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MEMORANDUM

TO:	Jon Holan, Community Development Director City of Forest Grove
FROM:	Anne Sylvester, PTE and Jim Gibson, PE
DATE:	June 24, 2016
PROJECT #:	0742.01 Forest Grove Westside Planning Project
SUBJECT:	Revised Final Westside Water, Sewer and Stormwater Infrastructure Analysis

Introduction and Background

This memorandum presents an assessment of the key municipal infrastructure systems that needs to be in place to develop property in the Westside Planning Area. This infrastructure system includes: a collector level street system, a water service system, a sewer system and a stormwater management system. Included in the memorandum are:

- Maps that lay out the proposed systems for providing municipal services,
- Descriptive text that outlines key assumptions, findings and conclusions for each system, and
- Cost estimates for each road and for each element of the water, sewer and stormwater management systems.

As illustrated in Figure 1, two areas within the City of Forest Grove are included in the Westside Planning Project:

- David Hill planning area
- Purdin Road planning area

David Hill - The David Hill planning area is located in the northwestern portion of the City of Forest Grove and has been included in the Urban Growth Boundary (UGB) for several years. David Hill is one of the city's prime growth areas and over 90% of this area is projected to develop by 2025. While urban land use designations currently exist, the need for street and infrastructure planning is urgent. As noted in the figure, the David Hill planning area also incorporates an area between David Hill Road and Gales Creek Road. Much of this area is already developed but it is included to address the integration of land uses and transportation/urban service connectivity.

Purdin Road - The Purdin Road planning area is located east of David Hill and directly north of the city. Today it is predominately used for agricultural purposes. This area was added to the UGB through legislative action in 2014, but there has been no comprehensive planning to guide the designation of urban land uses or infrastructure development. The Westside Planning Project is intended to meet these needs.

Figure 1. Westside Planning Project Study Areas

Organization of This Memorandum

In addition to this Introduction, this memorandum includes five additional sections. These are:

- Land Use Development Assumptions
- Internal Street System
- Sewer System
- Stormwater Management System
- Water System

Revised Land Use Development Assumptions

The development of municipal infrastructure to serve properties in the David Hill and Purdin Road planning areas is based on both the types of land uses that are envisioned for these areas and the magnitude of development that is anticipated.

As with the traffic impact analysis documented in a separate memorandum and conducted to identify roadway improvement needs, potential Transportation System Plan (TSP) amendments, and Transportation Planning Rule (TPR) compliance, the analysis of municipal utility infrastructure is based on the Westside Land Use Alternative as developed by the City and dated October 26, 2015. Figure 2 was developed by City staff to illustrate the component elements of this alternative.

This figure identifies a series of transportation zones by which different land uses are aggregated for analysis purposes. Table 1 includes detailed information concerning the specific land use types and

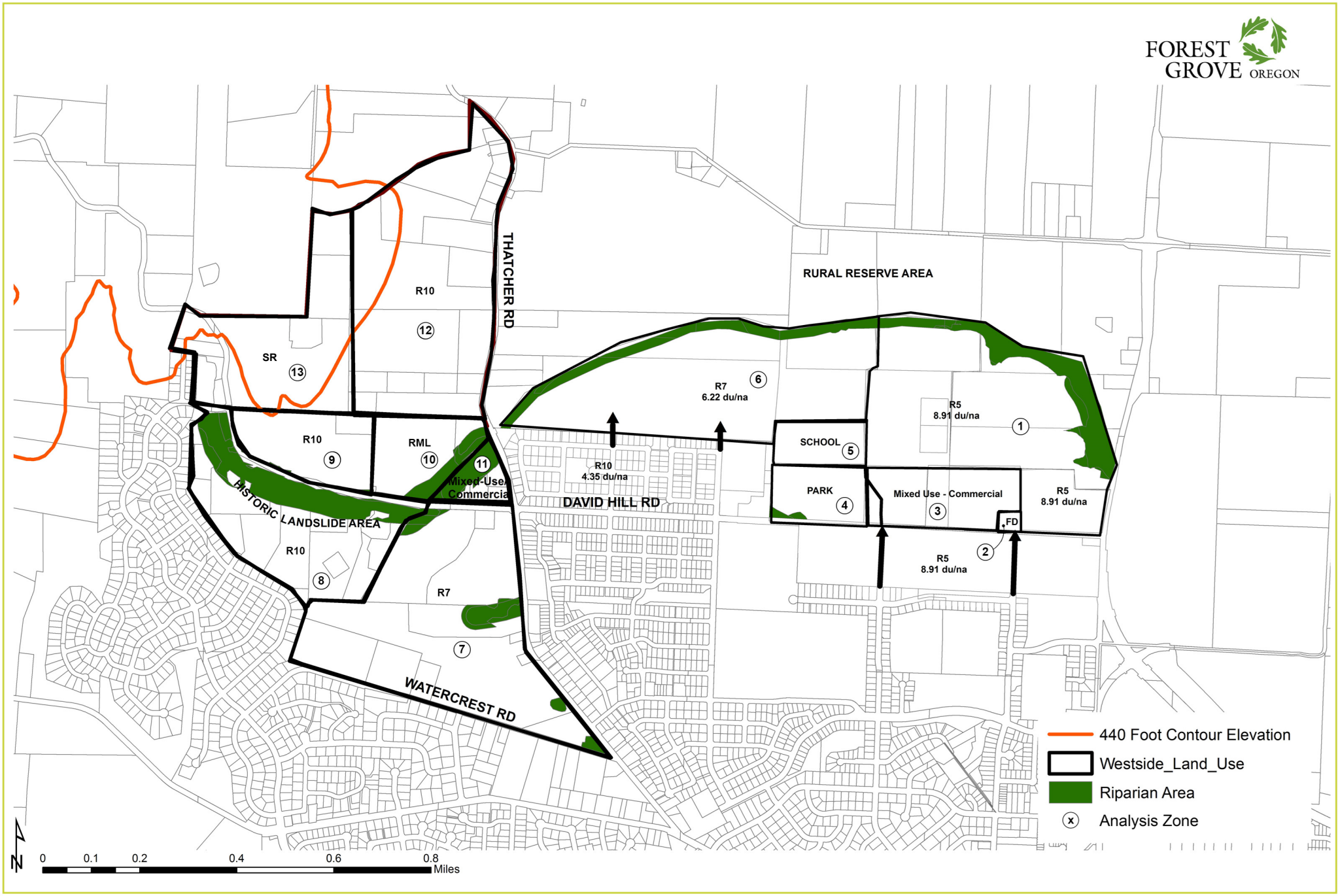

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Figure 2
Revised Land Use Alternative (10/26/15)

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Table 1. Comparison of Existing Comprehensive Plan and Revised Alternative

		Revised Land Use Alternative (4/15/2016)							2014 Comprehensive Plan			
Zone	Area	Density (units/ac)	Net Ac	Slope Deduction	Dwelling Units	KSF	Acres	Employees	Density (units/ac)	Net Ac	Slope Deduction	Dwelling Units
1	Purdin (R5)	8.71	67.76	0%	590					67.76	0%	2
2	Fire Station		2.00	0%				3		2.00	0%	
3	Purdin (Residential)	12.0	18.50	0%	221					18.50	0%	
3	Purdin (Retail Commercial)[1]					46.5		46				
4	Purdin (Park)		10.98	0%			10.98			10.98	0%	
5	Purdin (Elementary School)[2]		11.96	0%		65.0				11.96	0%	
6	Purdin (R7)	6.22	62.08	0%	386				1/20 ac	62.08	0%	3
	Sub-Total Purdin		*173.28*		*1,197*	*111.5*	*10.98*	*49*		*173.28*		*5*
7	Watercrest (R7)[3]	6.22	56.50	10%	316				4.35	56.50	10%	220
8	South of David Hill Rd (R10)[4]	4.35	10.39	20%	36				4.35	10.39	20%	36
9	North of David Hill Rd (R10)	4.35	14.18	15%	52				4.35	14.18	15%	52
10	David Hill Village (R10)	4.35	12.05	15%	44				4.35	12.05	15%	44
11	David Hill Village (Comm)		2.90	0%		15.0		32		2.90	0%	
11	David Hill Village (Res)[5]	12.0	--	0%	4				4.35	--	0%	12
12	Thatcher (R10)	4.35	76.65	10%	300				4.35	76.65	10%	300
13	David Hill (R10)[6]	4.35	28.50	15%	105				1.0	28.50	15%	24
	Sub-Total David Hill/Gales Creek		*201.17*		*857*	*15.0*	*0*	*32*		*201.17*		*688*
	Totals		**374.45**		**2,054**	**126.5**	**10.98**	**81**		**374.45**		**693**

[1] Retail employment based on FAR of 0.25 for retail uses and 11 employees per net acre of commercial land within mixed-use area (approximately 4.2 net acres).
[2] Assumes average school size of 65,000 sq. ft. consistent with newer elementary schools in Forest Grove.
[3] Land area within Thatcher Park and Thatcher Woods has been deducted from total land area. This deduction is approximately 25.18 acres.
[4] Area outside of riparian zone and landslide hazard area.
[5] Assumes limited residential above retail or standalone-plex development
[6] While Figure 2 shows SR zoning for this area, analysis was based on R10 level of development to provide a “worst case” scenario.

quantities included in each zone. Figure 2 also shows existing riparian areas which must be avoided as the area is developed, along with the 440-foot contour interval on the west side of the David Hill area. This elevation represents the limit of existing city water service.

As indicated in Table 1, a net total of just over 374 acres have been identified for development as part of the Westside Planning Project. This excludes areas designated as vegetated corridors under Clean Water Services standards. Under the existing Comprehensive Plan (adopted in 2014) the two planning areas are entirely zoned for residential development yielding a total of 693 single family dwelling units. Under this Revised land use scenario, mixed use development is proposed consisting of single and multi- family dwellings, retail, a fire station and an elementary school. This development would include an estimated 2,054 dwelling units, an increase of 1,361 units over the existing plan with 169 more in the David Hill planning area and 1,192 more in the Purdin Road planning area. The development would also include 61,500 square feet of retail (yielding an estimated 78 employees), a 10.98-acre park, a 2-acre fire station with an estimated 3 employees, and a 65,000-square foot elementary school.

The land use assumptions shown in Table 1 should be considered as a "worst case" scenario for purposes of infrastructure planning. These land uses differ from the version originally endorsed by the Forest Grove Planning Commission in 2015 as follows:

- **Purdin Road** - In the Purdin Road Planning Area the April 2016 documented in this report include a total of 1,197 dwelling units in comparison to the Planning Commission which included 979 dwelling units. Conversely, the Planning Commission version showed a much higher growth assumption for commercial development with 202,600 square feet compared to the 46,500 square feet in the April 2016 version. Fundamentally, the current version assumed much higher residential development (218 more units) and much lower commercial development (156,100 fewer square feet) than the Planning Commission version.
- **David Hill** – Residential development assumptions for the April 2016 version are slightly higher than the Planning Commission version (857 as compared to 776). The primary difference lies in the assumed development density for the area at the western edge of the David Hill. This area has been identified for Suburban Residential development at 1 du/acre in both scenarios, but has been analyzed at a higher density (R10) for purposes of this infrastructure memo. This approach provides a means of testing the financial feasibility of a higher level of development.

Internal Street System

Due to the extent of unknown factors affecting the development of a transportation system for David Hill, the City's recently adopted Transportation System Plan (TSP) did not identify a potential future street system. The TSP called for further refinement planning to address the unique aspects of providing urban services in this topographically challenged area. This refinement planning effort has been incorporated into the Westside Project, along with consideration of connectivity issues for the Gales Creek area located immediately south of David Hill Road. In addition, since the Purdin Road Planning Area was incorporated into the Urban Growth Boundary by Legislative action, no concept plan had been prepared outlining an internal street system. The Westside Project is also intended to address this need.

The development of an internal street system focused on laying out a system of collector level roads intended to provide access to and connectivity through major portions of each planning area.

Street Layout Assumptions

Assumptions made for the initial planning level layout of this collector street system include:

- The number of internal roads and their points of connection to the surrounding street system relies on the traffic impact and improvement needs analysis discussed in a separate memorandum. Internal roads will generally have a single travel lane in each direction with left turn channelization at key intersections.
- The layout of all internal collector streets was based on the collector street classification in the City's Development Code that requires 60 feet of right-of-way and a 40-foot street cross-section. However the streets with half-street roadway improvements require modified collector street standards. (See the Appendix for each street geometric section.)
- All internal collector streets would have bicycle lanes and sidewalks on both sides.
- Connectivity to the surrounding street system takes into account some of the key findings in the City's TSP with respect to the following roads:
    - **David Hill Road** – The extension of David Hill Road is included from its current terminus eastward to intersect at Highway 47 (this project is currently under design and is expected to open in 2018). A single lane roundabout was assumed for the intersection with Highway 47 based on existing project development activities.
    - **Vista Drive** – The addition of the Vista Drive extension between Gales Creek and Thatcher Roads is included in the TSP. With this improvement a significant volume of existing and projected future traffic would be diverted away from the intersection of Gales Creek and Thatcher Roads. Without this improvement it will be necessary to signalize or otherwise improve traffic operations at the Gales Creek/Thatcher intersection.
    - **Main Street and B Street Extensions** – The proposed recommended street layout for the Purdin Road area includes connections into developed portions of the city via extensions of Main Street and B Street. Extensions of these two streets are included in the adopted TSP between Hartford Drive and the David Hill Road extension.

General Street Design Assumptions and Conclusions

- As each road is actually designed it will need to be fully reviewed for compliance with AASHTO, City and/or County standards.
- Vertical curves will need to be designed. The length of each vertical curve identified during final design will affect the volume of cut and fill that were identified based on the initial planning level layout.
- A sight distance review has not been completed. This will need to be included in the roadway final design. This review may require adjustments to the volume of cut and fill initially identified.
- Due to the poor quality of soil infiltration that was identified by the geo-technical consultant for the Westside Planning Project, stormwater is expected to be collected in catch basins and conveyed to stormwater facilities for treatment and detention prior to being released.
- Wetland studies may be required to refine the level of detail currently available about possible wetland locations and impacts to determine if it is necessary to modify the proposed internal street system to avoid wetland impacts or to provide for necessary mitigation.
- It will be necessary to review where and how site access is provided along the proposed collector street system. Where appropriate, site access should occur on the lowest order street

in the functional classification hierarchy (i.e., onto a collector street rather than an arterial like David Hill or NW Thatcher Roads, or onto a local street rather than a collector).

- Roadway access in the David Hill planning area must also consider how topography will affect access to property adjacent to collector roads if this access is required. In many portions of David Hill 3:1 side slopes from the proposed roads would extend up or down for approximately 10 feet. This would make it hard for residential driveways to be constructed. Further, any secondary or local road connections to a collector street will likely start 10 feet below or above the adjacent road grade. This will make it difficult to construct the local road with a grade of less than 12%.
- In-road sewer lines and water line pressure will need to be reviewed with respect to roadway grades. A water storage tank may be needed for additional storage/fire flow or to increase the pressure for the lots. These are further discussed in the sections on the sewer and water systems.
- While the planning level street system layout considers the intersection and driveway spacing requirements of relevant City and/or County standards, the spacing of these connection points will need to be reviewed during final design.
- Roadway design will need to coordinate with all the utilities in addition to the municipal services addressed in this memorandum (i.e., cable, electrical, phone, fiber-optic, natural gas, and/or others).

Individual Street Assumptions and Conclusions

This section presents assumptions, findings and conclusions from the initial planning level layout of individual collector streets within the David Hill and Purdin Road planning areas. These streets are illustrated in Figure 3 and each has been assigned a unique identifier number. It should be noted that only proposed collector roads are shown within the planning areas in this figure. All other internal streets would be considered local roads, and would be identified and laid out when property development proposals are prepared.

Road 1

Road 1 is a northerly extension of Vista Drive which is identified for implementation in the City's 2014 TSP. This road would provide a connection between Watercrest Road and NW Thatcher Road, helping to relieve traffic congestion at the intersection of Thatcher Road with Gales Creek Road. The road would be located through undeveloped property. Planning level roadway design considerations included:

- A collector road way section was used with catch slopes of 3:1.
- Traffic control during construction would be required at intersections with Watercrest Drive and NW Thatcher Road.
- Road grade would be approximately 8 to 10%.

Road 2

This road would provide connectivity to potential future development along the south side of David Hill Road between the Vista Drive extension (Road 1) and a proposed extension of Valley Crest Way from south of Lavina Drive into the development area. The roadway will be located south of an existing resource parcel.

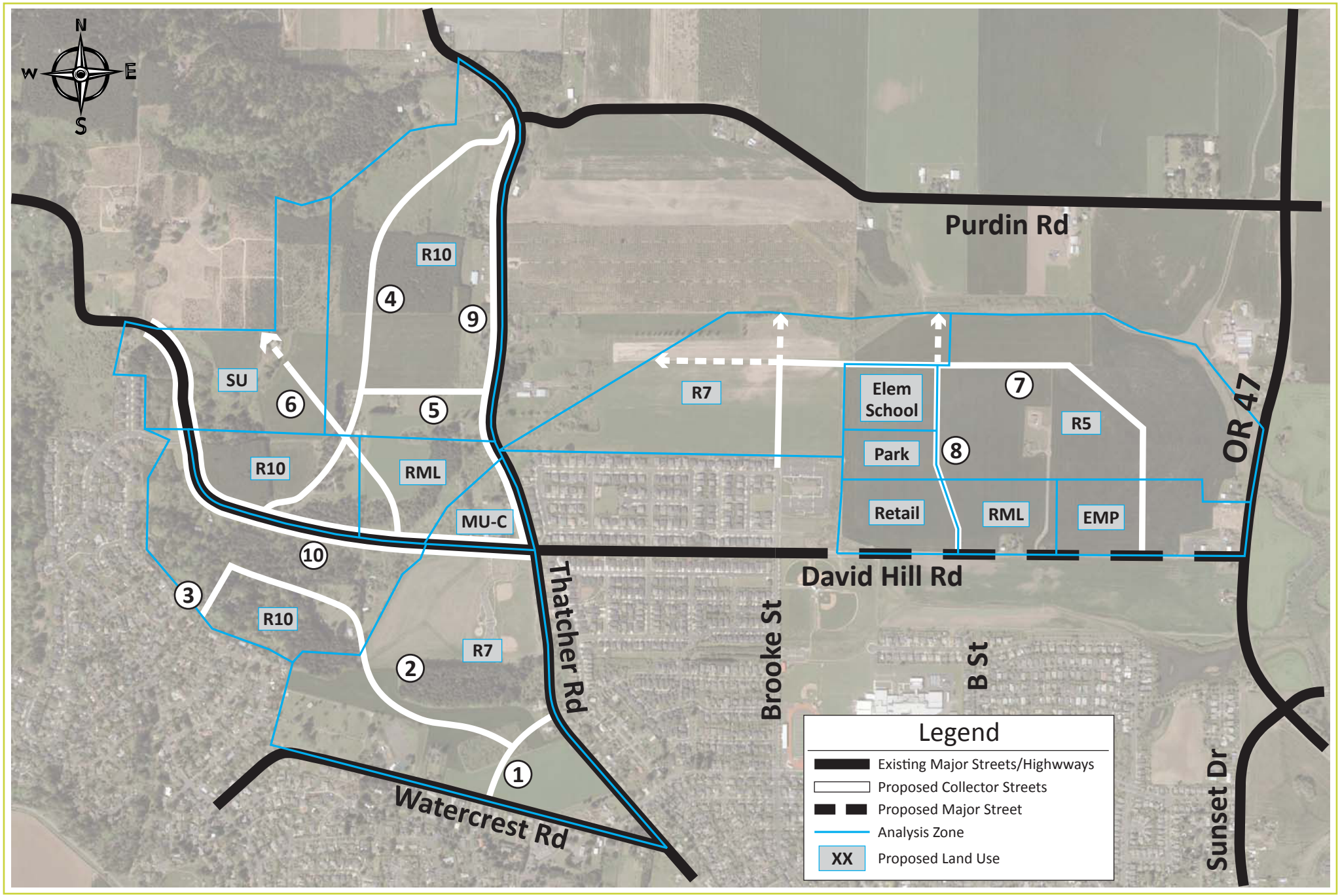

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Figure 3
Proposed Street System

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This area has been identified as a Landslide Hazard Zone and further investigation related to the feasibility of building residential development and associated infrastructure in this area will likely be necessary prior to final design and/or construction of this road. Planning level roadway design considerations included:

- A collector roadway section was used with catch slopes of 3:1.
- Road grade is assumed to be 15% to match the existing site grade of 15% through three small segments of the road totaling 1,250 feet. The remainder of the road would have a grade of 12% or less. If the entire road grade were limited to 12% as required by City Code, additional cut and fill (with associated additional costs) would be required.
- Culverts will need to be sized and placed under the road to allow for stormwater runoff to flow from south to north to the existing creek along the south side of David Hill Road. A minimum of three culverts may be required. See Figure 5 for locations.

Road 3

This road would be an extension of Valley Crest Way north of Lavina Drive. As with Road 2, ultimate feasibility of this road would linked to the overall feasibility of development in the Landslide Hazard Area. Planning level roadway design considerations included:

- A collector road way section was used with catch slopes of 3:1.
- The road grade was assumed to be 12%.
- The road would have an intersection at Lavina Drive that would require traffic control during construction.
- The existing terrain where the road is to be located is forested.

A connection from Road 3 to David Hill Road is not shown due to the potential landslide hazard in this area and the need to cross the stream and vegetative corridor that runs along the south side of David Hill Road through this area.

Road 4

This road would provide major north/south access through the entire David Hill planning area. It would intersect David Hill Road at an existing driveway approximately 2,500 feet west of the intersection with NW Thatcher Road, and then extend generally north and northeast for approximately 4, 700 feet to intersect NW Thatcher Road at Purdin Road. This road represents the spine around which most access into and out of the David Hill planning area would congregate. Planning level roadway design considerations included:

- A collector road way section was used with catch slopes of 3:1.
- Road grade is assumed to be 15% to match the existing site grade of 15% through a small segment of the road totaling slightly over 600 feet in a single location. The remainder of the road would have a grade of 12% or less. If the entire road grade were limited to 12% as required by City Code, additional cut and fill (with associated additional costs) would be required. The earthwork cut section would start out as negligible and increase to an additional six fee of cut at the center and ultimately daylight at the top of the rise. This represents an excavation cost increase of approximately 40% over the 15% design. The cost estimate for this road assumes concrete pavement for this distance.

The analysis in this memo is based on aerial contours and GIS information provided by the City, Metro and other sources. It is possible that when a future developer conducts a field survey of the area and prepares preliminary roadway design, actual topography may be somewhat different than the values assumed in this report. If that were to occur, then it may be possible to meet the 12% grade limitation of the existing Development Code. However, it is also possible that a revision to the City's Development Code may be necessary to allow 15% grades longer than 250 feet. This issue should be addressed if and when it becomes necessary.

- The elevation of Road 4 at its intersection of with Road 6 will need to match. This may control the slope of one or both of the roads.
- The two intersections at the connecting streets were aligned to follow the existing grades more closely. Retaining walls will need to be constructed on each side of the roadway for about 400 feet to match into existing grades at each of these intersections. The wall locations and types will be determined by the residential development during the final design phase.

Road 5

Using the existing alignment of the privately-owned Plum Hill Road, Road 5 would be constructed to urban standards to provide a direct connection between Road 4 and NW Thatcher Road. Planning level roadway design considerations included:

- A collector road way section was used with catch slopes of 3:1.
- Road 5 would have grades ranging from 12% to 15% for the full length of the roadway. If a consistent grade of 12% is used for the design of this road, the elevation of the intersection would need to match Road 4.

Road 6

This road would also provide access into the David Hill planning area from David Hill Road at a new intersection approximately 1,250 feet west of NW Thatcher Road. This access point takes advantage of a location where grades are less steep than most locations along the north side of David Hill Road at this location. This road is assumed to run approximately 2,300 feet north and west of the David Hill Road intersection, serving the far western edge of the planning area. When initially constructed it is expected that this road would end in a temporary turnaround at its western end, but it will be extended further west into the City's Urban Reserve area at such time as this area comes into the UGB and development occurs. Planning level roadway design considerations included:

- A collector road way section was used with catch slopes of 3:1.
- The road grade is assumed to be 15% to match the existing 15% grade for the entire length of the road. If a flatter (12%) slope was assumed, it would require approximately 240,000 cubic yards of additional cut and fill above the level required to achieve a 15% grade. The cul-de-sac at the westerly end of this road would be 40-feet below existing grade if a 12% slope was used.
- The elevation of Road 6 at its intersection with Road 4 will need to match. This may control the slope of one or both of the roads.
- There is an existing residence in the vicinity of the proposed cul-de-sac.

Road 7

Road 7 is the primary road serving the Purdin Road planning area. On its easterly end, it intersects the David Hill Road extension approximately 900 feet west of Highway 47 and then runs north and west into

the planning area. This road would bisect the proposed employment area and provide access into and through the single family residential areas. It turns south at a point that generally aligns with Brooke Street (a city-designated collector street facility). Other roads serving the proposed single family residential areas located in the northern portion of the planning area would be local streets. They are not shown in Figure 3 but would be identified when and as development proposals are prepared. Planning level roadway design considerations included:

- A collector road way section was used with catch slopes of 3:1.
- The road is flat with grades under 5%.
- Culverts will need to be sized and placed under the road to allow for stormwater runoff to flow from west to east. A minimum of two culverts may be required.
- The turns in Road 7 as shown in Figure 3 are for illustrative purposes and will need to be adjusted during final design to meet ASSHTO standards.

Road 8

This north/south road connects to David Hill Road on its southern end approximately 2,400 feet west of Highway 47. This connection is recommended to occur directly opposite an extension of B Street as proposed in the TSP and identified in the pending Silverstone development. On its northern end, Road 8 would intersect Road 7 about 1,500 east of the extension of Brooke Street north into the planning area (i.e., the westernmost end of Road 7). Road 8 provides direct access to a mixed use residential area and commercial development proposed for the north side of David Hill Road. It would also serve the proposed park and elementary school in the heart of the planning area, and provides an alternate route into the single family residential area. Planning level roadway design considerations included:

- A collector road way section was used with catch slopes of 3:1.
- The road is flat with grades under 5%.

Road 9 (Thatcher Road)

Planning level roadway design discussions with the City indicate that half street improvements will be required on the east side of this roadway from Purdin Road to David Hill Road, a distance of approximately 4,050 feet in length. A section of the roadway will be raised to allow for a gravity sewer line to cross over the existing drainage located approximately 900 north of David Hill Road. Crossing the creek depression will take a fill prism of 800 feet. The fill would start at existing grade at the beginning and increase to 15 feet in the center of the depression (approximately 400 feet of distance) then transition back down to existing grade at the 800-foot mark. These improvements are considered as a portion of the City's roadway collector requirements and are included in the cost estimate. See the Appendix for details.

Road 10 (David Hill Road)

David Hill Road is planned for a reconstruction from Thatcher Road west by 5,100 feet. A three lane section is proposed from Thatcher Road west by 850 feet to the existing drainage way. A two lane section is proposed from the drainage way west for another 4,250 feet. Planning level roadway design consideration include:

- A road way section was used with catch slopes of 3:1.
- The road grade is assumed to match the existing grade for the entire length of the road.

Other Roads

Figure 3 also illustrates some potential future roadway connections that are intended to provide collector arterial road access into the Rural Reserve area south of Purdin Road and north of the existing east/west creek (the current UGB line). It is not anticipated that these connections would be made within the 20-year planning horizon for the Westside Planning Area study. However, they are shown to provide a very long-term vision of a future transportation network to both serve this area and to provide guidance on the type and size of roads that should be built within the UGB.

In Figure 3, these roads are shown as dashed lines with arrows that point to the future extension. They include future extensions of Brooke Street and B Street north of Road 7, and a westerly extension of Road 7 to the UGB that would be aligned north of and parallel to David Hill Road. This westerly extension could ultimately connect with Road 5 on the west side of Thatcher Road providing additional east/west connectivity between the David Hill area and the Purdin Road area.

These street extensions would be designated as collector streets and designed accordingly. It is anticipated that they will provide local access only if the Rural Reserve area develops. At that time they will function as collectors.

Internal Road System Cost Estimates

Table 2 summarizes planning level cost estimates prepared for the ten internal roads in the Westside Planning Project area. More detailed information is included in a cost estimate worksheet prepared for each road and included in Appendix A. As indicated in the table, total estimated cost for constructing the designated collector street system with the amenities and cross-section required by City Code would be $29,463,900. It should be noted that this estimate does not include any local street construction or any street mitigation that may be required as a result of the traffic impact assessment. This estimate is subject to the limitations and caveats noted above in general and/or for each specific roadway. All costs included in Table 2 are assumed to be private costs associated with providing access for development or traffic impact mitigation.

Table 2. Westside Planning Project Area Internal Street System Cost Estimates

No.	Street Name	Limits	Description	Estimated Cost
1	Road 1 – Gales Ck (Vista Drive)	Watercrest Road to NW Thatcher Road	Construct new 1,050-foot urban collector street	$1,000,300
2	Road 2 – Gales Ck	Area 7 to Area 8	Construct new 3,200-foot urban collector street	$4,246,000
3	Road 3 – Gales Ck	Area 8 Connector	Construct new 600-foot urban collector street	$787,200
4	Road 4 – David Hill	David Hill Road to Purdin Road	Construct new 4,700-foot urban collector street	$6,409,200
5	Road 5 – David Hill (Plum Hill Road)	Area 13 Mid-Block Connection to Thatcher Road	Construct new 1,250-foot urban collector street	$1,212,200
6	Road 6 – David Hill	Area 13 to temporary turn-around	Construct new 2,300-foot urban collector street	$2,391,000
7	Road 7 – Purdin	Brooke Street to David Hill Road	Construct new 5,500-foot urban collector street	$4,766,200

Table 2 Continued. Westside Planning Project Area Internal Street System Cost Estimates

No.	Street Name	Limits	Description	Estimated Cost
8	Road 8 - Purdin	David Hill Road to Proposed Brooke Street	Construct new 1,750-foot urban collector street	$1,583,700
9	Road 9 – Thatcher	David Hill Road to Purdin Road	Half street reconstruction, 4050-foot ½ street improvements	$3,124,600
10	Road 10 – David Hill	Thatcher Road to West of Area 9	Full street reconstruction, 5,100-foot urban collector street	$3,943,500
			Totals	**$29,463,900**

Note: See Figure 2 for an illustration of the areas that are referenced in this table.

Sewer System

This section presents a discussion of the proposed sewer system to serve residential and other urban development in the Westside Planning Area. The analysis of sewer system needs is based on the development assumptions identified in Table 2. Sewer services should be designed to meet City of Forest Grove development standards.

Figure 4 illustrates the proposed sewer system improvements to provide service to both the David Hill and Purdin Road planning areas. This system typically follows the existing and/or proposed street system. It includes both sewer lines and manholes.

General Sewer System Design Assumptions and Conclusions

Specific observations, findings and recommendations with respect to the provision of future sewer service to the Westside Planning Area are summarized in the bullet points below:

- The lots off of Road 2 and 3 will flow to a sewer line located south of David Hill Road as indicated in Figure 4. An 8” diameter sewer pipe will be required, but its ultimate location will be determined at the time of development application, and will depend on the nature of development in this area.
- Based on the alignment shown in Figure 3, Road 4 would slope in two directions. The southern ends of Road 4 and Road 6 would generally slope to the south and east. Sewage is this area would be served by gravity flow to an existing connection point at a manhole located at the intersection of David Hill Road and NW Thatcher Road.
- Sewage flow from the north end of Road 4 would flow north and then south along NW Thatcher Road to an existing manhole located approximately 560 feet north of the intersection of David Hill Road and NW Thatcher Road. One of the challenges of making this connection is the stream crossing north of David Hill Road. As noted in the discussion of Road 9 (Thatcher Road), the proposed improvements on this road would include raising approximately 800-feet of this facility to allow gravity flow for the sewer line. It should be recognized that there are other options for moving sewage across the creek including installation of either a siphon or a pump station. These options should be considered during final design of roadway improvements along Thatcher Road.

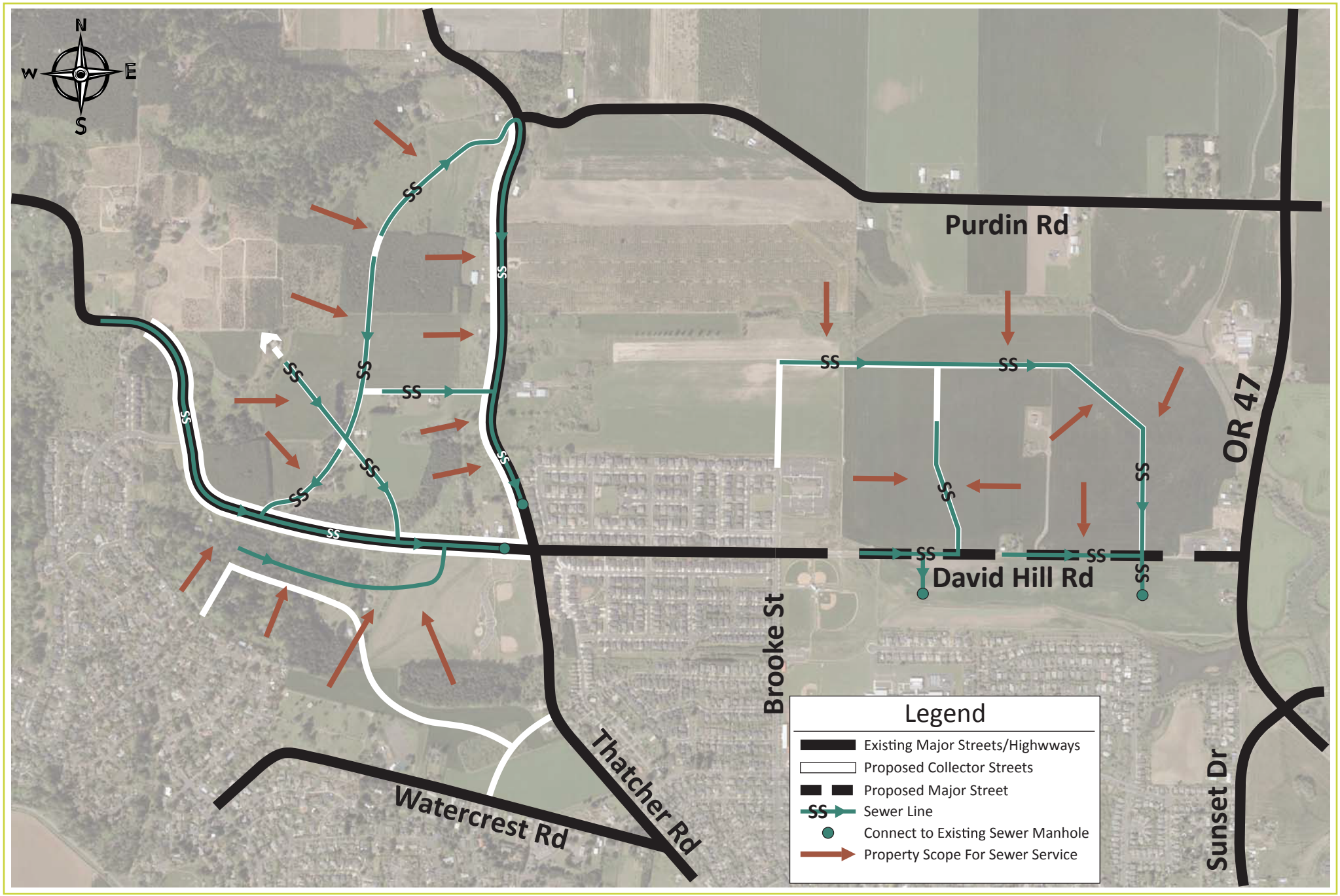

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Figure 4
Sewer Utilities

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Forest Grove, OR

- Sewage flow from Road 5 (Plum Hill Road) will flow east to a gravity sewer line located at the intersection of Road 5 and NW Thatcher Road. The sewer line proposed in Thatcher Road will flow south to an existing sewer line located 600 feet north of David Hill Road.
- The use of connections to the existing sewer system on Thatcher and David Hill Roads was based on an analysis of potential sewer flows from the David Hill Planning Area and a review of the 2009 *Sewer Master Plan*. The Master Plan did not identify a current constriction in the downstream system that would preclude service to the David Hill area. This area is in the current UGB and development at the level identified in the Comprehensive Plan would have been assumed in the development of the Master Plan. The David Hill development assumed in this report would have approximately 170 more dwelling units than were assumed in the Comprehensive Plan. Our analysis also took into account the sewer extensions/connections along David Hill Road (Nehalem Lateral in the 2009 *Sewer Master Plan,* see appendix for an illustration) that are being installed with the roadway connection as currently planned. The Nehalem Lateral extension would connect at generally the same location as the Future North Forest Grove Trunk line. This future trunk line is shown in the Rural Reserve Area north of the Westside Planning Area and the stream. The extension of a sewer line through a Rural Reserve area to connect two portions of a UGB is permitted under state land use regulations[1].
- Sewage flow from Roads 7 and 8 will gravity flow an existing sewer manhole located at the intersection of Hartford Drive and Main Street. This will require coordination with the pending Silverstone development located along the south side of the new David Hill Road alignment west of Highway 47.
- The system wide capacity and flow will need to be verified for design level documents. This report has used the proposed land uses and flows to provide planning level estimates for pipe sizing. This has shown that new 8" diameter sewer mains should be able to support the proposed land uses.
- Based on the assumption that for all new sewer mains 8 inches in size the installation shall be at the developers' expense and no cost sharing is expected between the City and future development. All new sewer mains that are expected to be more than 8 inches in size are assumed to be publicly-funded.
- Additional sewer calculations will need to be completed to determine the required pipe sizes, slopes and pipe cover.

Sewer System Cost Estimates

Table 3 summarizes planning level cost estimates prepared for the major components of the sewer system proposed for the Westside Planning Area. More detailed information is included in a cost estimate worksheet in the Appendix. As indicated in the table, total estimated cost for constructing the proposed sewer system as required by City Code would be $3,635,600. In most cases, the sewer lines were proposed to be 8-inches in diameter. Funding for all 8-inch pipes is assumed to be provided by private developers. Funding for pipes larger than 8 inches is expected to be publicly-funded. This includes the sewer lines proposed along Roads 7 and 8 that are anticipated to be 10-inches in diameter and the line along Road 10 (David Hill Road) is expected to be 12-inches in diameter.

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[1] Per email communication with Anne Debbaut of DLCD staff on May 23, 2016.

The Sewer system cost estimate is preliminary in nature and based best available information at the time of the report. Sewer main locations are based on preliminary roadway locations and GIS topography information. No survey or field verifications have been completed as part of this analysis.

Table 3. Westside Planning Project Area Sewer System Cost Estimates

No.	Description	Estimated Cost
1	Road 1, 2, 3 Sewer Line	$225,000
4	Road 4 Sewer Line	$300,000
5	Road 5 Sewer Line	$82,500
6	Road 6 Sewer Line	$165,000
7	Road 7 Sewer Line (10”)	$405,000
8	Road 8 Sewer Line (10”)	$255,000
9	Road 9 Sewer Line	$262,500
10	Road 10 Sewer Line (700 LF 12”)	$382,500
	Contingencies and Engineering	$1,558,100
	Totals	**$3,2635,600**

Stormwater System

This section presents a discussion of the proposed stormwater management system to the future collector streets being proposed in the Westside Planning Area. The analysis of stormwater system needs is based on the lineal footage of the road layout shown in Figure 3. At this time, the local streets that support the land uses identified in Table 2 have not been included, nor has runoff from property adjacent to the public street system. This memorandum only includes the requirements to construct stormwater ponds for the collector roadways. Future land use applicants will be required to make provisions to meet their own stormwater management needs. The stormwater system will need to be designed to meet Clean Water Services’ development standards. It will be challenging to construct a stormwater treatment facility on existing slopes which range from 8 to 20% in locations.

Figure 5 illustrates the proposed stormwater management system improvements to provide service to both the David Hill and Purdin Road planning areas. This system typically follows the existing and/or proposed street system alignment and places stormwater ponds in areas that are topographically reasonable to collect the stormwater from roadway conveyance systems. Stormwater modeling will be required prior to final design to verify locations, sizes, and elevations of each facility. Each location has assumed that the facility can treat its own stormwater within the footprint of the facility and no retaining walls will be required.

General Stormwater Management System Design Assumptions and Conclusions

Specific observations, findings and recommendations with respect to the provision of future stormwater management service to the Westside Planning Area are summarized in the bullet points below:

- Stormwater from Roads 1, 2 and 3 may be conveyed to a treatment facility located adjacent to NW Thatcher Road. Stormwater from this facility would need to be released to an acceptable location to be determined during design engineering. It is assumed that subdivisions next to public streets will develop their own approach to stormwater management in cooperation with public agencies. There are multiple options to engage in a comprehensive

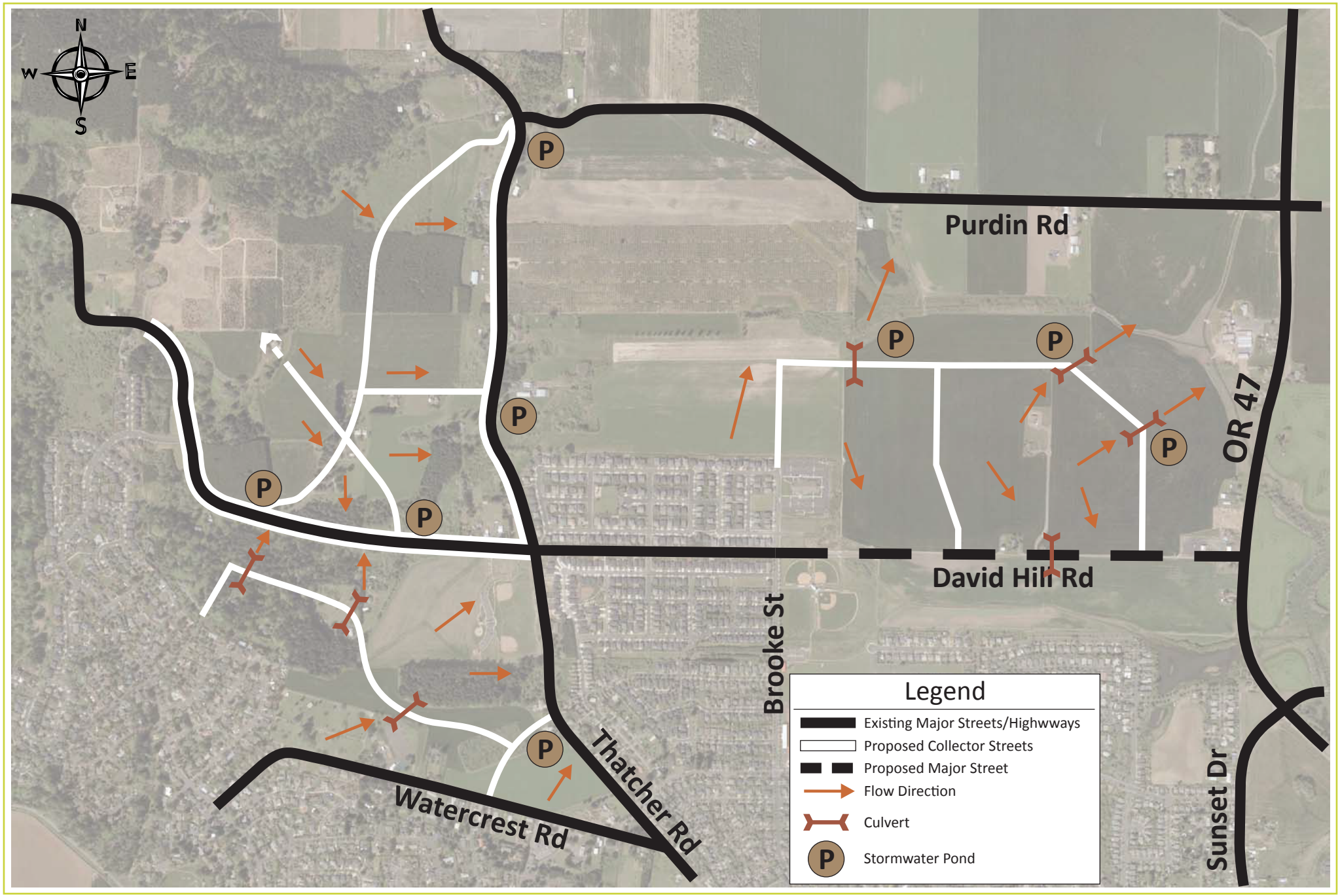

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Figure 5
Stormwater Utilities

Westside Planning Project
Forest Grove, OR

approach to overall stormwater management that must be developed during subdivision or general site design. Any facilities meeting a comprehensive public stormwater management need will be publicly owned and managed.

- Culverts may need to be installed under Road 2 in three locations.
- Stormwater from the south end of Road 4 would be conveyed to a treatment facility located adjacent to David Hill Road and released to an acceptable location to be determined during design engineering. It is assumed that subdivisions next to public streets will develop their own approach to stormwater management in cooperation with public agencies.
- Stormwater from north end of Road 4 would be conveyed to a treatment facility located adjacent to NW Thatcher Road and released to an acceptable location. It is assumed that subdivisions next to public streets will develop their own approach to stormwater management in cooperation with public agencies.
- Stormwater from Road 5 would be conveyed to a treatment facility located adjacent to NW Thatcher Road and released to an acceptable location. It is assumed that subdivisions next to public streets will develop their own approach to stormwater management in cooperation with public agencies.
- Stormwater from Road 6 would be conveyed to a treatment facility located adjacent to David Hill Rd and released to an acceptable location. It is assumed that subdivisions next to public streets will develop their own approach to stormwater management in cooperation with public agencies.
- Stormwater from Road 9 will be collected and conveyed to a treatment facility east of Roadway 5.
- Stormwater from Road 10 will be collected and conveyed to a treatment facility adjacent to Road 2.
- Stormwater from Road 7 may be detained in three treatment facilities and then released.
- Culverts may need to be installed under Road 7 in three locations.
- Stormwater from Road 8 may be detained in a treatment facility and then released.

It should be noted that the locations of the stormwater facilities in Figure 5 are only shown schematically. Based on details to be worked out during design for site development, it is expected that they would be located within public rights-of-way either on property dedicated to the City or County as part of a development-driven road construction or improvement project, or on property acquired by a jurisdiction. At the level of detail addressed in this memo, it cannot be precisely determined whether there is sufficient existing right-of-way along Thatcher Road to provide the stormwater treatment facilities indicated. Based on communications with the Oregon Department of Land Conservation and Development, construction and operation of stormwater treatment facilities in the Rural Reserve area along the east side of Thatcher Road is permitted under state statutes (OAR 660-033-130(10)(A).[2]

During discussions with Clean Water Services (CWS) it was generally accepted that the collector roadways will be constructed as part of the private developments and the stormwater facilities would

[2] Per email communication with Anne Debbaut of DLCD staff on May 23, 2016.

likely be handling stormwater from the collector streets, local streets and land uses. In doing so the private developers would be required to construct the stormwater facilities. For this report, we have only included an estimate of stormwater needs and costs for the collector streets.

All cities in urban Washington County, including the City of Forest Grove, use Clean Water Services' Design and Construction Standards (Standards) as their minimum requirements. The Standards identify how to manage both stormwater quality and quantity. These standards have been consulted during the development of the Westside stormwater management concept. The current CWS stormwater standards require stormwater to just be treated before being released downstream. It is also required to make sure the downstream conveyance is sufficient to handle the additional runoff. It should be noted that Clean Water Services (CWS) is currently making major modifications to these standards which may applicable as soon as 2016. These revisions are expected to require both water quality and quantity control will be the major focus during the upcoming modification process. Stormwater management strategies for collector streets, as well as local roads and individual properties should follow the CWS standards in place at the time of development.

Stormwater Management System Cost Estimates

Table 4 summarizes planning level cost estimates prepared for the proposed stormwater management system in the Westside Planning Area. These estimates include both facilities to address the quantity and quality of water flow. While they are identified separately in the table, they could be co-located when constructed. More detailed information is included in a cost estimate worksheet in the Appendix.

Table 4. Westside Project Planning Area Stormwater Management System Cost Estimates

No.	Description	Estimated Cost
Facilities to address management of stormwater quantity		
1	Road 1, 2, 3 Storm Pond	$75,000
2	Road 4 Storm Pond	$75,000
3	Road 5 and 9 Storm Pond	$100,000
4	Road 6 and 10 Storm Pond	$150,000
5	Road 7 Storm Pond	$200,000
6	Road 8 Storm Pond	$50,000
Facilities to address management of stormwater quality		
7	Road 1, 2, 3 Stormwater Treatment	$35,000
8	Road 4 Stormwater Treatment	$35,000
9	Road 5 and 9 Stormwater Treatment	$70,000
10	Road 6 and 10 Stormwater Treatment	$70,000
11	Road 7 Stormwater Treatment	$20,000
12	Road 8 Stormwater Treatment	$20,000
	Contingencies and Engineering	$675,000
	Totals	**$1,575,000**

As indicated in the table, the total estimated cost for constructing the proposed stormwater management system as required by Clean Water Services and City Code would be $1,575,000. It should

be noted that these cost estimates include construction and engineering only, and do not reflect the cost of any necessary right-of-way. It is to be assumed that developers will be required to dedicate additional land to construct the stormwater facilities. At this time, there is no anticipated public/private split of cost sharing for these facilities. If they are constructed as part of the private developments then the costs would be entirely private.

The Stormwater concept cost estimate is preliminary in nature and based best available information at the time of the report. Storm conveyance mains and pond locations are based on preliminary roadway locations and GIS topography information. No survey or field verifications have been completed as part of this analysis. All costs included in Table 4 are assumed to be private costs associated with providing the basic stormwater management infrastructure necessary for development.

Water System

This section presents a discussion of the proposed water system to serve residential and other urban development in the Westside Planning Area. The analysis of water system needs is based on the development assumptions identified in Table 2 and uses the internal road layout shown in Figure 3. The water system will need to be designed to meet the City of Forest Grove's development standards. New reservoirs will be required to serve the David Hill UGB and Purdin Road UGB. The new reservoirs will include:

- 2.25 Million Gallon (MG) reservoir located near or adjacent to the existing 5.0 MG reservoir at the Treatment Plan. This reservoir will provide service to areas from elevation 155 to 250.
- Two 0.3 MG reservoirs located near or adjacent to the existing 1.0 MG David Hill reservoir. These reservoirs will provide service to areas from elevation 250 to 440.
- One 0.5 MG reservoir located outside of the David Hill UGB and URA. This reservoir will provide service to areas from elevation 440 to 615 within the David Hill UGB and a portion of the David Hill URA from elevation 190 to 615. A future second reservoir of the same size will provide service to the remaining David Hill URA demand from elevation 190 to 615. Cost estimates include both reservoirs (plus land acquisition, piping, pressure reducing valves, and a pump station) to accommodate equitable cost sharing between the UGB and the URA

A key element of providing water service to the westerly portion of the David Hill planning area will be the need to develop and connect to a new reservoir to be located west of the planning area and outside of the City's Urban Reserve Area. Service from a new reservoir is necessary for all properties located above 440-feet of elevation which cannot currently be served by the existing city water system. This approach was selected as constructing a dedicated reservoir to serve the David Hill UGB above elevation 440 was cost prohibitive and did not consider the demands of the development in the David Hill URA. A siting study and sizing analysis will be part of the FY18 Water Master Plan Update.

Figure 6 illustrates the proposed water system improvements to provide service to both the David Hill and Purdin Road planning areas. This system typically follows the existing and/or proposed street system alignment. The areas above 440-feet in elevation and a service connection to proposed new reservoir locations are indicated in the figure. The figure also illustrates potential new reservoir locations in the southern portion of the study area just north of Watercrest Road and near the existing treatment plant.

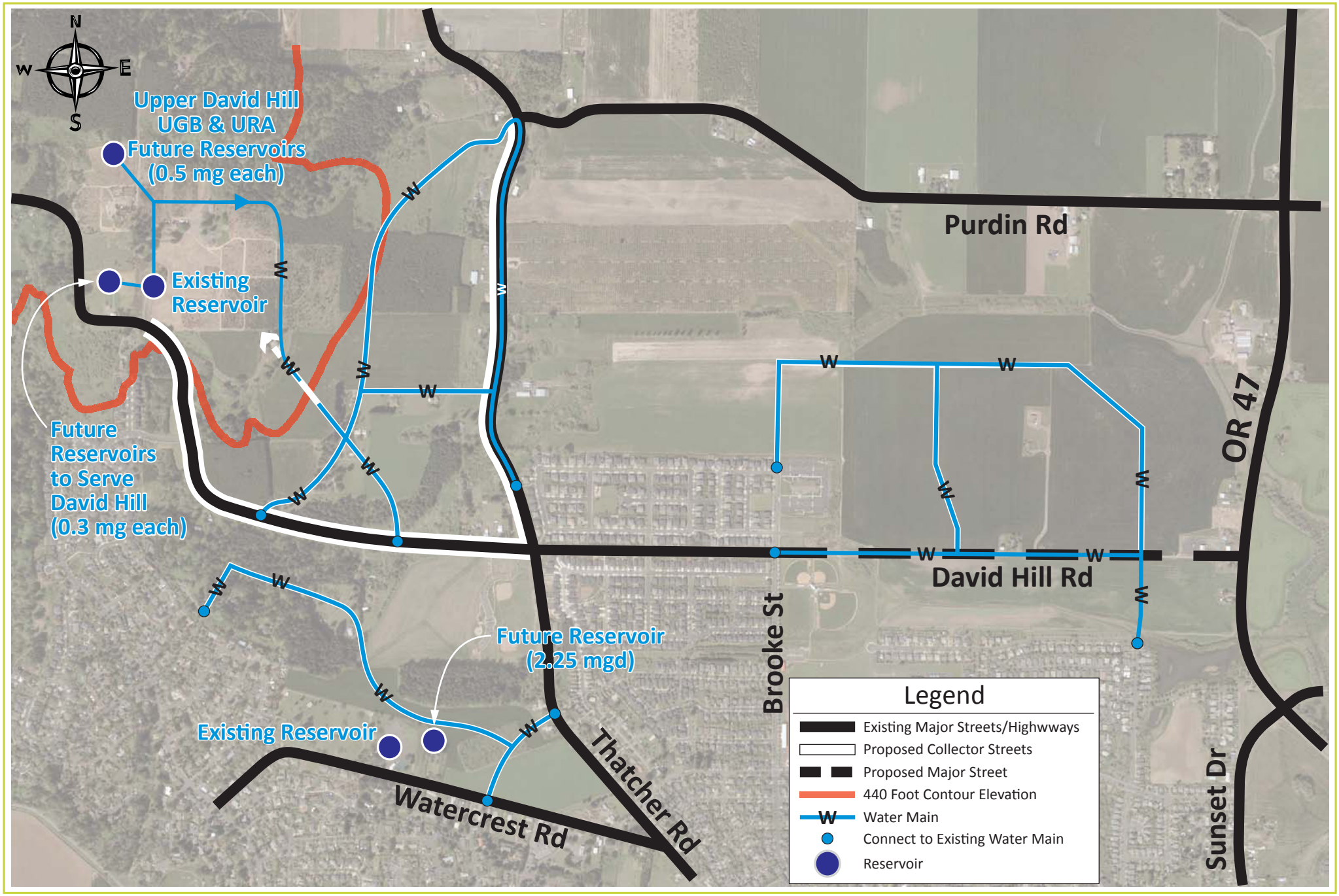

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Figure 6
Water Utilities

Westside Planning Project
Forest Grove, OR

General Water System Design Assumptions and Conclusions

Specific observations, findings and recommendations with respect to the provision of future water service to the Westside Planning Area are summarized in the bullet points below:

- The water main size will need to be analyzed to determine the final required pipe sizing.
- A siting study will be needed to locate reservoirs and determine land value.
- Sizing of the reservoirs and pump station will need to be evaluated.
- The pressure zones will need to be reviewed for the system.
- The system wide capacity and flow will need to be reviewed.
- The placement of fire hydrants will need to be placed based on City code.

Water System Cost Estimates

Table 5 summarizes planning level cost estimates prepared for the proposed water system in the Westside Planning Area. More detailed information is included in a cost estimate worksheet in the Appendix. As indicated in the table, total estimated cost for constructing the proposed water system as required by City Code would be $8,533,000.

Table 5. Westside Project Planning Area Water System Cost Estimates

No.	Description	Linear Feet	Estimated Cost
1	Road 1 Water main	1,050	$63,000
2	Road 2 Water main	3,200	$192,000
3	Road 3 Water main	600	$36,000
4	Road 4 Water main	4,700	$282,000
5	Road 5 Water main	1,250	$75,000
6	Road 6 Water main	2,300	$138,000
7	Road 7 Water main	5,500	$330,000
8	Road 8 Water main	1,750	$105,000
9	Road 9 Water main	3,500	$525,000
10	Two 0.5 MG reservoirs [1]	EA	$500,000
11	Two 0.3 MG reservoirs [2]	EA	$1,950,000
12	One 2.25 MG reservoir near Watercrest Road [3]	EA	$680,000
	Contingencies and Engineering		$3,657,000
	Totals		**$8,533,000**

[1] One reservoir expected to be used by development within David Hill from 440 to 615 feet in elevation and portions of the David Hill URA between 190 and 615 feet. The other reservoir expected to be used to serve the remainder of the David Hill URA between 190 and 615 feet which is included herein to account for the shared costs of land acquisition, piping, pressure reducing values and a pump station. Approximately $500,000 or 10.4% of total cost of these reservoirs would be attributed to serving the David Hill UGB above 440 feet which would include an estimated 105 dwelling units with R10 zoning. If there is a reduction in the density permitted in this area to SR (1 du/acre) approximately $120,000 or 2.5% of the total cost of these reservoirs would be attributed to serving the David Hill UGB above 440 feet which would include an estimated 24 dwelling units.

[2] A portion of these reservoirs will be used to serve the David Hill UGB between 250 and 440 feet. Approximately 67% of total costs would be associated with the David Hill Planning Area.
[3] Approximately 23% of the cost of this reservoir would be associated with the David Hill and Purdin Road Planning Areas.

It should be noted that cost estimates in this table for installation of the new reservoirs that will serve the Westside Planning Area were developed by City staff[3]. Reservoir costs in the table reflect only those costs allocated to the David Hill and Purdin Road UGBs for construction of new reservoirs , the pump station, piping, and pressure reducing valves needed to convey water from the existing David Hill 1.0 MG reservoir to the new reservoir, and land acquisition cost to serve the David Hill and Purdin Road UGBs. Total reservoir-related costs for these areas are $3.13 million which is a portion of the overall storage improvement costs (assuming 105 dwelling units with R10 zoning above elevation 440 feet). The total costs associate with growth for the construction of the reservoirs, pump station, piping, pressure reducing valves, and land acquisition will be paid for by the City using SDC funds.

The Water system cost estimate is preliminary in nature and based on best available information at the time of the report. Water main locations are based on preliminary roadway locations and GIS topography information. No survey or field verifications have been completed as part of this analysis.

Effect of Reduced Land Use Density on West Side of David Hill Planning Area

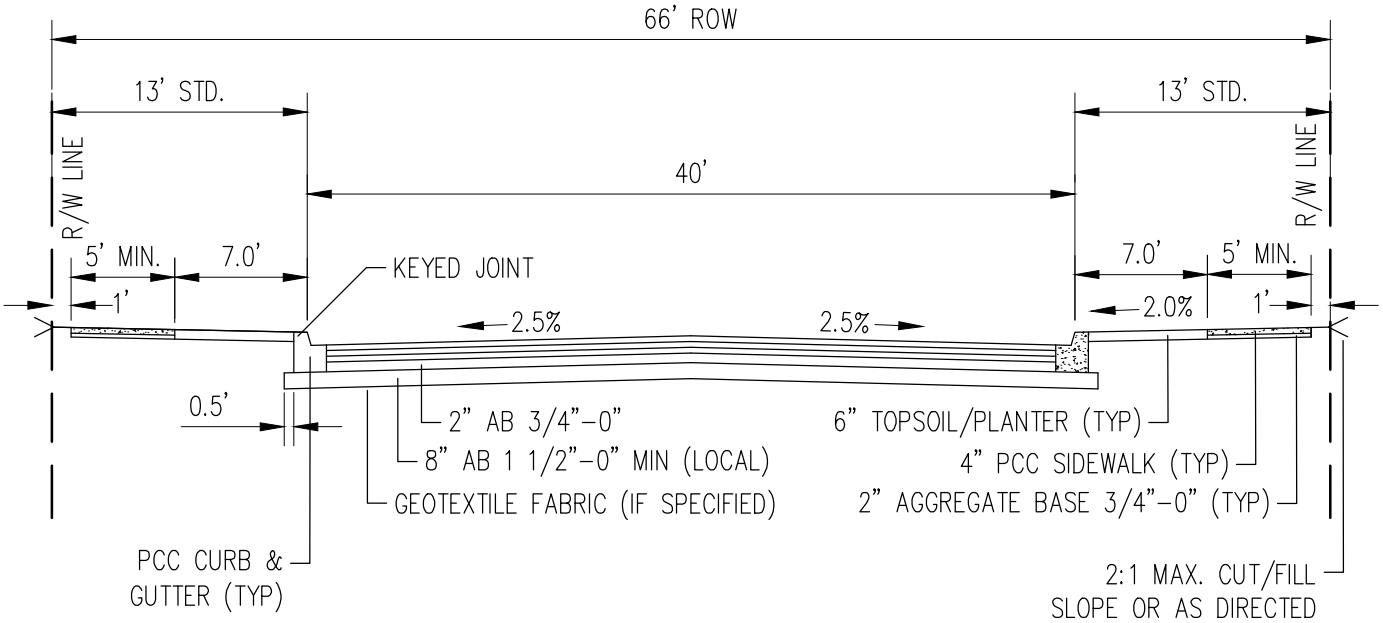
As noted previously, the analysis in this report assumes the land use types and intensities shown in Table 1 under “Revised Land Use Alternative” dated April 15, 2016. This includes medium density development in the western portion of the David Hill Planning Area, generally above 440 feet in elevation. The Planning Commission is proposing Suburban Residential (SR) at 1 dwelling unit per acre

The land use alternative used in this report would include approximately 105 dwelling units on 10,000 square foot lots in Area 13 (this area is assumed to generally represent the area above 440-feet within the Westside Planning Project area). If development intensity were retained at the existing Comprehensive Plan density of 1 unit / acre (SR), only 24 units could be developed. This represents a difference of 81 additional dwelling units between the two land use alternatives.

If the western portion of the David Hill Planning Area were developed at the level of intensity assumed in the Comprehensive Plan rather than the level assumed in Table 1 the cost for the needed reservoirs, their service mains and pump station would have to be borne by a lower number of units. The per unit cost for the added reservoirs would be $4,762 at R10 density ($500,000/105 units) and about $5,000 at SR density ($120,000/24). Some cost savings for the lower density development pattern would be realized for the localized system of roads, sewers and stormwater management facilities that must be borne by private developers. However, it is not expected that there would be a substantial reduction in the cost of collector roads (i.e., the portion of Road 6 leading to the temporary turn-around), or the major sewer, stormwater or water facilities that would serve the western portion of David Hill (as identified in Figures 4, 5 and 6). Private costs for these facilities would still need to be borne largely in their entirely. It should be noted that the value of development on a per unit basis would be higher at SR densities when compared with a R10 designation and have a greater capacity to absorb infrastructure costs. The concern is whether the higher per unit water cost for SR densities as noted above makes this option financially infeasible. This will be further explored as part of the financing program.

[3] Based on Tables 1 and 2 provided by City engineering staff on June 23, 2016.

APPENDIX



COLLECTOR ROADWAY SECTION

NTS

Oct 05, 2015 2:32:33pm – User Lane.sater
N:\PROJECTS\0742 CITY OF FOREST GROVE\0742.01 FOREST GROVE WESTSIDE PLAN\PHASE 10 – WESTSIDE PLAN\CADD\EXHIBITS\742.01 EXH1.DWG

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8730 TALLON LANE NE, SUITE 200, LACEY, WASHINGTON 98516
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HORIZONTAL SCALE:	NTS
DATE:	9/14/15
JOB No.:	742.01
DRAWING FILE No.:	742.01 EXH1.dwg

ROADWAY SECTIONS

FOREST GROVE

EXHIBIT No: **EXH1**

SHEET No: **1**

Option **Roadway 1** **Length** **1050 LF**

Desc. **Watercrest Rd to Thatcher Rd** **Roadway Section** **Collector**

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	MOBILIZATION	1	LS	$ 99,750.00	$ 99,750.00
2	HMAC	1000	TON	$ 110.00	$ 110,000.00
3	AGGREGATE BASE	2800	TON	$ 20.00	$ 56,000.00
4	12 INCH STORM PIPE	1400	LF	$ 40.00	$ 56,000.00
5	CONCRETE INLET	30	EACH	$ 1,500.00	$ 45,000.00
6	CURB AND GUTTER	2100	LF	$ 20.00	$ 42,000.00
7	SIDEWALK	1170	SY	$ 5.00	$ 5,850.00
8	PAVEMENT STRIPING	4200	LF	$ 0.50	$ 2,100.00
9	EARTHWORK	4000	CY	$ 20.00	$ 80,000.00
10	GEOTEXSTILE	5000	EACH	$ 1.50	$ 7,500.00
11	PLANTING STRIP	1600	SY	$ 20.00	$ 32,000.00
12	WATER QUALITY	1	LS	$ 1.00	
13	CLEARING AND GRUBBING	2.0	ACRE	$ 3,000.00	$ 6,000.00
14	SIGNING	1	LS	$ 3,150.00	$ 3,150.00
15	TRAFFIC CONTROL FOR CONSTRUCTION	1	LS	$ 5,250.00	$ 5,250.00
16	SURVEYING	1	LS	$ 21,000.00	$ 21,000.00
	ROADWAY CONSTRUCTION SUBTOTAL				$ 571,600.00
	CONTINGENCY (40%)				$ 228,640.00
	PRELIMINARY ENGINEERING (10%)				$ 80,024.00
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 120,036.00
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 1,000,300.00

Option **Roadway 2** **Length** **3700 LF**

Desc. **Area 7 to Area 8** **Roadway Section** **Collector**

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	MOBILIZATION	1	LS	$ 304,000.00	$ 304,000.00
2	HMAC	3600	TON	$ 110.00	$ 396,000.00
3	AGGREGATE BASE	8500	TON	$ 20.00	$ 170,000.00
4	12 INCH STORM PIPE	4000	LF	$ 40.00	$ 160,000.00
5	CONCRETE INLET	37	EACH	$ 1,500.00	$ 55,500.00
6	CURB AND GUTTER	6400	LF	$ 20.00	$ 128,000.00
7	SIDEWALK	3556	SY	$ 5.00	$ 17,777.78
8	PAVEMENT STRIPING	12800	LF	$ 0.50	$ 6,400.00
9	EARTHWORK	48000	CY	$ 20.00	$ 960,000.00
10	GEOTEXSTILE	18000	EACH	$ 1.50	$ 27,000.00
11	PLANTING STRIP	4700	SY	$ 20.00	$ 94,000.00
12	WATER QUALITY	1	LS	$ 1.00	$ -
13	CLEARING AND GRUBBING	6.0	ACRE	$ 3,000.00	$ 18,000.00
14	SIGNING	1	LS	$ 9,600.00	$ 9,600.00
15	TRAFFIC CONTROL FOR CONSTRUCTION	1	LS	$ 16,000.00	$ 16,000.00
16	SURVEYING	1	LS	$ 64,000.00	$ 64,000.00
	ROADWAY CONSTRUCTION SUBTOTAL				$ 2,426,277.78
	CONTINGENCY (40%)				$ 970,511.11
	PRELIMINARY ENGINEERING (10%)				$ 339,678.89
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 509,518.33
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 4,245,986.11

Option **Roadway 3** **Length** **600 LF**

Desc. **Area 8 Connector** **Roadway Section** **Collector**

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	MOBILIZATION	1	LS	$ 57,000.00	$ 57,000.00
2	HMAC	600	TON	$ 110.00	$ 66,000.00
3	AGGREGATE BASE	1600	TON	$ 20.00	$ 32,000.00
4	12 INCH STORM PIPE	800	LF	$ 40.00	$ 32,000.00
5	CONCRETE INLET	6	EACH	$ 1,500.00	$ 9,000.00
6	CURB AND GUTTER	1200	LF	$ 20.00	$ 24,000.00
7	SIDEWALK	667	SY	$ 5.00	$ 3,333.33
8	PAVEMENT STRIPING	2400	LF	$ 0.50	$ 1,200.00
9	EARTHWORK	9000	CY	$ 20.00	$ 180,000.00
10	GEOTEXSTILE	3000	EACH	$ 1.50	$ 4,500.00
11	PLANTING STRIP	900	SY	$ 20.00	$ 18,000.00
12	WATER QUALITY	1	LS	$ 1.00	$ -
13	CLEARING AND GRUBBING	2.0	ACRE	$ 3,000.00	$ 6,000.00
14	SIGNING	1	LS	$ 1,800.00	$ 1,800.00
15	TRAFFIC CONTROL FOR CONSTRUCTION	1	LS	$ 3,000.00	$ 3,000.00
16	SURVEYING	1	LS	$ 12,000.00	$ 12,000.00
	ROADWAY CONSTRUCTION SUBTOTAL				$ 449,833.33
	CONTINGENCY (40%)				$ 179,933.33
	PRELIMINARY ENGINEERING (10%)				$ 62,976.67
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 94,465.00
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 787,208.33

Option **Roadway 4** **Length** **4700 LF**

Desc. **David Hill Road to Purdin Road** **Roadway Section** **Collector**

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	MOBILIZATION	1	LS	$ 446,500.00	$ 446,500.00
2	HMAC	4500	TON	$ 110.00	$ 495,000.00
3	AGGREGATE BASE	12500	TON	$ 20.00	$ 250,000.00
4	12 INCH STORM PIPE	5900	LF	$ 40.00	$ 236,000.00
5	CONCRETE INLET	47	EACH	$ 1,500.00	$ 70,500.00
6	CURB AND GUTTER	9400	LF	$ 20.00	$ 188,000.00
7	SIDEWALK	5222	SY	$ 5.00	$ 26,111.11
8	PAVEMENT STRIPING	18800	LF	$ 0.50	$ 9,400.00
9	EARTHWORK	56000	CY	$ 20.00	$ 1,120,000.00
10	GEOTEXSTILE	22000	EACH	$ 1.50	$ 33,000.00
11	PLANTING STRIP	6800	SY	$ 20.00	$ 136,000.00
12	WATER QUALITY	1	LS	$ 1.00	$ -
13	CLEARING AND GRUBBING	9.0	ACRE	$ 3,000.00	$ 27,000.00
14	SIGNING	1	LS	$ 14,100.00	$ 14,100.00
15	TRAFFIC CONTROL FOR CONSTRUCTION	1	LS	$ 23,500.00	$ 23,500.00
16	SURVEYING	1	LS	$ 94,000.00	$ 94,000.00
17	RETAINING WALLS	6000	SF	$ 50.00	$ 300,000.00
	ROADWAY CONSTRUCTION SUBTOTAL				$ 3,469,111.11
	CONTINGENCY (40%)				$ 1,387,644.44
	PRELIMINARY ENGINEERING (10%)				$ 485,675.56
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 728,513.33
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 6,070,944.44

Option **Roadway 5** **Length** **1250 LF**

Desc. **Area 13 Mid-Block Connection to Thatcher Road** **Roadway Section** **Collector**

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	MOBILIZATION	1	LS	$ 118,750.00	$ 118,750.00
2	HMAC	1200	TON	$ 110.00	$ 132,000.00
3	AGGREGATE BASE	3400	TON	$ 20.00	$ 68,000.00
4	12 INCH STORM PIPE	1600	LF	$ 40.00	$ 64,000.00
5	CONCRETE INLET	13	EACH	$ 1,500.00	$ 19,500.00
6	CURB AND GUTTER	2500	LF	$ 20.00	$ 50,000.00
7	SIDEWALK	1389	SY	$ 5.00	$ 6,944.44
8	PAVEMENT STRIPING	5000	LF	$ 0.50	$ 2,500.00
9	EARTHWORK	7000	CY	$ 20.00	$ 140,000.00
10	GEOTEXSTILE	6000	EACH	$ 1.50	$ 9,000.00
11	PLANTING STRIP	1900	SY	$ 20.00	$ 38,000.00
12	WATER QUALITY	1	LS	$ 1.00	
13	CLEARING AND GRUBBING	3.0	ACRE	$ 3,000.00	$ 9,000.00
14	SIGNING	1	LS	$ 3,750.00	$ 3,750.00
15	TRAFFIC CONTROL FOR CONSTRUCTION	1	LS	$ 6,250.00	$ 6,250.00
16	SURVEYING	1	LS	$ 25,000.00	$ 25,000.00
	ROADWAY CONSTRUCTION SUBTOTAL				$ 692,694.44
	CONTINGENCY (40%)				$ 277,077.78
	PRELIMINARY ENGINEERING (10%)				$ 96,977.22
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 145,465.83
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 1,212,215.28

Option **Roadway 6** **Length** **2300 LF**

Desc. **Area 13 to Temporary Turn-around** **Roadway Section** **Collector**

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	MOBILIZATION	1	LS	$ 218,500.00	$ 218,500.00
2	HMAC	2200	TON	$ 110.00	$ 242,000.00
3	AGGREGATE BASE	6100	TON	$ 20.00	$ 122,000.00
4	12 INCH STORM PIPE	2900	LF	$ 40.00	$ 116,000.00
5	CONCRETE INLET	23	EACH	$ 1,500.00	$ 34,500.00
6	CURB AND GUTTER	4600	LF	$ 20.00	$ 92,000.00
7	SIDEWALK	2556	SY	$ 5.00	$ 12,777.78
8	PAVEMENT STRIPING	9200	LF	$ 0.50	$ 4,600.00
9	EARTHWORK	18000	CY	$ 20.00	$ 360,000.00
10	GEOTEXSTILE	11000	EACH	$ 1.50	$ 16,500.00
11	PLANTING STRIP	3400	SY	$ 20.00	$ 68,000.00
12	WATER QUALITY	1	LS	$ 1.00	$ -
13	CLEARING AND GRUBBING	5.0	ACRE	$ 3,000.00	$ 15,000.00
14	SIGNING	1	LS	$ 6,900.00	$ 6,900.00
15	TRAFFIC CONTROL FOR CONSTRUCTION	1	LS	$ 11,500.00	$ 11,500.00
16	SURVEYING	1	LS	$ 46,000.00	$ 46,000.00
	ROADWAY CONSTRUCTION SUBTOTAL				$ 1,366,277.78
	CONTINGENCY (40%)				$ 546,511.11
	PRELIMINARY ENGINEERING (10%)				$ 191,278.89
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 286,918.33
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 2,390,986.11

Option **Roadway 7** **Length** **5500 LF**

Desc. **Brook Street to David Hill Road** **Roadway Section** **Collector**

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	MOBILIZATION	1	LS	$ 522,500.00	$ 522,500.00
2	HMAC	5300	TON	$ 110.00	$ 583,000.00
3	AGGREGATE BASE	14600	TON	$ 20.00	$ 292,000.00
4	12 INCH STORM PIPE	6900	LF	$ 40.00	$ 276,000.00
5	CONCRETE INLET	55	EACH	$ 1,500.00	$ 82,500.00
6	CURB AND GUTTER	11000	LF	$ 20.00	$ 220,000.00
7	SIDEWALK	6111	SY	$ 5.00	$ 30,555.56
8	PAVEMENT STRIPING	22000	LF	$ 0.50	$ 11,000.00
9	EARTHWORK	16000	CY	$ 20.00	$ 320,000.00
10	GEOTEXSTILE	26000	EACH	$ 1.50	$ 39,000.00
11	PLANTING STRIP	8000	SY	$ 20.00	$ 160,000.00
12	WATER QUALITY	1	LS	$ 1.00	
13	CLEARING AND GRUBBING	11.0	ACRE	$ 3,000.00	$ 33,000.00
14	SIGNING	1	LS	$ 16,500.00	$ 16,500.00
15	TRAFFIC CONTROL FOR CONSTRUCTION	1	LS	$ 27,500.00	$ 27,500.00
16	SURVEYING	1	LS	$ 110,000.00	$ 110,000.00
	ROADWAY CONSTRUCTION SUBTOTAL				$ 2,723,555.56
	CONTINGENCY (40%)				$ 1,089,422.22
	PRELIMINARY ENGINEERING (10%)				$ 381,297.78
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 571,946.67
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 4,766,222.22

Option **Roadway 8** **Length** **1750 LF**

Desc. **David Hill Road to Proposed Brook Street** **Roadway Section** **Collector**

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	MOBILIZATION	1	LS	$ 166,250.00	$ 166,250.00
2	HMAC	1700	TON	$ 110.00	$ 187,000.00
3	AGGREGATE BASE	4700	TON	$ 20.00	$ 94,000.00
4	12 INCH STORM PIPE	2200	LF	$ 40.00	$ 88,000.00
5	CONCRETE INLET	40	EACH	$ 1,500.00	$ 60,000.00
6	CURB AND GUTTER	3500	LF	$ 20.00	$ 70,000.00
7	SIDEWALK	1950	SY	$ 5.00	$ 9,750.00
8	PAVEMENT STRIPING	7000	LF	$ 0.50	$ 3,500.00
9	EARTHWORK	5000	CY	$ 20.00	$ 100,000.00
10	GEOTEXSTILE	9000	EACH	$ 1.50	$ 13,500.00
11	PLANTING STRIP	2600	SY	$ 20.00	$ 52,000.00
12	WATER QUALITY	1	LS	$ 1.00	$ -
13	CLEARING AND GRUBBING	4.0	ACRE	$ 3,000.00	$ 12,000.00
14	SIGNING	1	LS	$ 5,250.00	$ 5,250.00
15	TRAFFIC CONTROL FOR CONSTRUCTION	1	LS	$ 8,750.00	$ 8,750.00
16	SURVEYING	1	LS	$ 35,000.00	$ 35,000.00
	ROADWAY CONSTRUCTION SUBTOTAL				$ 905,000.00
	CONTINGENCY (40%)				$ 362,000.00
	PRELIMINARY ENGINEERING (10%)				$ 126,700.00
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 190,050.00
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 1,583,750.00

Option **Roadway 9** **Length** **4050 LF**

Desc. **David Hill Road to Purdin Road** **Roadway Section** **1/2 Street Improvements**

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	MOBILIZATION	1	LS	$ 384,750.00	$ 384,750.00
2	HMAC	4100	TON	$ 110.00	$ 451,000.00
3	AGGREGATE BASE	5200	TON	$ 20.00	$ 104,000.00
4	12 INCH STORM PIPE	5100	LF	$ 40.00	$ 204,000.00
5	CONCRETE INLET	90	EACH	$ 1,500.00	$ 135,000.00
6	CURB AND GUTTER	4050	LF	$ 20.00	$ 81,000.00
7	SIDEWALK	2250	SY	$ 5.00	$ 11,250.00
8	PAVEMENT STRIPING	16200	LF	$ 0.50	$ 8,100.00
9	EARTHWORK	11000	CY	$ 20.00	$ 220,000.00
10	GEOTEXSTILE	10000	EACH	$ 1.50	$ 15,000.00
11	PLANTING STRIP	2300	SY	$ 20.00	$ 46,000.00
12	WATER QUALITY	1	LS	$ 1.00	$ -
13	CLEARING AND GRUBBING	4.0	ACRE	$ 3,000.00	$ 12,000.00
14	SIGNING	1	LS	$ 12,150.00	$ 12,150.00
15	TRAFFIC CONTROL FOR CONSTRUCTION	1	LS	$ 20,250.00	$ 20,250.00
16	SURVEYING	1	LS	$ 81,000.00	$ 81,000.00
	ROADWAY CONSTRUCTION SUBTOTAL				$ 1,785,500.00
	CONTINGENCY (40%)				$ 714,200.00
	PRELIMINARY ENGINEERING (10%)				$ 249,970.00
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 374,955.00
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 3,124,625.00

Option **Roadway 10** **Length** **5100 LF**

Desc. **Thatcher Road to West of Area 9** **Roadway Section** **Modified Collector Street**

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	MOBILIZATION	1	LS	$ 484,500.00	$ 484,500.00
2	HMAC	4100	TON	$ 110.00	$ 451,000.00
3	AGGREGATE BASE	11000	TON	$ 20.00	$ 220,000.00
4	12 INCH STORM PIPE	6400	LF	$ 40.00	$ 256,000.00
5	CONCRETE INLET	110	EACH	$ 1,500.00	$ 165,000.00
6	CURB AND GUTTER	10200	LF	$ 20.00	$ 204,000.00
7	SIDEWALK	3400	SY	$ 5.00	$ 17,000.00
8	PAVEMENT STRIPING	10200	LF	$ 0.50	$ 5,100.00
9	EARTHWORK	13000	CY	$ 20.00	$ 260,000.00
10	GEOTEXSTILE	20000	EACH	$ 1.50	$ 30,000.00
11	PLANTING STRIP	0	SY	$ 20.00	$ -
12	WATER QUALITY	1	LS	$ -	$ -
13	CLEARING AND GRUBBING	8.0	ACRE	$ 3,000.00	$ 24,000.00
14	SIGNING	1	LS	$ 15,300.00	$ 15,300.00
15	TRAFFIC CONTROL FOR CONSTRUCTION	1	LS	$ 25,500.00	$ 19,517.65
16	SURVEYING	1	LS	$ 102,000.00	$ 102,000.00
	ROADWAY CONSTRUCTION SUBTOTAL				$ 2,253,417.65
	CONTINGENCY (40%)				$ 901,367.06
	PRELIMINARY ENGINEERING (10%)				$ 315,478.47
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 473,217.71
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 3,943,480.89

Road	Length	Cut	Fill	Total	CY/FT
1	1050	2200	1600	3800	3.6
2	3200	20000	27000	47000	14.7
3	1050			0	0.0
4	4700	33500	22500	56000	11.9
5	1250	5000	1500	6500	5.2
6	2300	14000	4000	18000	7.8
7	5500	9000	6500	15500	2.8
8	1750	3500	800	4300	2.5
9					
10					

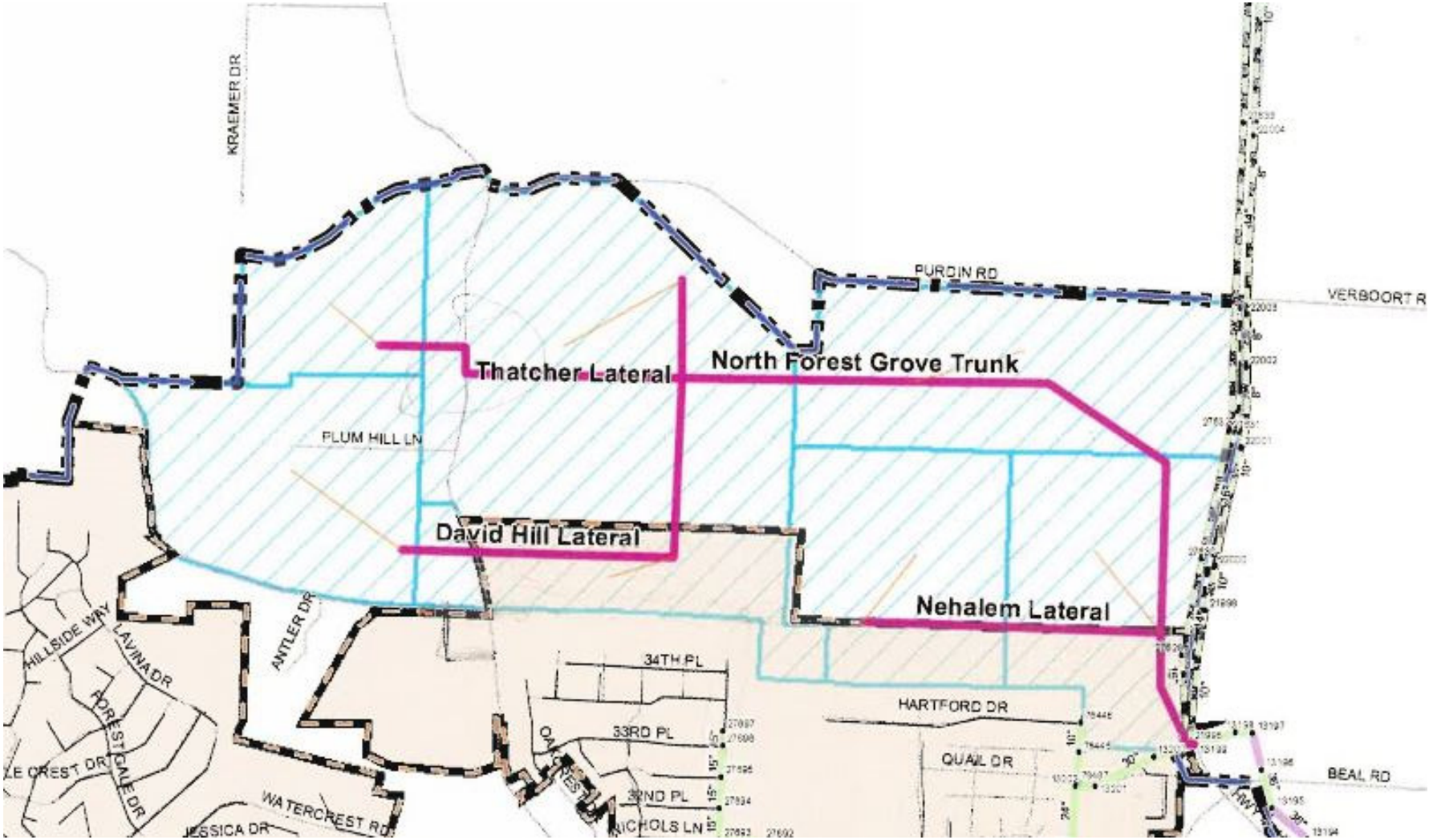
Stormwater Basin

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	Road 1,2,3 Storm Pond	1	EACH	$ 75,000.00	$ 75,000.00
2	Road 4 Storm Pond	1	EACH	$ 75,000.00	$ 75,000.00
3	Road 5 and 9 Storm Pond	1	EACH	$ 100,000.00	$ 100,000.00
4	Road 6 and 10 Storm Pond	1	EACH	$ 150,000.00	$ 150,000.00
5	Road 7 Storm Pond	1	EACH	$ 200,000.00	$ 200,000.00
6	Road 8 Storm Pond	1	EACH	$ 50,000.00	$ 50,000.00
7					$ -
8	Road 1,2,3 Stormwater Treatment	1	EACH	$ 35,000.00	$ 35,000.00
9	Road 4 Stormwater Treatment	1	EACH	$ 35,000.00	$ 35,000.00
10	Road 5 and 9 Stormwater Treatment	1	EACH	$ 70,000.00	$ 70,000.00
11	Road 6 and 10 Stormwater Treatment	1	EACH	$ 70,000.00	$ 70,000.00
12	Road 7 Stormwater Treatment	1	EACH	$ 20,000.00	$ 20,000.00
13	Road 8 Stormwater Treatment	1	EACH	$ 20,000.00	$ 20,000.00
					$ -
					$ -
					$ -
	RETAINING WALLS				
	ROADWAY CONSTRUCTION SUBTOTAL				$ 900,000.00
	CONTINGENCY (40%)				$ 360,000.00
	PRELIMINARY ENGINEERING (10%)				$ 126,000.00
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 189,000.00
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 1,575,000.00

Sewer

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	Road 1, 2 & 3 Sewer Line	3000	LF	$ 75.00	$ 225,000.00
2	Road 4 Sewer Line	4000	LF	$ 75.00	$ 300,000.00
3	Road 5 Sewer Line	1100	LF	$ 75.00	$ 82,500.00
4	Road 6 Sewer Line	2200	LF	$ 75.00	$ 165,000.00
5	Road 7 Sewer Line (10")	5400	LF	$ 75.00	$ 405,000.00
6	Road 8 Sewer Line (10")	3400	LF	$ 75.00	$ 255,000.00
7	Road 9 Sewer Line	3500	LF	$ 75.00	$ 262,500.00
8	Road 10 Sewer Line *	5100	LF	$ 75.00	$ 382,500.00
	ROADWAY CONSTRUCTION SUBTOTAL				$ 2,077,500.00
	CONTINGENCY (40%)				$ 831,000.00
	PRELIMINARY ENGINEERING (10%)				$ 290,850.00
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 436,275.00
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 3,635,625.00

Except from 2009 Sewer Master Plan



Water

				Engineer's Estimate	
Item No.	Bid Item Description	Quantity	Unit	Unit Price	Total
1	Road 1 Watermain	1050	LF	$ 60.00	$ 63,000.00
2	Road 2 Watermain	3200	LF	$ 60.00	$ 192,000.00
3	Road 3 Watermain	600	LF	$ 60.00	$ 36,000.00
4	Road 4 Watermain	4700	LF	$ 60.00	$ 282,000.00
5	Road 5 Watermain	1250	LF	$ 60.00	$ 75,000.00
6	Road 6 Watermain	2300	LF	$ 60.00	$ 138,000.00
7	Road 7 Watermain	5500	LF	$ 60.00	$ 330,000.00
8	Road 8 Watermain	1750	LF	$ 60.00	$ 105,000.00
9	Road 9 Watermain	3500	LF	$ 150.00	$ 525,000.00
10	2- 0.5 mg Water Reservoirs to serve David Hill (440-615 ft elevation)	1	LS	$ 500,000.00	$ 500,000.00
11	2- 0.3 mg Water Reservoirs to serve David Hill (250-440 ft elevation)	1	LS	$ 1,950,000.00	$ 1,950,000.00
12	1- 2.25 mg Water Reservoir to serve city (155-250 ft elevation)	1	LS	$ 680,000.00	$ 680,000.00
					$ -
					$ -
					$ -
					$ -
	RETAINING WALLS				
	WATER SYSTEM CONSTRUCTION SUBTOTAL				$ 4,876,000.00
	CONTINGENCY (40%)				$ 1,950,400.00
	PRELIMINARY ENGINEERING (10%)				$ 682,640.00
	ROADWAY CONSTRUCTION ENGINEERING (15%)				$ 1,023,960.00
	ROADWAY CONSTRUCTION & CONSTRUCTION ENGINEERING				$ 8,533,000.00

Note: Reservoir costs include only those portions of total costs that are attributable to the Westside Planning Area (including David Hill and Purdin Road)