



TECHNICAL MEMORANDUM

DATE: December 6, 2017 Project No.: 425-10-16-04.006
SENT VIA: EMAIL
TO: City of Stockton, Municipal Utilities Department
FROM: Douglas T. Moore, PE, RCE #58122
REVIEWED BY: Mark Kubik, PE, RCE #50963
SUBJECT: Stockton General Plan Update – Stormwater Master Plan Supplement

This Technical Memorandum (TM) presents the Stormwater Master Plan Supplement for the Stockton General Plan Update (GPU). This TM includes the following sections:

- Summary
 - Existing Conditions Summary
 - Detention Storage and Pumping Requirements for the Study Areas Summary
 - Cost Evaluations Summary
 - Potential Environmental Impacts and Mitigation Measures Summary
- Existing Conditions
- Detention Storage and Pumping Requirements for the Study Areas
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 - Storage Requirements
 - Pump Station Requirements
- Detention Storage and Pumping Cost Evaluations
 - Detention Storage Construction Costs
 - Pumping Construction Costs
 - Total Capital Costs
- Recommended Future Actions
- Conclusions

The analyses and conclusions presented in this TM are based on generalized land use data and preliminary engineering evaluations. All these evaluations should be refined and updated through detailed evaluations of each specific development project.

SUMMARY

A summary of this TM is presented below. The development of the summary data is presented in the following sections of this TM. The 2040 land uses are shown on Figure 1, and the General Plan Update buildout land use map is provided in Attachment A.

Existing Conditions Summary

The City's storm drain system is shown on Figure 2. The storm drain system includes 620 miles of 4-inch to 96-inch storm drains and over 22,500 drain inlets. A total of 58 pump stations and 19 lift stations are used to pump drainage into receiving waters, as shown on Figure 2.

The City of Stockton (City) is characterized by flat topography with a complex network of streams and rivers running through it. The northern portion of the City is protected by levees, and drainage is typically pumped into receiving waters. The southern portion of the City does not have many levees and is characterized by various floodplain designations by FEMA (Peterson Brustad Inc., 2008). A few of the waterways in the central and northern parts of the City, namely Bear Creek, Pixley Slough, Mosher Slough, and the Calaveras River, have sufficient capacity to handle buildout flows based on the 1990 General Plan, but do not have capacity to handle additional development beyond that. The creeks in the southeast portion of the planning area, (North Littlejohns Creek, Weber Slough, South Littlejohns Creek, and Lone Tree Creek) do not have capacity to contain the existing 100-year flows, resulting in overbank flooding predicted in much of those watersheds (West Yost Associates [West Yost], 2004).

Detention Storage and Pumping Requirements for the Study Areas Summary

Several development Study Areas were identified by Placeworks, as shown on Figure 2. Little infrastructure planning has been done for the Study Areas; consequently, detention storage and pumping requirements have been estimated for the Study Areas. Stormwater plans have been or will be prepared by others for the Approved/Pending Development Projects. To avoid conflicting infrastructure plans, no storage and pumping requirements have been estimated for the Approved/Pending Development Projects.

The detention storage volumes required per the City of Stockton's standards range from 0.5 to 50.4 acre-feet (ac-ft). The total new development tributary area that needs detention storage facilities is 547.8 acres of various land uses.

The San Joaquin County Improvement Standards requires that detention basins shall have outlet facilities providing terminal drainage capable of emptying a full basin in 24 hours in urban areas. Firm pumping capacity is the combined capacity of the individual pumps in the pump station, except the largest pump (assuming the largest pump is out of service). The firm pumping capacities for the Study Areas range from 0.3 to 25.4 cubic feet per second (cfs), and the combined firm capacity is 50.3 cfs. Total pumping capacity is the combined capacity of all the individual pumps in the pump station, including the largest pump (assuming the largest pump is in service). Total pumping capacity is included in this evaluation for estimating pump station costs. The total pumping capacities range from 0.5 to 38.1 cfs, and the combined total capacity is 88.0 cfs. The total tributary area is 547.8 acres of various land uses. On average, this results in about 0.09 cfs/acre of firm pumping capacity needed per acre of development.

Cost Evaluations Summary

Capital costs range from approximately \$95,000 to \$5.8 million, with a total of \$12.2 million. Land costs make up approximately \$2.8 million of the \$12.2 million. The cost per acre of development is approximately \$22,400.

Potential Environmental Impacts and Mitigation Measures Summary

This study is a high-level assessment to analyze detention basin and pumping capacity requirements based on increases in the volume of stormwater runoff resulting from development in the Study Areas. No hydraulic or hydrologic modeling was performed for this study, storm drainage pipe facilities were not sized, and water quality control measures were not considered. To address the potential impacts of development, a comprehensive City-wide storm drainage master plan should be completed. In addition, each development project should complete a drainage plan to appropriately size storm drainage facilities based on site specific constraints. Each drainage study should also consider stormwater quality control measures and trash control measures as applicable.

EXISTING CONDITIONS

The City's storm drain system is shown on Figure 2. The storm drain system includes 620-miles of 4-inch to 96-inch storm drains. Multiple pump stations and lift stations are used to pump drainage into receiving waters. Figure 2 shows the locations of the 58 pump stations and the 19 lift stations, and various sizes of storm drain pipes.

Major receiving waters include Pixley Slough, Bear Creek, Mosher Slough, Five Mile Slough, Calaveras River, Fourteen Mile Slough, Smith Canal, Stockton Deep Water Ship Channel, San Joaquin River, Walker/French Camp Slough, Duck Creek, and North Littlejohns Creek.

The information for the existing condition storm drains is compiled from a 2008 Conceptual Storm Drain Master Plan by Peterson Brustad Inc. and a 2004 Conceptual Storm Drain Master Plan by West Yost. The City of Stockton is situated on the eastern boundary of the Sacramento/San Joaquin River Delta. The City is characterized by flat topography with a complex network of streams and rivers running through it. The northern portion of the City is protected by levees, and drainage is typically pumped into receiving waters. The southern portion of the City does not have many levees and is characterized by various floodplain designations by FEMA (Peterson Brustad Inc., 2008). A few of the waterways in the central and northern parts of the city, namely Bear Creek, Pixley Slough, Mosher Slough, and the Calaveras River, have sufficient capacity to handle buildout flows based on the 1990 General Plan, but do not have capacity to handle additional development beyond that. The creeks in the southeast portion of the planning area (North Littlejohns Creek, Weber Slough, South Littlejohns Creek, and Lone Tree Creek) do not have capacity to contain the existing 100-year flows, resulting in overbank flooding in much of those watersheds (West Yost, 2004).

DETENTION STORAGE AND PUMPING REQUIREMENTS FOR THE STUDY AREAS

The development of the detention storage and pumping requirements are discussed below:

GPU Land Uses by Development Area

The land use data for this evaluation was provided by Placeworks and is provided in Attachment A (including the buildout land use map, the dwelling unit data, acreage data, and 2040 percent development data). The land use data has been reorganized in Table 1 to be suitable for estimating the stormwater detention storage and pumping requirements. The reorganized land use data includes existing land use data, net new land use data for 2040, and 2040 land use data in terms of gross acreages. The 2040 land use data is shown on Figure 1, and the Study Areas and the Approved/Pending Development Projects are shown on Figure 2.

Assumptions and Methodology

The following assumptions were made for this stormwater evaluation:

- Little infrastructure planning has been done for the Study Areas, consequently, detention storage and pumping requirements have been estimated for the Study Area.
- Stormwater plans have been or will be prepared by others for the Approved/Pending Development Projects. To avoid conflicting infrastructure plans, no storage and pumping requirements have been estimated for the Approved/Pending Development Projects.
- Without existing drainage models, it is not possible to accurately evaluate the need for detention storage and new pumping. Also, re-development projects will use the existing stormwater infrastructure, resulting in minimal new infrastructure requirements. Consequently, if the re-development project results in increased impervious coverage, detailed evaluations will need to be prepared in the future, including preparation of hydrologic and hydraulic models which can be used to accurately determine best drainage approach and size the required infrastructure.
 - Study areas that consisted primarily of new development or infill projects were assumed to need detention facilities if they did not already have detention basins.
 - Study areas that consisted primarily of re-development projects were assumed to not need detention facilities.
 - Study areas that had both re-development and infill projects were assumed to need detention facilities unless they already drained to a detention basin or if the receiving system appears to have adequate capacity for buildout conditions.
- Net new development areas were used to size stormwater facilities. Net new development areas do not include areas that are already developed and will not change as a result of new development.

The following methodology was used for evaluating the required stormwater detention storage and pumping requirements for the Study Areas.

Table 1. Land Use Data

Study Area or Development Name	Single Family, Gross Acres			Multi Family, Gross Acres			Commercial, Gross Acres			Industrial, Gross Acres		
	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040
Study Areas												
Study Area 1 - Eight Mile Rd Area	17.2	232.1	249.3	8.4	73.2	81.6	17.9	0.6	18.5	4.0	0.0	4.0
Study Area 2 - Pacific Ave Corridor	4.3	0.0	4.3	3.5	4.7	8.2	115.8	3.6	119.4	0.1	0.0	0.1
Study Area 3 - West Ln and Alpine Rd Area	38.7	51.6	90.2	5.8	29.9	35.7	68.4	6.2	74.6	54.5	0.0	54.5
Study Area 4 - Port/Waterfront	8.0	11.2	19.2	8.6	26.7	35.3	10.3	2.9	13.2	44.3	5.6	49.9
Study Area 5 - El Dorado/Center Corridors	5.5	0.0	5.5	8.3	17.2	25.5	8.1	1.8	9.9	9.9	0.0	9.9
Study Area 6 - Miner/Weber Corridors ^(a)	4.4	0.0	4.4	4.8	18.0	22.8	6.5	3.4	9.9	7.2	0.0	7.2
Study Area 7 - Wilson Way Corridor	1.6	0.0	1.6	0.2	6.8	7.1	2.1	5.1	7.2	14.9	0.0	14.9
Study Area 8 - I-5/Highway 4 Interchange	1.0	0.0	1.0	0.1	38.0	38.1	0.9	0.9	1.8	13.2	0.0	13.2
Study Area 9 - Railroad Corridor at California St	2.3	0.0	2.3	1.3	19.3	20.6	4.8	1.5	6.3	7.0	0.0	7.0
Study Area 10 - I-5 and Charter Way Area	42.8	57.9	100.7	4.1	4.2	8.3	26.3	2.6	28.9	4.6	2.7	7.3
Study Area 11 - Charter Way/MLK Jr Blvd Corridor	0.3	0.0	0.3	0.0	7.7	7.7	2.9	0.4	3.3	0.0	0.0	0.0
Study Area 12 - Airport Way Corridor	7.2	0.0	7.2	0.4	4.7	5.1	6.8	10.2	17.0	89.5	13.1	102.6
Study Area 13 - Mariposa and Charter Area	3.9	0.0	3.9	5.9	0.0	5.9	5.6	1.5	7.2	0.0	0.0	0.0
Study Area 14 - East Weston Ranch ^(b)	1.1	0.0	1.1	0.0	0.0	0.0	4.9	14.8	19.8	0.0	0.0	0.0
Study Area 15 - South of French Camp Rd	75.7	0.0	75.7	6.1	0.0	6.1	0.0	0.0	0.0	0.1	0.0	0.1
Study Area 16 - E French Camp Rd Area	122.7	0.0	122.7	9.1	0.0	9.1	0.1	0.0	0.1	0.2	0.0	0.2
Subtotal (Study Areas)	336.9	352.8	689.7	66.8	250.5	317.3	281.5	55.6	337.1	249.5	21.4	270.8
Approved/Pending Development Projects Within City Limit												
Westlake Villages	0.0	680.0	680.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delta Cove	0.0	132.7	132.7	0.0	47.6	47.6	0.0	2.6	2.6	0.0	0.0	0.0
North Stockton Projects III	38.0	355.0	393.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cannery Park	0.0	272.0	272.0	0.0	16.0	16.0	0.0	104.0	104.0	0.0	0.0	0.0
Nor Cal Logistics Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crystal Bay	0.0	19.4	19.4	0.0	78.7	78.7	0.0	0.0	0.0	0.0	0.0	0.0
Sanctuary	0.0	1,026.0	1,026.0	0.0	67.4	67.4	0.0	35.5	35.5	0.0	0.0	0.0
Tidewater Crossing	869.6	-869.6	0.0	0.0	0.0	0.0	0.0	16.0	16.0	0.0	0.0	0.0
Open Window ^(c)	0.0	0.0	0.0	0.0	11.9	11.9	12.9	-1.0	11.9	0.0	0.0	0.0
Weston Ranch Town Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.5	41.5	0.0	0.0	0.0
Subtotal (Approved/Pending Projects Within City Limit)	907.6	1,615.5	2,523.1	0.0	221.6	221.6	12.9	198.6	211.5	0.0	0.0	0.0
Approved/Pending Development Projects Outside City Limit but Within Sphere of Influence												
Mariposa Lakes	151.0	939.3	1,090.3	0.0	585.0	585.0	0.0	150.0	150.0	0.0	0.0	0.0
Airpark 599	0.0	0.0	0.0	0.0	0.0	0.0	0.0	128.0	128.0	0.0	0.0	0.0
Tra Vigne ^(d)	0.0	846.4	846.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal (Approved/Pending Projects Outside City Limit but Within Sphere of Influence)	151.0	1,785.7	1,936.7	0.0	585.0	585.0	0.0	278.0	278.0	0.0	0.0	0.0
Remaining City Outside of Study Areas and Outside of Approved/Pending Projects ^(e)	13,870.5	1,270.5	15,141.0	1,915.9	0.0	1,915.9	546.6	0.0	546.6	1,783.8	0.0	1,783.8
Grand Total	15,266.0	5,024.6	20,290.5	1,982.7	1,057.1	3,039.8	841.0	532.1	1,373.1	2,033.2	21.4	2,054.6

^(a) Excludes Open Window approved project.

^(b) Excludes Weston Ranch Town Center approved project.

^(c) The Master Development Plan for Open Window is approved for 1,034 units, with an option to expand to 1,400 units if the General Plan Update increases the maximum densities in the Downtown, which is being considered as part of this General Plan Update.

^(d) Pending; not approved.

^(e) Excludes approved/pending projects.

City of Stockton Standard Specifications, Section 77 requires:

- Detention basins be sized using the equation $\text{Volume (acre-feet)} = C \cdot A \cdot R / 12$, where
 - C = runoff coefficient,
 - A = area of the site (acres), and
 - R = rainfall depth (inches). Rainfall depths are shown in Table 2 and differ between areas that have discharge limitations or not.
- Discharge limitations were explained in the 2008 Conceptual Storm Drain Master Plan as receiving waters that had discharge constraints based on the existing capacity of the channel. Many Study Areas do not have a known receiving water, and therefore, it was assumed they were discharge limited unless otherwise noted in the PBI report (2008).
- Runoff coefficients were obtained from City Standard Drawing Number 76, as shown in Table 3.

Table 2. Rainfall Depth for Use in the Detention Basin Sizing Equation (above).	
Receiving Water Status	Rainfall ^(a) , inches
No discharge limitations	3.12
Discharge limitations	Use safety factor of 1.5 applied to size calculated for No Discharge Limitations
^(a) From City of Stockton Standard Specifications, Section 77m	

Table 3. Runoff Coefficients^(a)	
Land Use Category	C-Value
Single Family Residential	0.35
Multi-Family Residential	0.65
Commercial	0.90
Industrial	0.90
^(a) From City of Stockton Standard Drawing Number 76.	

Neither the City’s Specifications Section 74 nor 77 provided guidance on how to size pump stations to empty detention basins; therefore, guidance from San Joaquin County Improvement Standards were used. Section 3-4.05.C of the San Joaquin County Improvement Standards requires that detention basins shall have outlet facilities providing terminal drainage capable of emptying a full basin in 24 hours in urban areas. Although the San Joaquin County Improvement Standards encourage the use of gravity drained detention basins, it is difficult to know if a system will drain by gravity without additional modeling or design. Therefore, all detention basins were assumed to require pumping facilities.

Storage Requirements

Using the methodology described above, the required detention storage volumes are summarized in Table 4 for the Study Areas. As shown, the required detention storage volumes range from 0.5 to 50.4 ac-ft. The total combined detention storage volume for all of the Study Areas is 99.8 ac-ft. Storage volume was also included in Table 4 for extended detention basins located with the flood control basin assuming there were no volume reduction measures implemented. The total new development tributary area that needs facilities is 547.8 acres of various land uses.

Pumping Requirements

Using the methodology described above, the pumping requirements are summarized in Table 4. As shown, the firm pumping capacities range from 0.3 to 25.4 cfs, and the combined firm capacity is 50.3 cfs. The total pumping capacities range from 0.5 to 38.1 cfs, and the combined total capacity is 88.0 cfs. The total tributary area is 547.8 acres of various land uses. As stated above, the analyses and conclusions presented in this TM are based on generalized land use data and preliminary engineering evaluations. All these evaluations should be refined and updated through detailed evaluations of each specific development project.

Additionally, the pump stations that discharge into open channels, creek, or rivers may require acquisition of several permits such as Clean Water Act Section 401 and 404 permits/certification, California Department of Fish and Wildlife Stream Bed Alteration Agreement, Central Valley Flood Protection Board encroachment permit, and the San Joaquin County Flood Control and Water Conservation District permits.

Table 4. Detention Basin Volumes and Pump Station Capacities^(f)

Study Area Name	Location of Discharge	Limited or Unlimited Discharge	New Development, Re-development, or Infill	Facilities Needed? ^(d) (Yes or No)	Single Family, acres <i>Net New</i>	Multi Family, acres <i>Net New</i>	Industrial, acres <i>Net New</i>	Total Areas of Study Areas that Need Facilities, acres <i>Net New</i>	Area Weighted C-Value <i>Net New</i>	Extended Detention Basin Volume, ac-ft <i>Net New</i>	Volume ^(c) (discharge limitations), ac-ft <i>Net New</i>	Firm Pumping Capacity ^(b) for basins with discharge limitations, cfs <i>Net New</i>	Total Pumping Capacity ^(b, e) for basins with discharge limitations, cfs <i>Net New</i>
Study Areas													
Study Area 1 - Eight Mile Rd Area	Pixley Slough	Limited	100% new development	Yes	232.1	73.2	0.0	305.9	0.42	5.6	50.4	25.4	38.1
Study Area 2 - Pacific Ave Corridor	Unknown from PBI	Limited	100% re-development	No	0.0	4.7	0.0	0.0	--	--	--	--	--
Study Area 3 - West Ln and Alpine Rd Area	Unknown from PBI	Limited	50% re-development, 50% infill	Yes	51.6	29.9	0.0	87.7	0.49	1.9	16.8	8.5	16.9
Study Area 4 - Port/Waterfront	Unknown from PBI	Limited	60% re-development, 40% infill	Yes	11.2	26.7	5.6	46.5	0.62	1.3	11.3	5.7	11.4
Study Area 5 - El Dorado/Center Corridors	Unknown from PBI	Limited	80% re-development, 20% infill	No	0.0	17.2	0.0	0.0	--	--	--	--	--
Study Area 6 - Miner/Weber Corridors	Unknown from PBI	Limited	90% re-development, 10% infill	No	0.0	18.0	0.0	0.0	--	--	--	--	--
Study Area 7 - Wilson Way Corridor	Unknown from PBI	Limited	90% re-development, 10% infill	No	0.0	6.8	0.0	0.0	--	--	--	--	--
Study Area 8 - I-5/Highway 4 Interchange	Unknown from PBI	Limited	10% re-development, 90% infill	Yes	0.0	38.0	0.0	38.9	0.66	1.1	9.9	5.0	10.0
Study Area 9 - Railroad Corridor at California St	Unknown from PBI	Limited	60% re-development, 40% infill	No	0.0	19.3	0.0	0.0	--	--	--	--	--
Study Area 10 - I-5 and Charter Way Area	Unknown from PBI	Limited	60% re-development, 40% infill	Yes	57.9	4.2	2.7	67.4	0.41	1.2	10.8	5.5	10.9
Study Area 11 - Charter Way/MLK Jr Blvd Corridor	Unknown from PBI	Limited	100% re-development	No	0.0	7.7	0.0	0.0	--	--	--	--	--
Study Area 12 - Airport Way Corridor	Unknown from PBI	Limited	50% re-development, 50% infill	No	0.0	4.7	13.1	0.0	--	--	--	--	--
Study Area 13 - Mariposa and Charter Area	Potentially Calaveras River	Limited	30% redevelopment, 70% infill	Yes	0.0	0.0	0.0	1.5	0.90	0.1	0.5	0.3	0.5
Study Area 14 - East Weston Ranch	Unknown from PBI	Limited	100% infill	No	0.0	0.0	0.0	0.0	--	--	--	--	--
Study Area 15 - South of French Camp Rd	San Joaquin River	Limited	95% new development, 5% re-development	Yes	0.0	0.0	0.0	0.0	--	--	--	--	--
Study Area 16 - E French Camp Rd Area	Potentially French Camp Slough ^(a)	Limited	90% new development, 10% re-development	Yes	0.0	0.0	0.0	0.0	--	--	--	--	--
Total					352.8	250.5	21.4	547.8		11.1	99.8	50.3	88.0

^(a) PBI concluded that no proper hydraulic modeling existed for this conveyance system and comprehensive flood management was recommended for this area, and thus discharge constraints could not be developed. A limited discharge was assumed for this Study Area.

^(b) Detention basins should have outlet facilities capable of draining a basin in 24 hours in urban areas (per San Joaquin County Improvement Standards, 2014)

^(c) Volume (in acre-feet) is calculated using $V = C \cdot A \cdot R / 12$, where C = area weighted runoff coefficient, A = total area (acres), and R = rainfall depth (in)

^(d) Facilities are needed for areas where there is new development or infill with no existing facilities or capacity for buildout. Facilities are not needed if there is primarily re-development or the system already has the capacity for buildout conditions.

^(e) Total pumping capacity is included in this evaluation for estimating pump station costs.

^(f) The analyses and conclusions presented in this TM are based on limited land use data and preliminary engineering evaluations. All these evaluations should be refined and updated through detailed evaluations of each specific development project.

DETENTION STORAGE AND PUMPING COST EVALUATIONS

Approximate stormwater infrastructure unit costs are presented in Table 5 and discussed below. These unit costs were taken/developed from previous West Yost planning engineering studies, design, bid, construction projects, and general West Yost cost estimating experience from projects located in the California Central Valley for construction associated with medium to large development projects.

- The detention basin unit cost of \$28,000 per ac-ft is from actual construction costs for a detention basin project in the City of Dixon, but inflated from Spring 2005 to December 2016 (using the Engineering News Record 20 Cities Average). This unit cost includes detention basin excavation, an all-weather access road around the basin, inlet and outlet headwalls, and other facilities for a complete, urban detention basin. The basins are assumed to be 12 feet deep, with a water depth of 10 feet, a freeboard of 2 feet, and side slopes of 4H:1V.
- The pump station unit cost of \$37,000 per cfs is from actual construction costs for the Natomas Area of Sacramento, but inflated from October 1998 to December 2016.
- The land cost for detention basins was assumed to be \$200,000 per acre.
- The Engineering, Environmental, Administration, Construction Management, etc. multiplier of 40 percent is from West Yost Associates' experience with similar, typical projects.

Table 5. Stormwater Infrastructure Unit Costs		
Facility Type	Unit	Cost per Unit, dollars
Detention Basin (Storage Capacity)	Acre-feet	28,000
Pump Station (Total Pumping Capacity)	cfs	37,000
Land Acquisition	Acres	200,000
Engineering, Environmental, Administration, Construction Management, etc.	--	40 percent of construction cost

The estimated construction costs for the Study Areas are summarized in Table 6. The quantities for the cost calculations are also provided in Table 6. The construction costs are developed by multiplying the infrastructure quantities from Table 6 by the approximate unit costs from Table 5. The total capital costs additionally include the cost of Engineering, Environmental, Administration, Construction Management, etc., and the land acquisition for the detention basins.

Table 6. Estimated Stormwater Infrastructure Construction and Total Capital Costs

Study Area	Volume of required water storage	Excavation Volume ^(a)	Area of Basin	Total Pumping Capacity	Detention Basin Cost	Pump Station Cost	Construction Cost	Land Cost	Engineering, Administration, CM	Total Capital Cost
<i>Units, Unit Costs, and Multipliers</i>	<i>ac-ft</i>	<i>ac-ft</i>	<i>ac</i>	<i>cfs</i>	<i>\$28,000/ac-ft</i>	<i>\$37,000/cfs</i>	<i>dollars</i>	<i>\$200,000/ac</i>	<i>40%</i>	<i>dollars</i>
Study Area 1 - Eight Mile Rd Area	56.0	66.1	5.9	38.1	\$1,851,737	\$1,411,396	\$3,263,000	\$1,185,678	\$1,305,000.00	\$5,754,000
Study Area 2 - Pacific Ave Corridor	--	--	--	--	--	--	--	--	--	--
Study Area 3 - West Ln and Alpine Rd Area	18.7	22.0	2.2	16.9	\$616,464	\$626,492	\$1,243,000	\$439,722	\$497,000.00	\$2,180,000
Study Area 4 - Port/Waterfront	12.5	14.8	1.6	11.4	\$414,630	\$421,375	\$836,000	\$311,814	\$334,000.00	\$1,482,000
Study Area 5 - El Dorado/Center Corridors	--	--	--	--	--	--	--	--	--	--
Study Area 6 - Miner/Weber Corridors	--	--	--	--	--	--	--	--	--	--
Study Area 7 - Wilson Way Corridor	--	--	--	--	--	--	--	--	--	--
Study Area 8 - I-5/Highway 4 Interchange	11.1	13.0	1.4	10.0	\$365,106	\$371,046	\$736,000	\$279,785	\$294,000.00	\$1,310,000
Study Area 9 - Railroad Corridor at California St	--	--	--	--	--	--	--	--	--	--
Study Area 10 - I-5 and Charter Way Area	12.0	14.2	1.5	10.9	\$397,379	\$403,844	\$801,000	\$300,694	\$320,000.00	\$1,422,000
Study Area 11 - Charter Way/MLK Jr Blvd Corridor	--	--	--	--	--	--	--	--	--	--
Study Area 12 - Airport Way Corridor	--	--	--	--	--	--	--	--	--	--
Study Area 13 - Mariposa and Charter Area	0.6	0.8	0.2	0.5	\$22,997	\$20,278	\$43,000	\$35,424	\$17,000.00	\$95,000
Study Area 14 - East Weston Ranch	--	--	--	--	--	--	--	--	--	--
Study Area 15 - South of French Camp Rd	--	--	--	--	--	--	--	--	--	--
Study Area 16 - E French Camp Rd Area	--	--	--	--	--	--	--	--	--	--
Total	110.9	131.0	12.8	88.0	\$3,668,312	\$3,254,432	\$6,922,000	\$2,553,116	\$2,767,000	\$12,243,000

^(a) Excavation values based on:
 1) San Joaquin County Improvement Standards requires the depth of basin to be 2 feet above groundwater, detention basin side slopes be at least 4H:1V, and that the water surface be a minimum of 2-feet below all ground surface elevations upstream from the basin.
 2) City of Stockton and County of San Joaquin Final Stormwater Quality Control Criteria Plan, March 2009.
 3) Sizing assumptions include: A depth to groundwater of 12 feet, a square detention basin shape, and a maximum water depth of 10 feet.

Detention Storage Construction Costs

Detention basin construction costs range from approximately \$23,000 to \$1.8 million, with a total of \$3.7 million.

Pump Station Construction Costs

Pump station construction costs range from approximately \$20,000 to \$1.4 million, with a total of \$3.3 million.

Total Capital Costs

Capital costs range from approximately \$95,000 to \$5.8 million, with a total of \$12.2 million. Land costs make up approximately \$2.8 million of the \$12.2 million. The cost per acre of development is approximately \$22,400.

RECOMMENDED FUTURE ACTIONS

The recommended actions to address stormwater infrastructure needs are addressed in this section.

City-Wide Stormwater Master Plan for the Existing City

The City does not have a City-wide storm drainage master plan with hydrologic and hydraulic models. The previous storm drain master plans did not incorporate modeling and therefore lacked information critical to infrastructure planning for the existing City. Consequently, the storm drain system improvements for the existing City areas identified in previous storm drain master plans may no longer be appropriate. This could result in some storm drain infrastructure being undersized, which could lead to flooding, or oversized which could lead to unnecessary infrastructure capital expenditures and increased operations and maintenance efforts and costs.

The City should complete a City-wide storm drainage master plan, including hydrologic and hydraulic models for existing land use conditions. The master plan should identify the future stormwater infrastructure needs to solve existing stormwater system deficiencies. The City's current stormwater fee program is insufficient to fund the required operations and maintenance needs of the City's aging stormwater and flood control infrastructure and insufficient to fund the required future repairs and replacements for the existing facilities. The City stormwater fee program should be revised based on the updated storm drainage master plan, operations and maintenance requirements, and future repairs and replacements to ensure the City collects enough money to adequately operate and maintain the existing system and construct the required future repairs and replacements.

City-Wide Stormwater Master Plan for the Future Development

The City does not have a City-wide storm drainage master plan with hydrologic and hydraulic models. The previous storm drain master plans did not incorporate modeling and therefore lacked information critical to infrastructure planning for future development. In addition, the projected land uses for 2040 are different than the buildout land uses from the 2035 General Plan. Consequently, the storm drain system improvements identified in previous storm drain master plans may no longer be appropriate. This could result in some storm drain infrastructure being

undersized, which could lead to flooding, or oversized which could lead to unnecessary infrastructure capital expenditures and increased operations and maintenance efforts and costs.

The City should complete a City-wide stormwater master plan, including hydrologic and hydraulic models for the 2040 land uses. The master plan should identify the future stormwater infrastructure needs and develop a capital improvement plan that is adequate to fund improvements needed for the City to serve the future development, including both infrastructure capital costs and future system operation and maintenance costs.

Future Development-Specific Stormwater Drainage and Flood Control Plans

This stormwater study is a high-level assessment of required detention volume and pumping capacity for the Study Areas, and does not assess storm drainage piping facilities. These facilities are sized based on generalized land use data and preliminary engineering evaluations, and it is difficult to size stormwater facilities without knowing the layout of the development and site-specific constraints.

The City should require each new development to prepare a stormwater drainage and flood control plan covering drainage (storm drains, detention basins, pump stations, and associated hydrologic and hydraulic models *etc.*) and flood control. As development projects progress, the specific infrastructure serving the development should be reviewed and verified using the updated storm drain master plan models. The models should be used to identify both on-site and off-site development related infrastructure requirements. The development projects should be required to construct the identified on-site and to fund or construct the off-site infrastructure.

Future Development-Specific Stormwater Quality and Permitting Plans

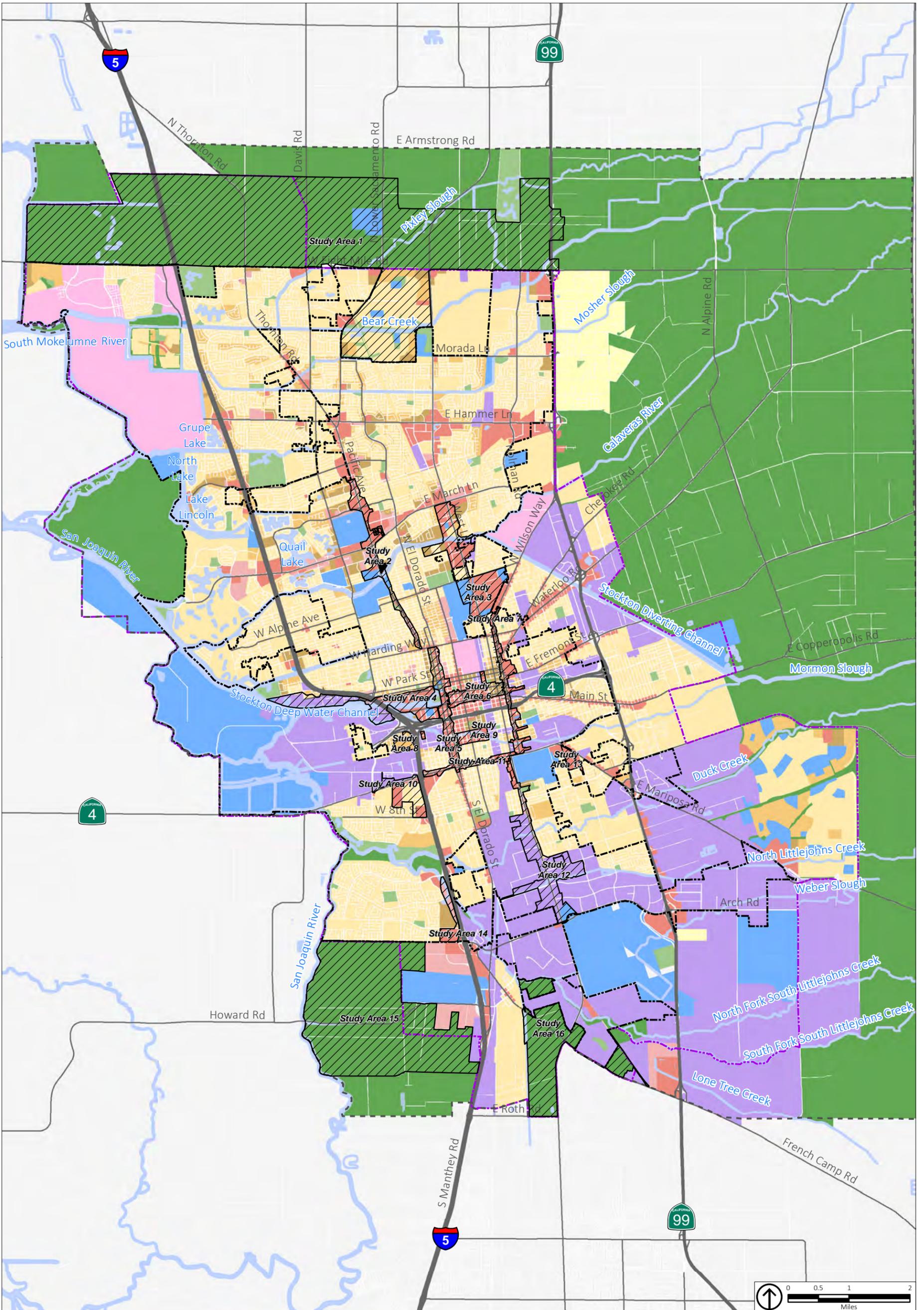
This study does not fully consider the sizing of detention basins or other facilities to address stormwater quality and stormwater pollution control measures. Stockton has a Phase 1 Municipal Separate Storm Sewer System permit that requires stormwater quality be considered. In addition, the State of California recently mandated that trash should be captured from stormwater runoff in high generating trash land use areas, including commercial, industrial, and high density residential areas. It is difficult to size these trash capture and stormwater quality systems without knowing the layout plan of the developing area.

Each Study Area should develop a Stormwater Quality and Permitting Plan that is consistent with Stockton's Stormwater Quality Control Criteria Plan (March 2009) and is consistent with the City's trash control requirements. The Stormwater Quality and Permitting Plans could be combined with the Stormwater Drainage and Flood Control Plans into a single document.

CONCLUSIONS

Stormwater infrastructure conclusions are provided below:

- Detention basins and pump stations were sized to account for the net increase in the Study Areas.
- Areas that are already developed and/or already have capacity for buildout conditions were assumed to not need additional detention facilities.
- The estimated total capital costs of storm drain detention basins and pump stations is \$11.8 million.
- The estimated cost of detention basins and pumping facilities for developing areas was estimated to be approximately \$21,600 /acre of development.
- The analyses and conclusions presented in this TM are based on generalized land use data and preliminary engineering evaluations. All these evaluations should be refined and updated through detailed evaluations of each specific development project.

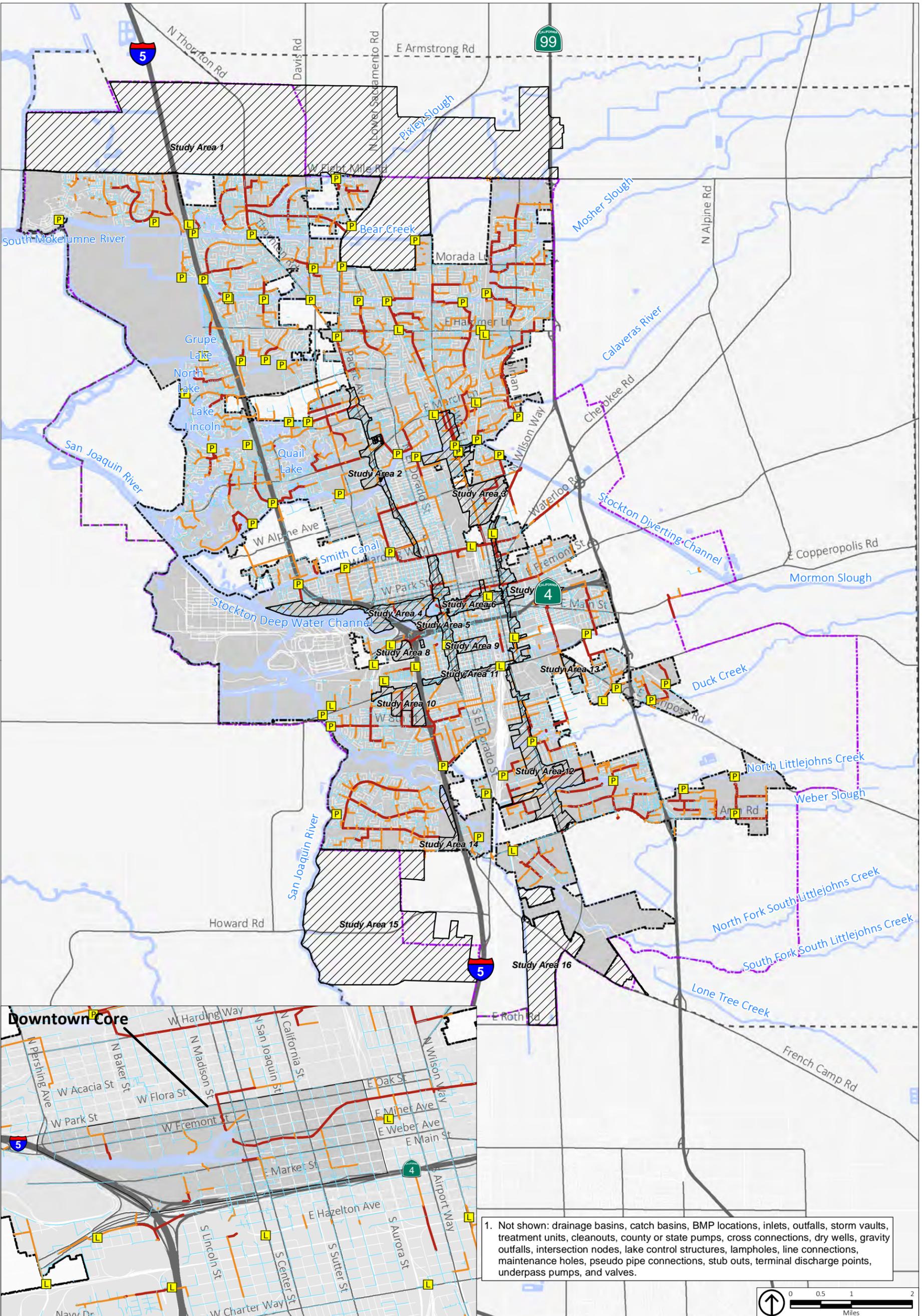


Source: City of Stockton, August 2017.

- | | | | |
|--------------------------------|----------------------------|-----------------------------|-----------------------------------|
| --- General Plan Planning Area | Residential Estate | Mixed Use | Economic and Education Enterprise |
| --- City Limit | Low Density Residential | Commercial | Institutional |
| --- Sphere of Influence | Medium Density Residential | Administrative Professional | Parks and Recreation |
| --- Major Creeks CAD | High Density Residential | Industrial | Open Space/Agriculture |

Figure 1

2017 Preferred 2040 Land Uses



1. Not shown: drainage basins, catch basins, BMP locations, inlets, outfalls, storm vaults, treatment units, cleanouts, county or state pumps, cross connections, dry wells, gravity outfalls, intersection nodes, lake control structures, lampholes, line connections, maintenance holes, pseudo pipe connections, stub outs, terminal discharge points, underpass pumps, and valves.

Existing Storm Facility Existing Storm Drain (Diameter)

- L Lift Station
- P Pump Station
- Study Areas
- < 22 Inches
- 24 - 36 Inches
- >39 Inches
- MajorCreeksCAD

Figure 2
Storm System Facilities

ATTACHMENT A

Land Use Data Received from Placeworks and Buildout Land Use Map

Acreage Gross or Net	Study Area Name	Single Family Net New 2040	Single Family Net New 2040	Single Family Net New 2040 + Existing	Single Family Net New 2040 + Existing	Multi Family Net New 2040	Multi Family Net New 2040	Multi Family Net New 2040 + Existing	Multi Family Net New 2040 + Existing	Commercial Net New 2040 + Existing	Commercial Net New 2040 + Existing	Industrial Net New 2040	Industrial Net New 2040 + Existing							
		Units	Acres	Units	Acres	Units	Acres	Units	Acres	Units	Acres	Total Square Feet	0.3 FAR Sq Ft	0.5 FAR Sq Ft	5.0 FAR Sq Ft	0.3 FAR Acres	0.5 FAR Acres	5.0 FAR Acres	Sq Ft	Acres
Gross	Study Area 1 - Eight Mile Rd Area	1,379	646	1,500	663	1,198	209	1,294	217	39,408	39,408	0	0	15	0	0	241,408	20	0	105,400
Net	Study Area 2 - Pacific Ave Corridor	0	0	22	4	110	19	224	22	93,961	93,961	0	0	17	0	0	1,560,846	103	0	1,980
Net	Study Area 3 - West Ln and Alpine Rd Area	77	13	285	52	680	120	774	125	323,399	323,399	0	0	102	0	0	975,325	163	0	1,423,576
Net	Study Area 4 - Port/Waterfront	17	3	71	11	1,770	33	2,058	42	2,040,010	6,100	0	2,033,911	2	0	31	2,865,512	62	580,859	1,739,495
Net	Study Area 5 - El Dorado/Center Corridors	0	0	45	6	1,196	22	1,555	30	1,310,216	0	0	1,310,216	0	0	21	2,158,663	53	0	258,300
Net	Study Area 6 - Miner/Weber Corridors ^(a)	0	0	47	4	1,248	22	1,467	27	1,463,025	0	0	1,463,025	0	0	14	2,152,972	33	0	187,300
Net	Study Area 7 - Wilson Way Corridor	0	0	12	2	234	27	240	28	606,716	103,753	0	502,963	19	0	5	1,321,076	65	0	390,342
Net	Study Area 8 - I-5/Highway 4 Interchange	0	0	8	1	659	47	660	48	388,671	0	0	388,671	0	0	4	388,671	4	0	344,300
Net	Study Area 9 - Railroad Corridor at California St	0	0	19	2	1,340	24	1,363	25	1,299,279	0	0	1,299,279	0	0	24	1,365,999	26	0	182,658
Net	Study Area 10 - I-5 and Charter Way Area	86	15	314	58	98	42	127	46	133,864	133,864	0	0	42	0	0	377,363	77	83,678	203,939
Net	Study Area 11 - Charter Way/MLK Jr Blvd Corridor	0	0	5	0	396	15	396	15	323,733	9,597	0	314,135	6	0	7	703,670	38	0	0
Net	Study Area 12 - Airport Way Corridor	0	0	53	7	108	19	112	19	205,461	135,225	70,236	0	14	4	0	272,544	48	1,368,744	3,709,140
Net	Study Area 13 - Mariposa and Charter Area	0	0	12	4	0	0	77	6	80,944	80,944	0	0	25	0	0	93,560	28	0	0
Net	Study Area 14 - East Weston Ranch ^(b)	0	0	1	1	0	0	0	0	430,677	0	430,677	0	0	26	0	430,677	26	0	0
Net	Study Area 15 - South of French Camp Rd	0	0	89	76	0	0	9	6	0	0	0	0	0	0	0	0	0	0	1,700
Net	Study Area 16 - E French Camp Rd Area	0	0	59	123	0	0	4	9	0	0	0	0	0	0	0	5,100	17	0	4,900
Net	Outside of Study Areas ^(c)	1,501	246	77,964	14,117	0	0	33,183	1,916	0	0	0	0	0	0	0	23,811,089	1,607	0	46,620,901
	Grand Total	3,059	923	80,505	15,131	9,036	600	43,542	2,583	8,739,364	926,252	500,913	7,312,200	242	31	105	38,724,475	2,371	2,033,281	55,173,931

^(a) Excludes Open Window approved project.

^(b) Excludes Weston Ranch Town Center approved project.

^(c) Excludes approved/pending projects.

Acreage Gross or Net	Approved/Pending Projects Details	Net New						Full Build (2040)					
		Single Family Units	Single Family Acres	Multi-Family Units	Multi-Family Acres	Commercial Square Feet	Commercial Acres	Single Family Units	Single Family Acres	Multi-Family Units	Multi-Family Acres	Commercial Square Feet	Commercial Acres
Approved within city limit													
Gross	Westlake Villages	2,630	680	0		0		2,630	680	0		0	
Gross	Delta Cove	1,164	133	381	48	31,000	3	1,164	133	381	48	31,000	2.6
Gross	North Stockton Projects III	2,220	355	0		0		2,455	393	0		0	
Gross	Cannery Park	981	272	210	16	1,078,762	104	981	272	210	16	1,078,762	104
Gross	Nor Cal Logistics Center	0	0	0	0	0	0	0	0	0	0	0	0
Gross	Crystal Bay	951	19	392	79	0		951	19	392	79	0	0
Gross	Sanctuary	5,452	1,026	1,618	67	692,256	36	5,452	1,026	1,618	67	692,256	36
Gross	Tidewater Crossing	-310	-870	0		186,200	16	0	0	0	0	186,200	16
Net	Open Window ^(a)	0	0	1,391	12	-68,800	-1	0	0	1,400	12	290,000	12
Gross	Weston Ranch Town Center	0	0	0	0	481,000	41	0	0	0	0	481,000	41
Approved/pending outside city limit, inside SOI													
Gross	Mariposa Lakes	8,955	939	1,553	585	1,009,503	150	8,960	1,090	1,556	585	1,009,503	150
Gross	Airpark 599	0	0	0	0	1,678,500	128	0	0	0	0	1,678,500	128
Gross	Tra Vigne ^(b)	1,244	846	0	0	0	0	1,244	846	0	0	0	0

^(a) The Master Development Plan for Open Window is approved for 1,034 units, with an option to expand the capacity to 1,400 units if the General Plan Update increases the maximum densities in the Downtown, which is being considered as part of this General Plan Update.

^(b) Pending; not approved.

2040 Development Study Area

	Net New Single Family Units (full buildout)	Percent applied to 2040	Net New Single Family Units (2040)	Net New Multi-Family Units (full buildout)	Percent applied to 2040	Net New Multi-Family Units (2040)	Net New Commercial Square Feet (full buildout)	Percent applied to 2040	Net New Commercial Square Feet (2040)	Net New Industrial Square Feet (full buildout)	Percent applied to 2040	Net New Industrial Square Feet (2040)
Study Area 1 – Eight Mile Rd Area	3,940	35%	1,380	3,420	35%	1,200	197,000	20%	39,000	0	0%	0
Study Area 2 – Pacific Ave Corridor	0	0%	0	440	25%	110	188,000	50%	94,000	0	0%	0
Study Area 3 – West Ln and Alpine Rd Area	80	100%	80	2,720	25%	680	1,294,000	25%	323,000	0	0%	0
Study Area 4 – Port/Waterfront	20	100%	20	2,210	80%	1,770	6,800,000	30%	2,040,000	2,323,000	25%	581,000
Study Area 5 – El Dorado/Center Corridors	0	0%	0	1,500	80%	1,200	4,367,000	30%	1,310,000	0	0%	0
Study Area 6 – Miner/Weber Corridors ^(a)	0	0%	0	1,560	80%	1,250	2,926,000	50%	1,463,000	0	0%	0
Study Area 7 – Wilson Way Corridor	0	0%	0	940	25%	230	1,213,000	50%	607,000	0	0%	0
Study Area 8 – I-5/Highway 4 Interchange	0	0%	0	820	80%	660	777,000	50%	389,000	0	0%	0
Study Area 9 – Railroad Corridor at California St	0	0%	0	1,680	80%	1,340	5,197,000	25%	1,299,000	0	0%	0
Study Area 10 – I-5 and Charter Way Area	90	100%	90	980	10%	100	535,000	25%	134,000	98,000	85%	84,000
Study Area 11 – Charter Way/MLK Jr Blvd Corridor	0	0%	0	790	50%	400	1,619,000	20%	324,000	0	0%	0
Study Area 12 – Airport Way Corridor	0	0%	0	430	25%	110	274,000	75%	205,000	5,475,000	25%	1,369,000
Study Area 13 – Mariposa and Charter Area	0	0%	0	570	0%	0	324,000	25%	81,000	0	0%	0
Study Area 14 – East Weston Ranch ^(b)	0	0%	0	610	0%	0	574,000	75%	431,000	0	0%	0
Study Area 15 – South of French Camp Rd	0	0%	0	0	0%	0	0	0%	0	0	0%	0
Study Area 16 – E French Camp Rd Area	0	0%	0	0	0%	0	0	0%	0	0	0%	0
Outside of Study Areas ^(c)	16,360	9%	1,500	29,810	0%	0	19,487,000	0%	0	126,805,000	0%	0
Grand Total^(d)	20,480		3,060	48,470		9,040	45,773,000		8,739,000	134,701,000		2,033,000

^(a) Excludes Open Window approved project.

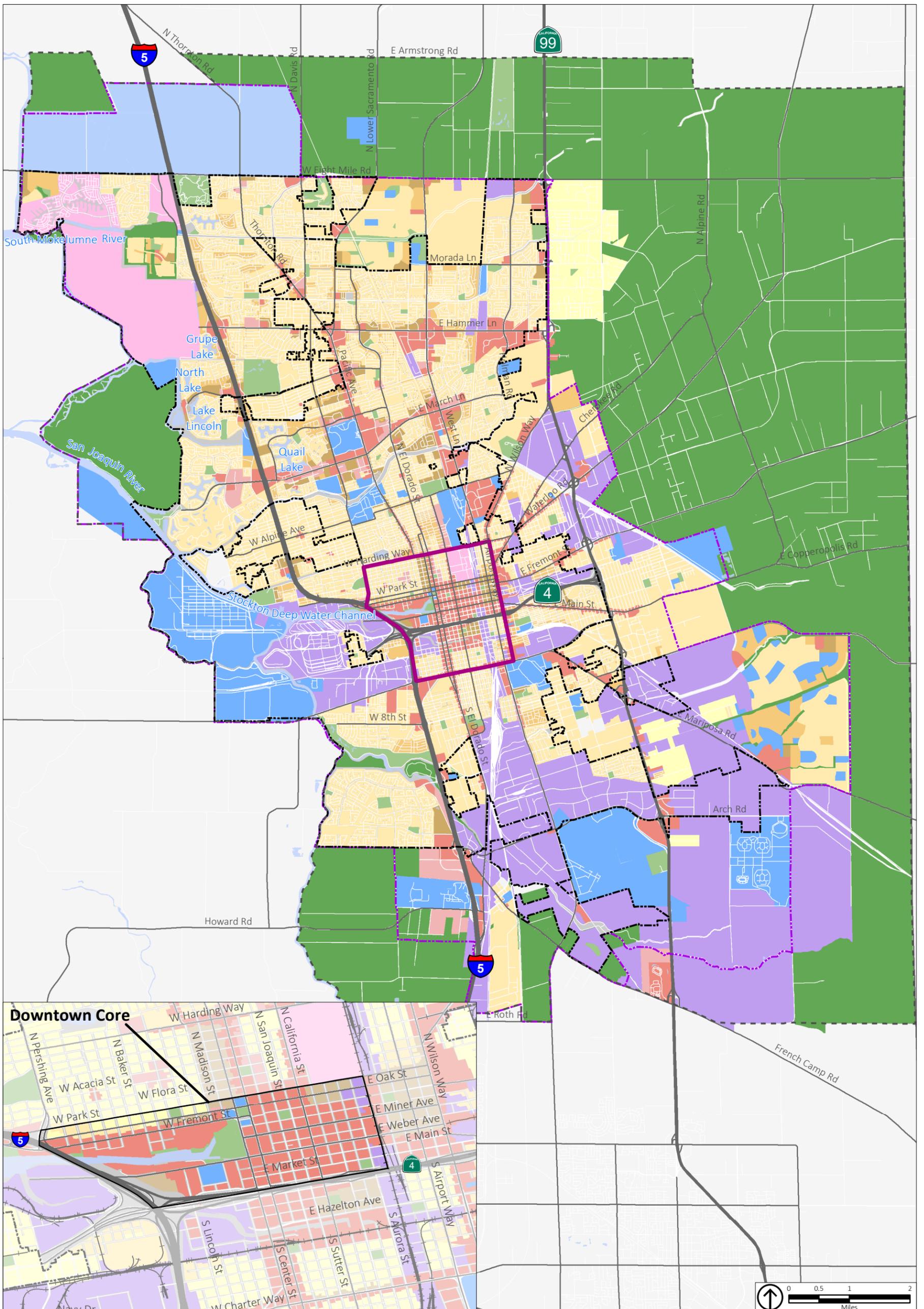
^(b) Excludes Weston Ranch Town Center approved project.

^(c) Excludes approved/pending projects

^(d) Numbers do not always add up due to rounding.

The "full buildout" of the proposed General Plan assumes the maximum development of every parcel, combined with approved and pending developments throughout the Planning Area. The 2040 land uses are based on realistic land use demand projections. The full buildout of the General Plan would result in almost three times more new housing units and over 24 times more new non-residential development than estimated for 2040. Therefore, it is extremely unlikely that the full buildout would occur by the year 2040. Full buildout may not occur until well beyond the useful lifespan of the proposed infrastructure (for example, the lifespan of concrete structures is typically 50 to 75 years). Consequently, this infrastructure planning was based on the estimated 2040 level of development. This table is included in this TM to document the relationship between the buildout land uses and the 2040 land uses.

Source: PlaceWorks, 2017.



Source: City of Stockton, 2017; PlaceWorks, 2017.

- | | | | | |
|----------------------------|-----------------------------|-----------------------------------|----------------------------|---------------------------|
| Residential Estate | Mixed Use | Economic and Education Enterprise | City Limit | Greater Downtown Boundary |
| Low Density Residential | Commercial | Institutional | Sphere of Influence | |
| Medium Density Residential | Administrative Professional | Parks and Recreation | General Plan Planning Area | |
| High Density Residential | Industrial | Open Space/Agriculture | | |

Figure 3-3

Proposed General Plan Land Use Map