City of Bandon
Coos County, Oregon

STORM DRAINAGE MASTER PLAN ADDENDUM NO. 2 – ROSA ROAD STORM WATER DIVERSION

AUGUST 2014

The Dyer Partnership
Engineers & Planners, Inc.

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Project No. 101.85

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Introduction

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Introduction

1.1 BACKGROUND AND NEED

The purpose of this study is to provide an amendment to the *Storm Water Master Plan* completed in June 1999. The *Storm Water Master Plan* divided the city of Bandon into nine major drainage basins. These major basins were further divided into 27 sub-basins. The study recommended improvements for 15 of the sub-basins. This Addendum addresses changes to two of the recommended projects in the original *Storm Water Master Plan*, specifically Projects 6A.1 and 6A.4. These projects are located near the intersection of Fillmore Avenue (Rosa Road) and 11th Street* and concern runoff flows from Sub-basins 6A, 6F and 5A as identified in the original *Storm Water Master Plan*. (See Figure 1, Vicinity Map in Appendix A.) The sub-basins have been modified and additional sub-basins have been identified within these basins for the analysis carried out in this study. In addition to the proposed changes to project 6A.1, this addendum will recommend several future storm drain projects within the affected drainages that were not discussed in the original *Storm Drain Master Plan*.

The purpose of Project 6A.1 in the original *Storm Water Master Plan* was to divert some of the runoff flow coming from the area south and east on Rosa Road from the 48-inch storm main running north on the east side of Fillmore Avenue. The storm system in Fillmore Avenue eventually outfalls to Ferry Creek near the intersection of Grand Avenue and Third Street. This area is considered a light industrial area and is seeing rapid development, which is taxing the existing storm system. Project 6A.1 would have diverted some 30 plus cfs of flow away from the Fillmore storm system to a new outfall upstream on Ferry Creek. However, Ferry Creek has historically experienced some flooding in its lower reaches, and it was decided to examine options for diverting some of the runoff flow from Project 6A.1 westward on 11th Street to another drainage that outfalls to the Coquille River in the Boat Basin near 1st Street and Chicago Ave. This revised 6A.1 project is the main reason for this Addendum.

Project 6A.4 in the original *Storm Water Master Plan* is a small drainage project designed to drain light industrial areas east of Rosa Road just south of 11th Street. This area has been designated as the future City Shop area. This project remains basically unchanged except that it will now be connecting to the revised 6A.1 project and the flows will be diverted westward on 11th Street rather than eastward toward Ferry Creek.

**All references to streets, avenues, etc. in this document refer to the southeast section of the city, unless otherwise noted.*

1.2 SCOPE OF STUDY

The Dyer Partnership Engineers & Planners, Inc. has been authorized by the city of Bandon to provide master planning and engineering services as further described below. These services will develop an Addendum to the Storm Drain Master Plan that specifically addresses revised drainage Project 6A.1. The following items are included in the scope of this study.

Watershed Map of the Drainage Basins

Prepare new drainage basin maps based on the latest survey data and on the existing and proposed systems. The new drainage basin maps redefine Drainage Basins 6A, 6F and 5A from the original master plan and include additional sub-basins needed for delineating flows to new and existing receiving structures. This focused basin analysis is needed to determine the capacity of existing pipes and structures and to size the new system. The new Drainage Basin Map is presented as Figure 2 in Appendix A.

Hydrological Analysis

Conduct a hydrological analysis of the study area utilizing new survey data, existing aerial topographic data and aerial photos. This data will help determine ground slopes, level of development, existing impervious surfaces, local topography and other information needed for a hydrological analysis. Because the basin areas involved are relatively small (under 500 acres), the analysis method used will be the Rational Method as outlined in the ODOT Hydraulics Manual. In addition to collected data in the field, Dyer will use anecdotal information collected from city staff, site visits, and previous site investigations and studies to help determine hydrological factors for the analysis.

Hydraulic Modeling to Size Culverts and Pipes

The information obtained in the previous steps will be used to determine capacity of the existing storm drain system and to size new system elements using Manning's formula. Additionally, hydraulic grade lines will be calculated for both the existing storm drain system and for any new storm drain elements for the design storm to determine surcharged areas that may require modification to accommodate additional flow. In addition, the analysis will look at possible future development and its impact on runoff flows.

Cost Estimate for the New Storm Drain Improvements

Cost estimates will be developed for the revised Project 6A.1 and the recommended projects based on the most current project cost information.

1.3 PREVIOUS STUDIES AND INFORMATION

This report is the second addendum to the *Storm Drain Master Plan* for the city of Bandon (Project 4501.15) prepared June 1999. The first addendum (Project 101.50) was prepared by The Dyer Partnership in June 2006 and is titled *Storm Drainage Master Plan Addendum – South*

Bandon. Other information used to prepare this report includes the two-foot contour aerial and survey mapping databases prepared and periodically updated for the city of Bandon by The Dyer Partnership.

1.4 AUTHORIZATION

The Dyer Partnership Engineers & Planners, Inc. was retained by the city of Bandon to prepare a second storm drain master plan addendum, and was authorized to proceed with services in May 2014.

1.5 ACKNOWLEDGMENTS

This addendum is the result of contributions made by a number of individuals and agencies. We wish to acknowledge the efforts of Matt Winkel, City Manager; Richard Anderson, Public Works Director; Beverly Lanier, Administrative Assistant; and the staff of the city of Bandon.

Study Area

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Study Area

2.1 Location and Definition of Study Area and Existing Drainage Patterns

The revised diversion project is near the center of the study area and is in the vicinity of the intersection of Fillmore Avenue and 11th Street*. Fillmore Avenue turns into Rosa Road south of this intersection. The 14 drainage basins defined for the analysis of the new diversion system and downstream systems total approximately 166 acres and are comprised of residential areas, pasture lands, forested lands, light industrial areas and business areas. The boundaries for the storm water drainage basins are shown in Figure 1 in Appendix A.

The uppermost reach of the drainage area, and the initial source of the runoff flow to the drainage is about 0.8 miles south-southeast of the intersection of Fillmore Avenue and 11th Street. Flow begins as surface sheet flow on gently sloping pasture land and lightly forested areas that eventually concentrates in interior drainage ditches located east of Rosa Road. These drainage ditches flow in a general northwest direction and eventually discharge to the roadside ditch on the east side of Rosa Road. The Rosa Road ditch flows to the north and by the time the flow reaches the intersection of Fillmore Avenue (Rosa Road) and 11th Street, the calculated 25-year storm runoff rate is approximately 18.5 cfs. This runoff currently continues flowing northward, crossing 11th Street and flowing along the east side of Fillmore Avenue through culverts and ditches and finally to the 48-inch storm sewer system that outfalls to Ferry Creek downstream of the Third Street Bridge.

Project 6A.1 from the *Storm Water Master Plan* proposed intercepting the runoff at the intersection of Fillmore Avenue and 11th Street and diverting it to the east along 11th Street. This flow combines with the flow from additional storm drain improvements for projects 6A.1, 6A.3 and 6C.1 and eventually outfalls to Ferry Creek. The revised project proposes to divert this flow westward along 11th Street through new and existing systems, eventually to outfall at the boat basin near First Street and Chicago Avenue. See Figure 3 in Appendix A.

2.2 Study Area Characteristics

2.2.1 Climate

The city of Bandon experiences a mild marine climate. The presence of the Pacific Ocean to the west directly affects prevailing wind patterns in the region. Summer breezes blow from the northwest and winter winds gust from the southwest. Daytime heating produces warm

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temperatures inland and establishes a convective heating pattern that leads to the development of onshore winds. During the nighttime hours, as land surfaces cool, the reverse occurs and offshore winds develop. Fog is often present in the area, particularly during the morning hours. Again, the presence of the Pacific Ocean influences the development of this weather phenomenon. The fog may develop as warm moist air meets cooler land surfaces or it may form at sea and move inland. Rainfall averages about 60 inches a year. More complete climate information for Bandon is provided in the *Storm Drain Master Plan* of June 1999.

2.2.2 Topography and Natural Drainage Courses

The study area for this addendum rests on sandy loamy soils. The study area is generally flat with some gently sloping hills. There are no named waterways within the study area. Elevations for the study area range from about 120 feet to sea level at the outfall in the boat basin.

Basin boundaries and runoff patterns were defined from aerial photography, aerial survey, city infrastructure maps and new survey data collected near the project site (Fillmore Avenue and 11^{th} Street). For the purposes of this addendum, the study area was divided into 14 drainage basins which are described in Section 3.

2.2.3 Soils

The type of soil in a drainage basin will have some bearing on the choice of runoff coefficient. The following soil types are found within the study area. A map showing the locations of these soil groups within the study area is included with the National Resource and Conservation Service (NRCS) Soil Report in Appendix C.

Soil Type 5 Blacklock fine sandy loam, **Type A, 0-3% slope and Type B, 3 to 7% slope**. These soils (primarily Type A) are found mostly in the southern portion of the study area. They are a deep, poorly drained soil in depressional areas of marine terraces. Permeability of this soil is moderate above the cemented layer, very slow through it and moderately rapid below it. Runoff is very slow. In some areas, ground water can be elevated above grade for significant periods throughout the year.

Soil Type 8 Bullards sandy loam is found extensively throughout the study area as Type B, 0 to 7% slope with a very small amount of Type E, 30 to 50% slope in the gully located in the north portion of the study area. This is deep, well-drained soil on dissected marine terraces. Permeability of the soil is moderate. Runoff is slow. The hazard of soil blow is severe.

Soil Type 57, Udorthents, Level 0 to 1% slopes. This soil type is primarily found in low-lying areas near the outfall to the boat basin, and is classified as flood plains and tidal flats. This is a poorly drained soil consisting of alluvium, dredging spoils, dune sand and wood chips.

2.2.4 Geologic Hazards

Geologic hazards are those hazards that, as a result of natural phenomena, result in damage or destruction of property. The proximity of the Pacific Ocean, the presence of underlying fault zones, and the physical characteristics of native rock formations create potential geologic hazards in the vicinity of Bandon and all along the Oregon Coast. Within the Study Area, the following geologic hazards have been identified: flooding, high windstorms, tsunamis (tidal waves), and coastal erosion.

Flooding

The majority of the study area, as is the case for most of the city of Bandon, is safe from the hazard and damage caused by floodwaters. However, low-lying areas near the boat basin have the potential to flood, especially during large weather events coupled with high tides.

High wind

Strong wind is a regular occurrence in Bandon, with high wind occurring only occasionally during severe storms. Only minor damage is expected from a high windstorm, with a 90 mph wind statistically occurring once in every 100 years.

Tsunamis

Tsunamis are long-period waves generated by several mechanisms: submarine earthquakes, submarine landslides , and underwater volcanoes. The tsunami waves may travel distances of more than 5,000 miles from their origin and exceed speeds of 500 miles per hour. Wave heights of tsunamis in coastal regions have been known to exceed 100 feet. The potential devastation for any coastal city is obvious, but fortunately, major tsunamis do not occur frequently. Most of the study area addressed in this addendum report is located at elevations above modeled tsunamis effects.

Coastal erosion

The potential for enhanced coastal erosion from the discharge of storm water outfalls should be considered in the development of storm water facilities. Discharge of high volumes of water, even from private property roof drains, can cause erosion of the sandy soils (Soil Type 8 - Bullards sandy loam) typically found in several areas of Bandon and throughout the study area. Once exposed, the sandy soils are subject to wind erosion, compounding the erosive forces from the ocean wave action and runoff. Consequently, any improvements or alteration of outfalls should include precautions to prevent storm discharges from eroding coastal banks. In residential areas constructed on sandy soils, particular attention should be given to locating outfalls.

2.2.5 Environmental Issues

The city of Bandon is situated along the coast of the Pacific Ocean; consequently, there are extensive shorelands in the area. The shorelands in the Bandon area are characterized as ocean and estuarine. These shorelands have been recognized as providing “areas of exceptional aesthetic or scenic quality." Although the study area addressed in this report is not directly adjacent to the shoreline, the potential impact to the shoreline of storm water runoff needs to be considered in any storm water project. The revised project will utilize man-made and natural channels for the conveyance of storm water. The impact to the channels from the added runoff flow in the form of erosion and siltation should be taken into account in any design. Culverts and outfalls should be designed to minimize scour and siltation. More complete environmental information for Bandon is provided in the *Storm Drain Master Plan* of June 1999.

2.2.6 Precipitation

Annual rainfall in the area, based on National Oceanic and Atmospheric Administration (NOAA) data, is approximately sixty inches, most of this falling between the November to March time period. Snowfall during the year is slight, with a mean yearly total of less than one inch. When snow fall occurs, it is generally during the December to March time period.

Storm water drainage planning is not necessarily concerned with the annual rainfall total occurring in a region; rather, storm water planning is more concerned with the type, intensity, and the daily rainfall total of the storms. These elements, known as the design storm, are used to analyze the drainage system and its components. A further discussion of the Bandon design storm and its use to analyze drainage components is provided in Chapter 5.

2.3 Economic Conditions and Trends

Population growth and development in Bandon will occur and is anticipated to accelerate in the immediate future. The City has basic commercial amenities and also lies within a reasonable distance of the cities of Coos Bay and North Bend, where larger, more urban amenities are readily accessible. During the summer months, the scenic vistas attract a large number of tourists. Commercial enterprises cater to this seasonal influx of visitors. Bandon Dunes Golf Resort is also a significant tourist draw. Cranberry production, tourism and the emergence of the City as a popular retirement location have helped to spur growth rates in recent years. The proximity to Coos Bay and North Bend, the relatively rural flavor of Bandon, and the ocean views will likely be the major factors stimulating continued long-term and second-home residential growth within Bandon. City services to these residents will include water, sewer, streets, port facilities, and storm drainage. Much of the study area for this addendum is urban and residential and has already been developed more or less to capacity. The main undeveloped regions within the study area are in the southern portions east of Rosa Road. It is anticipated that these areas will experience slow growth and that they will most likely remain agricultural/rural residential areas in the near and moderately distant future. New drainage facilities should take into account future growth of this area to ensure an adequate functional project lifespan.

2.4 Population

The current population estimate is derived from the population projections made in the *Bandon Water Master Plan*, 2003. The projections have been adjusted for the period from 2014 to 2034.

TABLE 2.4.1 POPULATION ESTIMATE AND PROJECTIONS

Year	2014	2019	2024	2029	2034
Residential Inside - Full-time	3617	3947	4307	4699	5128
Residential Outside - Full-time	244	269	298	329	363
Residential Inside - Peak additional	339	370	404	441	481
Residential Outside - Peak additional	11	12	14	15	17
Transient - Off Peak	310	338	369	403	440
Transient - Peak Additional	575	628	685	747	815
Total Peak Equivalent Population	5096	5564	6075	6633	7243
Total Off-Peak Equivalent Population	4171	4554	4973	5431	5930

Population is used only indirectly for planning storm water systems. While the rate of population growth is indicative of the amount of land that would be developed, land use is employed for forecasting hydraulic loads in storm drain analysis. Within the study area, the primary type of development considered is residential. Most of the drainage basins within the study area for this Addendum are business, light industrial, farmland and residential, and are, more or less, fully developed. The exception is Drainage Basin 1, which represents a large percentage of the total study area (55.4%) and has some residential areas, but is mostly undeveloped or farmland.

Existing Conditions

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Section 3

Existing Conditions

3.1 Drainage Basins

The entire city of Bandon was divided into nine major drainage basins and 27 sub-basins for the June 1999 *Storm Water Master Plan*. Within this master plan Amendment Study there are 14 basins defined by their respective discharge points for the purpose of sizing drainage pipe and analyzing the existing storm drainage system. Figure 2 in Appendix A shows these basins. The combined area of these basins is about 166 acres. The gentle slopes and flat terrain make absolute boundaries between basins subjective in most cases. Runoff coefficients for the basins were chosen based on average slopes and the type and amount of development within the basins. A brief description of the drainage basins is provided below.

Basin 1: Basin 1 is a 92-acre basin located south of 11th Street* and east of Rosa Road. This is the largest of the drainage basins and comprises 55.4% of the study area. This basin is the main diversion basin for the proposed 11th Street Storm Improvement Project, which triggered the need for this Addendum. Flow from this basin currently flows northward along the east side of Fillmore Avenue and eventually to the 48-inch outfall at Ferry Creek. The proposed project would divert flow from this basin to the west within the upsized storm drainage system in 11th Street. This basin contains mostly undeveloped land and farmland. The basin is relatively flat with slopes averaging less than 2 percent. Currently, runoff is conveyed via overland sheet flow to ditches located centrally within the basin. These ditches eventually drain to the roadside ditches on the east side of Rosa Road where the runoff is directed northward toward the discharge point at the intersection of 11th Street and Rosa Road. An average runoff coefficient of 0.3 was used for this basin.

Basins 2, 3, 4, 5, and 6: These basins are all small drainage basins that discharge to catch basins along 11th Street. The basins comprise the light industrial area west of Rosa Road and south of 11th Street along with some of the residential areas along 11th Street westward to Delaware Avenue. The combined area of these basins is 7.5 acres. The basins are relatively flat and contain a large percentage of impervious areas consisting of roofs and paved parking areas and driveways. Runoff coefficients ranged from 0.5 for most areas to 0.9 for areas with large percentages of impervious surface.

Basin 7: Basin 7 is located north and south of 11th Street between Elmira Avenue and Baltimore Avenue. This basin contains the ditch and culvert system in the rectangular area bordered by 10th Street, 11th Street, Baltimore Avenue and Elmira Avenue, as well as residential areas south of 11th Street. The basin is 7.3 acres in size and is relatively flat. Residential development in the basin is light density. The runoff coefficient used for this basin is 0.4.

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Basin 8: Basin 8 is the second largest drainage basin in the study area at 22 acres. This basin discharges to the storm drainage system in Baltimore Avenue near the intersection of Baltimore Avenue and Tenth Street. This basin is located east of Highway 101; most of the area is south of 11^{th} Street. The basin contains mostly light density residential development with some commercial areas near Highway 101. There are some undeveloped areas on the east side of the basin. As with most of the study area, the basin is relatively flat with slopes averaging around 1 percent. The runoff coefficient used for this basin is 0.5.

Basins 9 and 10: Basins 9 and 10 are located near the intersection of Baltimore Avenue and 10th Street east of Highway 101. These basins have a combined area of 3.9 acres and contain residential and commercial areas with a large amount of impervious surface. Runoff flow from these basins joins with runoff from the previous basins in the 24-inch storm drain system located in Baltimore Avenue and 10th Street. This part of the storm drain system discharges at the outfall to the gully area north of 10th Street. Once again, slopes are relatively flat within these basins. The runoff coefficient used for Basin 9 is 0.5 and for Basin 10 is 0.7.

Basin 11: Basin 11 is an 18-acre basin that contains the gully area behind Bandon City Hall. The basin is located east of Highway 101 and north of 10th Street. In addition to the overgrown gully area, Basin 11 contains portions of the residential area to the east and commercial areas fronting Highway 101 to the west. This basin discharges to the 36-inch storm drain that crosses Highway 101 and flows along Chicago Avenue toward the small boat basin in the Coquille River. The basin includes areas that are thickly wooded and brushy as well as some impervious surfaces on its edges. The gully area has steeply sloping sides, but the areas on top are relatively flat. There is a small stream drainage that runs through the gully which transports runoff flows from upstream areas. This stream is reported to have little or no flow during the dry months, but may be perennial in wet years. The runoff coefficient used for this basin is 0.3.

Basin 12: Basin 12 is a 10.1-acre basin that consists of mostly commercial areas and Highway 101 drainage. The basin is a one-half -mile long strip of Highway 101 with runoff that flows to receiving structures that eventually drain into the 36-inch storm drainage main that outfalls to the Bandon Boat Basin. This basin is mostly impervious surface and a runoff coefficient of 0.8 was used for runoff calculations.

Basin 13: Basin 13 is a 3-acre basin that contains the commercial area at the south end of the Old Town section of Bandon around Chicago Avenue and Second Street S.E. This basin's runoff drains to catch basins that connect to the 36-inch storm drain main running through Chicago Avenue. This basin contains a large amount of impervious area; a runoff coefficient of 0.65 was used.

Basin 14: Basin 14 contains the final areas that drain into the 36-inch storm drain in Chicago Avenue before runoff reaches the outfall in the Bandon Boat Basin. The basin is a 2.1-acre basin located between First Street and Second Street, centered on Chicago Avenue. The basin contains mostly commercial development and has a high percentage of impervious area. The runoff coefficient used for this basin is 0.8.

3.2 Existing Storm Drainage Facilities

The existing storm drainage system on 11th Street west of Fillmore Avenue consists of 18-inch pipe between ditch sections and under driveway approaches on the south side of the roadway. The system crosses 11th Street south to north between Elmira Avenue and Delaware Avenue, and outfalls to the ditch and culvert system bordered by 11th Street to the south, 10th Street to the north, Elmira Avenue to the east and Baltimore Avenue to the west. See Figure 4 in Appendix A. The ditch and culvert system flows in a general northwest direction. Runoff leaves the ditch and culvert system and enters the 24-inch piped system at the intersection of Baltimore Avenue and 10th Street. The 24-inch storm drainage in this area picks up additional flow from areas south and east along Baltimore Avenue and then outfalls to the large gully area behind Bandon City Hall. Flow leaves the gully area at the north end and enters the 36-inch storm drain pipe that crosses Highway 101 and runs down Chicago Avenue. Additional runoff enters the system from the old town areas around First and Second Streets and Chicago Avenue. The 36-inch storm drain eventually outfalls at the boat basin in the Coquille River near the intersection of First Street and Chicago Avenue.

Planning Criteria

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Section

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Planning Criteria

4.1 Federal and State Regulations

Coos County and the city of Bandon are not on the State of Oregon Department of Environmental Quality (DEQ) Phase II NPDES permit list. See Section 4.2.8 below. As currently regulated, the city of Bandon is not required by Federal Law to permit or monitor its storm water discharges. However, as cited in 40 CFR 122.26, other Federal agencies may require permits for some storm water discharge.

The U.S. Army Corps of Engineers (USACE), Oregon Division of State Lands (DSL) and Oregon Department of Fish and Wildlife (ODFW) are all agencies that may require permits or special construction methods to accommodate fish passage when construction activities may affect sensitive habitat areas.

As part of the permitting process, the city of Bandon has toured the project area with agency representatives and submitted a Joint Permit application to USACE and DSL. The diversion project, as planned, will not impact open channel areas and falls under system maintenance criteria. In addition, it has been determined that the drainage ditches contain intermittent flow and are not being used by fish species. For these reasons, USACE and other agencies will likely not require permits for this project.

4.2 Local Drainage Regulations and Review Procedures

The city of Bandon currently has ordinances pertaining to storm water for new development. These include Municipal Ordinance.12.060 “Application Requirements” Section B.12 and 16.12.240 “Criteria for Approval” Section F.2. The City requires that a developer address storm water issues by providing adequate facilities for runoff generated from the proposed site. The intention of these ordinances is to protect lower developments from excess flows.

Review procedures require the developer to provide for all on-site drainage as well as to participate in the improvement of downstream drainage systems if the runoff from the improved property causes these downstream facilities to be overloaded. It requires all new drainage facilities to be sized to accommodate future runoff from potential upstream developments. Most of the drainage basins within the study area for this addendum have been fully developed. However, there are some undeveloped areas that may be developed in the future. Any future development will have to address impacts to downstream storm drain facilities. A brief description of common drainage review criteria is provided below.

4.2.1 General Provisions

The review body should approve a development request only when adequate provisions for storm and flood water runoff have been made as determined by the City Engineer. The storm water drainage system must be separate and independent of any sanitary sewerage system. Where possible, inlets should be provided, ensuring surface water is not carried across intersections or allowed to flood streets. Surface water drainage patterns and proposed storm drainage must be shown on every development proposal plan. All proposed storm sewer plans and systems must be approved by the City Engineer as part of the tentative plat or site plan review process.

Ditches will not be allowed without specific approval of the City Engineer. Open natural drainage ways of sufficient width and capacity to provide for flow and maintenance may be permitted. By definition, an open natural drainage way is a natural path that has the specific function of transmitting natural stream water or storm water runoff from a point of higher elevation to a point of lower elevation.

4.2.2 Easements

Where a subdivision or development property is traversed by a water course, drainage way, channel or stream, there shall be provided a public storm water easement or drainage right-of-way conforming substantially with the lines of such water course and such further width as the City Engineer determines will be adequate for conveyance and maintenance. Improvements to the drainage way, or streets or parkways parallel to the water course, may be required.

The Storm Water Diversion Project will require that the City obtain both permanent drainage maintenance easements and temporary construction easements in the ditch and culvert area bounded by 10th and 11th Streets to the north and south and Baltimore Avenue and Elmira Avenue to the west and east. The work on 11th Street as planned will be within the existing right-of-way. See Figure 5 in Appendix A.

4.2.3 Accommodation of Upstream Drainage

A culvert or other drainage facility shall be large enough to accommodate potential runoff from its entire upstream drainage area, whether inside or outside of the development. The City Engineer will review and approve the size required of the facility, based on provisions of the *City of Bandon Storm Drain Master Plan*, and sound engineering principles, assuming conditions of maximum potential watershed development permitted by the *City of Bandon Comprehensive Plan*.

4.2.4 Effect On Downstream Drainage

Where it is anticipated by the City Engineer that additional runoff resulting from the development will overload an existing drainage facility, the review body should withhold approval of the development until provisions have been made for improvement of said potential condition.

4.2.5 Drainage Management Practices

Development must employ drainage management practices approved by the City Engineer which minimize the amount and rate of surface water runoff into receiving streams or drainage facilities, or onto adjoining properties. Drainage management practices must include, but are not limited to, one or more of the following:

- Temporary ponding or detention of water;
- Permanent storage basins;
- Minimization of impervious surfaces;
- Emphasis on natural drainage ways;
- Prevention of water flowing from the development in an uncontrolled fashion;
- Stabilization of natural drainage ways as necessary below drainage and culvert discharge points for a distance sufficient to convey the discharge without channel erosion;
- Runoff from impervious surfaces must be collected and transported to a natural drainage facility with sufficient capacity to accept the discharge; and
- Other practices and facilities designed to transport storm water and improve water quality.

4.2.6 Design Requirements for New Development

All new development within the City must, where appropriate, make provisions for the continuation or appropriate projection of existing storm sewer lines or drainage ways serving surrounding areas. Extensions may be required through the interior of a property to be developed where the City determines that the extension is needed to provide service to upstream properties.

4.2.7 NPDES Permit Requirements

Since November 2002, a National Pollutant Discharge Elimination System (NPDES) permit must be obtained from the Department of Environmental Quality (DEQ) for construction activities, including clearing, grading, and excavation that disturb one or more acres of land. The developer must complete NPDES General Permit Form 1200-C for storm water discharge associated with construction activities. For construction activities disturbing 20 or more acres, the plan must be prepared and stamped by an Oregon Registered Professional Engineer, Oregon Registered Landscape Architect, or Certified Professional in Erosion and Sediment Control. Addition information regarding the NPDES Storm Water Regulations for Construction Activities may be found on the Internet at:

www.deq.state.or.us/wq/stormwater/swpconstrapp.htm#app

4.2.8 Small MS4 Requirements

Small MS4 stands for Small Municipal Separate Storm Sewer System. It is defined as a publicly owned conveyance or system of conveyances from ditches, curbs or underground pipes that divert storm water into the surface waters of the state. A small MS4 is subject to storm water regulation if it is located within an "Urbanized Area" as defined by the U.S. Census Bureau in the 2000 (or later) census. The Bureau of the Census has defined an "Urbanized Area" as a central place (or places) adjacent to a densely settled surrounding territory that together has a residential population of at least 50,000 and an average density of at least 1,000 people per square mile. Bandon does not currently appear to meet the definition of an urbanized area, but should anticipate future inclusion since the history of this set of regulations has been to include small areas as time goes on. Communities subject to this regulation are required to design their programs to do the following: reduce the discharge of pollutants to the "maximum extent practicable" (MEP), protect water quality and satisfy the appropriate water quality requirements of the Clean Water Act. Implementation of the MEP standard will require the development and implementation of best management practices (BMP) and the achievement of measurable goals to satisfy each of the following six minimum control measures:

- **Public Education and Outreach**
  Distributing educational materials and performing outreach to inform citizens about the impacts polluted storm water runoff discharges can have on water quality.

- **Public Participation/Involvement**
  Providing opportunities for citizens to participate in program development and implementation, including effectively publicizing public hearings and/or encouraging citizen representatives on a storm water management panel.

- **Illicit Discharge Detection and Elimination**
  Developing and implementing a plan to detect and eliminate illicit discharges to the storm sewer system (includes developing a system map and informing the community about hazards associated with illegal discharges and improper disposal of waste).

- **Construction Site Runoff Control**
  Developing, implementing and enforcing an erosion and sediment control program for construction activities that disturb one or more acres of land (controls could include silt fences and temporary storm water detention ponds).

- **Post-construction Runoff Control**
  Developing, implementing and enforcing a program to address discharges of post-construction storm water runoff from new development and redevelopment areas. Applicable controls could include preventive actions such as protecting sensitive areas (e.g., wetlands) or the use of structural BMPs such as grassed swales or porous pavement.

- **Pollution Prevention/Good Housekeeping**
  Developing and implementing a program with the goal of preventing or reducing pollutant runoff from municipal operations. The program must include municipal staff

training on pollution prevention measures and techniques (e.g., regular street sweeping, reduction in the use of pesticides or street salt, or frequent catch-basin cleaning).

Additional information may be obtained from the following website regarding the Small MS4 program from:

http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

4.3 Urban Growth Area Management and Agreement

The Urban Growth Area (UGA) lies outside the city limits but within the Urban Growth Boundary (UGB). The UGA includes a large portion of Drainage Basin 1 (the main diversion basin), as well as portions of several other drainage basins, and they are addressed by this addendum. UGA has historically been under county jurisdiction. The remaining drainage areas analyzed are within city limits. All project work planned for the diversion project will take place within city limits, therefore, responsibility for development review takes place at the city level.

4.4 Civil Law Criteria

Storm drainage for non-urbanized areas is not regulated by state or federal agencies. However, the State of Oregon provides civil laws pertaining to drainage. Civil drainage laws prescribe the entitlement of a property owner to have normal natural drainage ways maintained. Under this doctrine, a landowner must accept water that naturally flows across his property, but the owner is entitled to not have the natural drainage changed or substantially increased. Similarly, this law provides that a landowner must not obstruct the natural drainage way if the upper drainage way is properly discharged.

The Oregon Department of Transportation Hydraulics Manual provides a summary of Oregon drainage law. The three basic elements of drainage that must be followed, according to civil law, as interpreted by ODOT are:

- A landowner may not divert water to adjoining land that would not otherwise flow there. Diverted water is further described by ODOT as water routed from one drainage area to another and water collected and discharged that would normally infiltrate, pond, or evaporate.

- A landowner may not divert or change the place where water flows onto a lower property. ODOT interprets this element to limit diversion of water from grading and paving work and/or improvements to storm water collection systems.

- An upper landowner may not accumulate large quantities of water, then release it, greatly accelerating the flow onto a lower property. The ODOT interpretation notes that noncompliance with this element occurs when the flow of water has been substantially increased.

Clearly, violations of Oregon drainage law are subjective. Where questions arise, ODOT recommends that its engineering staff acquire easements to avoid the potential for litigation. Natural drainage ways have been impacted by development and, consequently, are no longer, readily apparent. In such cases, corrections made by the City should be particularly sensitive to the potential for rerouting drainage to properties that cannot be proven as the original drainage way. Future developments within the City, and city improvements to the existing drainage system, should be required to subscribe to the City's legal interpretation of the Oregon drainage law. Where questionable conditions may exist, the City should seek or require acquisition of easements.

Section

5

Hydrological Analysis

Hydrological Analysis

Section 5

5.1 Storm Frequency

An essential part of storm water analysis is selection of the design storm or storm frequency that will be used. Selection of the design storm includes economic and statistical relations. The frequency chosen for a storm depends upon such factors as the existing drainage system, the nature of the contributing areas, and the cost of storm drainage improvements.

The design storm is the total amount of rainfall that will occur over a period of time based on the statistical evaluation of precipitation records. Typical intervals for storm frequencies are 2, 5, 10, 25, 50, and 100 years. A 25-year storm can be expected to occur once within a 25-year period. The 25-year storm could occur any year during a 25-year time span, although each year it only has a 4 percent chance of occurring. The 25-year storm could conceivably occur for several years, or even twice in a given year, even though, statistically, it would not be probable.

Economic factors are considered when selecting the design storm in the engineering analysis. For instance, a drainage system sized for the 100-year storm will result in a larger, more costly drainage system than for a more frequent storm. Conversely, a drainage system designed for the frequent storm, though less costly, may not prevent property flooding, damage to public facilities, and the potential loss of life. Costs of improvements must be compared to the potential risks.

Selection of the storm frequency for this analysis is based on individual basins and projects. Based on the *State of Oregon Department of Transportation Hydraulics Manual*, a 50-year recurrent storm should be utilized for facilities draining through state highways and a 25-year storm can be used for smaller city streets. In cases where roadway overtopping is a problem, the 100-year storm, may be used.

For development anticipated within the study area, a storm with a recurrent interval of 25 years is selected as the design and analysis storm. Per NOAA isopluvial maps, the rainfall total for the 25-year storm in Bandon is 7.0 inches in a 24-hour period. The existing and new systems were also analyzed using 100-year storm flows in order to predict potential flooding issues during a very large weather event.

5.2 Channelization

As storm water flows downstream, it travels in some type of channel, for example, ditch, culvert, natural creek, or pipes. A common mathematical formula used to characterize the hydraulic behavior of these conduits is Manning's Equation, which is generally expressed as:

$$Q=(1.49/n)*A*R^{2/3}*S^{1/2}$$

Where:
Q=Channel Flow (cfs)
A=Cross-Sectional Area (sf)
R=Hydraulic Radius=A/P (ft)
P=Wetted Perimeter (ft)
S=Channel Slope (ft/ft)
n=Manning's Roughness Coefficient

Channels vary widely in their hydraulic performance. The roughness coefficient "n" is used to describe the general type of channel and the surface texture of the channel flow regime. Channel wall materials differ in surface friction. If a channel is made up of a rough surface, there is more friction as the water flows through the channel, and more energy is used to overcome that friction. The result is lower water velocities and therefore lower flows or higher water levels for a given flow. Many jurisdictions dictate specific Manning's coefficients to use for all piped flow calculations. A Manning's coefficient of 0.013 was used for all pipe flow calculations for this addendum. Table 5.2.1 lists some commonly used Manning's "n" values for different pipe and channel surfaces.

TABLE 5.2.1
TYPICAL MANNING'S ROUGHNESS COEFFICIENT

SURFACE OR MATERIAL	MANNING'S "n"
Finished Concrete	0.012
Unfinished Concrete	0.014
Plastic Pipe	0.009
Brick	0.016
Cast Iron	0.015
Concrete Pipe	0.015
Bare Earth	0.022
Corrugated Metal Flumes	0.025
Corrugated Metal Pipe	0.026
Rubble	0.030
Earth with Stones and Weeds	0.035

5.3 Runoff Analysis Method

The term "storm water" typically refers to rainfall runoff, snowmelt runoff, and surface runoff and drainage. Effective storm water management includes the accurate sizing of storm water conveyance systems, specifically culverts, catch basins, detention/retention ponds, and storm drainage pipelines. Sizing for conveyance systems is generally estimated by using instantaneous peak runoff from a storm of specified frequency.

There are numerous methods for estimating peak runoff. For purposes of this study, the Rational Method was used to estimate peak runoff values.

The Rational Method is relatively simple analysis method and is commonly used for engineering analysis of smaller drainage basins of less than 300 acres. In general, the Rational Method is considered a conservative approach for estimating storm water runoff.

5.3.1 Rational Method

The Rational Method is based upon the concept of mass balance and relates rainfall intensity to runoff intensity. The Rational Method incorporates the use of the rational formula, which is generally expressed as:

$$Q_p = CIA$$

Where:
Q_p = peak discharge (cfs)
C = runoff coefficient (dimensionless)
I = rainfall intensity (in/hr)
A = watershed area (ac)

Once values for the runoff coefficient, rainfall intensity, and watershed area have been determined, peak discharge (Q_p) values for drainage basins in the area are calculated. Each of the parameters in the formula is described below.

Runoff Coefficients
Values for C, the runoff coefficient, are readily available in most hydrology or engineering handbooks. Some common C values are listed in Table 5.3.1.1.

TABLE 5.3.1.1
COMMON RUNOFF COEFFICIENTS

AREA DESCRIPTION	RUNOFF COEFFICIENT
Downtown Business	0.70 to 0.95
Neighborhood	0.50 to 0.70
Single Family (Residential)	0.30 to 0.50
Detached Multi-units (Residential)	0.40 to 0.60
Attached Multi-units (Residential)	0.60 to 0.75
Light Industrial	0.50 to 0.80
Parks, Cemeteries	0.10 to 0.25
Unimproved	0.10 to 0.30

Rainfall Intensity
Rainfall intensity (I) is the intensity (inches per hour) of rainfall for a given design storm at a given time in the storm. Intensity is typically determined from Rainfall Intensity, Duration, and Frequency (IDF) curves. IDF curves are used to determine rainfall intensity associated with a specific storm frequency and time of concentration. The IDF curves for Bandon are provided in Appendix C with the runoff calculations.

Time of Concentration
Rainfall duration in a drainage basin is computed by determining the time of concentration for that drainage basin. Time of concentration (t_c) is defined as the longest travel time it takes a particle of water to reach a discharge point in a watershed. While traveling towards a discharge point, a water particle may experience sheet flow, shallow concentrated flow, open channel flow, or a combination of these. The *ODOT Hydraulic Manual* describes the use of the kinematic wave equation to calculate the time of concentration for overland sheet flow.

$$T_c = 0.93(L^{0.6}n^{0.6})/(i^{0.4}S^{0.3})$$

Where:

T_c = Time of concentration for overland sheet flow (minutes)
L = Length of sheet flow segment (feet)
n = Manning’s Roughness Coefficient
i = Rainfall intensity (inches/hour)
S = Average slope of the sheet flow segment (feet/feet)

The time of concentration for shallow concentrated flow and open channel flow can be calculated once the velocity is known by dividing the segment length by the velocity of the flow. The *ODOT Hydraulics Manual* provides a chart for determining flow velocity in the case of shallow concentrated flow. The State of Washington Department of Transportation has prepared coefficients based on different surfaces using Manning's Equation for ease of calculating both shallow concentrated flow and open channel flow velocities. Typical values for these coefficients are presented in Table 5.3.1.2.

TABLE 5.3.1.2
WASHINGTON DOT SHALLOW CONCENTRATED FLOW AND OPEN CHANNEL FLOW COEFFICIENTS

Shallow Concentrated Flow

SURFACE DESCRIPTION	COEFFICIENT
Forest with heavy ground litter	3
Brushy ground with some trees	5
Fallow or minimum tillage cultivation	8
High grass	9
Short grass, pasture and lawns	11
Nearly bare ground	13
Paved and gravel areas	27

TABLE 5.3.1.2 (Continued)

Open Channel Flow

SURFACE DESCRIPTION	COEFFICIENT
Forested swale with heavy ground litter	5
Forested drainage course with defined bed	10
Rock-lined waterway	15
Grassed waterway	17
Earth-lined waterway	20
Meandering stream	20
CMP pipe	21
Rock-lined stream	23
Grass-lined stream	27
Concrete pipe	42

The time of concentration for a particular basin is the sum of the times of concentration for each type of flow and for each segment of the flow line. This total time of concentration is used as the duration when determining the rainfall intensity for the design storm frequency from the IDF curves.

Area
The final variable in the rational formula is the watershed area (A). Watershed area is determined from topographic maps of the area.

Storm runoff analysis using the rational formula can easily be performed using spreadsheet software. The runoff analysis calculations for this addendum are included in Appendix C.

Section 6

Storm Drain Model & System Analysis

Storm Drain Model & System Analysis

Section 6

6.1 Post Diversion Impact to the Existing Storm Drain System

See Appendix C for existing and new storm system capacity calculations and HGL profiles. Diverting runoff from Basin 1 westward on 11th street will add approximately 19 cfs of additional flow to the receiving storm drain system. In order to determine the impact to the existing receiving system and which system elements might require upgrading or upsizing to accommodate the added flow, a storm water runoff model was developed using the Rational Method. The model divided the study area up into 14 drainage basins. The drainage basins were estimated using topographical data, aerial photos and recent surveys. Basin boundaries were based on their respective receiving structures such as ditches and catch basins in order to analyze individual pipe runs within the storm drain system. See Section 3 of this addendum report for a description of the drainage basins.

6.2 Discharge Estimates

Twenty-five year storm discharge estimates that included the proposed diverted flow for the entire storm drain system down to the outfall at the boat basin in the Coquille River were developed according to the methodology in Section 5. Table 6.2.1 provides discharge flows and other analysis information for each of the 14 drainage basins.

An analysis of the impact of the 100-year storm event was also performed. The 100-year storm analysis shows that much of the existing system would experience flooding issues during an event this large. This is to be expected as it is impractical to design a storm drain system for the 100-year event unless there are critical facilities to be protected. The proposed new 30-inch storm drain system in 11th Street does have the capacity to handle the theoretical flows from a 100-year event although the system would experience surcharging. The 100-year storm calculations and HGL analysis are included in Appendix C.

In addition to the 25-year and 100-year storm analysis, an analysis of the system was computed for the 25-year storm assuming that Basin 1 had been developed as residential, thereby increasing the amount of diverted runoff. This analysis indicates that much of the downstream system will be surcharged should Basin 1 be developed. It is important that any future development that would increase runoff flows to this part of Bandon's storm drain system, or any part of the City's storm drain system, should be required to address impacts to downstream storm drains.

TABLE 6.2.1
DRAINAGE BASIN RUNOFF ANALYSIS SUMMARY

BASIN NUMBER	AREA (ACRES)	RUNOFF COEFFICIENT	25-YEAR T_c (MIN)	25-YEAR RAINFALL INTENSITY (IN/HR)	25-YEAR RUNOFF FLOW (CFS)	25-YEAR CUMULATIVE FLOW (CFS)
1	92	0.3	150	0.67	18.49	18.49
2	3.4	0.5	22	1.95	3.32	21.81
3	0.66	0.9	10	2.75	1.63	23.44
4	2	0.5	10	2.75	2.75	26.19
5	1	0.5	10	2.75	1.38	27.57
6	0.48	0.5	10	2.75	0.66	28.23
7	7.3	0.4	15	2.35	6.86	35.09
8	22	0.5	71	0.93	10.23	45.32
9	1.2	0.5	10	2.75	1.65	46.97
10	2.7	0.7	10	2.75	5.20	52.17
11	18	0.3	34	1.5	8.10	60.27
12	10.1	0.8	18	2.15	17.37	77.64
13	3	0.65	10	2.75	5.36	83.00
14	2.1	0.8	10	2.75	4.62	87.62

MAX FLOW THROUGH NEW 11TH STREET STORM SYSTEM
MAX FLOW THROUGH DITCHES & CULVERTS
MAX FLOW THROUGH BALTIME AND 10TH STREET SYSTEM
MAX FLOW THROUGH LOWER 36-INCH SYSTEM TO OUTFALL

6.3 Applying the Analysis Results to the Existing Storm System

By applying the results of the hydrological analysis with the added 25-year-storm diversion flow to the existing system, it can be determined whether the existing system has sufficient capacity to handle the additional flow or if the pipe and receiving structures will need to be modified or upsized. The calculated runoff for each basin is added to the storm system at each receiving point or structure and capacity calculations are performed in order to determine if a deficiency exists.

It should be noted that some surcharging of the system may occur and can be allowed, provided there is sufficient freeboard at the lowest structure to avoid overflowing. ODOT generally allows a minimum of 12 inches of freeboard in a surcharged system when conveying design storm flows. In order to determine the elevation at which water will rise in a surcharged system, a separate hydraulic grade line (HGL) analysis must be performed. In order to determine the hydraulic grade line, the elevation of the crown of the pipe at the outfall must be known or assumed. When the system is full, water leaving the end of the outfall is assumed to be at the crown. Pipe head losses are calculated using Manning's Equation; these, along with minor losses due to structures and fittings, are added back into the system going upstream from the outfall to create the energy grade line (EGL) for the system. The hydraulic grade line can be found by subtracting the velocity head at any point from the energy grade line. Hydraulic grade lines for the entire study area system were prepared for this addendum and are presented in Appendix C.

A brief summary of findings for each receiving pipe system is provided below:

11th Street Storm System: The existing storm drain system consists of 18-inch culverts and piping on the south side of 11th Street. Diverted flow will enter this part of the system first. Basin 1 (the proposed diversion basin) and Basins 2, 3, 4 and 5 all flow to this part of the storm drain system. Table 6.3.1 provides the analysis results for this part of the system.

TABLE 6.3.1
EXISTING 11TH STREET STORM DRAIN SYSTEM WITH DIVERSION FLOW
25-YEAR STORM FLOWS

	Flow from Basin 1	Added flow from Basin 2	Added flow from Basin 3	Added flow from Basin 4	Added flow from Basin 5
Basin area (acres)	92	3.4	0.66	2	1
T_c (min)	150	22	10	10	10
C	0.3	0.5	0.9	0.5	0.5
I (in/hr)	0.67	1.95	2.75	2.75	2.75
Q section	18.49	3.32	1.63	2.75	1.38
Q cumulative	18.49	21.81	23.44	26.19	27.57

Pipe dia. (in)	18	18	18
Slope (ft/ft)	0.0064	0.0225	0.0100
Pipe Capacity (cfs)	8.43	15.80	10.53
Pipe excess capacity (cfs)	-15.01	-10.39	-17.03

The negative excess pipe capacities shown in Table 6.3.1 indicate a surcharged condition in this section of the storm drain system with the added diversion flows. Subsequent hydraulic grade line analysis indicates that the water level would be well above the rim elevations of existing structures; therefore, this section of the storm drain system would require upgrades to handle the additional diversion flows.

Ditch and Culvert Section: After leaving the 11th Street storm drain system, storm water flows to the ditch and culvert system bordered by 10th Street to the north, 11th Street to the south, Elmira Avenue to the east and Baltimore Avenue to the west. In addition to the flows coming from the upstream system, this part of the storm drain picks up flows from Basins 6 and 7.

Table 6.3.2 provides the analysis results for this part of the system. Culvert excess capacities were based on the maximum flow after the addition of runoff from Basin 7 (35.09 cfs). Culvert numbering is in the direction of flow, from upstream to downstream; thus Culvert No. 1 is the first culvert in the section.

TABLE 6.3.2
EXISTING DITCH AND CULVERT SECTION WITH DIVERSION FLOW
25-YEAR STORM FLOWS

	Incoming flow from upstream system	Added flow from Basin 6	Added flow from Basin 7
Basin area (acres)	-	0.48	7.3
T_c (min)	-	10.00	15.00
C	-	0.5	0.4
I (in/hr)	-	2.75	2.35
Q Section (cfs)	-	0.66	6.86
Q cumulative (cfs)	27.57	28.23	35.09

CULVERT CAPACITIES

	Culvert #1	Culvert #2	Culvert #3	Culvert #4
Pipe dia. (in)	24	24	36	24
Slope (ft/ft)	0.0092	0.0133	0.0314	0.0266
Pipe Capacity (cfs)	21.76	26.16	118.51	37.00
Pipe excess capacity (cfs)	-13.33	-8.93	83.42	1.91

Two of the existing culverts, Culvert Nos. 1 and 2, have negative excess capacities and will require up-sizing to avoid surcharging this section of the storm drain system. Surcharging in this section is not desirable due to the potential for water to back up into the ditches and possibly overflow. The remaining culverts have the capacity to handle the added diversion flow, provided they are kept clean. Other work recommended for this section consists of ditch cleaning and jet cleaning the culverts as part of general system maintenance.

An open channel flow calculation was performed on a typical ditch cross section between Culvert Nos. 1 and 2. The analysis showed that at the expected design flows for the 25-year storm, the water depth in the ditches would be about 18 inches, which allows sufficient freeboard to avoid overtopping the bank. The calculations are included in Appendix C.

Storm Drain at the Intersection of 10th Street and Baltimore Avenue: Storm water leaving the ditch and culvert section enters the piped storm drain at the southeast corner of the intersection of 10th Street and Baltimore Avenue. This section of storm drain consists of about 107 feet of 36-inch pipe from the outfall in the gully to the first upstream manhole, and about

200 additional feet of 24-inch pipe with two more manholes in the run prior to the inlet at the ditch and culvert section. In addition to the flow from the ditch and culverts section, this part of the storm drain system picks up additional flow from Drainage Basins 8, 9 and 10. The final 36-inch storm drain pipe in this section delivers 52.17 cfs of the 25-year storm to the gully area. The storm drain is installed deep with inverts between 14 feet and 18 feet below grade. Table 6.3.3 provides the analysis results for this part of the system.

TABLE 6.3.3
EXISTING STORM DRAIN AT INTERSECTION OF 10TH STREET AND BALTIMORE AVENUE
25-YEAR STORM FLOWS

	Incoming flow from upstream system	Added flow from Basin 8	Added flow from Basin 9	Added flow from Basin 10
Basin area (acres)	-	22	1.2	2.7
T_c (min)	-	71.00	10.00	10.00
C	-	0.5	0.5	0.7
I (in/hr)	-	0.93	2.75	2.75
Q Section (cfs)	-	10.2300	1.6500	5.1975
Q cumulative (cfs)	35.09	45.32	47.00	52.17

PIPE CAPACITIES

Pipe dia. (in)	24	24	24	36
Slope (ft/ft)	0.0192	0.0469	0.0072	0.0336
Pipe Capacity (cfs)	31.43	49.12	19.25	122.59
Pipe excess capacity (cfs)	-3.66	3.80	-27.75	70.42

The negative excess pipe capacity shown for the first and third pipes in the system indicates a surcharged condition. However, the HGL analysis for this section shows that, due to the depth of the storm drain, there is sufficient freeboard within the piped system to allow surcharging at 25-year design storm flows. It should be noted that the surcharging may cause storm water to back up into the upstream ditch at the southeast corner of 10th Street and Baltimore Avenue. The HGL analysis indicates water levels in the ditch could reach 59 feet at design storm flows. This theoretical water level elevation is approximately 6 feet below the top of bank elevation for the ditch. However, larger storm events have the potential to overtop the ditch bank. In addition, there is an existing structure at the southeast corner of 10th Street and Baltimore Avenue located very close to the south bank of the ditch. Field measurements on the foundation show that the base of the footing is at an elevation of approximately 59 feet, which is the same elevation as the theoretical 25-year high water mark for the ditch. Larger storm events may put this structure at risk if erosion occurs around the foundation footing.

Because of the conservative approach to the analysis, the system can be assumed to have the ability to transport 25-year storm runoff flows with the added diversion flow, therefore, there are no storm drain system improvements planned as part of the diversion project for this section of the system other than ditch cleaning and maintenance of the inlet structure. However, the system should be deemed to be at capacity. Future upstream development that may cause the addition of more runoff to the system will likely have to address improvements to this section of the storm drain system or detain runoff.

The Gully Section: The gully section is a densely overgrown depressed area with steep sides. The gully depth near the outlet end is about 20 feet. The size of the area provides ample excess storage capacity for design storm runoff flows. Drainage Basin 11 consists of the gully area and some of the surroundings areas around the top edge of the gully. Basin 11 adds approximately 8.1 cfs to the runoff flow within the gully. The 25-year storm flow rate leaving the gully at the north end and entering the lower 36-inch storm drain system is about 60.3 cfs.

Existing 36-inch Storm Drain System to Outfall: Storm water leaving the gully area enters the final 36-inch piped storm drain section prior to the outfall in the boat basin. This part of the storm system receives flow from the gully and picks up additional flow from Drainage Basins 12, 13 and 14. These basins contain commercial areas along and near Highway 101 and in the Old Town areas around Chicago Avenue. Because the basins have a large percentage of impervious surface, storm water loading from these basins is relatively high. Table 6.3.4 provides the analysis results for this part of the system.

TABLE 6.3.4
EXISTING 36-INCH STORM DRAIN SYSTEM TO OUTFALL
25-YEAR STORM FLOWS

	Incoming flow from upstream system	Added flow from Basin 12	Added flow from Basin 13	Added flow from Basin 14
Basin area (acres)	-	10.1	3	2.1
T_c (min)	-	18.00	10.00	10.00
C	-	0.8	0.65	0.8
I (in/hr)	-	2.15	2.75	2.75
Q Section (cfs)	-	17.3720	5.3625	4.6200
Q cumulative (cfs)	60.27	77.64	83.00	87.62

PIPE CAPACITIES

Pipe dia. (in)	36	36	36	36	36
Slope (ft/ft)	0.0078	0.0156	0.0325	0.0126	-0.0305
Pipe Capacity (cfs)	59.0650	83.5305	120.5659	75.0703	< 0.00
Pipe excess capacity (cfs)	-1.20	5.89	42.93	-7.93	<< 0.00

The negative excess capacities shown in Table 6.3.4 indicate a surcharged condition in two of the upstream pipes. Note that the last section of pipe prior to the outfall flows uphill at 3.05%. This adds approximately 1.7 feet to the HGL for this section of the storm drain system. This can be compensated for by adding 1.7 feet to the starting water level in the HGL analysis. HGL analysis of the system shows a minimum freeboard of 0.8 feet at the second manhole upstream of the outfall, which is slightly less than the ODOT recommended minimum of one foot. Because of the conservative analysis approach, the system can be considered functional with the additional flow and no system upgrades are required. However, any future upstream development that may cause the addition of more runoff to the system will likely have to address improvements to this section of the storm drain system or detain runoff.

Section 7

Recommended Storm Water Improvements

Section 7

Recommended Storm Water Improvements

7.1 Proposed Storm Drain Improvements

The proposed improvements to the existing storm drain system to accommodate the additional flow from diverting Basin 1 runoff consists of one project. Most of the storm drain improvements for the project are located on 11th Street; therefore, the project will be referred to as the *11Th Street Storm Drain Improvements Project*. See Figure 6 in Appendix A. Starting at the inlet located at the end of the ditch at the southeast corner of the intersection of Rosa Road and 11th Street, a new winged inlet structure would be installed along with new 30-inch storm drain pipe diverting flow to the west along the south side of 11th Street. The new pipe would intercept the existing system, and the existing system would be enlarged from 18-inch to 30-inch pipe. The new system will require the installation of five manholes. The manholes will have an inside diameter of 60 inches to accommodate the new 30-inch storm drain. The new system will more or less follow the same alignment as the existing system and will cross 11th Street between Elmira Avenue and Delaware Avenue. The new 30-inch storm drain will outfall at the same location as the existing system at the ditch and culvert section located north of 11th Street. In addition to the work done in 11th Street, the first two culverts in the ditch and culvert system bounded by 10th Street to the north, 11th Street to the south, Baltimore Avenue to the west and Elmira Avenue to the east will be upsized from 24 inches to 30 inches.

The project is expected to be the responsibility of the City of Bandon with respect to capital improvements.

7.2 Recommended Future Storm Drain Improvements

Diverting flow westward on 11th Street will add runoff loading to the affected existing facilities. The flow diversion will also decrease runoff loading in the storm system that continues northward on Fillmore Avenue and on the remaining portion of Project 6A.1 east of Fillmore Avenue/Rosa Road as originally shown in the *Storm Water Master Plan*. In Addition to the proposed diversion project, the following storm system improvements are recommended in the near future. See Figure 3 in Appendix A.

Revision to the Remaining Portion of Project 6A.1, 6A.3 & 6C.1 East of Fillmore Avenue

The areas east of the intersection of Fillmore Avenue and 11th Street will still require storm drainage improvements. However, because approximately 19 cfs will diverted westward, two of the pipe sections in 11th Street can be downsized from 36-inch to 18-inch and 24-inch. The remaining portions of Projects 6A.1, 6A.3 and 6C.1 to the east of Fillmore Avenue should remain unchanged to allow for extra capacity if needed.

Storm Drain Improvements at 10th Street and Baltimore Avenue

With the addition of the diverted flow the existing 24-inch storm drain in the intersection of 10th Street and Baltimore Avenue is at or near capacity. It is recommended that the 24-inch pipe in this section of the storm drain system be replaced with 36-inch pipe to accommodate future increased loading and to prevent potential overflow of the ditches upstream. This system is very deep at 14 to 18 feet below grade, therefore, excavation will be expensive and it is likely that a good portion of the intersection will have to be demolished and replaced.

Adding an Overflow Baffle to the Existing Manhole at Fillmore Avenue and 4th Street

The existing large storm drain manhole at the intersection of Fillmore Avenue and 4th Street is part of the 48-inch storm drain system that runs northward on the east side of Fillmore Avenue. The 48-inch pipe turns eastward at this manhole and continues down 4th Street to eventually outfall in Ferry Creek near 3rd Street and Grand Avenue.

In addition to the 48-inch outlet pipe in this manhole, there is an 18-inch outlet to the north that continues northward on Fillmore Avenue. The invert of the 18-inch pipe is installed at near the same invert elevation of the 48-inch pipe and appears to have been installed to divert some of the flow away from the 48-inch system. 24-inch storm drainage for the Woolen Mill Phase 1 - Stage 2 project has been constructed in 3rd Street and flows to the west to connect with the existing 18-inch pipe on Fillmore Avenue. As the system is currently constructed, the 18-inch pipe may be at or near capacity when there is a large storm event and the upstream 48-inch system is flowing at half capacity. This creates a potential surcharged condition, especially when flow from 3rd Street hits the 18-inch system.

As part of overall upgrades for this part of the Bandon storm drain system, it is recommended that a concrete baffle be installed in the existing manhole at Fillmore Avenue and 4th Street to prevent flow in the 18-inch pipe except in the case of a very large storm event that would cause the 48-inch system to become surcharged. The top of the baffle would be set at the crown elevation of the 48-inch pipe. Water would only enter the 18-inch pipe when it overflows over the baffle wall.

This project could be done concurrently with the next recommended future project.

Upsizing and Straightening the Storm Drain Crossing at Highway 101 and Fillmore Avenue

This project was originally included as part of the Woolen Mill Phase 1 – Stage 2 project.

Currently the 18-inch storm drain in Fillmore continues past 3rd Street to the intersection of Highway 1010 and Fillmore Avenue. The pipe crosses Highway 101 at angle to the north east and connects to a catch basin on the north side of Highway 101. Flow leaves the catch basin at an acute angle of less than 90 degrees and enters the newer 24-inch storm system that continues northward on Fillmore Avenue toward the outfall at the 1st Street/Riverside Drive Bridge over Ferry Creek.

The small size and gentle slope of the 18-inch pipe, along with the sharp angle through the catch basin on the north side of Highway 101, create large head losses in the system. Future development on the south side of 3rd Street will likely utilize this storm drainage and will almost certainly cause surcharging and system overflow conditions.

The recommended future project, would be to up size the storm drain from 18-inch to 24-inch downstream from the Fillmore Avenue and 3rd Street manhole. In addition, the project should straighten the system and eliminate the head losses due to the acute angle of flow at the catch basin on Highway 101.

7.3 Basis of Cost Estimates

The magnitude cost estimate for the project has three components: construction costs, engineering costs and legal and administrative costs. The cost estimate is preliminary in nature and is based on previous project cost information from similar projects in Bandon at the time of the writing of this addendum. Actual project costs may differ from what is shown here.

Construction Cost

The construction costs for this project are based on current averages of actual bidding results from similar work. Future changes in the cost of labor, equipment, and materials will require that these costs be updated if construction is delayed.

Construction costs are broken out into two portions: Project elements completed by the City; and project elements completed by Contractor. The City will be replacing one of the culverts north of 11th Street and doing ditch and culvert maintenance on an in-house basis.

A contingency factor of 10 percent of the contracted construction cost was added to the total project cost. Contingency costs are included because allowances must be made for variations in final quantities, bidding market conditions, adverse construction conditions, and other difficulties which cannot be fully known prior to project construction.

Engineering Cost

The cost of engineering services for projects typically include special investigations, a pre-design report, surveying, geotechnical exploration, preparation of contract drawings and specifications, bidding services, construction management, inspection, construction staking, start-up services, and the preparation of operation and maintenance manuals. Depending on the size and type of project, engineering costs may range from 15 to 25 percent of the contract cost when all of the above services are provided. The lower percentage applies to large projects without complicated mechanical systems. The higher percentage applies to small, complicated projects. The engineering costs for design and construction used in this study average 16.5 percent of the construction cost.

Environmental Review and Permits

Replacing the culverts in the ditch and culvert section of the system will require a joint permit application to the U.S. Army Corps of Engineers (USACE) and the Oregon Department of State Lands (DSL). In addition, the Oregon Department of Fish and Wildlife (ODFW) will likely review the site to determine if the ditches are being used by fish species and may require fish passage designs for the culverts.

Because the plan for replacement of the culverts can be considered as system maintenance and the project plan does not call for any placement of fill in the ditch flow channels, it is likely that the project will be exempt from a Joint USACE/DSL permit. In addition, there is no evidence that any fish species has currently or historically used the ditches in the project area; therefore, it is unlikely that special fish passage design requirements will be needed for the new culverts.

Legal and Administrative Cost

An allowance of $5,000 was added for legal and administrative services for the project. This allowance is intended to include internal project planning, defining easements, public notification and budgeting.

Property Acquisition Cost

Costs for property acquisition and easements were not included in the cost estimates. It may be necessary to purchase easements or properties in order to accommodate these projects.

7.4 Cost Estimate for the 11th Street Storm Water Improvements Project

Tables 7.4.1 and 7.4.2 provide cost estimates for the various elements included for completion of the 11th Street Storm Water Improvements Project. The City has stated that the Bandon Public Works Department will perform some of construction tasks for this project, specifically ditch cleaning and maintenance, and replacement of the first culvert in the ditch and culvert system that crosses the unpaved portion of Delaware Avenue north of 11th Street. Table 7.4.1 shows the estimated costs for the portion of the project that the City will construct. Table 7.4.2 provides estimated costs for the portion of the project to be completed by a contractor. Engineering and surveying costs represent 18% of the construction costs and contingency costs represent 15% of the construction and engineering costs. Costs may be rounded slightly up or down.

TABLE 7.4.1
PROJECT ELEMENTS COMPLETED BY THE CITY

No.	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Item Cost*
1	Cleaning and brushing existing ditches	1	EA	$3,500	$3,500
2	Jetting, cleaning and repair of existing culverts	1	EA	$4,500	$4,500
3	30" HDPE culvert installed	62	LF	$50	$3,100
4	Easement and legal costs	1	EA	$5,000	$5,000
	Items Completed by the City	**Subtotal**			**$16,100**

TABLE 7.4.2
PROJECT ELEMENTS COMPLETED BY CONTRACTOR

CULVERT REPLACEMENT					
No.	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Item Cost*
1	Construction Facilities and Temporary Controls	1	LS	$7,500	$7,500
2	Demo/Remove Existing Culvert	105	LF	$25	$2,625
3	30" HDPE Culvert Installed	105	LF	$175	$18,375
4	Landscaping Reseeding of Disturbed Areas	1	LS	$3,500	$3,500
	Culvert Replacement	**Subtotal**			**$32,000**

TABLE 7.4.2 Continued

11th Street Storm Drain Improvements					
No.	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Item Cost*
1	Construction Facilities and Temporary Controls	1	EA	$7,500	$7,500
2	Demolition and Site Prep	1	EA	$10,000	$10,000
3	30" Storm Drain Pipe HDPE (Class C Backfill) In AC Pavement Areas	195	LF	$150	$29,250
4	30" Storm Drain Pipe HDPE (Class C Backfill) In PCC Areas	45	LF	$225	$10,125
5	30" Storm Drain Pipe HDPE (Class B Backfill) Outside Paved Areas	290	LF	$120	$34,800
6	Repair Existing French Drain	1	LS	$2,500	$2,500
7	Concrete Saddle at Water Main Crossing	1	LS	$1,500	$1,500
8	60" Storm Manhole	5	EA	$6,000	$30,000
9	30" Storm Riser Catch Basin	1	EA	$2,500	$2,500
10	30" ADS Flared End Sections	2	EA	$1,500	$3,000
11	Sidewalk Replacement	100	SF	$50	$5,000
12	Concrete Curb and Gutter Replacement	35	LF	$60	$2,100
13	Landscaping Reseeding of Disturbed Areas	1	EA	$3,500	$3,500
14	Traffic Control	1	LS	$5,000	$5,000

11th Street Construction Subtotal	**$146,775**
Total Contracted Construction Costs	**$178,775**
Total City Construction Costs	**$16,100**
Engineering Services (18% of Contracted Construction Cost)	**$32,000**
Contingency (15% of Contracted Construction Cost)	**$27,000**
Estimated Project Total Cost	**$253,875**

7.5 Cost Estimates for the Recommended Future Projects

Tables 7.5.1 through 7.5.4 provide cost estimates for the recommended future projects. Costs for the revised projects were taken from the Storm Water Master Plan with an applied inflation rate of 2.0% per year and then rounded. Engineering and surveying costs represent 18% of the construction costs and contingency costs represent 15% of the construction and engineering costs.

TABLE 7.5.1
REVISION TO THE REMAINING PORTION OF
PROJECT 6A.1, 6A.3 AND 6C.1 EAST OF FILLMORE AVENUE

Item No.	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Item Cost*
1	Construction Facilities and Temporary Controls	1	LS	$59,000	$59,000
2	Demolition and Site Prep	1	LS	$41,000	$41,000
3	Catch Basins	7	EA	$1,000	$7,000
4	72" Storm Manhole	7	EA	$6,000	$42,000
5	48" Storm Manhole	2	EA	$3,500	$7,000
6	12" Storm Drain	160	LF	$45	$7,200
7	18" Storm Drain	260	LF	$50	$13,000
8	24" Storm Drain	540	LF	$70	$37,800
9	36" Storm Drain	1410	LF	$90	$126,900
10	Outlet Structure	1	EA	$7,600	$7,600
11	Utility Adjustments	1	LS	$9,000	$9,000
12	AC Patch	1000	LF	$40	$40,000
13	Gravel Surface Replacement	700	LF	$10	$7,000
14	Rip Rap	100	CY	$60	$6,000
15	Slope Anchors	7	EA	$2,100	$14,700
16	Aggregate Base	800	CY	$35	$28,000
17	Foundation Stabilization	200	CY	$50	$10,000
18	Ditch Excavation	1000	LF	$10	$10,000
	Construction Subtotal				**$473,200**
	Engineering/Surveying				**$85,000**
	Contingency				**$70,000**
	Revised Project 6A.1 Total				**$628,200**

Project 6A.3 Total (From Master Plan with 2% Annual Inflation Rate Applied)

$100,000

Project 6C.1 Total (From Master Plan with 2% Annual Inflation Rate Applied)

$182,000

TABLE 7.5.2
STORM DRAIN IMPROVEMENTS AT 10th STREET AND BALTIMORE AVENUE

Item No.	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Item Cost*
1	Construction Facilities and Temporary Controls	1	EA	$10,000.00	$10,000
2	Demolition and Site Prep	1	EA	$15,000.00	$15,000
3	36" Storm Drain Pipe HDPE Includes AC Pavement Replacement and Aggregate Base	210	LF	$250.00	$52,500
4	72" Storm Manhole includes Aggregate Base	3	EA	$10,000.00	$30,000
5	Incidental Sidewalk Replacement	1000	SF	$25.00	$25,000
6	Incidental Concrete Curb and Gutter Replacement	160	LF	$25.00	$4,000
	Foundation Stabilization	50	CY	$50.00	$2,500
7	Landscaping Reseeding of Disturbed Areas	1	EA	$5,000.00	$5,000
8	Traffic Control	1	LS	$7,500.00	$7,500
	Construction Subtotal				**$151,500**
	Engineering/Surveying				**$27,270**
	Contingency				**$26,816**
	Project Total				**$205,586**

TABLE 7.5.3
ADDING AN OVERFLOW BAFFLE TO THE EXISTING MANHOLE
AT FILLMORE AVENUE AND 4th STREET

Item No.	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Item Cost*
1	Construction Facilities and Temporary Controls	1	EA	$5,000	$5,000
3	Concrete Baffle	1	EA	$8,500	$8,500
5	Incidental AC Replacement	500	SF	$20	$10,000
8	Traffic Control	1	LS	$5,000	$5,000
	Construction Subtotal				**$28,500**
	Engineering/Surveying				**$6,000**
	Contingency				**$5,000**
	Project Total				**$39,500**

TABLE 7.5.4
UPSIZING AND STRAIGHTENING THE STORM DRAIN CROSSING AT HIGHWAY 101 AND FILLMORE AVENUE

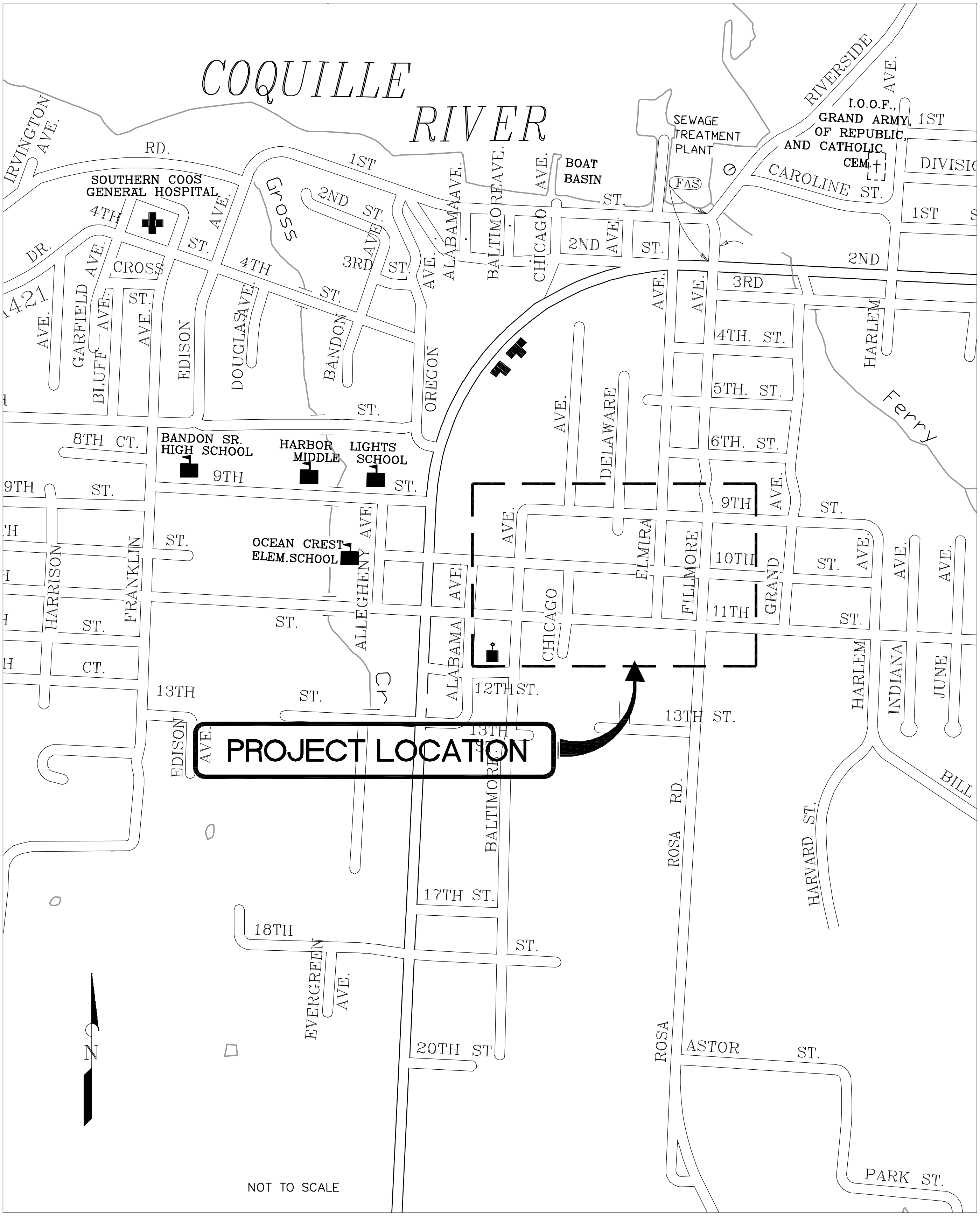
Item No.	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Item Cost*
1	Construction Facilities And Temporary Controls	1	LS	$30,000	$30,000
2	Demolition and Site Prep	1	LS	$10,000	$10,000
3	Foundation Stabilization	50	CY	$50	$2,500
4	Sheet Pile Shoring	1	LS	$25,000	$25,000
5	De-watering and Sediment Control	1	LS	$5,000	$5,000
6	Traffic Control	1	LS	$50,000	$50,000
7	Temporary Trench Plating	1	LS	$7,500	$7,500
8	AC Pavement - 8" thickness	1000	SF	$25	$25,000
9	AC Pavement - inlay overlay	1200	SF	$15	$18,000
10	24" Storm Drain Pipe HDPE (Class G Backfill)	75	LF	$125	$9,375
11	24" Storm Drain Pipe HDPE (Class C Backfill)	140	LF	$100	$14,000
12	18" Storm Drain Pipe HDPE (Class G Backfill)	65	LF	$100	$6,500
13	12' Storm Drain Pipe HDPE (Class G Backfill)	20	LF	$90	$1,800
14	24" x 12" Storm Drain Tee	1	EA	$750	$750
15	18" x 12" Storm Drain Tee	1	EA	$500	$500
16	Catch Basins	2	EA	$1,500	$3,000
17	10" PVC Waterline (installed)	20	LF	$200	$4,000
18	Abandon 18" & 12" Pipes In Place with Slurry	1	LS	$5,000	$5,000
19	Concrete Sidewalk ADA Ramps - R & R	2000	SF	$15	$30,000
20	Concrete Curb and Gutter - R & R	180	LF	$25	$4,500
21	Traffic Loop R & R	1	LS	$5,000	$5,000
22	Thermoplastic Pavement Markings / Stop Bars	80	LF	$15	$1,200
	Construction Subtotal				**$258,625**
	Engineering/Surveying				**$43,000**
	Contingency				**$36,000**
	Project Total				**$337,625**

Appendices

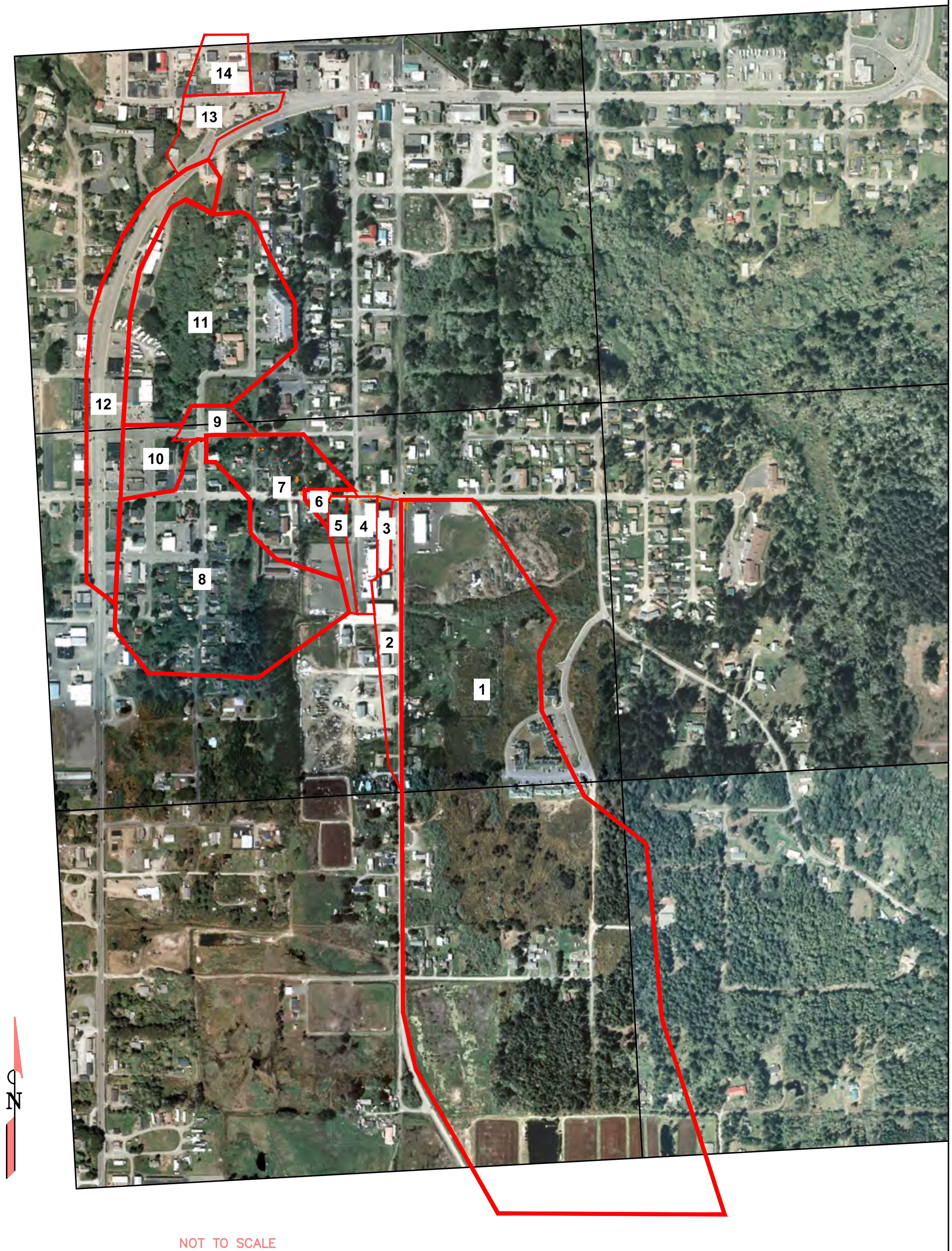
APPENDIX

A

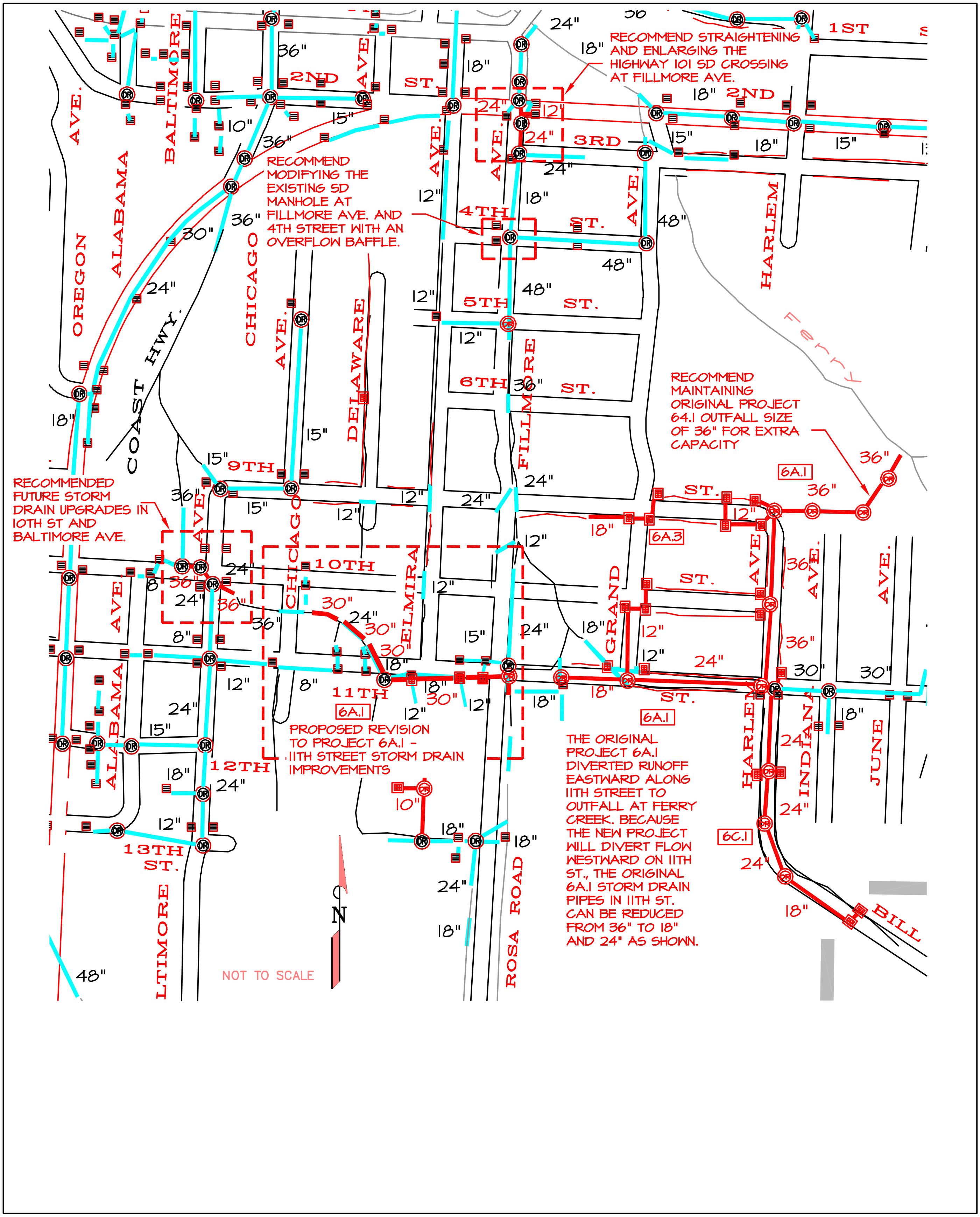
Figures



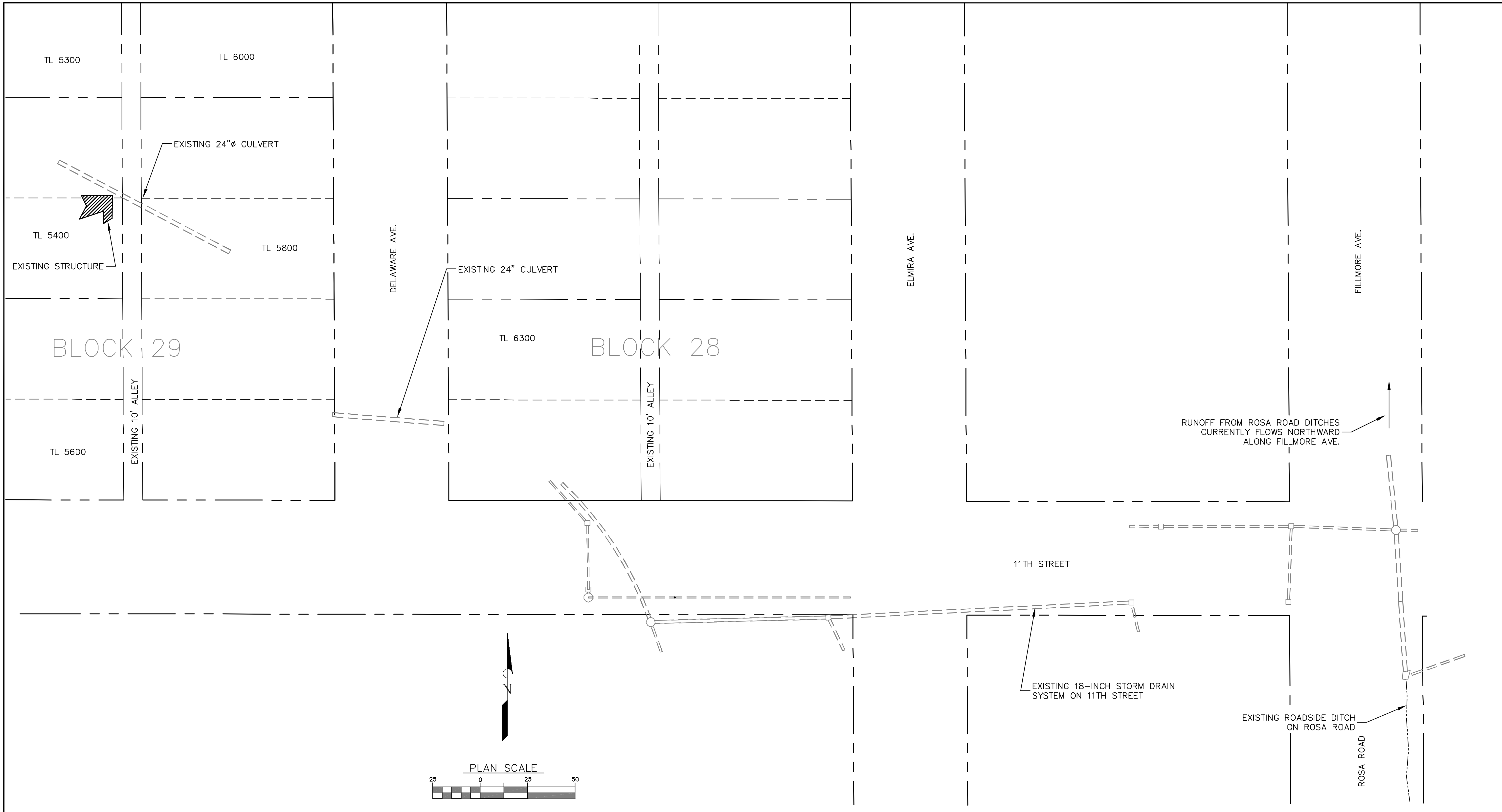
THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	***CITY OF BANDON*** ***STORM WATER MASTER PLAN ADDENDUM 2***	FIGURE NO.
DATE: AUGUST 2014 PROJECT NO.: 101.85	***VICINITY MAP***	**1**



THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	***CITY OF BANDON*** ***STORM WATER MASTER PLAN ADDENDUM 2***	FIGURE NO. ***2***
DATE: AUGUST 2014 PROJECT NO.: 101.85	***RUNOFF BASIN MAP***	



THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	***CITY OF BANDON*** ***STORM WATER MASTER PLAN ADDENDUM 2***	FIGURE NO.
DATE: AUGUST 2014	***REVISED PROJECT 6A.1 & RECOMMENDED FUTURE PROJECTS***	***3***
PROJECT NO.: 101.85		



SUBMITTED BY:	REVISIONS					DESIGNED:
DATE:	REVISED	DESCRIPTION	SUBMIT.	APPR'D.	DATE	DRAWN:
APPROVED BY:						CHECKED:
DATE:						APPROVED:

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS, INC.
1330 TEAKWOOD AVENUE
COOS BAY, OREGON 97420
TELEPHONE: (541) 269-0732
www.dyerpart.com

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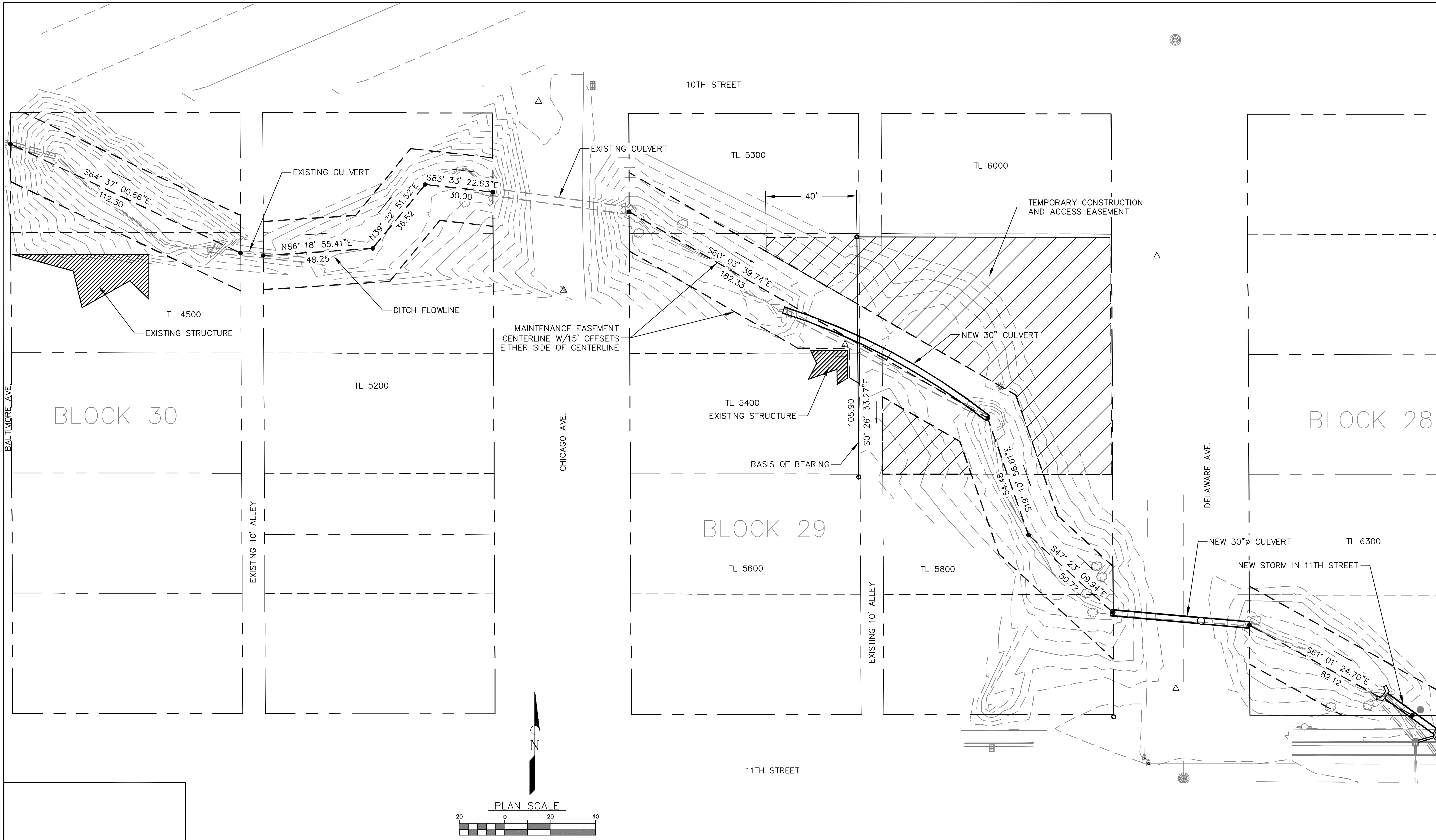
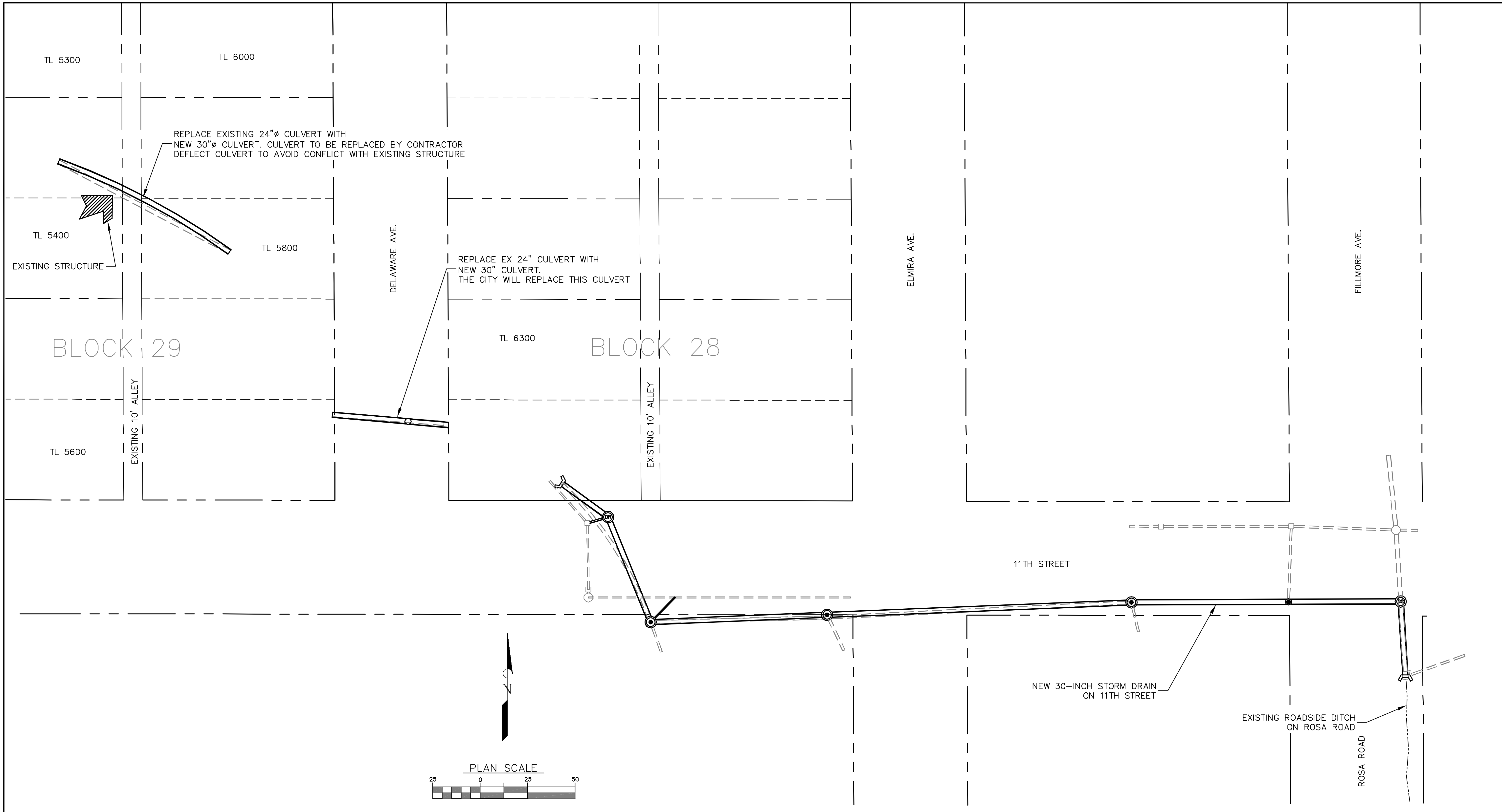
CITY OF BANDON
STORM WATER MASTER PLAN ADDENDUM NO.2

11TH STREET STORM DRAIN IMPROVEMENTS
EXISTING STORM DRAIN SYSTEM TO BE REVISED

PROJECT NO.	DRAWING NO.
101.85	FIG 4
DATE	SHEET NO.
AUG 2014	1 OF 1



SUBMITTED BY: ____________ DATE: ______	REVISIONS	DESIGNED: MKF	**THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.** 1330 TEAKWOOD AVENUE COOS BAY, OREGON 97420 TELEPHONE: (541) 269-0732 www.dyerpart.com	CITY OF BANDON	PROJECT NO.	DRAWING NO.	
	REVISED | DESCRIPTION | SUBMIT. | APPR'D. | DATE	DRAWN: MKF		STORM WATER MASTER PLAN ADDENDUM NO. 2	101.85	FIG - 5	
APPROVED BY: ____________ DATE: ______		CHECKED: SBM	LINE IS 1 INCH AT FULL SCALE IF NOT 1-INCH - SCALE ACCORDINGLY	11TH STREET STORM DRAIN IMPROVEMENTS	DATE	SHEET NO.	
		APPROVED: SBM		EASEMENT MAP	AUG 2014	1 OF 1	



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APPROVED BY:		DATE:

REVISIONS

REVISED	DESCRIPTION	SUBMIT.	APPR'D.	DATE

DESIGNED:
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CHECKED:
APPROVED:

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CITY OF BANDON
STORM WATER MASTER PLAN ADDENDUM
11TH STREET STORM WATER IMPROVEMENTS PROPOSED PROJECT

PROJECT NO.	DRAWING NO.
101.85	FIG 6
DATE	SHEET NO.
AUG 2014	1 OF 1

APPENDIX

B

Proposed Project Area Photos

APPENDIX

C

NRCS Soils Report

Calculations

United States Department of Agriculture

NRCS

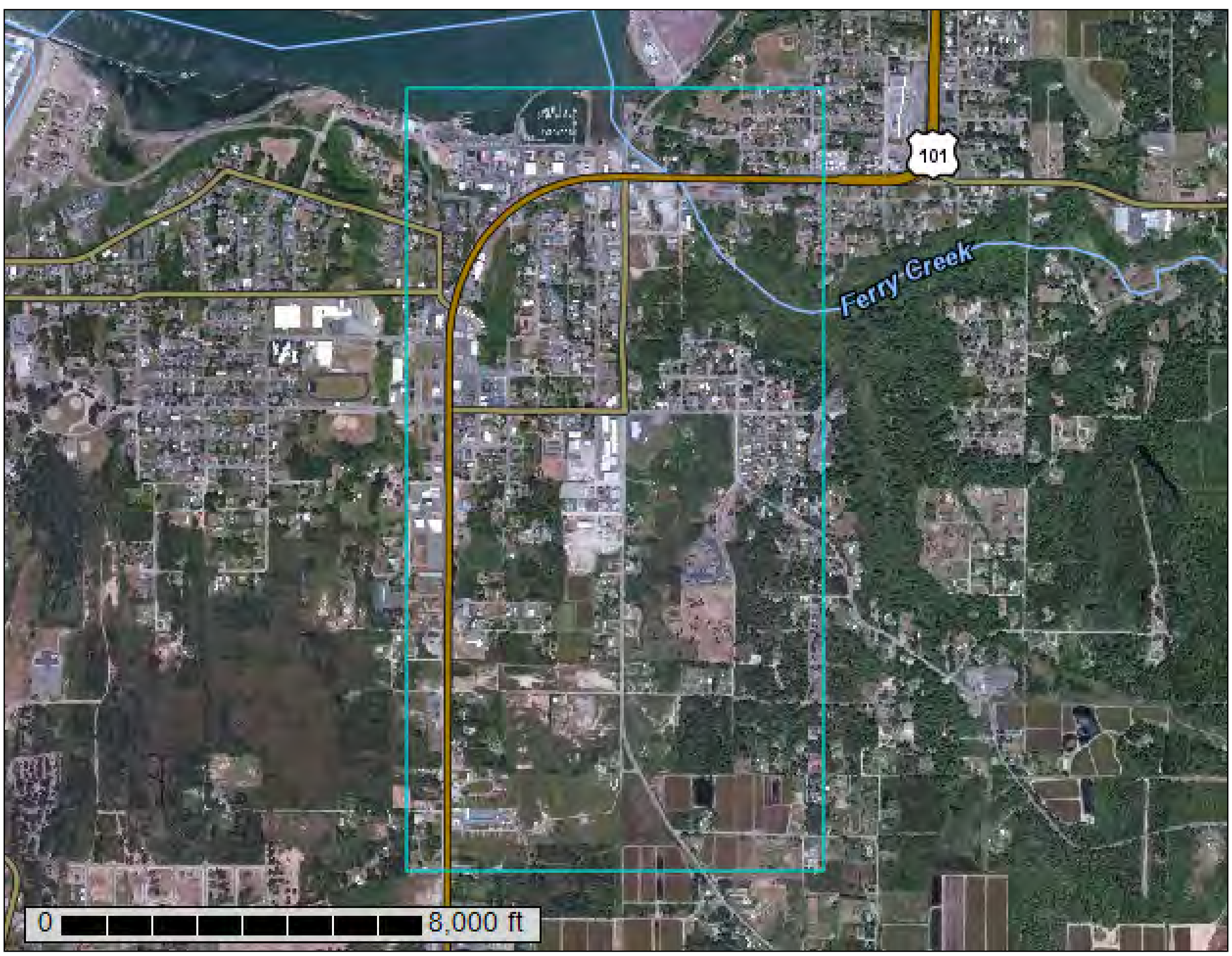
Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Coos County, Oregon

Rosa Road Storm Water Diversion



May 30, 2014

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

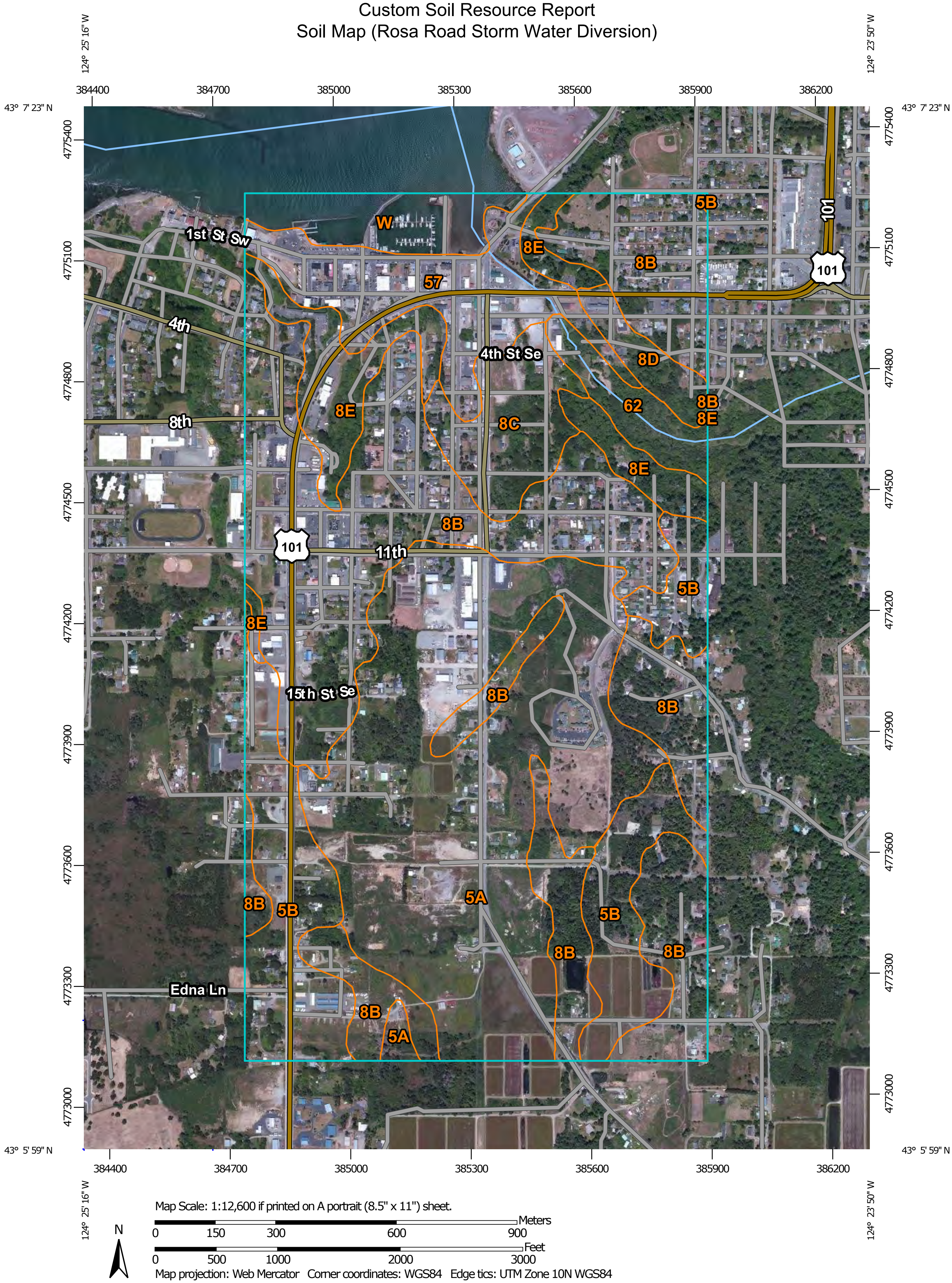
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map (Rosa Road Storm Water Diversion)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Coos County, Oregon
Survey Area Data: Version 8, Dec 4, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 6, 2010—Jul 13, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (Rosa Road Storm Water Diversion)

Coos County, Oregon (OR011)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
5A	Blacklock fine sandy loam, 0 to 3 percent slopes	173.1	28.1%
5B	Blacklock fine sandy loam, 3 to 7 percent slopes	76.1	12.4%
8B	Bullards sandy loam, 0 to 7 percent slopes	217.3	35.3%
8C	Bullards sandy loam, 7 to 12 percent slopes	26.1	4.2%
8D	Bullards sandy loam, 12 to 30 percent slopes	9.4	1.5%
8E	Bullards sandy loam, 30 to 50 percent slopes	36.7	6.0%
57	Udorthents, level	43.6	7.1%
62	Willanch fine sandy loam	13.0	2.1%
W	Water	20.0	3.2%
Totals for Area of Interest		**615.2**	**100.0%**

Map Unit Descriptions (Rosa Road Storm Water Diversion)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Coos County, Oregon

5A—Blacklock fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

Elevation: 30 to 350 feet
Mean annual precipitation: 55 to 75 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 200 to 240 days

Map Unit Composition

Blacklock and similar soils: 75 percent
Minor components: 8 percent

Description of Blacklock

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

Oi - 0 to 1 inches: very strongly acid, slightly decomposed plant material
H1 - 1 to 4 inches: very strongly acid, fine sandy loam
H2 - 4 to 16 inches: very strongly acid, loamy fine sand
H3 - 16 to 53 inches: , cemented
H4 - 53 to 76 inches: slightly acid, sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 12 to 20 inches to ortstein
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Farmland classification: Farmland of unique importance
Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: C/D

Minor Components

Blacklock, clayey substratum

Percent of map unit: 8 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

5B—Blacklock fine sandy loam, 3 to 7 percent slopes

Map Unit Setting

Elevation: 0 to 350 feet
Mean annual precipitation: 50 to 75 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 200 to 240 days

Map Unit Composition

Blacklock and similar soils: 75 percent
Minor components: 8 percent

Description of Blacklock

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

Oi - 0 to 1 inches: very strongly acid, slightly decomposed plant material
H1 - 1 to 4 inches: very strongly acid, fine sandy loam
H2 - 4 to 16 inches: very strongly acid, loamy fine sand
H3 - 16 to 53 inches: , cemented
H4 - 53 to 76 inches: slightly acid, sand

Properties and qualities

Slope: 3 to 7 percent
Depth to restrictive feature: 12 to 20 inches to ortstein
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Farmland classification: Farmland of unique importance
Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: C/D

Minor Components

Heceta

Percent of map unit: 8 percent
Landform: Deflation basins on dunes

Down-slope shape: Linear
Across-slope shape: Linear

8B—Bullards sandy loam, 0 to 7 percent slopes

Map Unit Setting

Elevation: 30 to 600 feet
Mean annual precipitation: 55 to 75 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 200 to 240 days

Map Unit Composition

Bullards and similar soils: 75 percent
Minor components: 9 percent

Description of Bullards

Setting

Landform: Marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed eolian and marine deposits

Typical profile

Oi - 0 to 3 inches: very strongly acid, slightly decomposed plant material
H1 - 3 to 10 inches: very strongly acid, sandy loam
H2 - 10 to 44 inches: very strongly acid, gravelly sandy loam
H3 - 44 to 63 inches: moderately acid, sand

Properties and qualities

Slope: 0 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B

Minor Components

Blacklock

Percent of map unit: 9 percent

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

8C—Bullards sandy loam, 7 to 12 percent slopes

Map Unit Setting

Elevation: 30 to 600 feet
Mean annual precipitation: 55 to 75 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 200 to 240 days

Map Unit Composition

Bullards and similar soils: 75 percent
Minor components: 8 percent

Description of Bullards

Setting

Landform: Marine terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed eolian and marine deposits

Typical profile

Oi - 0 to 3 inches: very strongly acid, slightly decomposed plant material
H1 - 3 to 10 inches: very strongly acid, sandy loam
H2 - 10 to 44 inches: very strongly acid, gravelly sandy loam
H3 - 44 to 63 inches: moderately acid, sand

Properties and qualities

Slope: 7 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B

Minor Components

Blacklock

Percent of map unit: 8 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

8D—Bullards sandy loam, 12 to 30 percent slopes

Map Unit Setting

Elevation: 30 to 600 feet
Mean annual precipitation: 55 to 75 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 200 to 240 days

Map Unit Composition

Bullards and similar soils: 75 percent
Minor components: 8 percent

Description of Bullards

Setting

Landform: Marine terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed eolian and marine deposits

Typical profile

Oi - 0 to 3 inches: very strongly acid, slightly decomposed plant material
H1 - 3 to 10 inches: very strongly acid, sandy loam
H2 - 10 to 44 inches: very strongly acid, gravelly sandy loam
H3 - 44 to 63 inches: moderately acid, sand

Properties and qualities

Slope: 12 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance
Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B

Minor Components

Blacklock

Percent of map unit: 8 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

8E—Bullards sandy loam, 30 to 50 percent slopes

Map Unit Setting

Elevation: 50 to 600 feet
Mean annual precipitation: 55 to 75 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 200 to 240 days

Map Unit Composition

Bullards and similar soils: 80 percent

Description of Bullards

Setting

Landform: Marine terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed eolian and marine deposits

Typical profile

Oi - 0 to 3 inches: very strongly acid, slightly decomposed plant material
H1 - 3 to 10 inches: very strongly acid, sandy loam
H2 - 10 to 44 inches: very strongly acid, gravelly sandy loam
H3 - 44 to 63 inches: moderately acid, sand

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Farmland classification: Not prime farmland

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

57—Udorthents, level

Map Unit Composition

Udorthents and similar soils: 100 percent

Description of Udorthents

Setting

Landform: Flood plains, tidal flats, marshes
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium, dredging spoil, dune sand, and wood chips

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

62—Willanch fine sandy loam

Map Unit Setting

Elevation: 10 to 40 feet
Mean annual precipitation: 50 to 80 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 200 to 240 days

Map Unit Composition

Willanch and similar soils: 75 percent

Description of Willanch

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 13 inches: slightly acid, fine sandy loam
H2 - 13 to 35 inches: moderately acid, sandy loam

H3 - 35 to 60 inches: moderately acid, loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Available water storage in profile: Moderate (about 7.4 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance
Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D

W—Water

Map Unit Composition

Water: 100 percent

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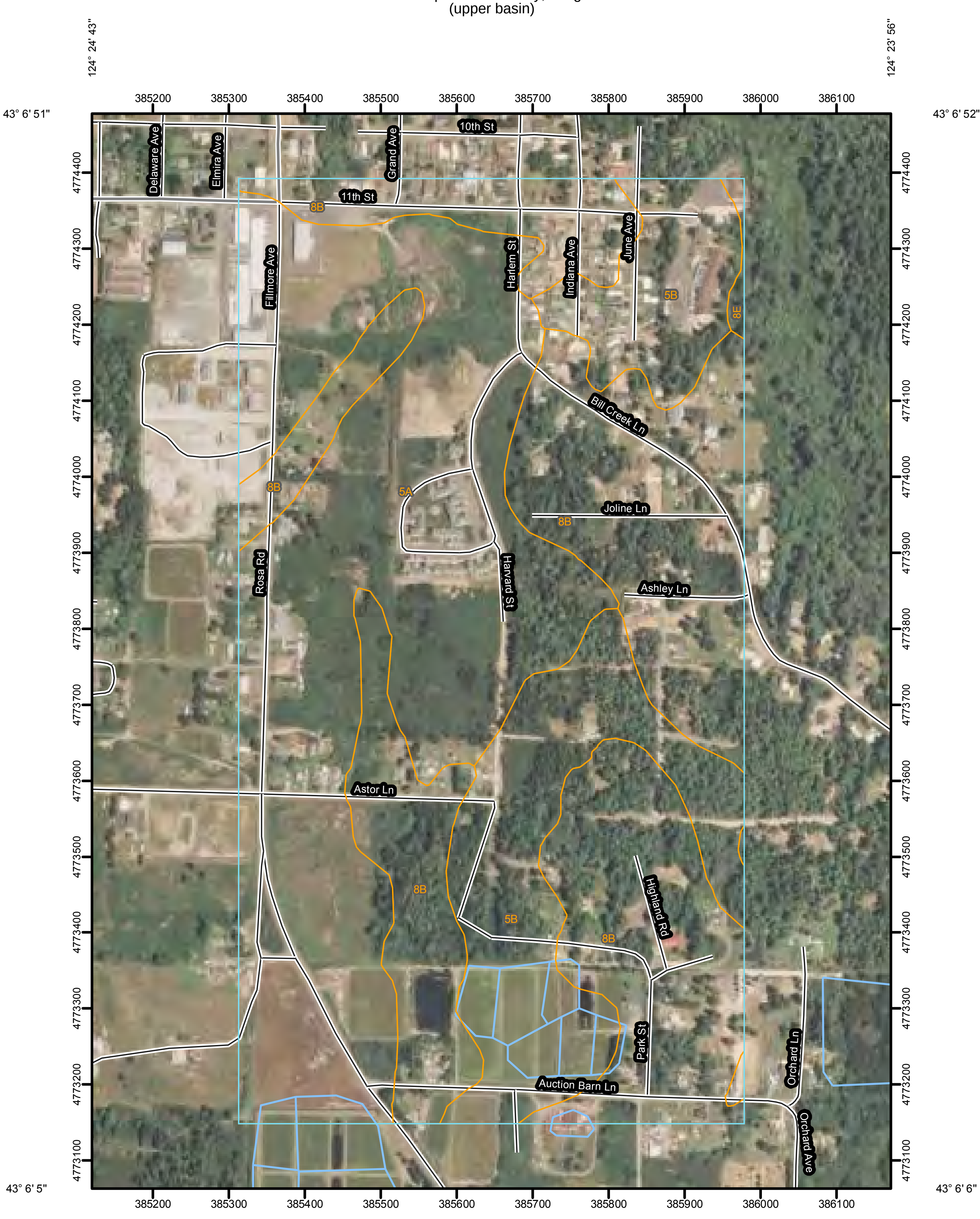
Soil Map—Coos County, Oregon
(upper basin)



Map Scale: 1:6,750 if printed on A size (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1,000 1,500

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

- Gully
- Short Steep Slope
- Other

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:6,750 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Coos County, Oregon
Survey Area Data: Version 7, Aug 20, 2012

Date(s) aerial images were photographed: 7/17/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Coos County, Oregon (OR011)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
5A	Blacklock fine sandy loam, 0 to 3 percent slopes	84.3	41.1%
5B	Blacklock fine sandy loam, 3 to 7 percent slopes	39.5	19.3%
8B	Bullards sandy loam, 0 to 7 percent slopes	80.5	39.3%
8E	Bullards sandy loam, 30 to 50 percent slopes	0.7	0.3%
Totals for Area of Interest		**205.0**	**100.0%**

RAINFALL INTENSITY - DURATION - RECURRENCE INTERVAL CURVES

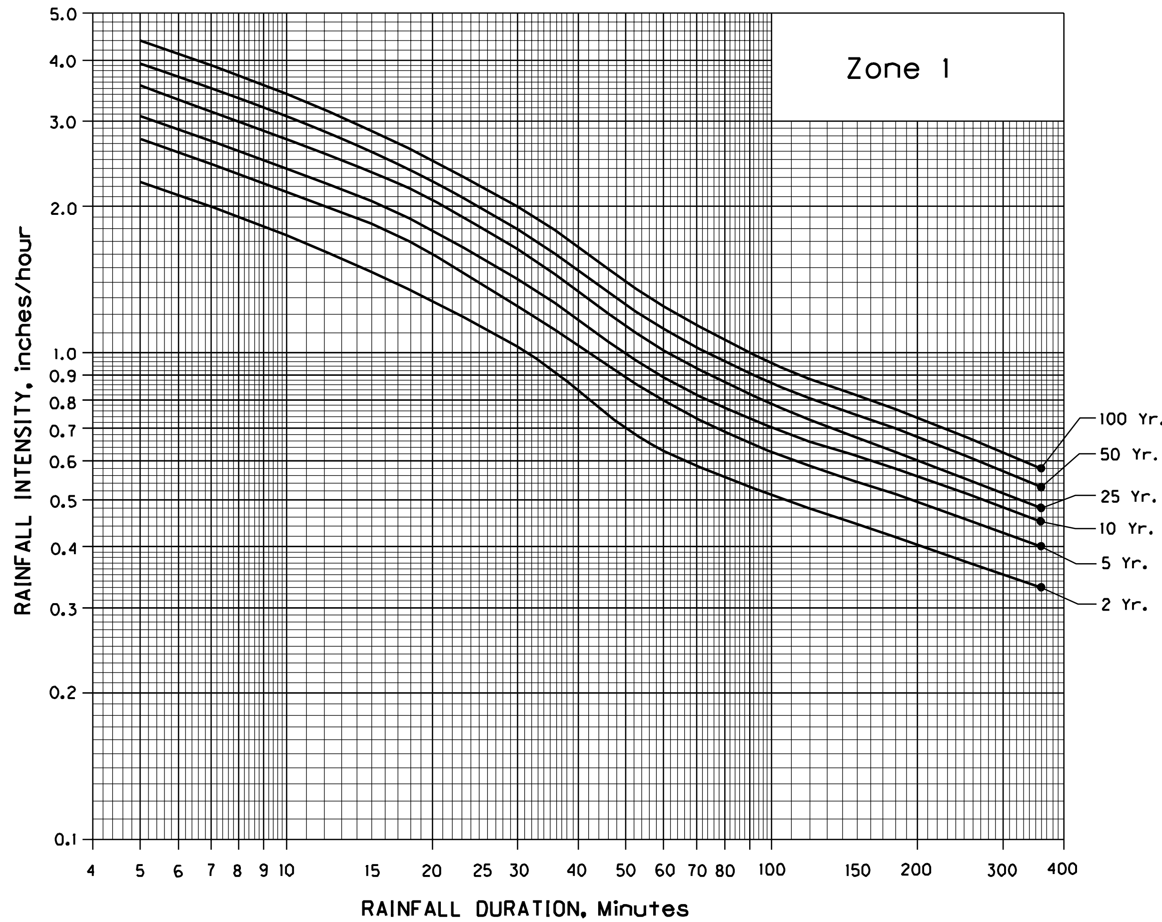


TABLE 1 - SUMMARY OF STORM CALCULATION VALUES

BASIN NUMBER	AREA (ACRES)	PERCENT OF TOTAL AREA	RUNOFF COEFFICIENT	25 YR TIME OF CONCENTRATION (MIN)	100 YR TIME OF CONCENTRATION (MIN)	25 YR RAINFALL INTENSITY (IN/HR)	100 YR RAINFALL INTENSITY (IN/HR)	25 YR RUNOFF FLOW (CFS)	25 YR CUMULATIVE FLOW (CFS	100 YR RUNOFF FLOW (CFS)	100 YR CUMULATIVE FLOW (CFS
1	92	55.4%	0.3	150	142	0.67	0.84	18.49	18.49	23.18	23.18
1 (PROJECTED)	92	55.4%	0.5	85	-	0.84	-	38.64	-	-	-
2	3.4	2.0%	0.5	22	21	1.95	2.45	3.32	21.81	4.17	27.35
3	0.66	0.4%	0.9	10	10	2.75	3.4	1.63	23.44	2.02	29.37
4	2	1.2%	0.5	10	10	2.75	3.4	2.75	26.19	3.40	32.77
5	1	0.6%	0.5	10	10	2.75	3.4	1.38	27.57	1.70	34.47
6	0.48	0.3%	0.5	10	10	2.75	3.4	0.66	28.23	0.82	35.28
7	7.3	4.4%	0.4	15	14	2.35	2.9	6.86	35.09	8.47	43.75
8	22	13.3%	0.5	71	66	0.93	1.2	10.23	45.32	13.20	56.95
9	1.2	0.7%	0.5	10	10	2.75	3.4	1.65	46.97	2.04	58.99
10	2.7	1.6%	0.7	10	10	2.75	3.4	5.20	52.17	6.43	65.42
11	18	10.8%	0.3	34	33	1.5	1.9	8.10	60.27	10.26	75.68
12	10.1	6.1%	0.8	18	18	2.15	2.6	17.37	77.64	21.01	96.69
13	3	1.8%	0.65	10	10	2.75	3.4	5.36	83.00	6.63	103.32
14	2.1	1.3%	0.8	10	10	2.75	3.4	4.62	87.62	5.71	109.03
	165.94										

MAX FLOW THROUGH NEW 11TH STREET STORM SYSTEM
MAX FLOW THROUGH CULVERTS
MAX FLOW THROUGH BALTIME AND 10TH STREET SYSTEM
MAX FLOW THROUGH LOWER 36-INCH SYSTEM TO OUTFALL

Project: 101.82 City Hall Drainage Diversion Project

25 year storm - Tc in minutes

BASIN 1 - DIVERSION BASIN
woods with light underbrush, pasture and grasslands
first 300 ft sheet flow then shallow concentrated for 1161 ft. Then intermittal channel flow 1230 ft.
5% or less slope.

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.15	ks:	5	kc	10		
L(ft):	300	L(ft)	1161	L(ft)	1230		
i (in/hr):	0.86	s(ft/ft):	0.0144	s(ft/ft):	0.0146		
s(ft/ft):	0.0008	V(ft/s):	0.6	V(ft/s):	1.208305		
Tt(min):	82.35388	Tt(min):	32.25	Tt(min):	16.96592	T1:	131.5698

Segment description
Channel flow to and along Rosa Road Total length 1800 ft. Assume grass lined waterway.

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.17	ks:	11	kc	17		
L(ft):	0	L(ft)	0	L(ft)	1800		
i (in/hr):	1.2	s(ft/ft):	0.04	s(ft/ft):	0.0091		
s(ft/ft):	0.0144	V(ft/s):	2.2	V(ft/s):	1.621697		
Tt(min):	0	Tt(min):	0	Tt(min):	18.49914	T1:	18.49914
						TOTAL Tc	150.0689

BASIN 2

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.03	ks:	5	kc	20		
L(ft):	300	L(ft)	0	L(ft)	1242		
i (in/hr):	2.8	s(ft/ft):	0.03	s(ft/ft):	0.0072		
s(ft/ft):	0.0093	V(ft/s):	0.866025	V(ft/s):	1.697056		
Tt(min):	9.367428	Tt(min):	0	Tt(min):	12.19759	T1:	21.56502

BASIN 7

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.03	ks:	20	kc	17		
L(ft):	284	L(ft)	279	L(ft)	650		
i (in/hr):	2.95	s(ft/ft):	0.0082	s(ft/ft):	0.0265		
s(ft/ft):	0.0115	V(ft/s):	1.811077	V(ft/s):	2.7674		
Tt(min):	8.329301	Tt(min):	2.567533	Tt(min):	3.914626	T1:	14.81146

BASIN 8

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.3	ks:	11	kc	21		
L(ft):	300	L(ft)	153	L(ft)	906		
i (in/hr):	1.2	s(ft/ft):	0.0002	s(ft/ft):	0.008		
s(ft/ft):	0.0133	V(ft/s):	0.155563	V(ft/s):	1.878297		
Tt(min):	47.01111	Tt(min):	16.39202	Tt(min):	8.039197	T1:	71.44232

BASIN 11

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.1	ks:	3	kc	5		
L(ft):	300	L(ft)	0	L(ft)	915		
i (in/hr):	2.3	s(ft/ft):	0.2	s(ft/ft):	0.0297		
s(ft/ft):	0.0213	V(ft/s):	1.341641	V(ft/s):	0.861684		
Tt(min):	16.27611	Tt(min):	0	Tt(min):	17.6979	T1:	33.97401

BASIN 12

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.014	ks:	27	kc	21		
L(ft):	200	L(ft)	217	L(ft)	2374		
i (in/hr):	3.75	s(ft/ft):	0.0084	s(ft/ft):	0.022		
s(ft/ft):	0.0103	V(ft/s):	2.474591	V(ft/s):	3.114803		
Tt(min):	4.011567	Tt(min):	1.461521	Tt(min):	12.70278	T1:	18.17587

STORM SEWER DESIGN
RATIONAL METHOD

PROJECT: **101.82 - Bandon - City Hall Drainage**
STORM EVENT **25 yr**
Prepared by: Michael K. Field, PE
Date: 5/14/2014
NOTE: using basin 1 Tc provides maximum flow to all sections of the system

		FLOW TO 11TH STREET STORM SYSTEM						FLOW TO DITCHES AND CULVERTS NORTH OF 11TH STREET	FLOW TO BALTIMORE AND 10TH STORM DRAIN			FLOW TO GULLY	FLOW TO 36-INCH PIPE DOWNSTREAM FROM GULLY		
		flow from basin 1	added flow from basin 2	added flow from basin 3	added flow from basin 4	added flow from basin 5	added flow from basin 6	added flow from basin 7	added flow from basin 8	added flow from basin 9	added flow from basin 10	added flow from basin 11	added flow from basin 12	added flow from basin 13	added flow from basin 14
LINE LENGTH (FT)		0	0	0	0	0	0	0	0	0	0	0	0	0	0
AREA	ACRES	92	3.4	0.66	2	1	0.48	7.3	22	1.2	2.7	18	10.1	3	2.1
Tc (MIN)	TO UPPER END	150.00	22.00	10.00	10.00	10.00	10.00	15.00	71.00	10.00	10.00	34.00	18.00	10.00	10.00
	IN SECTION	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	TOTAL	150.00	22.00	10.00	10.00	10.00	10.00	15.00	71.00	10.00	10.00	34.00	18.00	10.00	10.00
AVG RUNOFF COEFFICIENT		0.3	0.5	0.9	0.5	0.5	0.5	0.4	0.5	0.5	0.7	0.3	0.8	0.65	0.8
RAINFALL INTENSITY (INCH/HOUR)		0.67	1.95	2.75	2.75	2.75	2.75	2.35	0.93	2.75	2.75	1.5	2.15	2.75	2.75
RUNOFF IN SECTION	25 yr	18.4920	3.3150	1.6335	2.7500	1.3750	0.6600	6.8620	10.2300	1.6500	5.1975	8.1000	17.3720	5.3625	4.6200
TOTAL FLOW IN PIPE	25 yr	18.4920	21.8070	23.4405	26.1905	27.5655	28.2255	35.0875	45.3175	46.9675	52.1650	60.2650	77.6370	82.9995	87.6195
pipe design															
n		0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
pipe ID (inches)		30	30	30	30	30	30	30	24	24	36	36	36	36	36
slope (ft/ft)		0.0060	0.0100	0.0100	0.0069	0.0020	0.0020	0.0050	0.0469	0.0072	0.0336	0.0078	0.0156	0.0126	-0.0305
A (ft^2)		4.9087	4.9087	4.9087	4.9087	4.9087	4.9087	4.9087	3.1416	3.1416	7.0686	7.0686	7.0686	7.0686	7.0686
V (fps)		6.4899	8.3784	8.3784	6.9597	3.7470	3.7470	5.9244	15.6366	6.1266	17.3428	8.3560	11.8171	10.6203	#NUM!
CAPACITY Q (cfs)		31.8573	41.1275	41.1275	34.1631	18.3928	18.3928	29.0816	49.1239	19.2474	122.5893	59.0650	83.5305	75.0703	#NUM!

EXCESS CAPACITY (CFS)															
25 yr		13.3653	19.3205	17.6870	7.9726	-9.1727	-9.8327	-6.0059	3.8064	-27.7201	70.4243	-1.2000	5.8935	-7.9292	#NUM!

STORM SEWER DESIGN
RATIONAL METHOD

PROJECT:	**101.82 - Bandon - City Hall Drainage**
STORM EVENT	**25 yr**
Prepared by:	Michael K. Field, PE
Date:	5/14/2014
NOTE:	culverts

		FLOW TO 11TH STREET STORM SYSTEM						FLOW TO DITCHES AND CULVERTS NORTH OF 11TH STREET USING ADDED FLOW FROM BASIN 7 FOR ALL CULVERTS					
		flow from basin 1	added flow from basin 2	added flow from basin 3	added flow from basin 4	added flow from basin 5	added flow from basin 6	ex culvert 1	new culvert	ex culvert 2	new culvert	ex culvert 3	ex culvert 4
LINE LENGTH (FT)		0	0	0	0	0	0	0	0	0	0	0	0
AREA	ACRES	92	3.4	0.66	2	1	0.48	7.3	7.3	7.3	7.3	7.3	7.3
Tc (MIN)	TO UPPER END	150.00	22.00	10.00	10.00	10.00	10.00	15.00	15.00	15.00	15.00	15.00	15.00
	IN SECTION	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	TOTAL	150.00	22.00	10.00	10.00	10.00	10.00	15.00	15.00	15.00	15.00	15.00	15.00
AVG RUNOFF COEFFICIENT		0.3	0.5	0.9	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
RAINFALL INTENSITY (INCH/HOUR)		0.67	1.95	2.75	2.75	2.75	2.75	2.35	2.35	2.35	2.35	2.35	2.35
RUNOFF IN SECTION	25 yr	18.4920	3.3150	1.6335	2.7500	1.3750	0.6600	6.8620	6.8620	6.8620	6.8620	6.8620	6.8620
TOTAL FLOW IN PIPE	25 yr	18.4920	21.8070	23.4405	26.1905	27.5655	28.2255	35.0875	35.0875	35.0875	35.0875	35.0875	35.0875
pipe design													
n		0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
pipe ID (inches)		30	30	30	30	30	30	24	30	24	30	36	24
slope (ft/ft)		0.0060	0.0100	0.0100	0.0069	0.0020	0.0020	0.0092	0.0317	0.0133	0.0124	0.0314	0.0266
A (ft^2)		4.9087	4.9087	4.9087	4.9087	4.9087	4.9087	3.1416	4.9087	3.1416	4.9087	7.0686	3.1416
V (fps)		6.4899	8.3784	8.3784	6.9597	3.7470	3.7470	6.9255	14.9174	8.3269	9.3298	16.7655	11.7760
CAPACITY Q (cfs)		31.8573	41.1275	41.1275	34.1631	18.3928	18.3928	21.7571	73.2255	26.1597	45.7977	118.5080	36.9953
EXCESS CAPACITY (CFS)													
25 yr		13.3653	19.3205	17.6870	7.9726	-9.1727	-9.8327	-13.3304	38.1380	-8.9278	10.7102	83.4205	1.9078

MANNING EQUATION FOR OPEN CHANNEL FLOW
Project: Bandon 11th Street Storm Improvement Project
Check ditch capacity at section 5 - see USACE application figures
Q=AV=A*1.486/n*R^(2/3)*S^(1/2)

A= area of flow
n=manning roughness coefficient
R=hydraulic radius=A/P
P=wetted perimeter
S=channel bottom slope

ENTER:

Depth:	18	inches
A:	5.72	SF
P:	7.43	FT
S:	0.0342	FT/FT
n:	0.035	

RESULTS:

R=	0.769851952	FT
Q=	37.72518026	CFS

Project: 101.82 City Hall Drainage Diversion Project

100 year storm - Tc in minutes

BASIN 1 - DIVERSION BASIN

woods with light underbrush, pasture and grasslands
first 300 ft sheet flow then shallow concentrated for 1161 ft. Then intermittal channel flow 1230 ft.
5% or less slope.

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.15	ks:	5	kc:	10		
L(ft):	300	L(ft)	1161	L(ft)	1230		
i (in/hr):	1.1	s(ft/ft):	0.0144	s(ft/ft):	0.0146		
s(ft/ft):	0.0008	V(ft/s):	0.6	V(ft/s):	1.208305		
Tt(min):	74.63222	Tt(min):	32.25	Tt(min):	16.96592	T1:	123.8461

Segment description
Channel flow to and along Rosa Road Total length 1800 ft. Assume grass lined waterway

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.17	ks:	11	kc	17		
L(ft):	0	L(ft)	0	L(ft)	1800		
i (in/hr):	1.2	s(ft/ft):	0.04	s(ft/ft):	0.0091		
s(ft/ft):	0.0144	V(ft/s):	2.2	V(ft/s):	1.621697		
Tt(min):	0	Tt(min):	0	Tt(min):	18.49914	T1:	18.49914
						TOTAL Tc	142.3473

BASIN 2

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.03	ks:	5	kc	20		
L(ft):	300	L(ft)	0	L(ft)	1242		
i (in/hr):	3.65	s(ft/ft):	0.03	s(ft/ft):	0.0072		
s(ft/ft):	0.0093	V(ft/s):	0.866025	V(ft/s):	1.697056		
Tt(min):	8.424932	Tt(min):	0	Tt(min):	12.19759	T1:	20.62252

BASIN 7

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.03	ks:	20	kc	17		
L(ft):	284	L(ft)	279	L(ft)	650		
i (in/hr):	3.75	s(ft/ft):	0.0082	s(ft/ft):	0.0265		
s(ft/ft):	0.0115	V(ft/s):	1.811077	V(ft/s):	2.7674		
Tt(min):	7.567019	Tt(min):	2.567533	Tt(min):	3.914626	T1:	14.04918

BASIN 8

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.3	ks:	11	kc	21		
L(ft):	300	L(ft)	153	L(ft)	906		
i (in/hr):	1.6	s(ft/ft):	0.0002	s(ft/ft):	0.008		
s(ft/ft):	0.0133	V(ft/s):	0.155563	V(ft/s):	1.878297		
Tt(min):	41.90106	Tt(min):	16.39202	Tt(min):	8.039197	T1:	66.33227

BASIN 11

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.1	ks:	3	kc	5		
L(ft):	300	L(ft)	0	L(ft)	915		
i (in/hr):	2.9	s(ft/ft):	0.2	s(ft/ft):	0.0297		
s(ft/ft):	0.0213	V(ft/s):	1.341641	V(ft/s):	0.861684		
Tt(min):	14.83483	Tt(min):	0	Tt(min):	17.6979	T1:	32.53273

BASIN 12

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.014	ks:	27	kc	21		
L(ft):	200	L(ft)	217	L(ft)	2374		
i (in/hr):	4.7	s(ft/ft):	0.0084	s(ft/ft):	0.022		
s(ft/ft):	0.0103	V(ft/s):	2.474591	V(ft/s):	3.114803		
Tt(min):	3.665114	Tt(min):	1.461521	Tt(min):	12.70278	T1:	17.82942

STORM SEWER DESIGN
RATIONAL METHOD

PROJECT:	**101.82 - Bandon - City Hall Drainage**
STORM EVENT	**100 YR**
Prepared by:	Michael K. Field, PE
Date:	5/14/2014
NOTE:	using basin 1 Tc provides maximum flow to all sections of the system

		FLOW TO 11TH STREET STORM SYSTEM						FLOW TO DITCHES AND CULVERTS NORTH OF 11TH STREET	FLOW TO BALTIMORE AND 10TH STORM DRAIN			FLOW TO GULLY	FLOW TO 36-INCH PIPE DOWNSTREAM FROM GULLY		
		flow from basin 1	added flow from basin 2	added flow from basin 3	added flow from basin 4	added flow from basin 5	added flow from basin 6	added flow from basin 7	added flow from basin 8	added flow from basin 9	added flow from basin 10	added flow from basin 11	added flow from basin 12	added flow from basin 13	added flow from basin 14
LINE LENGTH (FT)		0	0	0	0	0	0	0	0	0	0	0	0	0	0
AREA	ACRES	92	3.4	0.66	2	1	0.48	7.3	22	1.2	2.7	18	10.1	3	2.1
Tc (MIN)	TO UPPER END	142.00	21.00	10.00	10.00	10.00	10.00	14.00	66.00	10.00	10.00	33.00	18.00	10.00	10.00
	IN SECTION	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	TOTAL	142.00	21.00	10.00	10.00	10.00	10.00	14.00	66.00	10.00	10.00	33.00	18.00	10.00	10.00
AVG RUNOFF COEFFICIENT		0.3	0.5	0.9	0.5	0.5	0.5	0.4	0.5	0.5	0.7	0.3	0.8	0.65	0.8
RAINFALL INTENSITY (INCH/HOUR)		0.84	2.45	3.4	3.4	3.4	3.4	2.9	1.2	3.4	3.4	1.9	2.6	3.4	3.4
RUNOFF IN SECTION	100 YR	23.1840	4.1650	2.0196	3.4000	1.7000	0.8160	8.4680	13.2000	2.0400	6.4260	10.2600	21.0080	6.6300	5.7120
TOTAL FLOW IN PIPE	100 YR	23.1840	27.3490	29.3686	32.7686	34.4686	35.2846	43.7526	56.9526	58.9926	65.4186	75.6786	96.6866	103.3166	109.0286
pipe design															
n		0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
pipe ID (inches)		30	30	30	30	30	30	30	24	24	36	36	36	36	36
slope (ft/ft)		0.0060	0.0100	0.0100	0.0069	0.0020	0.0020	0.0060	0.0469	0.0072	0.0336	0.0078	0.0156	0.0126	-0.0305
A (ft^2)		4.9087	4.9087	4.9087	4.9087	4.9087	4.9087	4.9087	3.1416	3.1416	7.0686	7.0686	7.0686	7.0686	7.0686
V (fps)		6.4899	8.3784	8.3784	6.9597	3.7470	3.7470	6.4899	15.6366	6.1266	17.3428	8.3560	11.8171	10.6203	#NUM!
CAPACITY Q (cfs)		31.8573	41.1275	41.1275	34.1631	18.3928	18.3928	31.8573	49.1239	19.2474	122.5893	59.0650	83.5305	75.0703	#NUM!
EXCESS CAPACITY (CFS)															
100 YR		8.6733	13.7785	11.7589	1.3945	-16.0758	-16.8918	-11.8953	-7.8287	-39.7452	57.1707	-16.6136	13.1561	-28.2463	#NUM!

STORM SEWER DESIGN
RATIONAL METHOD

PROJECT: **101.82 - Bandon - City Hall Drainage**
STORM EVENT **100 YR**
Prepared by: Michael K. Field, PE
Date: 5/14/2014
NOTE: culverts

		FLOW TO 11TH STREET STORM SYSTEM						FLOW TO DITCHES AND CULVERTS NORTH OF 11TH STREET USING ADDED FLOW FROM BASIN 7 FOR ALL CULVERTS					
		flow from basin 1	added flow from basin 2	added flow from basin 3	added flow from basin 4	added flow from basin 5	added flow from basin 6	ex culvert 1	new culvert	ex culvert 2	new culvert	ex culvert 3	ex culvert 4
LINE LENGTH (FT)		0	0	0	0	0	0	0	0	0	0	0	0
AREA	ACRES	92	3.4	0.66	2	1	0.48	7.3	7.3	7.3	7.3	7.3	7.3
Tc (MIN)	TO UPPER END	142.00	21.00	10.00	10.00	10.00	10.00	14.00	14.00	14.00	14.00	14.00	14.00
	IN SECTION	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	TOTAL	142.00	21.00	10.00	10.00	10.00	10.00	14.00	14.00	14.00	14.00	14.00	14.00
AVG RUNOFF COEFFICIENT		0.3	0.5	0.9	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
RAINFALL INTENSITY (INCH/HOUR)		0.84	2.45	3.4	3.4	3.4	3.4	2.9	2.9	2.9	2.9	2.9	2.9
RUNOFF IN SECTION	100 YR	23.1840	4.1650	2.0196	3.4000	1.7000	0.8160	8.4680	8.4680	8.4680	8.4680	8.4680	8.4680
TOTAL FLOW IN PIPE	100 YR	23.1840	27.3490	29.3686	32.7686	34.4686	35.2846	43.7526	43.7526	43.7526	43.7526	43.7526	43.7526
pipe design													
n		0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
pipe ID (inches)		30	30	30	30	30	30	24	30	24	30	36	24
slope (ft/ft)		0.0060	0.0100	0.0100	0.0069	0.0020	0.0020	0.0092	0.0317	0.0133	0.0124	0.0314	0.0266
A (ft^2)		4.9087	4.9087	4.9087	4.9087	4.9087	4.9087	3.1416	4.9087	3.1416	4.9087	7.0686	3.1416
V (fps)		6.4899	8.3784	8.3784	6.9597	3.7470	3.7470	6.9255	14.9174	8.3269	9.3298	16.7655	11.7760
CAPACITY Q (cfs)		31.8573	41.1275	41.1275	34.1631	18.3928	18.3928	21.7571	73.2255	26.1597	45.7977	118.5080	36.9953
EXCESS CAPACITY (CFS)													
100 YR		8.6733	13.7785	11.7589	1.3945	-16.0758	-16.8918	-21.9955	29.4729	-17.5929	2.0451	74.7554	-6.7573

Project: 101.82 City Hall Drainage Diversion Project
PROJECTED FLOWS FOLLOWING DEVELOPMENT IN BASIN 1
25 year storm - Tc in minutes

BASIN 1 - DIVERSION BASIN

woods with light underbrush, pasture and grasslands
first 300 ft sheet flow then shallow concentrated for 1161 ft. Then intermittal channel flow 1230 ft.
5% or less slope.

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.08	ks:	5	kc	21		
L(ft):	300	L(ft)	0	L(ft)	2500		
i (in/hr):	1.15	s(ft/ft):	0.0144	s(ft/ft):	0.0146		
s(ft/ft):	0.0008	V(ft/s):	0.6	V(ft/s):	2.53744		
Tt(min):	50.28096	Tt(min):	0	Tt(min):	16.42075	T1:	66.70171

Segment description
Channel flow to and along Rosa Road Total length 1800 ft. Assume grass lined waterway.

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.17	ks:	11	kc	17		
L(ft):	0	L(ft)	0	L(ft)	1800		
i (in/hr):	1.2	s(ft/ft):	0.04	s(ft/ft):	0.0091		
s(ft/ft):	0.0144	V(ft/s):	2.2	V(ft/s):	1.621697		
Tt(min):	0	Tt(min):	0	Tt(min):	18.49914	T1:	18.49914
						TOTAL Tc	85.20086

BASIN 2

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.03	ks:	5	kc	20		
L(ft):	300	L(ft)	0	L(ft)	1242		
i (in/hr):	2.8	s(ft/ft):	0.03	s(ft/ft):	0.0072		
s(ft/ft):	0.0093	V(ft/s):	0.866025	V(ft/s):	1.697056		
Tt(min):	9.367428	Tt(min):	0	Tt(min):	12.19759	T1:	21.56502

BASIN 7

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.03	ks:	20	kc	17		
L(ft):	284	L(ft)	279	L(ft)	650		
i (in/hr):	2.95	s(ft/ft):	0.0082	s(ft/ft):	0.0265		
s(ft/ft):	0.0115	V(ft/s):	1.811077	V(ft/s):	2.7674		
Tt(min):	8.329301	Tt(min):	2.567533	Tt(min):	3.914626	T1:	14.81146

BASIN 8

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.3	ks:	11	kc	21		
L(ft):	300	L(ft)	153	L(ft)	906		
i (in/hr):	1.2	s(ft/ft):	0.0002	s(ft/ft):	0.008		
s(ft/ft):	0.0133	V(ft/s):	0.155563	V(ft/s):	1.878297		
Tt(min):	47.01111	Tt(min):	16.39202	Tt(min):	8.039197	T1:	71.44232

BASIN 11

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.1	ks:	3	kc	5		
L(ft):	300	L(ft)	0	L(ft)	915		
i (in/hr):	2.3	s(ft/ft):	0.2	s(ft/ft):	0.0297		
s(ft/ft):	0.0213	V(ft/s):	1.341641	V(ft/s):	0.861684		
Tt(min):	16.27611	Tt(min):	0	Tt(min):	17.6979	T1:	33.97401

BASIN 12

Sheet Flow		Shallow Concentrated Flow		Open Channel Flow			
enter:		enter		enter			
n:	0.014	ks:	27	kc	21		
L(ft):	200	L(ft)	217	L(ft)	2374		
i (in/hr):	3.75	s(ft/ft):	0.0084	s(ft/ft):	0.022		
s(ft/ft):	0.0103	V(ft/s):	2.474591	V(ft/s):	3.114803		
Tt(min):	4.011567	Tt(min):	1.461521	Tt(min):	12.70278	T1:	18.17587

STORM SEWER DESIGN
RATIONAL METHOD

PROJECT: **101.82 - Bandon - City Hall Drainage**
STORM EVENT **25 yr PROJECTED FLOW FOLLOWING DEVELOPMENT OF BASIN 1**
Prepared by: Michael K. Field, PE
Date: 5/14/2014
NOTE: using basin 1 Tc provides maximum flow to all sections of the system

		FLOW TO 11TH STREET STORM SYSTEM						FLOW TO DITCHES AND CULVERTS NORTH OF 11TH STREET	FLOW TO BALTIMORE AND 10TH STORM DRAIN			FLOW TO GULLY	FLOW TO 36-INCH PIPE DOWNSTREAM FROM GULLY		
		flow from basin 1	added flow from basin 2	added flow from basin 3	added flow from basin 4	added flow from basin 5	added flow from basin 6	added flow from basin 7	added flow from basin 8	added flow from basin 9	added flow from basin 10	added flow from basin 11	added flow from basin 12	added flow from basin 13	added flow from basin 14
LINE LENGTH (FT)		0	0	0	0	0	0	0	0	0	0	0	0	0	0
AREA	ACRES	92	3.4	0.66	2	1	0.48	7.3	22	1.2	2.7	18	10.1	3	2.1
Tc (MIN)	TO UPPER END	85.00	22.00	10.00	10.00	10.00	10.00	15.00	71.00	10.00	10.00	34.00	18.00	10.00	10.00
	IN SECTION	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	TOTAL	85.00	22.00	10.00	10.00	10.00	10.00	15.00	71.00	10.00	10.00	34.00	18.00	10.00	10.00
AVG RUNOFF COEFFICIENT		0.5	0.5	0.9	0.5	0.5	0.5	0.4	0.5	0.5	0.7	0.3	0.8	0.65	0.8
RAINFALL INTENSITY (INCH/HOUR)		0.84	1.95	2.75	2.75	2.75	2.75	2.35	0.93	2.75	2.75	1.5	2.15	2.75	2.75
RUNOFF IN SECTION	25 yr	38.6400	3.3150	1.6335	2.7500	1.3750	0.6600	6.8620	10.2300	1.6500	5.1975	8.1000	17.3720	5.3625	4.6200
TOTAL FLOW IN PIPE	25 yr	38.6400	41.9550	43.5885	46.3385	47.7135	48.3735	55.2355	65.4655	67.1155	72.3130	80.4130	97.7850	103.1475	107.7675
pipe design															
n		0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
pipe ID (inches)		30	30	30	30	30	30	30	24	24	36	36	36	36	36
slope (ft/ft)		0.0060	0.0100	0.0100	0.0069	0.0020	0.0020	0.0060	0.0469	0.0072	0.0336	0.0078	0.0156	0.0126	-0.0305
A (ft^2)		4.9087	4.9087	4.9087	4.9087	4.9087	4.9087	4.9087	3.1416	3.1416	7.0686	7.0686	7.0686	7.0686	7.0686
V (fps)		6.4899	8.3784	8.3784	6.9597	3.7470	3.7470	6.4899	15.6366	6.1266	17.3428	8.3560	11.8171	10.6203	#NUM!
CAPACITY Q (cfs)		31.8573	41.1275	41.1275	34.1631	18.3928	18.3928	31.8573	49.1239	19.2474	122.5893	59.0650	83.5305	75.0703	#NUM!

EXCESS CAPACITY (CFS)														
25 yr	-6.7827	-0.8275	-2.4610	-12.1754	-29.3207	-29.9807	-23.3782	-16.3416	-47.8681	50.2763	-21.3480	-14.2545	-28.0772	#NUM!

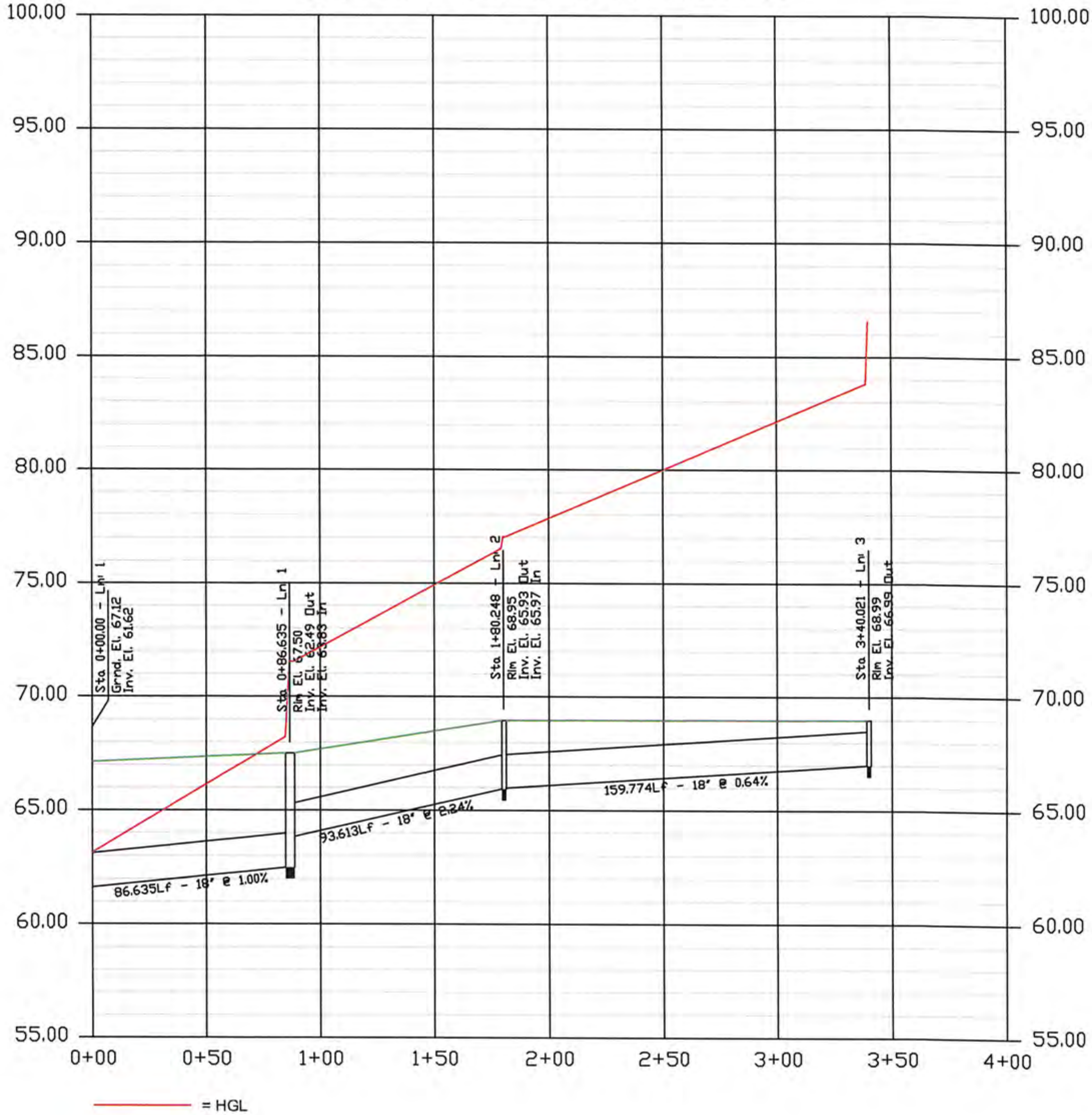
STORM SEWER DESIGN
RATIONAL METHOD

PROJECT: **101.82 - Bandon - City Hall Drainage**
STORM EVENT **25 yr - PROJECTED FLOW FOLLOWING DEVELOPMENT OF BASIN 1**
Prepared by: Michael K. Field, PE
Date: 5/14/2014
NOTE: culverts

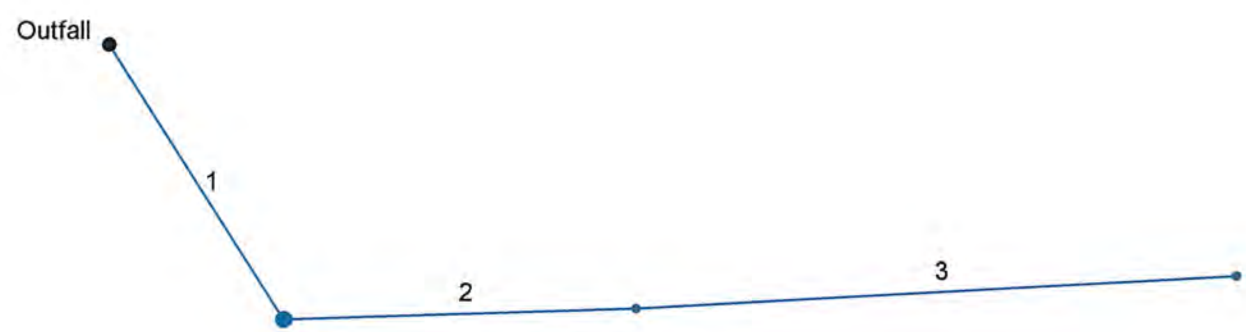
		FLOW TO 11TH STREET STORM SYSTEM					
		flow from basin 1	added flow from basin 2	added flow from basin 3	added flow from basin 4	added flow from basin 5	added flow from basin 6
LINE LENGTH (FT)		0	0	0	0	0	0
AREA	ACRES	92	3.4	0.66	2	1	0.48
Tc (MIN)	TO UPPER END	85.00	22.00	10.00	10.00	10.00	10.00
	IN SECTION	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	TOTAL	85.00	22.00	10.00	10.00	10.00	10.00
AVG RUNOFF COEFFICIENT		0.5	0.5	0.9	0.5	0.5	0.5
RAINFALL INTENSITY (INCH/HOUR)		0.84	1.95	2.75	2.75	2.75	2.75
RUNOFF IN SECTION	25 yr	38.6400	3.3150	1.6335	2.7500	1.3750	0.6600
TOTAL FLOW IN PIPE	25 yr	38.6400	41.9550	43.5885	46.3385	47.7135	48.3735
pipe design							
n		0.013	0.013	0.013	0.013	0.013	0.013
pipe ID (inches)		30	30	30	30	30	30
slope (ft/ft)		0.0060	0.0100	0.0100	0.0069	0.0020	0.0020
A (ft^2)		4.9087	4.9087	4.9087	4.9087	4.9087	4.9087
V (fps)		6.4899	8.3784	8.3784	6.9597	3.7470	3.7470
CAPACITY Q (cfs)		31.8573	41.1275	41.1275	34.1631	18.3928	18.3928
EXCESS CAPACITY (CFS)							
25 yr		-6.7827	0.8275	-2.4610	-12.1754	-29.3207	-29.9807

		FLOW TO DITCHES AND CULVERTS NORTH OF 11TH STREET USING ADDED FLOW FROM BASIN 7 FOR ALL CULVERTS					
		ex culvert 1	new culvert	ex culvert 2	new culvert	ex culvert 3	ex culvert 4
LINE LENGTH (FT)		0	0	0	0	0	0
AREA	ACRES	7.3	7.3	7.3	7.3	7.3	7.3
Tc (MIN)	TO UPPER END	15.00	15.00	15.00	15.00	15.00	15.00
	IN SECTION	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	TOTAL	15.00	15.00	15.00	15.00	15.00	15.00
AVG RUNOFF COEFFICIENT		0.4	0.4	0.4	0.4	0.4	0.4
RAINFALL INTENSITY (INCH/HOUR)		2.35	2.35	2.35	2.35	2.35	2.35
RUNOFF IN SECTION	25 yr	6.8620	6.8620	6.8620	6.8620	6.8620	6.8620
TOTAL FLOW IN PIPE	25 yr	55.2355	55.2355	55.2355	55.2355	55.2355	55.2355
pipe design							
n		0.013	0.013	0.013	0.013	0.013	0.013
pipe ID (inches)		24	30	24	36	36	24
slope (ft/ft)		0.0092	0.0317	0.0133	0.0124	0.0314	0.0266
A (ft^2)		3.1416	4.9087	3.1416	7.0686	7.0686	3.1416
V (fps)		6.9255	14.9174	8.3269	10.5356	16.7655	11.7760
CAPACITY Q (cfs)		21.7571	73.2255	26.1597	74.4721	118.5080	36.9953
EXCESS CAPACITY (CFS)							
25 yr		33.4784	17.9900	-29.0758	19.2366	63.2725	-18.2402

25 YR STORM - EXISTING 11TH STREET STORM SYSTEM WITH DIVERTED FLOWS ADDED



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



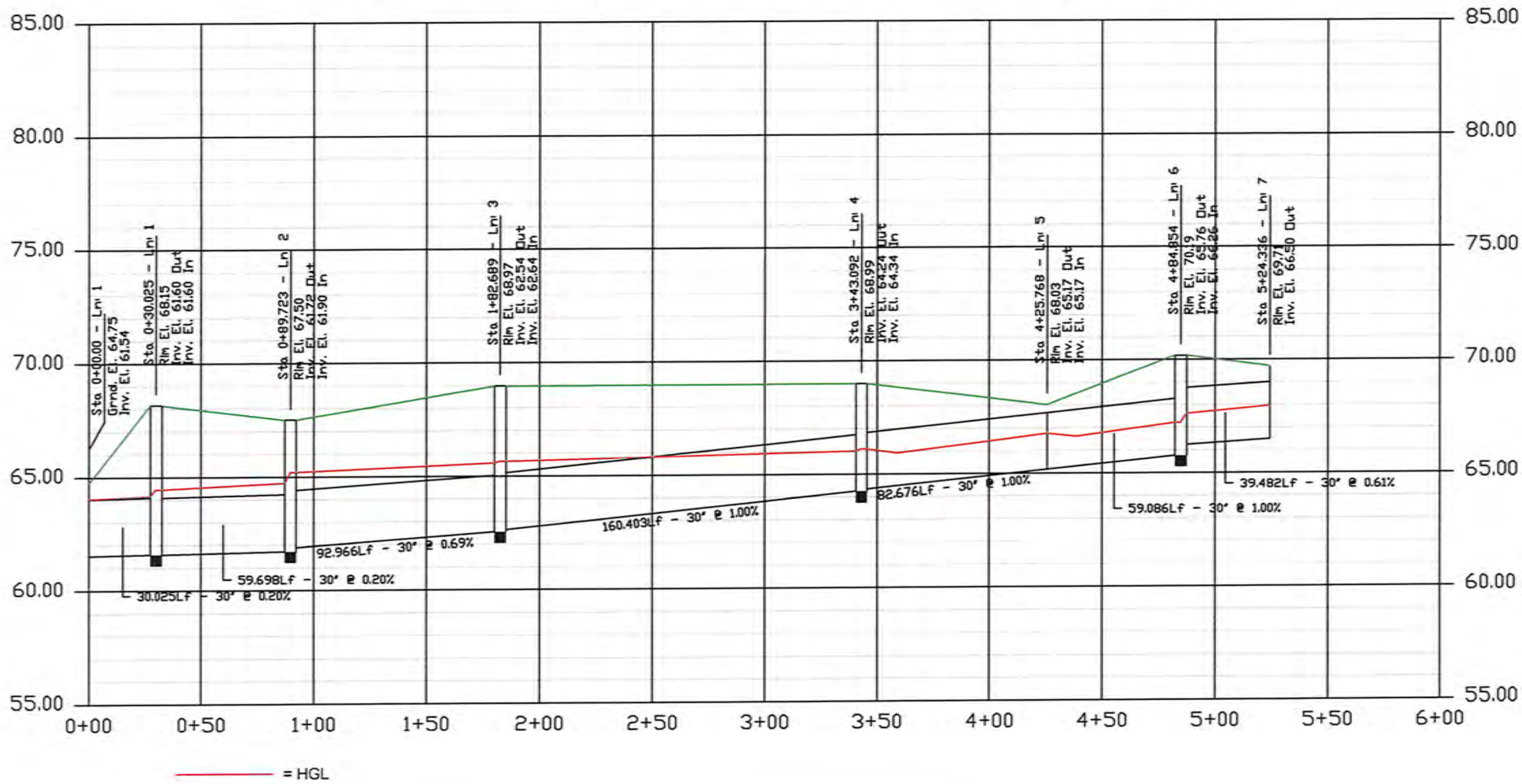
Project File: 25 YR EXISTING 11TH STREET STORM DRAIN.stm	Number of lines: 3	Date: 8/2/2014

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	Pipe - (118)	27.57	18	Cir	86.635	61.62	62.49	1.004	63.12*	68.21*	3.33	71.54	End	Manhole
2	Pipe - (49)	26.19	18	Cir	93.613	63.83	65.93	2.243	71.54*	76.50*	0.51	77.01	1	Manhole
3	Pipe - (10)	23.44	18	Cir	159.774	65.97	66.99	0.638	77.01*	83.80*	2.74	86.54	2	Manhole

Project File: 25 YR EXISTING 11TH STREET STORM DRAIN.stm	Number of lines: 3	Run Date: 8/2/2014
NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown).		

25 YR STORM - NEW 30-INCH STORM SYSTEM IN 11TH STREET



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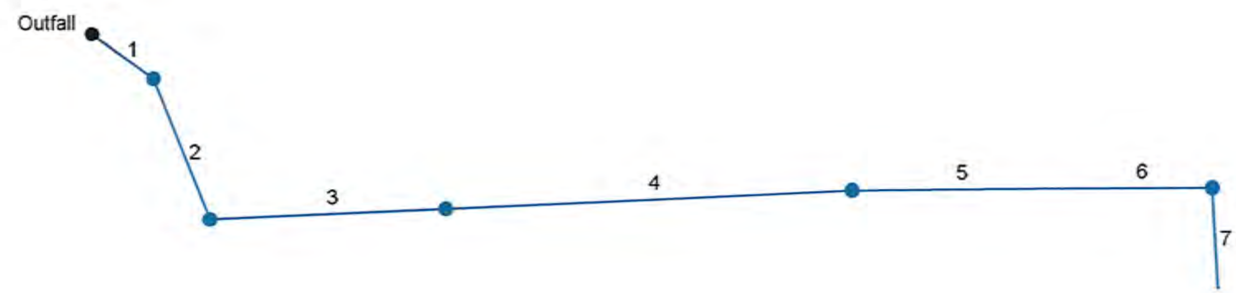


Project File: 25 yr new 11th street storm drain.stm	Number of lines: 7	Date: 8/2/2014

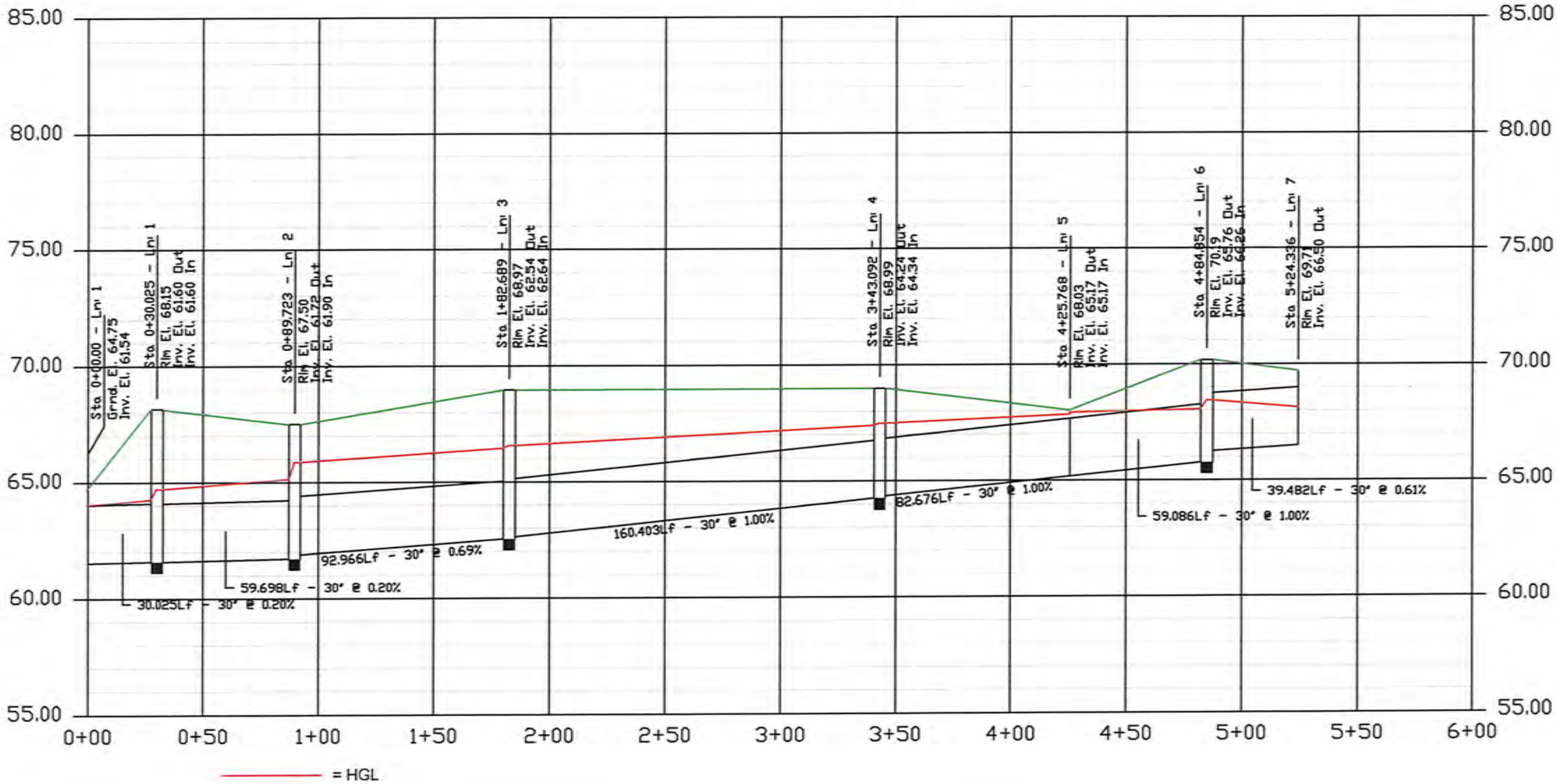
Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	Pipe - (125)	28.23	30	Cir	30.025	61.54	61.60	0.200	64.04*	64.18*	0.30	64.48	End	Manhole
2	Pipe - (124)	27.57	30	Cir	59.698	61.60	61.72	0.201	64.48*	64.75*	0.47	65.22	1	Manhole
3	Pipe - (75)	26.19	30	Cir	92.966	61.90	62.54	0.688	65.22*	65.60*	0.07	65.66	2	Manhole
4	Pipe - (74)	23.44	30	Cir	160.403	62.64	64.24	0.997	65.66	66.03	0.09	66.12	3	Manhole
5	Pipe - (73)	21.81	30	Cir	82.676	64.34	65.17	1.004	66.12	66.76	n/a	66.76 j	4	None
6	NEW STM PIPE #2	18.49	30	Cir	59.086	65.17	65.76	0.999	66.76	67.22	n/a	67.22 j	5	Manhole
7	Pipe - (88)	18.49	30	Cir	39.482	66.26	66.50	0.608	67.62	67.96	n/a	67.96	6	Manhole

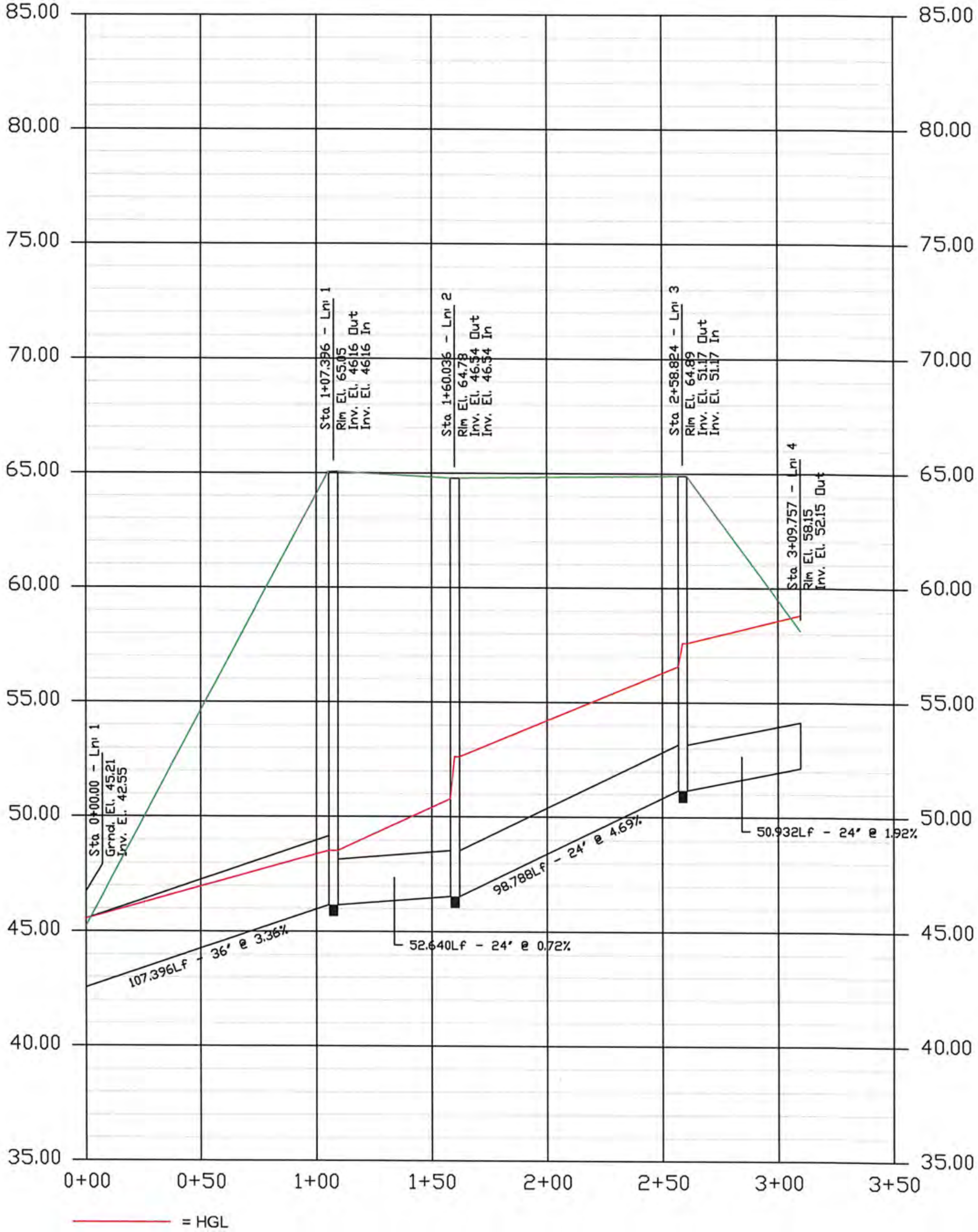
Project File: 25 yr new 11th street storm drain.stm | Number of lines: 7 | Run Date: 8/2/2014

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

100 YR STORM - NEW 30-INCH STORM SYSTEM IN 11TH STREET



25 YR STORM - BALTIMORE AND 10TH STREET SYSTEM



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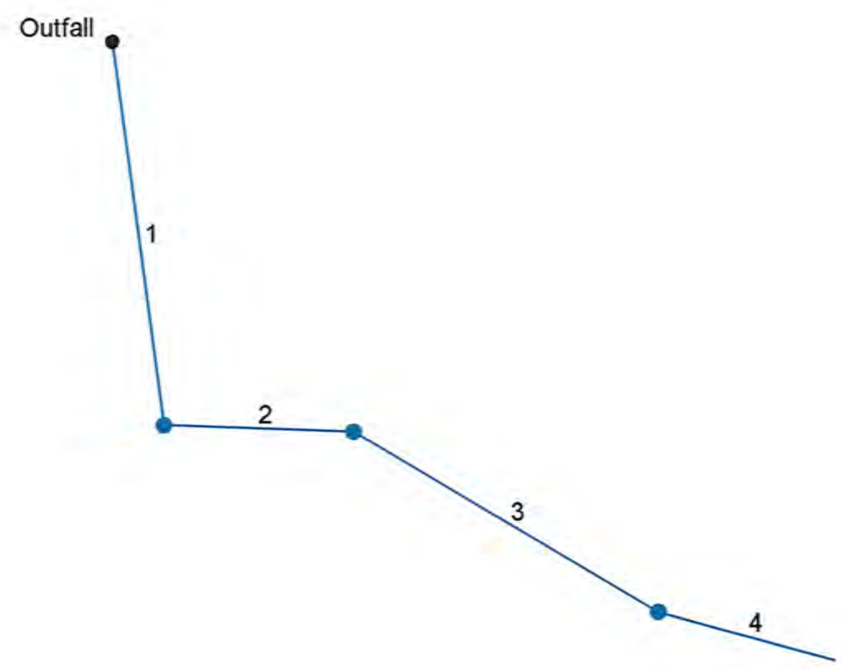


Project File: 25 yr Baltimore and 10th storm drain.stm	Number of lines: 4	Date: 8/2/2014

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	EX STM PIPE #4	52.17	36	Cir	107.396	42.55	46.16	3.361	45.55	48.51	1.19	48.51	End	Manhole
2	EX STM PIPE #3	46.97	24	Cir	52.640	46.16	46.54	0.722	48.51*	50.78*	1.84	52.62	1	Manhole
3	EX STM PIPE #2	45.32	24	Cir	98.788	46.54	51.17	4.687	52.62*	56.59*	1.00	57.59	2	Manhole
4	EX STM PIPE #1	35.09	24	Cir	50.932	51.17	52.15	1.924	57.59*	58.82*	1.94	60.76	3	None

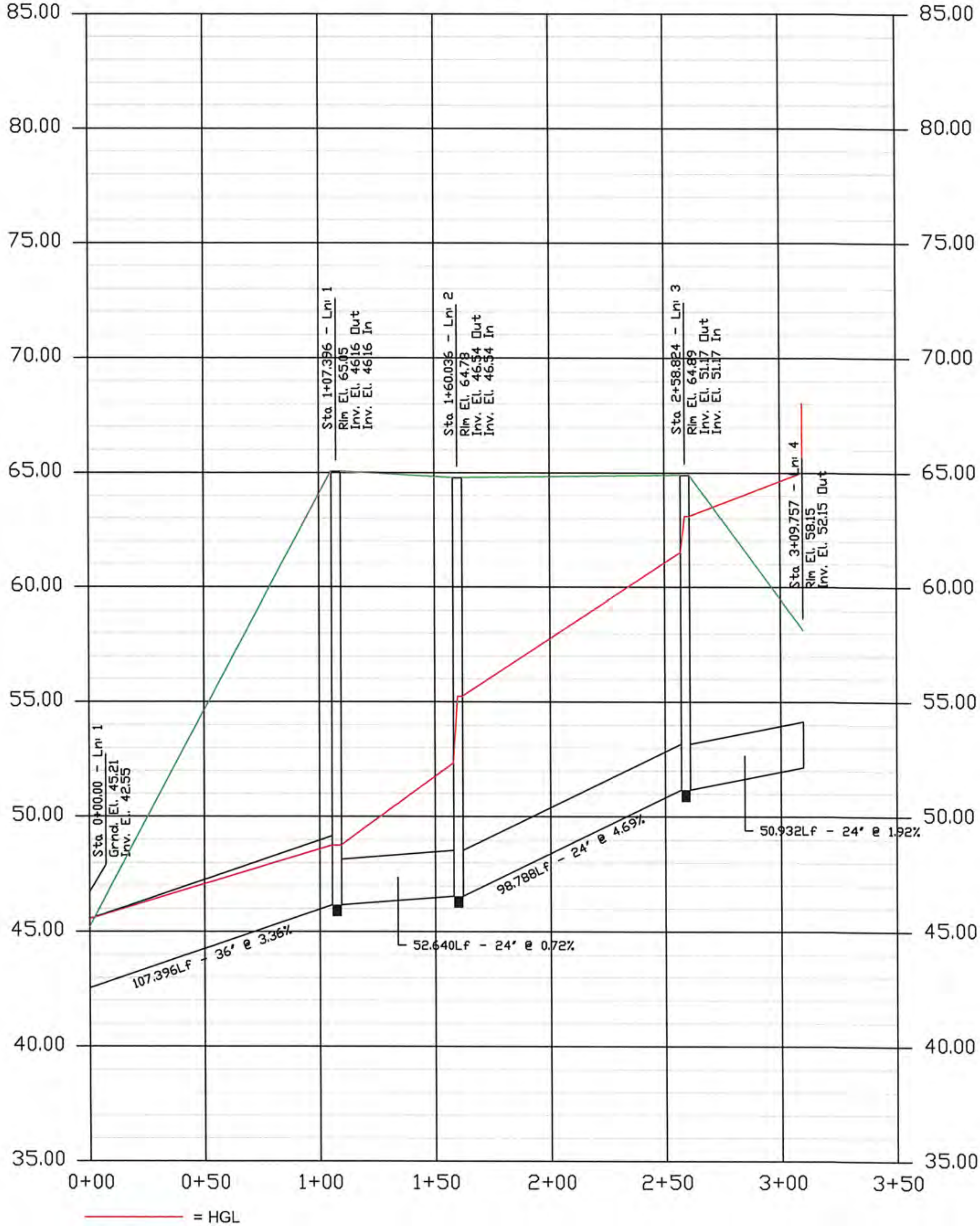
Project File: 25 yr Baltimore and 10th storm drain.stm

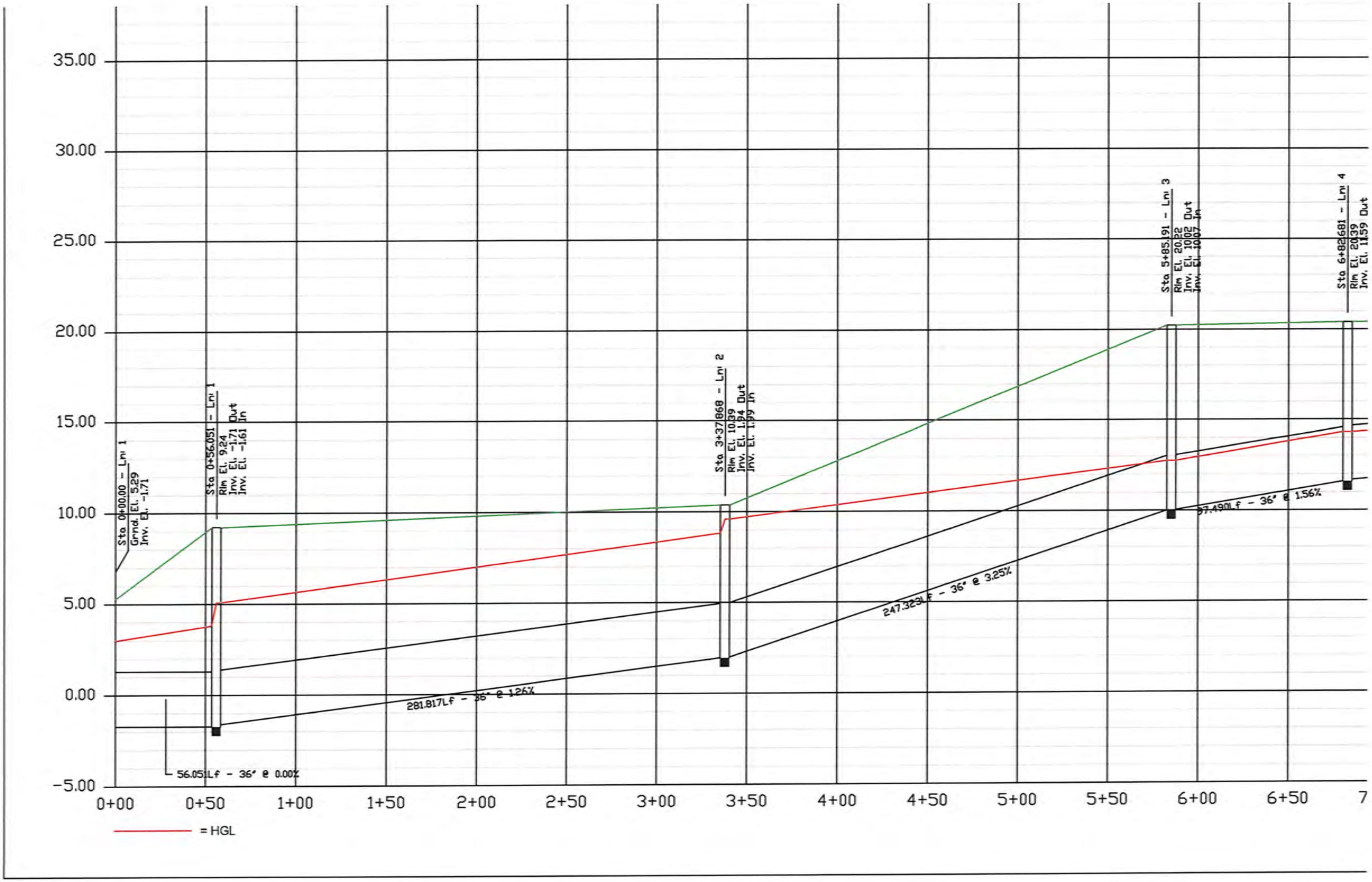
Number of lines: 4

Run Date: 8/2/2014

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown).

100 YR STORM - BALTIMORE AND 10TH STREET SYSTEM





35.00
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5+50
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6+50
7
Sta 0+00.00 - Ln: 1
Grnd. El. 5.29
Inv. El. -1.71
Sta 0+56.051 - Ln: 1
Rim El. 9.24
Inv. El. -1.71 Out
Inv. El. -1.61 In
Sta 3+37.868 - Ln: 2
Rim El. 10.39
Inv. El. 1.94 Out
Inv. El. 1.99 In
Sta 5+85.191 - Ln: 3
Rim El. 20.22
Inv. El. 10.02 Out
Inv. El. 10.07 In
Sta 6+82.681 - Ln: 4
Rim El. 20.39
Inv. El. 11.59 Out
56.051Lf - 36" @ 0.00%
281.817Lf - 36" @ 1.26%
247.323Lf - 36" @ 3.25%
97.490Lf - 36" @ 1.56%
= HGL

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan

Project File: 25 yr lower 36-inch section to outfall.stm	Number of lines: 5	Date: 8/2/2014

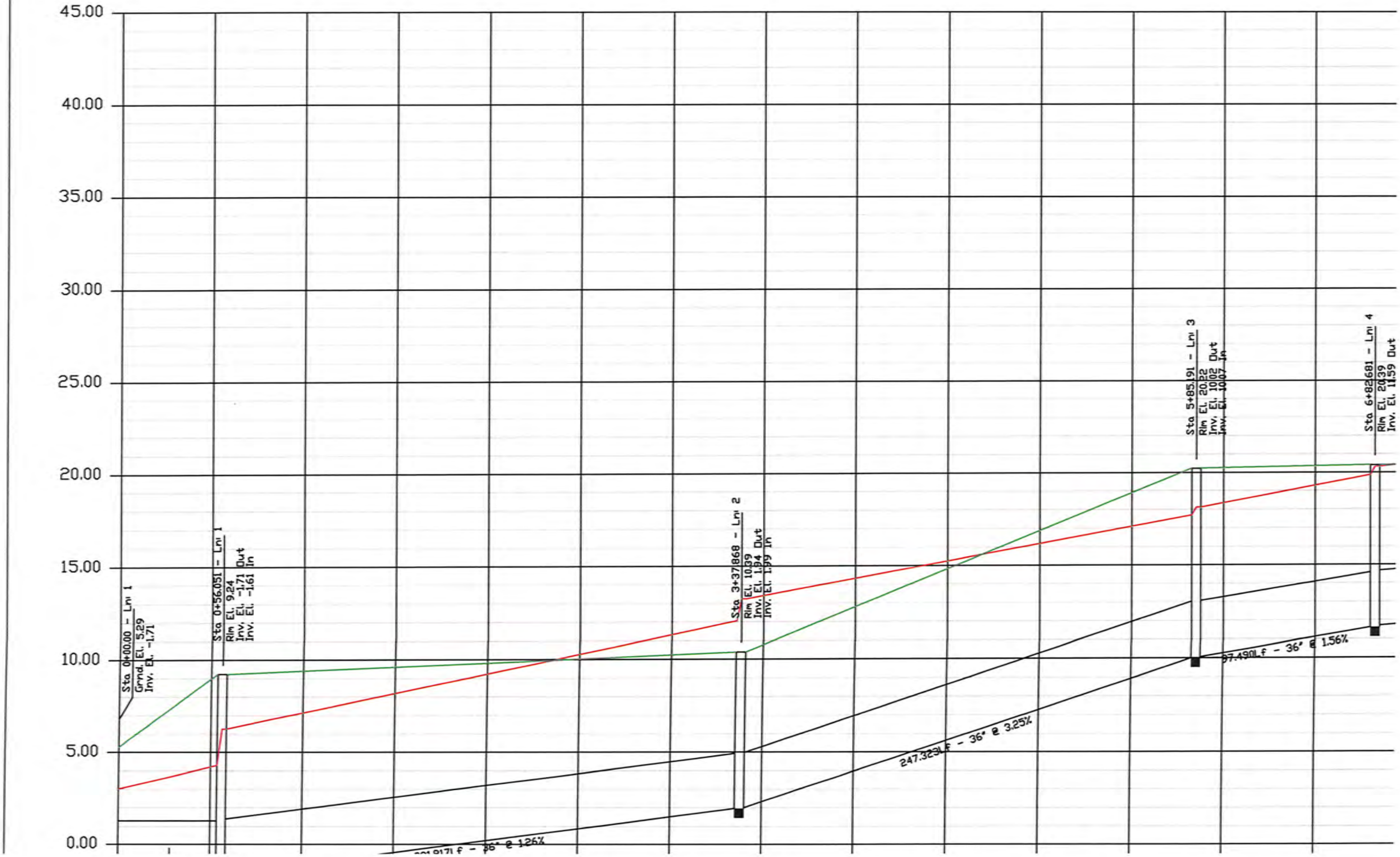
Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	EX STM PIPE #9	87.62	36	Cir	56.051	-1.71	-1.71	0.000	3.00*	3.83*	1.29	5.12	End	Manhole
2	EX STM PIPE #8	83.00	36	Cir	281.817	-1.61	1.94	1.260	5.12*	8.84*	0.77	9.61	1	Manhole
3	EX STM PIPE #7	77.64	36	Cir	247.323	1.99	10.02	3.247	9.61	12.77	0.31	12.77	2	Manhole
4	EX STM PIPE #6	77.64	36	Cir	97.490	10.07	11.59	1.559	12.77	14.34	0.31	14.34	3	Manhole
5	EX STM PIPE #5	60.27	36	Cir	248.342	11.69	13.63	0.781	14.34	16.13	1.42	16.13	4	None

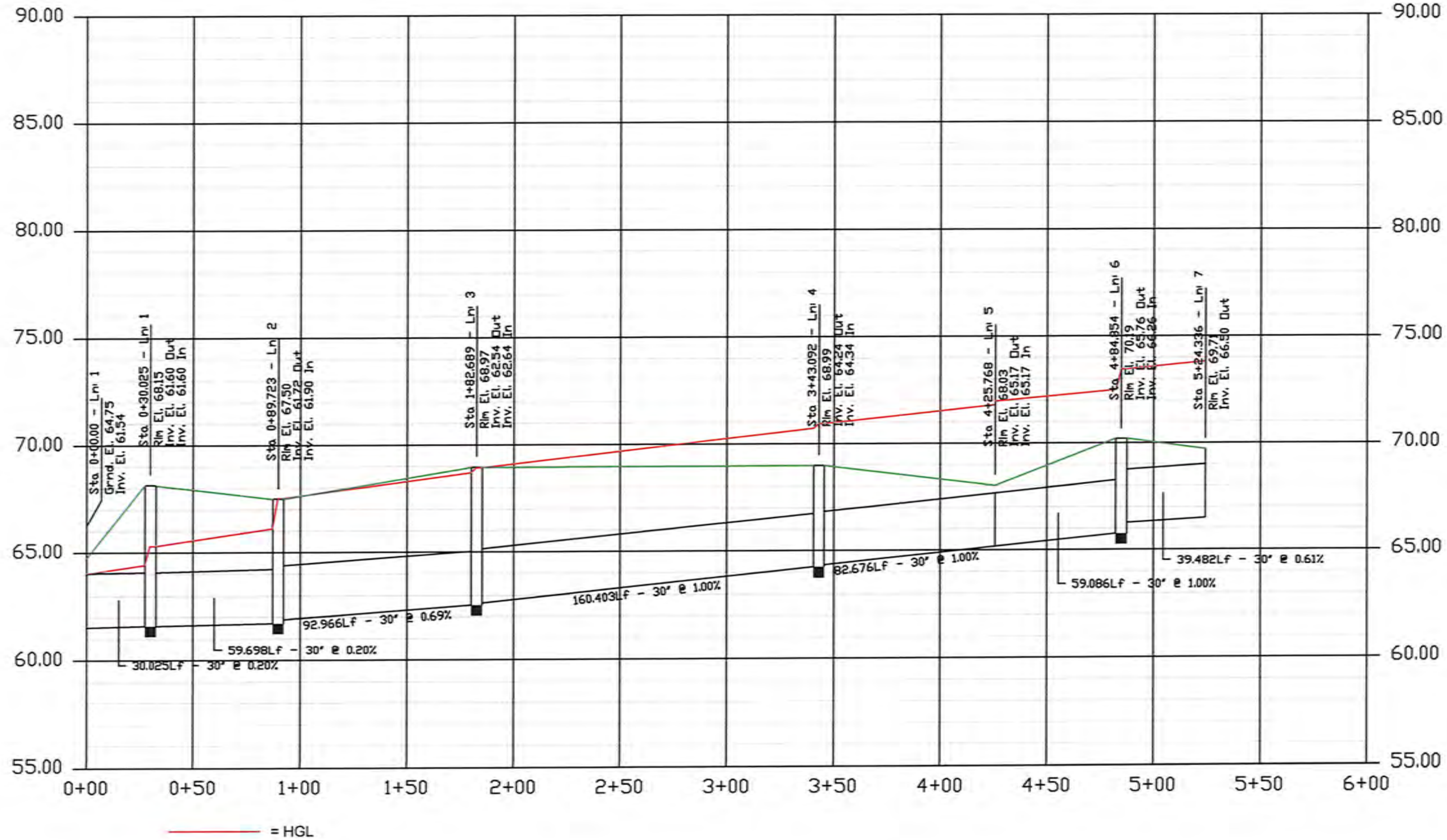
Project File: 25 yr lower 36-inch section to outfall.stm | Number of lines: 5 | Run Date: 8/2/2014

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown).

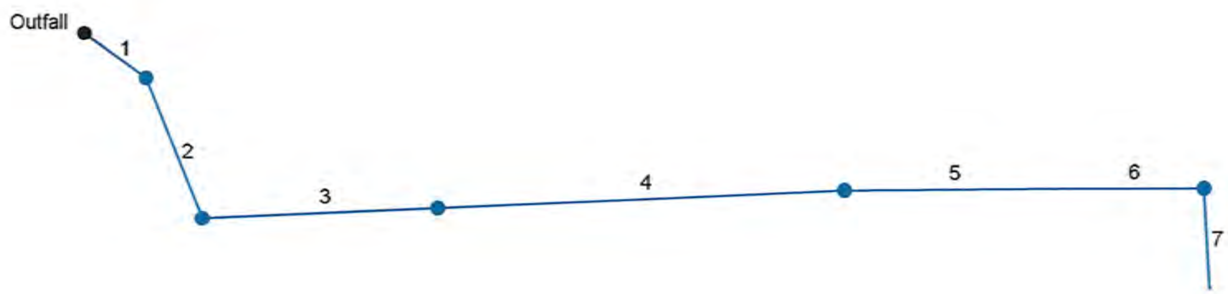
100 YR STORM - EXISTING 36-INCH LOWER STORM SYSTEI



25 YR STM - NEW 11TH STREET SYSTEM WITH DEVELOPED BASIN 1 FLOW



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 25 yr new 11th st storm W-PROJECTED FLOWS FROM DEVELOPED BASIN 1.stm	Number of lines: 7	Date: 8/2/2014

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	Pipe - (125)	48.38	30	Cir	30.025	61.54	61.60	0.200	64.04*	64.46*	0.88	65.33	End	Manhole
2	Pipe - (124)	47.72	30	Cir	59.698	61.60	61.72	0.201	65.33*	66.14*	1.40	67.54	1	Manhole
3	Pipe - (75)	46.34	30	Cir	92.966	61.90	62.54	0.688	67.54*	68.73*	0.21	68.93	2	Manhole
4	Pipe - (74)	43.59	30	Cir	160.403	62.64	64.24	0.997	68.93*	70.75*	0.18	70.93	3	Manhole
5	Pipe - (73)	41.96	30	Cir	82.676	64.34	65.17	1.004	70.93*	71.80*	0.17	71.97	4	None
6	NEW STM PIPE #2	38.64	30	Cir	59.086	65.17	65.76	0.999	71.97*	72.49*	0.96	73.46	5	Manhole
7	Pipe - (88)	38.64	30	Cir	39.482	66.26	66.50	0.608	73.46*	73.81*	0.96	74.77	6	Manhole

Project File: 25 yr new 11th st storm W-PROJECTED FLOWS FROM DEVELOPED BASIN 1.stm | Number of lines: 7 | Run Date: 8/2/2014

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown).

Provide PHOTOCOPIES of the completed notification form and map to the local offices of the Water Resources Department and the Oregon Department of Fish and Wildlife IF AND ONLY IF you plan to use on-site water to mix pesticides or to control slash burns. In the applicant remarks section of the notification form identify the proposed water source. Addresses of the Water Resources and ODF&W offices are available in each Forestry office.

<u>A notification is not considered accepted until it is received by the Forestry office that handles the location of your planned activity.</u> Mail, fax or hand-deliver the notification form to the offices whose addresses are shown below.

For assistance filling out the notification form, contact your local ODF office.

OFFICE	COUNTIES COVERED	ADDRESS	PHONE NO.	FAX NO.
ASTORIA	Clatsop	92219 Hwy #202, 97103	503-325-5451	503-325-2756
BAKER CITY	Baker	2995 HUGHES LANE, 97814	541-523-5831	541-523-5874
CENTRAL POINT	Jackson	5286 TABLE ROCK ROAD, 97502	541-664-3328	541-776-6184
COLUMBIA CITY	Columbia, Clatsop	405 E STREET, 97018	503-397-2636	503-397-6361
COOS BAY	Coos, Curry, Douglas	63612 FIFTH STREET, 97420	541-267-4136	541-269-2027
DALLAS	Polk, Yamhill	825 OAK VILLA ROAD, 97338	503-623-8146	503-623-9034
FOREST GROVE	Tillamook, Washington, West Multnomah, Yamhill	801 GALES CREEK ROAD 97116-1199	503-357-2191	503-357-4548
FOSSIL	Wheeler, Morrow, Gilliam	45945 HWY 19, 97830	541-763-2575	541-763-2027
GRANTS PASS	Josephine	5375 MONUMENT DRIVE, 97526	541-474-3152	541-474-3158
JOHN DAY	Grant	PO BOX 546, 97845 (415 PATTERSON BRIDGE RD.)	541-575-1139	541-575-2253
KLAMATH FALLS	Klamath, Lake	3200 DELAP ROAD 97601	541-883-5681	541-883-5555
LAGRANDE	Baker, Malheur, Union	611 20TH STREET, 97850	541-963-3168	541-962-1058
LAKEVIEW	Lake, Klamath	2290 NORTH 4TH STREET, 97630	541-947-3311	541-947-3078
MEHAMA	Linn, Marion	22965 N. FORK ROAD SE, LYONS 97358	503-859-2151	503-859-2158
MOLALLA	Clackamas, East Multnomah	14995 S. HWY 211, 97038	503-829-2216	503-829-4736
MONUMENT	Grant, Wheeler	PO BOX 386, 97864 (MAY STREET)	541-934-2300	541-934-2301
PENDLETON	Umatilla, Grant, Morrow	1055 AIRPORT ROAD 97801	541-276-3491	541-276-0710
PHILOMATH	Benton	24533 ALSEA HWY, 97370	541-929-3266	541-929-5549
PRINEVILLE	Crook, Deschutes, Jefferson	3501 NE 3RD, 97754	541-447-5658	541-447-1469
ROSEBURG	Douglas	1758 NE AIRPORT ROAD 97470-1499	541-440-3412	541-440-3424
SPRINGFIELD	Lane	3150 E MAIN STREET, 97478	541-726-3588	541-726-2501
SWEET HOME	Linn	4690 HWY 20, 97386	541-367-6108	541-367-5613
THE DALLES	Hood River, Sherman, Wasco	3701 W. 13TH ST., 97058	541-296-4626	541-298-4993
TILLAMOOK	Tillamook	5005 THIRD STREET, 97141-2934	503-842-2545	503-842-3143
TOLEDO	Lincoln	763 NW FORESTRY ROAD, 97391	541-336-2273	541-336-5261
VENETA	Lane, Douglas	PO BOX 157, 97487 (87950 TERRITORIAL HWY)	541-935-2283	541-935-0731
WALLOWA	Wallowa	802 WEST HWY 82, 97885	541-886-2881	541-886-9085

PLEASE PRINT OR TYPE INFORMATION ONTO THE FORM. Please don't write in shaded areas. The instructions are numbered to match numbered areas on the notification form.

Instructions For Filling Out The Notification Of Operation/Application For Permits form 629-2-1-002A

File notice with the State Forester at least **15 days** prior to the date you would like to start operating.

File a notification (form 629-2-1-002A) at an Oregon Department of Forestry (ODF) office if **any** of the following conditions apply:

- Your operation area is brand new.
- You are adding a new activity to the operation.
- You are changing or increasing the area involved in an existing operation.
- It is after February 28, and you are continuing an operation that has been idle since the end of the previous calendar year and you have not informed ODF you intend to continue the operation before now.

1. "COUNTY (Enter only one)." Fill in the county name where the operation will take place. If an operation spans two or more counties, file a separate notification for each county. The address list shows which counties are handled by which offices.

2. "NOTICE AND PERMIT TYPE" Check Appropriate Boxes (2A, 2B and/or 2C). Checkmark in the boxes next to the notices you are giving and/or the permit you need. Anyone filing a notification for hauling only should check box 2B.

3. "REPRESENTATIVE" The person ODF should contact in case of fire emergency. Print the name and phone number. This person must know what resources you have available to fight the fire and have the authority to commit those resources.

4. "Timber Sale Name and/or Number" This information is required for all state and federal sales and is <u>optional</u> for private land sales.

"CHECK ONE BOX NEXT TO 5, 6, OR 7 TO INDICATE WHO FILLED OUT THE APPLICATION."

5. "OPERATOR" The name, address and phone of the person or company who is doing the work.

6. "LANDOWNER" The name, address and phone of the person who owns the land. **Harvesting timber may result in a tree planting requirement for the landowner.** RC (Recipient Class) EG (Ethnic Group) and S (Size of land ownership) boxes gather information about the landowner. We ask you to voluntarily enter this information which we will use for annual reports. In these reports, no names are connected with the codes.

Recipient Class	Ethnic Group	Size
1. Local Government	1. Does not apply	1. Does not apply
2. State Government	2. White	2. 0-9 acres
3. Federal Government	3. Black	3. 10-99 acres
4. Individual/Non-industrial Private Forest Landowner (someone who owns 5,000 or fewer acres of forest land, and makes less than 50% of his or her annual income from the primary processing of forest products.)	4. Hispanic	4. 100-499 acres
5. Partnership/Corp. Industrial Forest Landowner	5. American Indian/Alaskan Native	5. 500-999 acres
6. Other (private landowner such as a church or non-profit organization.)	6. Asian/Pacific Islander	6. 1,000-4,999 acres
No number seven.	7. All Other	7. 5,000 + acres

7. "TIMBER OWNER AND TAX PAYER" Enter the name of the person or company, their address and phone number. Fill in EITHER the timber owner's Employer Identification number OR the **last four digits** of the timber owner's Social Security number. The Social Security number information will be held in confidence. The party who owns timber at the point of first measure is the timber owner, and <u>is responsible for paying the harvest and, if applicable, severance taxes</u>.

8. "TYPE OF ACTIVITY." "UNIT NUMBERS" Assign a unit number between 1 and 99. A unit can be:

- A single operating area within a continuous boundary; or
- An operating area with a state or federal sale unit number; or
- A separate area within your total operation area on which you plan to conduct a single type of activity (for example, 30 acres of harvest type 3 only).

Multiple harvest units may be listed on one notification. **BUT**, if **HARVEST** units are **separated** by a mile or more (in a straight line), file separate notifications for each unit.

In all cases, all activities you plan on that unit should be listed beside the unit number. For example, road construction activity needed prior to starting a commercial timber harvest should be described along with the harvest activity. Multiple lines may be used for each unit to describe the activity.

Activity Code	Methods Used	Activity Code	Methods Used
1a. Commercial Thinning. Most of the conifer timber or large hard woods will remain uncut on the unit after harvesting (such as commercial thinning or selective cutting).	Cable/Ground/Other	2a. Road Construction 2b. Road Reconstruction 3. Site Preparation. **(Do not use for building site preparation, this is preparing for planting.)**	Dozer/Backhoe/Other Dozer/Backhoe/Other Manual/Mechanical/ Burning (not slash)
1b. Most, or all, conifer timber or large hardwoods will be cut and removed from the unit during harvesting (such as in clearcuts, shelterwood, and seed tree harvests). 1c. Felling only (no yarding or decking involved).	Cable/Ground/Other	4a. Herbicide Application 4b. Insecticide Application 4c. Rodenticide Application 4d. Fertilizer Application 4e. Fungicide Application 4f. Repellent Application	**For Pesticides:** • Ground or Aerial • Common Name (always), Brand Name (if known) • Carrier/Additives • For 2,4-D or triclopyr: specify amine or ester
1d. Other Harvest Type not covered in 1a. or 1b. Describe in applicant's remarks box. (Examples are removal of just cedar timber from a mixed conifer stand, or creating salable chips.)	Other	5. Land Use Change Planned • to agricultural use • to residential use • to other uses Local government land use approval may be required.	**For Fertilizers:** List all the above plus the application rate
1e. Sort Yard. A single location where woods-direct logs are stored prior to being taken to a mill.		6. Treatment of Slash	Manual/Chemical/ Burning/Mechanical
		7. Pre-commercial Thinning	
		8. Others	Explain EXAMPLES: rockpits used in roadway construction and chipping

"Quantity by Unit." Enter either the acres (A) or lineal feet (F) involved in the activity.

"Approximate Thousand Board Feet (MBF) Removed." List the approximate MBF to be removed, for each unit with <u>commercial</u> timber harvesting. For example 50 MBF = 50,000 Board Feet.

9. The starting date **must** be at least 15 days after the date the notification form is received by the appropriate ODF office. Continuation into the next calendar year requires written notification to the local ODF office.

10. "Site Codes." You must enter the W, S, and T conditions code(s) for each unit. Fill in concerns, waters, and resources code(s) when known. We are asking for your assistance in identifying units with characterics that we are bound by law to protect. If you don't know whether any of these characteristics exist, go to item 12.

CONDITIONS	CONCERNS	WATERS	RESOURCES
W100 Within 100 feet of any lake, stream (a channel flowing surface water during some part of the year) **W300** Within 300 ft. of any **estuary** or any **wetland** greater than 8 acres. **WNA** Waters Not Applicable. **S1** No evidence of mass soil movement (landslides, slips slumps) **S2** Evidence of old slides, small failures **S3** Recent or active movement; wet areas. **T1** Slope of **0%** to **35%**. **T2** Slope of **36%** to **65%**. **T3** Slope greater than **65%**. *Enter "T" codes based on the steepest 1/3 of the operation area.	**ARC**(haeological) site. **CGG** Columbia Gorge General management area. **CGS** Columbia Gorge Special management area. **SH** Scenic Highway. The operation takes place near a FPA Scenic Highway. **SW** The operation takes place near a <u>state</u> Scenic Waterway. **UGB** The operation takes place within an Urban Growth Boundary **WG** The operation takes place in the Willamette Greenway.	**SIGNIF. WET.** A wetland 8+ acres. **OTHER WET** (land) **LAKE** 8+ acres. **OTHER LAKES** **STREAM** A channel flowing surface water during some part of the year. **EOS**, important spring in Eastern Oregon. **BOG** Any size Bog. **ES**(tuary) A type of bay. **DWS** Domestic Water Supply. **SEEP** Water **seeps** out of ground, no flow evident.	**BEN** Bald Eagle Nesting site **BEP** Bald Eagle foraging site (A perch.) **BER** Bald Eagle Roosting site **BIO**(logical) site of a rare life form or community, example: a rare snake pit. **BPS** Band-tailed Pigeon Spring. **CC** The operation will result in a single ClearCut or continuation of contiguous clearcuts that exceed 120 acres. **CWD** Columbia White Tail Deer. **GBH** Great Blue Heron nest site. **GLD** Golden eagle nest site. **HLH** High Landslide Hazard Location. **MUR** Marbled Murrelet nesting site. **NSO** Northern Spotted Owl nesting sites. **OSP** Presence of Osprey nest and key components. **RAP** Other Raptor nests. **SBS** Sensitive Bird roosting, nesting, watering site. **T or E** Threatened or Endangered species.

11 "Government Lot Numbers." Special numbers for map locations that do not fit the standard Township/Range grid.

12. "Location of Operation." If the activities codes description for a unit takes up several lines, REPEAT THE CODES ON EACH LINE. DO NOT REPEAT THE LEGAL DESCRIPTION.

13. To request a waiver of the 15-day waiting period, check the box and contact the Stewardship Forester (SF) at the ODF office where the notification is filed. The SF will decide if a waiver will be granted.

14. Print your name in 14a., sign your name and write the date in 14b.

15. "<u>ATTACH MAP AND/OR AERIAL PHOTOS!</u>" The notification form is <u>NOT</u> complete unless a map or aerial photo of the operation area is attached.

On-site inspections may be conducted by the Stewardship Forester to ensure compliance with state laws and rules governing fire protection and forest practices on private land.