087	3.5	3.23	422.19	423.12	422.17	424.66	28.5	423.87	423.12	423.85	424.66
L39	N39	N40	421.087	421.02	3	3.23	422.17	423.62	422.10	424.03	28.46	423.85	423.62	423.73	424.03
L40	N40	N41	421.02	420.94	2.85	3.22	422.10	423.82	422.00	423.79	28.39	423.73	423.82	423.56	423.79
L41	N41	N42	420.94	420.86	2.65	3.22	422.00	423.45	421.90	422.64	28.33	423.56	423.45	423.37	422.64
L42	N42	N27	420.86	420.82	2.65	3.22	421.90	422.64	421.83	421.53	28.29	423.37	422.64	423.22	421.53
L5	N5	N6	426.64	426.91	2.46	13.15	427.97	429.10	427.78	429.37	72.38	429.30	429.10	428.87	429.37
L6	N6	N7	426.91	426.24	2.46	13.15	427.78	429.37	427.53	428.70	72.35	428.87	429.37	428.65	428.70
L7	N7	N37	426.24	423.89	2.95	13.14	427.53	429.19	425.43	426.84	72.28	428.65	429.19	427.20	426.84
Oak1	N18	N19	421.498	421.234	3	6.81	422.74	424.94	422.59	424.53	33.82	424.65	424.94	424.11	424.53
Oak2	N18	N19	421.498	421.234	3	6.81	422.74	424.80	422.59	424.67	33.82	424.65	424.80	424.11	424.67
Oak-RD	N18	N19	425.86	425.86	0.5	0.00	422.59	426.36	422.59	426.36	0	424.11	426.36	424.11	426.36
Perkins1	N2	N3	428.046	427.798	2	2.71	428.58	430.05	428.33	429.80	18.18	429.78	430.05	429.54	429.80
Perkins2	N2	N3	427.808	427.748	2	3.63	428.58	429.81	428.41	429.75	17.14	429.78	429.81	429.54	429.75
Perkins3	N2	N3	427.982	427.71	2	3.55	428.58	429.98	428.30	429.71	18.72	429.78	429.98	429.54	429.71
PerkinsRD	N2	N3	432.356	432.356	0.5	0.00	428.07	432.86	428.07	432.86	0	429.54	432.86	429.54	432.86

▨ Surcharging or Flooding of Conduit for CIP Option

OPTION 3A

						NOVEMBER 2006 FUTURE					25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.394	426.25	2.5	5.47	427.984	428.75	427.97	428.89	26.58	429.438	428.75	429.228	428.89
Blek2	N4	N5	426.532	426.518	2.5	4.43	427.984	429.02	427.97	429.03	27.55	429.438	429.02	429.228	429.03
BlekRD	N4	N5	430.01	430.01	0.5	0	427.97	430.51	427.97	430.51	0	429.228	430.51	429.228	430.51
Cherry1	N21	N22	420.952	421.108	3.3	5.54	422.139	424.41	422.024	424.25	21.57	423.764	424.41	423.257	424.25
Cherry2	N21	N22	420.994	421.114	3.3	5.33	422.139	424.41	422.024	424.29	21.55	423.764	424.41	423.257	424.29
Cherry-RD	N21	N22	425.06	425.06	0.5	0	422.024	425.56	422.024	425.56	0	423.257	425.56	423.257	425.56
Concrete	N34	N35	414.654	414.684	4	9.13	416.166	418.68	416.104	418.65	42.9	417.467	418.68	417.273	418.65
County	N34	N35	414.654	414.684	4	9.13	416.166	418.68	416.104	418.65	42.9	417.467	418.68	417.273	418.65
RD	N34	N35	420.37	420.37	0.5	0	416.104	420.87	416.104	420.87	0	417.273	420.87	417.273	420.87
CulvA1	N8	N9	423.602	423.998	2.5	13.19	425.158	426.50	425.158	426.10	34.76	426.952	426.50	426.765	426.10
CulvA2	N8	N9	423.672	423.778	2.5	-1.62	425.158	426.28	425.158	426.17	37.39	426.952	426.28	426.765	426.17
CulvA-RD	N8	N9	428.884	428.884	0.5	0	425.158	429.38	425.158	429.38	0	426.765	429.38	426.765	429.38
CulvB1	N14	N15	423.202	423.266	2	4.57	424.492	425.27	424.46	425.20	23.4	426.385	425.27	425.947	425.20
CulvB2	N14	N15	423.206	423.302	2	4.69	424.492	425.30	424.46	425.21	23.4	426.385	425.30	425.947	425.21
CulvB3	N14	N15	423.272	423.274	2	3.99	424.492	425.27	424.46	425.27	23.39	426.385	425.27	425.947	425.27
CulvB-RD	N14	N15	426.46	426.46	0.5	0	424.46	426.96	424.46	426.96	0	425.947	426.96	425.947	426.96
CulvC1	N16	N17	422.698	422.918	2	5.41	423.8	424.92	423.695	424.70	23.71	425.359	424.92	424.941	424.70
CulvC2	N16	N17	422.874	422.89	2	3.94	423.8	424.89	423.695	424.87	23.59	425.359	424.89	424.941	424.87
CulvC3	N16	N17	422.83	422.89	2	4.29	423.8	424.89	423.695	424.83	23.68	425.359	424.89	424.941	424.83
CulvC-RD	N16	N17	425.36	425.36	0.5	0	423.695	425.86	423.695	425.86	0	424.941	425.86	424.941	425.86
L1	N1	N2	427.59	427.59	2.59	9.9	428.626	430.18	428.575	430.18	54.13	429.833	430.18	429.72	430.18
L10	N9	N10	424.14	423.66	3.5	13.27	425.158	427.16	425.149	427.64	71.64	426.765	427.16	426.739	427.64
L11	N38	N12	423.89	424.03	2.77	13.27	425.136	426.80	424.908	426.66	71.03	426.733	426.80	426.59	426.66
L13	N12	N13	423.72	423.89	3.25	13.26	424.908	426.66	424.886	426.49	70.64	426.59	426.66	426.59	426.49
L14	N13	N14	423.46	423.72	2.95	13.26	424.886	426.67	424.492	426.41	70.42	426.59	426.67	426.385	426.41
L16	N15	N16	423.1	423.37	2.76	13.26	424.46	426.13	423.8	425.86	69.71	425.947	426.13	425.359	425.86
L18	N17	N18	421.55	422.88	3.91	13.64	423.695	425.85	422.735	424.52	70.46	424.941	425.85	424.612	424.52
L20	N19	N20	421.1	421.38	4	13.63	422.581	425.38	422.149	425.10	69.03	424.042	425.38	423.773	425.10
L21	N20	N21	421.1	421.1	4	10.87	422.149	425.10	422.139	425.10	43.13	423.773	425.10	423.764	425.10
L23	N22	N23	420.94	420.952	3.69	10.86	422.024	424.64	421.977	424.61	43.1	423.257	424.64	423.211	424.61
L24	N23	N24	420.92	420.94	3.25	10.86	421.977	424.53	421.932	424.17	43.06	423.211	424.53	423.169	424.17
L25	N24	N25	420.87	420.92	3.25	10.85	421.932	424.11	421.857	424.50	42.94	423.169	424.11	423.096	424.50
L26	N25	N26	420.86	420.87	2.2	10.85	421.857	423.50	421.845	424.05	42.85	423.096	423.50	423.084	424.05
L27	N26	N27	420.82	420.86	2.43	10.85	421.845	423.93	421.673	423.56	42.83	423.084	423.93	422.953	423.56
L28	N27	N28	420.223	420.82	2.43	14.27	421.673	423.56	421.115	423.45	71.17	422.953	423.56	422.391	423.45
L29	N28	N29	419.74	420.223	2.54	14.27	421.115	423.56	420.656	423.25	71.12	422.391	423.56	421.879	423.25
L3	N3	N4	426.92	427.18	3.16	9.89	428.066	430.34	427.984	430.08	54.08	429.477	430.34	429.438	430.08
L30	N29	N30	419.324	419.74	2.55	14.26	420.656	423.26	420.176	422.97	71.1	421.879	423.26	421.261	422.97
L31	N30	N31	419.091	419.324	2.5	14.26	420.176	422.92	419.739	422.56	71.08	421.261	422.92	420.682	422.56
L32	N31	N33	416.899	419.091	2.5	14.24	419.739	422.56	417.26	422.26	70.97	420.682	422.56	417.883	422.26
L33	N33	N34	414.684	416.899	2.8	14.23	417.26	422.56	416.166	420.17	70.94	417.883	422.56	417.467	420.17
L35	N35	N36	414.65	414.654	6	18.25	416.104	420.65	415.44	420.65	85.8	417.273	420.65	416.349	420.65
L36	N37	N8	423.7	423.89	4.35	13.14	425.426	428.24	425.158	428.05	71.58	427.219	428.24	426.952	428.05
L37	N10	N38	424.03	424.14	3	13.27	425.149	427.14	425.136	427.03	71.53	426.739	427.14	426.733	427.03
L38	N20	N39	421.087	421.1	3.5	3.21	422.149	423.12	422.132	424.66	27.64	423.773	423.12	423.747	424.66
L39	N39	N40	421.02	421.087	3	3.21	422.132	423.62	422.045	424.03	27.61	423.747	423.62	423.609	424.03
L40	N40	N41	420.94	421.02	2.85	3.2	422.045	423.82	421.927	423.79	27.55	423.609	423.82	423.413	423.79
L41	N41	N42	420.86	420.94	2.65	3.2	421.927	423.45	421.79	422.64	27.51	423.413	423.45	423.17	422.64
L42	N42	N27	420.82	420.86	2.65	3.2	421.79	422.64	421.673	421.53	27.48	423.17	422.64	422.953	421.53
L5	N5	N6	426.91	426.64	3	13.16	427.97	429.10	427.782	429.37	72.51	429.228	429.10	428.857	429.37
L6	N6	N7	426.24	426.91	3	13.16	427.782	429.37	427.53	428.70	72.5	428.857	429.37	428.62	428.70
L7	N7	N37	423.89	426.24	3.95	13.15	427.53	429.19	425.426	426.84	72.44	428.62	429.19	427.219	426.84
Oak1	N18	N19	421.234	421.498	3	6.82	422.735	424.94	422.581	424.53	34.54	424.612	424.94	424.042	424.53
Oak2	N18	N19	421.234	421.498	3	6.82	422.735	424.80	422.581	424.67	34.54	424.612	424.80	424.042	424.67
Oak-RD	N18	N19	425.86	425.86	0.5	0	422.581	426.36	422.581	426.36	0	424.042	426.36	424.042	426.36
Perkins1	N2	N3	427.798	428.046	2	2.71	428.575	430.05	428.326	429.80	17.89	429.72	430.05	429.477	429.80
Perkins2	N2	N3	427.748	427.808	2	3.63	428.575	429.81	428.414	429.75	17.59	429.72	429.81	429.477	429.75
Perkins3	N2	N3	427.71	427.982	2	3.55	428.575	429.98	428.302	429.71	18.6	429.72	429.98	429.477	429.71
PerkinsRD	N2	N3	432.356	432.356	0.5	0	428.066	432.86	428.066	432.86	0	429.477	432.86	429.477	432.86

🟥 Surcharging or Flooding of Conduit for CIP Option

OPTION 4

						NOVEMBER 2006 FUTURE					25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.25	426.394	2.5	5.47	427.98	428.75	427.97	428.89	26.6	429.51	428.75	429.30	428.89
Blek2	N4	N5	426.518	426.532	2.5	4.43	427.98	429.02	427.97	429.03	27.46	429.51	429.02	429.30	429.03
BlekRD	N4	N5	430.01	430.01	0.5	0.00	427.97	430.51	427.97	430.51	0	429.30	430.51	429.30	430.51
Cherry1	N21	N22	421.108	420.952	3.3	0.63	422.00	424.41	422.00	424.25	8.73	423.23	424.41	423.15	424.25
Cherry2	N21	N22	421.114	420.994	3.3	0.59	422.00	424.41	422.00	424.29	8.72	423.23	424.41	423.15	424.29
Cherry-RD	N21	N22	425.06	425.06	0.5	0.00	422.00	425.56	422.00	425.56	0	423.15	425.56	423.15	425.56
Concrete	N34	N35	414.684	414.654	4	8.95	416.16	418.68	416.09	418.65	38.78	417.35	418.68	417.17	418.65
County	N34	N35	414.684	414.654	4	8.95	416.16	418.68	416.09	418.65	38.78	417.35	418.68	417.17	418.65
RD	N34	N35	420.37	420.37	0.5	0.00	416.09	420.87	416.09	420.87	0	417.17	420.87	417.17	420.87
CulvA1	N8	N9	423.998	423.602	2.5	13.18	425.16	426.50	425.16	426.10	34.79	426.96	426.50	426.78	426.10
CulvA2	N8	N9	423.778	423.672	2.5	-1.62	425.16	426.28	425.16	426.17	37.28	426.96	426.28	426.78	426.17
CulvA-RD	N8	N9	428.884	428.884	0.5	0.00	425.16	429.38	425.16	429.38	0	426.78	429.38	426.78	429.38
CulvB1	N14	N15	423.266	423.202	2	4.57	424.49	425.27	424.46	425.20	23.11	426.40	425.27	425.98	425.20
CulvB2	N14	N15	423.302	423.206	2	4.69	424.49	425.30	424.46	425.21	23.11	426.40	425.30	425.98	425.21
CulvB3	N14	N15	423.274	423.272	2	3.99	424.49	425.27	424.46	425.27	23.1	426.40	425.27	425.98	425.27
CulvB-RD	N14	N15	426.46	426.46	0.5	0.00	424.46	426.96	424.46	426.96	0	425.98	426.96	425.98	426.96
CulvC1	N16	N17	422.918	422.698	2	5.40	423.80	424.92	423.69	424.70	22.95	425.46	424.92	425.11	424.70
CulvC2	N16	N17	422.89	422.874	2	3.94	423.80	424.89	423.69	424.87	23.03	425.46	424.89	425.11	424.87
CulvC3	N16	N17	422.89	422.83	2	4.29	423.80	424.89	423.69	424.83	23.07	425.46	424.89	425.11	424.83
CulvC-RD	N16	N17	425.36	425.36	0.5	0.00	423.69	425.86	423.69	425.86	2.62	425.46	425.86	425.42	425.86
L1	N1	N2	427.59	427.59	2.59	9.90	428.63	430.18	428.58	430.18	54.1	429.88	430.18	429.78	430.18
L10	N9	N10	423.66	424.14	3.5	13.26	425.16	427.16	425.15	427.64	71.4	426.78	427.16	426.76	427.64
L11	N38	N12	424.03	423.89	2.77	13.26	425.14	426.80	424.91	426.66	70.68	426.75	426.80	426.60	426.66
L13	N12	N13	423.89	423.72	2.77	13.25	424.91	426.66	424.89	426.49	70.24	426.60	426.66	426.59	426.49
L14	N13	N14	423.72	423.46	2.95	13.25	424.89	426.67	424.49	426.41	69.8	426.59	426.67	426.40	426.41
L16	N15	N16	423.37	423.1	2.76	13.25	424.46	426.13	423.80	425.86	68.43	425.98	426.13	425.46	425.86
L18	N17	N18	422.88	421.55	2.97	13.63	423.69	425.85	422.68	424.52	67.14	425.11	425.85	425.01	424.52
L20	N19	N20	421.38	421.1	4	13.62	422.56	425.38	422.00	425.10	65.19	423.72	425.38	423.23	425.10
L21	N20	N21	421.1	421.1	4	1.22	422.00	425.10	422.00	425.10	17.45	423.23	425.10	423.23	425.10
L23	N22	N23	420.952	420.92	3.69	1.22	422.00	424.64	421.99	424.61	17.44	423.15	424.64	423.11	424.61
L24	N23	N24	420.92	420.56	3.61	1.21	421.99	424.53	421.99	424.17	17.41	423.11	424.53	423.10	424.17
L25	N24	N25	420.56	420.95	3.55	1.21	421.99	424.11	421.99	424.50	17.3	423.10	424.11	423.04	424.50
L26	N25	N26	420.95	421.5	2.55	1.20	421.99	423.50	421.98	424.05	17.22	423.04	423.50	423.02	424.05
L27	N26	N27	421.5	420.378	2.43	1.20	421.98	423.93	421.43	423.56	17.2	423.02	423.93	422.82	423.56
L28	N27	N28	420.378	420.085	2.5	14.24	421.43	423.56	421.15	423.45	66.85	422.82	423.56	422.51	423.45
L29	N28	N29	420.085	419.849	2.5	14.23	421.15	423.56	420.90	423.25	66.77	422.51	423.56	422.20	423.25
L3	N3	N4	427.18	426.92	3.16	9.89	428.07	430.34	427.98	430.08	53.99	429.54	430.34	429.51	430.08
L30	N29	N30	419.849	419.645	2.5	14.23	420.90	423.26	420.59	422.97	66.7	422.20	423.26	421.83	422.97
L31	N30	N31	419.645	419.53	2.5	14.22	420.59	422.92	420.31	422.56	66.62	421.83	422.92	421.56	422.56
L32	N31	N33	419.53	418.456	3	14.16	420.31	422.56	419.64	422.26	66.12	421.56	422.56	420.97	422.26
L33	N33	N34	418.456	417.37	3.5	14.00	419.64	422.56	417.75	420.17	65.34	420.97	422.56	418.39	420.17
L35	N35	N36	414.654	414.65	6	17.90	416.09	420.65	415.43	420.65	77.55	417.17	420.65	416.27	420.65
L36	N37	N8	423.89	423.7	4.35	13.14	425.43	428.24	425.16	428.05	71.39	427.22	428.24	426.96	428.05
L37	N10	N38	424.14	424.03	3	13.26	425.15	427.14	425.14	427.03	71.24	426.76	427.14	426.75	427.03
L38	N20	N39	421.1	421.067	3.5	12.85	422.00	423.12	421.97	424.66	49.36	423.23	423.12	423.21	424.66
L39	N39	N40	421.067	420.903	3	12.84	421.97	423.62	421.83	424.03	49.28	423.21	423.62	423.11	424.03
L40	N40	N41	420.903	420.702	3	12.83	421.83	423.82	421.68	423.79	49.15	423.11	423.82	423.01	423.79
L41	N41	N42	420.702	420.505	3	12.83	421.68	423.45	421.56	422.64	49.03	423.01	423.45	422.92	422.64
L42	N42	N27	420.505	420.378	3	12.83	421.56	422.64	421.43	421.53	48.95	422.92	422.64	422.82	421.53
L5	N5	N6	426.64	426.91	2.46	13.15	427.97	429.10	427.78	429.37	72.38	429.30	429.10	428.87	429.37
L6	N6	N7	426.91	426.24	2.46	13.15	427.78	429.37	427.53	428.70	72.35	428.87	429.37	428.65	428.70
L7	N7	N37	426.24	423.89	2.95	13.14	427.53	429.19	425.43	426.84	72.26	428.65	429.19	427.22	426.84
Oak1	N18	N19	421.638	421.234	3.3	6.77	422.68	424.94	422.56	424.53	32.6	425.01	424.94	423.72	424.53
Oak2	N18	N19	421.498	421.368	3.3	6.86	422.68	424.80	422.56	424.67	32.6	425.01	424.80	423.72	424.67
Oak-RD	N18	N19	425.86	425.86	0.5	0.00	422.56	426.36	422.56	426.36	0	423.72	426.36	423.72	426.36
Perkins1	N2	N3	428.046	427.798	2	2.71	428.58	430.05	428.33	429.80	18.18	429.78	430.05	429.54	429.80
Perkins2	N2	N3	427.808	427.748	2	3.63	428.58	429.81	428.41	429.75	17.14	429.78	429.81	429.54	429.75
Perkins3	N2	N3	427.982	427.71	2	3.55	428.58	429.98	428.30	429.71	18.72	429.78	429.98	429.54	429.71
PerkinsRD	N2	N3	432.356	432.356	0.5	0.00	428.07	432.86	428.07	432.86	0	429.54	432.86	429.54	432.86

▨ Surcharging or Flooding of Conduit for CIP Option

OPTION 4A

						NOVEMBER 2006 FUTURE					25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.25	426.394	2.5	5.47	427.98	428.75	427.97	428.89	26.58	429.438	428.75	429.228	428.89
Blek2	N4	N5	426.518	426.532	2.5	4.43	427.98	429.02	427.97	429.03	27.55	429.438	429.02	429.228	429.03
BlekRD	N4	N5	430.01	430.01	0.5	0.00	427.97	430.51	427.97	430.51	0	429.228	430.51	429.228	430.51
Cherry1	N21	N22	421.108	420.952	3.3	0.29	421.86	424.41	421.86	424.25	6.9	422.895	424.41	422.854	424.25
Cherry2	N21	N22	421.114	420.994	3.3	0.27	421.86	424.41	421.86	424.29	6.88	422.895	424.41	422.854	424.29
Cherry-RD	N21	N22	425.06	425.06	0.5	0.00	421.86	425.56	421.86	425.56	0	422.854	425.56	422.854	425.56
Concrete	N34	N35	414.684	414.654	4	9.04	416.16	418.68	416.10	418.65	40.56	417.401	418.68	417.217	418.65
County	N34	N35	414.684	414.654	4	9.04	416.16	418.68	416.10	418.65	40.56	417.401	418.68	417.217	418.65
RD	N34	N35	420.37	420.37	0.5	0.00	416.10	420.87	416.10	420.87	0	417.217	420.87	417.217	420.87
CulvA1	N8	N9	423.998	423.602	2.5	13.06	425.15	426.50	425.15	426.10	34.71	426.978	426.50	426.792	426.10
CulvA2	N8	N9	423.778	423.672	2.5	-1.53	425.15	426.28	425.15	426.17	37.26	426.978	426.28	426.792	426.17
CulvA-RD	N8	N9	428.884	428.884	0.5	0.00	425.15	429.38	425.15	429.38	0	426.792	429.38	426.792	429.38
CulvB1	N14	N15	423.266	423.202	2	4.57	424.49	425.27	424.46	425.20	23.15	426.405	425.27	425.985	425.20
CulvB2	N14	N15	423.302	423.206	2	4.69	424.49	425.30	424.46	425.21	23.15	426.405	425.30	425.985	425.21
CulvB3	N14	N15	423.274	423.272	2	3.99	424.49	425.27	424.46	425.27	23.14	426.405	425.27	425.985	425.27
CulvB-RD	N14	N15	426.46	426.46	0.5	0.00	424.46	426.96	424.46	426.96	0	425.985	426.96	425.985	426.96
CulvC1	N16	N17	422.918	422.698	2	5.40	423.80	424.92	423.69	424.70	23	425.457	424.92	425.098	424.70
CulvC2	N16	N17	422.89	422.874	2	3.94	423.80	424.89	423.69	424.87	23.1	425.457	424.89	425.098	424.87
CulvC3	N16	N17	422.89	422.83	2	4.29	423.80	424.89	423.69	424.83	23.14	425.457	424.89	425.098	424.83
CulvC-RD	N16	N17	425.36	425.36	0.5	0.00	423.69	425.86	423.69	425.86	2.54	425.457	425.86	425.42	425.86
L1	N1	N2	427.59	427.59	2.59	9.90	428.63	430.18	428.58	430.18	54.13	429.833	430.18	429.72	430.18
L10	N9	N10	423.66	424.14	3.5	13.26	425.15	427.16	425.14	427.64	71.38	426.792	427.16	426.768	427.64
L11	N38	N12	424.03	423.89	2.77	13.26	425.13	426.80	424.89	426.66	70.66	426.762	426.80	426.598	426.66
L13	N12	N13	423.89	423.72	3.77	13.25	424.89	426.66	424.89	426.49	70.22	426.598	426.66	426.597	426.49
L14	N13	N14	423.72	423.46	2.95	13.25	424.89	426.67	424.49	426.41	69.8	426.597	426.67	426.405	426.41
L16	N15	N16	423.37	423.1	2.76	13.25	424.46	426.13	423.80	425.86	68.63	425.985	426.13	425.457	425.86
L18	N17	N18	422.88	421.55	2.95	13.63	423.69	425.85	422.67	424.52	67.88	425.098	425.85	424.964	424.52
L20	N19	N20	421.38	421.1	4	13.62	422.55	425.38	421.86	425.10	66.22	423.641	425.38	422.897	425.10
L21	N20	N21	421.1	421.1	4	0.57	421.86	425.10	421.86	425.10	13.79	422.897	425.10	422.895	425.10
L23	N22	N23	420.952	420.92	3.69	0.56	421.86	424.64	421.86	424.61	13.77	422.854	424.64	422.817	424.61
L24	N23	N24	420.92	420.56	3.61	0.56	421.86	424.53	421.86	424.17	13.76	422.817	424.53	422.807	424.17
L25	N24	N25	420.56	420.95	3.55	0.56	421.86	424.11	421.86	424.50	13.73	422.807	424.11	422.735	424.50
L26	N25	N26	420.95	421.5	2.55	0.55	421.86	423.50	421.86	424.05	13.7	422.735	423.50	422.694	424.05
L27	N26	N27	421.5	420.378	2.43	0.55	421.86	423.93	420.76	423.56	13.7	422.694	423.93	422.041	423.56
L28	N27	N28	419.858	419.355	2.5	14.28	420.76	423.56	420.29	423.45	68.43	422.041	423.56	421.56	423.45
L29	N28	N29	419.355	418.947	2.5	14.27	420.29	423.56	419.90	423.25	68.4	421.56	423.56	421.11	423.25
L3	N3	N4	427.18	426.92	3.16	9.89	428.07	430.34	427.98	430.08	54.08	429.477	430.34	429.438	430.08
L30	N29	N30	418.947	418.597	2.5	14.26	419.90	423.26	419.46	422.97	68.37	421.11	423.26	420.564	422.97
L31	N30	N31	418.597	418.4	2.5	14.26	419.46	422.92	419.01	422.56	68.34	420.564	422.92	420.084	422.56
L32	N31	N33	418.4	416.552	3	14.23	419.01	422.56	417.55	422.26	68.1	420.084	422.56	418.962	422.26
L33	N33	N34	416.552	414.684	3.5	14.20	417.55	422.56	416.16	420.17	67.83	418.962	422.56	417.401	420.17
L35	N35	N36	414.654	414.65	6	18.07	416.10	420.65	415.44	420.65	81.11	417.217	420.65	416.304	420.65
L36	N37	N8	423.89	423.7	4.35	13.14	425.42	428.24	425.15	428.05	71.37	427.23	428.24	426.978	428.05
L37	N10	N38	424.14	424.03	3	13.26	425.14	427.14	425.13	427.03	71.25	426.768	427.14	426.762	427.03
L38	N20	N39	421.1	421.043	3.5	13.51	421.86	423.12	421.81	424.66	54.1	422.897	423.12	422.851	424.66
L39	N39	N40	421.043	420.76	3.2	13.50	421.81	423.62	421.54	424.03	54.07	422.851	423.62	422.634	424.03
L40	N40	N41	420.76	420.415	3	13.50	421.54	423.82	421.24	423.79	54.02	422.634	423.82	422.404	423.79
L41	N41	N42	420.415	420.077	3.4	13.49	421.24	423.45	421.00	422.64	53.96	422.404	423.45	422.226	422.64
L42	N42	N27	420.077	419.858	2.95	13.49	421.00	422.64	420.76	421.53	53.93	422.226	422.64	422.041	421.53
L5	N5	N6	426.64	426.91	3.4	13.15	427.97	429.10	427.78	429.37	72.51	429.228	429.10	428.857	429.37
L6	N6	N7	426.91	426.24	2.96	13.15	427.78	429.37	427.53	428.70	72.5	428.857	429.37	428.62	428.70
L7	N7	N37	426.24	423.89	3.95	13.15	427.53	429.19	425.42	426.84	72.44	428.62	429.19	427.23	426.84
Oak1	N18	N19	421.638	421.234	3.3	6.75	422.67	424.94	422.55	424.53	33.11	424.964	424.94	423.641	424.53
Oak2	N18	N19	421.498	421.368	3.3	6.87	422.67	424.80	422.55	424.67	33.11	424.964	424.80	423.641	424.67
Oak-RD	N18	N19	425.86	425.86	0.5	0.00	422.55	426.36	422.55	426.36	0	423.641	426.36	423.641	426.36
Perkins1	N2	N3	428.046	427.798	2	2.71	428.58	430.05	428.33	429.80	17.89	429.72	430.05	429.477	429.80
Perkins2	N2	N3	427.808	427.748	2	3.63	428.58	429.81	428.41	429.75	17.59	429.72	429.81	429.477	429.75
Perkins3	N2	N3	427.982	427.71	2	3.55	428.58	429.98	428.30	429.71	18.6	429.72	429.98	429.477	429.71
PerkinsRD	N2	N3	432.356	432.356	0.5	0	428.066	432.86	428.066	432.86	0	429.477	432.86	429.477	432.86

🟥 Surcharging or Flooding of Conduit for CIP Option

OPTION 5

						NOVEMBER 2006 FUTURE					25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.39	426.25	2.50	5.47	427.98	428.75	427.97	428.89	26.59	429.51	428.75	429.30	428.89
Blek2	N4	N5	426.53	426.52	2.50	4.43	427.98	429.02	427.97	429.03	27.45	429.51	429.02	429.30	429.03
BlekRD	N4	N5	430.01	430.01	0.50	0.00	427.97	430.51	427.97	430.51	0.00	429.30	430.51	429.30	430.51
Cherry1	N21	N22	420.95	421.11	3.30	1.87	422.81	424.41	422.80	424.25	8.79	424.17	424.41	424.09	424.25
Cherry2	N21	N22	420.99	421.11	3.30	1.84	422.81	424.41	422.80	424.29	8.78	424.17	424.41	424.09	424.29
Cherry-RD	N21	N22	425.06	425.06	0.50	0.00	422.80	425.56	422.80	425.56	0.00	424.09	425.56	424.09	425.56
Concrete	N34	N35	414.65	414.68	4.00	8.80	416.14	418.68	416.08	418.65	32.12	417.15	418.68	417.00	418.65
County	N34	N35	414.65	414.68	4.00	8.80	416.14	418.68	416.08	418.65	32.12	417.15	418.68	417.00	418.65
RD	N34	N35	420.37	420.37	0.50	0.00	416.08	420.87	416.08	420.87	0.00	417.00	420.87	417.00	420.87
CulvA1	N8	N9	423.60	424.00	2.50	13.18	425.16	426.50	425.16	426.10	34.30	427.08	426.50	426.90	426.10
CulvA2	N8	N9	423.67	423.78	2.50	-1.62	425.16	426.28	425.16	426.17	36.73	427.08	426.28	426.90	426.17
CulvA-RD	N8	N9	428.88	428.88	0.50	0.00	425.16	429.38	425.16	429.38	0.00	426.90	429.38	426.90	429.38
CulvB1	N14	N15	423.20	423.27	2.00	4.57	424.49	425.27	424.46	425.20	22.61	426.47	425.27	426.06	425.20
CulvB2	N14	N15	423.21	423.30	2.00	4.69	424.49	425.30	424.46	425.21	22.61	426.47	425.30	426.06	425.21
CulvB3	N14	N15	423.27	423.27	2.00	3.99	424.49	425.27	424.46	425.27	22.60	426.47	425.27	426.06	425.27
CulvB-RD	N14	N15	426.46	426.46	0.50	0.00	424.46	426.96	424.46	426.96	0.01	426.47	426.96	426.46	426.96
CulvC1	N16	N17	422.70	422.92	2.00	5.41	423.81	424.92	423.71	424.70	20.98	425.67	424.92	425.52	424.70
CulvC2	N16	N17	422.87	422.89	2.00	3.93	423.81	424.89	423.71	424.87	21.58	425.67	424.89	425.52	424.87
CulvC3	N16	N17	422.83	422.89	2.00	4.29	423.81	424.89	423.71	424.83	21.53	425.67	424.89	425.52	424.83
CulvC-RD	N16	N17	425.36	425.36	0.50	0.00	423.71	425.86	423.71	425.86	22.85	425.67	425.86	425.62	425.86
L1	N1	N2	427.59	427.59	2.59	9.90	428.63	430.18	428.58	430.18	54.10	429.88	430.18	429.78	430.18
L10	N9	N10	424.14	423.66	3.50	13.26	425.16	427.16	425.15	427.64	70.37	426.90	427.16	426.87	427.64
L11	N38	N12	423.89	424.03	2.77	13.26	425.14	426.80	424.91	426.66	69.38	426.87	426.80	426.65	426.66
L13	N12	N13	423.72	423.89	2.77	13.25	424.91	426.66	424.89	426.49	68.82	426.65	426.66	426.64	426.49
L14	N13	N14	423.46	423.72	2.95	13.25	424.89	426.67	424.49	426.41	68.22	426.64	426.67	426.47	426.41
L16	N15	N16	423.10	423.37	2.76	13.25	424.46	426.13	423.81	425.86	67.12	426.06	426.13	425.67	425.86
L18	N17	N18	421.55	422.88	2.97	13.63	423.71	425.85	422.96	424.52	63.86	425.52	425.85	425.49	424.52
L20	N19	N20	421.10	421.38	4.00	13.60	422.91	425.38	422.81	425.10	62.27	424.32	425.38	424.18	425.10
L21	N20	N21	421.10	421.10	4.00	3.71	422.81	425.10	422.81	425.10	17.58	424.18	425.10	424.17	425.10
L23	N22	N23	420.92	420.95	3.69	3.70	422.80	424.64	422.80	424.61	17.58	424.09	424.64	424.08	424.61
L24	N23	N24	420.56	420.92	3.61	3.70	422.80	424.53	422.80	424.17	17.58	424.08	424.53	424.08	424.17
L25	N24	N25	420.95	420.56	3.55	3.67	422.80	424.11	422.80	424.50	17.58	424.08	424.11	424.07	424.50
L26	N25	N26	421.50	420.95	2.55	3.65	422.80	423.50	422.79	424.05	17.58	424.07	423.50	424.06	424.05
L27	N26	N27	421.13	421.50	2.43	3.65	422.79	423.93	422.76	423.56	14.22	424.06	423.93	424.06	423.56
L28	N27	N28	421.02	421.13	2.43	14.10	422.76	423.56	422.50	423.45	54.67	424.06	423.56	423.42	423.45
L29	N28	N29	420.71	421.02	2.54	14.08	422.50	423.56	422.31	423.25	54.45	423.42	423.56	423.19	423.25
L3	N3	N4	426.92	427.18	3.16	9.89	428.07	430.34	427.98	430.08	53.99	429.55	430.34	429.51	430.08
L30	N29	N30	420.42	420.71	2.55	14.07	422.31	423.26	421.96	422.97	54.39	423.19	423.26	422.82	422.97
L31	N30	N31	420.06	420.42	2.50	14.05	421.96	422.92	421.72	422.56	54.33	422.82	422.92	422.54	422.56
L32	N31	N33	419.76	420.06	2.50	13.94	421.72	422.56	421.07	422.26	54.01	422.54	422.56	422.03	422.26
L33	N33	N34	417.37	419.76	2.80	13.80	421.07	422.56	418.02	420.17	53.75	422.03	422.56	418.59	420.17
L35	N35	N36	414.65	414.65	6.00	17.59	416.08	420.65	415.43	420.65	64.24	417.00	420.65	416.13	420.65
L36	N37	N8	423.70	423.89	4.35	13.14	425.43	428.24	425.16	428.05	70.64	427.30	428.24	427.08	428.05
L37	N10	N38	424.03	424.14	3.00	13.26	425.15	427.14	425.14	427.03	70.19	426.87	427.14	426.87	427.03
L38	N20	N39	421.10	421.10	2.80	10.33	422.81	423.12	422.80	424.66	46.21	424.18	423.12	424.17	424.66
L39	N39	N40	421.11	421.10	3.30	10.31	422.80	423.62	422.79	424.03	46.22	424.17	423.62	424.14	424.03
L40	N40	N41	421.12	421.11	3.30	10.29	422.79	423.82	422.78	423.79	46.22	424.14	423.82	424.11	423.79
L41	N41	N42	421.13	421.12	3.30	10.27	422.78	423.45	422.77	422.64	46.22	424.11	423.45	424.08	422.64
L42	N42	N27	421.13	421.13	2.90	10.26	422.77	422.64	422.76	421.53	46.23	424.08	422.64	424.06	421.53
L5	N5	N6	426.91	426.64	2.46	13.15	427.97	429.10	427.78	429.37	72.36	429.30	429.10	428.87	429.37
L6	N6	N7	426.24	426.91	2.46	13.15	427.78	429.37	427.53	428.70	72.32	428.87	429.37	428.66	428.70
L7	N7	N37	423.89	426.24	2.95	13.14	427.53	429.19	425.43	426.84	72.18	428.66	429.19	427.30	426.84
Oak1	N18	N19	421.23	421.64	3.30	6.89	422.96	424.94	422.91	424.53	31.13	425.49	424.94	424.32	424.53
Oak2	N18	N19	421.37	421.50	3.30	6.71	422.96	424.80	422.91	424.67	31.13	425.49	424.80	424.32	424.67
Oak-RD	N18	N19	425.86	425.86	0.50	0.00	422.91	426.36	422.91	426.36	0.00	424.32	426.36	424.32	426.36
Perkins1	N2	N3	427.80	428.05	2.00	2.71	428.58	430.05	428.33	429.80	18.19	429.78	430.05	429.55	429.80
Perkins2	N2	N3	427.75	427.81	2.00	3.63	428.58	429.81	428.41	429.75	17.13	429.78	429.81	429.55	429.75
Perkins3	N2	N3	427.71	427.98	2.00	3.55	428.58	429.98	428.30	429.71	18.73	429.78	429.98	429.55	429.71
PerkinsRD	N2	N3	432.36	432.36	0.50	0.00	428.07	432.86	428.07	432.86	0.00	429.55	432.86	429.55	432.86

🟥 Surcharging or Flooding of Conduit for CIP Option

OPTION 6

						NOVEMBER 2006 FUTURE					25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.25	426.394	2.5	5.48	427.963	428.75	427.948	428.89	26.69	429.36	428.75	429.15	428.89
Blek2	N4	N5	426.518	426.532	2.5	4.42	427.963	429.02	427.948	429.03	27.44	429.36	429.02	429.15	429.03
BlekRD	N4	N5	430.01	430.01	0.5	0	427.948	430.51	427.948	430.51	0	429.15	430.51	429.15	430.51
Cherry1	N21	N22	421.108	420.952	3.3	0.52	422.066	424.41	422.065	424.25	5.29	422.95	424.41	422.93	424.25
Cherry2	N21	N22	421.114	420.994	3.3	0.5	422.066	424.41	422.065	424.29	5.3	422.95	424.41	422.93	424.29
Cherry-RD	N21	N22	425.06	425.06	0.5	0	422.065	425.56	422.065	425.56	0	422.93	425.56	422.93	425.56
Concrete	N34	N35	414.684	414.654	4	8.97	416.155	418.68	416.095	418.65	43.78	417.49	418.68	417.29	418.65
County	N34	N35	414.684	414.654	4	8.97	416.155	418.68	416.095	418.65	43.78	417.49	418.68	417.29	418.65
RD	N34	N35	420.37	420.37	0.5	0	416.095	420.87	416.095	420.87	0	417.29	420.87	417.29	420.87
CulvA1	N8	N9	423.998	423.602	2.5	0.8	424.236	426.50	424.248	426.10	8.48	424.90	426.50	424.90	426.10
CulvA2	N8	N9	423.778	423.672	2.5	-0.66	424.236	426.28	424.248	426.17	-1.81	424.90	426.28	424.90	426.17
CulvA-RD	N8	N9	428.884	428.884	0.5	0	424.248	429.38	424.248	429.38	0	424.90	429.38	424.90	429.38
CulvB1	N14	N15	423.266	423.202	2	0.05	423.541	425.27	423.54	425.20	2.49	424.23	425.27	424.21	425.20
CulvB2	N14	N15	423.302	423.206	2	0.05	423.541	425.30	423.54	425.21	2.56	424.23	425.30	424.21	425.21
CulvB3	N14	N15	423.274	423.272	2	0.04	423.541	425.27	423.54	425.27	2.09	424.23	425.27	424.21	425.27
CulvB-RD	N14	N15	426.46	426.46	0.5	0	423.54	426.96	423.54	426.96	0	424.21	426.96	424.21	426.96
CulvC1	N16	N17	422.918	422.698	2	0.25	423.137	424.92	423.121	424.70	3.61	423.64	424.92	423.57	424.70
CulvC2	N16	N17	422.89	422.874	2	0.14	423.137	424.89	423.121	424.87	2.5	423.64	424.89	423.57	424.87
CulvC3	N16	N17	422.89	422.83	2	0.16	423.137	424.89	423.121	424.83	2.78	423.64	424.89	423.57	424.83
CulvC-RD	N16	N17	425.36	425.36	0.5	0	423.121	425.86	423.121	425.86	0	423.57	425.86	423.57	425.86
L1	N1	N2	427.59	427.59	2.59	9.9	428.626	430.18	428.575	430.18	54.13	429.78	430.18	429.66	430.18
L10	N9	N10	423.66	424.14	3.5	0.14	424.248	427.16	424.248	427.64	7.28	424.90	427.16	424.89	427.64
L11	N38	N12	424.03	423.89	2.77	0.14	424.182	426.80	424.018	426.66	7.24	424.88	426.80	424.64	426.66
L13	N12	N13	423.89	423.72	2.77	0.14	424.018	426.66	423.897	426.49	7.2	424.64	426.66	424.61	426.49
L14	N13	N14	423.72	423.46	2.95	0.14	423.897	426.67	423.541	426.41	7.18	424.61	426.67	424.23	426.41
L16	N15	N16	423.37	423.1	2.76	0.14	423.54	426.13	423.16	425.86	7.13	424.21	426.13	423.64	425.86
L18	N17	N18	422.88	421.55	2.97	0.55	423.121	425.85	422.074	424.52	8.82	423.57	425.85	423.00	424.52
L20	N19	N20	421.38	421.1	4	0.56	422.07	425.38	422.066	425.10	8.51	422.98	425.38	422.95	425.10
L21	N20	N21	421.1	421.1	4	1.01	422.066	425.10	422.066	425.10	10.62	422.95	425.10	422.95	425.10
L23	N22	N23	420.952	420.92	3.69	1.01	422.065	424.64	422.064	424.61	10.54	422.93	424.64	422.91	424.61
L24	N23	N24	420.92	420.56	3.61	1.01	422.064	424.53	422.064	424.17	10.47	422.91	424.53	422.90	424.17
L25	N24	N25	420.56	420.95	3.55	1.01	422.064	424.11	422.061	424.50	10.32	422.90	424.11	422.87	424.50
L26	N25	N26	420.95	421.5	2.55	1	422.061	423.50	422.058	424.05	10.2	422.87	423.50	422.86	424.05
L27	N26	N27	421.5	421.13	2.43	1	422.058	423.93	421.704	423.56	10.17	422.86	423.93	422.64	423.56
L28	N27	N28	421.13	421.02	2.43	1.28	421.704	423.56	421.614	423.45	11.08	422.64	423.56	422.44	423.45
L29	N28	N29	421.02	420.71	2.54	1.27	421.614	423.56	421.404	423.25	10.92	422.44	423.56	422.29	423.25
L3	N3	N4	427.18	426.92	3.16	9.89	428.052	430.34	427.963	430.08	54.09	429.40	430.34	429.36	430.08
L30	N29	N30	420.71	420.42	2.55	1.27	421.404	423.26	421.019	422.97	10.83	422.29	423.26	422.10	422.97
L31	N30	N31	420.42	420.06	2.5	1.27	421.019	422.92	420.757	422.56	10.87	422.10	422.92	422.01	422.56
L32	N31	N33	420.06	418.041	2.5	14.15	420.757	422.56	418.08	422.26	72.5	422.01	422.56	420.04	422.26
L33	N33	N34	418.041	416	3.5	14.1	418.08	422.56	416.155	420.17	71.9	420.04	422.56	417.49	420.17
L35	N35	N36	414.654	414.65	6	17.93	416.095	420.65	415.433	420.65	87.57	417.29	420.65	416.36	420.65
L36	N37	N8	423.89	423.7	4.35	-0.03	424.236	428.24	424.236	428.05	6.64	425.09	428.24	424.90	428.05
L37	N10	N38	424.14	424.03	3	0.14	424.248	427.14	424.182	427.03	7.27	424.89	427.14	424.88	427.03
L38	N20	N39	421.1	422.64	2.02	0	422.066	423.12	422.64	424.66	0.04	422.95	423.12	422.95	424.66
L39	N39	N40	422.67	423.08	0.95	0	422.64	423.62	422.64	424.03	0	422.95	423.62	423.08	424.03
L40	N40	N41	423.08	423.05	0.74	0	423.05	423.82	423.05	423.79	0	423.05	423.82	423.05	423.79
L41	N41	N42	423.05	422.24	0.4	0	422.24	423.45	422.24	422.64	0	423.05	423.45	422.64	422.64
L42	N42	N27	422.24	421.13	1.6	0	422.24	422.64	421.704	421.53	-0.09	422.64	422.64	422.64	421.53
L5	N5	N6	426.64	426.91	3.46	13.15	427.948	429.10	427.742	429.37	72.53	429.15	429.10	428.71	429.37
L6	N6	N7	426.91	426.24	3.46	13.15	427.742	429.37	427.072	428.70	72.52	428.71	429.37	428.04	428.70
L7	N7	N37	426.24	423.89	2.95	0	425.88	429.19	424.236	426.84	6.75	427.25	429.19	425.09	426.84
Oak1	N18	N19	421.638	421.234	3.3	0.25	422.074	424.94	422.07	424.53	4.38	423.00	424.94	422.98	424.53
Oak2	N18	N19	421.498	421.368	3.3	0.3	422.074	424.80	422.07	424.67	4.19	423.00	424.80	422.98	424.67
Oak-RD	N18	N19	425.86	425.86	0.5	0	422.07	426.36	422.07	426.36	0	422.98	426.36	422.98	426.36
Perkins1	N2	N3	428.046	427.798	2	2.71	428.575	430.05	428.326	429.80	17.74	429.66	430.05	429.40	429.80
Perkins2	N2	N3	427.808	427.748	2	3.63	428.575	429.81	428.414	429.75	17.76	429.66	429.81	429.40	429.75
Perkins3	N2	N3	427.982	427.71	2	3.55	428.575	429.98	428.302	429.71	18.6	429.66	429.98	429.40	429.71
PerkinsRD	N2	N3	432.356	432.356	0.5	0	428.052	432.86	428.052	432.86	0	429.40	432.86	429.40	432.86
Link44	N7	N61	425.24	424.168	3.95	13.14	425.88	429.24	424.972	428.17	65.71	427.25	429.24	426.51	428.17
Link45	N61	N62	424.168	423.76	3.95	13.13	424.972	428.17	424.848	427.76	65.6	426.51	428.17	426.34	427.76
Link46	N62	N63	423.76	423.292	3.6	13.12	424.848	426.76	424.382	429.00	65.42	426.34	426.76	425.81	429.00
Link47	N63	N64	423.292	422.503	3	13.09	424.382	429.00	423.375	428.96	65.02	425.81	429.00	424.67	428.96
Link48	N64	N65	422.503	421.611	2.3	13.04	423.375	428.96	422.511	424.00	64.3	424.673	428.96	423.77	424.00
Link49	N65	N66	421.611	420.085	2.3	12.96	422.511	424.00	420.807	424.30	63.28	423.769	424.00	422.05	424.30
Link50	N66	N31	420.085	420.06	2.4	12.93	420.807	424.30	420.757	422.56	62.2	422.048	424.30	422.01	422.56

🟥 Surcharging or Flooding of Conduit for CIP Option

OPTION 7

						NOVEMBER 2006 FUTURE					25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.25	426.394	2.5	5.47	427.98	428.75	427.97	428.89	26.6	429.515	428.75	429.23	428.89
Blek2	N4	N5	426.518	426.532	2.5	4.43	427.98	429.02	427.97	429.03	27.44	429.515	429.02	429.23	429.03
BlekRD	N4	N5	430.01	430.01	0.5	0.00	427.97	430.51	427.97	430.51	0	429.304	430.51	429.23	430.51
Cherry1	N21	N22	421.108	420.952	3.3	4.99	422.90	424.41	422.88	424.25	19.47	424.413	424.41	423.63	424.25
Cherry2	N21	N22	421.114	420.994	3.3	4.98	422.90	424.41	422.88	424.29	19.45	424.413	424.41	423.63	424.29
Cherry-RD	N21	N22	425.06	425.06	0.5	0.00	422.88	425.56	422.88	425.56	0	424.001	425.56	423.63	425.56
Concrete	N34	N35	414.684	414.654	4	6.42	415.97	418.68	415.92	418.65	25.72	416.933	418.68	416.69	418.65
County	N34	N35	414.684	414.654	4	6.42	415.97	418.68	415.92	418.65	25.72	416.933	418.68	416.69	418.65
RD	N34	N35	420.37	420.37	0.5	0.00	415.92	420.87	415.92	420.87	0	416.809	420.87	416.69	420.87
CulvA1	N8	N9	423.998	423.602	2.5	49.43	426.53	426.50	426.19	426.10	49.43	426.533	426.50	426.19	426.10
CulvA2	N8	N9	423.778	423.672	2.5	27.32	426.61	426.28	426.52	426.17	27.32	426.61	426.28	426.52	426.17
CulvA-RD	N8	N9	428.884	428.884	0.5	0.00	426.52	429.38	426.52	429.38	0	426.516	429.38	426.52	429.38
CulvB1	N14	N15	423.266	423.202	2	3.33	424.34	425.27	424.32	425.20	13.82	425.573	425.27	424.88	425.20
CulvB2	N14	N15	423.302	423.206	2	3.42	424.34	425.30	424.32	425.21	13.79	425.573	425.30	424.88	425.21
CulvB3	N14	N15	423.274	423.272	2	2.84	424.34	425.27	424.32	425.27	13.68	425.573	425.27	424.88	425.27
CulvB-RD	N14	N15	426.46	426.46	0.5	0.00	424.32	426.96	424.32	426.96	0	425.434	426.96	424.88	426.96
CulvC1	N16	N17	422.918	422.698	2	3.92	423.68	424.92	423.60	424.70	14.28	425.155	424.92	424.21	424.70
CulvC2	N16	N17	422.89	422.874	2	2.74	423.68	424.89	423.60	424.87	13.78	425.155	424.89	424.21	424.87
CulvC3	N16	N17	422.89	422.83	2	3.03	423.68	424.89	423.60	424.83	13.92	425.155	424.89	424.21	424.83
CulvC-RD	N16	N17	425.36	425.36	0.5	0.00	423.60	425.86	423.60	425.86	0	425.011	425.86	424.21	425.86
L1	N1	N2	427.59	427.59	2.59	9.90	428.63	430.18	428.58	430.18	54.11	429.887	430.18	429.72	430.18
L10	N9	N10	423.66	424.14	3.5	9.57	425.01	427.16	425.00	427.64	41.42	426.008	427.16	425.56	427.64
L11	N38	N12	424.03	423.89	2.77	9.57	424.99	426.80	424.76	426.66	41.37	425.979	426.80	425.34	426.66
L13	N12	N13	423.89	423.72	2.77	9.56	424.76	426.66	424.73	426.49	41.33	425.828	426.66	425.33	426.49
L14	N13	N14	423.72	423.46	2.95	9.59	424.73	426.67	424.34	426.41	41.34	425.823	426.67	424.95	426.41
L16	N15	N16	423.37	423.1	2.76	9.59	424.32	426.13	423.68	425.86	41.19	425.434	426.13	424.31	425.86
L18	N17	N18	422.88	421.55	2.97	9.69	423.60	425.85	422.98	424.52	41.13	425.011	425.85	424.07	424.52
L20	N19	N20	421.38	421.1	4	9.65	422.95	425.38	422.91	425.10	40.23	424.465	425.38	423.81	425.10
L21	N20	N21	421.1	421.1	4	9.98	422.91	425.10	422.90	425.10	38.93	424.417	425.10	423.81	425.10
L23	N22	N23	420.952	420.92	3.69	9.97	422.88	424.64	422.87	424.61	38.92	424.001	424.64	423.58	424.61
L24	N23	N24	420.92	420.56	3.61	9.96	422.87	424.53	422.86	424.17	38.91	423.931	424.53	423.57	424.17
L25	N24	N25	420.56	420.95	3.55	9.92	422.86	424.11	422.83	424.50	38.82	423.913	424.11	423.52	424.50
L26	N25	N26	420.95	421.5	2.55	9.91	422.83	423.50	422.81	424.05	38.75	423.854	423.50	423.51	424.05
L27	N26	N27	421.5	421.13	2.43	9.90	422.81	423.93	422.55	423.56	38.72	423.826	423.93	423.35	423.56
L28	N27	N28	421.13	421.02	2.43	10.01	422.55	423.56	422.33	423.45	41.52	423.67	423.56	422.94	423.45
L29	N28	N29	421.02	420.71	2.54	9.99	422.33	423.56	422.14	423.25	41.48	423.231	423.56	422.74	423.25
L3	N3	N4	427.18	426.92	3.16	9.89	428.07	430.34	427.98	430.08	53.98	429.548	430.34	429.44	430.08
L30	N29	N30	420.71	420.42	2.55	9.98	422.14	423.26	421.77	422.97	41.45	422.992	423.26	422.39	422.97
L31	N30	N31	420.42	420.06	2.5	9.96	421.77	422.92	421.55	422.56	41.43	422.644	422.92	422.11	422.56
L32	N31	N33	420.06	419.76	2.5	9.86	421.55	422.56	420.91	422.26	41.23	422.344	422.56	421.48	422.26
L33	N33	N34	419.76	417.37	2.8	9.72	420.91	422.56	417.92	420.17	40.86	421.78	422.56	418.27	420.17
L35	N35	N36	414.654	414.65	6	12.82	415.92	420.65	415.31	420.65	51.38	416.809	420.65	415.88	420.65
L36	N37	N8	423.89	423.7	4.35	13.08	425.46	428.24	425.24	428.05	71.04	427.418	428.24	426.27	428.05
L37	N10	N38	424.14	424.03	3	9.57	425.00	427.14	424.99	427.03	41.41	425.99	427.14	425.54	427.03
L38	N20	N39	421.1	422.64	2.02	-0.02	422.91	423.12	422.91	424.66	2.57	424.417	423.12	423.81	424.66
L39	N39	N40	422.67	423.08	0.95	0.00	422.91	423.62	423.08	424.03	2.43	424.417	423.62	423.80	424.03
L40	N40	N41	423.08	423.05	0.74	0.00	423.05	423.82	423.05	423.79	2.3	424.402	423.82	423.77	423.79
L41	N41	N42	423.05	422.24	0.4	0.00	423.05	423.45	422.55	422.64	2.25	424.371	423.45	423.72	422.64
L42	N42	N27	422.24	421.13	0.4	-0.04	422.55	422.64	422.55	421.53	2.24	423.945	422.64	423.35	421.53
L5	N5	N6	426.64	426.91	2.46	13.15	427.97	429.10	427.78	429.37	72.36	429.304	429.10	428.85	429.37
L6	N6	N7	426.91	426.24	2.46	13.15	427.78	429.37	427.53	428.70	72.32	428.875	429.37	428.60	428.70
L7	N7	N37	426.24	423.89	2.95	13.14	427.53	429.19	425.46	426.84	72.19	428.674	429.19	426.86	426.84
Oak1	N18	N19	421.638	421.234	3.3	4.92	422.98	424.94	422.95	424.53	20.14	424.95	424.94	423.85	424.53
Oak2	N18	N19	421.498	421.368	3.3	4.73	422.98	424.80	422.95	424.67	20.14	424.95	424.80	423.85	424.67
Oak-RD	N18	N19	425.86	425.86	0.5	0.00	422.95	426.36	422.95	426.36	0	424.465	426.36	423.85	426.36
Perkins1	N2	N3	428.046	427.798	2	2.71	428.58	430.05	428.33	429.80	18.21	429.785	430.05	429.47	429.80
Perkins2	N2	N3	427.808	427.748	2	3.63	428.58	429.81	428.41	429.75	17.11	429.785	429.81	429.47	429.75
Perkins3	N2	N3	427.982	427.71	2	3.55	428.58	429.98	428.30	429.71	18.73	429.785	429.98	429.47	429.71
PerkinsRD	N2	N3	432.356	432.356	0.5	0.00	428.07	432.86	428.07	432.86	0	429.548	432.86	429.47	432.86
New Culv	N8	N9	423.998	423.602	2.5	9.57	425.24	426.20	425.01	426.10	41.42	427.351	426.20	425.57	426.10

🟥 Surcharging or Flooding of Conduit for CIP Option

OPTION 8

						NOVEMBER 2006 FUTURE					25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.25	426.39	2.50	5.47	427.98	428.75	427.97	428.89	26.71	429.59	428.75	429.38	428.89
Blek2	N4	N5	426.52	426.53	2.50	4.43	427.98	429.02	427.97	429.03	27.18	429.59	429.02	429.38	429.03
BlekRD	N4	N5	430.01	430.01	0.50	0.00	427.97	430.51	427.97	430.51	0.00	429.38	430.51	429.38	430.51
Cherry1	N21	N22	421.11	420.95	3.30	6.76	423.12	424.41	423.07	424.25	17.39	424.19	424.41	423.86	424.25
Cherry2	N21	N22	421.11	420.99	3.30	6.75	423.12	424.41	423.07	424.29	17.37	424.19	424.41	423.86	424.29
Cherry-RD	N21	N22	425.06	425.06	0.50	0.00	423.07	425.56	423.07	425.56	0.00	423.86	425.56	423.86	425.56
Concrete	N34	N35	414.68	414.65	4.00	8.48	416.12	418.68	416.06	418.65	26.13	416.95	418.68	416.82	418.65
County	N34	N35	414.68	414.65	4.00	8.48	416.12	418.68	416.06	418.65	26.13	416.95	418.68	416.82	418.65
RD	N34	N35	420.37	420.37	0.50	0.00	416.06	420.87	416.06	420.87	0.00	416.82	420.87	416.82	420.87
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
New Ch 1	N8	N9	423.70	423.60	5.50	13.22	425.68	428.50	425.67	428.50	69.12	428.04	428.50	428.04	428.50
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CulvB1	N14	N15	423.27	423.20	2.00	4.45	424.47	425.27	424.44	425.20	16.82	426.02	425.27	425.79	425.20
CulvB2	N14	N15	423.30	423.21	2.00	4.57	424.47	425.30	424.44	425.21	16.82	426.02	425.30	425.79	425.21
CulvB3	N14	N15	423.27	423.27	2.00	3.88	424.47	425.27	424.44	425.27	16.98	426.02	425.27	425.79	425.27
CulvB-RD	N14	N15	426.46	426.46	0.50	0.00	424.44	426.96	424.44	426.96	0.00	425.79	426.96	425.79	426.96
CulvC1	N16	N17	422.92	422.70	2.00	5.35	423.71	424.92	423.50	424.70	16.60	425.40	424.92	425.18	424.70
CulvC2	N16	N17	422.89	422.87	2.00	3.75	423.71	424.89	423.55	424.87	17.41	425.40	424.89	425.18	424.87
CulvC3	N16	N17	422.89	422.83	2.00	4.12	423.71	424.89	423.54	424.83	17.20	425.40	424.89	425.18	424.83
CulvC-RD	N16	N17	425.36	425.36	0.50	0.00	423.50	425.86	423.50	425.86	0.36	425.40	425.86	425.38	425.86
L1	N1	N2	427.59	427.59	2.59	9.90	428.63	430.18	428.58	430.18	54.08	429.94	430.18	429.85	430.18
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
New Ch.6	N13	N 44 Opt 8	423.42	423.34	3.20	12.92	424.58	426.80	424.52	426.66	51.18	426.10	426.80	426.06	426.66
New Ch. 7	N 44	N14	423.34	423.27	3.40	12.91	424.52	426.66	424.47	426.49	50.60	426.06	426.66	426.02	426.49
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L16	N15	N16	423.37	423.10	2.76	12.89	424.44	426.13	423.72	425.86	50.04	425.79	426.13	425.40	425.86
New Ch.7	N17	N18	422.70	421.50	2.97	13.18	423.50	425.85	423.21	425.10	50.83	425.18	425.85	425.07	425.10
L20	N19	N20	421.38	421.10	4.00	13.13	423.16	425.38	423.12	425.10	50.81	424.30	425.38	424.20	425.10
L21	N20	N21	421.10	421.10	4.00	13.51	423.12	425.10	423.12	425.10	34.76	424.20	425.10	424.19	425.10
L23	N22	N23	420.95	420.92	3.69	13.51	423.07	424.64	423.04	424.61	34.76	423.86	424.64	423.80	424.61
L24	N23	N24	420.92	420.56	3.61	13.50	423.04	424.53	423.04	424.17	34.76	423.80	424.53	423.78	424.17
L25	N24	N25	420.56	420.95	3.55	13.47	423.04	424.11	423.00	424.50	34.75	423.78	424.11	423.72	424.50
L26	N25	N26	420.95	421.50	2.55	13.45	423.00	423.50	422.98	424.05	34.74	423.72	423.50	423.70	424.05
L27	N26	N27	421.50	421.13	2.43	13.45	422.98	423.93	422.74	423.56	34.74	423.70	423.93	423.52	423.56
L28	N27	N28	421.13	421.02	2.43	13.62	422.74	423.56	422.48	423.45	36.14	423.52	423.56	423.14	423.45
L29	N28	N29	421.02	420.71	2.54	13.60	422.48	423.56	422.29	423.25	36.10	423.14	423.56	422.90	423.25
L3	N3	N4	427.18	426.92	3.16	9.89	428.07	430.34	427.98	430.08	53.86	429.62	430.34	429.59	430.08
L30	N29	N30	420.71	420.42	2.55	13.59	422.29	423.26	421.94	422.97	36.09	422.90	423.26	422.56	422.97
L31	N30	N31	420.42	420.06	2.50	13.57	421.94	422.92	421.71	422.56	36.07	422.56	422.92	422.26	422.56
L32	N31	N33	420.06	419.76	2.50	13.48	421.71	422.56	421.05	422.26	35.95	422.26	422.56	421.67	422.26
L33	N33	N34	419.76	417.37	2.80	13.35	421.05	422.56	418.01	420.17	35.75	421.67	422.56	418.38	420.17
L35	N35	N36	414.65	414.65	6.00	16.95	416.06	420.65	415.41	420.65	52.21	416.82	420.65	415.99	420.65
L36	N37	N8	423.89	423.70	4.35	13.12	425.77	428.24	425.68	428.05	69.62	428.10	428.24	428.04	428.05
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L38	N20	N39	421.10	422.64	2.02	0.03	423.12	423.12	423.12	424.66	17.26	424.20	423.12	424.19	424.66
L39	N39	N40	422.67	423.08	0.95	0.03	423.12	423.62	423.12	424.03	17.25	424.19	423.62	423.83	424.03
L40	N40	N41	423.08	423.05	0.74	0.02	423.12	423.82	423.07	423.79	17.25	423.83	423.82	423.79	423.79
L41	N41	N42	423.05	422.24	0.40	0.01	423.07	423.45	422.74	422.64	2.06	423.79	423.45	423.55	422.64
L42	N42	N27	422.24	421.13	0.40	0.07	422.74	422.64	422.74	421.53	1.99	423.55	422.64	423.52	421.53
L5	N5	N6	426.64	426.91	2.46	13.15	427.97	429.10	427.78	429.37	72.12	429.38	429.10	428.98	429.37
L6	N6	N7	426.91	426.24	2.46	13.15	427.78	429.37	427.53	428.70	71.99	428.98	429.37	428.89	428.70
L7	N7	N37	426.24	423.89	2.95	13.14	427.53	429.19	425.77	426.84	71.53	428.89	429.19	428.10	426.84
Oak1	N18	N19	421.64	421.23	3.30	6.68	423.21	424.94	423.16	424.53	25.40	425.07	424.94	424.30	424.53
Oak2	N18	N19	421.50	421.37	3.30	6.45	423.21	424.80	423.16	424.67	25.40	425.07	424.80	424.30	424.67
Oak-RD	N18	N19	425.86	425.86	0.50	0.00	423.16	426.36	423.16	426.36	0.00	424.30	426.36	424.30	426.36
Perkins1	N2	N3	428.05	427.80	2.00	2.71	428.58	430.05	428.33	429.80	18.44	429.85	430.05	429.62	429.80
Perkins2	N2	N3	427.81	427.75	2.00	3.63	428.58	429.81	428.41	429.75	16.84	429.85	429.81	429.62	429.75
Perkins3	N2	N3	427.98	427.71	2.00	3.55	428.58	429.98	428.30	429.71	18.67	429.85	429.98	429.62	429.71
PerkinsRD	N2	N3	432.36	432.36	0.50	0.00	428.07	432.86	428.07	432.86	0.00	429.62	432.86	429.62	432.86

▨ Surcharging or Flooding of Conduit for CIP Option

Appendix D

CIP Unit Cost Tables

Appendix D Overview

The following tables provide the unit costs and back-up documentation associated with material and construction costs for various drainage system components. Although not all costs documented in Tables D-1 through D-9 are used in the development of CIP costs for the Coyote Creek Tributary Basin Plan, these costs may allow the City to estimate costs associated with additional stormwater infrastructure improvements in the future and for other watershed.

Tables D-1 through D-4 – Tables D-1 through D-4 provide estimated capital/construction costs for each CIP type (e.g., pipe installation, open channel improvements, and detention and water quality facilities). Table D-1 provides cost estimates for all of the CIP types except for pipes and water quality structures. Table D-2 provides cost estimates for drainage pipe, based on pipe size and depth of cover. Table D-3 provides detailed back-up information regarding estimated construction costs for drainage pipe installation. Table D-4 provides cost estimates for five different sized structural water quality facilities (i.e., CONTECH Storm Filter). For many of the CIPs in Table D-1 and the pipe costs in Table D-2, the unit cost must be multiplied by a quantity such as acre-feet, square yards, or lineal feet to come up with the total estimated capital cost for that CIP.

Tables D-5 through D-7 – Tables D-5 through D-7 provide the back-up information that was used to estimate the unit costs for CIP types listed in Table D-1. Table D-5 provides unit costs for the various elements that comprise each CIP (e.g., labor, excavation, etc.). Table D-6 provides the quantities of each element that comprise the CIPs (e.g., 1 hour of labor, 6 cubic yards of excavation, etc.). Table D-7 provides the detailed back-up capital/construction cost information for each CIP type based on Tables D-5 and D-6.

Table D-8 – Table D-8 provides the estimated maintenance costs for each CIP type. For many of the CIPs, the maintenance cost must be multiplied by a unit such as acre-feet or square yards in order to come up with the total estimated maintenance cost.

Table D-9 – Table D-9 provides the detailed back-up information for estimating the maintenance costs for each CIP type except for increased pipe sizes. A maintenance cost is not provided for capital projects to increase the pipe sizes based on the assumption that maintenance of piped systems typically includes catch basin/manhole cleaning and that this cleaning is already being conducted for the existing piped system.

Tables D-1, D-2, D-4, and D-8 were used to estimate capital and maintenance costs that are provided in the draft CIP fact sheets. Tables D-3, D-5, D-6, D-7 and D-9 are only provided to show back-up for information presented in tables D-1, D-2, D-4, and D-8.

The purpose of these tables is to provide general guidance with respect to CIP costs and to allow for cost comparisons between CIPs. These costs are only applicable to the scale of projects in the City’s preliminary storm system CIP list. They are not applicable to projects that are of a much smaller or larger scale than those preliminary CIPs.

STORMWATER FACILITIES
ESTIMATED CONSTRUCTION COSTS PER UNIT
Table D-1

Stormwater Facility Type	Unit	$/Unit[Notes 1+2]	Description of Stormwater Facility Construction Activities
Trash Rack Inlet (Type 1)	EA	$5,940	Cone shaped rebar cage bolted to an inlet structure (manhole or vault), inlet protection (riprap, geotextile fabric), clearing of invasive vegetation, grading and revegetation .
Trash Rack Inlet (Type 2)	EA	$9,970	Steel trash rack approximately 15 ft wide and 4 ft high placed in the channel with concrete foundation walls on both banks. Also includes inlet protection, clearing of invasive vegetation, grading and revegetation.
Garbage and Debris Removal	CY	$120	Hand collected debris not requiring mechanical means to lift, hauled in 10 CY truck to disposal.
Sediment Removal	CY	$250	Removal of sediment from channels and culverts with heavy equipment. Includes hydroseeding for revegetation.
Streambank Stabilization	SY	$90	Grading, geotextile, toe reinforcement, revegetation and erosion control.
Open Channel Improvements (Type 1)	LF	$350	Traffic control, excavation (0 to10 ft bottom width, 4 to 6 ft depth, 3:1 side slopes), hydroseed, erosion protection at inlet and outlet. Modification of existing channel.
Open Channel Improvements (Type 2)	LF	$730	Same as above except 10 to 20 ft bottom width, 6 to 10 ft depth.
Dry Extended Pond	Ac-Ft	$59,700	Gravel access road (25 ft long x 12 ft width), clearing & grubbing, excavation (3 ft depth), grading, erosion protection at inlet & outlet, hydroseed, trees & shrubs, safety fence, erosion control.
Wet Extended Pond	Ac-Ft	$59,700	Gravel access road (25 ft long x 12 ft width), clearing & grubbing, excavation (3-6 ft depth), grading, erosion protection at inlet & outlet, hydroseed, trees & shrubs, safety fence, erosion control. No lining has been included.
Stormwater Marsh/Wetland	AC	$88,300	Gravel access road (25 ft long x 12 ft width), grading (1-2 ft depth, no removal from site), erosion protection at inlet & outlet, hydroseed, vegetation and erosion control.
Flood Control Facility	Ac-Ft	$59,700	Gravel access road (25 ft long x 12 ft width), clearing & grubbing, excavation (3 ft depth), grading, erosion protection at inlet & outlet, hydroseed, trees & shrubs, safety fence, erosion control.
Outfall Protection	EA	$7,670	Precast concrete outlet structure, erosion protection, geotextile fabric, clearing of vegetation around structure, grading and revegetation.
Vegetated Swale	LF	$17	Traffic control, clearing & grubbing, excavation (4ft bottom width, 2 ft depth, 4:1 side slopes), hydroseed, erosion protection at inlet and outlet.
Infiltration Trench	LF	$50	Clearing & grubbing, excavation (2ft bottom width, 4 ft depth), geotextile fabric, 4"-8" perforated pipe, drain rock, and hydroseed.
Natural Resource Enhancement[Note 3]	SY	$10	Add additional vegetation
Natural Resource Revegetation[Note 3]	SY	$56	Remove invasive vegetation, grade and revegetate.
Recreational Trail	SF	$5	Clearing & grubbing, grading (up to 1 ft depth), erosion control, cedar shavings. Does not include storm drainage, signage, benches or other recreational amenities.

Note 1: The costs in this table reflect an update of the original unit cost prepared in 1999 for the City of Eugene Stormwater Master Plan. These costs are based on a 2007 update that included an accross the board increase of 15% to all unit costs in Table D-7. It also includes the inclusion of geotextile fabric for all types of open channel improvements (see update to Table D-7).

Note 2: Construction costs presented in this table are planning level estimates. They are reflective of average facilities constructed under typical conditions. Each facility will vary depending on site conditions, the size and number of facilities constructed, and depending on the local construction market at the time of bidding. Contingencies should be reflected for budgeting purposes based on the variety of possible conditions.

Note 3: These 2 categories have been combined and called Natural Resource Enhancement.

Reference:

Table D-1 summarizes data in Table D-7.
Table D-5 (Unit Cost) x Table D-6 (Quantities) = Table D-7 (Unit Cost per CIP Type)

STORMWATER FACILITIES
ESTIMATED CONSTRUCTION COSTS
FOR STORM DRAIN INSTALLATION IN IMPROVED AREAS
Table D-2

Storm Drain Pipe Construction Cost per Linear Foot												
	Diameter (inches)											
Cover Depth (feet)	18	24	30	36	42	48	54	60	66	72	84	96
2-5	$90	$120	$170	$220	$250	$300	$350	$400	$480	$520	$680	$830
5-10	$110	$150	$200	$250	$290	$340	$400	$450	$540	$580	$760	$920
10-15	$120	$170	$230	$280	$330	$380	$440	$500	$600	$650	$830	$1000
15-20	$140	$190	$250	$310	$360	$420	$490	$560	$660	$710	$910	$1090

Note 1: The costs in this table reflect an update of the original table prepared for the City of Eugene Stormwater Master Plan in 1999. The 2007 update includes a 15% increase to all unit costs.

Note 2: Construction costs presented in this table are planning level estimates. These estimated costs include shoring, excavation, backfill/air tamped compaction, piping, pavement restoration, minor stream management, and traffic control costs associated with typical projects, and average utility relocation in improved areas. Trench excavation is assumed to be by excavator or backhoe (mechanical means or blasting not included). Utility easement or other land acquisition costs are excluded. Information presented in this table is a summary of Table D-3.

Reference: Cost = volume * ($excavation + $backfill) + $shoring + $piping + 5 + $pavement + $traffic control + $stream management

STORMWATER FACILITIES
ESTIMATED CONSTRUCTION COSTS
FOR STORM DRAIN INSTALLATION IN IMPROVED AREAS
BACK UP INFORMATION
Table D-3

Storm Drain Pipe Construction Cost per Linear Foot												
	Diameter (inch)											
Depth of Cover (ft)	18	24	30	36	42	48	54	60	66	72	84	96
Sub Task												
Pipe + Bed (ft)	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7.5	8.5
Width (ft)	3	4	5	6	7	8	9	10	11	12	14	16
Bedding (ft)	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.6
Shoring (lf)	$ 10.34	$12.42	$14.90	$17.88	$21.46	$25.75	$30.90	$30.90	$37.09	$44.51	$53.41	$64.09
Excavation (CY)	$ 11.50	$11.50	$11.50	$11.50	$11.50	$11.50	$11.50	$11.50	$11.50	$11.50	$11.50	$11.50
Backfill and Air Tamped Compaction	$ 17.25	$17.25	$17.25	$17.25	$17.25	$17.25	$17.25	$17.25	$17.25	$17.25	$17.25	$17.25
Piping (lf)	$ 15.00	$29.33	$59.80	$79.35	$90.85	$108.10	$131.10	$154.10	$204.70	$203.55	$304.75	$379.50
Pavement Restoration	$ 6.40	$8.54	$10.67	$12.81	$14.94	$17.08	$19.21	$21.35	$23.48	$25.62	$29.89	$34.16
Traffic Control	$ 20.91	$23.00	$25.30	$27.83	$30.61	$33.67	$37.04	$40.75	$44.82	$49.30	$54.23	$59.66
Stream Management	$ 12.54	$14.38	$16.53	$19.01	$21.86	$25.14	$28.91	$33.25	$38.24	$43.97	$50.57	$58.15
Cover (CY)												
2-5	0.7	1.1	1.5	1.9	2.3	2.8	3.3	3.9	4.5	5.1	6.5	8.0
5-10	1.4	1.9	2.4	3.0	3.6	4.3	5.0	5.7	6.5	7.3	9.1	11.0
10-15	1.9	2.6	3.3	4.1	4.9	5.8	6.7	7.6	8.6	9.6	11.7	13.9
15-20	2.3	3.3	4.3	5.2	6.2	7.3	8.3	9.4	10.6	11.8	14.3	16.9
2-5	$90.32	$124.60	$174.80	$216.19	$251.81	$295.67	$348.00	$397.15	$482.17	$518.89	$684.19	$830.56
5-10	$110.44	$145.90	$201.42	$248.13	$289.08	$338.26	$395.92	$450.39	$540.73	$582.78	$758.72	$915.74
10-15	$124.82	$167.20	$228.04	$280.08	$326.35	$380.85	$443.83	$503.63	$599.30	$646.67	$833.26	$1,000.93
15-20	$136.32	$188.49	$254.66	$312.02	$363.62	$423.45	$491.75	$556.87	$657.86	$710.56	$907.80	$1,086.11

Note 1: The costs in this table reflect an update of the original unit cost table prepared in 1999 for the City of Eugene Master Plan. The 2007 update includes a 15% increase to all unit costs.

Note 2: Construction costs presented in this table are planning level estimates. These estimated costs include minor stream management, traffic control costs associated with typical in-stream culvert projects, average utility relocation and pavement restoration costs in improved areas. Utility easement or other land acquisition costs are excluded. Information presented in this table is summarized in Table D-2.

STORMWATER FACILITIES
ESTIMATED CONSTRUCTION COSTS
FOR WATER QUALITY STRUCTURES

Table D-4

Device/Model	**Total Installed Cost**
Compost Storm Filter (CSF) Function: Primarily metals uptake and oil & grease removal. Commonly used with sediment manhole.	
CSF 8x6	$58,500
CSF 8x6	$70,000
CSF 12x6	$73,280
CSF 16x8	$138,560
CSF 16x8	$157,000

Note 1: Only the costs for CSF StormFilter units have been updated for 2007 and shown in Table D-4. If other proprietary treatment systems are proposed, costs for other facilities will be updated.

Note 2: Construction costs presented in this table are planning level estimates. Costs represent installation of average facilities under typical conditions. Estimates reflect vaults installed in public right of way, in an existing residential paved street, with average utility conflicts and restoration costs.

STORMWATER FACILITIES
CONSTRUCTION COST ESTIMATE
BACK-UP INFORMATION
Table D-5

Construction Activity/Materials	Units	$/Unit
Manual Labor	Labor-Hr	$35
Traffic Control	Labor-Hr	$32
Gravel Access Road	SF	$4.37
Clearing & Grubbing	AC	$2,300
General Excavation	CY	$17
Grading	CY	$6
Inlet Cone & Structure	EA	$4,025
Trash Rack Structure	EA	$8,050
Pond Outlet	EA	$5,750
Curb & Gutter	LF	$14
Hydroseed	AC	$2,300
Trees & Shrubs	EA	$58
Geotextile Fabric	SY	$2.01
Rip Rap	TN	$69
Chain Link Fence	LF	$20
Erosion Control	AC	$2,300
Drain Rock	CY	$30
Crushed Rock	CY	$25
Truck Haul (Disposal)	CY	$21
Perforated Drain Pipe	LF	$30
Cedar Savings	CY	$25

Note 1: The above costs (originally prepared in 1999) were updated in 2007 with an across the board increase of 15%.

Note 2: The above costs were originally based on representative unit cost information collected from bid tabulation sheets during the period from 1997-1999 in the Eugene, Lebanon and Portland areas. These original costs are representative of average conditions and assume that the CIP projects are competitively bid. Unit costs include materials and installation. Actual construction cost will vary with site conditions and local factors at time of bidding.

Unit cost for trees assumes bare root stock with temporary water for 2-3 years.

Note 3: With respect to Natural Resource Enhancement and Open Waterway Improvement Construction Costs, the original unit costs were revised (Nov. 2001) for clearing & grubbing, hydroseeding, trees & shrubs, and erosion control.

Reference:

Table D-5 (Unit Cost) x Table D-6 (Quantities) = Table D-7 (Unit Cost per CIP Type)

STORMWATER FACILITIES
CONSTRUCTION EFFORT/QUANTITIES ESTIMATE
BACK-UP INFORMATION
Table D-6

Construction Activity/ Materials	Unit	Trash Rack Inlet (Type 1)	Trash Rack Inlet (Type 2)	Garbage and Debris Removal	Sediment Removal	Streambank Stabilization	Open Channel Improvements (Type 1)	Open Channel Improvements (Type 2)	Dry Extended Pond	Wet Extended Pond	Stormwater Marsh/Wetland	Flood Control Facility	Outfall Protection	Vegetated Swale	Infiltration Trench	Natural Resource Revegetation*	Natural Resource Enhancement*	Recreational Trail
		EA	EA	CY	CY	SY	LF	LF	Ac-Ft	Ac-Ft	AC	Ac-Ft	EA	LF	LF	SY	SY	SF
Manual Labor	**Lb-Hr**			3														
Traffic Control	**Lb-Hr**						0.6	1.2						0.16				
Gravel Access Road	**SF**								350	350	350	350						
Clearing & Grubbing	**AC**	0.1	0.1		0.0002				0.33	0.33		0.33	0.1	0.0002	0.0002			0.00002
General Excavation	**CY**				8		2	6	1600	1600	500	1600		0.3	0.3	0.5		
Grading	**CY**	8	8			0.6			100	100	1000	100	8					0.4
Inlet Cone & Structure	**EA**	1							1	1	1	1						
Trash Rack Structure	**EA**		1															
Pond Outlet Structure	**EA**								1	1	1	1	1					
Curb & Gutter	**LF**								20	20	20	20						
Hydroseed	**AC**	0.1	0.1		0.0002	0.0002	0.008	0.02	0.33	0.33	1	0.33	0.1	0.0002	0.0002	0.0002		
Trees & Shrubs	**EA**	5	5		2	1	4	8	100	100	1000	100	5	0.1		0.5	0.21	
Geotextile Fabric	**SY**	45	45			1	3	3					45		1.1			
Rip Rap	**CY**	15	15			0.33	0.28	0.5	3	3	3	3	15					
Chain Link Fence	**LF**								600	600		600						
Erosion Control	**AC**				0.0002	0.0002	0.008	0.016	0.33	0.33	1	0.33		0.0002		0.008		0.00002
Drain Rock	**CY**														0.3			
Crushed Rock	**CY**																	
Truck Haul	**CY**			1														
Perforated Drain Pipe	**LF**														1			
Cedar Shavings	**CY**																	0.11

Note 1: An update to this table was made in 2007 to add 3SY of geotextile fabric for each lineal foot of open channel improvement for all Channel Improvements types.

Note 2: The above are representative quantities based on average construction conditions. Actual construction quantities will vary with site conditions. The quantities above represent the volume and effort to construct/perform each unit of water quality facility (i.e. 1 CY of Sediment Removal). Volumes of excavation are assumed to include hauling offsite (approximately 10 mile round trip) and disposal.

*The Natural Resource Revegetation and Natural Resource Enhancement columns were combined into one column called Natural Resources Enhancement and associated quantities were also revised.

Reference:
Table D-5 (Unit Cost) x Table D-6 (Quantities) = Table D-7 (Cost per CIP)

STORMWATER FACILITIES
CONSTRUCTION COST ESTIMATE
BACK-UP INFORMATION
Table D-7

Construction Activity/ Materials		Trash Rack Inlet (Type 1)	Trash Rack Inlet (Type 2)	Garbage and Debris Removal	Sediment Removal	Streambank Stabilization	Open Channel Improvements (Type 1)	Open Channel Improvements (Type 2)	Dry Extended Pond	Wet Extended Pond	Stormwater Marsh/Wetland	Flood Control Facility	Outfall Protection	Vegetated Swale	Infiltration Trench	Natural Resource Revegetation*	Natural Resource Enhancement*	Recreational Trail
	Unit	EA	EA	CY	CY	SY	LF	LF	Ac-Ft	Ac-Ft	AC	Ac-Ft	EA	LF	LF	SY	SY	SF
Manual Labor	**Lb-Hr**	$ -	$ -	$ 103.50	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Traffic Control	**Lb-Hr**	$ -	$ -	$ -	$ -	$ -	$ 19.32	$ 38.64	$ -	$ -	$ -	$ -	$ -	$ 5.15	$ -	$ -	$ -	$ -
Gravel Access Road	**SF**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,529.50	$ 1,529.50	$ 1,529.50	$ 1,529.50	$ -	$ -	$ -	$ -	$ -	$ -
Clearing & Grubbing	**AC**	$ 230.00	$ 230.00	$ -	$ 0.46	$ -	$ -	$ -	$ 759.00	$ 759.00	$ -	$ 759.00	$ 230.00	$ 0.46	$ 0.46	$ -	$ -	$ 0.05
General Excavation	**CY**	$ -	$ -	$ -	$ 138.00	$ -	$ 34.50	$ 103.50	$ 27,600.00	$ 27,600.00	$ 8,625.00	$ 27,600.00	$ -	$ 5.18	$ 5.18	$ 8.63	$ -	$ -
Grading	**CY**	$ 46.00	$ 46.00	$ -	$ -	$ 3.45	$ -	$ -	$ 575.00	$ 575.00	$ 5,750.00	$ 575.00	$ 46.00	$ -	$ -	$ -	$ -	$ 2.30
Inlet Cone & Structure	**EA**	$ 4,025.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,025.00	$ 4,025.00	$ 4,025.00	$ 4,025.00	$ -	$ -	$ -	$ -	$ -	$ -
Trash Rack Structure	**EA**	$ -	$ 8,050.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pond Outlet Structure	**EA**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,750.00	$ 5,750.00	$ 5,750.00	$ 5,750.00	$ 5,750.00	$ -	$ -	$ -	$ -	$ -
Curb & Gutter	**LF**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 276.00	$ 276.00	$ 276.00	$ 276.00	$ -	$ -	$ -	$ -	$ -	$ -
Hydroseed	**AC**	$ 230.00	$ 230.00	$ -	$ 0.46	$ 0.46	$ 18.40	$ 46.00	$ 759.00	$ 759.00	$ 2,300.00	$ 759.00	$ 230.00	$ 0.46	$ 0.46	$ 0.46	$ -	$ -
Trees & Shrubs	**EA**	$ 287.50	$ 287.50	$ -	$ 115.00	$ 57.50	$ 230.00	$ 460.00	$ 5,750.00	$ 5,750.00	$ 57,500.00	$ 5,750.00	$ 287.50	$ 5.75	$ -	$ 28.75	$ 12.08	$ -
Geotextile Fabric	**SY**	$ 90.56	$ 90.56	$ -	$ -	$ 2.01	$ 6.04	$ 6.04	$ -	$ -	$ -	$ -	$ 90.56	$ -	$ 2.21	$ -	$ -	$ -
Rip Rap	**CY**	$ 1,035.00	$ 1,035.00	$ -	$ -	$ 22.77	$ 19.32	$ 34.50	$ 207.00	$ 207.00	$ 207.00	$ 207.00	$ 1,035.00	$ -	$ -	$ -	$ -	$ -
Chain Link Fence	**LF**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,730.00	$ 11,730.00	$ -	$ 11,730.00	$ -	$ -	$ -	$ -	$ -	$ -
Erosion Control	**AC**	$ -	$ -	$ -	$ 0.46	$ 0.46	$ 18.40	$ 36.80	$ 759.00	$ 759.00	$ 2,300.00	$ 759.00	$ -	$ 0.46	$ -	$ 18.40	$ -	$ 0.05
Drain Rock	**CY**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8.97	$ -	$ -	$ -
Crushed Rock	**CY**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Truck Haul	**CY**	$ -	$ -	$ 20.70	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Perforated Drain Pipe	**LF**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 29.90	$ -	$ -	$ -
Cedar Shavings	**CY**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2.78
Total $/Unit CIP		$ 5,944.06	$ 9,969.06	$ 124.20	$ 254.38	$ 86.65	$ 345.98	$ 725.48	$ 59,719.50	$ 59,719.50	$ 88,262.50	$ 59,719.50	$ 7,669.06	$ 17.46	$ 47.18	$ 56.24	$ 12.08	$ 5.18

Note 1: These costs that were originally estimated in 1999 now reflect a 15% increase for 2007 conditions. The updates in this table are based on the 15% increase to costs as applied in Table D-5.

**Note 2: ***The Natural Resource Revegetation and Natural Resource Enhancement columns were combined into one column called Natural Resources Enhancement and associated quantities were also revised.

Reference:
Table D-5 (Unit Cost) x Table D-6 (Quantities) = Table D-7 (Unit Cost per CIP Type)
Table D-7 Total Cost per Unit of CIP is Summarized in Table D-1

STORMWATER FACILITIES
ESTIMATED ANNUAL MAINTENANCE COSTS
Table D-8

Stormwater Facility Type	Unit	Annual $/Unit	Description of Stormwater Facility Maintenance Activities
Trash Rack Inlet (Type 1 & 2)	1 EA	$3,080	Inspect and clean inlet, inspect vegetation and slope protection, remove debris.
Open Channel (all types)	500 LF	$3,800	Inspect sediment loading and vegetation, remove sediment and debris.
Dry Extended Pond	5 AC-FT	$6,490	Inspect and clean inlet and outlet, maintain vegetation, inspect sediment loading, remove sediment, remove debris, inspect separation berm.
Wet Extended Pond	5 AC-FT	$6,030	Inspect and clean inlet and outlet, maintain vegetation, inspect sediment loading, remove sediment, remove debris, inspect and repair separation berm.
Flood Control Facility	5 AC-FT	$4,810	Inspect and clean inlet and outlet, maintain vegetation, inspect sediment loading, remove sediment, remove debris, inspect and repair separation berm.
Stormwater Marsh/Wetland	5 AC	$3,310	Inspect and clean inlet and outlet, inspect & maintain vegetation, remove debris.
Vegetated Swale	500 LF	$4,090	Inspect and clean inlet and outlet, remove debris, remove sediment, maintain vegetation.
Infiltration Trench	500 LF	$2,700	Inspect and clean inlet, remove debris, remove sediment.
Water Quality Structures	1 EA	$1,170	Inspect and remove debris and sediment from structures.
Natural Resource Enhancement	5 AC	$644	Inspect vegetation, remove debris.
Natural Resource Revegetation	5 AC	$1,012	Inspect vegetation, remove debris.
Recreational Trail	1,000 LF	$2,300	Inspect trail, remove debris and maintain vegetation.

Note: Maintenance costs presented in this table are planning level estimates and are based on information provided by the Unified Sewerage Agency of Washington County (1999). They are representative of average facilities maintained under typical conditions. Each facility will vary depending on site conditions and the size of the facility.

Reference:
Table D-8 is a summary of data presented in Table D-9.

STORMWATER FACILITIES
ESTIMATED ANNUAL MAINTENANCE COSTS
Calculation Table D-9

	Frequency	Effort/Time		Equip./Time			
	Times/Year	Lb-Hr	$ @ $46/hr	Hours	$/hr Rate	$ Total	Comments
Trash Rack Inlet (Type 1 & 2)							
Emergency Response	10	1	$ 460.00	0	$ -	$ -	
Inspect & Clean Inlet/Outlet	4	4	$ 736.00	2	$ 172.50	$ 1,380.00	Vactor Truck & Operator
Routine Repair			$ -		$ -	$ -	
Maintain Vegetation	4	2	$ 368.00	2	$ 11.50	$ 92.00	Mower, Weedeater, Etc.
Disposal Costs	4		$ 46.00		$ -	$ -	
Subtotals			*$ 1,610.00*			*$ 1,472.00*	
Total Estimate Annual Maintenance				***$ 3,082.00***			
Open Channel (all types)							
Inspect Vegetation & Sediment Loading	2	1	$ 92.00	0	$ -	$ -	
Maintain Vegetation			$ -		$ -	$ -	
Remove Debris/Garbage	4	2	$ 368.00	0	$ -	$ -	
Remove Sediment	1	8	$ 368.00	4	$ 345.00	$ 1,380.00	Tractor Shovel, 10 CY Dump & Operators
Disposal Costs	1		$ 920.00		$ -	$ -	Assumes 10 CY/Year
Inspect Slopes	2	1	$ 92.00	0	$ -	$ -	
Repair Slopes (On Going Activity)			$ 575.00	0	$ -	$ -	Annual Misc. Cost
Subtotals			*$ 2,415.00*			*$ 1,380.00*	
Total Estimate Annual Maintenance				***$ 3,795.00***			
Dry Extended Pond							
Inspect & Clean Inlet/Outlet	4	4	$ 736.00	2	$ 172.50	$ 1,380.00	Vactor Truck & Operator
Inspect Vegetation	2	1	$ 92.00	0	$ -	$ -	
Remove Debris/Garbage	4	2	$ 368.00	0	$ -	$ -	
Maintain Vegetation	4	4	$ 736.00	4	$ 11.50	$ 184.00	Mower, Weedeater, Etc.
Inspect Sediment Loading	2	1	$ 92.00	0	$ -	$ -	
Remove Sediment	0.5	12	$ 276.00	6	$ 345.00	$ 1,035.00	Tractor Shovel, 10 CY Dump & Operators
Disposal Costs	0.5		$ 920.00		$ -	$ -	Assumes 10 CY Every Two Years
Inspect slopes	2	1	$ 92.00	0	$ -	$ -	
Repair Slopes (On Going Activity)			$ 575.00		$ -	$ -	Annual Misc. Cost
Subtotals			*$ 3,887.00*			*$ 2,599.00*	
Total Estimate Annual Maintenance				***$ 6,486.00***			
Wet Extended Pond							
Inspect & Clean Inlet/Outlet	4	4	$ 736.00	2	$ 172.50	$ 1,380.00	Vactor Truck & Operator
Inspect Vegetation	2	1	$ 92.00	0	$ -	$ -	
Remove Debris/Garbage	4	2	$ 368.00	0	$ -	$ -	
Maintain Vegetation	4	4	$ 736.00	4	$ 11.50	$ 184.00	Mower, Weedeater, Etc.
Inspect Sediment Loading	2	1	$ 92.00	0	$ -	$ -	
Remove Sediment	0.5	12	$ 276.00	6	$ 345.00	$ 1,035.00	Tractor Shovel, 10 CY Dump & Operators
Disposal Costs	0.5		$ 460.00		$ -	$ -	Assumes 10 CY Every TwoYears
Inspect slopes	2	1	$ 92.00	0	$ -	$ -	
Repair Slopes			$ 575.00		$ -	$ -	Annual Misc. Cost
Subtotals			*$ 3,427.00*			*$ 2,599.00*	
Total Estimate Annual Maintenance				***$ 6,026.00***			
Flood Control Facility							
Inspect & Clean Inlet/Outlet	4	2	$ 368.00	2	$ 172.50	$ 1,380.00	Vactor Truck & Operator
Inspect Vegetation	2	1	$ 92.00	0	$ -	$ -	
Remove Debris/Garbage	4	1	$ 184.00	0	$ -	$ -	
Maintain Vegetation	4	4	$ 736.00	4	$ 11.50	$ 184.00	Mower, Weedeater, Etc.
Inspect Sediment Loading	2	1	$ 92.00	0	$ -	$ -	
Remove Sediment	0.5	8	$ 184.00	4	$ 345.00	$ 690.00	Tractor Shovel, 10 CY Dump & Operators
Disposal Costs	0.5		$ 230.00			$ -	Assumes 5 CY Every two Years
Inspect slopes	2	1	$ 92.00	0	$ -	$ -	
Slope Repair (On Going Activity)			$ 575.00		$ -	$ -	Annual Misc. Cost
Subtotals			*$ 2,553.00*			*$ 2,254.00*	
Total Estimate Annual Maintenance				***$ 4,807.00***			
Stormwater Marsh/Wetland							
Inspect & Clean Inlet/Outlet	4	4	$ 736.00	2	$ 172.50	$ 1,380.00	Vactor Truck & Operator
Inspect Vegetation	2	1	$ 92.00	0	$ -	$ -	
Remove Debris/Garbage	2	2	$ 184.00	0	$ -	$ -	
Maintain Vegetation	4	4	$ 736.00	4	$ 11.50	$ 184.00	Mower, Weedeater, Etc.
Subtotals			*$ 1,748.00*			*$ 1,564.00*	
Total Estimate Annual Maintenance				***$ 3,312.00***			
Vegetated Swale							
Inspect & Clean Inlet/Outlet	4	2	$ 368.00	1	$ 172.50	$ 690.00	Vactor Truck & Operator
Remove Debris/Garbage	2	2	$ 184.00	0	$ -	$ -	
Maintain Vegetation	4	4	$ 736.00	4	$ 11.50	$ 184.00	Mower, Weedeater, Etc.
Inspect Sediment Loading	2	1	$ 92.00	0	$ -	$ -	
Remove Sediment/Regrade	1	8	$ 368.00	4	$ 345.00	$ 1,380.00	Tractor Shovel, 10 CY Dump & Operators
Disposal Costs	1		$ 92.00		$ -	$ -	Assumes 2 CY Per Year
Subtotals			*$ 1,840.00*			*$ 2,254.00*	
Total Estimate Annual Maintenance				***$ 4,094.00***			

	Frequency	Effort/Time		Equip./Time			
	Times/Year	**Lb-Hr**	**$ @ $40/hr**	**Hours**	**$/hr Rate**	**$ Total**	**Comments**
Infiltration Trench							
Inspect & Clean Inlet/Outlet	4	4	$ 736.00	2	$ 172.50	$ 1,380.00	Vactor Truck & Operator
Remove Debris/Garbage	2	2	$ 184.00	0	$ -	$ -	
Inspect Sediment Loading	2	2	$ 184.00	0	$ -	$ -	
Remove Sediment	0.3	8	$ 110.40	4	$ 86.25	$ 103.50	Water Truck (Flush lines) & Operator
Disposal Costs	0.3		$ 28.75		$ -	$ -	Assumes 2 CY Every Three Years
Subtotals			*$ 1,214.40*			*$ 1,483.50*	
Total Estimate Annual Maintenance				***$ 2,697.90***			
Water Quality Structures							
Remove Debris/Garbage	2	2	$ 184.00	0	$ -	$ -	
Inspect Sediment Loading	2	2	$ 184.00	0	$ -	$ -	
Remove Sediment	0.3	8	$ 110.40	4	$ 172.50	$ 690.00	Vactor Truck & Operator
Disposal Costs	4		$ 276.00		$ -	$ -	Assumes 3 CY a Year
Subtotals			*$ 478.40*			*$ 690.00*	
Total Estimate Annual Maintenance				***$ 1,168.40***			
Natural Resource Enhancement							
Inspect Vegetation	1	1	$ 46.00	0	$ -	$ -	
Routine Repair			$ 230.00		$ -	$ -	Annual Misc. Cost
Remove Debris/Garbage	2	4	$ 368.00	0	$ -	$ -	
Subtotals			*$ 644.00*			*$ -*	
Total Estimate Annual Maintenance				***$ 644.00***			
Natural Resource Revegetation							
Inspect Vegetation	2	2	$ 184.00	0	$ -	$ -	
Routine Repair			$ 460.00		$ -	$ -	Annual Misc. Cost
Remove Debris/Garbage	2	4	$ 368.00	0	$ -	$ -	
Subtotals			*$ 1,012.00*			*$ -*	
Total Estimate Annual Maintenance				***$ 1,012.00***			
Recreational Trail							
Inspect Vegetation	2	2	$ 184.00	0	$ -	$ -	
Remove Debris/Garbage	4	4	$ 736.00	0	$ -	$ -	
Maintain Vegetation	2	12	$ 1,104.00	12	$ 11.50	$ 276.00	Mower, Weedeater, Etc.
Subtotals			*$ 2,024.00*			*$ 276.00*	
Total Estimate Annual Maintenance				***$ 2,300.00***			

Note: Labor rate of $40/hr from the original table produced in 1999 was updated with an increase of 15% to $46/hr in 2007. The original information was based on information provided by the Unified Sewerage Agency of Washington County (now Clean Water Services). Labor for maintenance activities was assumed to be City maintenance staff averaged for maintenance and supervisor effort. Effort shown includes travel time and office documentation time.

This table also reflects a 2007 update of of +15% to the unit costs for equipment, disposal, and slope repair.

Reference:
Table D-9 information is summarized in Table D-8.

Appendix E

Photos and Modeling Results for the System Verification

Cherry Lane Culvert - Estimated depth from crown elevation to WSE is 8”.

Oak Island Drive Culvert – Estimated depth from crown elevation to WSE is 8”.

Culvert C (L17) – Estimated depth from crown elevation to WSE is 14”.

Segment Name	US Node	DS node	Run #	Calibration Change	Depth from Culvert crown to WSE from photo (inches)	Depth from Culvert crown to WSE from Model (inches)	% difference
L17 (Culvert C)	N16	N17	1	No changes. Initial model setup	14	15	7
Oak (Oak Island Culvert)	N18	N19			8	7.8	-3
L22 (Cherry Lane Culvert)	N21	N22			8	5.4	-33
L17 (Culvert C)	N16	N17	2	Decrease subbasin width by 20%	14	15	7
Oak (Oak Island Culvert)	N18	N19			8	7.8	-3
L22 (Cherry Lane Culvert)	N21	N22			8	5.4	-33
L17 (Culvert C)	N16	N17	3	Decrease Impervious % by 20%	14	15.6	11
Oak (Oak Island Culvert)	N18	N19			8	9	13
L22 (Cherry Lane Culvert)	N21	N22			8	6.6	-18
L17 (Culvert C)	N16	N17	4	Increase Impervious % by 10%	14	15	7
Oak (Oak Island Culvert)	N18	N19			8	7.2	-10
L22 (Cherry Lane Culvert)	N21	N22			8	4.8	-40

Note

The above water depth are at the time photos were taken.

Summary results for each model run show water surface elevation at time of peak and not at time and day the photos were taken (Sept. 7/2007 at 2pm)

Selected

Appendix F

Figures and Modeling Results for the Upgraded CIP Options

OPTION 3A Upgraded

						25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.25	426.39	2.50	28.93	428.48	428.75	428.23	428.89
Blek2	N4	N5	426.52	426.53	2.50	25.23	428.48	429.02	428.24	429.03
BlekRD	N4	N5	430.01	430.01	0.50	0.00	426.85	430.51	426.85	430.51
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NewCherryCul	N21	N22	421.02	420.64	3.00	58.94	422.40	424.41	422.43	424.29
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete	N34	N35	414.68	414.65	4.00	47.36	417.59	418.68	417.37	418.65
County	N34	N35	414.68	414.65	4.00	47.36	417.59	418.68	417.37	418.65
RD	N34	N35	420.37	420.37	0.50	0.00	417.37	420.87	417.37	420.87
NewCulvA1	N8	N9	423.70	423.68	3.00	36.36	425.97	426.50	425.85	426.10
NewCulvA2	N8	N9	423.70	423.68	3.00	36.36	425.97	426.28	425.85	426.17
CulvA-RD	N8	N9	428.88	428.88	0.50	0.00	425.85	429.38	425.85	429.38
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NewCulvb1	N14	N15	423.46	423.37	3.00	36.26	425.16	425.30	425.04	425.21
Newculvb2	N14	N15	423.46	423.37	3.00	36.26	425.16	425.27	425.04	425.27
CulvB-RD	N14	N15	426.46	426.46	0.50	0.00	425.04	426.96	425.04	426.96
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NewCulvC	N16	N17	422.54	422.47	2.70	37.10	424.42	424.89	424.07	424.87
NewCulvc1	N16	N17	422.54	422.47	2.70	37.10	424.42	424.89	424.07	424.83
CulvC-RD	N16	N17	425.36	425.36	0.50	0.00	424.07	425.86	424.07	425.86
L1	N1	N2	427.59	427.59	2.59	54.18	429.68	430.18	429.58	430.18
L10	N9	N10	423.68	423.67	3.50	72.70	425.85	427.16	425.81	427.64
L11	N38	N12	423.66	423.57	2.77	72.64	425.79	426.80	425.58	426.66
L13	N12	N13	423.57	423.56	2.77	72.58	425.58	426.66	425.55	426.49
L14	N13	N14	423.56	423.46	2.95	72.55	425.55	426.67	425.16	426.41
L16	N15	N16	423.37	422.53	2.76	72.50	425.04	426.13	424.42	425.86
L18	N17	N18	422.47	421.70	2.97	74.19	424.07	425.85	423.22	424.52
L20	N19	N20	421.38	421.10	4.00	74.17	422.85	425.38	422.46	425.10
L21	N20	N21	421.10	421.02	4.00	58.97	422.46	425.10	422.40	425.10
L23	N22	N23	420.64	420.47	3.69	58.92	422.43	424.64	422.20	424.61
L24	N23	N24	420.47	420.29	3.25	58.90	422.20	424.53	421.98	424.17
L25	N24	N25	420.29	419.59	3.25	58.82	421.98	424.11	421.65	424.50
L26	N25	N26	419.59	419.41	2.20	58.70	421.65	423.50	421.63	424.05
L27	N26	N27	419.41	419.00	2.43	58.66	421.63	423.93	421.41	423.56
L28	N27	N28	419.00	418.58	2.43	76.94	421.41	423.56	420.99	423.45
L29	N28	N29	418.58	418.24	2.54	76.84	420.99	423.56	420.57	423.25
L3	N3	N4	427.18	426.92	3.16	54.15	428.76	430.34	428.48	430.08
L30	N29	N30	418.24	417.95	2.55	76.79	420.57	423.26	420.04	422.97
L31	N30	N31	417.95	417.78	2.50	76.75	420.04	422.92	419.54	422.56
L32	N31	N33	417.78	416.24	2.50	76.48	419.54	422.56	417.65	422.26
L33	N33	N34	416.24	414.68	2.80	77.01	417.65	422.56	417.59	420.17
L35	N35	N36	414.65	414.65	6.00	94.72	417.37	420.65	416.43	420.65
L36	N37	N8	423.89	423.70	4.35	72.11	426.20	428.24	425.97	428.05
L37	N10	N38	423.67	423.66	3.00	72.68	425.81	427.14	425.79	427.03
L38	N20	N39	421.10	421.00	3.50	17.40	422.46	423.12	422.38	424.66
L39	N39	N40	421.00	420.53	3.00	17.39	422.38	423.62	421.99	424.03
L40	N40	N41	420.53	419.94	2.85	17.35	421.99	423.82	421.65	423.79
L41	N41	N42	419.94	419.37	2.65	17.29	421.65	423.45	421.47	422.64
L42	N42	N27	419.37	419.00	2.65	17.25	421.47	422.64	421.41	421.53
L5	N5	N6	425.00	424.67	2.46	72.57	426.85	429.10	426.61	429.37
L6	N6	N7	424.67	424.58	2.46	72.51	426.61	429.37	426.56	428.70
L7	N7	N37	424.58	423.89	2.95	72.37	426.56	429.19	426.20	426.84
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
New-OakCul	N18	N19	421.70	421.38	4.00	74.18	423.22	424.80	422.85	424.67
Oak-RD	N18	N19	425.86	425.86	0.50	0.00	422.85	426.36	422.85	426.36
Perkins1	N2	N3	428.05	427.80	2.00	17.24	429.58	430.05	429.29	429.80
Perkins2	N2	N3	427.81	427.75	2.00	18.09	429.58	429.81	429.28	429.75
Perkins3	N2	N3	427.98	427.71	2.00	18.85	429.58	429.98	429.27	429.71
PerkinsRD	N2	N3	432.36	432.36	0.50	0.00	428.76	432.86	428.76	432.86

🟪	Surcharging or Flooding of Conduit for CIP Option

OPTION 4A Upgraded

						25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.25	426.39	2.50	28.93	428.48	428.75	428.23	428.89
Blek2	N4	N5	426.52	426.53	2.50	25.23	428.48	429.02	428.24	429.03
BlekRD	N4	N5	430.01	430.01	0.50	0.00	426.85	430.51	426.85	430.51
Cherry1	N21	N22	421.07	420.94	3.30	9.97	422.37	N/A	422.36	N/A
Cherry2	N21	N22	421.07	420.94	3.30	9.97	422.37	424.41	422.36	424.29
CherryRd	N21	N22	425.06	425.06	0.50	0.00	422.19	N/A	422.36	N/A
Concrete	N34	N35	414.68	414.65	4.00	47.23	417.58	418.68	417.37	418.65
County	N34	N35	414.68	414.65	4.00	47.23	417.58	418.68	417.37	418.65
RD	N34	N35	420.37	420.37	0.50	0.00	417.37	420.87	417.37	420.87
NewCulvA1	N8	N9	423.70	423.68	3.00	36.36	425.97	426.50	425.85	426.10
NewCulvA2	N8	N9	423.70	423.68	3.00	36.36	425.97	426.28	425.85	426.17
CulvA-RD	N8	N9	428.88	428.88	0.50	0.00	425.85	429.38	425.85	429.38
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NewCulvb1	N14	N15	423.46	423.37	3.00	36.26	425.16	425.30	425.04	425.21
Newculvb2	N14	N15	423.46	423.37	3.00	36.26	425.16	425.27	425.04	425.27
CulvB-RD	N14	N15	426.46	426.46	0.50	0.00	425.04	426.96	425.04	426.96
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NewCulvC	N16	N17	422.54	422.47	2.70	37.10	424.41	424.89	424.07	424.87
NewCulvc1	N16	N17	422.54	422.47	2.70	37.10	424.41	424.89	424.07	424.83
CulvC-RD	N16	N17	425.36	425.36	0.50	0.00	424.07	425.86	424.07	425.86
L1	N1	N2	427.59	427.59	2.59	54.18	429.68	430.18	429.58	430.18
L10	N9	N10	423.68	423.67	3.50	72.70	425.85	427.16	425.81	427.64
L11	N38	N12	423.66	423.57	2.77	72.64	425.79	426.80	425.58	426.66
L13	N12	N13	423.57	423.56	2.77	72.58	425.58	426.66	425.55	426.49
L14	N13	N14	423.56	423.46	2.95	72.55	425.55	426.67	425.16	426.41
L16	N15	N16	423.37	422.53	2.76	72.50	425.04	426.13	424.42	425.86
L18	N17	N18	422.47	421.70	2.97	74.19	424.07	425.85	423.22	424.52
L20	N19	N20	421.38	421.10	4.00	74.18	422.82	425.38	422.45	425.10
L21	N20	N21	421.10	421.07	4.00	19.95	422.39	425.10	422.44	425.10
L23	N22	N23	420.94	420.88	3.69	19.94	422.19	424.64	422.31	424.61
L24	N23	N24	420.88	420.82	3.25	19.93	422.08	424.53	422.30	424.17
L25	N24	N25	420.82	420.58	3.25	19.91	422.02	424.11	422.23	424.50
L26	N25	N26	420.58	420.52	2.20	19.88	421.65	423.50	422.20	424.05
L27	N26	N27	420.52	420.38	2.43	19.87	421.58	423.93	420.88	423.56
L28	N27	N28	419.00	418.58	2.43	77.15	420.88	423.56	420.46	423.45
L29	N28	N29	418.58	418.24	2.54	76.99	420.46	423.56	420.12	423.25
L3	N3	N4	427.18	426.92	3.16	54.15	428.76	430.34	428.48	430.08
L30	N29	N30	418.24	417.95	2.55	76.86	420.12	423.26	419.84	422.97
L31	N30	N31	417.95	417.78	2.50	76.75	419.84	422.92	419.68	422.56
L32	N31	N33	417.78	416.24	2.50	76.50	419.68	422.56	417.57	422.26
L33	N33	N34	416.24	414.68	2.80	77.11	417.57	422.56	417.58	420.17
L35	N35	N36	414.65	414.65	6.00	94.45	417.37	420.65	416.42	420.65
L36	N37	N8	423.89	423.70	4.35	72.11	426.20	428.24	425.97	428.05
L37	N10	N38	423.67	423.66	3.00	72.68	425.81	427.14	425.79	427.03
L38	N20	N39	421.10	421.00	3.50	56.46	422.39	423.12	422.36	424.66
L39	N39	N40	421.00	420.53	3.00	56.45	422.30	423.62	421.91	424.03
L40	N40	N41	420.53	419.94	2.85	56.40	421.85	423.82	421.41	423.79
L41	N41	N42	419.94	419.37	2.65	56.33	421.37	423.45	421.03	422.64
L42	N42	N27	419.37	419.00	2.65	56.24	421.01	422.64	420.88	421.53
L5	N5	N6	425.00	424.67	2.46	72.57	426.85	429.10	426.61	429.37
L6	N6	N7	424.67	424.58	2.46	72.52	426.61	429.37	426.56	428.70
L7	N7	N37	424.58	423.89	2.95	72.37	426.56	429.19	426.20	426.84
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
New-OakCul	N18	N19	421.70	421.38	4.00	74.19	423.21	424.80	422.84	424.67
Oak-RD	N18	N19	425.86	425.86	0.50	0.00	422.82	426.36	422.84	426.36
Perkins1	N2	N3	428.05	427.80	2.00	17.24	429.58	430.05	429.29	429.80
Perkins2	N2	N3	427.81	427.75	2.00	18.09	429.58	429.81	429.28	429.75
Perkins3	N2	N3	427.98	427.71	2.00	18.85	429.58	429.98	429.27	429.71
PerkinsRD	N2	N3	432.36	432.36	0.50	0.00	428.76	432.86	428.76	432.86

▨ Surcharging or Flooding of Conduit for CIP Option

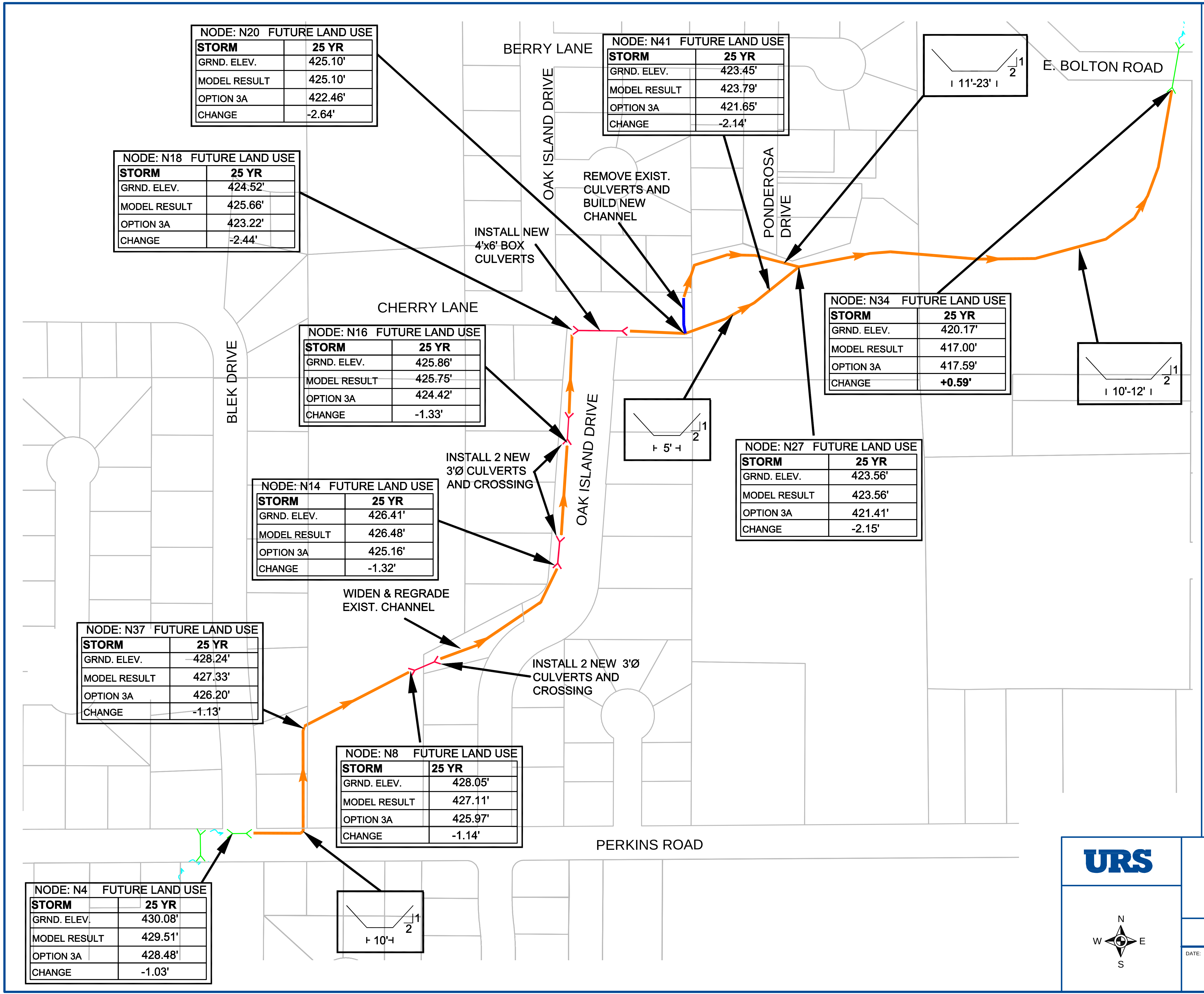
OPT 6 Upgraded

						25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.25	426.39	2.50	26.58	428.85	428.75	428.64	428.89
Blek2	N4	N5	426.52	426.53	2.50	27.62	428.85	429.02	428.64	429.03
BlekRD	N4	N5	430.01	430.01	0.50	0.00	428.64	430.51	428.64	430.51
Cherry1	N21	N22	421.11	420.95	3.30	4.03	422.24	424.41	422.21	424.25
Cherry2	N21	N22	421.11	420.99	3.30	3.86	422.24	424.41	422.21	424.29
Cherry-RD	N21	N22	425.06	425.06	0.50	0.00	422.21	425.56	422.21	425.56
Concrete	N34	N35	414.68	414.65	4.00	43.95	417.50	418.68	417.30	418.65
County	N34	N35	414.68	414.65	4.00	43.95	417.50	418.68	417.30	418.65
RD	N34	N35	420.37	420.37	0.50	0.00	417.30	420.87	417.30	420.87
CulvA1	N8	N9	424.00	423.60	2.50	5.32	424.69	426.50	424.70	426.10
CulvA2	N8	N9	423.78	423.67	2.50	-1.68	424.69	426.28	424.70	426.17
CulvA-RD	N8	N9	428.88	428.88	0.50	0.00	424.70	429.38	424.70	429.38
CulvB1	N14	N15	423.27	423.20	2.00	1.32	424.03	425.27	424.02	425.20
CulvB2	N14	N15	423.30	423.21	2.00	1.36	424.03	425.30	424.02	425.21
CulvB3	N14	N15	423.27	423.27	2.00	1.08	424.03	425.27	424.02	425.27
CulvB-RD	N14	N15	426.46	426.46	0.50	0.00	424.02	426.96	424.02	426.96
CulvC1	N16	N17	422.92	422.70	2.00	2.34	423.50	424.92	423.44	424.70
CulvC2	N16	N17	422.89	422.87	2.00	1.57	423.50	424.89	423.44	424.87
CulvC3	N16	N17	422.89	422.83	2.00	1.76	423.50	424.89	423.44	424.83
CulvC-RD	N16	N17	425.36	425.36	0.50	0.00	423.44	425.86	423.44	425.86
L1	N1	N2	427.59	427.59	2.59	54.18	429.68	430.18	429.58	430.18
L10	N9	N10	423.66	424.14	3.50	3.86	424.70	427.16	424.69	427.64
L11	N38	N12	424.03	423.89	2.77	3.83	424.68	426.80	424.44	426.66
L13	N12	N13	423.89	423.72	2.77	3.81	424.44	426.66	424.39	426.49
L14	N13	N14	423.72	423.46	2.95	3.79	424.39	426.67	424.03	426.41
L16	N15	N16	423.37	423.10	2.76	3.74	424.02	426.13	423.50	425.86
L18	N17	N18	422.88	421.55	2.97	5.63	423.44	425.85	422.41	424.52
L20	N19	N20	421.38	421.10	4.00	5.49	422.36	425.38	422.25	425.10
L21	N20	N21	421.10	421.10	4.00	7.91	422.25	425.10	422.24	425.10
L23	N22	N23	420.95	420.92	3.69	7.87	422.21	424.64	422.16	424.61
L24	N23	N24	420.92	420.56	3.61	7.84	422.16	424.53	422.15	424.17
L25	N24	N25	420.56	420.95	3.55	7.80	422.15	424.11	422.00	424.50
L26	N25	N26	420.95	421.50	2.55	7.79	422.00	423.50	421.78	424.05
L27	N26	N27	421.50	419.00	2.43	7.79	421.78	423.93	420.01	423.56
L28	N27	N28	419.00	418.58	2.43	8.51	420.01	423.56	419.95	423.45
L29	N28	N29	418.58	418.24	2.54	8.05	419.95	423.56	419.94	423.25
L3	N3	N4	427.18	426.92	3.16	54.15	428.98	430.34	428.85	430.08
L30	N29	N30	418.24	417.95	2.55	8.14	419.94	423.26	419.93	422.97
L31	N30	N31	417.95	417.78	2.50	8.30	419.93	422.92	419.93	422.56
L32	N31	N33	417.78	416.24	2.50	72.59	419.93	422.56	418.53	422.26
L33	N33	N34	416.24	414.68	3.50	72.12	418.53	422.56	417.50	420.17
L35	N35	N36	414.65	414.65	6.00	87.90	417.30	420.65	416.37	420.65
L36	N37	N8	423.89	423.70	4.35	3.20	424.83	428.24	424.69	428.05
L37	N10	N38	424.14	424.03	3.00	3.85	424.69	427.14	424.68	427.03
L38	N20	N39	421.10	422.64	2.02	0.00	422.25	423.12	422.64	424.66
L39	N39	N40	422.67	423.08	0.95	0.00	422.64	423.62	422.64	424.03
L40	N40	N41	423.08	423.05	0.74	0.00	423.05	423.82	423.05	423.79
L41	N41	N42	423.05	422.24	0.40	0.00	422.24	423.45	422.24	422.64
L42	N42	N27	422.24	419.00	1.30	0.00	422.24	422.64	420.01	421.53
L5	N5	N6	426.39	426.27	3.46	72.60	428.64	429.10	428.11	429.37
L6	N6	N7	426.27	426.24	3.46	72.60	428.11	429.37	427.76	428.70
L7	N7	N37	426.24	423.89	2.95	3.28	427.01	429.19	424.83	426.84
Oak1	N18	N19	421.64	421.23	3.30	2.73	422.41	424.94	422.36	424.53
Oak2	N18	N19	421.50	421.37	3.30	2.78	422.41	424.80	422.36	424.67
Oak-RD	N18	N19	425.86	425.86	0.50	0.00	422.36	426.36	422.36	426.36
Perkins1	N2	N3	428.05	427.80	2.00	17.24	429.58	430.05	429.29	429.80
Perkins2	N2	N3	427.81	427.75	2.00	18.09	429.58	429.81	429.28	429.75
Perkins3	N2	N3	427.98	427.71	2.00	18.85	429.58	429.98	429.27	429.71
PerkinsRD	N2	N3	432.36	432.36	0.50	0.00	428.98	432.86	428.98	432.86
Link44	N7	N61	425.24	423.70	3.95	69.26	427.01	429.24	425.79	428.17
Link45	N61	N62	423.70	423.11	3.95	69.17	425.79	428.17	425.56	427.76
Link46	N62	N63	423.11	422.44	3.60	69.02	425.56	426.76	424.86	429.00
Link47	N63	N64	422.44	421.30	3.00	68.68	424.86	429.00	423.33	428.96
Link48	N64	N65	421.30	420.02	2.30	68.14	423.33	428.96	422.04	424.00
Link49	N65	N66	420.02	417.82	2.30	66.85	422.04	424.00	419.95	424.30
Link50	N66	N31	417.82	417.78	2.40	65.43	419.95	424.30	419.93	422.56

OPTION 7 Upgraded

						25 YEAR FUTURE				
Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation ft	Downstream Invert Elevation ft	Diameter (Height) ft	Max Flow cfs	Maximum Water Elevation (US) ft	Calculated Top of Bank (US)	Maximum Water Elevation (DS) ft	Calculated Top of Bank (DS)
Blek1	N4	N5	426.25	426.39	2.50	28.91	428.47	428.75	428.23	428.89
Blek2	N4	N5	426.52	426.53	2.50	25.20	428.47	429.02	428.24	429.03
BlekRD	N4	N5	430.01	430.01	0.50	0.00	427.64	430.51	427.64	430.51
Cherry1	N21	N22	421.11	420.95	3.30	20.62	422.76	424.41	422.15	424.25
Cherry2	N21	N22	421.11	420.99	3.30	19.63	422.76	424.41	422.21	424.29
Cherry-RD	N21	N22	425.06	425.06	0.50	0.00	422.15	425.56	422.15	425.56
Concrete	N34	N35	414.68	414.65	4.00	30.71	417.10	418.68	416.96	418.65
County	N34	N35	414.68	414.65	4.00	30.71	417.10	418.68	416.96	418.65
RD	N34	N35	420.37	420.37	0.50	0.00	416.96	420.87	416.96	420.87
CulvA1	N8	N9	424.00	423.60	2.50	49.43	426.53	426.50	426.19	426.10
CulvA2	N8	N9	423.78	423.67	2.50	27.32	426.61	426.28	426.52	426.17
CulvA-RD	N8	N9	428.88	428.88	0.50	0.00	426.52	429.38	426.52	429.38
CulvB1	N14	N15	423.27	423.20	2.00	15.73	425.50	425.27	425.31	425.20
CulvB2	N14	N15	423.30	423.21	2.00	15.70	425.50	425.30	425.31	425.21
CulvB3	N14	N15	423.27	423.27	2.00	15.43	425.50	425.27	425.31	425.27
CulvB-RD	N14	N15	426.46	426.46	0.50	0.00	425.31	426.96	425.31	426.96
CulvC1	N16	N17	422.92	422.70	2.00	17.21	424.61	424.92	424.37	424.70
CulvC2	N16	N17	422.89	422.87	2.00	15.12	424.61	424.89	424.37	424.87
CulvC3	N16	N17	422.89	422.83	2.00	15.62	424.61	424.89	424.37	424.83
CulvC-RD	N16	N17	425.36	425.36	0.50	0.00	424.37	425.86	424.37	425.86
L1	N1	N2	427.59	427.59	2.59	54.15	429.68	430.18	429.58	430.18
L10	N9	N10	423.66	424.14	3.50	30.16	425.94	427.16	425.93	427.64
L11	N38	N12	424.03	423.89	2.77	29.92	425.92	426.80	425.84	426.66
L13	N12	N13	423.89	423.72	2.77	29.72	425.84	426.66	425.84	426.49
L14	N13	N14	423.72	423.46	2.95	46.86	425.84	426.67	425.50	426.41
L16	N15	N16	423.37	423.10	2.76	46.85	425.31	426.13	424.61	425.86
L18	N17	N18	422.88	421.55	2.97	47.90	424.37	425.85	424.07	424.52
L20	N19	N20	421.38	421.10	4.00	47.64	423.38	425.38	422.80	425.10
L21	N20	N21	421.10	421.10	4.00	40.25	422.80	425.10	422.76	425.10
L23	N22	N23	420.95	420.75	3.69	40.25	422.15	424.64	421.95	424.61
L24	N23	N24	420.75	420.54	3.61	40.25	421.95	424.53	421.76	424.17
L25	N24	N25	420.54	419.70	3.55	40.24	421.76	424.11	421.05	424.50
L26	N25	N26	419.70	419.49	2.55	40.24	421.05	423.50	420.92	424.05
L27	N26	N27	419.49	419.00	2.43	40.23	420.92	423.93	420.69	423.56
L28	N27	N28	419.00	418.58	2.43	49.41	420.69	423.56	420.28	423.45
L29	N28	N29	418.58	418.24	2.54	49.39	420.28	423.56	419.94	423.25
L3	N3	N4	427.18	426.92	3.16	54.13	428.76	430.34	428.47	430.08
L30	N29	N30	418.24	417.95	2.55	49.38	419.94	423.26	419.66	422.97
L31	N30	N31	417.95	417.78	2.50	49.37	419.66	422.92	419.50	422.56
L32	N31	N33	417.78	416.24	2.50	49.35	419.50	422.56	418.09	422.26
L33	N33	N34	416.24	414.68	2.80	49.37	418.09	422.56	417.10	420.17
L35	N35	N36	414.65	414.65	6.00	61.43	416.96	420.65	416.10	420.65
L36	N37	N8	424.75	423.70	3.35	71.30	426.85	428.24	426.66	428.05
L37	N10	N38	424.14	424.03	3.00	30.11	425.93	427.14	425.92	427.03
L38	N20	N39	421.10	421.00	2.02	9.98	422.80	423.12	422.80	424.66
L39	N39	N40	421.00	420.53	0.95	9.67	422.80	423.62	422.75	424.03
L40	N40	N41	420.53	419.94	0.74	9.18	422.75	423.82	422.60	423.79
L41	N41	N42	419.94	419.37	0.40	8.62	422.60	423.45	421.44	422.64
L42	N42	N27	419.37	419.00	0.40	8.57	421.44	422.64	420.69	421.53
L5	N5	N6	426.00	425.97	2.46	72.60	427.64	429.10	427.59	429.37
L6	N6	N7	425.97	425.83	2.46	72.56	427.59	429.37	427.49	428.70
L7	N7	N37	425.83	424.75	2.95	72.34	427.49	429.19	426.83	426.84
Oak1	N18	N19	421.64	421.23	3.30	23.82	424.07	424.94	423.38	424.53
Oak2	N18	N19	421.50	421.37	3.30	23.82	424.07	424.80	423.38	424.67
Oak-RD	N18	N19	425.86	425.86	0.50	0.00	423.38	426.36	423.38	426.36
Perkins1	N2	N3	428.05	427.80	2.00	17.22	429.58	430.05	429.29	429.80
Perkins2	N2	N3	427.81	427.75	2.00	18.07	429.58	429.81	429.28	429.75
Perkins3	N2	N3	427.98	427.71	2.00	18.83	429.58	429.98	429.27	429.71
PerkinsRD	N2	N3	432.36	432.36	0.50	0.00	428.76	432.86	428.76	432.86
New Culv	N8	N9	423.998	423.602	2.5	30.2	426.656	426.50	425.938	426.61

🟥 Surcharging or Flooding of Conduit for CIP Option



NODE: N20 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	425.10'
MODEL RESULT	425.10'
OPTION 3A	422.46'
CHANGE	-2.64'

NODE: N41 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	423.45'
MODEL RESULT	423.79'
OPTION 3A	421.65'
CHANGE	-2.14'

NODE: N18 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	424.52'
MODEL RESULT	425.66'
OPTION 3A	423.22'
CHANGE	-2.44'

NODE: N34 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	420.17'
MODEL RESULT	417.00'
OPTION 3A	417.59'
CHANGE	**+0.59'**

NODE: N16 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	425.86'
MODEL RESULT	425.75'
OPTION 3A	424.42'
CHANGE	-1.33'

NODE: N27 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	423.56'
MODEL RESULT	423.56'
OPTION 3A	421.41'
CHANGE	-2.15'

NODE: N14 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	426.41'
MODEL RESULT	426.48'
OPTION 3A	425.16'
CHANGE	-1.32'

NODE: N37 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	428.24'
MODEL RESULT	427.33'
OPTION 3A	426.20'
CHANGE	-1.13'

NODE: N8 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	428.05'
MODEL RESULT	427.11'
OPTION 3A	425.97'
CHANGE	-1.14'

NODE: N4 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	430.08'
MODEL RESULT	429.51'
OPTION 3A	428.48'
CHANGE	-1.03'

LEGEND

⌇	EXISTING DITCH
⟩—⟨	EXISTING CULVERT
➝	WIDEN AND REGRADE CHANNEL
⟩—⟨	NEW CULVERT
➝	NEW CHANNEL

GENERAL DESCRIPTION → 25 YEAR FUTURE LAND USE

DESIGN STORM → STORM
NODE GROUND ELEVATION → GRND. ELEV.
MAX. WATER ELEVATION BEFORE PROPOSED IMPROVEMENTS → MODEL RESULT
MAX. WATER ELEVATION AFTER PROPOSED IMPROVEMENTS → OPTION X
DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS → CHANGE

25 YEAR FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	XX.XX'
MODEL RESULT	XX.XX'
OPTION X	± XX.XX'
CHANGE	± XX.XX'

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS (- INDICATES A DECREASE IN WSE AND + INDICATES AN INCREASE IN WSE)

URS

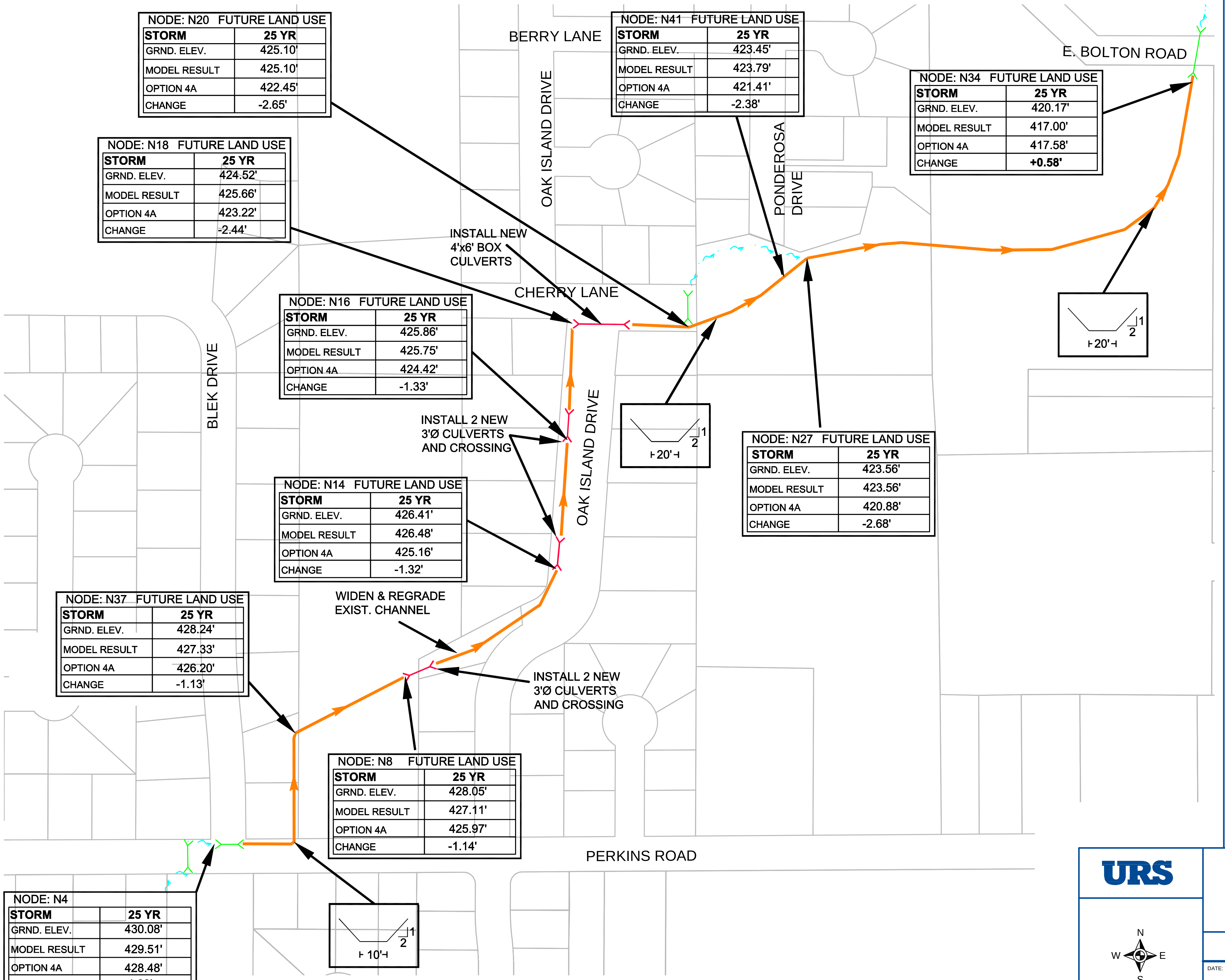
N
W E
S

STORMWATER BASIN PLAN
FOR THE CITY OF VENETA

OPTION 3A: UPGRADE ENTIRE SYSTEM EXCLUDING MISC. CULVERTS

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	3A UPGRADED

25696393.00003 Option 3A.dwg



NODE: N20 FUTURE LAND USE

STORM	**25 YR**
GRND. ELEV.	425.10'
MODEL RESULT	425.10'
OPTION 4A	422.45'
CHANGE	-2.65'

NODE: N41 FUTURE LAND USE

STORM	**25 YR**
GRND. ELEV.	423.45'
MODEL RESULT	423.79'
OPTION 4A	421.41'
CHANGE	-2.38'

NODE: N34 FUTURE LAND USE

STORM	**25 YR**
GRND. ELEV.	420.17'
MODEL RESULT	417.00'
OPTION 4A	417.58'
CHANGE	**+0.58'**

NODE: N18 FUTURE LAND USE

STORM	**25 YR**
GRND. ELEV.	424.52'
MODEL RESULT	425.66'
OPTION 4A	423.22'
CHANGE	-2.44'

NODE: N16 FUTURE LAND USE

STORM	**25 YR**
GRND. ELEV.	425.86'
MODEL RESULT	425.75'
OPTION 4A	424.42'
CHANGE	-1.33'

NODE: N27 FUTURE LAND USE

STORM	**25 YR**
GRND. ELEV.	423.56'
MODEL RESULT	423.56'
OPTION 4A	420.88'
CHANGE	-2.68'

NODE: N14 FUTURE LAND USE

STORM	**25 YR**
GRND. ELEV.	426.41'
MODEL RESULT	426.48'
OPTION 4A	425.16'
CHANGE	-1.32'

NODE: N37 FUTURE LAND USE

STORM	**25 YR**
GRND. ELEV.	428.24'
MODEL RESULT	427.33'
OPTION 4A	426.20'
CHANGE	-1.13'

NODE: N8 FUTURE LAND USE

STORM	**25 YR**
GRND. ELEV.	428.05'
MODEL RESULT	427.11'
OPTION 4A	425.97'
CHANGE	-1.14'

NODE: N4

STORM	**25 YR**
GRND. ELEV.	430.08'
MODEL RESULT	429.51'
OPTION 4A	428.48'
CHANGE	-1.03'

LEGEND

EXISTING DITCH
EXISTING CULVERT
WIDEN AND REGRADE CHANNEL
NEW CULVERT
NEW CHANNEL

GENERAL DESCRIPTION → 25 YEAR FUTURE LAND USE
DESIGN STORM →
NODE GROUND ELEVATION →
MAX. WATER ELEVATION BEFORE PROPOSED IMPROVEMENTS →
MAX. WATER ELEVATION AFTER PROPOSED IMPROVEMENTS →
DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS →

STORM	25 YR
GRND. ELEV.	XX.XX'
MODEL RESULT	XX.XX'
OPTION X	± XX.XX'
CHANGE	± XX.XX'

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS
(- INDICATES A DECREASE IN WSE AND
+ INDICATES AN INCREASE IN WSE)

URS

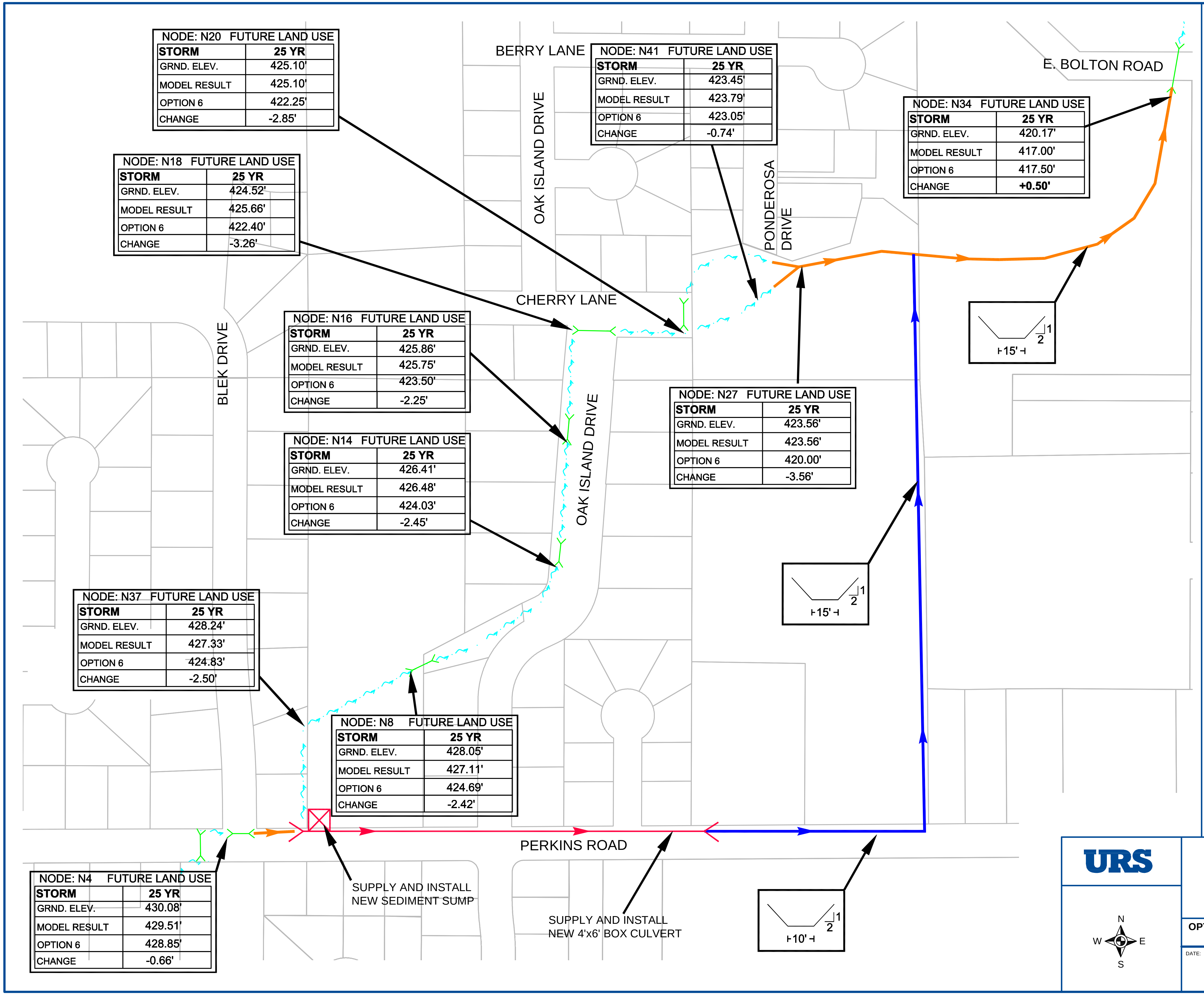
N
W E
S

STORMWATER BASIN PLAN
FOR THE CITY OF VENETA

OPTION 4A: UPGRADE ENTIRE SYSTEM EXCLUDING MAIN
CHANNEL AT BY-PASS AND MISC. CULVERTS

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	4A UPGRADED

25696393.00003 Option 4A.dwg



NODE: N20 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	425.10'
MODEL RESULT	425.10'
OPTION 6	422.25'
CHANGE	-2.85'

NODE: N18 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	424.52'
MODEL RESULT	425.66'
OPTION 6	422.40'
CHANGE	-3.26'

NODE: N41 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	423.45'
MODEL RESULT	423.79'
OPTION 6	423.05'
CHANGE	-0.74'

NODE: N34 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	420.17'
MODEL RESULT	417.00'
OPTION 6	417.50'
CHANGE	**+0.50'**

NODE: N16 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	425.86'
MODEL RESULT	425.75'
OPTION 6	423.50'
CHANGE	-2.25'

NODE: N27 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	423.56'
MODEL RESULT	423.56'
OPTION 6	420.00'
CHANGE	-3.56'

NODE: N14 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	426.41'
MODEL RESULT	426.48'
OPTION 6	424.03'
CHANGE	-2.45'

NODE: N37 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	428.24'
MODEL RESULT	427.33'
OPTION 6	424.83'
CHANGE	-2.50'

NODE: N8 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	428.05'
MODEL RESULT	427.11'
OPTION 6	424.69'
CHANGE	-2.42'

NODE: N4 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	430.08'
MODEL RESULT	429.51'
OPTION 6	428.85'
CHANGE	-0.66'

LEGEND

- EXISTING DITCH
- EXISTING CULVERT
- WIDEN AND REGRADE CHANNEL
- NEW CULVERT
- NEW CHANNEL

GENERAL DESCRIPTION → 25 YEAR FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	XX.XX'
MODEL RESULT	XX.XX'
OPTION X	± XX.XX'
CHANGE	± XX.XX'

DESIGN STORM → STORM
NODE GROUND ELEVATION → GRND. ELEV.
MAX. WATER ELEVATION BEFORE PROPOSED IMPROVEMENTS → MODEL RESULT
MAX. WATER ELEVATION AFTER PROPOSED IMPROVEMENTS → OPTION X
DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS → CHANGE

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS
(- INDICATES A DECREASE IN WSE AND
+ INDICATES AN INCREASE IN WSE)

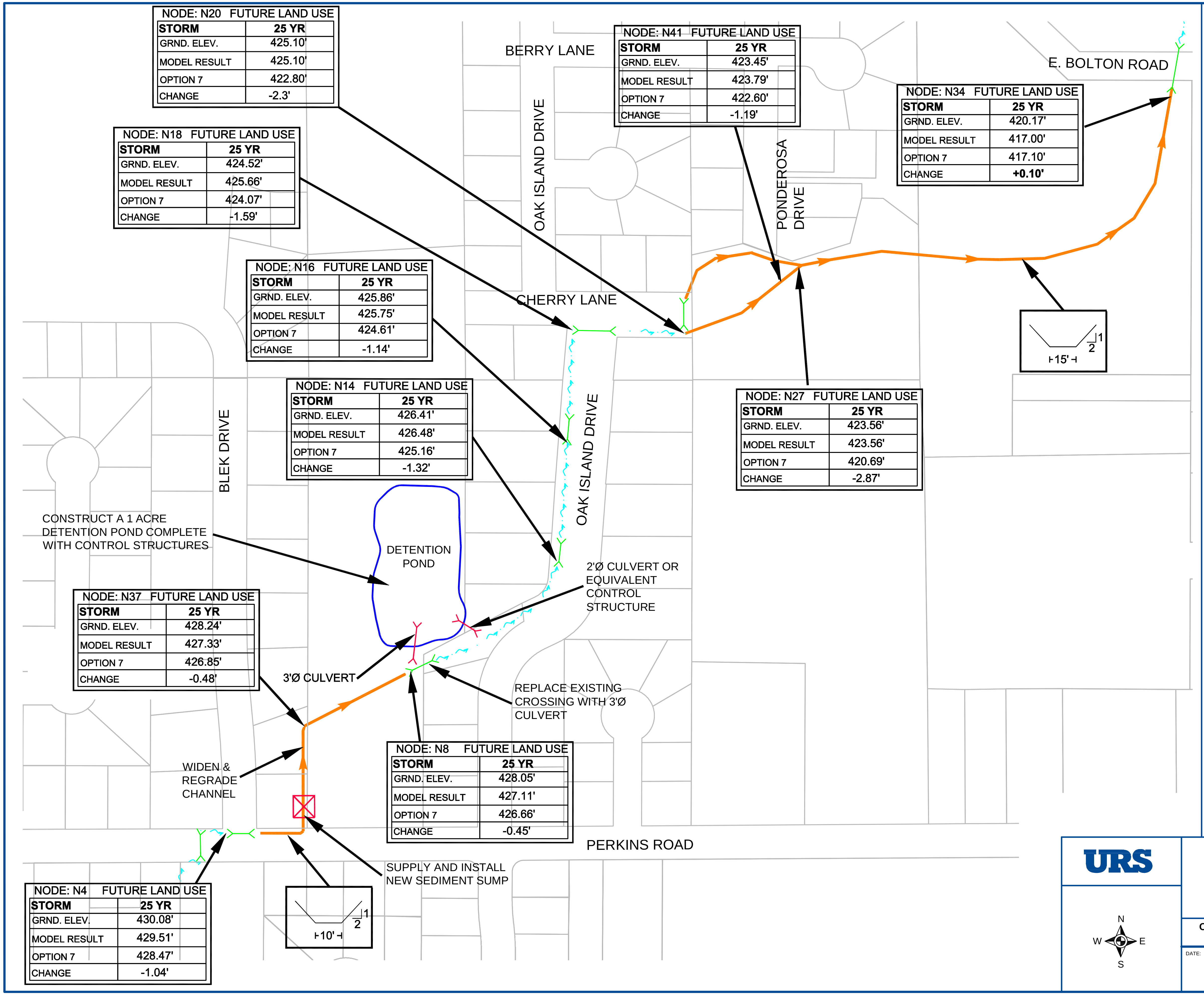
URS

N
W E
S

STORMWATER BASIN PLAN
FOR THE CITY OF VENETA

OPTION 6: INSTALL NEW BY-PASS CHANNEL AND REGRADE AND WIDEN LOWER DOWNSTREAM CHANNEL

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	6 UPGRADED



NODE: N20 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	425.10'
MODEL RESULT	425.10'
OPTION 7	422.80'
CHANGE	-2.3'

NODE: N41 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	423.45'
MODEL RESULT	423.79'
OPTION 7	422.60'
CHANGE	-1.19'

NODE: N34 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	420.17'
MODEL RESULT	417.00'
OPTION 7	417.10'
CHANGE	**+0.10'**

NODE: N18 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	424.52'
MODEL RESULT	425.66'
OPTION 7	424.07'
CHANGE	-1.59'

NODE: N16 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	425.86'
MODEL RESULT	425.75'
OPTION 7	424.61'
CHANGE	-1.14'

NODE: N14 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	426.41'
MODEL RESULT	426.48'
OPTION 7	425.16'
CHANGE	-1.32'

NODE: N27 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	423.56'
MODEL RESULT	423.56'
OPTION 7	420.69'
CHANGE	-2.87'

NODE: N37 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	428.24'
MODEL RESULT	427.33'
OPTION 7	426.85'
CHANGE	-0.48'

NODE: N8 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	428.05'
MODEL RESULT	427.11'
OPTION 7	426.66'
CHANGE	-0.45'

NODE: N4 FUTURE LAND USE

STORM	25 YR
GRND. ELEV.	430.08'
MODEL RESULT	429.51'
OPTION 7	428.47'
CHANGE	-1.04'

LEGEND

⌇	EXISTING DITCH
⟩—⟨	EXISTING CULVERT
→	WIDEN AND REGRADE CHANNEL
⟩—⟨	NEW CULVERT
→	NEW CHANNEL

GENERAL DESCRIPTION → 25 YEAR FUTURE LAND USE

DESIGN STORM → STORM | 25 YR

NODE GROUND ELEVATION → GRND. ELEV. | XX.XX'

MAX. WATER ELEVATION BEFORE PROPOSED IMPROVEMENTS → MODEL RESULT | XX.XX'

MAX. WATER ELEVATION AFTER PROPOSED IMPROVEMENTS → OPTION X | ± XX.XX'

DIFFERENCE IN W.S.E. BETWEEN EXISTING AND PROPOSED SYSTEMS → CHANGE | ± XX.XX'

WATER SURFACE ELEVATION BASED ON SYSTEM IMPROVEMENTS
(- INDICATES A DECREASE IN WSE AND
+ INDICATES AN INCREASE IN WSE)

URS

N
W E
S

STORMWATER BASIN PLAN
FOR THE CITY OF VENETA

OPTION 7: INSTALL NEW 1 ACRE DETENTION POND AND WIDEN
& REGRADE PORTIONS OF THE OPEN CHANNEL SYSTEM

DATE:	PROPOSAL NO.:	DRAWN BY:	REVISION NO.:	FIGURE NO.:
January 2008	25696393.00003	JS	0	7 UPGRADED

20071686.184 Veneta Civil Engineering.Figure 7.dwg