City of Merced
Wastewater Collection System
Master Plan

Prepared for:
City of Merced

Prepared by:
Stantec Consulting Services Inc.

December 15, 2017

Sign-off Sheet

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Executive Summary

The City of Merced (City) Vision 2030 General Plan (2030 General Plan) discusses City growth that may occur by the year 2030. Much of that growth requires construction of new infrastructure that is to be funded by the proponents of growth needing public services which the City provides. Key infrastructure needs relevant to this Wastewater Collection System Master Plan (WCS Master Plan) include the wastewater collection system, itself; wastewater treatment, disposal, and reuse facilities; and various potable and non-potable water needs for the growing areas of the City. This WCS Master Plan is focused on wastewater collection system (aka, sewer system) needs and planning. However, wastewater collection system planning is driven by 1) where the wastewater is generated (i.e., collected from), and 2) where it is conveyed to receive treatment, and then subsequent disposal or reuse of the treated wastewater, which is termed "effluent". The siting of wastewater treatment facilities is driven by many factors including land use/zoning, how/where the treated wastewater is to be disposed/reused, and overall life cycle costs. The City is in the process of updating its master plan for wastewater treatment needs and recently updated a draft of its water master plan (AECOM, 2015 draft). This WCS Master Plan is believed to integrate the intent and objectives expressed by City staff relevant to these related infrastructure planning efforts. The most important concept coming out of these concurrent planning efforts is that the City is not planning to implement extensive effluent reuse (i.e. the City is not planning to install a "purple pipe" distribution system) in the North Merced area. This WCS Master Plan considers the collection system needs of the existing City as well as future needs of the Specific Urban Development Plan (SUDP) identified in the 2030 General Plan, see **Figure ES-1**.

Because wastewater collection systems are designed to have an effective service life of over 50 years and can be expected to be in service up to 75 or 100 years, such systems are designed and constructed based on best professional judgement of wastewater collection system needs under "reasonable build-out" conditions, not just City growth envisioned in the 2030 General Plan (which has a mandated 20-year planning horizon). The City's collection system is to be designed and constructed to serve "reasonable build-out" of the General Plan SUDP depicted in **Figure ES-1**. "Reasonable build-out" conditions (hereinafter, simply "build-out", or "build-out conditions") are City growth and wastewater flow estimates based on development density assumptions outlined in Section 5.0 of this WCS Master Plan. Application of maximum densities on all properties within the 2030 General Plan SUDP could result in higher flow estimates than presented herein. Planning for maximum densities is unrealistic for a city like Merced (versus "land-locked" cities like San Francisco). Consequently, this WCS Master Plan is based on reasonable build-out of the City utilizing current development trends and judgment of City staff. Prior to actual design and construction of infrastructure improvements, developers should be given the opportunity to fund maximum density sewer capacity, if that is their desire.

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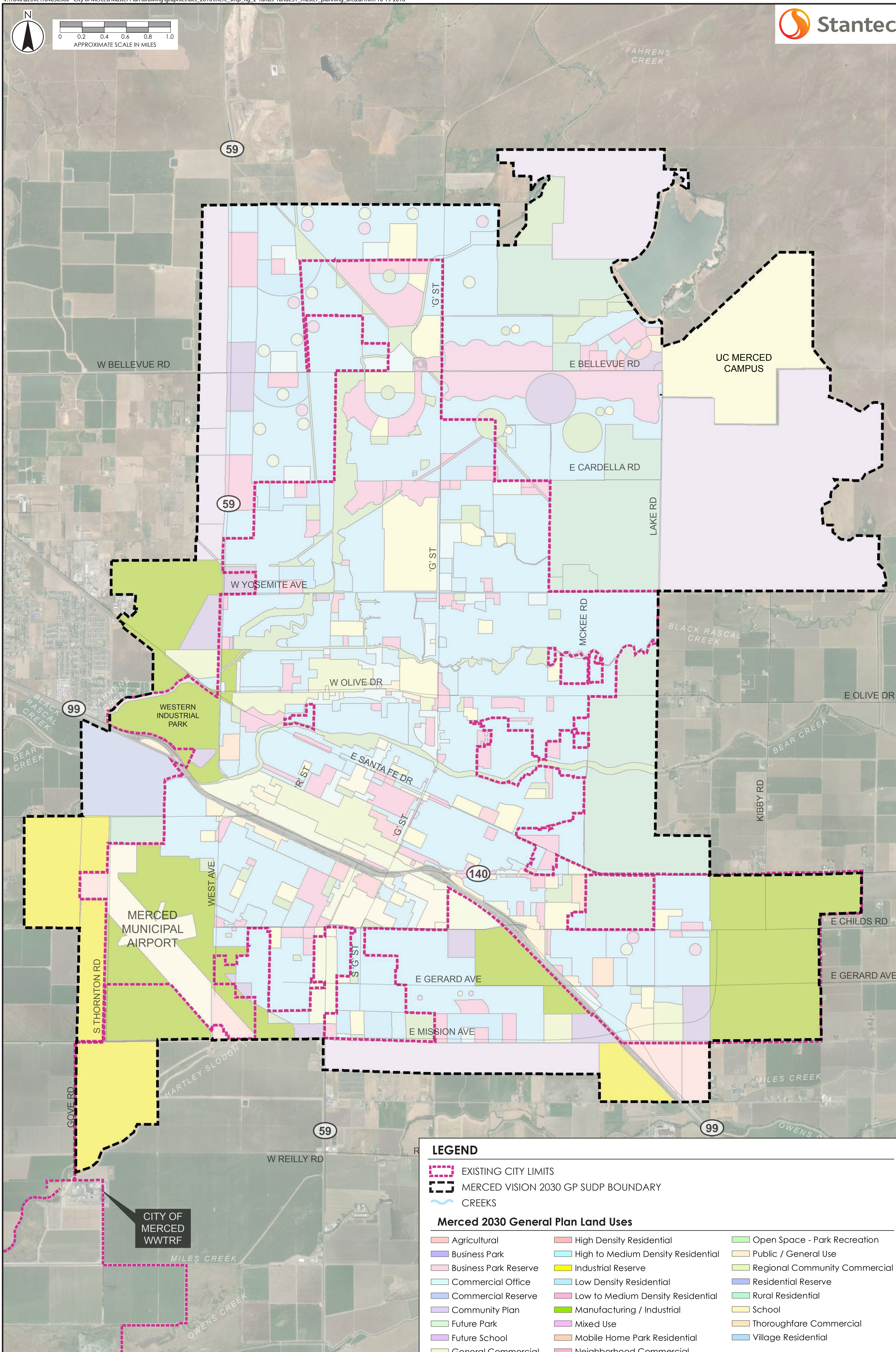

Figure ES-1
Master Planning Area

Because wastewater collection systems flow to wastewater treatment plant sites and related effluent disposal/reuse facilities, these plant sites and effluent facilities must also be evaluated conceptually for function/viability under "build-out" flow conditions. The importance of this concept of planning infrastructure for build-out conditions becomes evident from the forecasts of current (2017), 2030 General Plan, and build-out design wastewater flows presented in **Table ES-1**.

Table ES-1 Design Wastewater ADWFs for the City of Merced (a)

Time Frame	Entire City	North Merced (b)	Rest of City (c)
	ADWF, Mgal/d	ADWF, Mgal/d	ADWF, Mgal/d
Current (2017) (d)	~ 8	--	--
2030 General Plan	~ 16 to 17	~ 4 to 5	~ 12
Build-out	~ 34 to 35	~ 14 to 15	~ 20

(a) Design flow= expected flow for design purposes, not actual flow which can vary materially from year-to-year. ADWF = average dry weather flow.

(b) Represents new flow from the North Merced service area requiring new trunk sewers and additional wastewater treatment and effluent disposal/reuse capacity.

(c) Represents flow to the existing trunk sewer system, including some flow (about 4 Mgal/d) from proposed projects entitled to connect to the existing trunk sewer system.

(d) Current flows include a mix of wastewater from both North Merced (including UC Merced) and the rest of the existing City.

Like collection systems, wastewater treatment plants are master planned to serve "reasonable build-out", but construction of these facilities can be more cost effectively phased. Collection system sewer lines, particularly large trunk sewers, are often located within roadways. This WCS Master Plan has identified locations for trunk sewers which are consistent with the Vision 2030 General Plan Circulation Plan. Trunk sewers require deep excavations and are most cost effectively installed prior to, or concurrent with construction of major roadway and other surface improvements. Replacing sewers or putting in parallel sewers after the fact is disruptive to the public and very expensive.

Treatment plants, when properly sited have generous buffers to limit exposure of commercial and residential land uses to objectionable odors, noise and visual impacts associated with them. Thus, construction activities occurring on treatment plant sites do not involve significant traffic disruptions like trunk sewers and typically result in less exposure of the general public to noise and other potential impacts. So, although treatment plants must be planned for "reasonable build-out" to ensure these generous buffers are in place, they allow for construction of capacity expansions to be phased to keep pace with population growth and take advantage of advances in treatment process technology and consideration of regulatory requirements.

This WCS Master Plan, after consideration of many alternatives, describes two basic plans for building the wastewater collection system infrastructure needed to serve 2030 General Plan growth projections and City forecasts of reasonable "build-out" conditions. All flow capacities referred to in the following bullets are design, ADWF (Average Dry Weather Flow) capacities.

- Plan A: Under Plan A, the collection system takes all municipal wastewater to the City's existing 12 Mgal/d capacity wastewater treatment and reclamation facility (WWTRF) located southwest of the City, as shown in **Figure ES-2**. The existing WWTRF would be expanded, as needed, to handle 2030 General Plan flows. The effluent disposal and reuse facilities needed by the planned expansions largely exist; however, developers still need to buy their fair shares of all existing City facilities they use, including the land on which that infrastructure is located. The existing WWTRF site is believed to have sufficient land and disposal potential to serve "reasonable build-out" design flow estimates of 34 to 35 Mgal/d, if/when needed.

- Plan B: Under Plan B, the collection system takes most municipal wastewater generated by growth in North Merced to a new North Merced WWTRF (NMWWTRF) located on industrially zoned land west of the intersection of W. Yosemite Avenue and Highway 59 (aka, Snelling Highway), see **Figure ES-3**. The NMWWTRF site would be planned for 2030 General Plan and build-out capacities of approximately 4 to 5 Mgal/d, and 14 to 15 Mgal/d, respectively. The existing WWTRF would serve the remainder of the City and its growth, and would have approximate planned capacities for 2030 General Plan, and build-out conditions of 12 Mgal/d and 20 Mgal/d, respectively. Both the new NMWWTRF and existing WWTRF would be built and expanded in stages, or phases, as needed. The NMWWTRF would also need new effluent disposal and reuse facilities master planned for its 2030 General Plan and build-out flow conditions. This is because there are no existing effluent facilities or related effluent discharge permits for the NMWWTRF site, at this time, whereas they do exist at the WWTRF site.

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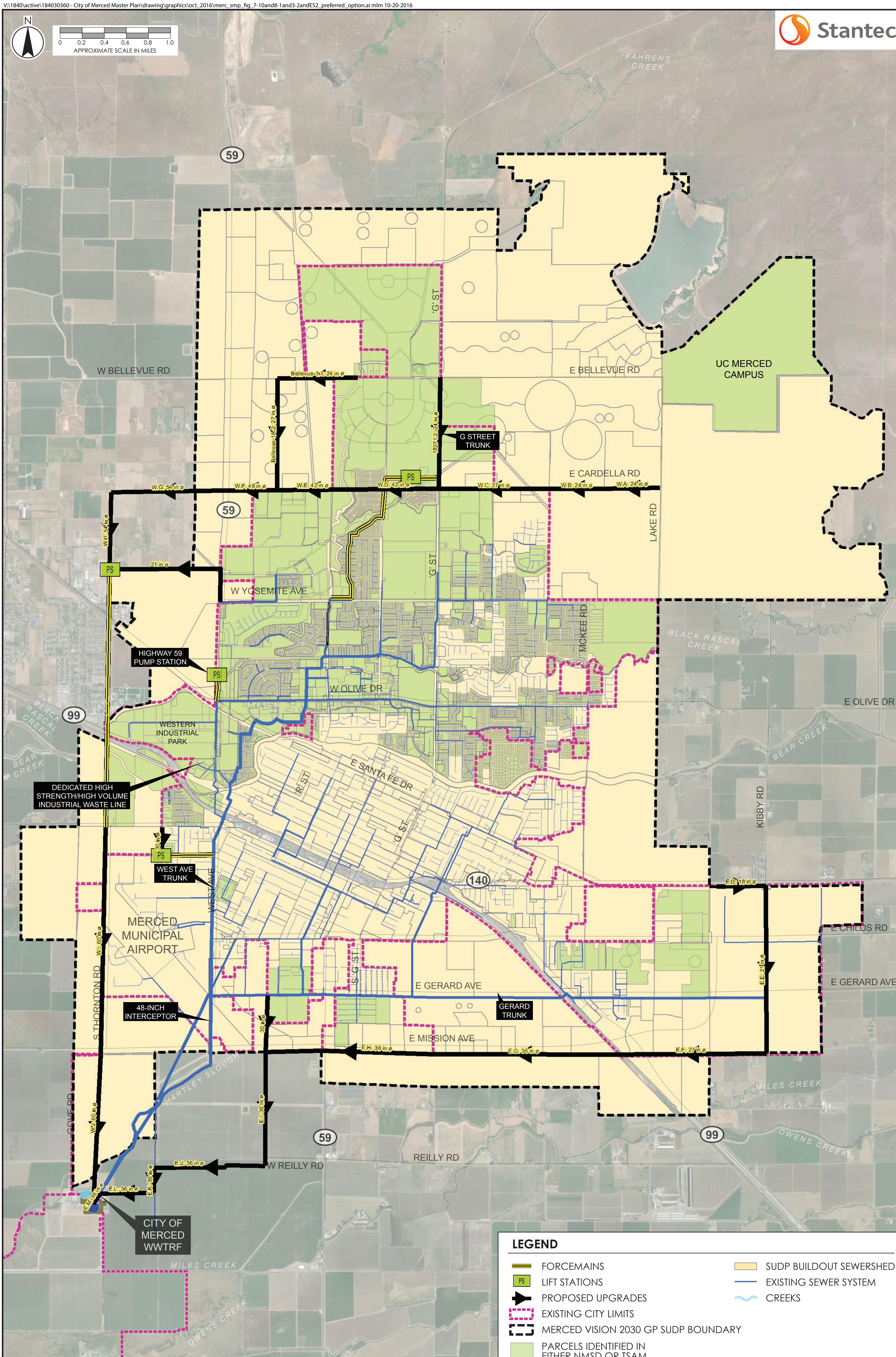

City of Merced
Wastewater Collection System Master Plan

Figure ES-2
WCS Plan A

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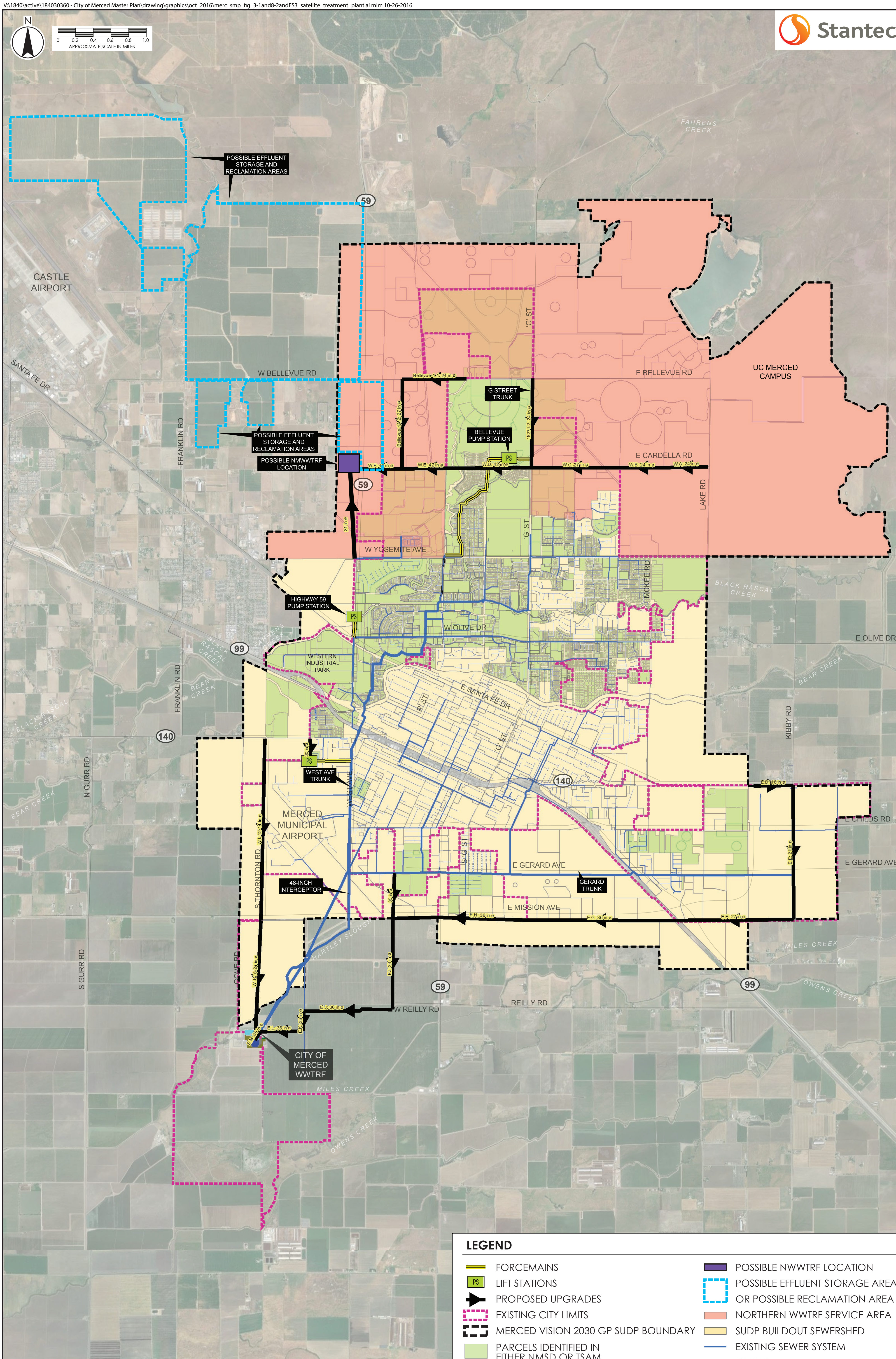

City of Merced
Wastewater Collection System Master Plan

Figure ES-3
WCS Plan B

When comparing wastewater collection system needs under Plan A (**Figure ES-2**) to the wastewater collection system needs under Plan B (**Figure ES-3**), it becomes evident that there is one major similarity and four major differences between these two plans, as summarized below.

Similarities:

S-1. The wastewater collection systems servicing North Merced and the rest of the City are the same under both plans except that under Plan A the North Merced sewer system leads to a pump station conveying the wastewater to the existing WWTRF, whereas under Plan B, the North Merced sewer system leads to a pump station (in essentially the same location as Plan A) lifting the wastewater into the new NMWWTRF.

Differences:

D-1. Plan A builds a pipeline between the North Merced pump station (see S-1, above) and the existing WWTRF, whereas Plan B does not.

D-2. Plan A expands the existing WWTRF, whereas Plan B builds a new NMWWTRF on industrially zoned land adjacent to the North Merced pump station (see S-1, above).

D-3. Plan A expands effluent disposal capacity at the existing WWTRF, whereas Plan B builds a new effluent disposal facility in the greater North Merced area. The new effluent disposal/reuse area could occupy up to approximately 3,800 acres of land under build-out conditions. Effluent reuse is envisioned to entail irrigation of agricultural crops in this WCS Master Plan in the absence of there being any other plan for NMWWTRF effluent, at this time.

D-4. Plan B facilitates effluent reuse in the North Merced area, and therefore has the potential to reduce agricultural use of groundwater in the area, which has been over-utilized historically.

Because actual wastewater collection system needs under Plan A and Plan B are very similar, a comparison of Plan A and Plan B is presented in **Table ES-2** to help avoid confusion as to the major and material differences between these two plans.

Because the wastewater collection system improvements needed under Plans A and B are virtually identical except as noted under "D-1" of Table ES-2, the City Council's decision regarding which wastewater collection system plan to implement will be based more on wastewater treatment and disposal/reuse issues (and associated costs) than on wastewater collection issues (and associated costs). Besides these differences and their costs, the City Council's decision will also be based on many other considerations including recommendations from City staff, City consultants, the general public, and various special interest groups; water resource planning considerations; economics; political considerations; specific service area needs/objectives; etc.

Table ES-2 Differences Between Plan A and Plan B

Major Differences	Plan A	Plan B
D-1. Raw sewage pipeline from North Merced to existing WWTRF	Approximately 2.5 miles of dual 24 and 36-inch forcemains and approximately 3 miles of 60-inch diameter gravity sewer	Not required.
D-2. WWTRF Needs	Expand existing WWTRF to approximately 34 Mgal/d, as needed.	Build new approximately 14 Mgal/d NMWWTRF, and expand existing WWTRF to approximately 20 Mgal/d, both as needed.
D-3. Effluent disposal needs a. Land b. Storage c. Conveyance pipe	 a. None b. None c. None	 a. Up to ~3,800 acres b. Up to ~750 acres c. Approximately 2 miles to ag land north of Bellevue Road and west of Highway 59
D-4. Effluent reuse potential	Indirect via MID (Merced Irrigation District)	Indirect via MID and direct from NMWWTRF to ag land in/near North Merced area

An important consideration in the City Council's final decision regarding Plan A and Plan B is cost and cost differences between A and B. As will be discussed, the costs and cost differences between Plan A and Plan B are dependent on many factors, including whether the City plans to implement extensive effluent reuse via agricultural irrigation in the North Merced area to reduce agricultural use of the North Merced groundwater resource. This groundwater resource serving the City, agriculture, and other uses in the greater Merced area is currently heavily utilized. Extensive agricultural reuse of effluent in the North Merced area could potentially reduce agricultural use of the groundwater resource, and possibly play a role in helping sustain the City's potable water supply.

When put in those terms, without benefit of a more complete understanding of City water resource planning, it may seem irresponsible to not implement Plan B and associated effluent reuse in North Merced. However, the City has engaged in extensive water resource planning to help achieve the goal of making the City's potable water supply more sustainable and reliable. The most significant planning relative to this WCS Master Plan is between the City and Merced Irrigation District (MID) to swap effluent water from the existing WWTRF for Merced River water to be used to 1) recharge the area's groundwater resource, and 2) irrigate parks and other City landscaping (in place of using groundwater).

In summary, not implementing effluent reuse in the North Merced area does not mean the City is ignoring groundwater resource issues. It means the City is attempting to address the issue via different means involving use of lower salinity and lower nitrogen content Merced River water rather than tertiary-treated effluent. This is important because the two most common contaminants of concern in groundwater resources are salinity and nitrogen. With this insight, one may ask, "Why even consider effluent reuse in North Merced when better quality water is available?" The answer is reliability. The City has greater control over an effluent reuse program than over a water swap program involving MID and parties impacted by changes in Merced River flows and/or diversions. This is why the City continues to consider effluent reuse in the North Merced area and throughout the City.

In so far as Plan A and Plan B both include effluent reclamation and groundwater resource considerations, the choice between Plan A and Plan B is primarily a matter of economics from an engineering perspective. Specifically, is the overall life cycle cost of Plan A more or less than the overall life cycle cost of Plan B? Life cycle costs cover the upfront cost of building the infrastructure (the primary concern of developers, who typically pay this bill when assessment districts are not involved), and the present worth of the on-going annual costs necessary to operate, maintain, and ultimately rebuild the infrastructure (the primary concern of businesses and residents, who pay these bills after occupying the developers' projects). The desires for low, up-front construction costs versus low, long-term annual costs are generally competing interests. The City's objective is to act as the fair deal broker between these two special interest groups, who are both essential to City growth.

Stantec's reconnaissance opinion of probable total project costs to plan, design and construct Plan A and Plan B (to serve "reasonablel build-out", or ~34 Mgal/d, ADWF) reflects a difference of approximately 15 to 20 percent, with Plan B having the higher expected cost. Detailed breakdowns of the estimated costs for Plan A and Plan B are presented in Section 8.0 of this WCS Master Plan, along with discussion of the anticipated process and facility components associated with each. Major uncertainties (known to exist, at this time) associated with each plan are presented in **Table ES-3**. Schematics of the relative locations of infrastructure needs for Plan A and Plan B are shown in **Figure ES-2** and **Figure ES-3**, respectively.

Table ES-3 Major Uncertainties Associated with Plan A and Plan B

	Uncertainties
Plan A	• Will water swap with MID occur and be a long-term proposition?
Plan B	• Does the City wish to devote 35 acres of industrially zoned land for the new NMWWTRF? Will the presence of a major WWTRF in the industrial park discourage other industries from locating there, particularly food processing industries? • Which agricultural lands in the greater North Merced area will become part of the NMWWTRF effluent reclamation system, and how/when will those lands be secured for City use under build-out conditions? • Will CEQA analyses and/or Regional Water Board permitting present any roadblocks to implementing Plan B either near-term or long term? • Will Plan B help or hinder maintenance of the quantity and/or quality of the City's groundwater potable water supply?

Under Plan A, wastewater treatment, disposal, and reuse are expansions in-kind of existing facilities and permits. Much of the effluent is planned to be swapped for Merced River water, as described previously. Under Plan B, effluent disposal from the new NMWWTRF is envisioned to entail dry season effluent irrigation of agricultural land under City ownership (effluent disposal facilities should be as permanent [i.e., secure] as the developments they serve), wet season storage of effluent for subsequent use during the following dry season, and possibly wet season effluent discharges to Fahrens Creek under very wet conditions when Fahrens Creek is both below flood stage, and has adequate flow to dilute effluent discharged to it (if realistic under CEQA and permitted by the Regional Water Board). As to whether effluent produced by the NMWWTRF under Plan B could be swapped for MID surface water (as is proposed under Plan A) is unknown at this time. Plan B should reduce use of North Merced area groundwater for agricultural purposes, but this is not an established fact at this time because the agricultural lands that would be used for effluent reclamation have not been identified by the City, let alone acquired by the City. Because the actual types, locations, and feasibilities of the new NMWWTRF effluent facilities have not been developed by the City, subjected to CEQA analyses, permitted by the Regional Water Board, etc., the estimated higher total project costs for Plan B NMWWTRF effluent facilities are based solely on Stantec's judgement and experience with somewhat similar facilities in the Central Valley.

Plan A is believed to have a total project cost and fewer uncertainties than Plan B. Plan A's effluent is proposed to be swapped by the City for MID surface water; Plan B's effluent may not have this potential benefit. Plan A is well precedented by similar sized cities throughout the Central Valley, and is in concert with Regional Water Board policy to regionalize WWTRFs to the extent feasible rather than have multiple WWTRFs servicing geographically contiguous areas. Based on available information, Stantec's recommendation is to implement Plan A, primarily for cost and water resource planning reasons. In other words, Stantec's preliminary recommendation is to pipe all municipal wastewater to the existing WWTRF for treatment, disposal, reuse, and water swapping.

In making that preliminary recommendation, Stantec believes both Plan A and Plan B are viable. Merced-sized cities with two WWTRFs are relatively rare in the Central Valley, but do exist. A good example of such a city is Roseville, California. Roseville elected to build a second WWTRF (the Pleasant Grove Creek facility: ADWF= 18 Mgal/d) just under 5 miles northwest from its existing Dry Creek facility (ADWF= 12 Mgal/d) to serve new growth that was occurring primarily in this northwesterly area. The two Cities (Roseville and Merced) face different circumstances relative to land use planning. The driving force behind Roseville's decision to bifurcate treatment and disposal was the reality that development had encroached upon the Dry Creek facility, surrounding it and making expansion in that location impractical. The City of Merced, in contrast, has large agricultural and industrial land use buffers surrounding its existing WWTRF making such conflicts far less likely in the future.

When considering the contents of this WCS Master Plan, likely questions are "Why not recommend this approach…or that approach?" A very brief discussion of some collection system options raised by special interests that have not been carried forward in this WCS Master Plan as being feasible for the City on a long-term, permanent basis are presented below.

1. *Why not install wastewater flow equalization basins in the collection system to utilize the existing sewers more efficiently, and more cost effectively?*

   Such basins are possible, but storing raw sewage for flow equalization purposes, in practice, is almost entirely limited to WWTRF sites. Such basins are rare in developed areas because they are ugly, are a potential nuisance, and are maintenance headaches. Such basins have aeration equipment (to minimize smells), have automatic wash-down systems (to scour "solids" from the basin when not in use), and may need a cover or other visual screening, noise attenuation, and/or odor scrubbing equipment (depending on situation-specific factors). Raw sewage equalization basins should not be a planned permanent component of a wastewater collection system (except in rare situations not applicable to Merced); however, such basins may be considered on a temporary basis (with specific closure criteria and financial guarantees) in specific situations authorized by the City Council. The entire cost of such a basin, if approved by the City Council, should be borne and bonded by the basin proponent, and in no way reduces proponent's fees for building the permanent wastewater collection system, which will be exactly the same regardless of whether the City Council permits temporary use of such a basin to expedite a specific development that otherwise would be on hold until sewer system capacity is built to meet the development's needs.

2. *Why not allow larger, planned community developments to build their own wastewater collection, treatment, and effluent reuse systems? We could save the cost of those big trunk sewers, implement effluent reuse, and expedite development all at the same time*

   This approach to implementing wastewater infrastructure reduces upfront construction costs (paid by developers) and increases long-term annual costs (paid by residents and businesses) because of loss of economy of scale on at least operations and maintenance, if not also construction when total construction costs are considered. As an example of total construction costs, such systems need places to store effluent within the planned communities through 100-year rainfall seasons. In this example, each planned community may plan to build an ornamental lake for seasonal tertiary effluent storage, but problems with such lakes are manifold. The lake's water level must be able to rise and fall seasonally because the only lake volume that counts as 100-year effluent storage is the volume of the lake that is empty each autumn. Algae that naturally grow in tertiary effluent lakes can be chronically problematic. The lake may need aeration, circulation, and chemical controls. Following construction and filling of ornamental lakes, midge populations can explode to nuisance levels until the natural ecology of the lake has time to develop (typically in a year or two). Such small, project-specific wastewater systems are difficult to permit with the Regional Water Board because they run contrary to Board policy, which was developed because the long-term track record of multiple small systems has been relatively poor. If/when such systems fail, the City will be responsible for correcting the failure. This is because the development is within the City, and the City permitted it to occur. Because the wastewater collection system was not planned for these "self-sufficient" planned community developments, the City will either reconstruct the wastewater collection system, or continue to rebuild and operate the small systems to prevent the planned community development from being condemned for health and safety reasons. However, as with the raw sewage equalization basins, temporary small wastewater systems (with specific closure criteria and financial guarantees) could be authorized by the City Council in specific situations to address specific development needs. The entire cost of the temporary system should be borne and bonded by the system proponent. The proponent still pays upfront for proponent's share of the permanent wastewater collection system and treatment facilities. The proponent still designs the development's collection system to tie into the permanent City trunk sewer by gravity flow when that trunk sewer reaches the development. Because the City has General Plan Policy UE-1.2 to maintain development in a compact urban form, any proposal for a temporary, development-specific wastewater treatment and reuse system should be located on the perimeter of existing City-served developments with the only hindrance to connecting to the City system being lack of capacity in the existing City wastewater collection system at the time the development desires to move forward.

The Regional Water Board is not expected to approve any small systems unless they are operated by the City, and are temporary (with specific and enforceable closure criteria and financial guarantees). Because of the poor economy of scale of operating and maintaining small WWTRFs, the annual costs (as reflected by monthly sewer use fees) for users of these small systems will be higher than normal City wastewater fees. As a matter of policy, the City Council (when approving any such temporary system) will need to decide whether the businesses and residents served by the temporary system pay higher monthly sewer use fees, or whether they pay the City's normal use fee with the system proponent covering the cost difference until the businesses and residents connect to the permanent City system.

Raw sewage equalization basins and development-specific WWTRFs are suggestions put forth by developers to reduce their infrastructure costs and/or to facilitate implementation of their developments that are on-hold because of the need for City wastewater infrastructure. Neither suggestion is recommended as a permanent facility; therefore, neither suggestion impacts the design or cost of Plan A, or Plan B. However, the City Council may wish to consider allowing developer use of temporary raw sewage equalization basins and/or development-specific WWTRFs on a project-specific basis for situation-specific reasons, e.g., to facilitate development critically needed by the community. If the City Council desires to consider temporary means to facilitate critically needed development, then Stantec recommends that the City develop an Implementation Plan describing use of and design criteria for temporary facilities.

Finally, this Executive Summary concludes with a list (see **Table ES-5**) of recommended trunk sewer projects:

- Improvements to existing trunk sewers (common to Plans A and B).
- New trunk sewers to serve new growth in SUDP (common to Plans A and B).
- New pump station, forcemain, and gravity sewer connecting North Merced area trunk sewers to the existing WWTRF (unique to Plan A).

Table ES-4 includes reconnaissance opinions of probable capital costs for each trunk sewer project.

Table ES-4 Recommended Trunk Sewer Improvements & Opinions of Probable Cost (a)

Service Area	Construction Cost (a)	Engineering, CM, Admin (20%)	Contingency (30%)	Total Project Costs (rounded)
Address Existing Deficiencies	$3,417,000	$683,000	$1,230,000	$5,330,000
North Merced SUDP (Plan A)	$67,139,000	$13,428,000	$24,171,000	$104,738,000
South Merced SUDP	$14,620,000	$2,924,000	$5,264,000	$22,808,000

(a) ENR CCI = 10703, June 2017. Costs presented do not include acquisition of additional right-of-way, environmental or permitting costs.

The improvement projects to address existing deficiencies identified in **Table ES-4** do not include repair and replacement (R&R) of City facilities. A robust R&R program is a key element of any properly managed public infrastructure system. The City's R&R program for the sewer utility includes an annual expenditure for the replacement of older, aging infrastructure. To replace all the facilities in the City's sewer enterprise would require a significant sum of money. An annual R&R allocation is recommended to reduce the impact of repairing and replacing critical portions of the City's sewer collection system by stretching them out over time.

Implementation of Plan A and the necessary improvements to convey wastewater to the existing City WWTRF site would require the construction of additional treatment capacity as needed. The City, as described previously and in more detail in Section 8.0 of this WCS Master Plan, intends to expand those facilities either in one 8 Mgal/d, ADWF phase, or in two 4 Mgal/d phases up to 20 Mgal/d. This would be sufficient to provide treatment and disposal capacity for the projected flows anticipated in 2030 (~16 to 17 Mgal/d, ADWF) as summarized in **Table ES-1**. **Table ES-5** summarizes the expected cost of those WWTRF improvements.

Table ES-5 An Estimate of Improvements Needed to Provide Capacity at Existing WWTRF to Serve 2030 Population Projections (a)

WWTRF Improvements	Opinion of Capital Costs to Expand Existing WWTRF to 20 Mgal/d (b)
Headworks and Primary Treatment Facilities	$2,474,000
Secondary Treatment	$21,901,000
Tertiary Treatment	$3,065,000
Disinfection System	$0
Effluent Disposal Facilities	$0
Solids Handling Facilities	$21,835,000
Miscellaneous Structures	$677,000
Subtotal 1	**$49,952,000**
Mobilization, Bonds, Insurance, Startup, Misc.	$6,808,000
Sitework	$6,152,000
Site Piping	$4,922,000
Electrical and Instrumentation	$10,663,000
Subtotal 2	**$78,497,000**
Contingencies @ 30%	$23,549,000
Subtotal 3	**$102,046,000**
Engineering and Administration @ 20%	$20,409,000
Total Project Cost	**$122,455,000**

a) 20 Mgal/d, ADWF is estimated to be sufficient to serve the 2030 population projected in the City's General Plan.

b) Based on ENR-CCI (20 Cities Index) = 10703, June 2017.

At this time, the City is planning to budget $600,000 to $800,000 annually for repair and replacement of collection system assets. Prioritization of R&R projects will be done within the typical five-year CIP timeframe, updated accordingly, but the City also recognizes that unforeseen incidents may require adjustments in the specific projects identified in any particular year. Further discussion of the City's R&R program is provided in Sections 7.0 and 8.0 of this WCS Master Plan.

1.0 INTRODUCTION, PURPOSE, STUDY AREA AND BACKGROUND

The City of Merced (City) retained Stantec to update the City's Wastewater Collection System Master Plan (WCS Master Plan). This WCS Master Plan addresses existing and future wastewater collection system capacity needs and alternative solutions based on 1) providing sewer service to planned community growth, and 2) eliminating known system deficiencies, when feasible. This plan recommends locations, sizes and/or mitigation measures for trunk sewers to serve areas within the existing City Limits, as well as areas within the City's Specific Urban Development Plan (SUDP) boundary as identified in the City of Merced Vision 2030 General Plan (2030 General Plan). "Trunk sewers" are the main sewers of a wastewater collection system to which other smaller, collector and neighborhood sewers drain. In the case of the City's system the trunk sewers have diameters ranging in size from 8 inches up to 48 inches.

This WCS Master Plan builds off previous City sewer planning documents, including the *City of Merced, Sewer Master Plan* (ECO:LOGIC Engineering, January 2007, Draft) which was prepared in the context of serving the City's Vision 2015 General Plan growth projections, and the *City of Merced, North Merced Sewer Master Plan* (ECO:LOGIC Engineering 2002, Draft) prepared to identify sewer needs in the North Merced area.

1.1 PURPOSE

The purposes of this WCS Master Plan are to:

1. Provide the City with an updated evaluation of options for serving the wastewater collection needs of the Vision 2030 General Plan;

2. Re-assess the capacity of existing trunk sewers within the City Limits and SUDP, including consideration of sewer performance during the wet 2017 water year;

3. Provide recommendations for upsizing existing trunk sewers, or other means to address deficiencies identified as part of the assessment of the current sewer system's capacity design conditions;

4. Revisit the assessment from the draft 2002 North Merced Sewer Master Plan of options for serving that area with a "satellite" wastewater treatment plant with the treated wastewater (termed "effluent") produced by that plant being reused in the North Merced area;

5. Provide recommendations for sewer projects that would fulfill the City's desire to serve growth envisioned in the Vision 2030 General Plan;

6. Prepare a list of capital improvement projects (with planning-level cost estimates) to address existing system deficiencies as well as projects that will be needed to serve new growth.

This Master Plan document addresses the following subjects:

- Section 2.0: An Overview of Planning Wastewater Service
- Section 3.0: The Basis for City Collection System Planning
- Section 4.0: Existing Wastewater Collection System
- Section 5.0: Sewer Flow Estimates
- Section 6.0: Hydraulic Model
- Section 7.0: Collection System Model Results
- Section 8.0: Feasible Alternative Wastewater Collection System Improvement Plans and Recommendations

1.2 STUDY AREA

The study area for this WCS Master Plan is as described in the 2030 General Plan, and shown in **Figure 1-1**, which covers the entire City and its planned growth areas. However, much of the sewer system for the City is in place, and performing satisfactorily. Consequently, the main focus of this WCS Master Plan is developing wastewater collection system alternatives to serve the SUDP area, relative to the existing City, its existing sewers, and the City's existing Wastewater Treatment and Reclamation Facility (WWTRF). In planning the wastewater collection system ("sewer system") for an area like the SUDP that is largely undeveloped at this time, the 2030 General Plan is the basis for evaluating what new development may occur, and therefore what level of sewer service (i.e., flow capacity) may be needed. The City also provided Stantec with information for planned land uses within the UC Merced Campus and adjoining Campus Community. Both areas are located in the SUDP and were described in separate documents including:

- UC Merced and University Community Project Draft EIS/EIR, November 2008
- UC Merced and University Community Project Final EIS/EIR, March 2009
- UC Merced 2020 Project Addendum No. 6 to the 2009 UC Merced Long Range Development Plan EIS/EIR, April 2013

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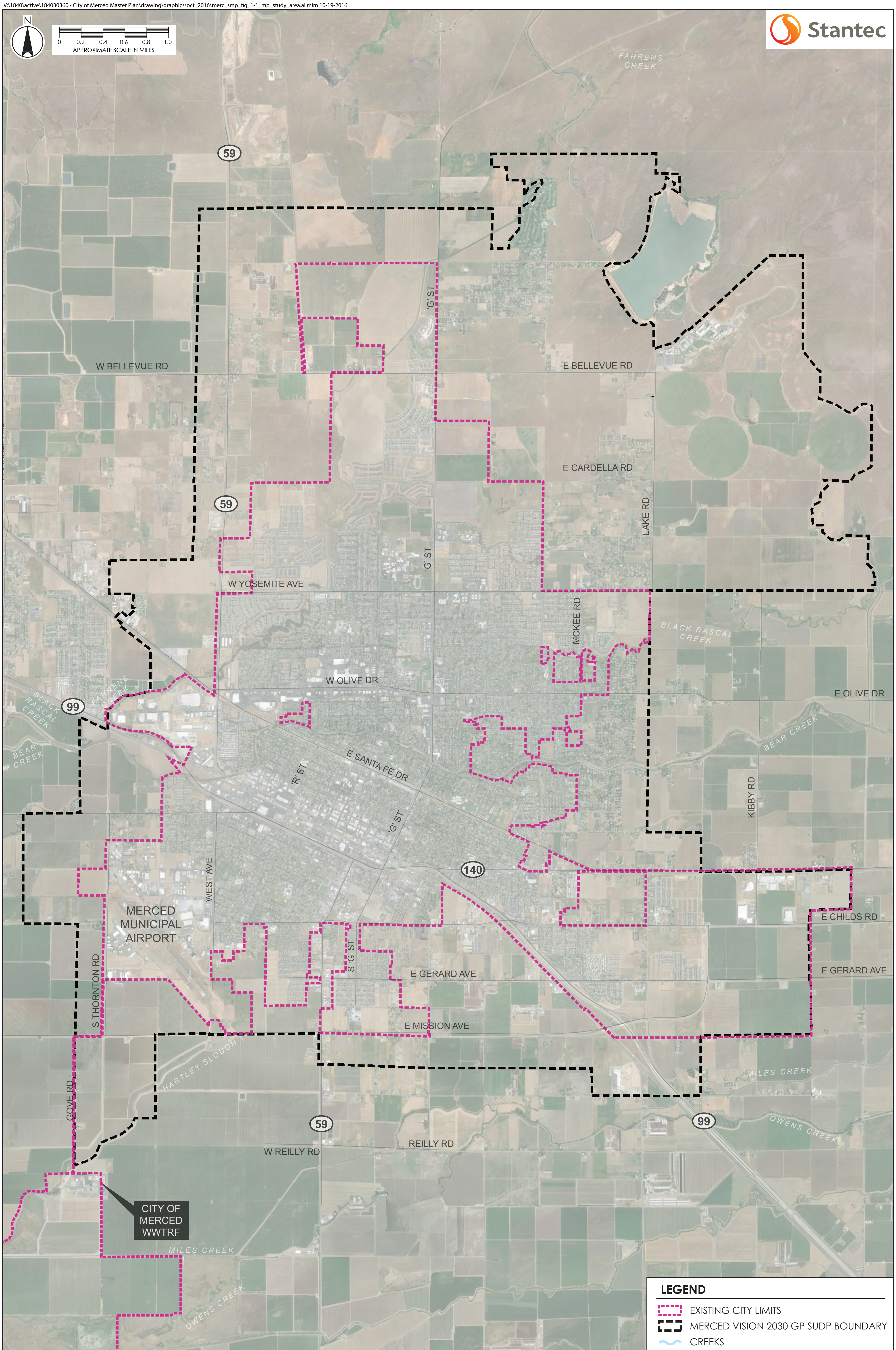

Figure 1-1
Master Plan Study Area

In addition, the City provided Stantec with information contained in the Bellevue Community Plan (BCP; April 2015, Lisa Wise Consulting), including land use types and acreages. The Bellevue Community Plan encompasses approximately 1,600 acres (gross) of property located north and south of Bellevue Road west of UC Merced, east of G Street, within the SUDP. Collectively, this information forms the basis for the analyses described in this WCS Master Plan.

As will be discussed, wastewater collection systems are designed based on a 50+ year service life, not the 20-year growth projections found in general plans. Therefore, the WCS Master Plan and related analyses are based on best professional judgment forecasts of "build-out" flow conditions, not 20-year planning conditions. This difference is important. City forecasts of "reasonable" build-out average dry weather flow (ADWF, the most common means of describing wastewater capacity) are presented in **Table 1-1**, along with ADWF estimates for more near-term growth as discussed in the 2030 General Plan.

Table 1-1 Design Wastewater ADWFs for the City of Merced (a)

Time Frame	Entire City	North Merced (b)	Rest of City (c)
	ADWF, Mgal/d	ADWF, Mgal/d	ADWF, Mgal/d
Current (2017) (d)	~ 8	--	--
2030 General Plan	~ 16 to 17	~ 4 to 5	~ 12
Build-out	~ 34 to 35	~ 14 to 15	~ 20

(a) Design flow= expected flow for design purposes, not actual flow which can vary materially from year-to-year. ADWF = average dry weather flow.

(b) Represents <u>new</u> flow from the North Merced service area potentially served by new trunk sewers or a new wastewater treatment plant located in the North Merced area.

(c) Represents flow to the existing trunk sewer system, including some flow (about 4 Mgal/d) from new growth in the North Merced area entitled to connect to the existing trunk sewer system.

(d) Current flows include a mix of sewage from both North Merced (including UC Merced) and the rest of the existing City.

These forecasts of ADWF are based on current City development trends and design standards. If maximum density development based on 2030 General Plan land zoning occurred, then future ADWFs could be greater than reported in **Table 1-1**. If developers wish to purchase capacity for maximum density developments, they should be given this opportunity prior to the City beginning the detailed design of the new trunk sewers.

1.3 BACKGROUND

The City's 2030 General Plan discusses City growth that may occur by the year 2030. Much of that growth requires construction of new infrastructure that is to be funded by the proponents of growth needing public services which the City provides. Key infrastructure needs relevant to this WCS Master Plan include the wastewater collection system, itself; wastewater treatment, disposal, and reuse facilities; and various potable and non-potable water needs for the growing areas of the City. This WCS Master Plan is focused on wastewater collection system (or sewer system) needs and planning. However, wastewater collection system planning is driven by 1) where the wastewater is generated (i.e., collected from), and 2) where it is conveyed to receive treatment, and then subsequent disposal or reuse of the treated wastewater, which is termed "effluent". The siting of wastewater treatment facilities is driven by many factors including land use/zoning, how/where the treated wastewater is to be disposed/reused, and overall life cycle costs. The City is in the process of updating its master plan for wastewater treatment facility needs and recently updated its draft water master plan (AECOM, 2015 draft). This WCS Master Plan is believed to integrate the intent and objectives expressed by City staff relevant to these related infrastructure planning efforts. The most important concept coming out of these concurrent planning efforts is that the City is not planning to implement extensive effluent reuse (i.e. the City is not planning to install a "purple pipe" reclaimed wastewater effluent distribution system) in North Merced.

With this insight, the concept of a second "satellite" WWTRF potentially located in North Merced which would dispose of its effluent primarily by irrigation of agricultural land, not irrigation of urban landscaping, has been considered and discussed in further detail in this WCS Master Plan. This means that a North Merced WWTRF (NMWWTRF) could use "secondary" treatment processes rather than the more expensive "tertiary" treatment processes. With NMWWTRF effluent being used to irrigate agricultural lands in the greater North Merced area, there is the potential for this effluent disposal option to reduce agricultural use of the North Merced groundwater resource, which is 1) the potable water supply for North Merced and the balance of the City of Merced, and 2) has historically been heavily utilized by the various users of this resource. This usage has implications for the City's potable water supply relevant to this WCS Master Plan, as will be discussed.

This concept of one or more WWTRFs in the North Merced area was also raised by developers as a potential means to reduce the size, cost, and time delays associated with taking City sewage to the existing WWTRF. Accordingly, a WWTRF (or multiple WWTRFs) in North Merced is discussed in this WCS Master Plan.

As noted earlier, this WCS Master Plan builds off previous City wastewater collection system documents that have identified portions of the City's existing wastewater collection system that could be improved. The City is in the process of making these improvements; therefore, the primary focus of this WCS Master Plan is the planning of new trunk sewers to serve new development. However, the capacity of the existing system, in particular any remaining capacity, is of importance when sizing and locating new trunk sewers and is of interest to the development community, some of whom have reserved capacity in the existing trunk sewer system. As a result, this WCS Master Plan presents the results of these capacity analyses and discusses improvements recommended to the existing sewer system. This is presented in the context of prior City planning efforts to provide completeness and continuity with previous City sewer planning documents.

2.0 AN OVERVIEW OF PLANNING WASTEWATER SERVICE

2.1 INTRODUCTION

This WCS Master Plan is focused on developing alternative plans for building new trunk sewers necessary to serve planned City growth. This plan also discusses known deficiencies with existing trunk sewers, and recommends mitigation measures when feasible. Wastewater collection system planning is not made in a vacuum. Other important factors, in addition to existing system capacity, must be considered:

- Where the collected sewage will be conveyed for treatment (Where is the WWTRF located, and how does the sewer get there?);
- How the treated wastewater (i.e., effluent) will be used for maximum benefit (This is important because water is becoming increasingly scarce in California);
- What quantities of sewage must be conveyed from new development to the WWTRF under design conditions considering land development variables, rainfall, and the reasonable deterioration of sewer pipes and joints over time; and,
- How the needed sewers (and WWTRF improvements) will be paid for, and how construction of wastewater collection system improvements may be staged, if feasible.

With that introduction to the integrated nature of wastewater collection system planning, the City retained Stantec to prepare an engineering analysis of probable wastewater collection system needs (aka, "sewer needs") to serve near-term and long-term City growth/development that does not have allocated service capacity in the City's existing sewer system. Part of the analyses provided, herein, include consideration of feasible alternative approaches to providing the needed sewer service, evaluation of those alternative approaches, and recommendation of the best apparent plan for expanding the City's sewer system to serve new growth based on information provided to Stantec by the City, as well as based on Stantec's experience with planning and evaluating sewer systems like the City's in the Central Valley.

The collection of municipal sewage/wastewater for safe treatment and reuse is a critical public service that is difficult to plan. Fundamental reasons for the inherent difficulty in planning wastewater collection systems (aka, "sewers") in many (if not most) municipal settings include:

- Sewers are buried, often deeply in the ground, and cross under many other utilities: roads, railroads, gas lines, water pipes, high voltage electrical wires, storm sewers, cable and broadband services, etc. Trunk sewers are typically deep in the ground because they are designed to flow by gravity (the most reliable and lowest operational cost means of conveying sewage). Therefore, the trunk sewers need to be deep enough to receive sewage flow from homes and businesses via sewer service laterals and neighborhood collector sewers which, then, drain by gravity to trunk sewers, which then flow by gravity to larger trunk sewers, and finally to the influent pump station at the WWTRF. To reduce the depth of trunk sewers to the extent feasible, they generally are designed, overall, to flow in the direction of downward sloping topography. In other words, they generally slope in the direction that creeks and drainages flow in the area, but within the limits of public road rights of way, which are also trunk sewer easements. Sewage lift stations (i.e., raw sewage pump stations) are installed in wastewater collection systems when gravity sewage flow is no longer cost effective. A consequence of designing trunk sewers to flow by gravity to the extent cost effective (on an overall life cycle cost basis) is that WWTRFs are located down-slope of the developed area they serve.

- Because sewers are often (but not always) buried deeply under a lot of infrastructure within urbanized areas, sewers are designed to remain in service for at least 50 years, and with modern pipe materials possibly 100 years, or more. No one wants to replace an existing sewer under streets and mazes of various pipes and cables with a larger sewer (or a second parallel sewer) to serve new growth unless it is necessary. Sewers are expensive to build or rebuild, and rebuilding sewers after an area has developed is both disruptive and dangerous, in general. Consequently, intelligent planning of wastewater collection systems is extremely important to a City. Additionally, new trunk sewers are designed to gravity flow around already urbanized areas to the extent cost effective to minimize the disruption and danger of installing a new trunk sewer in a major urban street, or through a residential neighborhood.

- The service life of sewers is well beyond the 20-year planning horizon of most general plans…thus the question arises "what will the city be like in 50 to 100 years…will sewers even be needed, or will they be replaced by some new technology?" Right now, the best guess is that sewers will still be needed in 50+ years, and the best guess as to how to plan those sewers is the reasonable (not maximum possible)"build-out" estimate for a city.

- Who will pay upfront for a sewer designed to serve community growth for 50+ years when growth is unpredictable, and uncertain beyond roughly the next 10 years?

- The foregoing point raises a logical question, "Instead of building sewers to serve 50+ years of growth in an area, can we build smaller sewers serving real, immediate growth needs that flow to a more localized WWTRF also designed to meet immediate growth needs?" In other words, with modern wastewater treatment facilities and water reuse options, can smaller, shallower sewers flowing to multiple, smaller WWTRFs replace the traditional approach of building large, long sewers to a single WWTRF. This approach of matching near-term infrastructure needs more closely to near-term development needs has particular relevance to the City's specific situation, and this WCS Master Plan, as will be discussed.

These issues (amongst many other issues) are being addressed by the City as it plans how, when, and where to convey future sewage so as to allow land owners/developers (hereinafter, developers) to develop their properties. The City, not the developers, is the decision-making body in such planning matters. This is because the City will be responsible for maintaining the sewer system using funds provided by City residents and businesses long after developers have sold their properties and have no further financial or legal responsibilities regarding the sewers. In essence, the City is the representative of existing and future City residents and businesses, and their collective concern that the planned wastewater collection system/sewer system will work over the next 50+ years, and will not become problematic and/or a disproportionate burden for users collectively (in terms of disruption and/or economics). Developers are the primary beneficiary of an expanded wastewater collection system, and are responsible for funding what is needed to facilitate their developments and profits. The City is the responsible public agency attempting to find common ground (the "fair deal") between two competing interests: the desires of developers to keep their upfront infrastructure costs low, and the desires of residents and businesses to keep their long-term infrastructure costs low. This is not a "pay me now, or pay me later" situation because developers do not sell their properties on a "cost plus" basis…the price of property is market driven, with any assessment district "bonds" on the property being a somewhat "hidden cost" to prospective buyers until they analyze their monthly/annual cost to occupy a property. As noted, it is a complicated planning process, and the City acts as the fair deal broker between these two competing special interest groups (developers and residents/businesses), with both groups being essential to City growth.

With that introduction to wastewater collection systems and their planning, the most critical matters before the City that are evaluated in this WCS Master Plan are summarized below:

- Much of the City's planned development is to the north of Bear Creek and the existing City, in the vicinity of the UC Merced campus, see **Figure 2-1**. This northern area is referred to throughout this Master Plan as the North Merced service area, or simply North Merced. The portion of the City's planned development located south of Bear Creek is referred to throughout this Master Plan as the South Merced service area (or simply South Merced).
- The City's existing WWTRF is located southwest of the existing City, see **Figure 2-1**.
- Wastewater collection, treatment, and reuse service for in-fill development within the City and for new development south of the City will be provided by the existing WWTRF as a matter of judgment by City management based on information and technologies available at this time. This is because sewer access to the existing WWTRF is relatively easy from these central and southern development areas. However, the North Merced area is sufficiently remote from the WWTRF (with the existing City and existing public infrastructure located between this area and the WWTRF), that the possibility of one or more WWTRFs serving the North Merced area is a credible alternative warranting consideration. This is because the alternatives of 1) taking new North Merced trunk sewers through existing Merced is very undesirable for reasons stated and 2) taking new North Merced trunk sewers around the west side of Merced to reach the existing WWTRF is expensive.

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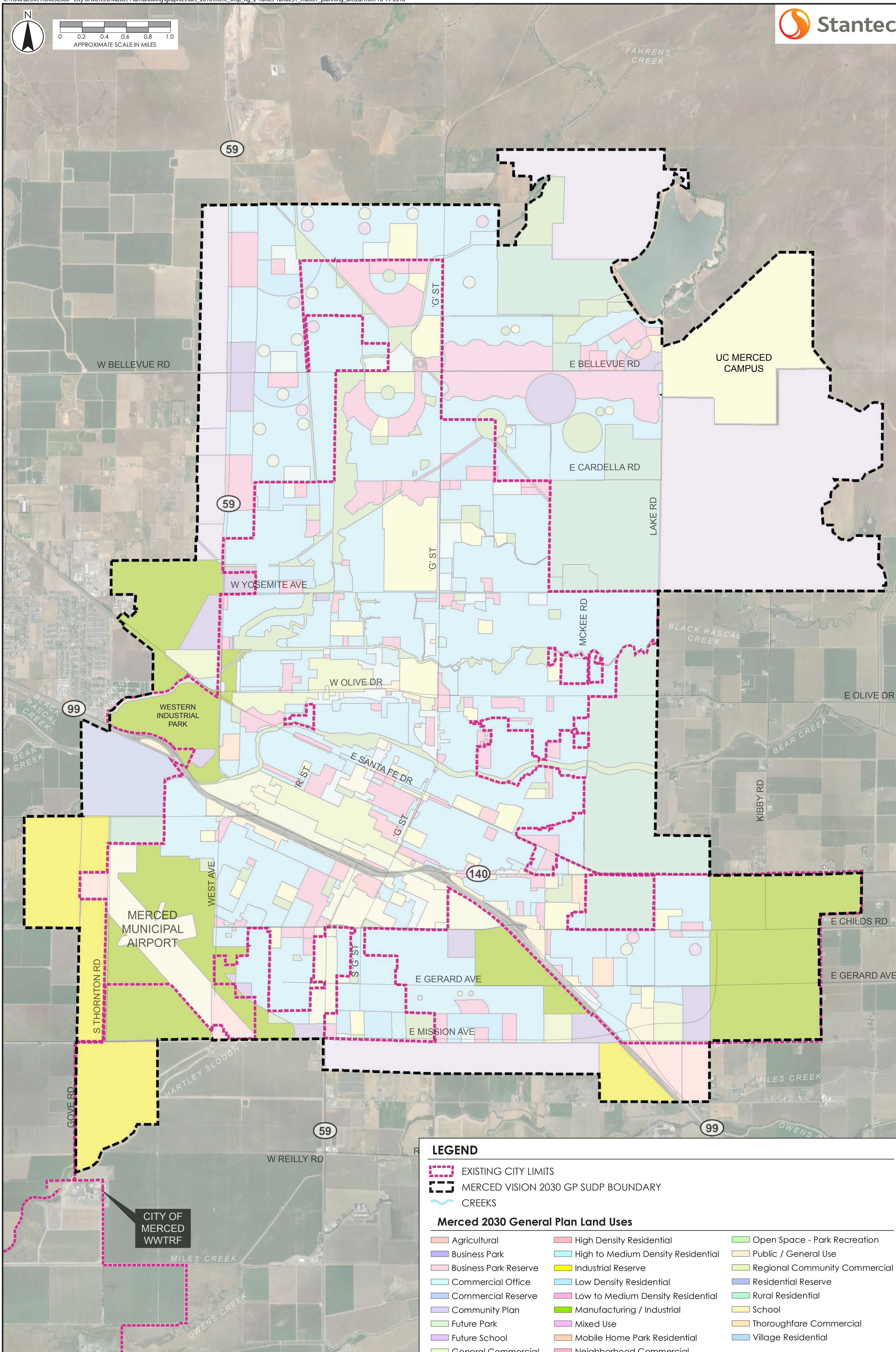

Figure 2-1
Master Planning Area

- The possibility of one or more northern WWTRFs has bearing on the planning of sewers for the North Merced area, and therefore has bearing on this WCS Master Plan which describes alternative plans for providing sewer service through City build-out based on Stantec's best professional judgment given situation specific factors. The objectives of this sewer plan and the judgment used to create it are:
  - Safe and reliable sewer facilities meeting long-term sewer service needs that can be built in stages, as needed, to the extent feasible.
  - Lowest overall life cycle cost for sewer service considering upfront costs (developer concern), and the present worth of anticipated operation and maintenance costs over the coming decades (resident/business, i.e. rate payer, concern).
  - The City's Vision 2030 General Plan estimates wastewater generation to increase with development of vacant parcels and redevelopment of existing parcels within the City Limits and development of properties within the SUDP boundary through 2030 (the planning horizon of the City's General Plan). It is estimated that approximately 16 to 17 Mgal/d of municipal wastewater on an average dry weather flow (ADWF) basis could be generated within the City in 2030. Reasonable build-out of the City could result in wastewater flows of 34 to 35 Mgal/d, ADWF. **Table 2-1** summarizes these ADWF flow estimates and a breakdown of their origins. The critical question is where will sewage treatment and disposal/reuse services be provided for these future, area-specific wastewater flows: at the existing WWTRF, or at new northern WWTRFs? In other words, the master planning of the wastewater collection system must be fully coordinated with the master planning of the wastewater treatment and reuse facilities.
  - The City's current WWTRF planning recommends expanding the existing 12 Mgal/d WWTRF to 20 Mgal/d (either in two 4 Mgal/d phases or one 8 Mgal/d phase). This planned capacity is sufficient to satisfy 2030 General Plan wastewater treatment needs, regardless of the origins of the wastewater. The current WWTRF Master Plan does not describe how or where City build-out wastewater flows of ~34 Mgal/d will be treated and reclaimed. However, the existing WWTRF site and effluent dispose/reuse facilities/method appear to have the potential to accommodate reasonable build-out flows.

Table 2-1 Design Wastewater ADWFs for the City of Merced [(a)]

Time Frame	Entire City	North Merced [(b)]	Rest of City [(c)]
	ADWF, Mgal/d	ADWF, Mgal/d	ADWF, Mgal/d
Current (2017) [(d)]	~ 8	--	--
2030 General Plan	~ 16 to 17	~ 4 to 5	~ 12
Build-out	~ 34 to 35	~ 14 to 15	~ 20

(a) Design flow= expected flow for design purposes, not actual flow which can vary materially from year-to-year. ADWF = average dry weather flow.

(b) Represents new flow from the North Merced service area potentially served by new trunk sewers or a new wastewater treatment plant located in the North Merced area.

(c) Represents flow to the existing trunk sewer system, including some flow (about 4 Mgal/d) from projects entitled to connect.

(d) Current flows include a mix of wastewater from both North Merced (including UC Merced) and the rest of the existing City.

When considering WWTRFs, two aspects about said facilities warrant note within the context of this WCS Master Plan. First, capacities are described in terms of flow, e.g., 1.0 Mgal/d, ADWF; therefore, someone may jump to the conclusion that all the City needs to do is conserve more water, i.e., each person/business uses less water. As a consequence, the service capacity of (i.e., the number of people and businesses that could be served by) both the existing WWTRF and the existing sewers would be increased relatively quickly at little to no cost. This is not a valid conclusion because the WWTRF treats the actual waste in the water, not the water itself. Therefore, it would be better to describe the capacity of WWTRFs in terms of "service population equivalents", e.g., a 1.0 Mgal/d WWTRF has roughly an equivalent 11,800 person capacity using the unit factors presented later in this report. Unfortunately, that approach is not fully descriptive either because the treatment of waste in water is governed by how much water those wastes are diluted in on a constituent-by-constituent basis. Water conservation can result in the cost of wastewater treatment increasing dramatically. This complicates the discussion, but it is important to understand that solving wastewater problems is not a simple matter of improved water conservation measures.

The second aspect of interest regarding WWTRFs is why they typically are designed for a 20-year planning horizon, not the 50+ year horizon of wastewater collection systems. This difference occurs for two primary reasons:

- WWTRFs are largely constructed above ground, not located in the midst of developed areas and are comparatively easy to modify, expand, and maintain compared to "build it once in a life time" sewers buried deep in the ground under other infrastructure.

- Permits regulating WWTRFs change from time-to-time…a facility designed to last for 50+ years will be partially (perhaps significantly) obsolete before its design service life is reached. For example, the City's sewers from the 1950s are generally the same pipes today; the City's current WWTRF is nothing like the City's 1950s sewage treatment plant from a process and operational perspective.

Based on the foregoing introduction to 1) collection system planning, 2) the need to integrate collection system and WWTRF planning, and 3) a brief overview of City wastewater needs near-term (20 year planning horizon) and long-term (50+ year planning horizon), this WCS Master Plan has been organized to:

a. present the basis for City wastewater collection system planning,

b. summarize how estimates of wastewater service needs have been developed,

c. evaluate the pros and cons of servicing alternatives, and

d. recommend the best apparent plan, from amongst the feasible alternatives.

3.0 THE BASIS FOR CITY COLLECTION SYSTEM PLANNING

As noted in Section 2.0, the foundational bases for wastewater system master planning include knowing 1) where the wastewater is generated, 2) where the generated sewage is flowing to for treatment and reuse, and 3) by what means the wastewater is to be conveyed. The City (as the public entity responsible for wastewater service within its corporate boundary) has the final say in the planning and implementation of its wastewater service. This section attempts to capture City desires and policies, and Stantec's professional judgment regarding wastewater facilities planning.

3.1 THE OPTIONS

Wastewater collection system planning is a bit like planning a road trip. One needs to know at least three basic things:

- The starting point A
- The end point B (i.e., the objective/destination)
- The options for getting from A to B

This section discusses, conceptually, the options for getting from A to B, i.e., the City's wastewater infrastructure from where it is today (2017) to where it needs to be to serve 2030 General Plan growth forecasts. Because wastewater infrastructure is fully integrated, planning the wastewater collection system (the subject of this WCS Master Plan) must also consider WWTRF planning, effluent reuse and disposal planning, and water resource planning (effluent is water, not waste). This specific section attempts to consider all credible options, and reduce that long list of "possibles", down to a short list of "probables" for more detailed evaluation, and consideration by the City, its City Council, and all other interested parties. The "possibles" considered, herein, are listed below, and discussed in the following subsections.

- On-site Wastewater Systems
- Development-Specific Wastewater Systems
- A North Merced Satellite WWTRF
- The Existing WWTRF
- Flow Equalization Basins as a Means to Increase Existing Sewer Service Capacity
- Water Conservation

- Gravity Sewers
- Pressure Sewers (aka, Forcemains)
- STEP Sewers
- Novel Sewer Technologies
- Sewer Routing Criteria

3.1.1 On-Site Wastewater Systems

On-site wastewater collection, treatment, and disposal systems are traditionally used in only rural, low density settings. This is not the case anymore. In landlocked cities (like San Francisco) where there is no place to grow except up, the major re-development projects that will increase water and wastewater service needs beyond the capacity of the existing infrastructure may be encouraged (or required) to implement on-site wastewater treatment (to reduce wastewater impacts on existing infrastructure) along with on-site effluent reuse (to reduce water supply impacts on existing infrastructure). In essence, such a building has its own water and wastewater utilities, its own licensed utilities operations and maintenance team, and its own water and wastewater permits from the appropriate regulatory body. Such systems are very expensive, and therefore can be sustained only by higher density development in locations with favorable market conditions.

Merced does not have such an economy, and is not landlocked. Such multiple and diverse on-site wastewater systems in an urbanized setting are contrary to Regional Water Board, and local planning policy as well. Consequently, permitting on-site systems for future development is not recommended for the City, and is given no further consideration in this report.

3.1.2 Development-Specific Wastewater Systems

As noted, with modern materials and technologies it is possible to build smaller, localized sewers and WWTRFs to serve immediate and near-term development needs in place of building larger sewers for build-out conditions leading to large WWTRFs located miles away. It is possible, but is it practical? From a developer perspective, this approach is likely practical because while it is expensive to build, it saves time, and in development, time is money. If the development-specific wastewater system is funded by an assessment district, then much of the expense to build the system is passed on to the residents and businesses, as well as the higher cost (on a per gallon basis) to operate and maintain a small wastewater system in perpetuum, which the City on behalf of the residents and businesses would be obligated to do.

With a development-specific wastewater system plan, each independent system would have its own:

- Collection system
- Influent pump station
- Wastewater treatment process
- Waste solids collection, treatment, storage, and disposal facilities
- Winter effluent storage reservoir (designed to contain 100-year rainfall years)
- Summer effluent irrigation/disposal system (also designed for 100-year rainfall conditions)
- Wastewater permit from the Regional Water Board, and associated monthly administrative and reporting requirements
- Title 22 Engineering Report (and operational requirements) approved by the Division of Drinking Water
- Operations and Maintenance Manual
- Spare parts inventory (unless the City specifies a standard type of "package" wastewater treatment plant to be used by all development-specific systems so that the City can have a single inventory of spare parts for all of the WWTRFs)

Development-specific wastewater systems are well precedented. Typically, such systems are permitted and built in rural, unincorporated areas for country clubs and golf course communities. The SUDP area is not rural, unincorporated, or planned to have multiple country clubs and golf course communities. The land needed to seasonally store and dispose of/reuse the wastewater is often guesstimated to be about the same area as the land being developed and producing the wastewater in need of storage and disposal. In other words, under a typical development-specific wastewater system plan, roughly half of the land in the SUDP area will remain undeveloped. This is contrary to the Vision 2030 General Plan; therefore, these development-specific wastewater systems would need to export their wastewater out of the SUDP area, which has not been investigated and/or evaluated at this time.

In other Central Valley settings, some planned communities have proposed to treat the wastewater to Title 22 (California Code of Regulations) tertiary standards such that the effluent storage reservoir can be an ornamental lake or wetlands/natural area enhancing the value of the specific development. The challenges with such lakes and similar natural areas are numerous. The lake's water level must be able to rise and fall seasonally because the only lake volume that counts as 100-year effluent storage is the volume of the lake that is empty each autumn. Algae that naturally grow in tertiary effluent lakes can be chronically problematic. The lake may need aeration, circulation, and chemical controls. Following construction and filling of ornamental lakes, midge populations can explode to nuisance levels until the natural ecology of the lake has time to develop (typically a year or two). If the lake is drained each year to maximize storage potential, a natural ecology may never establish itself. With natural areas, particularly wetlands, insects and mosquitos can be chronic problems without rigorous vector control measures. The stored effluent still needs to be disposed some place. With tertiary effluent, the options include irrigation of public landscaping and parks, residential front, and/or back yards, and export out of the SUDP area.

Such small, project-specific wastewater systems are difficult to permit with the Regional Water Board because they run contrary to Board policy, which was developed because the long-term performance record of multiple small systems has been relatively poor. If/when such systems fail, the City will be responsible for correcting the failure. This is because the development is within the City, and the City permitted it to occur. Because the wastewater collection system was not planned to convey wastewater from these "self-sufficient" planned community developments, the City will either reconstruct the wastewater collection system, or continue to rebuild and operate the small systems to prevent the planned community development from being condemned for health and safety reasons. Based on this evaluation, development-specific wastewater systems are not recommended for long-term use, and therefore are not recommended as a basis for wastewater collection system master planning.

However, temporary small wastewater systems (with specific closure criteria and financial guarantees) could be authorized by the City Council in specific situations to address specific development needs. The entire cost of the temporary system should be borne and bonded by the system proponent. The proponent still pays upfront for their share of the cost to tie into the permanent City trunk sewer when that trunk sewer reaches the development. Because, the City has General Plan Policy UE-1.12 to maintain development in a compact urban form, any proposal for a temporary, development-specific wastewater treatment and reuse system should be located on the perimeter of existing developments (e.g., on the edge of the City, or UC Merced campus) with the only hindrance to connecting to the City system being lack of capacity in the existing City wastewater collection system at the time the development desires to move forward.

The Regional Water Board is not expected to approve any small systems unless the City operates them, and they are temporary (with specific and enforceable closure criteria). Because of the poor economy of scale of operating and maintaining small WWTRFs, the annual costs (as reflected by monthly sewer use fees) for users of these small systems will be higher than normal City wastewater fees. As a matter of policy, the City Council (when approving any such temporary system) will need to decide whether the businesses and residents served by the temporary system pay higher monthly sewer use fees, or whether they pay the City's normal use fee with the system proponent covering the cost difference until the businesses and residents connect to the permanent City system.

City staff have asked if development-specific wastewater systems would have comparable life cycle costs to a more conventional wastewater utility. Stantec's experience and the defacto evidence provided by the wastewater utilities of Merced-sized cities in the Central Valley suggests the answer is "no". Economy of scale is real, and applicable to wastewater utilities, particularly to the operation and maintenance of WWTRFs. Based on this experience, evidence, and logic, City staff directed Stantec to not investigate this option further unless specifically authorized to do so by the City Council. Consequently, development-specific wastewater systems are given no further consideration in this report.

3.1.3 A North Merced Satellite WWTRF

As noted in **Table 2-1**, the North Merced area has a potential additional wastewater service need of ~4 to 5 Mgal/d for 2030 General Plan growth projections, and ~14 to 15 Mgal/d for reasonable build-out estimates. If a WWTRF is built to serve the North Merced area (in stages, of course), then it is not a "satellite" WWTRF, but rather a full-scale WWTRF larger than most municipal WWTRFs in the Central Valley. The economy of scale question for two versus one WWTRF serving the City still exists, but the added expense is nowhere near as severe as with development-specific wastewater systems.

As noted earlier, a second WWTRF in the North Merced area (hereinafter, referred to as the NMWWTRF) makes some sense because 1) it will grow into a large, reasonably cost-effective facility; and 2) it avoids the expense of taking new SUDP trunk sewers either through developed Merced, or around the west side of developed Merced to get to the existing WWTRF. Considering that the SUDP area trunk sewers will primarily be gravity sewers (as will be discussed), they will flow along road easements (in general) in an overall westerly and southerly direction per the overall topography of SUDP land and the general flow direction of local creeks and waterways. This means the probable location of a NMWWTRF is in the industrially zoned land west of the intersection of W. Yosemite Ave and Highway 59 (aka, Snelling Highway). This site would be planned out and sized for approximately 14 Mgal/d reasonable build-out ADWF conditions, though the actual NMWWTRF would likely be built in phases commensurate with the 14 Mgal/d layout on an "as-needed" basis. The size of the needed NMWWTRF site is estimated to be roughly 35 acres.

In addition to the 35 acre NMWWTRF site, land will be needed to store and dispose/reclaim the treated wastewater. The *Water Quality Control Plan for the California Regional Water Quality Control Board Central Valley Region, Fourth Edition, Revised July 2016 (with Approved Amendments for the Sacramento River Basin and the San Joaquin River Basin* (Basin Plan) prioritizes its preferred effluent disposal methods as being (from most to least acceptable):

- reclamation,
- disposal on land for no beneficial purpose,

- seasonal discharge to streams in amounts that do not cause effluent dominated conditions, and
- year-round discharge to streams in amounts that do not cause effluent dominated conditions.

While the possibility of limited wet season effluent discharges from NMWWTRF to Black Rascal Creek exist, this is viewed as being uncertain considering that 1) no CEQA document or similar environmental assessment exists for such a discharge, and 2) even a limited discharge to a surface water like Black Rascal Creek is discouraged by the Regional Water Board (the permitting regulatory authority). Accordingly, and at this level of analysis, it is believed appropriate to envision the NMWWTRF as reclaiming all of its effluent via irrigation of fodder crops (which requires a secondary level of treatment) versus food crops (which requires a tertiary level of treatment) and still raises public concerns. Very rough estimates of the wet season effluent storage needs, and irrigation reclamation land needs under 100-year design conditions and build-out flows are 9,300 acre-feet and 3,500 acres of actual irrigation fields, respectively. The total land need for the effluent reclamation portion of the NMWWTRF is estimated to be over 4,000 acres (for storage, irrigation, environmental setbacks, roads, etc.), possibly a lot more depending on local soils and shallow groundwater conditions affecting storage depth. As large as this seems, it is not overly conservative, and involves a relatively high leaching fraction to 1) reduce land needs, 2) increase water percolation to the underlying groundwater resource (which is currently impacted by over utilization), and 3) reduce the impact of effluent irrigation salinity increases on the underlying groundwater resource. Ideally, the agricultural land purchased to serve NMWWTRF effluent reclamation needs would currently be using underlying groundwater for irrigation purposes. This would mean the NMWWTRF reclamation operation would be reducing agricultural irrigation supply pumping from the impacted groundwater resource, which is the City's potable water supply.

Construction of a NMWWTRF and its associated wastewater collection system and effluent reclamation facilities is considered a "probable", and is carried forward in this report for further consideration. Central Valley City's with a second WWTRF designed specifically to serve an area of concentrated new growth include Rio Vista and Roseville. The City and interested parties should note that Regional Water Board Resolution No. R5-2009-0028, requires that new or existing dischargers owning or operating a WWTRF take steps to promote new or expanded wastewater recycling and reclamation opportunities and programs, water conservation measures <u>and</u> regional wastewater management opportunities and solutions. This resolution supports the concept of reclamation and encourages those activities, but also emphasizes those efforts be undertaken within the context of regional (centralized) solutions. This emphasis on regional/centralized treatment and reclamation solutions has been confirmed by Stantec through repeated interactions with Regional Water Board Management and staff over the last eight years.

3.1.4 The Existing WWTRF

The existing WWTRF and reclamation site have been planned to expand from the existing 12 Mgal/d capacity to 20 Mgal/d in stages, as needed. This plan covers 2030 General Plan needs. The WWTRF site has also been planned conceptually to handle the entire ~34 to 35 Mgal/d build-out wastewater flow for the City. The City and MID are planning to use the existing WWTRF effluent as part of a water swap program that involves the effluent being used by current MID agricultural customers such that MID can transfer low salinity and low nitrogen content Merced River water to 1) various City non-potable water uses (e.g., park irrigation), and 2) other area uses to help maintain the quantity and quality of that North Merced groundwater resource for potable and other beneficial uses. The latter point is important because virtually all conventional irrigated agricultural practices result in some increase in salinity and nitrogen in the underlying groundwater resource.

Considering the existing WWTRF site has been planned for 2030 General Plan sewer service needs, and has a credible and beneficial effluent disposal/reuse plan, the option of continuing to use the existing WWTRF to handle some, to all of the ~34 to 35 Mgal/d build-out wastewater flow is probable, and therefore considered further in this WCS Master Plan.

3.1.5 Flow Equalization Basins

As will be discussed, the City's trunk sewers are designed using a 2.3 peaking factor based on analysis of the range of peak flow to average flow ratios actually occurring in City trunk sewers. In other words, a trunk sewer with a design service capacity of say, 3 Mgal/d, can convey peak flows up to 6.9 Mgal/d (3 x 2.3 = 6.9) safely. Because full (x2.3) peak flows occur relatively rarely, there is unused hydraulic capacity in much of the existing sewer system at times. A legitimate question is whether there is any way to use this unused capacity to either reduce future sewer sizes (and therefore costs), or allow additional development to be served by the existing sewer system (on either an interim or permanent basis) when "peak flows" are not occurring. There is a way, but it comes with attendant problems. The "way" is via use of sewage flow equalization basins. To illustrate the idea, consider the following hypothetical situation:

> New development connects to an existing trunk sewer that is already at its design service capacity. New development installs a water level sensor in the "at capacity" sewer. When the sensor says the sewer is full, the sensor activates an engineered system to divert new development sewage into a basin built by the new development being served by the "at capacity" trunk sewer. When the sensor says there is available hydraulic capacity in the sewer, the sewage stored in the basin is metered into the sewer to use the sewer's unused capacity that exists between peak flow events. Thus, the basin allows the overall average flow in the trunk sewer to be increased, without exceeding its peak flow hydraulic capacity.

Raw sewage is "nasty" stuff…besides just the human waste present, there are rags, plastics, pieces of lumber, and many other things that can be flushed down toilets or thrown in sewer manhole lids in the street that have been pried up by someone wishing to dump some sort of waste. As such, the engineered systems designed make use of "off peak" hydraulic capacity in sewers are prone to plugging, odors, and failure, in general. Additionally, raw sewage equalization basins are ugly, are maintenance headaches, have automatic wash-down systems (to scour "solids" from the basin when not in use), and may need a cover or other visual screening, noise attenuation, and/or odor scrubbing equipment depending on situation-specific factors. Accordingly, use of sewage flow equalization basins is almost entirely limited to WWTRF sites where trained professionals are on-site to address such problems. An exception is in some older, highly urbanized sewer systems (like San Francisco's) where equalization basins or tunnels are sometimes utilized as an alternative to completely rebuilding the sewer system, which is extremely costly and presents increased risks within such a setting. However, raw sewage flow equalization basins should not be a permanent component of a new wastewater collection system (in other words the City should not plan to include permanent equalization in its collection system). The City has designed and built the existing sewer system to maximize its reliability, and the simplicity of its operation and maintenance. The existing sewer system has no raw sewage flow equalization basins, and City management and staff desire to keep it that way. Based on these facts and Stantec's experience with raw sewage flow equalization basins, such basins are not considered as permanent features of the wastewater collection system being planned. However, the City may consider them for temporary use in specific situations as outlined below.

The City Council wants to encourage development, and developers are working hard to make it happen. A major impedance to what both the City and developers want is the limited available capacity in trunk sewers between the areas wanting to develop (mostly in North Merced), and the existing WWTRF. It is feasible that the City Council may approve temporary installation and use of equalization basins under specific, tightly controlled conditions:

1. The basin proponent pays the entire cost of the basin: capital cost and annual cost with financial guarantees.

2. The basin proponent pays all fees for building the permanent sewer system and WWTRF capacity needed.

3. There is a specific basin closure plan with a bond or other financial guarantee for clearing the basin site for redevelopment.

4. The development's wastewater collection system is designed to flow by gravity and connect to the permanent sewer system when that system reaches the development.

The City Council may elect to allow temporary, conditional use of equalization basins for specific developments that are believed to be important to the community, that otherwise may be on hold for years until the new trunk sewer system is installed. It appears that there is a lot of desired development that may be on hold because of trunk sewer capacity limitations. This WCS Master Plan is limited to recommending permanent 50+ years sewer plans for serving City development as described in the Vision 2030 General Plan. It appears to Stantec that what the City may wish to consider is a separate Implementation Plan… a plan to use a range of temporary wastewater facilities to allow at least some desired development to move forward, now, while the new trunk sewer system is designed, financed, and built.

3.1.6 Water Conservation

As mentioned earlier in this section, one way to increase the sewer service capacity of the existing trunk sewer system is to mandate further in-home and in-business water conservation by existing and future developments. This also helps alleviate the heavily utilized water table which is the City's underlying potable groundwater supply. Problems with this approach include:

- Further reliable in-home/in-business water conservation is difficult to implement without impacting quality of life.
- Further water conservation is difficult to enforce and effective enforcement is invasive, e.g., policing how many people live in a particular home, and do they have special needs warranting the water they use?
- Concentrated wastewater may contain concentrations of specific contaminants that may require special treatment (at high cost) at the WWTRF.

Based on the foregoing, this WCS Master Plan does not consider further water conservation as a means to 1) increase the sewer service capacity of the existing trunk sewers, or 2) reduce the size and cost of new trunk sewers.

3.1.7 Gravity Flow Sewers

Gravity flow sewers are the most reliable means for conveying raw sewage. This is because gravity sewers require no energy to power them, and involve no moving parts to maintain or become fouled by sewage debris. Gravity flow sewers also have the largest pipe diameters for conveying a given sewage flow, which reduce the potential for the sewer to become plugged. The topography of Merced (relatively flat and gently sloped) is conducive to cost-effective use of gravity sewers. The City's existing wastewater collection system is primarily gravity flow sewers, and has served satisfactorily in terms of both operation and maintenance. Accordingly, the City desires to continue use of gravity flow sewers to the maximum extent feasible in the proposed expansion of the trunk sewer system. Consequently, this WCS Master Plan is developed around the principle of using gravity flow sewers to the extent feasible.

3.1.8 Pressure Flow Sewers

The most commonly used alternative to gravity flow sewers are pressure flow sewers, aka, forcemains. With forcemains, the sewage (via specialized pumps designed to minimize clogging from sewage debris) is pressurized into a closed pipe, with the pressure causing the sewage to flow to the open end of the pipe. The "pros" of forcemains are that:

1. They can be built at a relatively shallow depth in the ground, but they still tend to be beneath most other infrastructure (water pipes, gas lines, cable services, etc.).
2. They are generally smaller in diameter for a given flow (sewage can move faster under pressure, than under gravity).
3. Forcemains can flow uphill as well as downhill, making their installation less sensitive to undulations or constraints in area topography (such as creek, transportation corridor, or other crossings).

The "cons" of forcemains are that:

1. They require pump stations which are expensive to build and maintain. Specialized sewage pumps are reliable, but do fail from time-to-time, and require a lot of preventative maintenance and power. During power outages (they must have an emergency power source).
2. Forcemains are closed, therefore there is no air moving with the sewage to keep the sewage relatively "fresh" (i.e., relatively low in odor, and corrosiveness). Depending on the length of the forcemain, its hydraulics, area temperatures, and where the end of the forcemain is located, the forcemain may need special odor and corrosion control facilities. Such facilities are an additional expense to build, operate, and maintain.
3. While a "pro" of forcemains is that they can flow up and down with the topography, a "con" of this feature is that every time an up-flowing portion of forcemain changes to a down-flowing portion of forcemain, this apex of the forcemain pipe becomes a point of accumulation for odorous and corrosive gasses that can form in sewers, particularly forcemains. Special air release valves (and possibly odor control devices) are needed at apexes. These represent another expense to build and maintain.

The City's topography does not necessitate extensive use of forcemains and pump stations within the wastewater collection system. Accordingly, the City has used forcemains only when necessary. Necessary uses include:

1. When a gravity flow trunk sewer is becoming extremely deep in the ground (an expense to build and maintain). In such cases a "lift station" may be installed to pump the sewage back up to near the ground surface via a very short forcemain so that gravity flow of the sewage can continue to occur at much shallower (and lower cost) depths.
2. When a necessary sewer route passes through an area with topography making a gravity flow sewer not cost effective.

This WCS Master Plan applies these City criteria to the use of lift stations and forcemains in planning expansions to the City's wastewater collection system.

3.1.9 STEP Sewers

STEP (Septic Tank Effluent Pump) sewer systems require on-site septic tanks and small pump stations (either individually – one per lot, or collectively – one tank and pump serves several lots). STEP systems involve installation and maintenance of septic tanks and the associated septic tank effluent pump, as well as the system of small diameter forcemain pipes conveying the septic tank effluent to some discharge point (a WWTRF or a trunk sewer). STEP systems are most commonly used in rural settings with significant topography making conventional gravity sewers infeasible. They have been used in rural estate developments in foothill or high country settings where large lots make the per unit cost of conventional sewers cost prohibitive on a per unit basis. STEP systems have also been used effectively in communities where there have been significant on-site system failures and a conversion to a centralized public sewer system is required. STEP systems are not cost effective in flat topographic urban settings such as the City's. Consequently, STEP systems are given no further consideration in this report.

3.1.10 Novel Sewer Technologies

There are a number of novel sewage-related technologies, that if permitted by the City, could have potential bearing on sewer system planning. Vacuum sewers have been developed, waterless toilets with natural gas incineration of wastes are available, super low water use plumbing fixtures have been invented. City management desires no wastewater collection system technologies that do not have an extensive record of reliability, cost effectiveness, and ease of maintenance in settings similar to the City. Consequently, this report includes no further discussion of novel sewer technologies.

3.1.11 Sewer Routing Criteria

As noted above, the City desires to make maximum use of gravity sewers that, overall, flow in the direction of downward sloping topography, i.e., in a westerly and southerly direction in the Merced area. Additionally, the City desires to minimize disruption of the existing community that would result from constructing, new large, deep, trunk sewers through urban centers and/or residential neighborhoods. In the City's specific case, these two sewer routing criteria suggest the same basic and conceptual plan for the City's wastewater collection system that, then, must be evaluated for propriety in greater detail in the remainder of this report:

1. Existing Merced will continue to be served largely by the existing trunk sewer system. Relatively minor "swaps" in trunk sewer capacity between new development and existing development may be appropriate, and will be considered as part of the detailed evaluation, but overall in concept, existing Merced will be served by existing trunk sewers.

2. New development south of existing Merced will need some new trunk sewers flowing westerly and southerly to the existing WWTRF.

3. New development north of existing Merced without capacity in the existing trunk sewer system (through either existing agreement or City-approved capacity “swap”), will be served by new trunk sewers flowing westerly and southerly towards Snelling Highway for topographic reasons. At this point the wastewater will be either “lifted” into a new NMWWTRF in the immediate vicinity of this location, or pumped south to the existing WWTRF. This conceptual sewer plan meets the City’s objective of minimizing construction of new trunk sewers though highly urbanized areas, and is completely compatible with either of the WWTRF options carried forward for more detailed evaluation in this report.

3.2 SEWER SYSTEM OPTIONS SUMMARY

Based on the discussion presented in the foregoing sections, this WCS Master Plan develops permanent sewer designs based on:

- Either all sewage flowing to the existing WWTRF site, or North Merced sewage flowing largely to a new NMWWTRF with the remainder of the City being served by the existing WWTRF site.
- Gravity flow sewers are to be used to the maximum extent feasible. When trunk sewers become very deep, lift stations may be used to lift the sewage so that gravity flow can continue, but at a shallower depth.
- Where topography or other factors are not conducive to cost effective use of gravity sewers, pump stations and forcemains will be used with features, as may be necessary, to control odors and corrosion as well as to provide reliable operation during outages.
- New North Merced trunk sewers will flow in an overall westerly and southerly direction to follow topography and to minimize disruption of existing developments. This conceptual plan is compatible to either of the WWTRF options being considered, herein.

As discussed, the design, financing, and construction of the new trunk sewer system will take several years. Members of the community would like some new development to occur, now, rather than years from now when the new permanent trunk sewer system is completed. There are many ways to facilitate these developments, but they all involve use of temporary facilities, not permanent facilities (the subject of this WCS Master Plan). The City may wish to prepare an Implementation Plan discussing temporary wastewater facilities that if approved by the City Council may allow specific developments to occur ahead of completion of the new trunk sewer project.

3.3 DESIGN CONDITIONS

Sections 5 and 6 discuss the design conditions used in evaluating and sizing the sewer system. These design conditions include:

- The "design storm", i.e., what rainfall condition is the sewer system designed to handle without exceeding sewer performance design criteria.
- Sewer performance design criteria. How high the hydraulic grade line of the water in the sewer is allowed to rise under design conditions. Also, the design hydraulic friction coefficient "C" used in the sewer flow analyses.
- Design hydraulic peaking factor. By what multiplier do typical sewer flow rates increase above typical flow conditions under a) design storm conditions, occurring during the day when peak sewer flows naturally occur (sewage flow is not constant during the day).
- Design wastewater flows from various types of urban development/land use zoning.

3.4 MEANS OF SEWAGE CONVEYANCE

This WCS Master Plan is based on supplementing the City's existing wastewater collection system, not upsizing it through replacement because of the huge cost and community disruption that would result from such an unnecessary approach. This WCS Master Plan evaluates the performance, reliability, and capacity of existing trunk sewers (and recommends improvements, as needed) in Sections 4.0 through 6.0. It then presents a new trunk sewer system to serve the reasonable build-out sewer needs of the City not met by the existing sewer system. An introduction to the existing sewer system is presented below so that the reader has a better understanding of 1) why simply replacing the old sewer system with a new one is not an option, and 2) what the City has permitted in the past relative to wastewater collection system design.

The existing City sewer system, serving a population of roughly 87,600 people, consists of the following major elements:

- Approximately 400 miles of gravity flow sewers (6" diameter and larger).
- Two large pump stations: one located north of Fahren's Creek near Highway 59 (referred to as the Highway 59 pump station), and a second located north of Black Rascal Creek in the Bellevue Ranch development (referred to as the Bellevue Ranch pump station).

The City's existing system contains no raw sewage equalization basins, on-site sewage systems (there are some septic/leachfield systems serving rural residences within the City Limits, which are operated by the property owner or resident, but none owned or operated by the City), no septic tank effluent pump (STEP) systems, or any "unusual" sewer systems, e.g. vacuum systems, grind and pump systems, etc.

As indicated in Section 3.2, the intent of the City is to build, operate, and maintain a conventional wastewater collection system using gravity flow sewers to extent possible, with use of pump stations and forcemains occurring only when necessary. Stantec agrees with this intent based on its extensive experience with sewer systems in the Central Valley. Consequently, on-site systems, STEP systems, frequent use of pump stations to reduce sewer depth, unusual sewer systems, etc., are given no further consideration in this WCS Master Plan. On a commercial/industrial project-specific basis, the City is open to considering on-site systems operated by the owner of the property with proper permitting from the Regional Water Board and State Water Board Division of Drinking Water. However, the City's sewer system will be planned, and the subject property taxed/billed as if the property is connected to the sewer system (but not the WWTRF). This is because 1) properties wishing to use such novel systems have not been identified at this time (so the sewer system will be designed to serve the property), and 2) the subject property's owner may choose to "get out of the sewer business" after the novelty of an on-site system wears off, and operating the system becomes a burden. Such an on-site system would not be allowed to connect to the sewer system until there is capacity for the property at the WWTRF, and the property pays the appropriate WWTRF connection fees and user fees. On-site systems for residential developments are not being considered from a sewer system planning perspective.

The City does not desire to own, operate, or maintain any raw sewage flow equalization basins within the City remote from a WWTRF. The City recognizes such basins would allow some increase in the service capacity of existing sewers, and would allow future sewers to have slightly smaller diameters, but at a cost:

- As will be discussed, the peak flow factor for City sewers is only about 2.3, even under high and sustained rainfall conditions. While this suggests the capacity of the sewers could be doubled via flow equalization basins, that is not the case unless the City is prepared to store raw sewage both regularly throughout the year, and for extended periods of time during major storm events.

- Storing raw sewage remote from a WWTRF is difficult. Either the basin permanently has a minimum of 3 feet of water at all times, plus aeration equipment (virtually a "mini-wastewater treatment facility"), or the basin must drain dry regularly and have an automated wash-down system to hydraulically scour the basin of settled fecal solids, toilet paper, and other solids that naturally settle from sewage when stored. Such solids, if not scoured from the basin, present an odor, vector, and health risk to neighboring properties.

Based on these considerations, the City has allowed no raw sewage flow equalization basins, tanks, ponds, etc., to be built to date, and intends to continue with this precedent. Stantec agrees with this assessment of the problems associated with raw sewage flow equalization basins within a community (as opposed to at the WWTRF), and gives no further consideration to raw sewage flow equalization basins in this WCS Master Plan.

4.0 EXISTING WASTEWATER COLLECTION SYSTEM

4.1 INTRODUCTION

This section describes the City's existing wastewater collection system. Historically, the City has considered its wastewater collection system to consist of two primary sewer sub-basins: 1) the northern portion which includes all infrastructure north of Bear Creek, and 2) the southern portion consisting of all infrastructure south of Bear Creek.

This description of the existing wastewater collection system and available data is divided into the following sections:

- Section 4.2: Description of Existing Trunk Sewer System
- Section 4.3: Existing Wastewater Flows
- Section 4.4: Land Use Data
- Section 4.5: GIS Data
- Section 4.6: WCS Master Plan Relationship to Previous System Investigations

4.2 DESCRIPTION OF EXISTING TRUNK SEWER SYSTEM

Wastewater generated within the City is collected in a series of pipelines which the City owns, operates, and maintains. The City's collection system includes over 400 miles of gravity sewers ranging in size from six (6) to forty-eight (48) inches in diameter. "Trunk sewers" are the main sewers of a wastewater collection system to which other smaller, collector and neighborhood sewers drain. **Figure 4-1** depicts the existing trunk sewer system. The City's trunk system is described frequently in this document in terms of two major geographical areas: North Merced and South Merced. The boundary between these areas is Bear Creek, which runs roughly east to west through the City as shown in **Figure 4-1**.

The only major pumping facilities within the existing trunk sewer system are the Highway 59 pump station and Bellevue Ranch pump station. Several smaller pump stations serve smaller areas within the City (such as individual subdivisions). These are not considered part of the trunk sewer system; therefore, these smaller pump stations are not evaluated as part of this WCS Master Plan.

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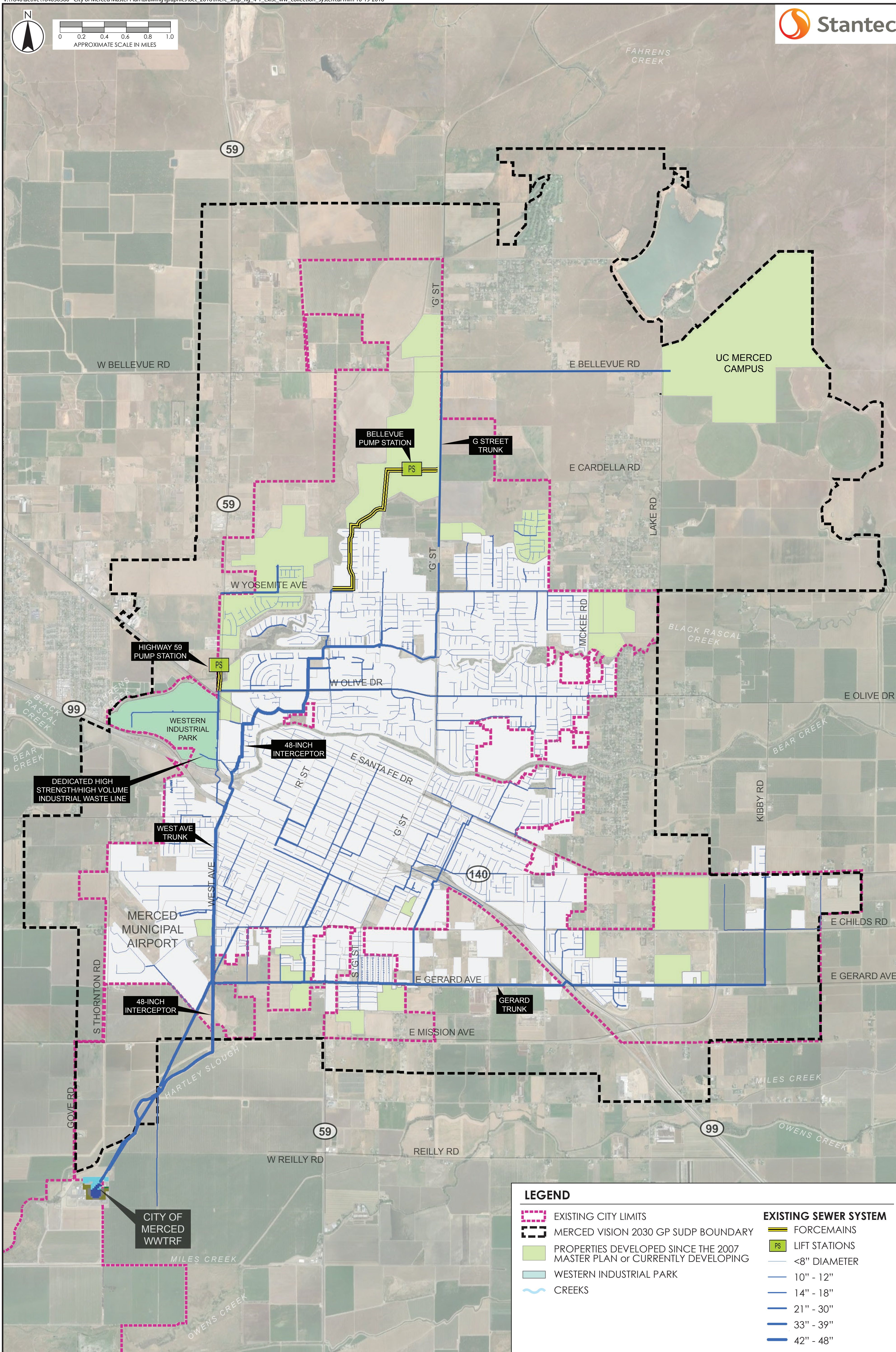

The existing City trunk sewer system consists of three primary branches which convey sewage from three distinct sewer sub-sheds:

1. The 48-inch trunk sewer "Interceptor". The Interceptor dates from the 1980s and replaced a pump station and portions of the West Avenue Trunk sewer. The interceptor conveys sewage from the northern portion of the City's sewer system.

2. The West Avenue Trunk serving the southwestern portion of the City.

3. The "Gerard Trunk" sewer serving the southern portion of the City system, east of the West Avenue Trunk service area. The Gerard Trunk intersects with the West Avenue Trunk and continues as a 42-inch gravity trunk to the City's WWTRF.

These three major trunk sewers as well as other significant features of the City's sewer system are illustrated in **Figure 4-1**. Creeks flow through the City and were factors in the configuration of the City's trunk sewer system. To the extent feasible, the City has constructed sewers that allow gravity flow at creek crossing locations. This minimizes the number of pump stations (and associated operation and maintenance costs) that would otherwise be required in the system.

In addition to the main trunks of the City's domestic sewer system, a portion of the Western Industrial Area located west of Highway 59, north-east of Highway 99, between Bear Creek and Black Rascal Creek is also served by a dedicated 14-inch forcemain originally constructed for use by a single user (the City refers to this as the "Old Ragu Line"). This conveyance runs south, all the way to the City's WWTRF where it previously discharged waste to existing ag fields. This line is not used currently, and was not modeled as part of this master planning effort. A separate assessment of the dedicated industrial line was summarized in a document entitled *Merced WWTF Industrial Waste Acceptance Evaluation* (Stantec, May 2014), which is provided in **Appendix A** to this WCS Master Plan. This dedicated line is reserved by the City for potential future industrial uses which may locate within the Western Industrial Area.

The current wastewater needs of the Western Industrial Area are served via a collector sewer which flows by gravity east along Cooper Avenue to a trunk sewer in Highway 59. The trunk in Highway 59 conveys flow from 1) the Western Industrial Area, 2) the Highway 59 pump station (located north of Black Rascal Creek), and 3) the trunk in West Olive Avenue, south to the City's 48-inch Interceptor which then conveys combined flows to the WWTRF. These features are all shown in **Figure 4-1**.

4.3 EXISTING WASTEWATER FLOWS

Wastewater sources in the City of Merced include residential customers, commercial users, industrial users and public uses (such as City administrative offices and public service facilities: libraries, parks, schools, etc.). A majority of the wastewater generated within the service area originates from residential customers.

Infiltration and inflow (I/I) of rainwater and/or shallow groundwater into the City's wastewater collection system also contribute to the volume of water that must be conveyed by the collection system. I/I enters the collection system through different mechanisms. Infiltration is non-wastewater that enters the collection system via sub-surface means such as damaged pipes, leaky pipe joints, leaky service connections and manholes. Etc. Inflow is non-wastewater that enters the collection system via more direct routes, such as leaky manhole lids, roof gutters or yard drains inappropriately connected to the sewer system, sewer clean-outs, etc. Peak volumes of I/I generally occur during rainy weather.

Like many communities in the Central Valley, average flows in the City's wastewater collection system declined over the last decade as a result of water conservation due to the regional drought and reduced occupancy resulting from the recent economic recession. This trend has reversed in recent months as the economy has recovered and wetter conditions have returned.

Until Water Year 2017, the recent lack of significant rainfall prevented accurate forecasts of peak wet weather flow conditions in the existing wastewater collection system. The Water Year 2017 wastewater collection system flow and performance data provided by the City have been incorporated into the analyses presented in this WCS Master Plan.

4.4 LAND USE DATA

Existing land uses within the City's current sewer service area are shown in **Figure 4-2**. **Table 4-1** categorizes and quantifies those land uses. The existing ADWF (July through September) as reported at the WWTRF, was 7.1 Mgal/d in 2014, 7.1 Mgal/d in 2015, 8 Mgal/d in 2016, and 7.9 Mgal/d in July 2017 (as of report completion in August 2017). It should be noted the City replaced the flume structure used to measure influent flow at the WWTRF in 2016.

Table 4-1 General Plan Land Uses within the Existing City Sewer Service Area

Land Use	Area (acres) (a)
Public	**1231.1**
Open Space - Park Recreation	352.1
Public / General Use	368.9
School	510.1
Commercial	**2,150.8**
Business Park	40.0
Commercial Office	270.3
General Commercial	349.1
Manufacturing / Industrial	843.1
Neighborhood Commercial	126.0
Regional Community Commercial	360.9
Thoroughfare Commercial	161.4

Land Use	Area (acres) [a]
Residential	**6,315.5**
High Density Residential	92.2
High to Medium Density Residential	570.9
Low Density Residential	4,908.8
Low to Medium Density Residential	609.1
Mobile Home Park Residential	76.4
Residential Reserve	4.4
Rural Residential	3.2
Village Residential	50.5
Total [b]	**9,697.4**

(a) Gross acreage within the City Limits is reported here and includes some projects which are only partially developed.

(b) **Appendix B** includes a summary of acreages for properties included in the North Merced Sewer Assessment District and the City's Tentative Subdivision Activity Map (July 2017) along with an exhibit identifying these parcels.

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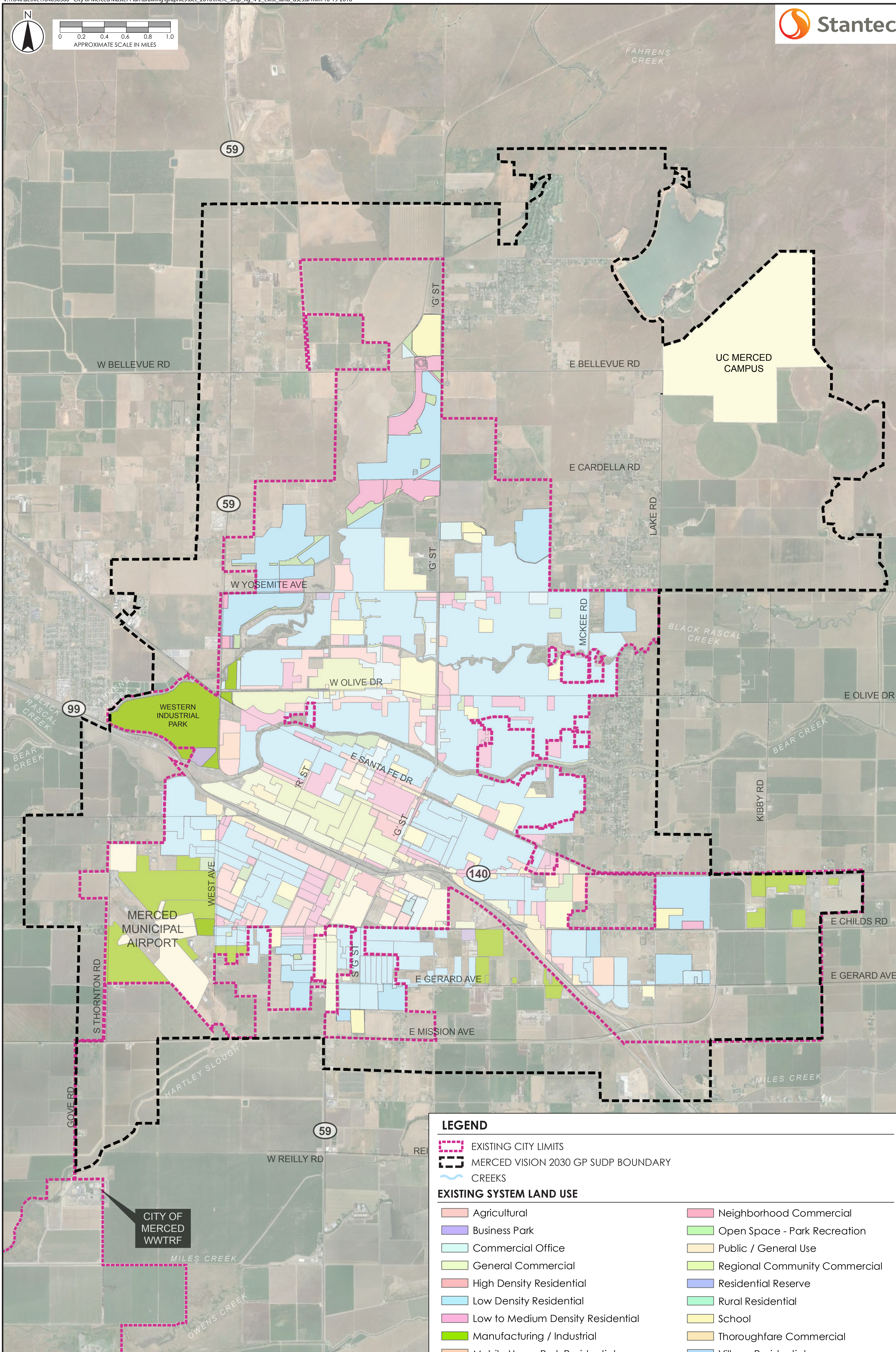

Figure 4-2
Existing Service Area Land Use

4.5 GIS DATA

Sewer system data and land use data were provided to Stantec by the City in GIS format. Sewer system data included the following information:

- Pipe and manhole locations
- Pump station locations
- Manhole rim and invert elevations (limited)
- Pipe lengths and slopes

Where information was missing (such as specific manhole rim and invert elevations), data were supplemented from atlas maps of the City's sewer system, as-built drawings of the sewer system, and linear interpolation from adjacent manhole data.

4.6 WCS MASTER PLAN RELATIONSHIPS TO PREVIOUS SYSTEM INVESTIGATIONS

Sewer service options for the North Merced area were considered in the draft 2002 North Merced Sewer Master Plan. Conclusions from those planning level analyses were carried over into the draft 2007 Master Plan. These plans recommended significant additional trunk sewer facilities to convey wastewater from areas of growth within North Merced to the existing WWTRF located southwest of the City, as illustrated in **Figures 4-1** and **4-2**.

Prior to development of the draft 2007 Master Plan, a flow monitoring study was conducted. The purpose of this flow monitoring effort was to determine the level of I/I flows contributed by different portions of the existing sewer system and service areas. This information was used to calibrate the sewer model developed at that time.

Calibration of the model allows the flows in particular segments of the sewer system to be simulated such that they more accurately reflect actual conditions. This adjustment of the model based on trunk sewer-specific hydraulic performance data provides a higher level of confidence in the hydraulic model's forecasts of overall trunk sewer system capacity and where "bottlenecks" limiting the capacity of the overall system may exist. Although reductions in wastewater flows have been noted, as discussed in Section 4.3, for the purposes of this WCS Master Plan, results from the 2007 flow monitoring study were determined to be sufficient, reasonable, and the most accurate data available to "reasonably" distribute flow spatially for level of service evaluations. Therefore, no new flow monitoring or re-calibration of the hydraulic model was conducted as part of this update to the 2007 Master Plan. With the high rainfall events of Water Year 2017, the City performed some focused flow monitoring within the trunk sewer north of Bear Creek (near West Olive and R Street. Based on 1) this Water Year 2017 sewer system flow monitoring data, 2) influent data from the WWTRF, and 3) performance assessments conducted by the City, minor adjustments to the model and sewer flow forecasts from specific developing areas were made to the existing system model in 2017. These minor adjustments to the model did not result in significant changes to the models forecasts of sewer system performance under design conditions, and therefore did not result in changes to the recommended improvements to the existing trunk sewer system in the resulting trunk sewer recommendations.

5.0 SEWER FLOW ESTIMATES

5.1 PURPOSE

The purposes of this section include correlating land use data and demographics with wastewater flow data, and from that correlation forecasting average and peak wastewater flows for future development under design conditions. The information presented, herein, is used to 1) model existing system performance, 2) size near-term system improvements, and 3) size system improvements needed to serve the needs at build-out of the Vision 2030 General Plan.

Average design wastewater flows were estimated for future City development conditions by multiplying residential development acreages and population estimates, commercial or industrial acreage, and public use acreages (such as schools) by unit flow generation factors. Peak flows were estimated by applying a peaking factor to the average flows, as described in more detail in this section.

These analyses are divided into the following sections:

- Section 5.2: Land Uses and Flow Estimates for Future Planning
- Section 5.3: Average Flow Estimates
- Section 5.4: Peak Flow Estimates

5.2 LAND USES AND FLOW ESTIMATES FOR FUTURE PLANNING

Land uses from the 2030 General Plan and supplemental information provided by the City were used in projecting wastewater flows for build-out of the City Limits and the SUDP. Land use mapping applicable to this WCS Master Plan is presented in **Figure 5-1**. The land uses shown in **Figure 5-1** constitute the "Planning Area" for this document.

5.3 AVERAGE FLOW ESTIMATES

Average wastewater flow estimates for residential development, schools, UC Merced, and Bellevue Ranch are discussed in this section. No further discussion of the unit factors for commercial and industrial development presented herein is needed as these are established City planning design standards.

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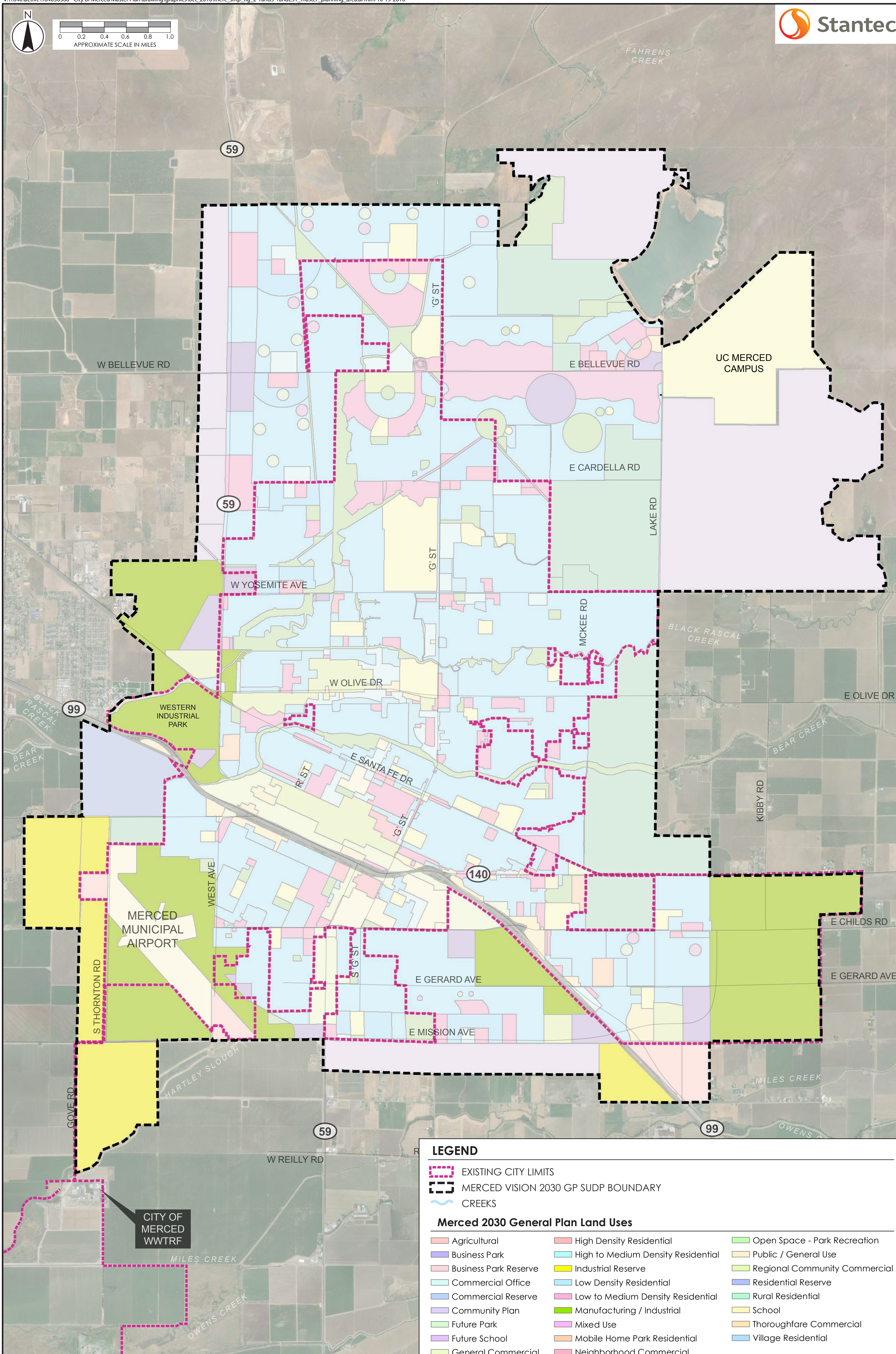

Figure 5-1
Master Planning Area

5.3.1 Residential Flow Estimates

For undeveloped residential lands within the Planning Area, specific residential land uses were assigned per the 2030 General Plan. Dwelling unit density factors (i.e., units/acre) applied to the various types of residential land uses within the 2030 General Plan are listed in **Table 5-1**. These dwelling unit densities were multiplied by the 2030 General Plan acreage allocated to each specific land use to estimate the total number of residential units needing sewer service. The number of residential units in a trunk sewer's service area multiplied by the appropriate "flow per unit" factor (discussed later in this section) represents an estimate of the average residential wastewater flow that needs to be handled by the serving trunk sewer.

Specific developments identified by City staff as either currently under construction, or expected to develop in the near future, were evaluated based on development-specific information provided by the City. In particular, the City identifies approved developments on its continuously evolving "Tentative Subdivision Activity Map" (as of July 2017) which includes development-specific counts of dwelling units. These July 2017 dwelling unit counts were used in the preparation of this WCS Master Plan.

Table 5-1 General Plan Residential Density Definitions

Residential Land Use	General Plan Residential Density (units/acre) (a)	Residential Density Used in this Study (units/acre) (a)	Residential Density in the 2007 Plan (units/acre)
Rural	1.0 to 3.0	2	2
Low Density	2.0 to 6.0	4.5	6
Low-Medium Density	6.1 to 12.0	8.5	9
High-Medium Density	12.1 to 24.0	18	18
High Density	24.1 to 36.0	28	30
Mobile Home Park	6.0 to 10.0	8	8
Village Core Residential	7.0 to 30.0	12	12
Residential Reserve	2.0 to 6.0	4.5	6
Community Plan	-	4.5 (b) (c)	(c)

(a) A "unit" is defined as one housing unit with an average of 3.02 persons. The 2030 General Plan defines the average residential density within the City's SUDP as 3.02 persons/housing unit.

(b) City Staff indicated that for Community Plan land use this WCS Master Plan was to assume 4.5 units/acre, which is consistent with the density assumption utilized for the Residential Reserve land use.

(c) The draft 2007 Sewer Master Plan included a number of specific development plans that were removed from the final General Plan. City staff indicated it was appropriate to utilize the Tentative Subdivision Activity Map which they provided to Stantec for this WCS Master Plan.

5.4 AVERAGE FLOW ESTIMATES

The estimation of average wastewater flows for planning purposes is based on the unit factors established in the draft 2007 Sewer Master Plan. After meeting with City engineering and planning staff, some of those factors for residential land uses were modified. The unit factors used in this Master Plan are presented in **Table 5-2** along with the factors used in the draft 2007 Sewer Master Plan for comparison purposes.

Table 5-2 Recommended Wastewater Unit Factors

Land Use Definitions	Units [a]	WCS Master Plan Unit Flow	2007 Sewer Master Plan Unit Flow
Commercial			
General Commercial	gpd/acre	1,500	1,500
Business Park	gpd/acre	1,500	1,500
Business Park Reserve	gpd/acre	1,500	1,500
Commercial Office	gpd/acre	1,500	1,500
Thoroughfare Commercial	gpd/acre	1,500	1,500
Regional Community Commercial	gpd/acre	1,500	1,500
Commercial Reserve	gpd/acre	1,500	1,500
Industrial			
Manufacturing/Industrial	gpd/acre	2,000	2,000
Industrial Reserve	gpd/acre	2,000	2,000
Schools/Public Use			
Schools			
Elementary/Middle Schools	gpd/student	25	25
High School	gpd/student	50	50
Future School			
Elementary/Middle Schools	gpd/student	25	25
High School	gpd/student	50	50
Public General Use	gpd/student	1,500	1,500
Open Space			
Agricultural	gpd/acre	0	0
Open Space – Park Recreation	gpd/acre	0	0
Future Park [b]	gpd/acre	0	0
Residential [c]			
If number of dwelling units (DU) IS NOT known:			
Rural Residential	gpd/acre	513	513
Low Density Residential	gpd/acre	1,155	1,540
Low to Medium Density Residential	gpd/acre	2,182	2,310
High to Medium Density Residential	gpd/acre	4,621	4,621

Land Use Definitions	Units [(a)]	WCS Master Plan Unit Flow	2007 Sewer Master Plan Unit Flow
Commercial			
High Density Residential	gpd/acre	7,188	7,701
Mobile Home Park Residential	gpd/acre	2,054	2,054
Village Residential	gpd/acre	3,080	3,080
Residential Reserve	gpd/acre	1,155	1,540
If number of dwelling units IS known:			
All Residential Categories	gpd/DU	257	257

(a) gpd/acre = gallons per day per acre, gpd/DU = gallons per day per dwelling unit.
(b) For the purposes of this Master Plan, while there will be restrooms available and connected to all parks, the actual contribution to the system on a per acre basis from these facilities is negligible. These areas have been included and considered in the analysis of existing and future capacity needs.
(c) Unit flows based on residential densities and an occupancy rate of 3.02 as discussed in 2030 General Plan, and a per capita flow of 85 gallons per capita per day (gpcd).

5.4.1 Future Schools

Unit flow factors for schools presented in **Table 5-2** were used as the basis for determining average wastewater contributions from school sites. Since the factors listed are based on a "per student" basis, the number of students attending the schools had to be estimated. The following assumptions were used to estimate student populations and resulting school wastewater flows:

- It was assumed that under design/build-out conditions there will be an even distribution of students across all grades: K through 12. K through 6 schools are estimated to produce 25 gpd/student (including waste from faculty, staff, students, food preparation, etc). Middle schools (grades 7 and 8) produce 40 gpd/student (an increase as a result of gym showers, in-room labs, bigger students, etc.). High schools (grades 9 through 12) produce 50 gpd. The overall average school wastewater production rate is estimated to be 35 gpd/student.

- Based on the 2010 census, the current population demographics for the City indicate approximately 31% of the population is under the age of 18. It was assumed that this distribution will not change as growth occurs, and that all 6 to 17 year-olds will be in school. Therefore, a credible "guess" is that 24% of the population will be in schools plus a portion of 5 and 18 year olds (entering and leaving the public school system).

- Based on growth projections utilizing information contained in the General Plan, it is estimated that a total of approximately 37,000 additional students will be present at built-out. This is based on approximately 155,000 additional people being added to the City population through build out, not counting contributions from UC Merced or the Campus Community, both discussed below. The reasoning for this distinction is the fact that planning documents for UC Merced and the Campus Community (*UC Merced and University Community Project Final EIS/EIR*, March 2009, *UC Merced 2020 Project Addendum No. 6 to the 2009 UC Merced Long Range Development Plan EIS/EIR, April*

2013), were used as the basis for estimating wastewater flows from these areas of the SUDP. No additional flow was therefore estimated for K through 12 students within these two areas of the SUDP for purposes of estimating flow contributions.

- 2030 General Plan added approximately 435 acres of land for schools and future schools, beyond the acreage included in the 2007 draft Master Plan existing service area, which means there will be approximately 85 students per acre. This acreage does not include the UC Merced Campus, flows from which are estimated from the planning documents referenced above.

5.4.2 UC Merced

Future flow estimates for UC Merced and the UC Campus Community were obtained from the UC Merced and University Community Project Environmental Impact Report (*UC Merced and University Community Project, Draft EIS/EIR, November 2008 and Final EIS/EIR*, March 2009). **Table 5-3** summarizes the dry weather wastewater generation rates listed in those documents, as well as the peak flow estimates (which were estimated by others based on development-specific factors). In addition, the City consulted the *UC Merced 2020 Project Addendum No. 6 to the 2009 UC Merced Long Range Development Plan EIS/EIR, April 2013* to confirm consistency with the flows presented in **Table 5-3**.

Table 5-3 UC Merced and Campus Community Wastewater Generation Rates (a)

	Dry Weather Flow (b) (Mgal/d)	Peak Wet Weather Flow (c) (Mgal/d)
UC Merced	1.13	2.54
Campus Community North	0.92	2.07
Campus Community South	1.04	2.34
Total Design flow	3.09	6.95

(a) Excerpted from Table 2.0-8, *UC Merced and University Community Project Final EIS/EIR*, March 2009.
(b) This Dry Weather Flow estimate is different from an ADWF estimate because the UC system has reduced activity during the typical July through September ADWF averaging period.
(c) A peaking factor of 2.25 has been accepted for UC Merced wastewater generation planning.

5.4.3 Bellevue Ranch

Future flow estimates for the Bellevue Ranch area were obtained from the Bancroft Drive Interim Sanitary Sewer Lift Station Design Study (January 2004). **Table 5-4** summarizes the design ADWF and peak flow generation rates listed in that report. An interim 14-inch forcemain has been designed to pump a peak flow of 1.95 Mgal/d to the G Street Trunk. Once the capacity of this interim forcemain is approached, a permanent 16-inch forcemain (already installed) will be placed in service to convey all flow from Bellevue Ranch to the R Street Trunk. The forcemain to the G Street Trunk from the Bellevue Ranch Pump Station will be abandoned when connection is made to the R Street Trunk.

Table 5-4 Bellevue Ranch Wastewater Generation Rates [a]

	Average DWF (Mgal/d)	Peak WWF (Mgal/d)
Bellevue Ranch East Phases 1 and 2	0.378	0.747
Bellevue Ranch East Phases 3 and 4 (24% of total flow)	0.245	0.511
Bellevue Ranch West Phases 1 and 2	0.508	0.968
Total Flow	**1.131**	**2.226 (1.950)** [b] [c]

(a) Excerpted from Section 2, *Bancroft Drive Interim Sanitary Sewer Lift station Design Study, January 2004*.

(b) A maximum of 1.950 Mgal/d will be conveyed to G Street Trunk. Once this max flow is approached, all flow is diverted to R Street Trunk. Then the peak flow is estimated to increase to a maximum of 2.226 Mgal/d.

(c) The report entitled *Sanitary Sewer Study Chalk Hill Drive, Bellevue Ranch* (October 2003, GC Wallace) presents flow estimates for development within Bellevue Ranch, as does the *Preliminary Interim Sanitary Sewer Lift Station Design Study, Bellevue Ranch* (January 2004, GC Wallace).

5.5 PEAK FLOW ESTIMATES

Precipitation events in January and April of 2006 produced flows at the WWTRF that were approximately 2.3 times the average dry weather flow at that time. Precipitation events in Water Year 2017 produced total flows at the WWTRF that were approximately 1.5 times the average dry weather flow in 2016. For this WCS Master Plan update, WWTRF influent flow data since 2006 were reviewed and the City continues to believe that peak wet weather flows should be estimated to be about 2.3 times design average dry weather flows, except for the UC Merced area and Bellevue Ranch development which have design peak flow factors of 2.25 and approximately 2, respectively. The peak flow factor for UC Merced is obtained directly from their long-term planning documents as referenced in section 5.4.2 and noted in **Table 5-3**. Peaking factors for Bellevue Ranch are discussed in Section 5.5.1.

5.5.1 Peaking Factor Formulas

Historically, the City has utilized the following equation to determine peak flows for sizing pipes and pump stations, although this methodology has never been officially adopted:

$$Q_p = 1.75 * Q_a^{7/8}$$

Where:

Q_p = peak flow, Mgal/d

Q_a = average flow, Mgal/d

Prior to the storm events of January and April 2006, this peaking factor formula provided reasonably conservative peak flows for planning purposes. The validity of this formula was verified through flow monitoring conducted in the winter of 2002/03 and August 2003 (*City of Merced August Flow Monitoring Report*, ECO:LOGIC Engineering, October 2003). As has been noted in previous reports, the only rain events which occurred during the flow monitoring that took place in 2002/2003 had return frequencies of 1 year or less. For this reason, and based on review of influent flow records during periods of heavier precipitation, as described above, a minimum peaking factor of 2.3 was used in the draft 2007 Sewer System Master Plan and is also applied in this WCS Master Plan.

The one location where flow has been estimated in this WCS Master Plan using the formula above ($Q_p = 1.75{*}Q_a^{7/8}$), rather than the simplified 2.3 peaking factor, is the Bellevue Ranch development. The report entitled *Sanitary Sewer Study Chalk Hill Drive, Bellevue Ranch* (October 2003, GC Wallace) presents the Q_p formula above as the basis for flow estimates and design within Bellevue Ranch, as does the *Preliminary Interim Sanitary Sewer Lift Station Design Study, Bellevue Ranch* (January 2004, GC Wallace). This is noted in footnote (c) to **Table 5-4**.

Since the January and April 2006 rainfall events and Water Year 2017 rainfall events ranged in frequency up to 50 years (a credible estimate of reasonable worst-case conditions) these storm events were considered to provide a conservative basis for the peaking factor formula used in this WCS Master Plan. The original peaking factor formula was adjusted to provide a minimum peaking factor (level of protection) of 2.3, dependent on generated average flow.

5.5.2 Application of Peaking Factor – Build-out Flow Estimates

For each build-out area, unless there was more specific information provided by the City, as described in Sections 5.4.2 (UC Merced and the Campus Community) and 5.5.1 (Bellevue Ranch), a peaking factor of 2.3 was applied to the average wastewater flow generation estimates to estimate peak flows in for this WCS Master Plan.

Table 5-5 summarizes land use areas, population estimates and resulting wastewater flow generation data for the City's SUDP. Should the SUDP develop to full build-out with the density assumptions summarized in **Table 5-1**, the ultimate flows from the SUDP are estimated to be as presented in **Table 5-5**, including flows contributed from existing service areas as indicated. The information used in assessing collection system capacity needs are consistent with the information presented in **Table 5-5**.

Table 5-5 Summary of Acreages and Estimated Wastewater Flows Under 2030 General Plan Build-out Conditions

Land Use	Total Area (ac)	Total EDUs	Total Population	DWF (Mgal/d)	PWWF (Mgal/d)	I&I (Mgal/d)
Existing [a][e]	9,582	--	87,600	8.0	18.4	10.4
Commercial	1,574	9,185	-	2.4	5.4	3.1
Industrial	3,217	25,038	-	6.4	14.8	8.4
School	142	2,081	-	0.5	1.2	0.7
Rural Residential	2,299	4,589	13,858	1.2	2.7	1.5
Low Density Residential	3,069	13,792	41,652	3.5	8.2	4.6
Low to Medium Density Residential	346	2,934	8,860	0.8	1.7	1.0
High to Medium Density Residential	135	2,429	7,336	0.6	1.4	0.8
High Density Residential	32	900	2,718	0.2	0.5	0.3
Mobile Home Park	3	25	75	0.0	0.0	0.0
Village Core Residential	304	3,645	11,008	0.9	2.2	1.2
Residential Reserve	206	926	2,796	0.2	0.5	0.3
Community Plan	1,617	7,269	21,952	1.9	4.3	2.4
Mixed Use	394	4,693	14,173	1.2	2.8	1.6
Other [b]	899		-	-	-	-
Sub-Total	**23,819**	**77,506**	**212,028**	**27.8**	**64.1**	**36.3**
UC Merced [c]	815			0.77 [d]	1.73[d]	0.96[d]
UC Campus Community [c]	1,951	13,585	41,026	1.96	4.41	2.45
Entitled Parcels, North Merced, Undeveloped Area [e]	2,002	11,229	33,911	2.9	6.6	3.8
Entitled Parcels, North Merced, Partially Developed [e]		3,812	11,513	1.0	2.3	1.3
Sub-total	**4,768**	**28,626**	**86,450**	**6.6 [d]**	**15.1 [d]**	**8.5 [d]**
Grand Total [f]	28,587	106,132	298,478	34.4	79.2	44.8

(a) Existing population is based on an estimate provided by City staff. Existing flow is based on approximate average dry weather flow reported at the WWTRF. This includes the existing wastewater generated by UC Merced with an estimated student population of 8,000.

(b) Land uses characterized as "Other" include "Agricultural", "Future Park", "Open Space – Park Recreation", and "Public / General Use"

(c) Population and flows for UC Merced and the *UC* Campus Community are excerpted from Table 2.0-8, *UC Merced and University Community Project Draft EIS/EIR, November 2008 and Final EIS/EIR*, March 2009. These are consistent with the *UC Merced and University Community Project Final EIS/EIR, March 2009, UC Merced 2020 Project Addendum No. 6 to the 2009 UC Merced Long Range Development Plan EIS/EIR, April 2013*. A peaking factor of 2.25 has been accepted for UC Merced wastewater generation planning.

(d) This WCS Master Plan assumes the current student population of UC Merced is ~8,000. The DWF and PWWF values for UC Merced not included in the existing flow in this table are adjusted using this assumption. A ratio of 8,000 students / 25,000 students is multiplied by ultimate DWF for UC Merced (1.13 Mgal/d) and PWWF (2.54 Mgal/d) and is removed from the totals where noted. This is also carried through the I & I column in this table. Sub-totals for flow are rounded.

(e) Entitled properties are further described in Section 6.5.3 of this WCS Master Plan. Some entitled properties are partially developed. The breakdown here attempts to identify future flow (beyond the existing ~ 8 Mgal/d) from those entitled parcels currently undeveloped or producing negligible wastewater currently and those which are partially developed (a portion of which is included in existing flows).

(f) Flows presented are unattenuated sum totals. Actual flows seen at the WWTRF would be expected to differ due to attenuation in the collection system, i.e., all peak flows from all service areas do not arrive at the WWTRF at the same time. Totals are based on rounded sub-totals.

6.0 HYDRAULIC MODEL

6.1 PURPOSE

The purpose of this section is to outline details of the sewer collection system model construction and the scenarios analyzed.

This section is divided into the following sub-sections:

- Section 6.2: Modeling Software
- Section 6.3: Model Inputs
- Section 6.4: Model Validation
- Section 6.5: Modeled Scenarios

6.2 MODELING SOFTWARE

Dynamic computer models are generally considered one of the most sophisticated means to assess sewer system capacity. For this study, Innovyze's *InfoWorks CS (version 15.0.2.28007)* software was used to analyze the City's sewer system prior to a recent upgrade to *InfoWorks ICM (version 6.5.5.13016)*. *InfoWorks* software was used in 2007 to develop the model which Stantec has updated as part of this WCS Master Plan.

6.3 MODEL INPUTS

The first step in constructing a collection system hydraulic model is to input the existing structural components of the system. These include:

- Pipes
- Manholes
- Pump stations (in this case, the Highway 59 pump station and Bellevue Ranch pump station)

Other inputs include:

- Sub-catchments (land use and water generation)
- Rainfall data and/or design storm(s)

These components are described in greater detail in the sections which follow.

6.3.1 Pipes and Manholes

The model used to evaluate existing and future capacity needs was constructed using pipes in the existing trunk system that are 8-inches in diameter, and larger. **Figure 6-1** illustrates the pipes which were modeled in the existing collection system.

6.3.2 Highway 59 Pump Station and Bellevue Ranch Pump Station

There are two major pump stations in the City's existing wastewater collection system: the Highway 59 pump station, and the Bellevue Ranch pump station. These stations are shown on **Figure 6-1**. The Highway 59 pump station is located next to Highway 59 just north of Black Rascal Creek and is equipped with three (two duty, one standby) 2,200 gpm (3.2 Mgal/d) centrifugal pumps. The Bellevue Ranch pump station is shown on **Figure 6-1** just west of G Street in the Bellevue Ranch development. It is important to note that a 14-inch force main is routed to the G Street trunk roughly as shown on **Figure 6-1**. This force main is intended to be utilized until flow at the pump station reaches 1.95 Mgal/d. At that time, the 14-inch force main is to be abandoned and an existing 16-inch force main installed for this purpose is to be brought into service to convey flow from the pump station to M Street where it connects to the existing R Street trunk. The 16-inch force main is designed to convey a peak flow of 2.23 Mgal/d.

6.3.3 Subcatchments

Subcatchments are geographic areas within each sewer collection basin that represent a composite of land uses such as residential, commercial, industrial, public, or school land uses. A population (as defined in Section 4.0) is associated with each catchment to represent a per capita flow rate based on the residential land use within the catchment. Commercial, industrial, school and public land use flows were calculated separately based on acreage and selected unit flows (gpd/acre). These flow projections were, then, imported into the computer model of the collection system to simulate both existing and future flow conditions.

6.3.4 Design Storm

To predict sewer system performance and assess needed and available capacity in the wastewater collection system, computational models, (such as the *InfoWorks* software used for this WCS Master Plan), the modeler must input a design rainfall condition that represents the reasonable worst-case conditions under which the sewer system is expected to operate within design hydraulic gradeline criteria (discussed later in this report). For rainfall conditions more severe than the input "design storm" condition, exceedances of the design hydraulic gradeline criteria are expected to occur, and spills of raw sewage may occur. The design storm selected for many Central Valley wastewater collection systems has a statistical 10-year return frequency, often with a 24 hour duration.

In the case of the City of Merced's model, storms in Water Year 2006 were considered in the establishment of the formula for predicting peak wet weather flows for model development (completed with the draft 2007 Sewer Master Plan). The 2006 storm events represented return frequencies of 5 and 50 years and were considered an appropriate basis on which to distribute "design storm" flow (including rainfall dependent I/I, or RDI/I) throughout the existing portions of the collection system in order to conduct collection system level of service analyses.

During the assessment of the City system conducted for this WCS Master Plan update, more recent WWTRF flows were evaluated and it was confirmed that 2.3 remains a reliable, conservative predictor of peak flow under design rainfall conditions. It should be pointed out, although based on storm events and recorded (flow monitoring) conditions at the time, the concept of a design storm does not directly affect predicted future flows to the City's collection system model with the peaking factor approach applied. The design storm approach is based on flow monitoring and precipitation data gathered at the time of model development (draft 2007 Master Plan) and remains the basis for distribution of flow within the existing portions of the City's collection system. But applying the peaking factor of 2.3 to all future flows represents a more steady-state approach which eliminates the need to apply design storm conditions to simulate future flow conditions.

As with most agencies responsible for wastewater collection system operation and maintenance in California, the City must comply with the State Water Board's Order No. 2006-0003-DWQ, *Statewide General Waste Discharge Requirements for Sanitary Sewer Systems* (the General Order). The General Order specifies that the City establish appropriate design criteria as part of a system evaluation and capacity assurance plan, or program, which will prevent sewer system overflows (SSOs) in the collection system. The approach to establishing design storm conditions to distribute flow from the existing collection system and application of the peaking factor of 2.3 to future flows is considered by the City to be an acceptable and conservative approach to meeting these State Water Board requirements. Recent wet conditions during Water Year 2017 did not result in any SSOs or other capacity related spills. This gives the City confidence in their established design criteria.

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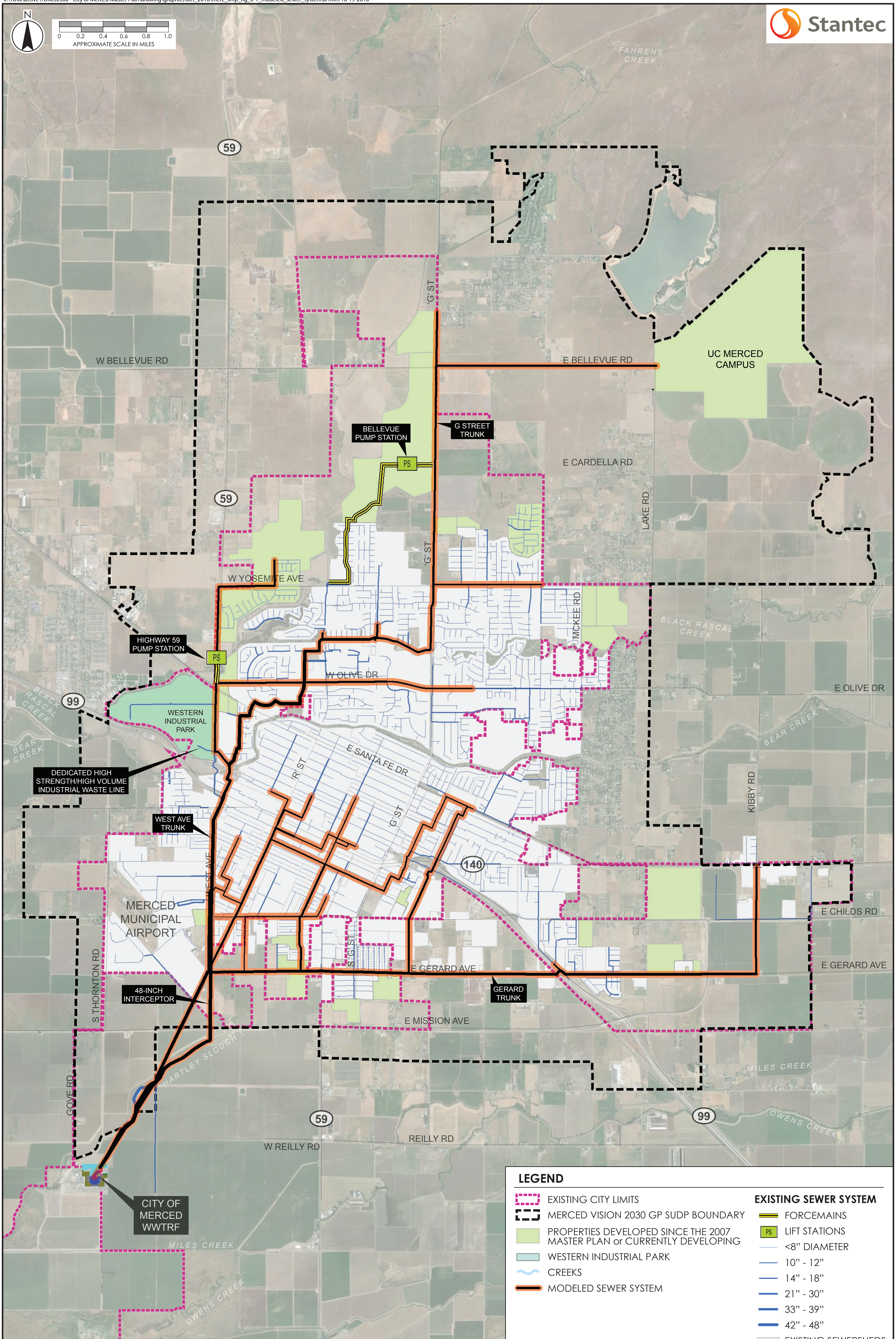

6.4 MODEL CALIBRATION

The model used for this evaluation was constructed and calibrated as part of the draft 2007 Master Plan process. Calibration (or validation) of the wastewater collection system computer model for both wet and dry weather conditions is necessary to ensure that model results correlate with observed real world performance, not just theory. In the case of the City's model, the version calibrated with the draft 2007 Master Plan effort was used. Due to the fact the model had been calibrated previously and was shown to produce acceptable results, the City decided not to revisit the calibration step with this WCS Master Plan update. The previous dry weather calibration was conducted using 1) flow monitoring data from selected locations within the collection system, and 2) flow data from the City WWTRF influent flow meter. The model was also calibrated for wet weather conditions such that peak influent flows at the WWTP were predicted by the model to be approximately 2.3 times the average dry weather flow at the WWTRF.

Note that the sewer diameters, slopes, and inverts used in the model as part of the 2007 master planning process have not been confirmed by field surveys as part of this study. It is understood that some of the slopes and inverts are based on record drawing information. It is recommended that prior to designing any wastewater collection system improvements, 1) the elevations of these sewers be confirmed, 2) the sewer model be updated, and 3) relevant simulations (i.e., model runs) be conducted, as appropriate. The City may wish to conduct limited surveying as part of any confirmation effort.

6.5 MODEL SCENARIOS SIMULATED

The computer model was used for analysis of a number of different scenarios:

- Existing system conditions – Evaluate the capacity within the existing trunk sewer system with only existing connections producing wastewater flow
- Interim conditions – Using interim development conditions defined by City staff, identify any remaining capacity in the existing trunk sewer system.
- Build out of the City SUDP area – Pipe sizes and slopes for future trunk sewers and pump stations were identified to serve the entire study area.

6.5.1 Recommended Level of Service Evaluation Criteria

Level of service (LOS) criteria used to assess capacity of sewers include:

- The extent of surcharging in the manholes,
- Minimum and maximum velocities predicted in pipelines, and
- Pipe capacity.

6.5.1.1 Surcharging Criteria

Surcharging in a manhole is defined in terms of the distance between the top of the sewer pipe leaving the manhole (i.e., the exist pipe's "crown elevation") and the hydraulic grade line (HGL) of water flowing through the manhole. A manhole is considered to be surcharged when the HGL exceeds the exit pipe's crown elevation.

For this WCS Master Plan, two surcharging design criteria are applied to capacity assessments of the existing trunk sewer system:

1. When the manhole rim elevation is less than 8-feet above the exit pipe crown elevation, no surcharging is allowed.
2. When the manhole rim elevation is equal to or greater than 8-feet above the exist pipe crown elevation, no more than 1 foot of surcharging is acceptable.

New trunk sewers are designed to have no surcharging allowed under design peak flow conditions.

6.5.1.2 Velocity

New gravity trunk sewers shall be designed to maintain a minimum flow velocity of 2.5 ft/s under dry weather flow conditions, and a maximum velocity of 7 ft/s under peak flow conditions. All existing trunk sewers that have velocities outside of these criteria shall be identified.

New forcemains shall be designed to have a minimum flow velocity of 2 ft/s and a maximum flow velocity of 7 ft/s under the full range of pumping conditions. All existing trunk system forcemains that have velocities outside of these criteria shall be identified.

6.5.1.3 Pipe Capacity

New gravity flow trunk sewers shall conform to the following capacity criteria under design peak flow conditions (where d = depth of flow in pipe, and D = pipe diameter):

- d/D shall be a maximum of 0.70 for gravity flow trunk sewers with diameters up to 24 inches.
- d/D shall be a maximum of 1.00 for gravity flow trunk sewers with diameters greater than 24 inches.

6.5.2 Existing System Simulation

Areas within the City's sewer service area that have connected to the trunk sewer system since preparation of the draft 2007 Master Plan were identified with assistance from City staff. These areas were added to the existing model and predicted flows checked against WWTRF influent flow records.

The existing system simulation relied on system configurations and data from the previously developed model (draft 2007 Sewer Master Plan). The evaluation of the existing system simulation produced results which are presented in Section 7.2 of this WCS Master Plan. Those results include identification of:

- Sewers predicted to have no capacity issues.
- Sewers predicted to surcharge due to downstream conditions (i.e., the trunk sewer has capacity, but is surcharged because sewage backs up into the trunk because of downstream capacity limitations, also referred to as backwater effect).
- Sewers predicted to surcharge due to insufficient capacity.
- Sewers predicted to surcharge to an extent they exceed the City's LOS criteria, regardless of whether the exceedance is caused by downstream conditions and/or insufficient capacity in the surcharged trunk sewer, itself.

The existing wastewater collection system and service area sewer service needs are presented in **Figure 6-1** and Section 5.0, respectively.

6.5.3 Interim Condition System Simulation

The interim condition trunk sewer system simulation is similar to the existing system simulation except that developments entitled to connect to the existing system are modeled as if they have connected to the existing system. This simulation is intended to guide the City and development community as to the potential limits of the existing system to convey flow from "entitled" properties before new, large diameter trunk sewers (or other measures) can be constructed. Entitled properties include those parcels which have paid into the North Merced Sewer Assessment District (NMSAD, established in 1981) and those parcels identified on the City's evolving Tentative Subdivision Activity Map (TSAM). The analysis of the interim condition includes those properties identified by the City as in the NMSAD, or on the TSAM. **Appendix B** includes a summary of acreages for properties included in NMSAD and TSAM (as of July 2017) along with an exhibit identifying these parcels.

The NMSAD was established in the 1980's to finance construction of trunk sewers to serve areas within the boundary of the District, the majority of which is located north of Bear Creek. The City has determined that properties which have received Final Maps, are entitled with approved Tentative Maps, or have otherwise received approval to develop (the TSAM) and connect to the North Merced trunk sewer system (north of Bear Creek) have paid their fair share of the total cost of those facilities.

In addition to the NMSAD and TSAM parcels, the interim condition also assumed entitled properties include full build-out of the UC Merced campus as excerpted from the *UC Merced and University Community Project Draft EIS/EIR,* November 2008 and *Final EIS/EIR*, March 2009.This WCS Master Plan assumes the average and peak flows presented in the Draft (November 2008) and Final (March 2009) EIS/EIR for the UC Merced and University Community Project. It is understood those flow projections did not change as a result of the adoption of the *UC Merced 2020 Project Addendum No. 6 to the 2009 UC Merced Long Range Development Plan EIS/EIR, April 2013*.

Figure 6-2 identifies entitled parcels added to those contributing to the existing system simulation. The acreages and estimated wastewater flows generated from entitled parcels are summarized in **Table 6-1**.

Results from previous analyses of interim conditions (draft 2002 North Merced Master Plan and draft 2007 Master Plan) indicate that investment in the existing sewer system should be relatively limited. This is because full build-out of the portion of the SUDP located in North Merced cannot be accommodated through these existing trunks without major investments expected to cost significantly more than construction of new trunks bypassing the existing collection system. Results from the current analyses of interim conditions indicate the same course of action by the City.

The interim condition simulation does not include any new trunk sewers. This interim condition scenario was modelled in order to identify deficiencies in, and any remaining capacity in the existing trunk sewer system if all areas identified in **Figure 6-2** were to develop. Results of this simulation are presented in Section 7.2.3 of this Master Plan report.

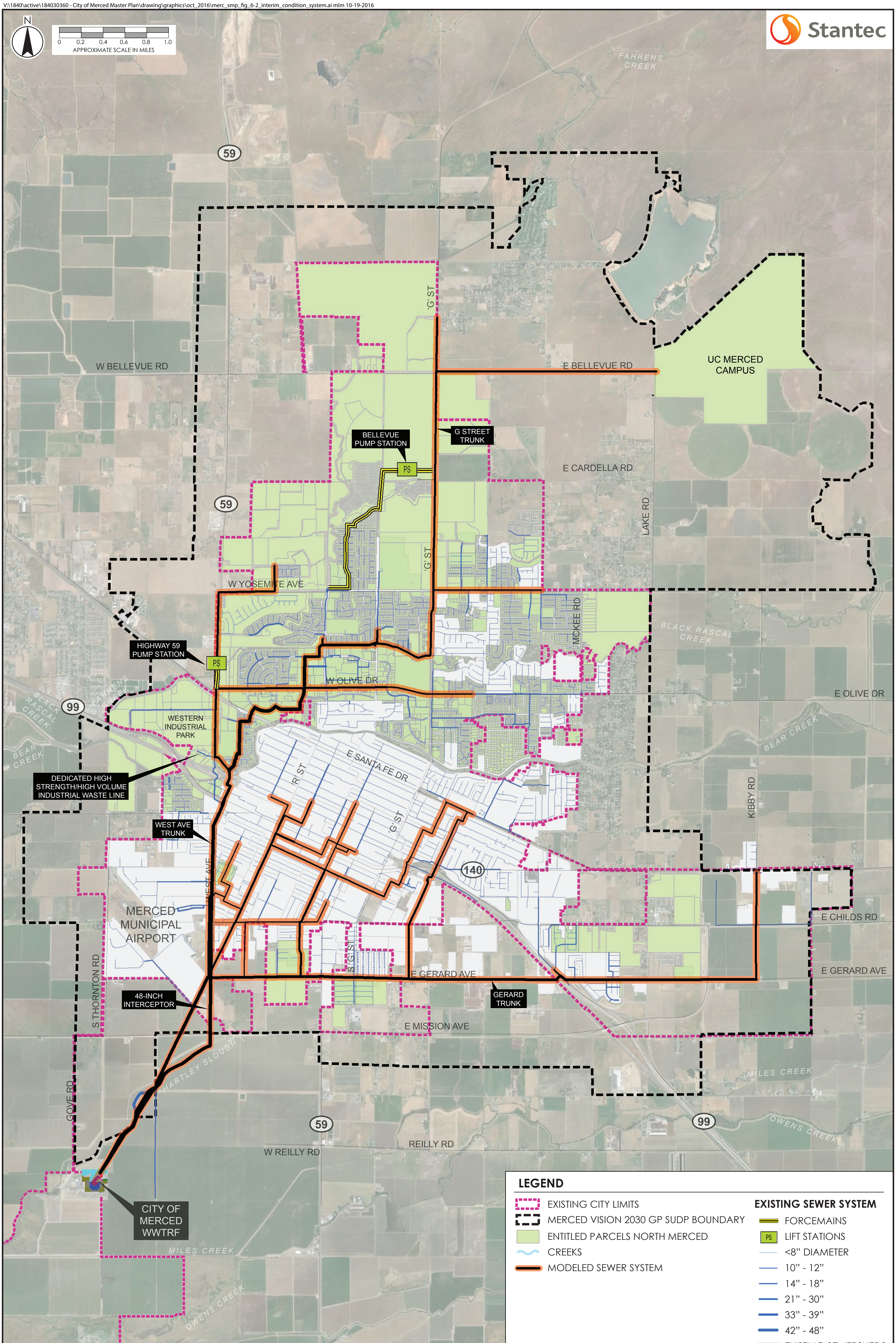

Figure 6-2
Interim Condition System Extents

Table 6-1 Summary of Acreages and Estimated Wastewater Flows from Entitled Parcels/Developments

Contributing Area	Total Area (ac)	Total EDUs	Total Population	DWF (Mgal/d)	PWWF (Mgal/d)	I&I (Mgal/d) (a)
G Street Entitlements	888	4,657	16,095	1.35	3.1	1.75
R Street Entitlements	1,209	6,847	22,111	1.88	4.32	2.44
Highway 59 Entitlements	342	2,718	8,208	0.70	1.6	0.90
Highway 59 Pump Station Entitlements	553	3,662	11,058	0.96	2.2	1.24
42-inch Interceptor Entitlements	167	819	2,474	0.22	0.5	0.28
UC Merced	815			1.13	2.54	1.41
Sub-total (b)	**3,974**		**59,946**	**6.24**	**14.26**	**8.02**

(a) I&I flow = PWWF - ADWF

(b) Flows reported in this table are total flows at buildout making no distinction between future development and developments already partially constructed. The one exception is approximately 168 acres of property under the control of Merced College included in the acreage totals in this table. These are currently athletic fields or ag land. Flow from this area is assumed zero (0) in the interim scenario. In the future build-out scenario, described in Section 6.5.4, flow in the model is assigned to this Merced College acreage.

6.5.4 SUDP Build-out System Simulation

The SUDP build-out sewer system simulation considered reasonable build-out of the City 2030 General Plan, which includes build-out of the UC Merced campus and the adjacent Campus Community. **Figure 6-3** illustrates the extent of the build-out service area used for this simulation.

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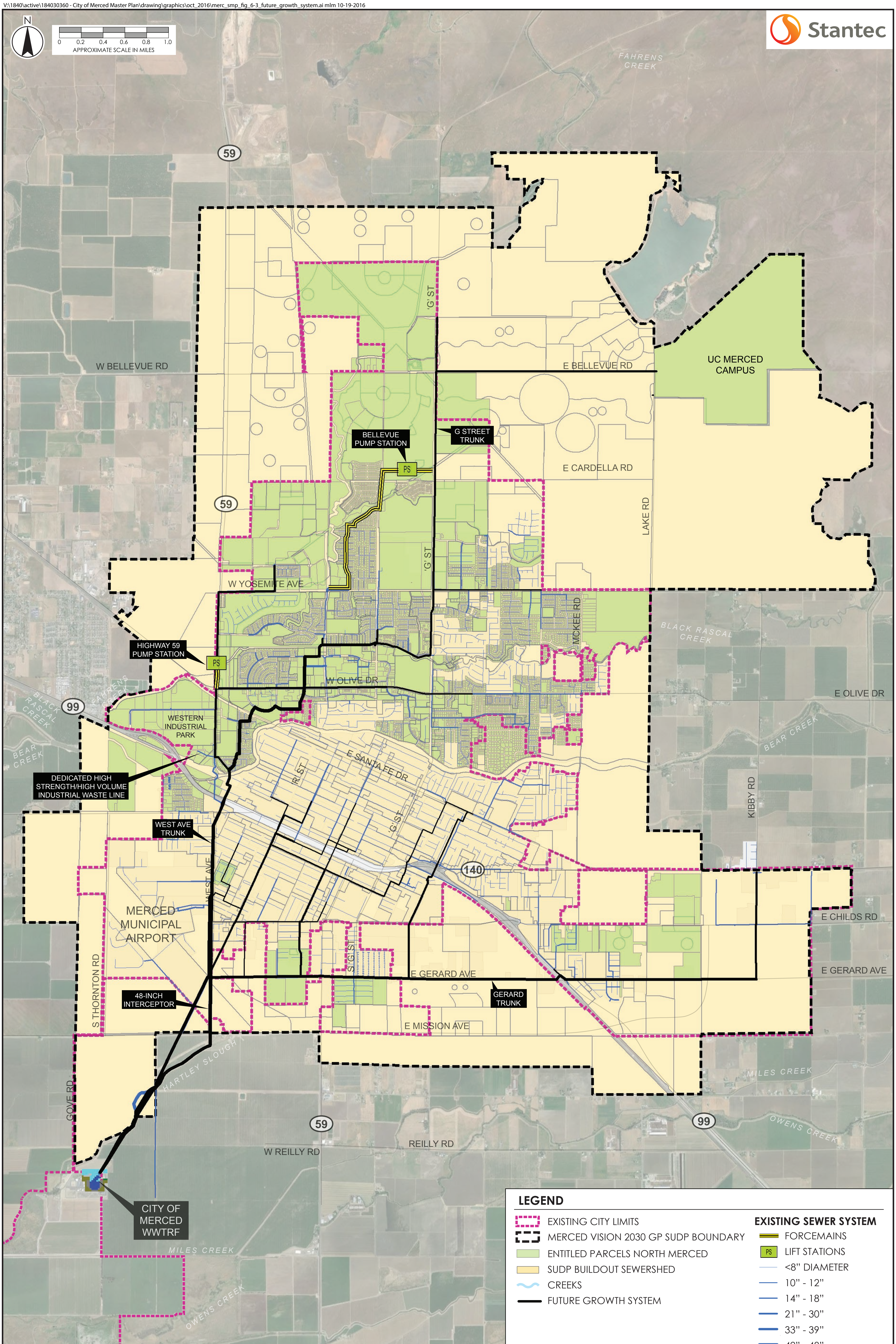


Figure 6-3
Sewer Service Area Future Growth

Table 6-2 summarizes the land uses and densities assumed to contribute additional wastewater flow (beyond the interim scenario) in the SUDP build-out scenario. **Table 6-2** summarizes only areas of future development contributing additional wastewater flow, unlike **Table 6-1**, which lists areas which are entitled, some of which are currently developing (partially developed). A portion of the area summarized in **Table 6-1** contributes to existing flows conveyed by the collection system and treated at the WWTRF (estimated to be a portion of the total acreage, as well as flow generated by ~8,000 students at UC Merced), with the remainder expected to generate wastewater as these areas fully develop. When the flows in **Table 6-2** are added to the flows applied in the interim condition simulation (which includes existing flows, plus entitled), the total ADWF (representing reasonable build-out of the City 2030 General Plan) is approximately 34 to 35 Mgal/d.

Unlike the existing service area and interim condition simulations, the SUDP build-out scenario considered several alternative servicing options during the process of draft WCS Master Plan development. Some options included all of the future areas identified in **Figure 6-3** and listed in **Table 6-2**. Others assumed certain areas would not contribute wastewater flow in the future. Still other simulations considered the timing of development within certain areas relative to construction of new trunk sewers. For example, one scenario considered the impact of participation by the UC Campus Community in new, trunk sewers planned for UC Merced campus and SUDP. Another scenario considered the impact of the Campus Community participating in separate trunk sewers that would be planned and designed after trunks for UC Merced Campus and the balance of the Vision 2030 SUDP were installed.

The SUDP build-out scenarios which the City considers most relevant to this WCS Master Plan are described in more detail, along with the results of those simulations, in Section 7.2.3 of this report.

Table 6-2 Summary of Additional Acreages and Estimated Wastewater Flows for the SUDP Build-out Scenario

Land Use	Total Area (ac)	Total EDUs	Total Population	DWF (Mgal/d)	PWWF (Mgal/d)	I&I (Mgal/d)
Commercial	1,574	9,185	N/A	2.4	5.4	3.1
Industrial	3,217	25,038	N/A	6.4	14.8	8.4
School	142	2,081	N/A	0.5	1.2	0.7
Rural Residential	2,299	4,589	13,858	1.2	2.7	1.5
Low Density Residential	3,069	13,792	41,652	3.5	8.2	4.6
Low Medium Density Residential	346	2,934	8,860	0.8	1.7	1.0
High Medium Density Residential	135	2,429	7,336	0.6	1.4	0.8
High Density Residential	32	900	2,718	0.2	0.5	0.3
Mobile Home Park	3	25	75	0.0	0.0	0.0

Land Use	Total Area (ac)	Total EDUs	Total Population	DWF (Mgal/d)	PWWF (Mgal/d)	I&I (Mgal/d)
Village Core Residential	304	3,645	11,008	0.9	2.2	1.2
Residential Reserve	206	926	2,796	0.2	0.5	0.3
Community Plan	1,617	7,269	21,952	1.9	4.3	2.4
Mixed Use	394	4,693	14,173	1.2	2.8	1.6
Other [b]	899	0	N/A	-		
Campus Community [a]	1,951	13,585	41,026	2	4.41	2.4
Sub-Total	**16,188**	**91,091**	**165,454**	**22** [c]	**50** [c]	**28** [c]

(a) Population and flows for the Campus Community are excerpted from Table 2.0-8, *UC Merced and University Community Project Draft EIS/EIR, November 2008 and Final EIS/EIR, March 2009*. These are consistent with the *UC Merced and University Community Project Final EIS/EIR, March 2009, UC Merced 2020 Project Addendum No. 6 to the 2009 UC Merced Long Range Development Plan EIS/EIR, April 2013*.

(b) Land uses characterized as "Other" include "Agricultural", "Future Park", "Open Space – Park Recreation", and "Public / General Use".

(c) Sub-totals rounded.

7.0 COLLECTION SYSTEM MODEL RESULTS

7.1 PURPOSE

This section summarizes and presents results from the three model simulations described in Section 6.0:

- Existing sewer system simulation (section 6.5.2)
- Interim condition sewer system simulation (section 6.5.3)
- SUDP build-out system simulation (section 6.5.4)

In addition to the simulation results, additional detail is provided where appropriate. Such details include the phasing of trunk sewer construction, and relevant alternative trunk alignments that were considered. The scenarios presented in this section are based on the premise that wastewater treatment and disposal/reclamation occurs at the existing WWTRF site, except as noted. A discussion of alternative WWTRF location and overall WCS Master Plan recommendations is presented in Section 8.0.

This discussion of model results is divided into the following sections:

- Existing System Simulation Results
  - South Merced
  - North Merced
  - Interim Condition System Deficiencies
- SUDP Build-Out System Needs
- Capital Improvement Projects
  - Existing Trunk System
  - Interim Capacity System Needs
  - Long Term System Needs
- Capital Cost Estimates & CIP

7.2 EXISTING SYSTEM SIMULATION RESULTS

The existing trunk sewer system was modeled to evaluate the extent of hydraulic deficiencies during design peak flow conditions. Current design peak wet weather flow at the WWTRF is predicted by the hydraulic model to be approximately 23.4 Mgal/d. Two specific storm events in January and April 2006 were referenced in the draft 2007 Master Plan. The peak hour flow rates measured at the WWTRF relative to these storm events were as high as 20 Mgal/d. Although Water Year 2017 produced very high total annual precipitation, storm events observed did not exceed the return frequencies that were seen in 2006 and did not warrant revision of the peak flow methodology developed in the draft 2007 Master Plan.

As a general note, the model currently applies I/I generation parameters to very broad areas within the collection system. For instance, the model currently assumes that I/I enters the wastewater collection system uniformly across the entirety of the South Merced basins. This may or may not be an accurate assumption. Without additional site specific observation/monitoring within the system, it is not possible to pinpoint sources of I/I. It is recommended that City staff monitor areas of the system which are predicted to experience surcharge or otherwise are capacity deficient based on the level of service criteria established for this model in Section 6.5.1 of this report.

It is important to point out that if sources of I/I can be pinpointed, the City can diagnose the nature of the I/I and make necessary repairs. It is also possible that the I/I within the sewer service area could be re-distributed in the model based on field observations. This could affect recommendations for upsizing, or otherwise addressing capacity deficiencies in the existing collection system. It should be further noted, however, that a design wet weather peaking factor of 2.3, as is estimated for Merced, and confirmed overall by flows observed at the WWTRF is not considered excessive.

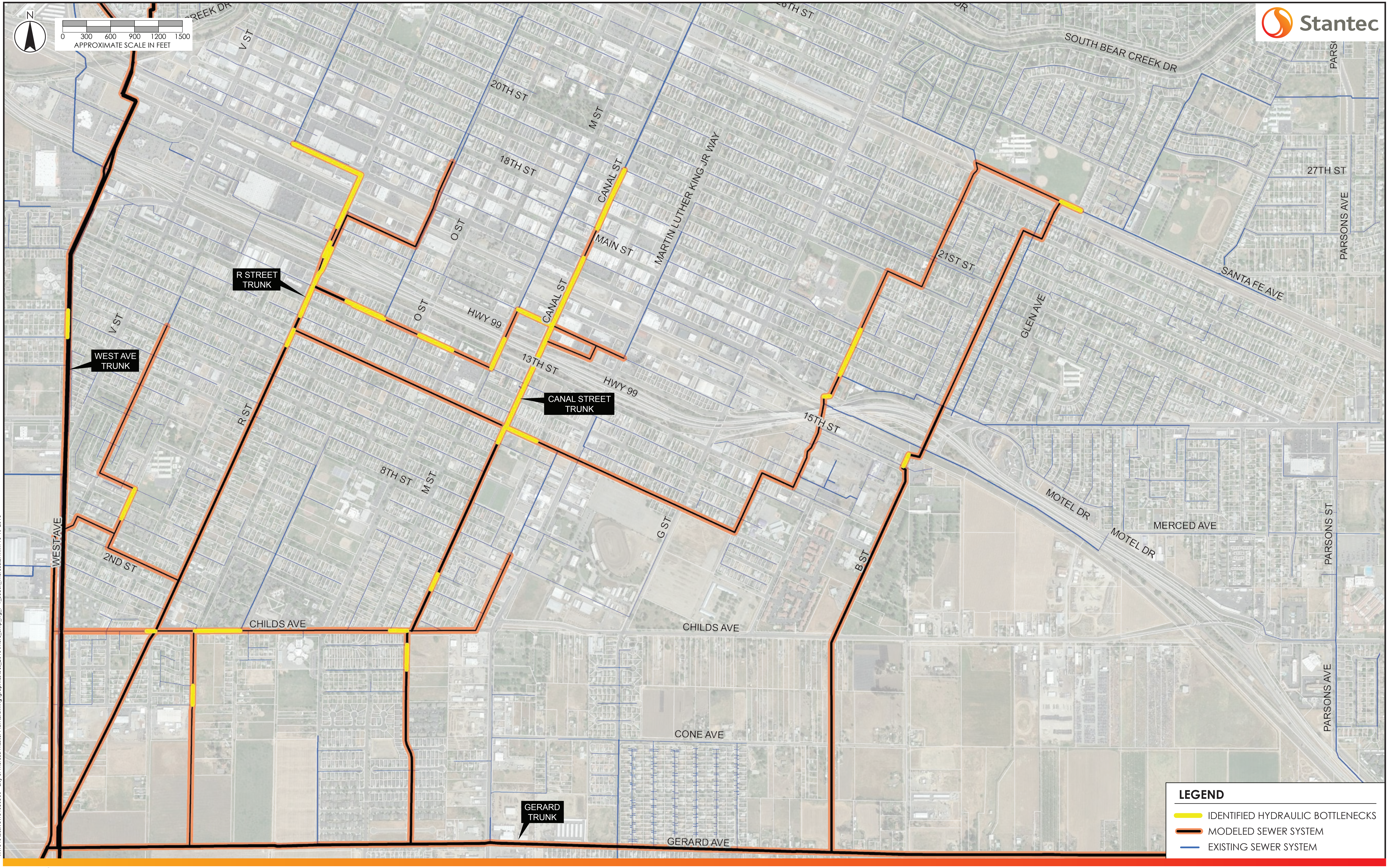
In general, new developments will not be added to existing sewers that are showing surcharging above the City's Level of Service criteria. As mentioned previously, the City will likely want to complete studies of the deficient sewers to validate these model predictions. For example, if the City's electronic mapping indicates the slope of a particular sewer is sufficient to cause surcharging according to the model, but actual field conditions differ sufficiently to eliminate this concern, then the City should confirm pipe conditions and actual flow conditions/capacities prior to 1) expending funds to upsize or parallel the subject trunk sewer, and/or 2) or to making final determinations as to the advisability of allowing additional development (flow) into the collection system in the subject area.

7.2.1 South Merced

Figure 7-1 shows areas within the existing wastewater collection system in South Merced that are predicted to have hydraulic limitations based on analysis using the Innovyze model to simulate existing peak flows under design storm conditions.

While the hydraulic model identifies several locations with hydraulic restrictions under design storm conditions, the most significant deficiencies occur in the major trunks along Canal Street and R Street. **Figure 7-2** shows the HGL (hydraulic grade line, i.e., sewage elevation) in the Canal Street Trunk. **Figure 7-3** shows the HGL in the R Street Trunk. Due to the level of service criterion that no surcharging is allowed to occur under design storm conditions in sewers with depths less than 8 feet, these two reaches are considered deficient.

It should be noted that while both locations of surcharging fail the Level of Service criterion, the surcharging along Canal Street is of greater magnitude than along R Street. It is predicted that surcharging along Canal Street will reach a peak of 1.8 feet above pipe crown at W Main Street and Canal Street. The peak surcharge along the R Street Trunk is predicted to be 0.3 feet at W 16th Street and T Street.



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City of Merced
Wastewater Collection System Master Plan

Figure 7-1
Results of Capacity Assessment of Existing Trunk Sewers in South Merced

Figure 7-2 HGL Profile of Canal Street Trunk Sewer Under Existing Conditions and Design Storm

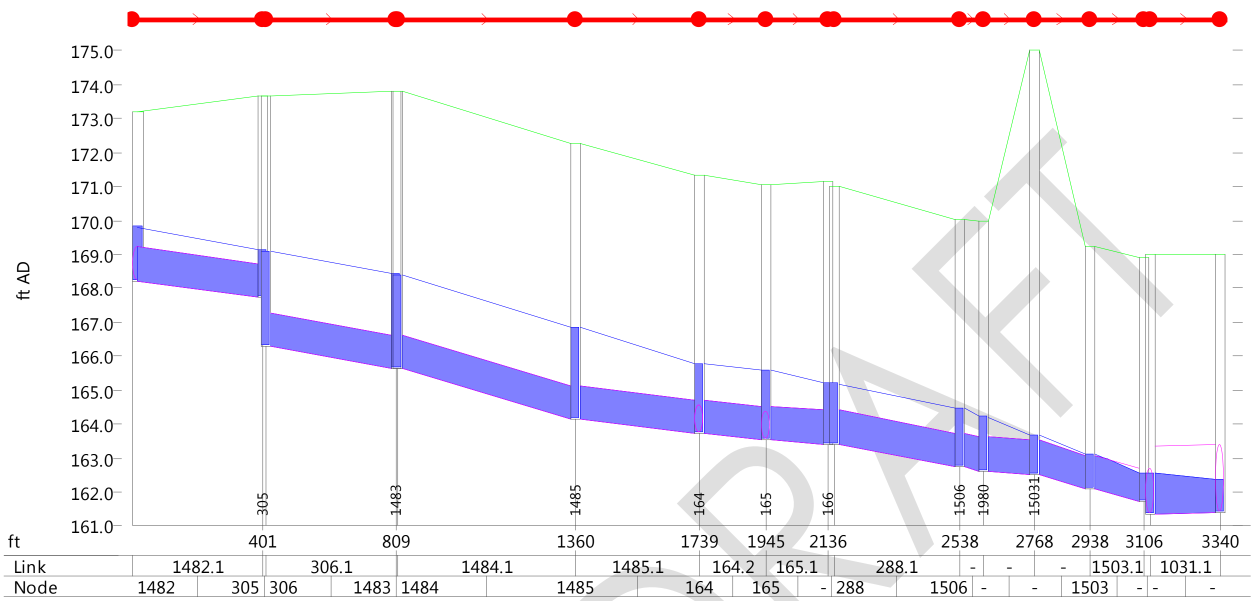
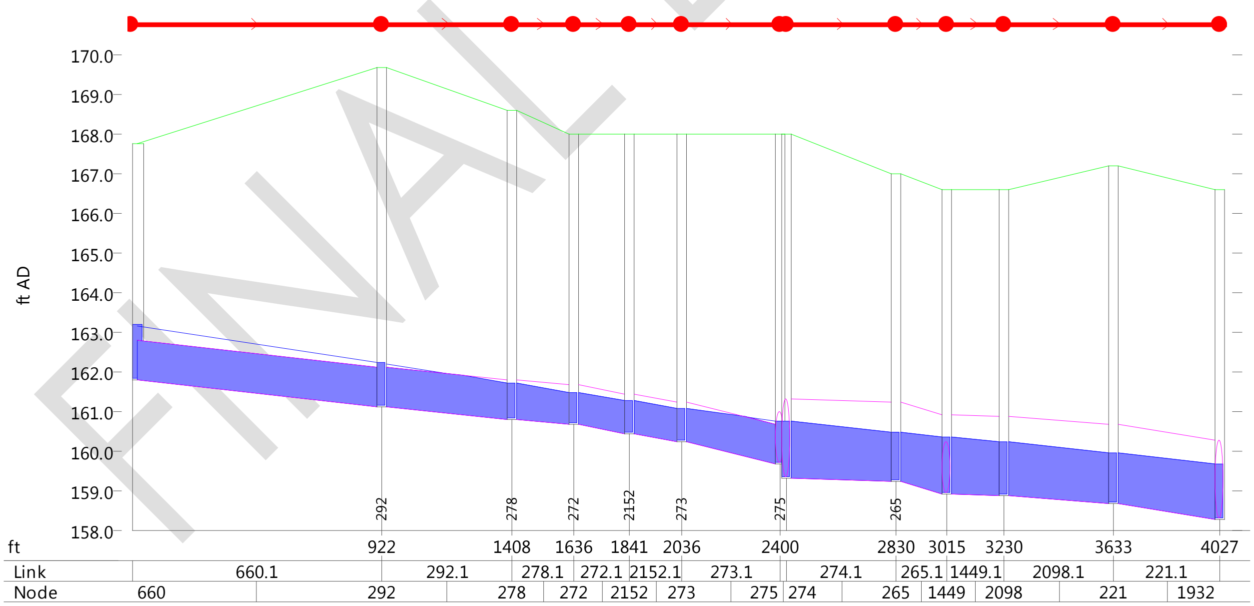


Figure 7-3 HGL Profile of R Street Trunk Sewer Under Existing Conditions and Design Storm



7.2.2 North Merced

Figure 7-4 shows areas within the existing wastewater collection system in North Merced that are predicted to have hydraulic limitations based on analysis using the Innovyze model to simulate existing peak flows under design storm conditions. The hydraulic model identified two locations with Level of Service failures within the North Merced sewer system:

- Just over 1000 feet of 21-inch diameter sewer along W Olive Avenue from R Street to Meadows Avenue. This trunk which is less than 8 feet deep is predicted to have minor surcharge (<0.1 feet).
- Approximately1900 feet of 24-inch diameter sewer and 400 feet of 21-inch diameter sewer along Highway 59, from W Olive Avenue (discharge of the Highway 59 Pump Station) to approximately 600 feet north of Holiday Mobile Estates. The surcharging is predicted to be approximately 1.1 feet above crown of pipe, resulting in approximately 5.2 feet of freeboard. The only connection to the trunk sewer at this location is from the Western Industrial area (12-inch sewer). Based upon the GIS information available, it appears that this LOS failure will not result in any residential surcharging.

7.2.3 Interim Condition System Results

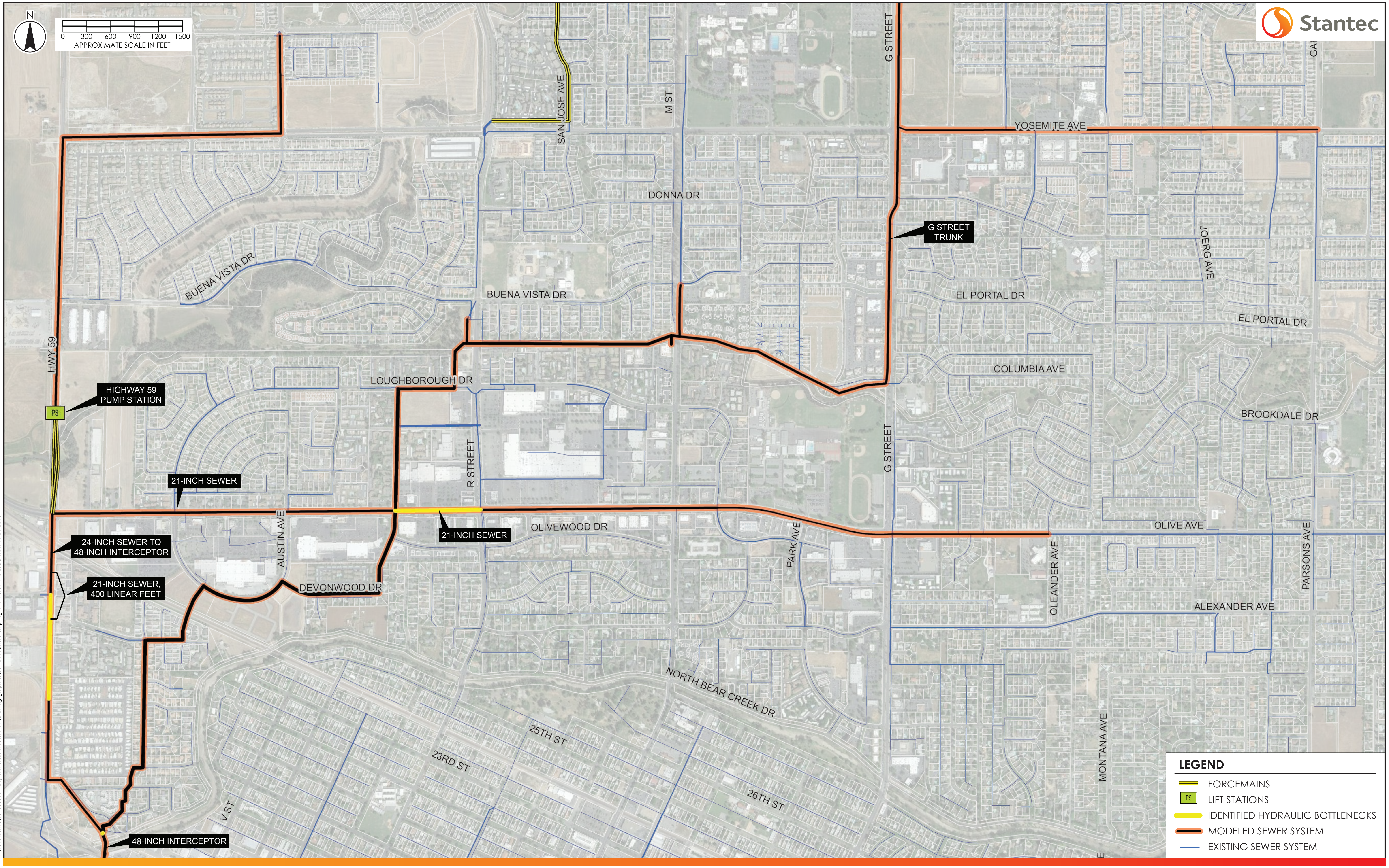
A variation of the existing system evaluation was simulated, as described in Section 6.5.3. This simulation includes those properties entitled to develop, largely within the North Merced area (north of Bear Creek). The results of the simulation are presented in **Figure 7-5**.

The primary difference between the Existing System results and Interim Condition System results is reflective of the greater number of sections shown to be deficient or at capacity in **Figure 7-5** when compared with **Figure 7-4**.

Segments of the Yosemite Avenue trunk are predicted be at or over capacity when the projects entitled to connect to that facility are built. Similarly, portions of the G Street trunk north of Black Rascal Creek and the 42-inch Interceptor along Devonwood Drive and Austin Avenue are predicted to be at or over capacity.

Of particular note, the portion of the trunk downstream of the Highway 59 pump station is predicted to be over capacity along the entire length of the alignment southward to the intersection with the 42-inch Interceptor. In addition, the Interceptor itself (which transitions from 42-inch to 48-inch downstream of West Childs Avenue) is surcharged a significant distance downstream of the intersection with the Highway 59 trunk. The impacts to the 48-inch Interceptor are technically within the level of service criteria established in Section 6.0 of this Master Plan, as the surcharging which is predicted to occur is greater than 8 feet below the various manhole rim elevations along this sewer alignment as it approaches the City's WWTRF to the south.

Generally, the City considers the deficiencies within the existing system under Interim Conditions to be acceptable, with some exceptions along the G Street trunk and the 42-inch Interceptor along Meadows Avenue, Loughborough Drive, Devonshire Drive and Highway 59. As a result, in the build-out scenario, some of the catchments included in the Interim Scenario are assumed to contribute to planned future trunks thereby reducing the magnitude of these deficiencies. This does not change the fact that entitled parcels will not be required to pay for connection to the collection system, although capacity charges at the WWTRF would still be required. More detail will be provided in the Engineering Report to be developed by the City to support of an assessment district to fund the new trunk sewers.



City of Merced
Wastewater Collection System Master Plan

Figure 7-4
Results of Capacity Assessment of Existing Trunk Sewers in North Merced

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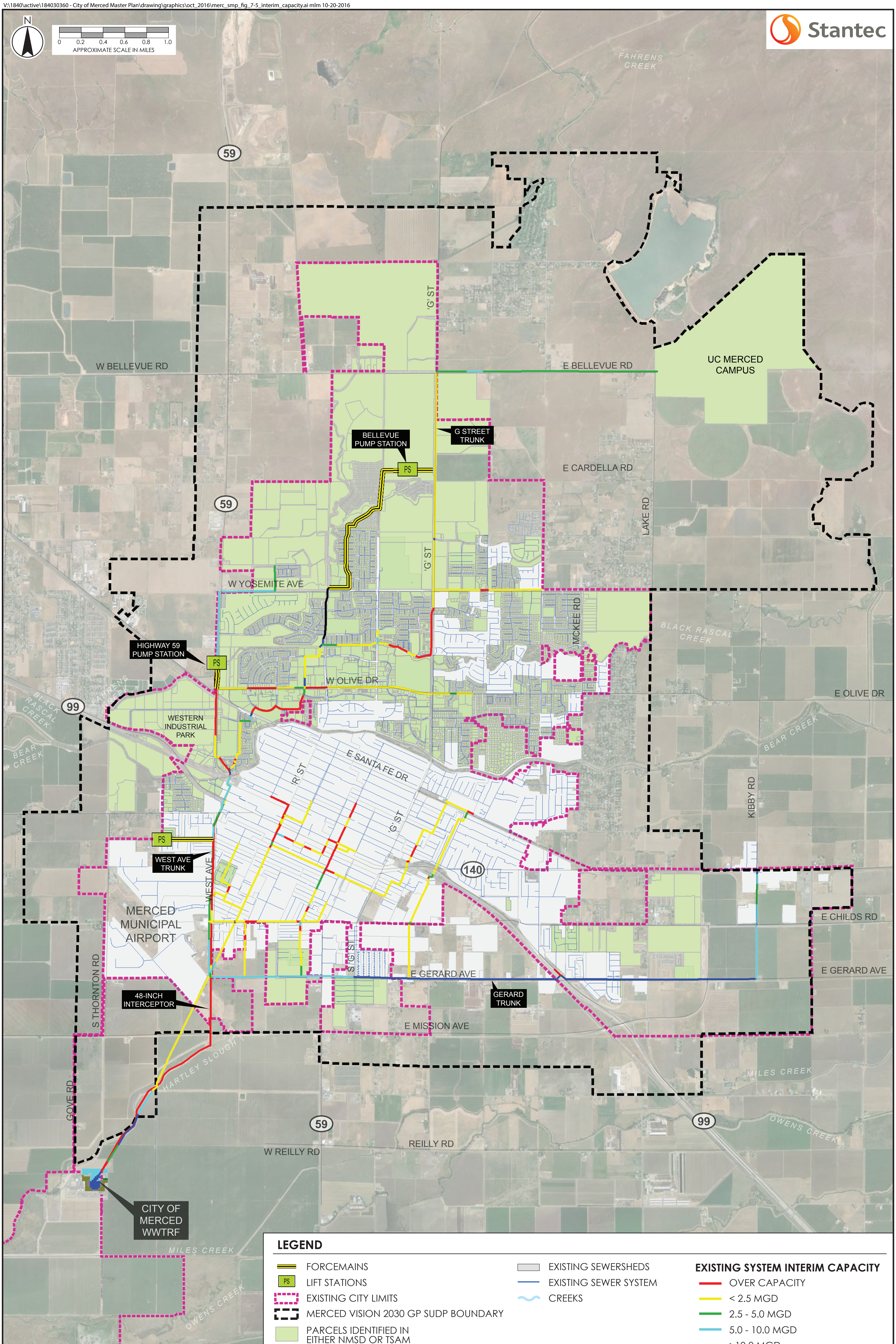

Figure 7-5
Results of Capacity Assessment of Existing Trunk Sewers Under Interim Conditions

7.3 RECOMMENDED CAPITAL IMPROVEMENT PROJECTS

This section describes improvements recommended to address deficiencies identified in the existing trunk sewer system, as well as the interim condition limitations and long-term system needs.

7.3.1 Existing Trunk System

The draft 2007 Master Plan described the age and condition of the Gerard Avenue Trunk and portions of the West Avenue Trunk as essentially poor. These are critical trunks in the existing collection system and will allow for servicing of a limited number of entitled or future connections without significant upgrades. Regardless, it is advised that the City consider the recommendations made in the draft 2007 Master Plan with regards to rehabilitation of these two trunk sewers.

In addition to the Gerard Avenue and West Avenue Trunk corrugated metal pipe (CMP) segments discussed in the draft 2007 Master Plan, there are other condition and capacity-related deficiencies in the South Merced system which should be addressed by either pipe rehabilitation projects, or upsizing the existing pipes or installing parallel pipes. The segments of trunk sewer identified as deficient in terms of capacity to serve existing flows are identified in **Figures 7-1** and **7-4**.

These trunks are summarized in **Table 7-1** along with the suggested diameter of replacement pipe necessary to mitigate the various capacity deficiencies.

Table 7-1 Recommended Sewer Upgrades for Existing System Under Existing Conditions (a)

Location	Total Sewer Length [feet]	Existing Sewer Diameter [inch]	Required Sewer Diameter [inch]
Canal Street	3,510	12-inch	15-inch
R Street	2,400	12-inch	15-inch
W Olive Avenue	1,040	21-inch	24-inch
Highway-59	2,300	24-inch	(b)

(a) Surveying and flow monitoring studies should be completed to validate model results prior to budgeting for these upgrades.

(b) The City is not currently intending to upsize or provide any capacity via parallel trunks or other upgrades to the Highway 59 Trunk.

7.3.2 Interim Condition System Needs

Results of system modeling suggest that the existing wastewater collection system is not sized sufficiently to provide capacity for forecast flows from “entitled” projects identified in Section 6.5.3 without some level of service failures. By extension, the existing system does not have sufficient capacity to serve build-out of the City’s SUDP. To serve these areas will require construction of several large trunk sewers. Financing, planning, and designing large trunk sewers to serve these areas will take time. This means that serving large portions of land that is ready to develop will need to wait until either the capacity of the collection system is increased or other means to serve these lands are implemented, of particular concern are the entitled projects.

This section outlines interim approaches to serving entitled projects via existing collection system infrastructure with limited new facilities and system upgrades.

South Merced

There are two primary trunks serving the existing development in the South Merced area: the Gerard Avenue Trunk and West Avenue Trunk. For the Interim Condition, the West Avenue Trunk appears to be able to provide approximately 4 Mgal/d of additional capacity beyond existing demands to North Merced. As mentioned previously, significant portions of this trunk were recommended for rehabilitation in the draft 2007 Master Plan that (has or has not occurred). Serving areas north of Bear Creek via the West Avenue Trunk would require a new pump station and forcemain to set wastewater from North Merced to this underutilized trunk. Considering these facts and other sewer projects discussed in this WCS Master Plan, it is recommended that the rehabilitated West Avenue Trunk be reserved to serve areas south of Bear Creek in the Interim Condition.

The Gerard Avenue Trunk is in the process of being rehabilitated. The section from West Avenue to just west of Doppler Road has been completed. Flow monitoring prior to 2007 indicated elevated flows in this sewer. Although rehabilitation of the Gerard Avenue Trunk may reduce I/I in this portion of the system, the benefit of that improvement cannot currently be quantified. As a result, the recommended Interim Condition approach assumes a limited service shed for the Gerard Avenue Trunk. The area of potential additional service is limited to areas east and north of the trunk.

North Merced

Significant remaining capacity to serve the area north of Bear Creek on an interim basis is limited to the G Street Trunk, Highway 59 Trunk and pump station, and Bellevue Trunk. Interim options for utilizing these sewers prior to construction of a new trunk crossing Bear Creek are described in more detail in the sections below.

Bellevue Trunk

The Bellevue Trunk was constructed to convey wastewater flows from the UC Merced campus at full build-out (studied population ~25,000) along with some additional capacity for planned development along the Bellevue Road corridor between G Street and Lake Road. The trunk has capacity to convey approximately 6.5 Mgal/d of wastewater under peak wet weather conditions. The plan for expanded enrollment at UC Merced is laid out in its Long Range Development Plan (*UC Merced and University Community Project Final EIS/EIR*, March 2009, *UC Merced 2020 Project Addendum No. 6 to the 2009 UC Merced Long Range Development Plan EIS/EIR, April 2013*). The enrollment at UC Merced during the 2016/17 school year was approximately 8,000 students. The Long Range Development Plan (LRDP) projects that enrollment will be approximately 10,000 students in 2020 (requiring about 0.45 Mgal/d, ADWF of capacity) and 25,000 in 2030 (requiring about 1.13 Mgal/d of capacity).

G Street Trunk

The G Street Trunk has capacity to convey approximately 4.14 Mgal/d (peak wet weather flow).

The available capacity in the G Street trunk and the commitment of capacity to parcels which previously contributed to the North Merced sewer assessment which funded, among other facilities, the G Street trunk, is not sufficient to convey flow from the entitled properties expected to utilize this facility. **Figure 7-5** illustrates the limitations in the G Street Trunk and the approximate locations. These capacity limitations suggest the City should begin to plan, fund, design and put into place new trunk sewers to serve the areas north of Bear Creek. This Master Plan represents the first step, albeit it a continuation of the draft 2007 Master Plan, toward describing and planning additional wastewater conveyance capacity for the North Merced area. **Figure 7-6** illustrates the approximate current, physically available capacity (in EDUs; 257 gpd/EDU times a peaking factor of 2.3, as described in Section 5.4, or 591.1 gpd/EDU) in the G Street Trunk. As stated above, capacity required to serve entitled properties will fully utilize this remaining capacity.

As shown in **Figure 7-6**, part of the interim plan for serving the North Merced area includes abandoning the 14-inch forcemain from the Bellevue Ranch pump station to G Street and utilizing the 16-inch forcemain from the pump station which extends to M Street where it connects to the R Street. This transition is to occur when flows at the pump station reach 1.95 Mgal/d. As discussed in the draft 2007 Master Plan, entitled developments to the west of Fahren's Creek which move forward prior to construction of new large trunk sewers are anticipated to use the Highway 59 Trunk and pump station.

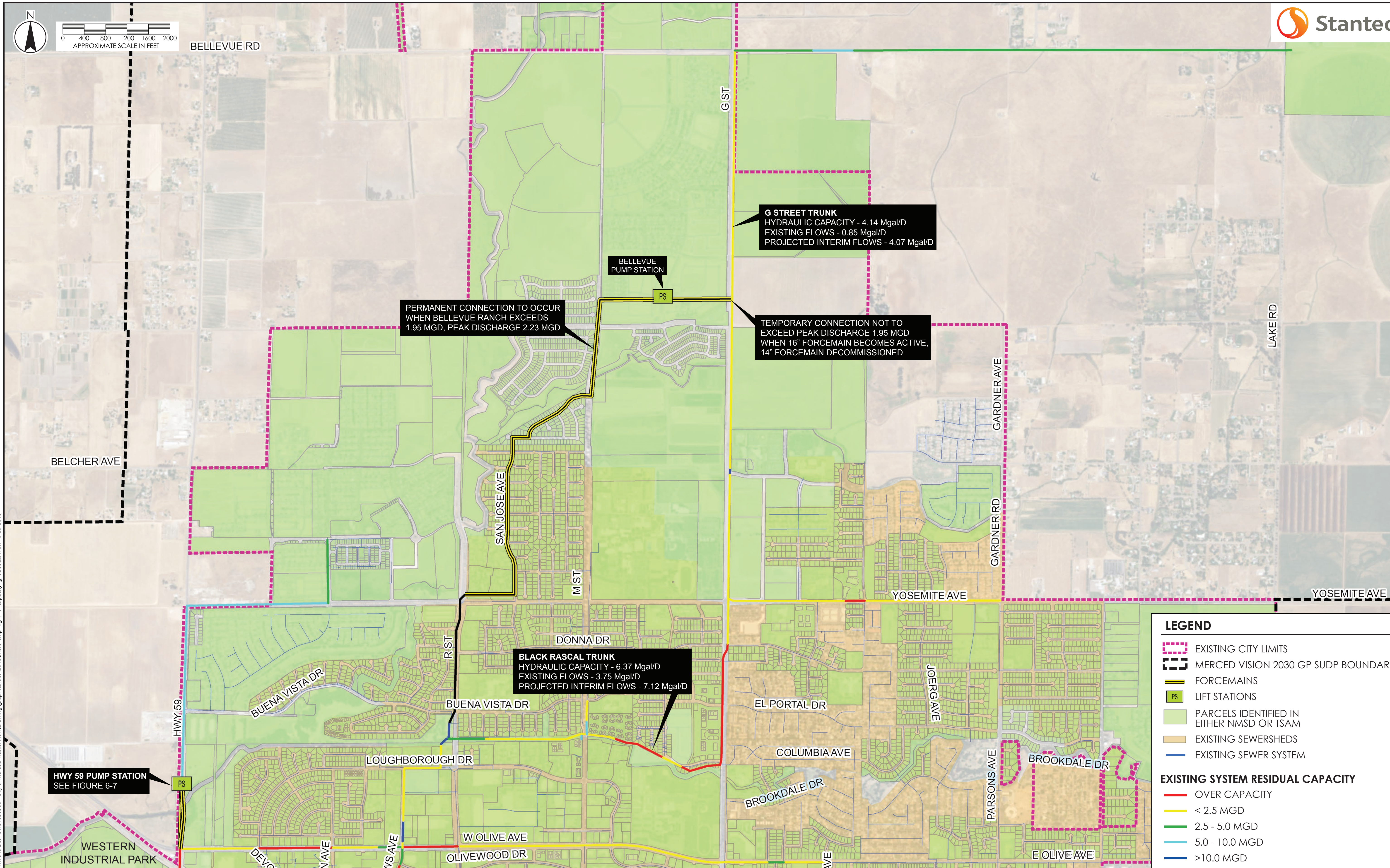

Figure 7-6
Capacity Remaining – G Street Trunk Under Interim Conditions

Highway 59 Trunk and Pump Station

Figure 7-7 shows the approximate location of the Highway 59 Trunk and pump station. The current capacity of the pump station is 3.17 Mgal/d (~5,360 EDUs) with a remaining, unused capacity of approximately 2.52 Mgal/d (~4,260 EDUs). The pump station is designed to allow a capacity expansion up to a total of 6.34 Mgal/d (~10,720 EDUs). If the City wished to realize the full, expanded capacity of the Highway 59 pump station (6.34 Mgal/d), the following would need to be implemented:

1. New, bigger pumps would need to be installed.
2. A second, parallel forcemain would need to be installed from the pump station across Black Rascal Creek.
3. The capacity of the trunk just downstream of the pump station forcemain discharge south of Black Rascal Creek needs to be increased by constructing a 30-inch diameter parallel gravity trunk sewer.
4. A portion of the Highway 59 Trunk north of the pump station (along Yosemite Avenue) has a limiting capacity of 5.3 Mgal/d (see **Figure 7-6**), therefore to realize the full 6.34 Mgal/d capacity of the pump station requires a parallel sewer to the Highway 59 Trunk at Yosemite Avenue.

The G Street Trunk and the Highway 59 Trunk both ultimately drain to the 42-inch interceptor upstream of that trunk crossing of Bear Creek. This trunk transitions to a 48-inch interceptor downstream of West Childs Avenue, a section with an existing capacity constraint of approximately 8,500 additional EDUs. If remaining capacity in the G Street Trunk is maximized (5,600 additional EDUs), the 48-inch Interceptor would only be able to accept an additional 2,900 EDUs from the Highway 59 pump station and from the other shed areas draining to it. This EDU count is less than the remaining additional capacity of the existing Highway 59 pump station (4,260 EDUs or 2.52 Mgal/d) and much less than the additional capacity of an expanded Highway 59 pump station which could add an additional 3.17 Mgal/d. In order to carry any additional flow within the level of service criteria established in Section 6.5.1, beyond the approximately 8.500 EDUs it may currently accommodate, the 48-inch Interceptor would need to be upsized to 54-inch diameter or a 30-inch diameter relief sewer installed parallel to the Interceptor. The length of the upsizing/paralleling required (~14,000 l.f.) is considered far too long and costly to undertake. As a result, no paralleling or upsizing is recommended in this WCS Master Plan.

Both a fully utilized Highway 59 pump station and a fully utilized G Street trunk cannot be accommodated in the 48-inch Interceptor. Additional cost would be required to expand capacity at the Highway 59 pump station. Additional cost is not required to fully utilize the remaining capacity in the G Street trunk. Therefore, it is recommended the excess capacity in the 48-inch Interceptor be reserved for flow from the G Street sewer. The complexity of expanding gravity sewer capacity south of W. Olive (and Black Rascal Creek) is problematic due to the number of existing utilities. As such, the assumption is currently that the trunk south of the Highway 59 pump station, upstream of the 42-inch Interceptor, has no additional (remaining) capacity and the scenarios in this WCS Master Plan assume no additional flow is added to this portion of the system until future large, parallel trunks are constructed to convey SUDP flows from North Merced to the WWTRF (which itself assumes a centralized WWTRF located at the site of the City's existing treatment facilities), as described in Section 7.3.3, which follows.

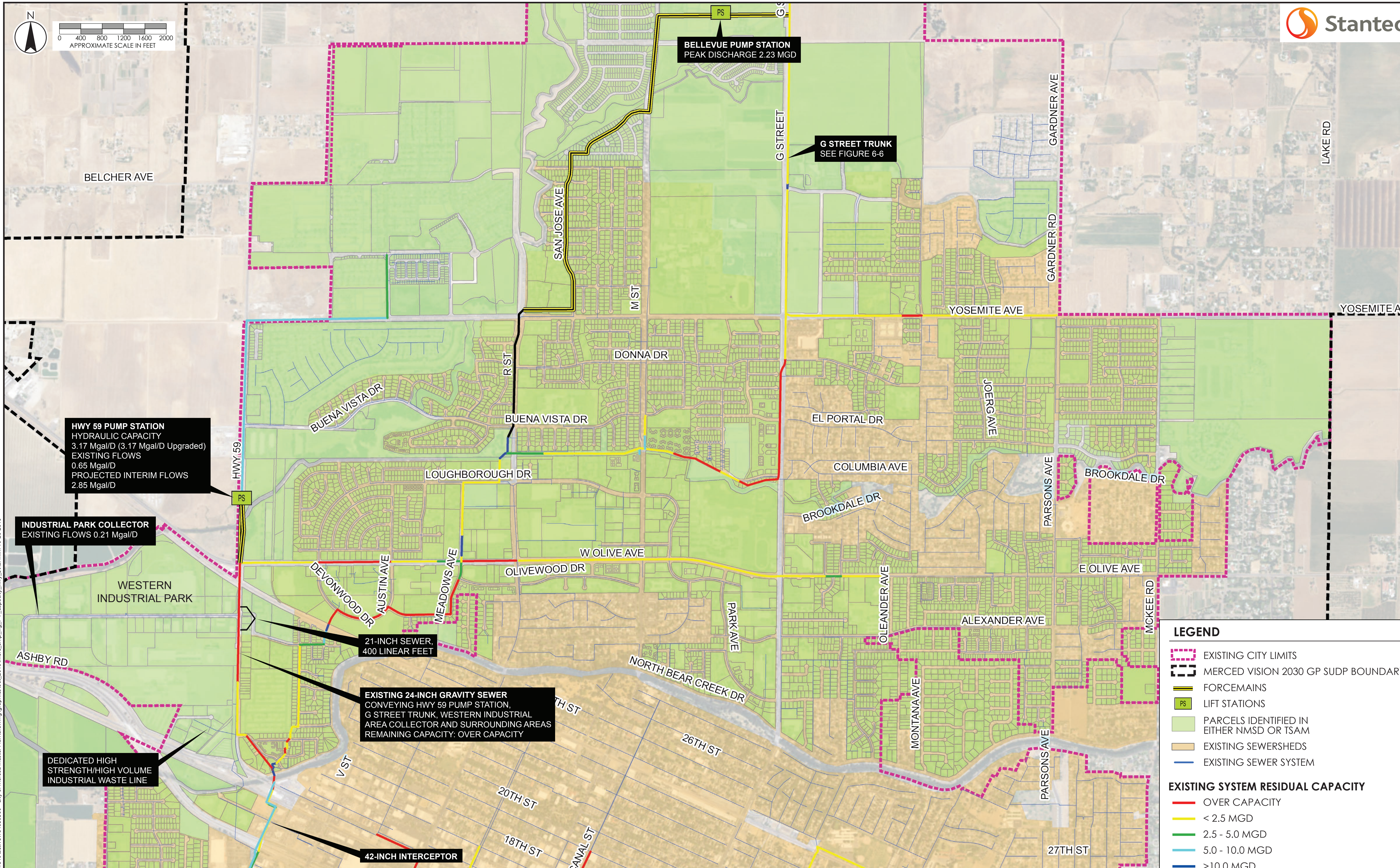

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Figure 7-7
Capacity Remaining – Highway 59 Trunk Under Interim Conditions

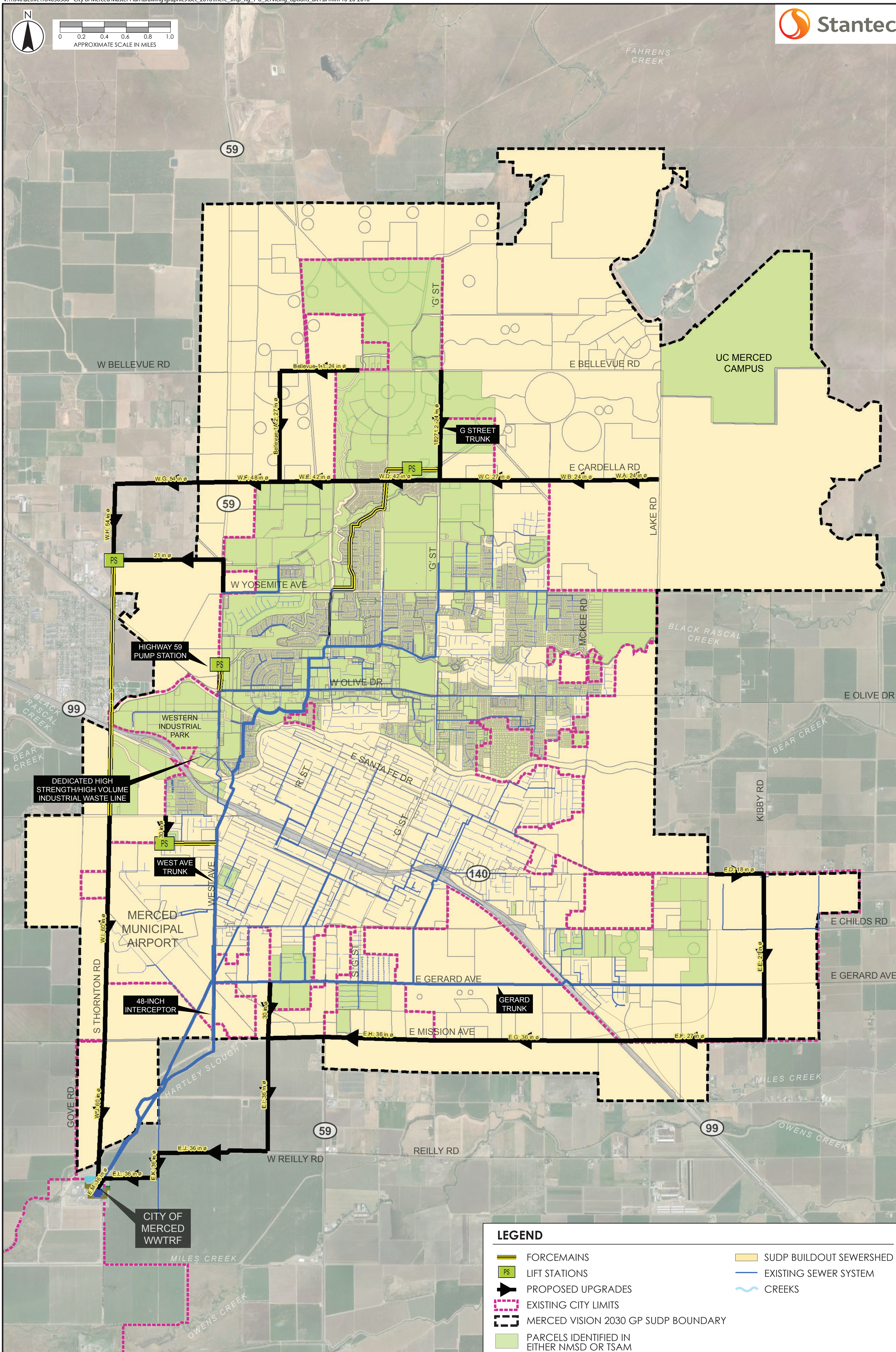
7.3.3 Long-Term System Needs

Due to the capacity limitations of the existing wastewater collection system, large trunk sewers must be constructed to accommodate future development within the SUDP. This is similar to conclusions presented in previous master planning documents. Alignments for these trunk sewers were determined based on conversations with City Public Works and Planning staff. The long-term system needs for large trunk sewers discussed in Section 7.0 are based on the assumption that future treatment and disposal/reclamation facilities will be centralized at the existing WWTRF site. This WCS Master Plan does evaluate the possibility of two WWTRFs and the implications of that plan on the future trunk layout in Section 8.0.

In addition to conversations internal to the Master Plan team, City staff also discussed alternative trunk alignments with representatives of UC Merced and other stakeholders within the SUDP including representatives of at least some of the "entitled" properties located in the North Merced area. The process of selecting the alignments discussed in this WCS Master Plan involved evaluating a number of alternative configurations of pump stations, forcemains and gravity sewers. The list of options was reduced to two primary alternatives following a stakeholder meeting in February 2016. The most significant difference between the two primary alternatives is the assumption of when the Campus Community area connects to the system. During Master Plan development, there was some uncertainty as to when the Campus Community may connect, and the second alternative provides an option for the Campus Community to connect at a later date. These two alternatives are described, generally below:

1. This alternative would serve the entire SUDP at current build-out flow estimates (with density assumptions as described in Section 3). Servicing the North Merced area would occur via a large new trunk starting in the vicinity of the intersection of Cardella Road and Lake Road, running east to west along Cardella Road, then south along Thornton Road to a pump station just north of Black Rascal Creek. A forcemain discharging from the new pump station north of Sante Fe Drive would extend to just south of CA 140, then transition to a new 60-inch gravity trunk from that point south to the WWTRF. Additionally, flow from the existing Highway 59 Pump Station would be diverted to the new pump station along Thornton Road, eliminating the long-term need to upgrade the existing forcemain and sewer along Highway 59 south of W Olive Avenue (one reason the City prefers not to invest in improvements in the pump station forcemain and downstream gravity trunk system). Servicing in South Merced would be via a new trunk running east to west along E. Mission Avenue which would intersect with a new trunk sewer running north to south west of Highway 59. This trunk would then turn west on Reilly Road and continue westward to the WWTRF. Alternative 1 is depicted in **Figure 7-8**.

2. Under the second alternative, the Campus Community is assumed to develop at a later date which would preclude participation in the new Cardella and Thornton trunks described in Alternative 1. The Campus Community would be served in Alternative 2 by a trunk line to the south from this special development area instead of to the west (the Cardella trunk) as shown in Alternative 1. Due to the uncertainty of when their share of the financing would be available under this scenario, a dedicated trunk would be constructed parallel to the new Alternative 1 South Merced trunk running along Mission which would be sized according to estimates of flow from the balance of the SUDP south of Bear Creek, and consistent with the sizing described in Alternative 1 for this trunk. A trunk would be extended from the southern Campus Community boundary to along the proposed Campus Parkway road alignment and back into the City's SUDP where it would connect with the new east-west trunk parallel to the trunk in E. Mission Avenue. **Figure 7-9** illustrates Alternative 2.



N
0 0.2 0.4 0.6 0.8 1.0
APPROXIMATE SCALE IN MILES
Stantec
FAHRENS CREEK
59
W BELLEVUE RD
E BELLEVUE RD
UC MERCED CAMPUS
G STREET TRUNK
E CARDELLA RD
LAKE RD
W YOSEMITE AVE
'G' ST
MCKEE RD
HIGHWAY 59 PUMP STATION
W OLIVE DR
E OLIVE DR
BLACK RASCAL CREEK
BEAR CREEK
99
WESTERN INDUSTRIAL PARK
E SANTA FE DR
R ST
DEDICATED HIGH STRENGTH/HIGH VOLUME INDUSTRIAL WASTE LINE
KIBBY RD
WEST AVE TRUNK
WEST AVE
140
MERCED MUNICIPAL AIRPORT
E CHILDS RD
E GERARD AVE
S THORNTON RD
48-INCH INTERCEPTOR
GERARD TRUNK
E MISSION AVE
HARTLEY SLOUGH
MILES CREEK
COVE RD
W REILLY RD
REILLY RD
OWENS CREEK
CITY OF MERCED WWTRF
LEGEND
FORCEMAINS
LIFT STATIONS
PROPOSED UPGRADES
EXISTING CITY LIMITS
MERCED VISION 2030 GP SUDP BOUNDARY
PARCELS IDENTIFIED IN EITHER NMSD OR TSAM
SUDP BUILDOUT SEWERSHED
EXISTING SEWER SYSTEM
CREEKS

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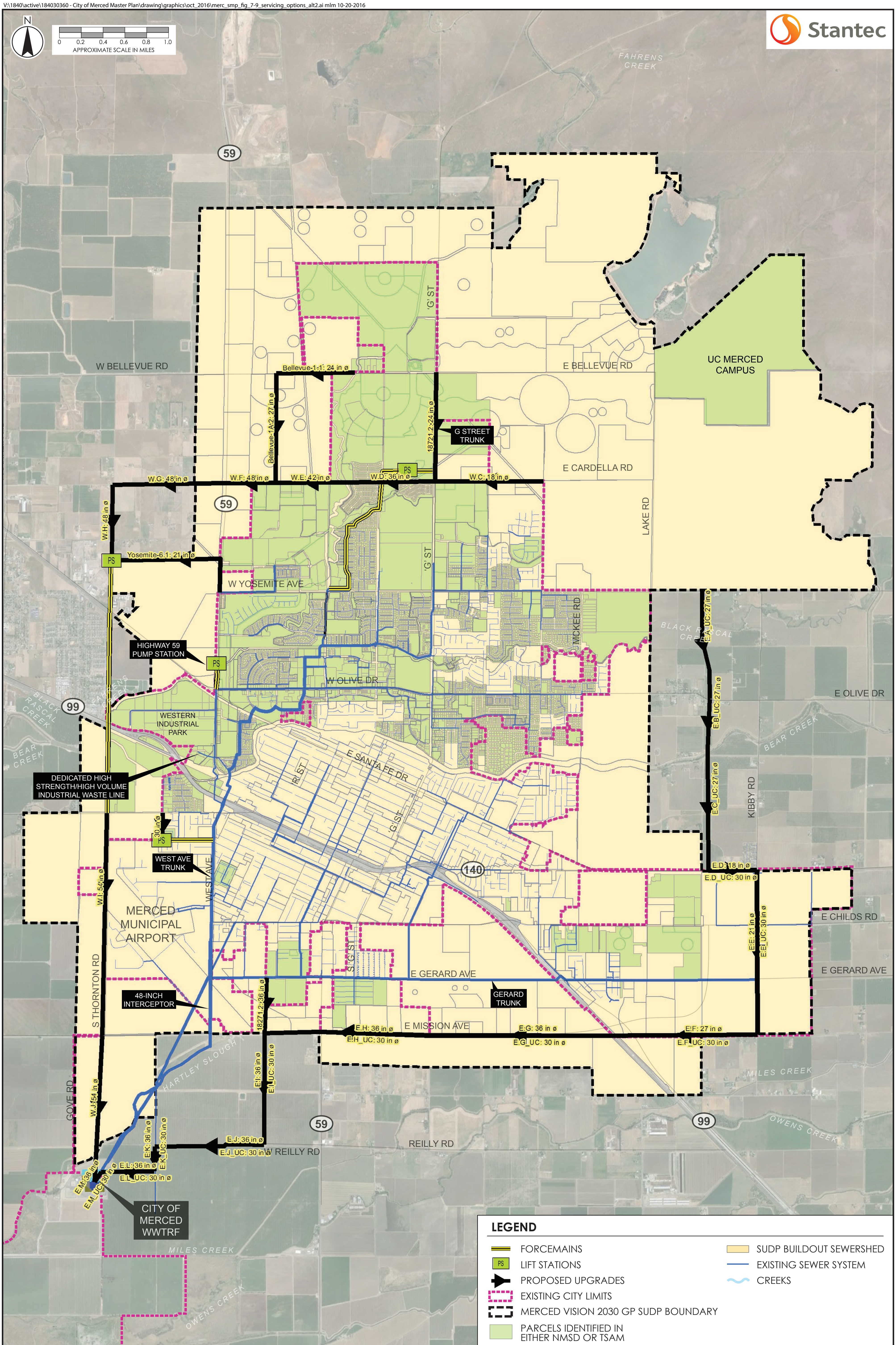

Figure 7-9
North Merced Servicing Options – Alternative 2

The City has selected Alternative 1 as the preferred Master Plan trunk alignment alternative. In addition to the facilities identified in the discussion above, and on **Figure 7-10**, further details of the new facilities proposed are provided in the following paragraphs.

As discussed, the servicing of North Merced would primarily be provided by new gravity sewer along Cardella Avenue and Thornton Road, with a pump station to convey flows from Sante Fe Drive to south of CA 140. A breakdown of the required new gravity sewer is provided in **Table 7-2**.

Table 7-2 Required Gravity Sewer for North Merced – Preferred Alternative 1

Sewer Location	Sewer Diameter [inch]	Sewer Length [ft]	Upstream Rim Elev. [ft]	Upstream Invert Elev. [ft]	Downstream Rim Elev. [ft]	Downstream Invert Elev. [ft]
Along Cardella Road, from Lake Road to Gardner Ave.	24	5,162	196.1	189.0	203.0	182.0
Along Cardella Road, from Gardner Ave. to G Street	27	5,160	203.0	182.0	181.3	171.6
Along Cardella Road, from G Street to Kansas Street	42	7,488	181.3	171.6	177.7	159.6
Along Cardella Road, from Kansas Street to Highway 59	48	2,509	177.7	159.6	174.1	156.5
Along Cardella Road, from Highway 59 to Thornton Ave.	54	5,370	174.1	156.5	172.1	151.0
Along Thornton Road, from Cardella Road to proposed Pump Station (S. of Belcher Ave.)	54	6,180	172.1	151.0	170	145.1
Flow Diversion from Highway 59 Pump Station to proposed Pump Station (S. Belcher Ave.)	21	6,800	167.3	145.4	170	142
Along Bellevue Road from Fahren's Creek to new 27-inch sewer	24	3,805	182	175	182.1	172.1
South from Bellevue Road to Cardella Ave.	27	5,291	182.1	172.1	177.7	159.6
Along G Street from Bellevue Road to Cardella Road [(a)]	24	5,270	185.6	175.8	181.3	171.6
Along Thornton Road, from McSwain Road to WWTRF	60	17,520	160	150.5	147	135

(a) New 24-inch sewer in parallel to existing 30-inch sewer.

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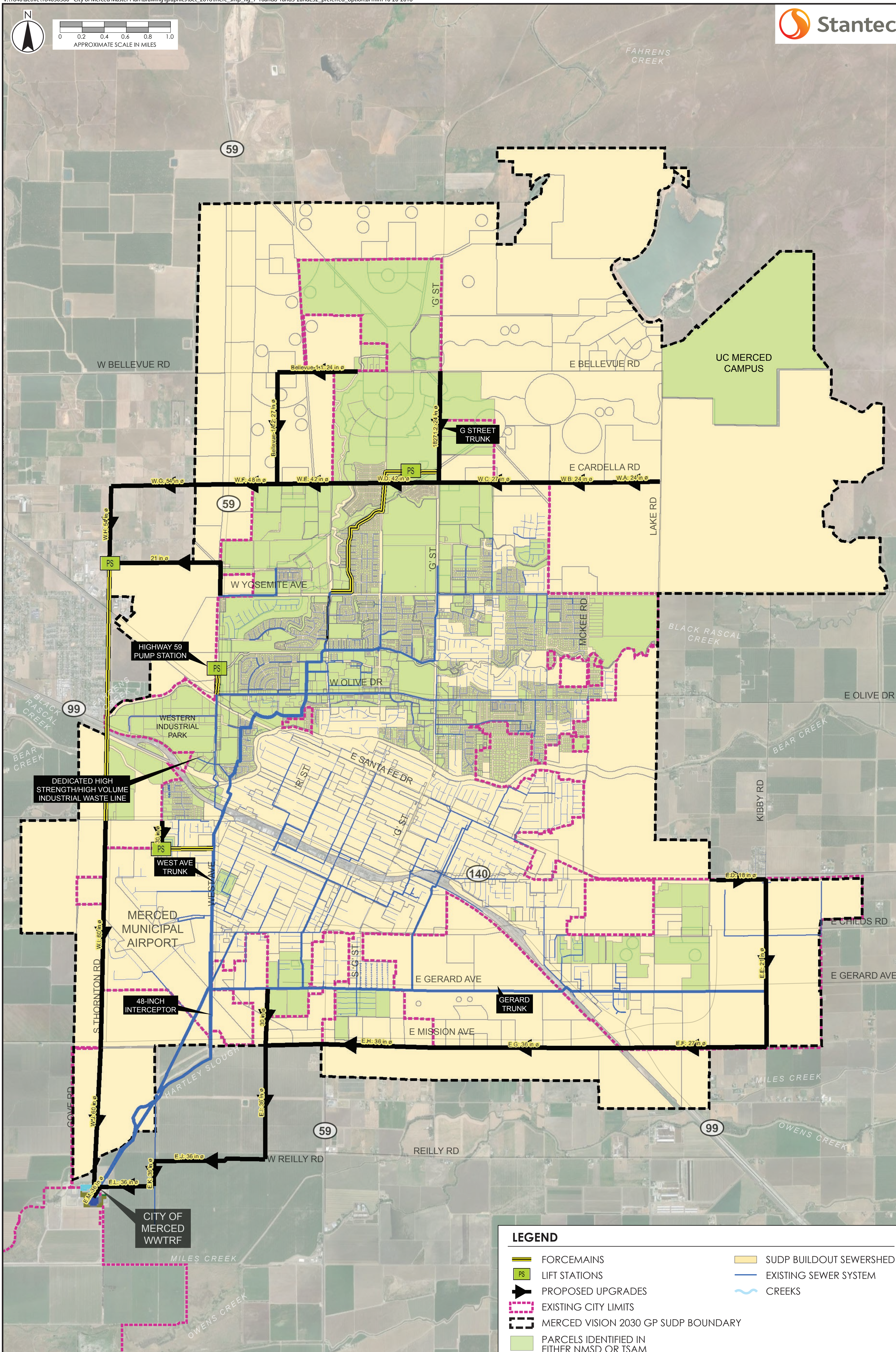

Figure 7-10
WCS Plan A

The servicing of South Merced would primarily be provided by new gravity sewer along Mission Avenue. A breakdown of the required new gravity sewer is provided in **Table 7-3**.

Table 7-3 Required Gravity Sewer for South Merced – Preferred Alternative 1

Sewer Location	Sewer Diameter [inch]	Sewer Length [ft]	Upstream Rim Elev. [ft]	Upstream Invert Elev. [ft]	Downstream Rim Elev. [ft]	Downstream Invert Elev. [ft]
Along Highway 140, from SUDP Boundary east to Kibby Road	18	2,184	190	175.7	194	174.6
Along Kibby Road, from Highway 140 to Mission Ave.	21	7,940	194	174.6	191	170.6
Along Mission Avenue, from Kibby Road to Miles Road	27	7,160	191	170.6	180	165.6
Along Mission Avenue, from Miles Road to approximately 0.5 miles west of Highway 59	36	16,640	180	165.6	170.1	153.9
Along Dickenson Ferry Road to WWTRF	36	15,032	170.1	153	147	134

7.4 CAPITAL COST ESTIMATES & CIP

Planning level opinions of probable cost for major trunk lines and pump stations have been developed. These planning level estimates include construction costs, a 30% contingency for unforeseen conditions, and a 20% allowance for design, construction management and contract administration. These costs have been estimated using a current ENR Construction Cost Index (ENRCCI) of 10435 (October 2016).

The growth rate of development within the City and the UC Merced campus will dictate the time horizon for build-out of the ultimate service area. However, it is possible this time horizon may be 50 years or more. As a result, the City may elect to phase all or a portion of the new large trunk sewers in North and South Merced which is beyond the scope of the analysis and discussion presented in this Master Plan. The City intends to work through possible options with the stakeholders in North and South Merced in order to come up with a detailed phasing plan for development of the new trunk sewers.

7.4.1 Capital Costs to Serve SUDP

Table 7-4 summarizes opinions of probable cost for new trunk sewers and pump stations to serve build-out of the SUDP. These build-out projections are based on the density assumptions presented in **Table 5-1**. The infrastructure components are based on the discussion in Section 6.5.3 for the Interim Condition Simulation and on Alternative 1 presented in Section 6.5.4 serving ultimate build-out. As mentioned in Section 7.3.3, the preferred long-term sewerage servicing plan could be (and likely would be) phased. This Master Plan does not attempt to identify the exact manner in which that phasing would occur. This phasing discussion is to be addressed in a separate document to be developed by the City in cooperation with affected stakeholders.

In addition to these costs, improvements to the Highway 59/G Street and 48-inch Interceptor system identified in Section 7.3.2 should also be factored into the City's plans, including identifying necessary revenue streams to fund those improvements.

Table 7-4 Opinion of Probable Cost – SUDP Servicing [a]

Service Area	Construction Cost [a]	Engineering, CM, Admin (20%)	Contingency (30%)	Total Project Costs (rounded)
North Merced SUDP	$67,139,000	$13,428,000	$24,171,000	$104,738,000
South Merced SUDP	$14,620,000	$2,924,000	$5,264,000	$22,808,000

(a) Costs presented do not include acquisition of additional right-of-way, environmental or permitting costs. ENR CCI = 10703, June 2017.

7.4.2 Repair and Replacement Costs

Table 7-5 summarizes opinions of probable cost for addressing existing system deficiencies identified in Section 7.2.1 and 7.2.2. The improvement projects identified in **Tables 7-4** and **7-5** do not include repair and replacement (R&R) of City facilities. A robust R&R program is a key element of any properly managed public infrastructure system. The City's R&R program for the sewer utility includes an annual expenditure for the replacement of older, aging infrastructure. To replace all of the facilities in the City's sewer enterprise would require a significant sum of money. The annual R&R allocation is intended to reduce the impact of repairing and replacing critical portions of the City's sewer collection system by stretching them out over time.

As a result, to ensure the elements of these systems which are in place today remain in service for perpetuity, the City has elected to fund their R&R program sufficiently to allow replacement of all collection system mechanical components (valves, pumps and appurtenances) on a schedule which is consistent with industry standard expectations for service life. The City is budgeting for replacement of all pipelines assuming an 80 year service life. Pump stations are assumed to have 20 year service life for mechanical components (i.e. pumps and emergency power generation), with wet wells and control buildings assumed to have 80 year service lives.

At this time, the City is planning to budget $300,000 annually for repair and replacement of system assets. Prioritization of R&R projects will be done within the typical five-year CIP timeframe, updated accordingly, but the City also recognizes that unforeseen incidents may require adjustments in the specific projects identified in any particular year.

The five year CIP for the City is summarized in **Table 7-6**. Where possible, the City has attempted to include R&R components in the improvement projects identified previously in **Tables 7-4** and **7-5** where they overlap and it makes sense to do so.

Table 7-5 Opinion of Probable Cost – Addressing Existing System Deficiencies (a)

Scenario	Construction Cost	Contingency (30%)	Engineering, CM, Admin (20%)	Total Project Costs (rounded)
Address Existing Deficiencies	$3,420,000	$1,030,000	$890,000	$5,340,000

(a) Planning level costs assume replacement of pipelines. Costs for pipe bursting may be lower. ENR = 10703, June 2017.

Table 7-6 Five Year CIP Budget for City of Merced Sewer Collection System (a)

System Component	Fiscal Year 2017/18	Fiscal Year 2018/19	Fiscal Year 2019/20	Fiscal Year 2020/21	Fiscal Year 2021/22
Address Existing Deficiencies	$250,000	$350,000	$350,000	$500,000	$500,000
Repair & Replacement Program	$600,000	$650,000	$700,000	$750,000	$800,000
Total Annual Cost	**$850,000**	**$1,000,000**	**$1,050,000**	**$1,250,000**	**$1,300,000**

(a) All annual costs are presented in November 2017 dollars

The detailed cost breakdown for the construction costs presented in this section are provided in **Appendix C**.

8.0 FEASIBLE ALTERNATIVE WASTEWATER COLLECTION SYSTEM IMPROVEMENT PLANS AND RECOMMENDATIONS

Based on the analyses and conclusions presented in this report, feasible alternatives for providing permanent sewer service to the City for 2030 General Plan growth and build-out conditions of the City include the following elements.

1. Relatively minor improvements to the existing trunk sewer system are recommended.
2. A new trunk sewer system is needed to provide sewer service for City growth, much of which is in North Merced.
3. Wastewater treatment, disposal, and reclamation facilities are needed to serve new growth. These new facilities could be built:
   a. Entirely at the City's existing WWTRF site; or,
   b. At the existing WWTRF site and at a new WWTRF site in North Merced serving the North Merced area (aka, a NMWWTRF).

Each of these elements are discussed in the following sections before specific alternative wastewater collection system improvement plans are presented.

8.1 RECOMMENDED IMPROVEMENTS TO THE EXISTING TRUNK SEWER SYSTEM

Based on the sewer system modeling results discussed in Section 7.0 and City staff observations of existing sewer system performance during very wet Water Year 2017, it is recommended that some improvements to the existing trunk sewer system be made regardless of alternative plans for serving new City growth. These recommended improvements to the existing trunk sewer system are common to all alternative plans for expanding the City's trunk sewer system. These recommended improvements are listed in **Table 8-1**, along with opinions of probable capital costs.

Table 8-1 Recommended Improvements to the Existing Trunk Sewer System Common to All WCS Master Plan Alternatives

Recommended Trunk Sewer Improvement [(a)]	Opinion of Capital Cost (rounded) [(b)]
Canal Street	$1,768,000
R Street	$1,209,000
W Olive Avenue	$703,000
Highway-59	$1,651,000

(a) See **Figures 7-1, 7-4 and 7-5** for the locations of recommended improvements.
(b) Based on ENR-CCI (20 Cities Index) = 10703, June 2017. This represents a breakdown of total project costs reported in **Table 7-5**.

8.2 RECOMMENDED NEW TRUNK SEWERS TO SERVE CITY GROWTH

As discussed in Section 3.0, WCS Master Plan trunk sewer alternatives to serve City growth are to be based on three basic principles:

1. Gravity flow trunk sewers shall be used to the extent feasible because of their reliability and ease of operation and maintenance. When gravity flow sewers are not feasible, conventional forcemains shall be used.
2. New gravity flow trunk sewers (and forcemains) shall be designed to minimize disruption of, and risk to, existing development and infrastructure (e.g., roads, water pipes, gas lines, cable services, etc.).
3. These new trunk sewers shall flow to either the existing WWTRF site or to both the existing WWTRF site and a new NMWWTRF site.

Based on these principles, City growth projections and locations, and City topography, the preferred trunk sewer plan for serving North Merced growth, existing City infill, and South Merced growth discussed in Section 7.0 requires one remaining variable/alternative to be addressed in order for that plan to be finalized and recommended for adoption, specifically whether a trunk sewer is to be built from North Merced to the existing WWTRF site, as described in Section 7.0 (a distance of approximately 6 to 7 miles), or whether a new NMWWTRF is built in North Merced in place of that trunk sewer. All new trunk sewers developed in this WCS Master Plan are common to all alternatives with the exception of a possible trunk sewer from North Merced to the existing WWTRF site. All new trunk sewers recommended to serve City growth are listed in **Table 8-2**, along with opinions of probable capital costs.

Table 8-2 Recommended New Trunk Sewers Common to All WCS Master Plan Alternatives

Recommended New Trunk Sewer [a]	Opinion of Capital Cost [b]
North Merced Area:	
Cardella Road from Lake Road to Gardner Ave., 24-inch, approximately 5,162 l.f.	$1,179,364
Cardella Road from Gardner Ave. to G Street, 27-inch, approximately 5,160 l.f.	$1,233,045
Cardella Road from G Street to Kansas Street, 42-inch, approximately 7,488 l.f.	$2,806,487
Cardella Road from Kansas Street to Highway 59, 48-inch, approximately 2,509 l.f.	$1,100,519
Flow Diversion from Highway 59 Pump Station to Proposed Pump Station (S. Belcher Ave.), 21-inch, approximately 6,800 l.f.	$1,457,065
Bellevue Road from Fahren's Creek west to new 27-inch sewer, 24-inch, approximately 3,805 l.f.	$623,801
From Bellevue Road to Cardella, 27-inch, approximately 5,291 l.f.	$1,237,399
G Street from Bellevue Road to Cardella Road, 24-inch, approximately 5,267 l.f.	$968,647
South Merced Area:	
From W. Gerard Avenue to W. Dickenson Ferry Road, approximately 2,679 l.f.	$741,282
End of Baker Drive to Kibby Road, 18-inch, approximately 2,180 l.f.	$422,187
Kibby Road from CA 140 to Mission Avenue, 21-inch, approximately 7,940 l.f.	$1,914,098
Mission Avenue from Kibby Road to Miles Road, 27-inch, approximately 7,160 l.f.	$2,016,994
Mission Avenue from Miles Road to approximately 0.5 miles west of Highway 59, 36-inch, approximately 16,640 l.f.	$4,472,605
Dickenson Ferry Road to WWTRF, 36-inch, approximately15,032 l.f.	$4,321,334
Subtotal (rounded)	**$24,500,000**
5% Mobilization/Demobilization	$1,225,000
Estimated Construction Subtotal	**$25,725,000**
30% Contingencies for Unknown Conditions	$7,718,000
Estimated Construction Cost	**$33,443,000**
ROW/ Easement Acquisition	**Not included**
20% Engineering, Environmental, & Admin	$6,689,000
Total Project Cost	**$40,132,000**

(a) See **Figure 7-10** for the locations of recommended new trunk sewers. **Tables 7-2** and **7-3** summarize the lengths, diameters, upstream and downstream pipe inverts and manhole rim elevations.

(b) Based on ENR-CCI (20 Cities Index) = 10703, June 2017.

8.3 NEW TRUNK SEWERS TO SERVE CITY GROWTH IN NORTH MERCED

As discussed in the preceding section and in Section 3.0, a trunk sewer would be necessary from Cardella Road in North Merced to the existing WWTRF site, if all City sewage is to be conveyed there for treatment, disposal, and reclamation. This trunk sewer would not be necessary if much of the North Merced wastewater is treated, disposed, and reclaimed in the greater North Merced area. The specifics of this trunk sewer are listed in **Table 8-3**, along with opinions of probable capital costs.

Table 8-3 Alternative New Trunk Sewer Needed if all City Wastewater is Treated at the Existing WWTRF

Alternative Trunk Sewer Components [a]	Opinion of Capital Cost [b]
33 Mgal/d peak flow capacity pump station	$7,500,000
~2.5 miles of 24-inch and 36-inch diameter force main	$20,416,833
~5 miles of gravity flow sewer 54 to 60-inches	$25,255,809
Subtotal (rounded)	**$53,173,000**
5% Mobilization/Demobilization	$2,659,000
Estimated Construction Subtotal	**$55,832,000**
30% Contingencies for Unknown Conditions	$16,750,000
Estimated Construction Cost	**$72,582,000**
ROW/ Easement Acquisition	**Not Included**
20% Engineering, Environmental, & Admin	$14,516,000
Total Project Cost	**$87,098,000**

(a) See **Figure7-10** for the locations of trunk sewer components.
(b) Based on ENR-CCI (20 Cities Index) = 10703, June 2017. Costs are rounded to the nearest $1,000.

8.4 ALTERNATIVE WASTEWATER TREATMENT, DISPOSAL, AND RECLAMATION FACILITY NEEDS TO SERVE CITY GROWTH

Where wastewater is treated has a major impact on planning trunk sewers. Section 3.0 develops two feasible wastewater treatment and disposal/reclamation siting options:

- All City wastewater is treated and disposed/reclaimed at the existing WWTRF site, or,
- A new WWTRF is built to serve North Merced growth needs, and all remaining sewage is treated at the existing WWTRF.

Because trunk sewers are designed for reasonable build-out development conditions and resulting build-out wastewater flows, wastewater treatment and disposal/reclamation facilities must also be evaluated (at least conceptually) for viability under build-out conditions. Design ADWFs and peak flows for City build-out conditions as a function of general sewer service area are presented in **Table 8-4**.

Table 8-4 Design Wastewater ADWFs and Peak Flows Under Build-Out Conditions as a Function of General Sewer Service Area

General Sewer Service Area	Est'd ADWF Under Build-Out Conditions, Mgal/d	Design Peak Flow Under Build-Out Conditions, Mgal/d
North Merced [(a)]	~14 to 15	~32 to 35
Rest of City [(b)]	~ 20	~46
Total for Entire Planning Area	~ 34 to 35	~78 to 81

(a) Represents new flow from the North Merced service area potentially served by new trunk sewers or a new WWTRF located in the North Merced area.

(b) These numbers include some flow from North Merced which is existing and/or entitled to connect to the existing trunk sewer system.

If all City sewage is treated at the existing WWTRF site, then the existing 12 Mgal/d WWTRF will be expanded in phases, as needed, to an ultimate capacity of ~ 34 to 35 Mgal/d, ADWF. The existing approximately 600 acre WWTRF site and primary effluent disposal method (discharge to Harley Slough) are believed to be sufficient under build-out flows with on-site improvements, including increased treatment capacity and additional effluent equalization storage capacity to prevent the higher build-out effluent discharge flow rates from exacerbating flooding along Harley Slough under high rainfall conditions.

If build-out sewage flows are to be split between the existing WWTRF and a new NMWWTRF, then the existing WWTRF will be expanded in phases up to a capacity of ~ 20 Mgal/d. The new NMWWTRF and associated effluent disposal/reclamation facilities will be expanded in phases up to a capacity of ~ 14 to 15 Mgal/d. The existing WWTRF can easily accommodate 20 Mgal/d flows, in terms of treatment and effluent disposal/reuse. This level of sewer service capacity has already been planned for the existing WWTRF. The viability of a ~ 14 to 15 Mgal/d NMWWTRF is unknown at this time. This is because it has not been studied in any detail. Building the ~ 14 to 15 Mgal/d NMWWTRF treatment process on industrially zoned land in North Merced is relatively straightforward, provided the CEQA and permitting process can be completed successfully, in a timely manner and at a reasonable cost. Disposing of ~ 14 to 15 Mgal/d of effluent in the greater North Merced area is the greater concern because of the large amounts of land needed (as will be discussed).

An opinion as to capital improvements needed at the existing WWTRF site and the NMWWTRF site to accommodate flows expected for Vision 2030 General Plan population estimates for the year 2030 are presented in **Table 8-5**, along with opinions of probable capital costs. As shown in **Table 8-5**, effluent disposal/reclamation facility needs/costs for the new NMWWTRF are significant.

Table 8-5 An Estimate of Improvements Needed to Provide Capacity to Serve 2030 Population Projections - 16 Mgal/d at Existing WWTRF and a ~ 4 Mgal/d Capacity NMWWTRF [(a)]

Improvements	Opinion of Capital Costs to Expand Existing WWTRF to 16 Mgal/d	~4 Mgal/d NMWWTRF Opinion of Capital Costs [(b)]
Headworks and Primary Treatment Facilities Influent Pump Station, Headworks, Equalization Basin, Primary Clarifiers	$533,000	$2,663,000
Secondary Treatment Aeration Basin Splitter Box, Aeration Basins, Blower Building and Blowers, Secondary Clarifiers, RAS/WAS Pump Stations	$13,126,000	$11,273,000
Tertiary Treatment Tertiary Pump Station, Rapid Mx and Flocculation Basins, Tertiary Disc Filters	$1,560,000	$0
Disinfection System UV Disinfection System	$0	$942,000
Effluent Disposal Facilities Outfall Structure, Irrigation System Improvements	$0	$47,360,000
Solids Handling Facilities DAFTs, Digester Control Building, Primary Digesters, Solids Holding Tank, Gas Holding System, Waste Gas Flare, Solids Dewatering Building, Active Solar Dryers, Centrate Equalization Tank, Centrate Pump Station	$15,908,000	$11,782,000
Miscellaneous Structures Operations / Lab / Admin Building (Limited), Generator Building, Chemical Storage Facility, Chemical Building, Plant Water Pump Station, Stormwater Pump Station, Stormwater Detention Basin	$623,000	$2,759,000
Subtotal 1	**$31,750,000**	**$76,779,000**
Mobilization, Bonds, Insurance, Startup, Misc.	$4,464,000	$2,501,000
Sitework	$4,034,000	$2,501,000
Site Piping	$3,227,000	$5,001,000
Electrical and Instrumentation	$6,992,000	$10,002,000
Subtotal 2	**$50,467,000**	**$96,784,000**
Contingencies @ 30%	$15,140,000	$29,035,000
Subtotal 3	**$65,607,000**	**$125,819,000**

Improvements	Opinion of Capital Costs to Expand Existing WWTRF to 16 Mgal/d	~4 Mgal/d NMWWTRF Opinion of Capital Costs (b)
Engineering and Administration @ 20%	$13,121,000	$25,164,000
Land Acquisition		$898,000
Planning, Permitting, Etc.		$1,000,000
Total Project Cost (rounded)	**$78,728,000**	**$152,881,000**
Grand Total	**$231,609,000**	

(a) Based on ENR-CCI (20 Cities Index) = 10703, June 2017.

(b) These costs are scaled from 14 Mgal/d estimate.

An opinion of the capital improvements needed at the existing WWTRF site to accommodate ~ 20 Mgal/d wastewater flows to accommodate 2030 population projections are presented in **Table 8-6**, along with opinions of probable capital costs.

Table 8-6 An Estimate of Improvements Needed to Provide Capacity to Serve 2030 Population Projections - 20 Mgal/d at Existing WWTRF [(a)]

Improvements	Opinion of Capital Costs [(a)]
Headworks and Primary Treatment Facilities Influent Pump Station, Headworks, Equalization Basin, Primary Clarifiers **Secondary Treatment** Aeration Basin Splitter Box, Aeration Basins, Blower Building and Blowers, Secondary Clarifiers, RAS/WAS Pump Stations **Tertiary Treatment** Tertiary Pump Station, Rapid Mx and Flocculation Basins, Tertiary Disc Filters **Disinfection System** UV Disinfection System **Effluent Disposal Facilities** Outfall Structure, Irrigation System Improvements **Solids Handling Facilities** DAFTs, Digester Control Building, Primary Digesters, Solids Holding Tank, Gas Holding System, Waste Gas Flare, Solids Dewatering Building, Active Solar Dryers, Centrate Equalization Tank, Centrate Pump Station **Miscellaneous Structures** Operations / Lab / Admin Building (Limited), Generator Building, Chemical Storage Facility, Chemical Building, Plant Water Pump Station, Stormwater Pump Station, Stormwater Detention Basin	**$49,952,000**
Mobilization, Bonds, Insurance, Startup, Misc.	$6,808,000
Sitework	$6,152,000
Site Piping	$4,922,000
Electrical and Instrumentation	$10,663,000
Subtotal 2	**$78,497,000**
Contingencies @ 30%	$23,549,000
Subtotal 3	**$102,046,000**
Engineering and Administration @ 20%	$20,409,000
Total Project Cost	**$122,455,000**

(a) Based on ENR-CCI (20 Cities Index) = 10703, June 2017.

8.5 WCS PLANNING ALTERNATIVES

Based on the foregoing analyses, this WCS Master Plan presents two wastewater collection system alternative plans as being feasible.

- Plan A: Under Plan A, the collection system takes all municipal wastewater to the City's existing 12 Mgal/d capacity WWTRF located southwest of the City, as shown in **Figure 8-1**. The existing WWTRF would be expanded in phases, as needed, to handle 2030 General Plan flows and build-out flows. The effluent disposal and reuse facilities needed by the planned expansions largely exist; however, developers still need to buy their fair shares of all existing City facilities they use, including the land on which that infrastructure is located. The existing WWTRF site is believed to have sufficient land and disposal potential to serve "reasonable build-out" design flow estimates of approximately 35 Mgal/d, if/when needed.
- Plan B: Under Plan B, the collection system takes most municipal wastewater generated by growth in North Merced to a new North Merced WWTRF (NMWWTRF) located on industrially zoned land west of the intersection of W. Yosemite Avenue and Highway 59 (aka, Snelling Highway), see **Figure 8-2**. The NMWWTRF site would be planned for 2030 General Plan and build-out capacities of approximately 4 to 5 Mgal/d, and 14 to 15 Mgal/d, respectively. The existing WWTRF would serve the remainder of the City and its growth, and would have approximate planned capacities for 2030 General Plan, and build-out conditions of 12 Mgal/d and 20 Mgal/d, respectively. Both the new NMWWTRF and existing WWTRF would be built and expanded in stages as needed. The NMWWTRF would also need new effluent disposal and reuse facilities master planned for its 2030 General Plan and reasonable build-out flow conditions.

8.5.1 Plan A

Wastewater collection system Plan A involves conveying all wastewater to the existing WWTRF site, as shown in **Figure 8-1**. Capital improvements needed to implement Plan A are presented in **Tables 8-2**, **8-3**, and **8-5**, which are summarized for ease of reference in **Table 8-7**. As shown in **Table 8-7**, Plan A is estimated to have a total capital improvement cost of around $491,662,000, including all collection system improvements, and all related improvements needed for wastewater treatment and effluent disposal/reclamation.

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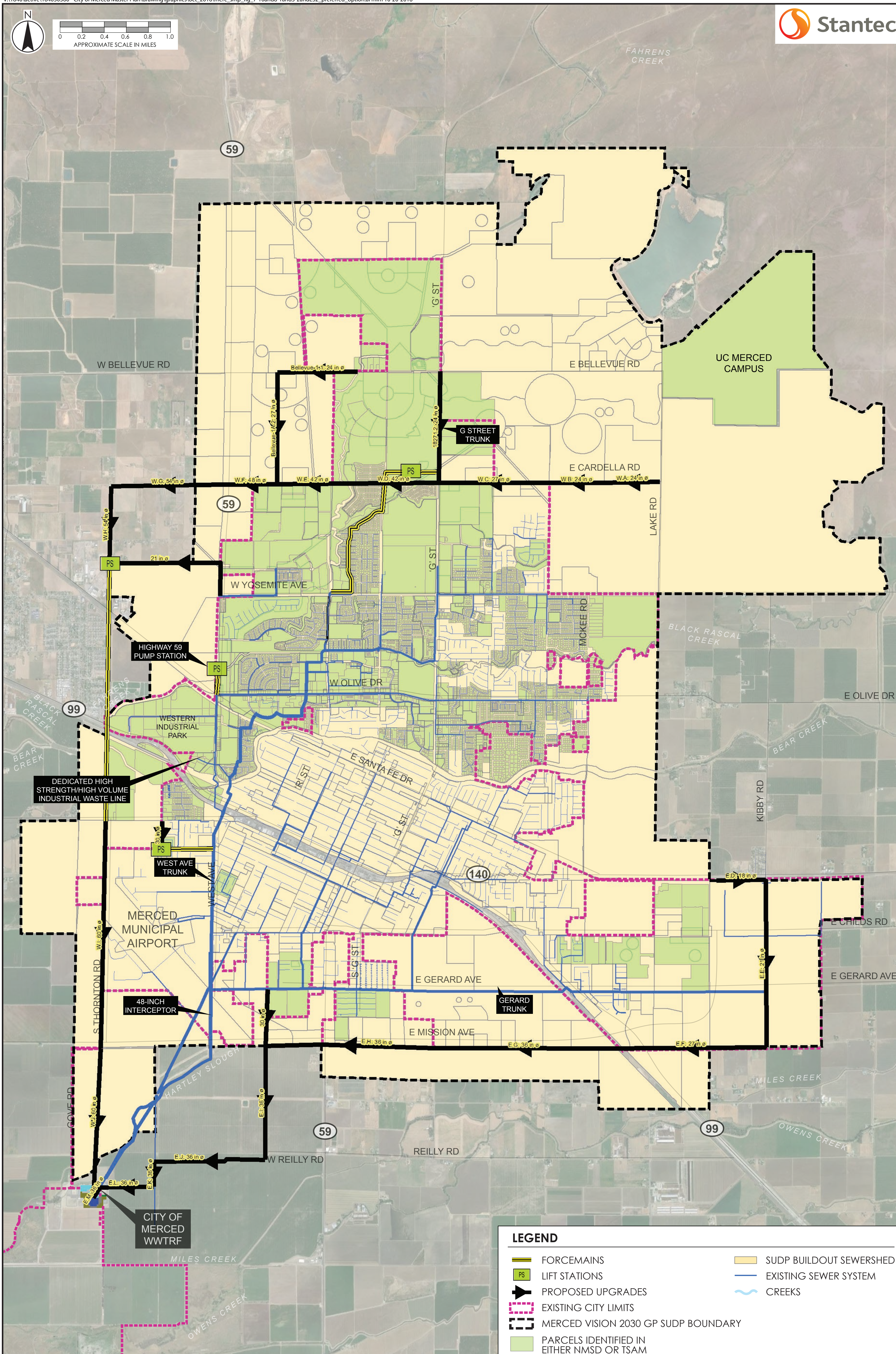

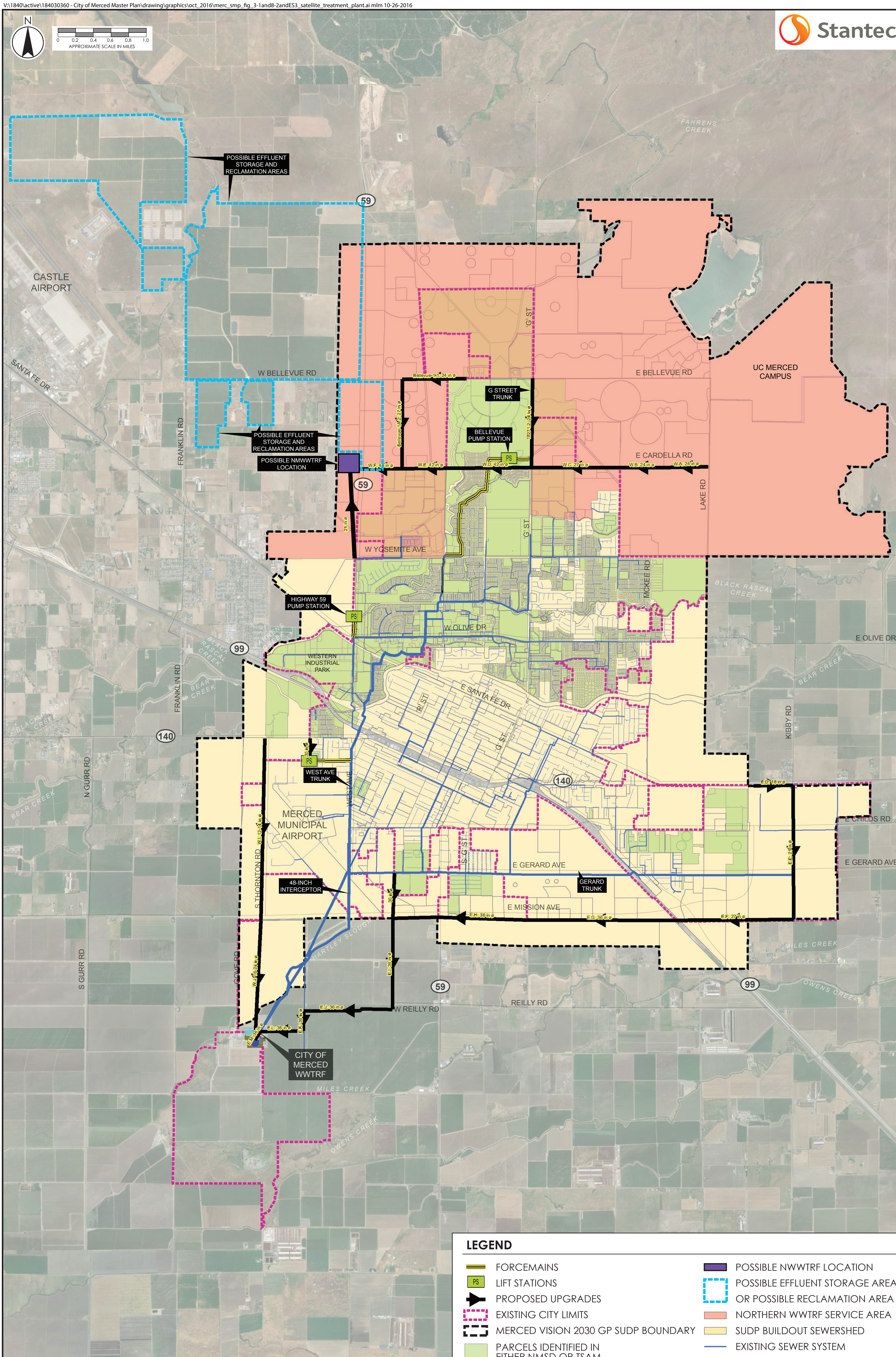
Stantec
APPROXIMATE SCALE IN MILES
POSSIBLE EFFLUENT STORAGE AND RECLAMATION AREAS
CASTLE AIRPORT
W BELLEVUE RD
E BELLEVUE RD
UC MERCED CAMPUS
G STREET TRUNK
BELLEVUE PUMP STATION
POSSIBLE EFFLUENT STORAGE AND RECLAMATION AREAS
POSSIBLE NMWWTRF LOCATION
E CARDELLA RD
LAKE RD
W YOSEMITE AVE
HIGHWAY 59 PUMP STATION
W OLIVE DR
E OLIVE DR
WESTERN INDUSTRIAL PARK
E SANTA FE DR
WEST AVE TRUNK
MERCED MUNICIPAL AIRPORT
E CHILDS RD
E GERARD AVE
GERARD TRUNK
48-INCH INTERCEPTOR
E MISSION AVE
W REILLY RD
REILLY RD
CITY OF MERCED WWTRF
FAHRENS CREEK
BLACK RASCAL CREEK
BEAR CREEK
MILES CREEK
OWENS CREEK
FRANKLIN RD
N GURR RD
S GURR RD
S THORNTON RD
KIBBY RD
MCKEE RD
SANTA FE DR
LEGEND
FORCEMAINS
LIFT STATIONS
PROPOSED UPGRADES
EXISTING CITY LIMITS
MERCED VISION 2030 GP SUDP BOUNDARY
PARCELS IDENTIFIED IN EITHER NMSD OR TSAM
POSSIBLE NWWTRF LOCATION
POSSIBLE EFFLUENT STORAGE AREA OR POSSIBLE RECLAMATION AREA
NORTHERN WWTRF SERVICE AREA
SUDP BUILDOUT SEWERSHED
EXISTING SEWER SYSTEM
CREEKS

Table 8-7 Summary of Capital Improvements Needed for Plan A

Improvements	Opinion of Capital Cost [a]
Trunk Sewers to Serve North Merced, includes ~33 Mgal/d pump station and trunk to WWTRF	$104,738,000
Trunk Sewers to Serve South Merced	$22,808,000
WWTRF Expansion to ~34 to 35 Mgal/d	$364,115,000
Grand Total	**$491,661,000**

(a) Based on ENR-CCI (20 Cities Index) = 10703, June 2017.

There is no question that the existing WWTRF would be permitted by the Regional Water Board (the State's regulatory authority in WWTRF matters) to handle all the City's wastewater flow. With water and its reuse being such a critical planning factor in California, the City has already reached an understanding with Merced Irrigation District (MID) on how increased effluent flows from the existing WWTRF site would be utilized. In summary, the City has completed planning to serve all City growth at the existing WWTRF site. This is a well precedented approach to wastewater treatment and reuse in the Central Valley. The City would need good reason to deviate from its current plan to provide all sewage treatment at the existing WWTRF site, which is remote from town, and requires only one fully integrated team of operators, one reclamation/discharge permit, one set of monitoring and reporting requirements, one set of redundant facilities, one emergency/contingency plan, and only one potential source for regulatory violations, with the associated legal and financial liabilities.

The City's existing WWTRF currently has a permitted Average Dry Weather Flow (ADWF) capacity of 12 Mgal/d, with plans to increase the capacity to 20 Mgal/d to serve 2030 growth needs, and sufficient land to increase the capacity to approximately 34 Mgal/d to serve City buildout, if/when needed. This option of one WWTRF is conventional wisdom followed by many Central Valley cities, including:

- Turlock (20 Mgal/d)
- Visalia (20 Mgal/d)
- Modesto (19.1 Mgal/d)
- Stockton (55 Mgal/d)
- Lodi (8.5 Mgal/d)
- Woodland (10.4 Mgal/d)
- Davis (7.5 Mgal/d)
- Tracy (16 Mgal/d)

- Manteca (17.5 Mgal/d)
- Porterville (8 Mgal/d)
- Lincoln (12.2 Mgal/d)
- Sacramento (181 Mgal/d – which is literally a regional facility combining the treatment and disposal facilities for several small cities in one centralized location)

The only real uncertainty associated with Plan A is the whether the MID water swap which the City has been planning for many years will actually occur and whether it will be a long-term proposition. Plan A is a good, well precedented plan.

8.5.2 Plan B

Wastewater collection system Plan B involves conveying most of the wastewater flow from growth in North Merced to a new NMWWTRF, located on industrially zoned land west of the intersection of W. Yosemite Avenue and Highway 59, and all other wastewater flows to the existing WWTRF site. As envisioned, the Plan B improvements are shown in **Figure 8-2**. The NMWWTRF effluent storage and agricultural reclamation facilities and sites shown in **Figure 8-2** are purely hypothetical, i.e., an example of what the needed effluent storage and reclamation facilities may look like (in the absence of there being project-specific study of the NMWWTRF and its effluent storage and reclamation needs).

Capital improvements needed to implement Plan B are presented in **Tables 8-2** and **8-6**, which are summarized for ease of reference in **Table 8-8**. As shown in **Table 8-8,** Plan B is estimated to have a total capital improvements cost of around $589,910,000, including all collection system improvements, and all related improvements needed for wastewater treatment and effluent disposal/reclamation.

Table 8-8 Summary of Capital Improvements Needed for Plan B

Improvements	Opinion of Capital Cost (a)
Trunk Sewers to Serve North Merced, includes trunk sewer to serve area southwest of State Route 99 along Thornton Road	$30,040,000
Trunk Sewers to Serve South Merced	$22,808,000
WWTRF Expansion to 20 Mgal/d	$122,455,000
New ~14 Mgal/d NMWWTRF (b)	$414,606,000
Grand Total	**$589,909,000**

(a) Based on ENR-CCI (20 Cities Index) = 10703, June 2017.
(b) Includes improvements to provide effluent storage and reclamation/disposal capacity.

The best precedent for two WWTRFs is the City of Roseville, and this best precedent occurred for various reasons, some of which have relevance to the City's situation. Roseville's Dry Creek WWTRF (18 Mgal/d) was becoming land limited and had encroaching residential development around its perimeters. Consequently, Roseville needed a new WWTRF site located near the bulk of Roseville's new development; thus, Roseville's second, newer Pleasant Grove Creek WWTRF (15 Mgal/d) was planned, designed and built. The City of Rio Vista also constructed a second WWTRF. This was done because there was no room at the existing Beach WWTRF to increase the capacity to serve community growth, most of which was in one area that could be served by a new WWTRF (the Northwest WWTRF) in that area.

Merced's existing WWTRF does not have land limitations or residential encroachment problems. Further, unlike the Roseville and Rio Vista examples, which located new treatment and disposal capacity to areas with fewer land use constraints, the Plan B option would actually locate future treatment and disposal/reuse facilities in areas with greater land use constraints and introduce permanent land uses within the SUDP, contrary to the Vision 2030 General Plan.

The regulatory future of a new WWTRF in the North Merced area is less certain, but by no means considered infeasible at this time with what is known. The biggest hurdle to building a new "satellite" WWTRF in northwestern Merced is the need for it to be planned in terms of land area and effluent reuse for build-out (50+ years of development potential) of the North Merced area. This is thought to be an approximately 14 Mgal/d (ADWF basis) WWTRF with local effluent reuse and/or disposal facilities capable of handling these flows through 100-year rainfall conditions. This is not a "satellite" WWTRF, but rather a stand-alone facility larger than the WWTRFs serving many smaller Central Valley cities. There is no pipeline between the two WWTRFs in this scenario, otherwise there is no point to building a new WWTRF. The WWTRF improvements can be made in stages, as needed, but the land needed for full buildout, and the effluent reuse plan for full buildout must be identified and developed upfront. Otherwise, there is the possibility of a pipeline being needed at some future date between the new and existing WWTRFs, and the financial risk posed by that possibility must be borne by the proponents of the new WWTRF, not the City.

Plan B is a good plan. In Roseville, major new growth was planned northeast of the existing city and its existing WWTRF (the "Dry Creek Facility"). Roseville opted to construct a new WWTRF (the "Pleasant Grove Creek Facility" just under 5 miles from the Dry Creek Facility) to serve new growth northeast of town. The current capacities of the Dry Creek Facility and Pleasant Grove Creek Facility are 12 Mgal/d and 18 Mgal/d, respectively. To our knowledge, Roseville has no regrets regarding its decision to build a second WWTRF to serve new growth remote from the existing WWTRF.

In summary, the Regional Water Board would favor permitting a single WWTRF based on its Basin Plan (and Central Valley precedents) unless there is a good reason to build a second WWTRF in the SUDP area. Such "good reasons" exist in the North Merced area that do not exist at the existing WWTRF if the proponents of a second WWTRF are prepared to commit to implementing these good reasons which include:

1. Title 22 tertiary effluent being used for virtually all landscaping in the SUDP area (possibly excluding residential backyards). This option reduces use of the City's potable water supply, but requires installation of "purple pipe" throughout all new SUPD developments, in addition to the distribution system for potable water. Landscape irrigation with effluent in California is well precedented and safe (again, in terms of both public health and property values).
2. Title 22 tertiary effluent being used to recharge the SUDP's heavily utilized groundwater resource. This option would be in concert with SGMA objectives and would augment the SUDP area's groundwater resource (the area's potable water supply).

The foregoing effluent beneficial reuse options are not mutually exclusive. The new WWTRF could implement either or both, and possibly include relatively rare effluent discharges to Fahrens Creek under very wet conditions (as long as said discharges do not exacerbate flooding along the creek).

A proposal to simply dispose of the effluent on land in the greater SUDP area without material beneficial use may not be successful with the Regional Water Board. Simply irrigating land for the sake of evaporating water to the atmosphere is no longer an appropriate effluent disposal plan when other feasible options exist at either the existing WWTRF or a new WWTRF. Besides losing a valuable water resource to the atmosphere, evaporation also leaves the salt naturally present in effluent in the soil, and eventually in the underlying groundwater resource. Evaporation (and vegetative evapotranspiration) also occur with agricultural irrigation and landscape irrigation but with the benefits resulting from these water uses offsetting to some extent the adverse impact of salt accumulation in the soil and groundwater. Even with agricultural irrigation use of effluent, salinity degradation of shallow groundwater is a material concern in lower rainfall areas such as Merced. Consequently, effluent irrigation of land already under irrigated agricultural use is preferred because the historically used irrigation water supply can be used to some extent to reduce salinity impacts on groundwater. Recent aerial satellite images of agricultural land use in the greater SUDP area suggest that historically irrigated lands exist approximately one mile northwest on a logical candidate site for a new WWTRF serving the North Merced area.

8.6 A COMPARISON OF PLANS A AND B

When comparing wastewater collection system needs under Plan A (**Figure 8-1**) to the wastewater collection system needs under Plan B (**Figure 8-2**), it becomes evident that there is one major similarity and four major differences between these two plans, as summarized below.

Similarities:

S-1. The wastewater collection systems servicing North Merced and the rest of the City are exactly the same under both plans, except that under Plan A, the North Merced sewer system leads to a pump station conveying the wastewater to the existing WWTRF, whereas under Plan B, the North Merced sewer system leads to a pump station (in essentially the same location as Plan A) lifting the wastewater into the new NMWWTRF.

Differences:

D-1. Plan A builds a pipeline between the North Merced pump station (see S-1, above) and the existing WWTRF, whereas Plan B does not.

D-2. Plan A expands the existing WWTRF, whereas Plan B builds a new NMWWTRF on industrially zoned land adjacent to the North Merced pump station (see S-1, above).

D-3. Plan A expands effluent disposal capacity at the existing WWTRF, whereas Plan B builds a new effluent disposal facility in the greater North Merced area. The new effluent disposal/reuse area could occupy up to approximately 5,200 acres of land under build-out conditions. Effluent reuse is envisioned to entail irrigation of agricultural crops in this WCS Master Plan in the absence of there being any other plan for NMWWTRF effluent at this time.

D-4. Plan B facilitates effluent reuse in the North Merced area, and therefore has the potential to reduce agricultural use of groundwater in the area, which is over-utilized at this time.

Because actual wastewater collection system needs under Plan A and Plan B are very similar, a comparison of Plan A and Plan B is presented in **Table 8-9** to help avoid confusion as to the major and material differences between these two plans.

Table 8-9 Differences Between Plan A and Plan B

Major Differences	Plan A	Plan B
D-1. Raw sewage pipeline from North Merced to existing WWTRF	Yes Approximately 2.5 miles of dual 24 and 36-inch forcemains and approximately 2 miles of 60-inch diameter gravity sewer	No
D-2. WWTRF Needs	Expand existing WWTRF to approximately 35 Mgal/d, as needed.	Build new approximately 14 Mgal/d NMWWTRF, and expand existing WWTRF to approximately 20 Mgal/d, both as needed.
D-3. Effluent disposal needs a. Land b. Storage c. Conveyance pipe	 a. None b. None c. None	 a. Up to ~4,200 acres b. Up to ~1,000 acres c. Approximately 2 miles to ag land north of Bellevue Road and west of Highway 59
D-4. Effluent reuse potential	Indirect via MID (Merced Irrigation District)	Indirect via MID and direct from NMWWTRF to ag land in/near North Merced area

Because the wastewater collection system improvements needed under Plans A and B are virtually identical except as noted under "D-1" of **Table 8-9**, the City Council's decision regarding which wastewater collection system plan to implement will be based more on wastewater treatment and disposal/reuse issues (and associated costs) than on wastewater collection issues (and associated costs). Besides these differences and their costs, the City Council's decision will also be based on many other considerations including recommendations from City staff, City consultants, the general public, and various special interest groups; water resource planning considerations; economics; political considerations; specific service area needs/objectives; etc. Much of the information that will be before the City Council at the time of its decision, is in a state of flux or unknown to Stantec as of preparation of this WCS Master Plan. Without complete information, it is premature for Stantec to make a firm recommendation regarding implementation of Plan A or B. However, Stantec believes the City is owed a preliminary recommendation based on information available today that provides the City and City Council with an approach to making the final decision, when needed, based on the information, comments, and input that will be available at that future time.

An important consideration in the City Council's final decision regarding Plan A and Plan B is cost and cost differences between Plan A and Plan B. As will be discussed, the costs and cost differences between Plan A and Plan B are dependent on many factors, including whether the City plans to implement extensive effluent reuse via agricultural irrigation in the North Merced area to reduce agricultural use of the North Merced groundwater resource. This groundwater resource serving the City, agriculture, and other uses in the greater Merced area is currently over-utilized and therefore the water table is declining. Extensive agricultural reuse of effluent in the North Merced area could reduce agricultural use of the groundwater resource, and thereby help sustain the City's potable water supply.

When put in those terms, without benefit of a more complete understanding of City water resource planning, it may seem irresponsible to not implement Plan B and associated effluent reuse in North Merced. However, the City has engaged in extensive water resource planning to help stabilize the declining groundwater table and sustain the City's potable water supply. The most significant planning relative to this WCS Master Plan is between the City and Merced Irrigation District (MID) to swap effluent water from the existing WWTRF for Merced River water to be used to 1) recharge the area's groundwater resource, and 2) irrigate parks and other City landscaping (in place of using groundwater).

In summary, not necessarily planning to implement effluent reuse in the North Merced area does not mean the City is ignoring the declining groundwater resource issue. It means the City is attempting to address the issue via different means involving use of lower salinity and lower nitrogen content Merced River water rather than tertiary-treated effluent. This is important because the two most common contaminants of concern in groundwater resources are salinity and nitrogen. With this insight, one may ask, "Why even consider effluent reuse in North Merced when better quality water is available?" The answer is reliability. The City has greater control over an effluent reuse program than over a water swap program involving MID and parties impacted by changes in Merced River flows and/or diversions. This is why the City continues to consider effluent reuse in the North Merced area.

In so far as Plan A and Plan B both include effluent reclamation and groundwater resource considerations, the choice between Plan A and Plan B is primarily a matter of economics from an engineering perspective. Specifically, is the overall life cycle cost of Plan A more or less than the overall life cycle cost of Plan B? Life cycle costs cover the upfront cost of building the infrastructure (the primary concern of developers, who typically pay this bill when assessment districts are not involved), and the present worth of the on-going annual costs necessary to operate, maintain, and ultimately rebuild the infrastructure (the primary concern of businesses and residents, who pay these bills after occupying the developers' projects). The desires for low, up-front construction costs versus low, long-term annual costs are generally competing interests. The City's objective is to act as the fair deal broker between these two special interest groups, who are both essential to City growth.

Stantec's reconnaissance opinion of probable costs to implement Plan A and Plan B is presented in **Table 8-10.** Major uncertainties (known to exist at this time) associated with each plan are presented in **Table 8-11**. Schematics of the relative locations of infrastructure needs itemized in **Table 8-10** for Plan A and Plan B are shown in **Figure 8-1** and **Figure 8-2**, respectively.

Under Plan A, wastewater treatment, disposal, and reuse are expansions in-kind of existing facilities and permits. Much of the effluent is planned to be swapped for Merced River water, as described previously. Under Plan B, effluent disposal from the new NMWWTRF is envisioned to entail dry season effluent irrigation of agricultural land under City ownership (effluent disposal facilities should be as permanent [i.e., secure] as the developments they serve), wet season storage of effluent for subsequent use during the following dry season, and possibly wet season effluent discharges to Fahrens Creek under very wet conditions when Fahrens Creek is both below flood stage, and has adequate flow to dilute effluent discharged to it (if realistic under CEQA and permitted by the Regional Water Board). As to whether effluent produced by NMWWTRF under Plan B could be swapped for MID surface water (as is proposed under Plan A) is unknown at this time. Plan B should reduce use of North Merced area groundwater for agricultural purposes, but this is not an established fact at this time because the agricultural lands that would be used for effluent reclamation have not been identified by the City, let alone acquired. Because the actual types, locations, and feasibilities of the new NMWWTRF effluent facilities have not been developed by the City, subjected to CEQA analyses, permitted by the Regional Water Board, etc., the **Table 8-10** costs for Plan B NMWWTRF effluent facilities are based solely on Stantec's judgement and experience with somewhat similar facilities in the Central Valley.

As shown in **Tables 8-10** and **8-11**, Plan A is believed to have a lower life cycle cost and fewer uncertainties than Plan B. Plan A's effluent is proposed by the City to be swapped for MID surface water; Plan B's effluent may not have this potential benefit. Plan A is well precedented by similar sized cities throughout the Central Valley, and is in concert with Regional Water Board policy to regionalize WWTRFs to the extent feasible rather than have multiple WWTRFs servicing geographically contiguous areas. Based on available information, Stantec's preliminary recommendation is to implement Plan A, primarily for cost and water resource planning reasons. In other words, Stantec's preliminary recommendation is to pipe all municipal wastewater to the existing WWTRF for treatment, disposal, reuse, and water swapping.

Table 8-10 Reconnaissance Opinions of Probable Life Cycle Costs to Implement Plan A or Plan B (a)

Infrastructure Components Relevant to Overall Wastewater Utility Costs	Probable Total Project Costs, (b)	
	Plan A	Plan B
1. Trunk sewers and associated pump stations:		
1.1. North Merced	$17,420,000	$17,420,000
1.2. South Merced	$22,808,000	$22,808,000
1.3. North Merced to WWTRF	$87,318,000	$12,620,000
Pipe and Pump Subtotal	**$127,546,000**	**$52,848,000**
2. WWTRF:		
2.1. New construction at existing WWTRF (Plan A – 22 Mgal/d, Plan B – 8 Mgal/d)	$364,115,000	$122,455,000
2.2. New NMWWTRF (secondary treatment)	$0	$222,248,000
Treatment Subtotal	**$364,115,000**	**$344,703,000**
3. Effluent Storage, Disposal, Reclamation		
3.1. Improvements at NMWWTRF:		
3.1.1. Planning, permitting, CEQA, etc.	$0	$1,000,000 (c)
3.1.2. Pump station and forcemain to storage	$0	$6,532,000 (d)
3.1.3. Effluent storage (9,300 AF)	$0	$145,080,000 (e)
3.1.4. Pump station and forcemains from storage to agricultural fields	$0	$6,532,000 (d)
3.1.5. Upgrades to agricultural fields (3,500 acres) for effluent reuse	$0	$30,916,000 (f)
3.1.6. Land purchase expenses (Storage and NMWWTRF site)	$0	$2,298,000 (g)
Effluent Related Subtotal	**$0**	**$192,358,000**
Subtotal of Infrastructure Costs	**$491,661,000**	**$589,909,000**

(a) Extensive unrestricted effluent reuse (installation of a purple pipe network) in North Merced will not be implemented.
(b) ENR-CCI (20 cities) = 10703, June 2017, an estimate of the construction inflation index at the mid-point of project construction. Construction costs include 20% for Engineering and Administration and a 30% contingency factor.
(c) Assumes $500,000 for new WDRs for NMWWTRF, $200,000 for resource permitting (wetlands, ESA, etc.) and $300,000 for CEQA documentation.
(d) Assumes 3 miles of transmission main total from WWTRF to effluent storage to reclamation area (ag fields).
(e) Assumes $11,000 per AF of storage.
(f) Assumes $5,000 per acre for effluent distribution mains from transmission main and improvements to ag fields, including tailwater return, fencing, signage, laser leveling, etc.
(g) Land purchase includes 35 acres for NMWWTRF and 730 acres for effluent storage (assumed 14 feet effective depth) @ $3,000 per acre. No cost is included for agricultural fields or for right of way acquisition for trunk sewers or pump stations.

Table 8-11 Major Uncertainties Associated with Plan A and Plan B

Uncertainties	
Plan A	• Will water swap with MID occur and be a long-term proposition?
Plan B	• Does the City wish to devote 35 acres of industrially zoned land for the new NMWWTRF? Will the presence of a major WWTRF in the industrial park discourage other industries from locating there, particularly food processing industries? • Which agricultural lands in the greater North Merced area will become part of the NMWWTRF effluent reclamation system, and how/when will those lands be secured for City use under build-out conditions? • Will CEQA analyses and/or Regional Water Board permitting present any roadblocks to implementing Plan B either near-term or long term? • Will Plan B help or hinder maintenance of the quantity and/or quality of the City's groundwater potable water supply?

In making that preliminary recommendation, Stantec believes both Plan A and Plan B are good plans, there is no bad choice. Merced-sized cities with two WWTRFs are relatively rare in the Central Valley, but do exist.

When considering the contents of this WCS Master Plan, likely questions are "Why not recommend this approach…or that approach?" A very brief discussion of some collection system options raised by special interests that have not been carried forward in this WCS Master Plan as being feasible for the City on a long-term, permanent basis are presented below.

1. Why not install wastewater flow equalization basins in the collection system to utilize the existing "sewers" more efficiently, and more cost effectively?

   Such basins are possible, but storing raw sewage for flow equalization purposes, in practice, is almost entirely limited to WWTRF sites. Such basins are rare in residential developed areas, behind industrial parks, etc. This is because raw sewage equalization basins they are ugly, a potential nuisance, and maintenance headaches. Such basins have aeration equipment (to minimize smells), have automatic wash-down systems (to scour "solids" from the basin when not in use), and may need a cover or other visual screening, noise attenuation, and/or odor scrubbing equipment (depending on situation-specific factors). Raw sewage flow equalization basins should not be a planned permanent component of a wastewater collection system (except in rare situations not applicable to Merced); however, such basins may be considered on a temporary basis (with specific closure criteria and financial guarantees) in specific situations authorized by the City Council. The entire cost of such a basin, if approved by the City Council, should be borne and bonded by the basin proponent, and in no way, reduces the proponent's fees for building the permanent wastewater collection system, which will be exactly the same regardless of whether the City Council permits temporary use of such a basin to expedite a specific development that otherwise would be on hold until sewer system capacity is built to meet the development's needs.

2. Why not allow larger, planned community developments to build their own wastewater collection, treatment, and effluent reuse systems? We could save the cost of those big trunk sewers, and implement effluent reuse, and expedite development all at the same!

   This approach to implementing wastewater infrastructure reduces upfront construction costs (paid by developers) and increases long-term annual costs (paid by residents and businesses) because of loss of economy of scale on at least operations and maintenance, if not also construction when total construction costs are considered. As an example of total construction costs, such systems need places to store effluent within the planned communities through 100-year rainfall seasons. In this example, each planned community may plan to build an ornamental lake for seasonal tertiary effluent storage, but problems with such lakes are manifold. The lake's water level must be able to rise and fall seasonally because the only lake volume that counts as 100-year effluent storage is the volume of the lake that is empty each autumn. Algae that naturally grow in tertiary effluent lakes can be chronically problematic. The lake may need aeration, circulation, and chemical controls. Following construction and filling of ornamental lakes, midge populations can explode to nuisance levels until the natural ecology of the lake has time to develop (typically in a year or two). Such small, project-specific wastewater systems are difficult to permit with the Regional Water Board because they run contrary to Board policy, which was developed because the long-term track record of multiple small systems has been relatively poor. If/when such systems fail, the City will be responsible for correcting the failure. This is because the development is within the City, and the City permitted it to occur. Because the wastewater collection system was not planned for these "self-sufficient" planned community developments, the City will either reconstruct the wastewater collection system, or continue to rebuild and operate the small systems to prevent the planned community development from being condemned for health and safety reasons. However, as with the raw sewage equalization basins, temporary small wastewater systems (with specific closure criteria and financial guarantees) could be authorized by the City Council in specific situations to address specific development needs. The entire cost of the temporary system should be borne and bonded by the system proponent. The proponent still pays upfront for proponent's share of the permanent wastewater collection system and treatment facilities. The proponent still designs the development's collection system to tie into the permanent City trunk sewer by gravity flow when that trunk sewer reaches the development. Because the City has General Plan Policy UE-1.2 to maintain development in a compact urban form, any proposal for a temporary, development-specific wastewater treatment and reuse system should be located on the perimeter of existing City-served developments (e.g., on the edge of the City, or SUDP area) with the only hindrance to connecting to the City system being lack of capacity in the existing City wastewater collection system at the time the development desires to move forward.

The Regional Water Board is not expected to approve any small systems unless they are operated by the City, and are temporary (with specific and enforceable closure criteria and financial guarantees). Because of the poor economy of scale of operating and maintaining small WWTRFs, the annual costs (as reflected by monthly sewer use fees) for users of these small systems will be higher than normal City wastewater fees. As a matter of policy, the City Council (when approving any such temporary system) will need to decide whether the businesses and residents served by the temporary system pay higher monthly sewer use fees, or whether they pay the City's normal use fee with the system proponent covering the cost difference until the businesses and residents connect to the permanent City system.

Raw sewage equalization basins and development-specific WWTRFs are suggestions put forth by developers to reduce their infrastructure costs and/or to facilitate implementation of their developments that are on-hold because of the need for City wastewater infrastructure. Neither suggestion is recommended as a permanent facility; therefore, neither suggestion impacts the design or cost of Plans A, or Plan B, should However, the City Council may wish to consider allowing developer use of elect to permit temporary raw sewage equalization basins and/or development-specific WWTRFs on a project-specific basis for situation-specific reasons, e.g., to facilitate development critically needed by the community. If the City Council desires to consider temporary means to facilitate critically needed development, then Stantec recommends that the City develop an Implementation Plan describing use of and design criteria for temporary facilities.

8.7 RECOMMENDED WCS PLAN

Finally, this WCS Master Plan concludes with a summary of recommended collection system improvements. As described herein, the City is advised to pursue the collection system planning associated with Plan A described in Section 8.0. Those are summarized in **Tables 8-1**, **8-2**, and **8-3**.

Existing system deficiency improvements are summarized in Sections 7.3.1, 7.4.2, and 8.1. The recommended improvements to serve the Vision 2030 General Plan SUDP are described in Sections 7.3.3, 7.4.1 and 8.5.1. **Figure 7-10** and **Figure 8-1** illustrate the recommended collection system improvements to serve SUDP build-out. Additional effort will be required to provide environmental clearances, design and to finance construction of the recommended improvements. The City is currently pursuing establishment of an assessment district to fund the recommended trunk sewer improvements.

In addition to significant improvements to the existing trunk sewer system and proposed new trunk sewers to serve SUDP growth, the City has also established a plan for ongoing repair and replacement (R&R) of the existing collection system assets. The City's planned expenditures on this R&R program and for addressing existing system deficiencies (summarized in **Table 8-1**) over the next five years is presented in **Table 7-6**.

APPENDICES

Appendix A MERCED WWTF INDUSTRIAL WASTE ACCEPTANCE EVALUATION

Merced WWTF Industrial Waste Acceptance Evaluation

Summary Report

Prepared for:
City of Merced

Prepared by:
Stantec Consulting Services Inc.
Rocklin CA

May 6, 2014

Draft

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Executive Summary

Why is a decision matrix needed?
The City of Merced is interested in attracting industrial enterprises to locate industrial processing facilities in the Merced service area. Though new industries provide economic benefits, connecting a new industry to the City's sewer collection system can have a number of impacts on collection system maintenance and wastewater treatment facility (WWTF) operation. A decision matrix has been developed to delineate probable impacts on the WWTF and to provide a framework for addressing potential issues related to attracting new industrial wastewater discharges.

How was the decision matrix developed?
The following items were taken into consideration in the development of the decision matrix:

- EPA's industrial pretreatment regulations
- City's wastewater ordinances
- WWTF design parameters and discharge permit
- Recent WWTF influent flows and loads
- Wastewater characteristics of potential industries desired in the Merced area
- Projected population growth and sewer commitments made by the City to UC Merced

What are the potential consequences (based on other case studies) of accepting industrial wastewater without adequate scrutiny?

- Overloading of treatment processes, resulting in permit compliance issues
- WWTF discharge permit compliance issues with specific constituents of concern (e.g., salinity, heavy metals, and priority pollutants), resulting in fines
- Clogging of sewer pipes, resulting in sewer overflows and higher maintenance costs
- Sludge settleability issues in clarifiers, resulting in permit compliance issues
- Foaming of anaerobic digesters, resulting in higher solids handling costs and a need for larger solids handling facilities
- Using existing treatment capacity that is currently dedicated to future residential development, resulting in the need to build new treatment facilities to accommodate future residential growth

With regards to the City of Merced, what are key industrial wastewater discharge parameters that need to be considered when evaluating potential new industrial wastewater?

- Salinity (Total dissolved solids [TDS] or salts), heavy metals, and priority pollutants
- BOD (Biochemical oxygen demand), i.e., organics
- TSS (Total suspended solids), i.e., particulates
- Flow rate

What are the significant aspects with regards to Salinity, Metals and Priority Pollutants?
The City is currently compliant with permitted discharge limits on TDS/Salinity, heavy metals, and priority pollutants present in the WWTF effluent. However, if not controlled, the new industrial discharges could increase the effluent concentrations of these constituents above discharge limits, requiring expensive

mitigation steps (such as reverse osmosis treatment). Therefore, it is recommended that the City conduct adequate review of new discharges before approval, and implement regular monitoring to ensure continued compliance with the City's pretreatment requirements.

Why is BOD the most important parameter when evaluating new industrial wastewater discharges?

The following factors make BOD the most important parameter when evaluating industrial wastewater:

1. Potential industries in the Merced area are expected to be mainly food and dairy based industries, which (by the nature of their business) have high BOD concentrations;
2. Recent drought and various water conservation measures have increased the BOD concentration in the domestic wastewater coming into the WWTF as a result of customers using less water.
3. Increases in WWTF BOD loading have the potential to overwhelm the City's existing treatment processes, and increase the possibility of permit violations
4. Accepting BOD from industrial wastewater dischargers reduces the WWTF ability to treat BOD loads from future residential wastewater and therefore limits the amount of resident population growth it is possible to serve with the existing treatment facility.

Could you provide a snapshot of BOD capacity at the WWTF?

Description	Value
WWTF Design BOD Load[(a)]	28,200 lb/d
Approximate Current WWTF BOD Load[(a)]	21,000 lb/d
Approximate BOD Capacity Committed to UC Merced	1,200 lb/d
Currently Uncommitted WWTF BOD Capacity	6,000 lb/d (21% of design)
Approximate BOD Loading per EDU[(b)]	0.664 lb/d
Approximate Future Population Growth that can be Supported from the Remaining BOD Capacity	27,270 pop. 9030 EDU[(b)]

a) Estimated based on max month BOD loading to WWTF

b) 3.02 persons/EDU (Equivalent Dwelling Unit)

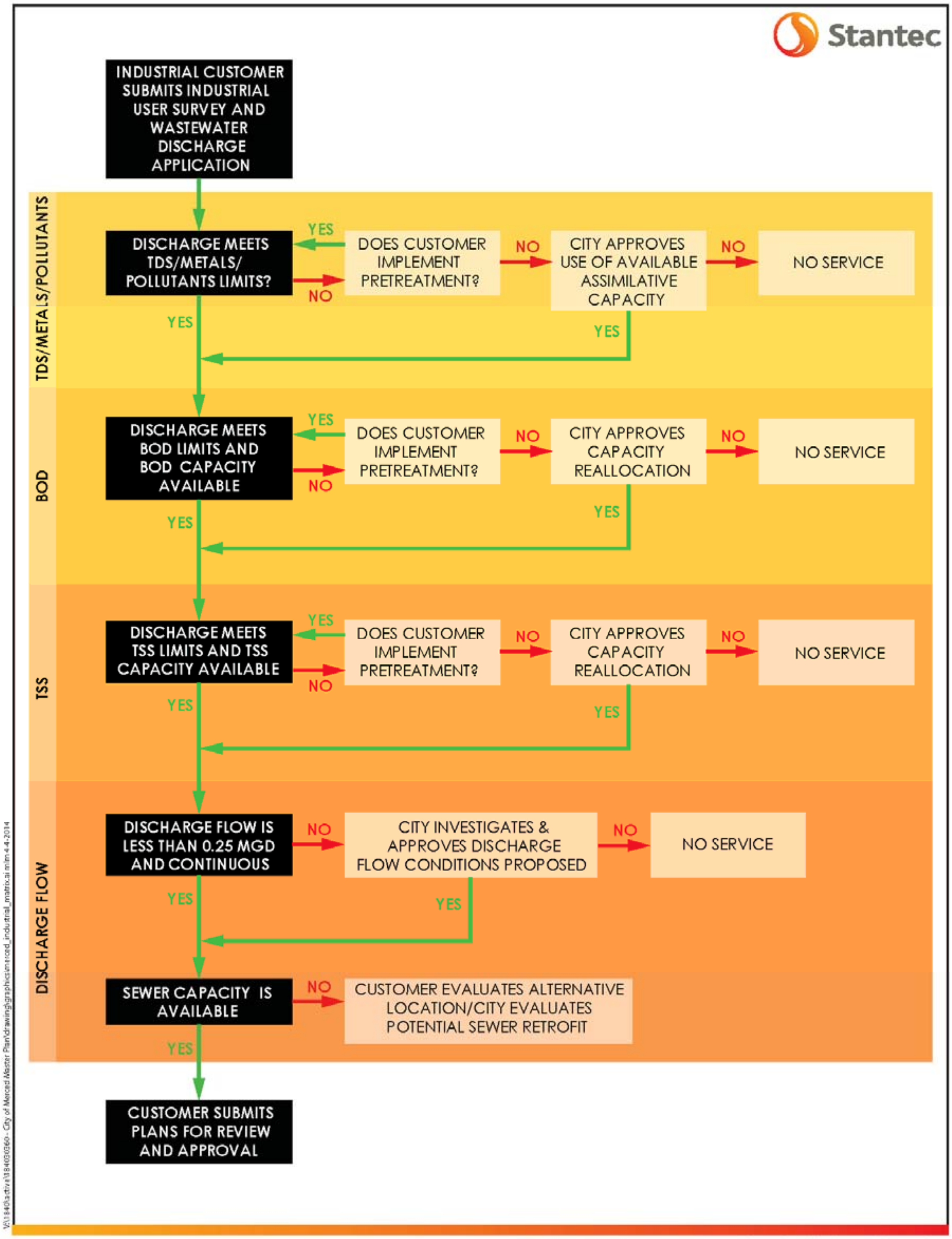
What are innovative approaches to address BOD load from industrial wastewater?

1. Onsite pretreatment at the industrial facility
2. Diversion of low flow wastewater with very high strength BOD directly to WWTF digesters
3. Construction of common industrial wastewater treatment facilities as implemented by the Cities of Lathrop, Tulare and others
4. City reallocates available WWTF BOD capacity to industries for short-term purposes and plans for next WWTF expansion, to accommodate future population growth.

What happens when an industrial discharge has elevated TSS levels?

Elevated TSS loads from industrial wastewater discharges will increase the loading on the primary clarifiers and digesters at the WWTF. If higher TSS is expected, industry can implement a pretreatment step to reduce the amount of particulates. Pretreatment for TSS is expected to be relatively simple when compared to BOD pretreatment, in general.

Does the City WWTF have required hydraulic (flow) capacity to accommodate industrial flow?
Due to recent water conservation efforts, the per capita wastewater flow from residences appears to be lower than per capita flows observed at the time of WWTF design. The drop in residential wastewater flows is also being observed by various nearby cities. Therefore, additional flows from industrial discharges may not pose a significant issue to the available sewer capacity necessary to convey the wastewater from the proposed industrial location to the WWTF. However, this characteristic of any proposed industrial wastewater discharge must be adequately evaluated by the City prior to committing to service.



Merced Industrial Wastewater Acceptance Decision Matrix

Abbreviations

BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
EC	Electrical Conductivity
EDU	Equivalent Dwelling Unit
FOG	Fats, Oils and Grease
gpd	Gallons per day
Lb/d	Pounds per day
Mgal	Million Gallons
Mgal/d or MGD	Million gallons per day
RO	Reverse Osmosis
SS	Suspended Solids
TDS	Total Dissolved Solids (Salinity)
TSS	Total Suspended Solids
UC	University of California
WQO	Water Quality Objective
WWTF	Wastewater Treatment Facility

1.0 INTRODUCTION

The City of Merced is interested in attracting industrial enterprises to locate industrial processing facilities in the Merced service area. These predominantly include food and dairy processers. Though new industries provide economic benefits, they may also require upgrades to the City's existing water, sewer, and road infrastructure. Connecting a new industry to the City's sewer collection system can have a number of impacts on collection system maintenance and WWTF operation. Some of the impacts that are widely reported by other facilities in the region include: 1) clogging of sewer pipes, 2) overloading of treatment processes, 3) sludge settleability issues, 4) foaming of anaerobic digesters, and 5) permit compliance issues. These potential adverse impacts can be avoided or minimized through effective implementation of the City's recently adopted industrial pretreatment program and by evaluating specific industrial discharges prior to approval.

2.0 OBJECTIVES

Following are the objectives of the Industrial Wastewater Acceptance Evaluation (IWAE):

1. Review City industrial pretreatment and wastewater ordinance;
2. Review current wastewater treatment facility (WWTF) flows, loads, and assimilative capacities;
3. Survey the wastewater characteristics of potential industries desired in the Merced area;
4. Conduct impact and benefit analyses; and
5. Develop an industrial waste acceptance decision matrix.

3.0 REVIEW OF CITY ORDINANCES

The recently adopted industrial pretreatment ordinance provides the City with a framework for evaluating and accepting industrial wastewater discharges. Hypothetical examples of sewer connection fees and capacity and user charges specified in the ordinance are shown in Table 1.

Table 1 Projected Fees and Monthly Charges from Potential New Industrial Users

Description	Industry #1 (Centralized Food Prep Facility)	Industry #2 (Dairy Facility with Pretreatment)	Industry #3 (Food Processor)
Requested Flow Capacity, gal/d	49,600	150,000	10,000
Estimated BOD Load, lb/d	320	626	500
Estimated TSS, lb/d	95	125	167
Connection Charges[(a)]			
Flow	$ 666,624	$ 2,016,000	$ 134,400
BOD	$ 645,760	$ 1,262,259	$ 1,009,807
TSS	$ 167,390	$ 220,426	$ 293,902
Total Connection Charges	**$ 1,479,774**	**$ 3,498,685**	**$ 1,438,109**
Monthly Charges			
Usage Charges[(b)]			
Flow	$ 1,464	$ 4,428	$ 295
BOD	$ 5,078	$ 9,927	$ 7,941
TSS	$ 1,872	$ 2,466	$ 3,288
Account Charges	$ 24	$ 24	$ 24
Total Usage Charges	$ 8,439	$ 16,844	$ 11,548
Capacity Charges[(b)]			
Flow	$ 539	$ 1,631	$ 109
BOD	$ 1,018	$ 1,989	$ 1,591
TSS	$ 494	$ 651	$ 867
Total Capacity Charges	$ 2,051	$ 4,270	$ 2,567
Monthly Usage & Capacity Charges	**$ 10,490**	**$ 21,114**	**$ 14,115**
Annual Usage & Capacity charges	**$ 125,875**	**$ 253,373**	**$ 169,383**

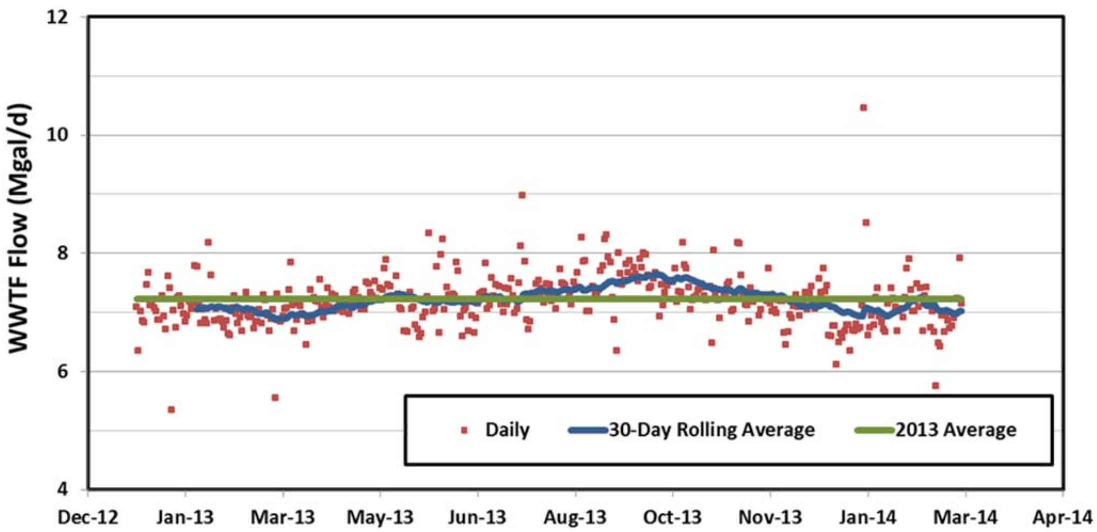
(a) City of Merced Code of Ordinances, Title 15, Chapter 15.16 – Facilities Charges.

(b) City of Merced Code of Ordinances, Title 15, Chapter 15.12 - Service Charges.

4.0 REVIEW OF WWTF CURRENT FLOWS AND LOADS

Merced WWTF flow, BOD and TSS data for the months of January 2013 through February 2014 were analyzed. Influent flowmeter readings were found to be inconsistent in a few cases. Therefore, effluent flowmeter readings (adjusted to reflect WWTF water losses) were used for the analysis. A summary of WWTF flowrate is presented in Figure 1.

Figure 1 WWTF Flow (Jan 2013- Feb 2014)



A summary of WWTF influent BOD loading is presented in Figure 2. As shown in Figure 2, average BOD loading to the WWTF is about 16,100 lb/d. The estimated maximum month BOD loading is projected to be about 21,000 lb/d. Very high influent BOD concentrations were observed during May 2013. A detailed analysis is recommended to determine the reasons for very high BOD events. Average influent TSS loading to the WWTF is about 17,000 lb/d. as shown in Figure 3. The estimated maximum month TSS loading is projected to be 20,000 lb/d.

Figure 2 WWTF BOD Loading

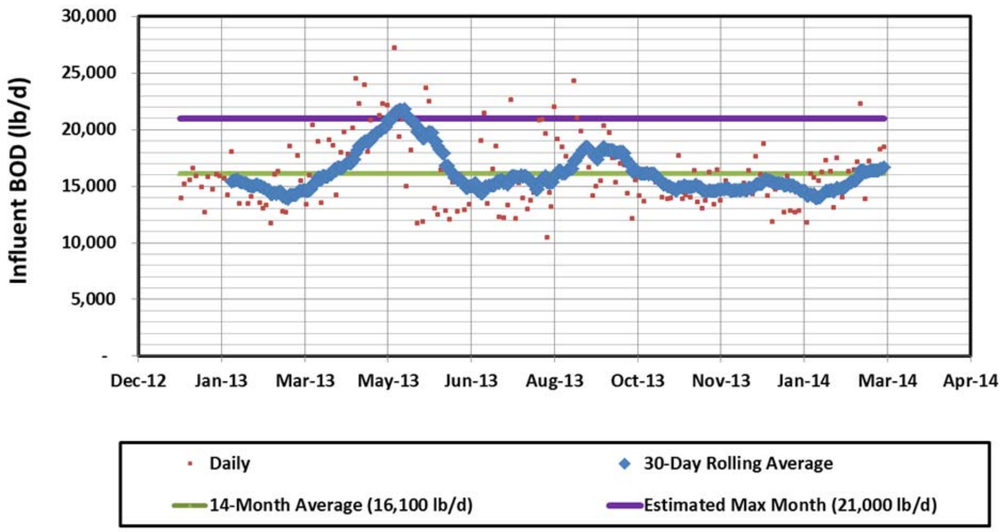
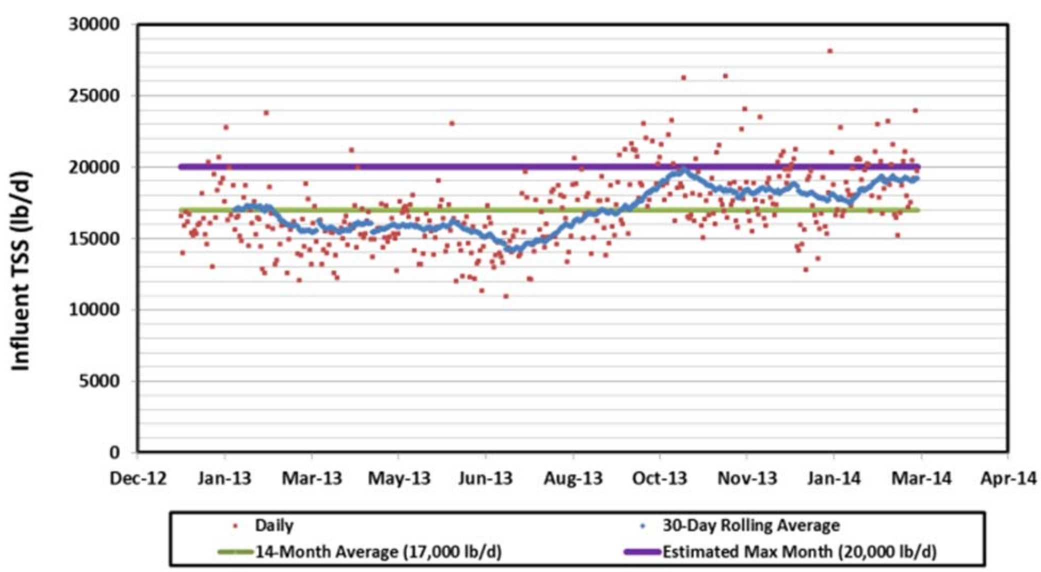


Figure 3 WWTF TSS Loading



5.0 POTENTIAL INDUSTRIAL CHARACTERITICS

A complete flow and load characterization of the proposed industrial wastewater discharge is required to evaluate its impacts on the sewer system and WWTF operation. Because there are no actual wastes from a proposed industry before the fact of construction and operation of the industry, potential industrial user profiles have been compiled (see Table 2) for new industries desired in Merced. These were identified based on a literature survey.

Table 2 Typical Wastewater Characteristics from Nearby Food Processing Industries

Evaluation of Potential Industrial Waste Characteristics						
	Description	**Unit**	**Industry 1**	**Industry 2**	**Industry 3**	**Industry 4**
Location & Size	**Location**	-	City of Newman, CA	Sonoma County , CA	Lynden, WA	Sonoma County, CA
	Type	-	Dairy - Cheese	Dairy - Cheese	Dairy - Various Products	Beverage - Wine
	No. of Employees	-	± 113	± 11	± 65	± 100
Flow	**Max Flow**	**gal/day**	± 300,000	8,300	221,700	217,500
	Average Flow	**gal/day**	± 300,000	3,500	158,200	38,640
BOD	**Average BOD**	**mg/L**	1,700	4,515	525	2,140
TSS	**Average TSS**	**mg/L**	-	1,107	200	304
COD	**Average COD**	**mg/L**	-	9,240	-	3,865
EC	**EC Range**	**umhos/cm**	3,600 - 3,700	-	-	-

6.0 PLANNED INDUSTRIAL GROWTH AROUND MERCED AREA

The Merced Vision 2030 General Plan has identified three areas for potential industrial activities (see Appendix A):

- Western Industrial Area
- Santa Fe Industrial Area
- Airport Industrial Area

Industrial development near the airport is not preferred due to potential risks from airport activities and allocation of available space for potential airport regionalization and expansion. The averages and wastewater flow potential of the remaining identified industrial areas are summarized in Table 3.

Table 3 Industrial Area Summary

Industrial Areas (Based on Merced Vision 2030 General Plan Land Use Map)	
Western Industrial Area - South (Previous & Existing Industrial Dischargers), acres	287
Western Industrial Area - North abutting Hwy 59, acres	426
Santa Fe Industrial Area abutting Hwy 140, acres	1014
Miscellaneous Industrial Area abutting Hwy 99, acres	217
Total Industrial Area (Excluding Airport Industrial Park), acres	**1944**
Flow Projection	
Estimated Industrial Land Use Flow, gpd/acre (from Master Plan)	2000
Estimated Industrial Flow at Build out, MGD	**3.9**

As the southern portion of the Western Industrial Area has been utilized for some time by industries, there is an existing separate 14" fiber reinforced plastic (FRP) industrial wastewater pipeline from this area to the WWTF. Therefore, industrial development of and repurposing of remaining space in the Western Industrial Area is recommended. This has advantage of not requiring additional capacity in the existing Collection System in addition to other utilities already being in place to serve this area. Western Industrial Area industries and current discharge flows are summarized in Table 4.

Table 4 Summary of Existing Industries in Western Industrial Area South

Planning Max Month Flow Estimates Based on Land Use Planning:	
Approximate Total Western Industrial Area South Acreage, acres	287
Design Industrial Land Use Flow, gpd/acre	2,000
Planned Max Month Industrial Flow, gpd	**574,000**
Existing Dischargers:	
Estimated Max Month Daily Flow – Industry 1, gpd	91,400
Max Month Daily Flow – Industry 2, gpd	103,400
Max Month Daily Flow – Industry 3, gpd	14,800
Max Month Total Daily Flow (worst-case), gpd	**209,600**
Capacity Available for Future Western Industrial Area Dischargers:	
Expected Industrial Flow from New Dischargers, gpd	**364,400**

7.0 INDUSTRIAL WASTEWATER ACCEPTANCE - IMPACTS AND BENEFITS

7.1 POTENTIAL IMPACTS

7.1.1 Overloading of Treatment Processes

Increased loading of organics (i.e., elevated BOD from high-strength wastewater) and/or the possible presence of toxic materials in some industrial wastewaters can cause upset of the City's secondary treatment process. Higher solids loading (i.e., TSS) can overwhelm the primary clarification designed to remove TSS and the City's solids handling processes: digesters, dewatering and drying processes.

7.1.2 Sludge Settleability and Digester Foaming

Some wastewater treatment plants handling dairy wastes encounter sludge settleability issues during the clarification step, which can result in violations of WWTF treatment requirements. Introduction of high-strength industrial wastewater can cause foaming in digesters, potentially resulting in violations of treatment requirements contained in the City's waste discharge requirements.

7.1.3 WWTF Discharge Compliance

Merced's current WWTF discharge complies with stringent requirements on heavy metals and priority pollutants (mainly industrial contaminants known to have significant adverse impacts on the environment). Acceptance of wastewater from new industrial dischargers can result in increased concentrations of heavy metals and/or priority pollutants, and therefore potential permit violations.

7.1.4 Inadequate Capacity for Residential Growth

Industrial use of existing treatment capacity currently dedicated to future residential development will necessitate construction of new treatment facilities to accommodate future residential growth, when it occurs.

7.1.5 Overloading of Sewer Capacity and Increased Sewer Maintenance

Industrial wastewater has the potential to be generated in high volume batches over the course of a day. Releases of high volumes of wastewater over a short period of time have the potential to overload the hydraulic capacity of the City sewer system. If industrial wastewater contains higher levels of fats, oils and grease (FOG) then the potential for clogging of sewer pipes is exacerbated bringing with it the need for increased frequency of cleaning.

7.2 POTENTIAL BENEFITS

7.2.1 Economic and Community Development

Development of industries has been identified as one of the top priority goals in the Merced Vision 2030 General Plan. Industries provide jobs, training opportunities, and an overall economic boost for the predominantly agriculture-based region.

7.2.2 Renewable Energy Generation

Receiving high-strength industrial waste either as WWTF influent via the sewer collection system, or as organic wastes diverted directly to the City's anaerobic digesters results in increased production of methane gas. The City has been planning to implement a cogeneration system at the WWTF to convert methane gas from the digestion process to generate renewable green power and waste heat that can be utilized for digester heating and sludge drying at the WWTF.

8.0 INDUSTRIAL WASTE ACCEPTANCE DECISION MATRIX

Though potential economic benefits from new industries in the Merced service area are indisputable, the potential impacts from accepting industrial wastewater need to be considered as well. The industrial waste acceptance decision matrix has been developed to assess the possible impacts of proposed industries on the WWTF and to provide a framework to address potential issues related to industrial wastewater discharges.

Some of the potential operational issues (e.g., digester foaming) associated with industrial discharges have to be evaluated on a case-by-case basis. Therefore, those issues are not considered in the development of the decision matrix.

With regards to the City of Merced, the following key parameters need to be considered while evaluating potential new industrial wastewater:

- Salinity (Total dissolved solids [TDS] or salts), heavy metals, and priority pollutants
- BOD (Biochemical oxygen demand)
- TSS (Total suspended solids) or particulates
- Flow rate

Each of the abovementioned parameters must be considered when evaluating the potential impacts of a proposed industrial waste discharge on the City's WWTF, and its ability to serve other forms of community development while complying with current wastewater treatment requirements.

8.1 SALINITY, HEAVY METALS AND PRIORITY POLLUTANTS

The City is currently compliant with permitted discharge limits on TDS/Salinity, heavy metals and priority pollutants present in the WWTF effluent. However, if not evaluated, new industrial discharges could increase effluent concentrations of one or more of these constituents to above water quality objectives (WQOs) and, possibly require expensive mitigation steps (such as reverse osmosis treatment). Therefore, it is recommended that the City a) conduct adequate review of new discharges before approval, and b) implement regular monitoring to ensure pre-treatment compliance.

8.2 BOD

The following factors make influent BOD load to the WWTF the most important parameter when evaluating industrial wastewater:

1. Potential industries in the Merced area are expected to be mainly food and dairy based industries, which (by the nature of their business) have high BOD concentrations;
2. Recent drought and various water conservations measures have increased the BOD concentration in the domestic wastewater coming into the WWTF, as a result of customers using less water.
3. Increases in WWTF BOD loading have the potential to overwhelm the City's existing treatment processes, and increase the possibility of permit violations.
4. Accepting BOD from industrial wastewater dischargers reduces the ability of the WWTF to treat BOD loads from future residential wastewater and therefore limits the amount of population growth possible with the existing treatment facility.

The Merced WWTF secondary treatment process is designed based on max month BOD loading. A summary of design max month BOD loading and associated influent flows for the WWTF is presented in Table 5.

Table 5 Projected Max Month BOD Loading

Average Dry Weather Flow (Mgal/d)	Max Month BOD Load (lb/d)
6.8	16,460
7.8	18,800
8.8	21,200
9.8	23,500
10.7	25,900
11.7	28,200

Based on the City's 2013-14 WWTF data, the current max month BOD load is estimated to be about 21,000 lb/d. The City has entered into an agreement with UC Merced to receive wastewater from the campus up to a peak flow of 1.58 Mgal/d with an estimated max month BOD loading of 1,200 lb/d (See Table 6)

Table 6 Future BOD Loading Expected from UC Merced

Description	*Value*
Committed Peak Flow to UC Merced, Mgal/d	*1.58*
Peaking Factor from UC Merced Report [a]	2.25
Committed ADWF to UC Merced	0.7
Existing ADWF from UC Merced	0.32
ADWF Committed and Expected in the Future from UC Merced, Mgal/d	0.38
Estimated Max Month BOD Loading from UC Merced from Future Flow of 0.38 MGD, lb/d	1,200

a) UC Merced Wastewater Recycle and Biosolids Reuse Alternatives Study, October 2010

The combined total of the current WWTF max month BOD loading (21,000 lb/d) and expected BOD load from UC Merced (1,200 lb/d) is 22,200 lb/d, indicating that roughly 79% of the WWTF BOD capacity has been utilized or committed. Therefore, roughly 21% of the WWTF BOD capacity is remaining for future residential, commercial, and industrial growth (see Table 7).

Table 7 WWTF BOD Capacity Summary

Description	Value
WWTF Design BOD Load[a]	28,200 lb/d
Approximate Current WWTF BOD Load[a]	21,000 lb/d
Approximate BOD Capacity Committed to UC Merced	1,200 lb/d
Currently Uncommitted WWTF BOD Capacity	6,000 lb/d (21% of design)
Approximate BOD Loading per EDU[b]	0.664 lb/d
Approximate Future Population Growth that can be Supported from the Remaining BOD Capacity	27,270 pop. 9030 EDU[b]

a) Estimated based on max month BOD loading to WWTF

b) 3.02 persons/EDU (Equivalent Dwelling Unit)

Predicting potential residential growth is a challenge as it will be dependent on various factors. The City's tentative subdivision maps provide a rough estimate of possible growth. However, most of the tentative subdivision maps have expired and are no longer guaranteed wastewater service on demand at the existing WWTF. The projected growth in the City population from filed subdivision maps (assuming all maps submitted in the last decade would get built with 3.02 person per unit) is approximately 30,200 (see Table 8). Based on available BOD capacity, if all of the BOD capacity available at the existing WWTF is allocated for residential growth, then the existing WWTF can accommodate an increase in population of about 27,250, if no industrial development is allowed.

Table 8 Projected Population from Tentative Subdivision Map

Description	Value
Total Lots/Units from Subdivision Map	10,001
Total EDUs from Subdivision Map	10,001
Person per EDU	3.02
Projected Population from Subdivision Map	30,200
Estimate Maximum Month BOD Load Required for Projected Population from Subdivision Map	6,644

8.3 TSS

Elevated TSS loads from industrial wastewater discharges will increase the solids loading on the primary clarifiers and digesters at the WWTF. If higher TSS is expected, industry can implement a pretreatment step to filter out the particulates. Pretreatment for TSS is expected to be relatively simple when compared to BOD pretreatment, in general.

8.4 FLOW

Due to recent water conservation efforts, the per capita wastewater flow from residences appears to be lower than per capita flows observed at the time of WWTF design. The drop in residential wastewater flows is also being observed by various nearby cities. Average WWTF influent flow for the year of 2013 is 7.22 Mgal/d, indicating that roughly 38% of the WWTF flow capacity (i.e., 11.7 Mgal/d ADWF) is available for future residential and industrial growth if current water use and conservation practices continue. There is more flow capacity (38%) than BOD capacity (21%) remaining in the WWTF. Therefore, additional flows from industrial discharges may not pose a significant issue for the WWTF, but still must be considered from a hydraulic perspective, including available sewer conveyance capacity, particularly if the industry proposes to release large volumes of wastewater over a short period of time.

9.0 SUSTAINABLE INTEGRATION OF INDUSTRIAL DISCHARGES

9.1 INSTALLATION OF ONSITE PRETREATMENT SYSTEMS

Installation of pretreatment systems onsite can alleviate impacts to the WWTF. However, maintaining pretreatment systems requires capital and human resources. Pretreatment systems for FOG and TSS are relatively simple compared to those for BOD, TDS, and priority pollutants. BOD and TDS are the most common parameters that require pretreatment in agricultural and dairy based industries. Treatment for dissolved BOD reduction typically involves biological treatment processes whereas TDS mitigation typically requires reverse osmosis (RO), other advanced treatment processes, or additional dilution water for blending. Therefore, pretreatment for BOD and TDS is probably more suitable for larger industries such as E.J. Gallo Winery, Sierra Nevada Brewery, etc.

9.2 HAULING AND DIVERTING WASTEWATER TO ANAEROBIC DIGESTION

The core biological secondary treatment process being utilized at the WWTF is aerobic activated sludge which requires energy to aerate and thereby treat the wastewater. However, WWTF solids are treated by an anaerobic process that a) needs no aeration, and b) generates methane gas that can be used for renewable energy generation. Therefore, if an industrial wastewater is low volume and high strength, then that discharge has the potential to be conveyed separately to the WWTF anaerobic digesters located at the WWTF. The literature survey conducted as a part of this evaluation indicated that wastes from specialized cheese producers tend to be suitable for this approach.

9.3 CONSTRUCTION OF INDUSTRIAL WASTEWATER TREATMENT FACILITY

Implementation of a separate industrial wastewater facility is more suitable when there are several potential industries that are interested in locating to a community. Wastewater treatment plants for industrial dischargers have been implemented by several Central Valley cities including Lathrop, Sanger, and Tulare.

The following factors need to be evaluated prior to implementing an industrial wastewater treatment facility:

- TDS (Salinity): Elevated TDS from one or two industries could impact the wastewater disposal options and trigger advanced treatment such as reverse osmosis

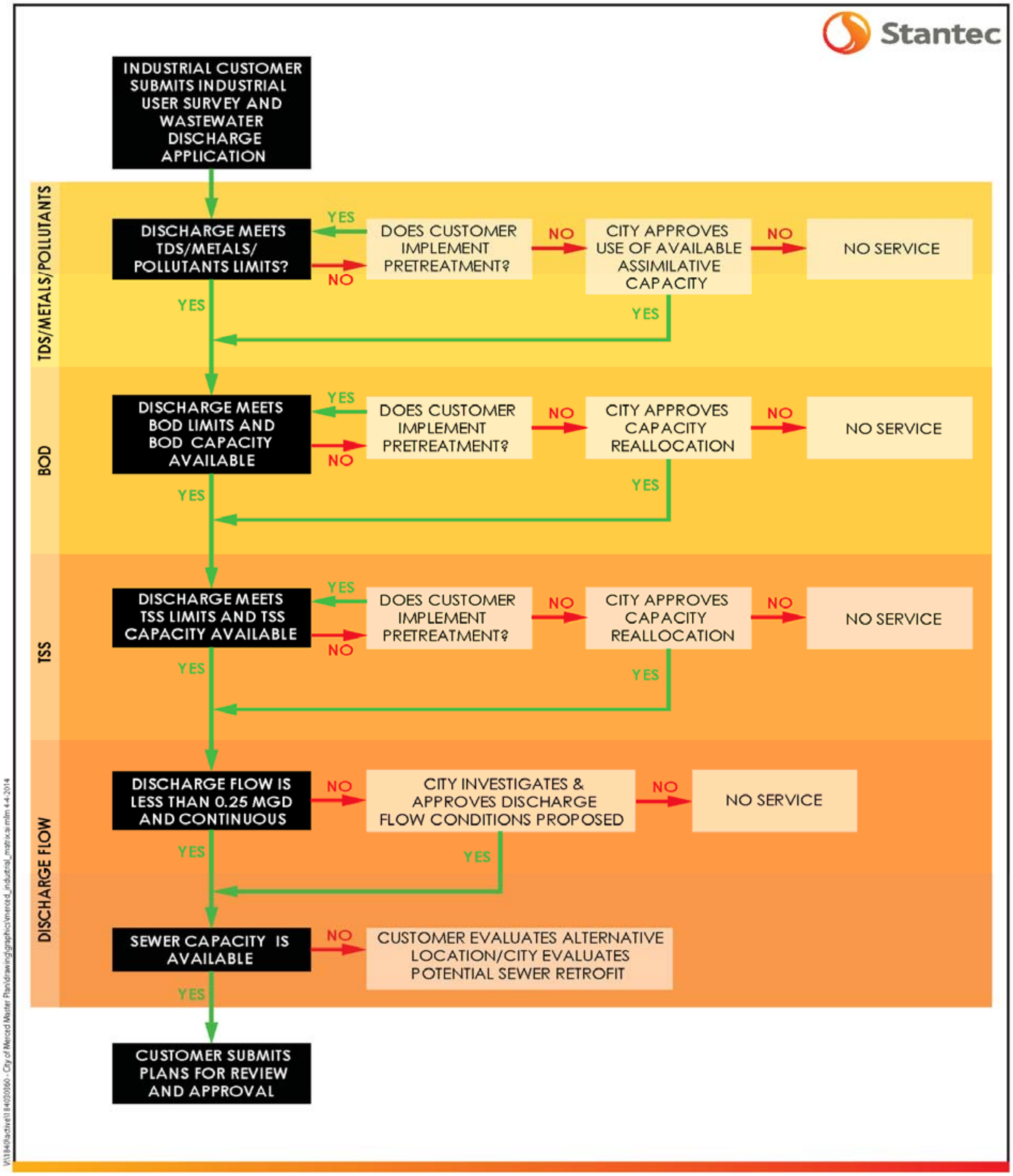
- Toxicity: Some industries may discharge compounds that are toxic to microbial populations that would be utilized in biological treatment processes

- Seasonal and diurnal variability: Depending on the type and scale of the industries, the wastewater variability could play a major role in a standalone industrial treatment facility when compared to the City's WWTF

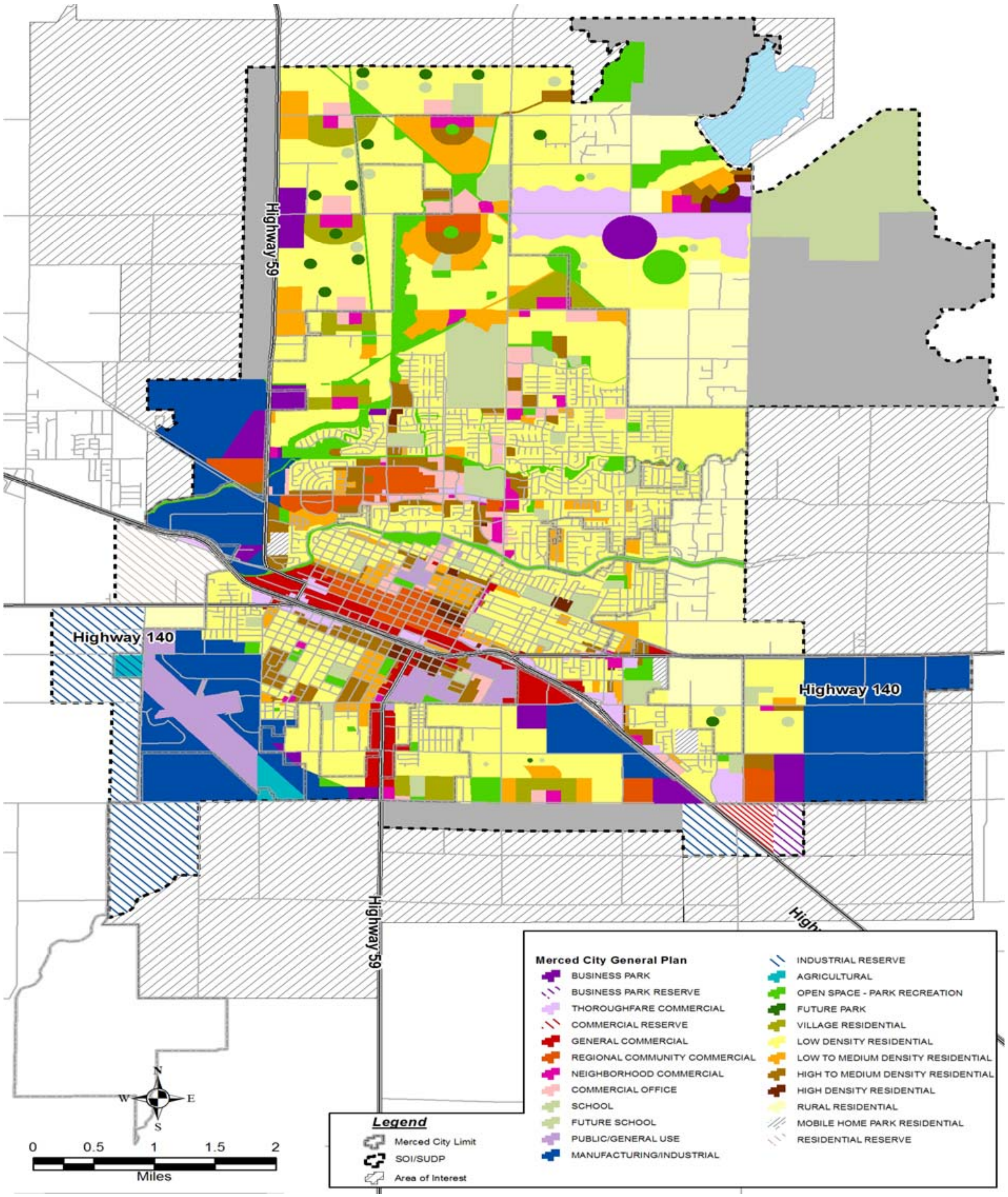
10.0 INDUSTRIAL DECISION MATRIX

A decision matrix (see Figure 4) has been developed based on an impacts and benefits analysis to delineate probable impacts on the WWTF and to provide a framework for addressing potential issues related to attracting new industrial wastewater discharges.

Figure 4 Merced Industrial Wastewater Acceptance Decision Matrix



Appendix A MERCED VISION 2030 GENERAL PLAN LAND USE MAP



Appendix B CITY OF MERCED ENVIRONMENTAL CONTROL DIVISION INDUSTRIAL USER SURVEY AND WASTEWATER DISCHARGE APPLICATION

Environmental Control Division

Industrial User Survey And Wastewater Discharge Application

INTRODUCTION

Pursuant to Local, State and Federal law, all persons who are users or may become users of the collection system and Wastewater Treatment Facility are subject to regulation. These regulations apply National Pretreatment Standards to protect the waters of the United States. The industrial user survey allows the City of Merced to maintain these standards with local users. Some of the objectives of these regulations are:

- To prevent the introduction of pollutants into the Collection System which will interfere with the operation of the Wastewater Treatment Facility or contaminate the resulting sludge generated;
- To prevent the introduction of pollutants into the Collection System which will pass through the system, inadequately treated, into any waters of the State or otherwise be incompatible with the Wastewater Treatment Facility; and
- To provide for the regulation of direct and indirect discharges to the Collection System and Wastewater Treatment Facility, through the issuance of permits to certain nondomestic Users and through enforcement of general requirements for the other Users; authorizes monitoring and enforcement activities, requires User reporting and provides for the setting of fees for the equitable distribution of costs.

1. COMPANY BUSINESS NAME ______________________________

Site Location: ______________________________ Phone: (   ) ________

City: ______________ State: ______ Zip: ____________

Mailing Address: ______________________________

City: ______________ State: ______ Zip: ____________

2. CHIEF EXECUTIVE OFFICER

Name: ______________________ Title: ______________________

Mailing Address: ______________________________ Phone: (   ) ________

City: ______________ State: ______ Zip: ____________

3. PERSON ON SITE ***(Authorized to Represent this Firm in Official Dealings with the City)***

Name: ______________________ Title: ______________________

4. TYPE OF APPLICATION & WASTEWATER SURVEY

☐ Renewal for existing facility

☐ Revision for change in discharge or facilities modification

☐ New facility (Anticipated date of discharge commencement: ______)

☐ Change in ownership

5. GENERAL CONDITIONS

a. All terms used herein are as defined in the Merced Municipal Code, Title 15.

b. Where industrial or commercial wastes are discharged, a Wastewater Discharge Permit may be issued to the User (or rejected) subject to the requirements of Federal, State and local regulations.

c. All information and data obtained from this industrial user survey shall be available to the public or other governmental agencies without restrictions unless the owner specifically requests and is able to demonstrate to the satisfaction of the city that the release of such information would divulge information, which would be detrimental to the owner's competitive position.

d. A Permit issued in response to this Application/Survey is subject to all applicable provisions of the Merced Municipal Code, NPDES No. CA 0079219 for the operation of the City of Merced Wastewater Treatment Facility and all applicable State and Federal Regulations.

e. A Permit issued in response to this Application/Survey is required for construction and operation of any industrial or commercial wastewater pretreatment facilities and/or continued operation of existing wastewater pretreatment facilities.

f. This Application/Survey, a Permit issued in response to this Application/Survey and all reports or information submitted pursuant to the requirements of such Permit must be signed and certified by an authorized representative of the User.

g. The provisions of a Permit issued in response to this Application/Survey are severable and, if any provision of such Permit or the Application/Survey of any provision of such Permit to any circumstances is held invalid, the Application/Survey of such provision to other circumstances and the remainder of such Permit shall not be affected thereby.

h. It is the responsibility of each Industrial or Commercial User to insure that all sludges generated by the User of a Permit issued in response to this Application/Survey, are managed under applicable sludge management requirements specified in all applicable State and Federal regulations.

i. Notice is hereby given that any and all significant violations of provisions of the Merced Municipal Code by the User of a Permit issued in response to this Application/Survey or any other Users of the Collection System and a list of resulting enforcement actions taken by the City of Merced will be published each year in the local newspaper. For the purpose of this Section, a "significant violation" shall be as defined in Subsection 1.03.64 of the Sewer Use Ordinance of MSD.

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6. GENERAL INSTRUCTIONS

a. Submit the completed Application/Survey and attachments to:

City of Merced
Environmental Control Division
1776 Grogan Ave.
Merced, CA 95340

7. INDUSTRIAL CATEGORY

If your facility employs processes in any of the industrial categories or business activities listed below, place a check beside the category or business activity. (Check all that apply.)

a. Industrial Categories

(1) ☐Aluminum Forming
(2) ☐Asphalt Manufacturing
(3) ☐Battery Manufacturing
(4) ☐Beverage Bottling
(5) ☐Canning Foods
(6) ☐Carbon Black Manufacturing
(7) ☐Cement Manufacturing
(8) ☐Coil Coating
(9) ☐Copper Forming
(10) ☐Dairy Products Processing
(11) ☐Electronic Components Mfg.
(12) ☐Electroplating
(13) ☐Explosives Manufacturing
(14) ☐Feedlots
(15) ☐Ferro Alloy Manufacturing
(16) ☐Fertilizer Manufacturing
(17) ☐Foundries: Metal Mold & Casting
(18) ☐Glass Manufacturing
(19) ☐Grain Mills
(20) ☐Gum & Wood Chemicals Mfg.
(21) ☐Ink Formulating
(22) ☐Inorganic Chemical Manufacturing
(23) ☐Laundry
(24) ☐Leather Tanning & Finishing
(25) ☐Meat Processing
(26) ☐Medical Care Operations
(27) ☐Metal Finishing
(28) ☐Metal Molding and Casting
(29) ☐Mineral and Ore Processing
(30) ☐Nonferrous Metal, Form & Powders
(31) ☐Nonferrous Metals Manufacturing
(32) ☐OCPSF, Organic Chemicals, Plastics, & Synthetic Fiber Mfg.
(33) ☐Oil & Gas Extraction
(34) ☐Paint Formulating
(35) ☐Roofing Materials Manufacturing
(36) ☐Pesticide Manufacturing
(37) ☐Petroleum Refining
(38) ☐Pharmaceutical Manufacturing
(39) ☐Phosphate Manufacturing
(40) ☐Photographic Developing
(41) ☐Plastic Injection Molding and Forming
(42) ☐Porcelain Enameling
(43) ☐Printing and Publishing
(44) ☐Rendering
(45) ☐Rubber Manufacturing
(46) ☐Soap & Detergent Manufacturing
(47) ☐Textile Mills
(48) ☐Timber products processing
(49) ☐**Service**
(50) ☐**Other**

b. Provide a brief narrative description of the manufacturing, production or service activities your firm performs.

Number	**Description of Activities**

7. **INDUSTRIAL CATEGORY** ***(Continued)***

c. Indicate Standard Industrial Classification Number(s) [SIC Code(s)] for all processes (if more than one applies, list in descending order of importance.

___________ ___________ ___________ ___________

d. List chemicals and other materials (both liquid and solid), which are used or stored in containers equal to or greater than 50 gallons. Please include the Safety Data Sheets for each of the chemicals, except for oils. (Attach additional sheets if needed.)

Chemical / Material	Size of Container	# of Containers on Hand	Chemical / Material	Size of Container	# of Containers on Hand

8. **SOURCES OF WATER**

a. Water Sources — Gallons Per Day (GPD) — Metered

1) City ________ GPD ☐
2) Well or Spring ________ GPD ☐
3) Surface Water ________ GPD ☐
4) Other ________ GPD ☐ Specify: ________

b. Name of Water Authority: City of Merced

c. Name of Water Bill Account: ________________

d. Water Bill Account Info.: ________________

Water Meter Number	Meter Size (inches)

9. DISPOSITION OF WATER

a. Disposition of Source Water (MGD)

Type of Disposition	City	Spring or Well	Surface Water	Other	Metered
1) Sewer					☐
2) Storm Drain					☐
3) Ground					☐
4) Incorporated in Product					☐
5) Waste Hauler					☐
6) Septic Tank					☐
7) Evaporation					☐
8) **Total (1) through (7)**					

---

10. SPECIFIC USES OF WATER

a. Identify the Uses of Incoming Water (Estimate Gallons Per Day, GPD)

Use	Amount (GPD)	Metered
1. Domestic (Restrooms)		☐
2. Boiler make-up		☐
3. Cooling Water, Non-contact		☐
4. Cooling Water, Contact		☐
5. Processing Product		☐
6. Washdown of Plant and/or Equipment		☐
7. Air Pollution Control Unit		☐
8. Other (specify)		☐
9. **Total (1) through (8)**		

---

11. BUSINESS HOURS AND NUMBER OF EMPLOYEES

a. Days per week that the facility is open for operations: ______

b. Number of Employees: ______

	1st Shift		2nd Shift		3rd Shift	
Number of Hours						
Average # of Employees						
Start Time						

12. INDUSTRIAL WATER USES

a. A daily average flow limit based on a 30-day period and a maximum 24-hour flow limit will be issued in the permit to Discharge Industrial Waste based on the information submitted below.

b. A daily average concentration limit based on a 30-day period and a maximum 24-hour concentration limit for Biochemical Oxygen Demand (BOD) and for Total Suspended Solids (TSS) will not to be exceeded during the period of the Permit.

1) Total discharges including sanitary wastes for which a Permit to Discharge Industrial Waste is requested:

	Currently		**During the Period of Upcoming Permit ****	
	Daily Average Based on 30-Day Period	**Maximum Based on 24-Hour Period**	**Daily Average Based on 30-Day Period**	**Maximum Based on 24-Hour Period**
Flow (GPD)				
BOD (mg/L) *				
TSS (mg/L) *				

(If known)*

2) Are any process changes or expansions planned during the next 5 years, which would alter wastewater volumes or characteristics?

☐ Yes

☐ No

3) If yes, briefly describe these changes and their effects on the wastewater volume and characteristics: (Attach additional sheets if needed)

____

____

____

____

____

13. PROCESS WASTES

a. Types of waste discharged to building sewer *(circle numbers)*:

1. Flammable
2. Temperature over 100^0 F.
3. Toxic or Poisonous
4. Toxic Gases
5. Colored
6. Odorous
7. Acidic or caustic (pH under 6.0 or over 10.5)
8. Saline (TDS above 2000 mg/L)
9. Sulfides
10. Cyanides
11. Radioactive materials
12. Heavy Metals
13. Cooling water, blowdown or bleed water
14. Petroleum based soluble oils
15. Petroleum based oils
16. Rainwater or dilution water
17. Wash & cleaning water
18. Particles larger than 3/8" in any dimension
19. Organic material (BOD, COD)
20. Suspended solids
21. Other *(specify)*:

____

13. **PROCESS WASTES** ***(Continued)***

b. Are any liquid wastes, by-products, material residues or sludges from this facility disposed of by a means other than discharging to the City of Merced Collection System?

☐ Yes (If "yes", complete items 13. b., c., d. and e.)

☐ No (If "no", skip remainder of Section 13.)

c. These wastes may best be described as:

Generated Wastes	Description	Estimated Gallons or Pounds Per Year Generated
Acids		
Alkalies		
Heavy Metal Sludges		
Inks/Dyes		
Oil and/or Grease		
Organic Compounds		
Paints		
Pesticides		
Settleable Residues		
Solvents		
Other Hazardous Wastes		
By-Products		
Other Wastes		

d. For the above checked wastes, does your company practice?

☐ On-site Storage

☐ Off-site Storage

☐ On-site Disposal

☐ Off-site Disposal

e. Has an Accidental Discharge Control and Countermeasure Plan been prepared for the facility?

☐ Yes

☐ No

f. Briefly describe the method(s) of storage or disposal checked above. Indicate whether landfill, incineration, resource recovery, contract hauling or RCRA regulated practices. Identify contract parties or facilities involved.

13. **<u>PROCESS WASTES</u>** ***(Continued)***

g. Do any of your substances require Resource Conservation and Recovery Act permits?

☐ Yes (If "yes", please specify.)

☐ No

____

____

____

14. **<u>PRETREATMENT</u>**

Is any water utilized at the facility pretreated before it is discharged to the City Collection System? *(Possible water uses requiring pretreatment are: contaminated cooling water, water used for processing product, equipment facility washdown, air pollution control unit)*

☐ Yes (If "Yes", please complete this section, Section 15.)

☐ No (If "No", skip this section, Section 15.)

a. Indicate all pretreatment devices or processes used for treating wastewater or sludge. (Check all that are utilized.)

☐ Activated carbon
☐ Air stripping
☐ Centrifuge/ Cyclone Separation
☐ Chemical Precipitation
☐ Chlorination
☐ Cyanide Destruction
☐ Dissolved Air Floatation
☐ Filtration
☐ Flocculation
☐ Flow Equalization
☐ Grease or Oil Separation (Petroleum)
☐ Grease Trap (Animal/Vegetable)
☐ Grit Sedimentation
☐ Ion Exchange
☐ Microfiltration
☐ Nanofiltration
☐ Ozonation
☐ pH Neutralization
☐ Reverse Osmosis
☐ Screening
☐ Septic Tank
☐ Silver Recovery
☐ Solvent Separation
☐ Biological Treatment
☐ Ultrafiltration
☐ Other *

* specify: ________________________

b. Are major pretreatment operations ☐ batch? ☐ continuous?

c. If the major pretreatment operations are batch, indicate:

Average number per month __________ or per day __________
Discharge per batch (gallons) __________

d. Is any new or modified pretreatment planned for this facility within the next 5 years?

☐ Yes (If "Yes", attach detailed <u>plans</u> and <u>operational descriptions.)</u>

☐ No

14. PRETREATMENT *(Continued)*

e. List raw materials that come in contact with process water.

1) ________	5) ________	9) ________
2) ________	6) ________	10) ________
3) ________	7) ________	11) ________
4) ________	8) ________	12) ________

15. OPERATIONS EFFECTING PRETREATMENT

a. Peak hourly flow (gal/min): ______________ Annual daily average flow (gal/day): ______________

b. Is operation subject to seasonal variation?

☐ Yes

☐ No

c. If "Yes", indicate:

(1) Seasonal maximum waste flow ☐ gallons per day (GPD) during the months of ☐

(2) Seasonal minimum waste flow ☐ gallons per day (GPD) during the months of ☐

d. Does operation shut down for vacation, maintenance, or other reasons?

☐ Yes

☐ No

e. If "Yes" indicate period when shutdown occurs: ______________________________

f. List any water recycling processes in use.

Type of process	Describe

g. If a new waste discharge is proposed, describe fully, all materials that will come in contact with water and anticipated volume and characteristics of wastewater and any by-products, materials residues or sludges.

____

____

____

16. MONITORING

a. Number of monitoring and/or sampling points located on property: ___________

b. Sewer connection and discharge information:

(1) Provide a facility site plan showing a flow diagram of the sewer lines indicating pipe sizes and types of manufacturing discharge they carry. Also show pertinent structures, streets, alleys, streams, manholes, and sewer sampling points. Label each sewer outlet from building as Pipe 1, Pipe 2, etc.

(2) Is there an existing sump(s) or manhole(s) on the premises where wastes (industrial waste other than sanitary waste) can be sampled and flow measured?

☐ Yes

☐ No

c. Permits and Wastewater Analyses

(1) List all environmental permits. (i.e.: NPDES, air, storm runoff)

Type of Permit	Permit Number	Expiration Date

(2) Have your wastes been sampled by the City or Merced County Environmental Health Department?

☐ Yes

☐ No

(3) If "Yes", then when was the last date? ____________________________________

d. If any chemical wastewater analyses have been performed on the wastewater discharge(s) from your facility, attach a copy of the most recent data to this application. Be sure to include the date of the analysis, name of laboratory performing the analysis, and location(s) from which sample(s) were taken (attach sketches, plans, etc., as necessary).

18. WASTE CHARACTERIZATION

a. Priority Pollutant Information: Please indicate by placing a "√ " in the appropriate box by each listed chemical that is in your manufacturing or service activity or generated as a by-product.

Chemical Name	EPA STORET Code	Check if Present at Facility	Check if Absent at Facility	Check if Present in Discharge	Check if Absent in Discharge	Concentration in Discharge, if Known (mg/l)
Acid Extractable Organics						
2-Chlorophenol	34586	☐	☐	☐	☐	☐
2,4-Dichlorophenol	34601	☐	☐	☐	☐	☐
2,4-Dimethyphenol	34606	☐	☐	☐	☐	☐
2,4-Dinitrophenol	34616	☐	☐	☐	☐	☐
2-Methyl-4,6-dinitrophenol	34657	☐	☐	☐	☐	☐
4-chloro-3-methylphenol	34452	☐	☐	☐	☐	☐
2-Nitrophenol	34591	☐	☐	☐	☐	☐
4-Nitrophenol	34646	☐	☐	☐	☐	☐
Pentachlorophenol	39032	☐	☐	☐	☐	☐
Phenol	34694	☐	☐	☐	☐	☐
2,4,6,-Trichlorophenol	34621	☐	☐	☐	☐	☐
Base Neutral Organics						
1,2,4-Trichlorobenzene	34551	☐	☐	☐	☐	☐
1,2-Dichlorobenzene	34536	☐	☐	☐	☐	☐
1,2-Diphenylhydrazine	34346	☐	☐	☐	☐	☐
1,3-Dichlorobenzene	34566	☐	☐	☐	☐	☐
1,4-Dichlorobenzene	34571	☐	☐	☐	☐	☐
2,4-Dinitrotoluene	34611	☐	☐	☐	☐	☐
2,6-Dinitrotoluene	34626	☐	☐	☐	☐	☐
2-Chloronaphthalene	34581	☐	☐	☐	☐	☐
3,3-Dichlorobenzidine	34631	☐	☐	☐	☐	☐
4-Bromophenyl phenyl ether	34636	☐	☐	☐	☐	☐
4-Chlorophenyl phenyl ether	34641	☐	☐	☐	☐	☐
Acenaphthene	03405	☐	☐	☐	☐	☐
Acenaphthylene	34200	☐	☐	☐	☐	☐
Anthracene	34220	☐	☐	☐	☐	☐
Benzidine	39120	☐	☐	☐	☐	☐
Benzo (a) anthracene	34526	☐	☐	☐	☐	☐
Benzo (a) pyrene	34247	☐	☐	☐	☐	☐
Benzo (b) fluoranthene	34230	☐	☐	☐	☐	☐
Benzo (ghi) perylene	34521	☐	☐	☐	☐	☐

18. WASTE CHARACTERIZATIONS *(Continued)*

Chemical Name	EPA STORET Code	Check if Present at Facility	Check if Absent at Facility	Check if Present in Discharge	Check if Absent in Discharge	Concentration in Discharge, if Known (mg/l)

Base Neutral Organics *(continued)*

Benzo (k) fluoranthene	34242	☐	☐	☐	☐	☐
Bis(2-chloroethoxy) methane	34278	☐	☐	☐	☐	☐
Bis(2-chloroethyl) ether	34273	☐	☐	☐	☐	☐
Bis(2-chloroisopropyl) ether	34283	☐	☐	☐	☐	☐
Bis(2-ethylehexyl) phthalate	39100	☐	☐	☐	☐	☐
Butyl benzyl phthalate	34292	☐	☐	☐	☐	☐
Chrysene	34320	☐	☐	☐	☐	☐
Di-n-butyl phthalate	39110	☐	☐	☐	☐	☐
Di-n-octyl phthalate	34596	☐	☐	☐	☐	☐
Dibenzo(a,h) anthracene	34556	☐	☐	☐	☐	☐
Diethyl phthalate	34336	☐	☐	☐	☐	☐
Dimethyl phthalate	34341	☐	☐	☐	☐	☐
Fluoranthene	34376	☐	☐	☐	☐	☐
Fluorene	34381	☐	☐	☐	☐	☐
Hexachlorobenzene	39700	☐	☐	☐	☐	☐
Hexachlorobutadiene	34391	☐	☐	☐	☐	☐
Hexachlorocyclopentadiene	34386	☐	☐	☐	☐	☐
Hexachloroethane	34396	☐	☐	☐	☐	☐
Indeno(1,2,3-cd)pyrene	34403	☐	☐	☐	☐	☐
Isophorone	34408	☐	☐	☐	☐	☐
N-nitroso-di-n-propylamine	34428	☐	☐	☐	☐	☐
N-nitrosodimethylamine	34438	☐	☐	☐	☐	☐
N-nitrosodiphenylamine	34433	☐	☐	☐	☐	☐
Naphthalene	34696	☐	☐	☐	☐	☐
Nitrobenzene	34447	☐	☐	☐	☐	☐
Phenanthrene	34461	☐	☐	☐	☐	☐
Pyrene	34469	☐	☐	☐	☐	☐

Metals

Aluminum	01104	☐	☐	☐	☐	☐
Antimony	01097	☐	☐	☐	☐	☐
Arsenic	01002	☐	☐	☐	☐	☐
Beryllium	01012	☐	☐	☐	☐	☐
Cadmium	01027	☐	☐	☐	☐	☐
Chromium	01034	☐	☐	☐	☐	☐

18. WASTE CHARACTERIZATIONS *(Continued)*

Chemical Name	EPA STORET Code	Check if Present at Facility	Check if Absent at Facility	Check if Present in Discharge	Check if Absent in Discharge	Concentration in Discharge, if Known (mg/l)
Metals *(continued)*						
Copper	01042	☐	☐	☐	☐	☐
Lead	01051	☐	☐	☐	☐	☐
Mercury	71900	☐	☐	☐	☐	☐
Molybdenum	01062	☐	☐	☐	☐	☐
Nickel	01067	☐	☐	☐	☐	☐
Selenium	01147	☐	☐	☐	☐	☐
Silver	01077	☐	☐	☐	☐	☐
Thalium	00982	☐	☐	☐	☐	☐
Zinc	01092	☐	☐	☐	☐	☐
Inorganics						
Barium	01007	☐	☐	☐	☐	☐
Chloride	00940	☐	☐	☐	☐	☐
Cyanide	00720	☐	☐	☐	☐	☐
Fluoride	00951	☐	☐	☐	☐	☐
Purgeable Volatile Organics						
1,1,1-Trichloroethane	34506	☐	☐	☐	☐	☐
1,1,2,2-Tetrachloroethane	34516	☐	☐	☐	☐	☐
1,1,2-Trichloroethane	34511	☐	☐	☐	☐	☐
1,1-Dichloroethane	34496	☐	☐	☐	☐	☐
1,1-Dichloroethylene	34501	☐	☐	☐	☐	☐
1,2-Dichloroethane	34531	☐	☐	☐	☐	☐
1,2-Dichloropropane	34541	☐	☐	☐	☐	☐
2-Chloroethyl vinyl ether	34576	☐	☐	☐	☐	☐
Acrolein	34210	☐	☐	☐	☐	☐
Acrylonitrile	34215	☐	☐	☐	☐	☐
Benzene	34030	☐	☐	☐	☐	☐
Bromodichloromethane	32101	☐	☐	☐	☐	☐
Bromoform	32104	☐	☐	☐	☐	☐
Bromomethane	34413	☐	☐	☐	☐	☐
Carbon tetrachloride	32102	☐	☐	☐	☐	☐
Chlorobenzene	34301	☐	☐	☐	☐	☐
Chloroethane	34311	☐	☐	☐	☐	☐
Chloroform	32106	☐	☐	☐	☐	☐
Chloromethane	34418	☐	☐	☐	☐	☐
cis 1,3-Dichloropropene	34704	☐	☐	☐	☐	☐
Dibromochloromethane	32105	☐	☐	☐	☐	☐
Ethylbenzene	34371	☐	☐	☐	☐	☐
Methylene chloride	34423	☐	☐	☐	☐	☐
Tetrachloroethylene	34475	☐	☐	☐	☐	☐

18. WASTE CHARACTERIZATIONS *(Continued)*

Chemical Name	EPA STORET Code	Check if Present at Facility	Check if Absent at Facility	Check if Present in Discharge	Check if Absent in Discharge	Concentration in Discharge, if Known (mg/l)
Purgeable Volatile Organics *(continued)*						
Toluene	34010	☐	☐	☐	☐	☐
trans 1,3-Dichloropropene	34699	☐	☐	☐	☐	☐
trans-1,2-Dichloroethylene	34546	☐	☐	☐	☐	☐
Trichloroethylene	39180	☐	☐	☐	☐	☐
Trichlorofluoromethane	34488	☐	☐	☐	☐	☐
Vinyle chloride	39175	☐	☐	☐	☐	☐
Others						
Xylene	81551	☐	☐	☐	☐	☐

b. For chemical compounds listed above which are indicated to be "Present at your facility", please list and provide the following data for each. (Attach additional sheets if needed.)

Chemical Compound	Annual Usage (lbs.)	Estimated Loss to Sewer (lbs./Yr.)	Chemical Compound	Annual Usage (lbs.)	Estimated Loss to Sewer (lbs./Yr.)

19. EXECUTION OF APPLICATION

Company Name: ______________________________

Authorized Signature: * ______________________________

Title: ______________________________

Date: ______________

**** Authorized signature must correspond to Item 2 or 3 from Page 1 of this Application.***

Appendix B NMSAD AND TSAM PROPERTIES

Table B-1 NMSAD and Tentative Subdivision Land Use [a]

Land Use	Total Area (ac)
Commercial	612
Industrial	305
School	474
Rural Residential	0
Low Density Residential	2,788
Low to Medium Density Residential	434
High to Medium Density Residential	365
High Density Residential	9
Mobile Home Park	26
Village Core Residential	135
Residential Reserve	150
Community Plan	0
Mixed Use	53
Other [b]	484
Total	**5,835**

(a) Specific parcels and their acreages are available within the City's GIS database.

(b) Land uses characterized as "Other" include "Agricultural", "Future Park", "Open Space – Park Recreation", and "Public / General Use"

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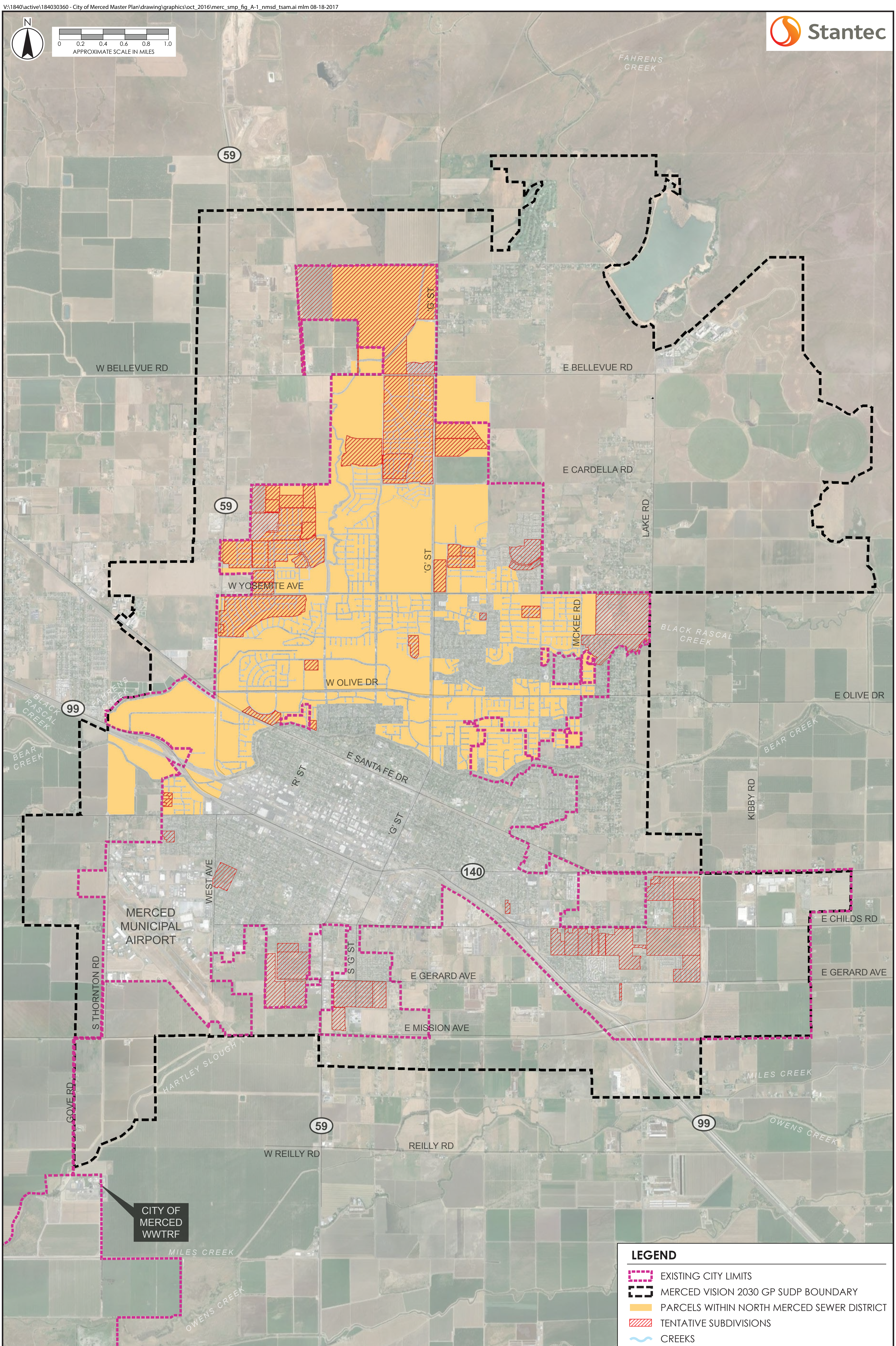

City of Merced
Wastewater Collection System Master Plan

Figure B-1
North Merced Sewer Assessment District & Tentative Subdivision Activity Map Parcels

Appendix C DETAILED COST BREAKDOWN

A detailed breakdown of the construction costs developed as part of this Master Plan are presented in the following tables. Planning level opinions of probable cost were developed for the recommended improvements to the existing collection system and future wastewater treatment and collection system infrastructure. These costs have been estimated using a ENR Construction Index (ENRCCI) of 10,703 (June 2017).

Two wastewater collection and treatment plans to support buildout development conditions have been considered in this Master Plan. The total opinion of probable cost for alternative Plan A and alternative Plan B are presented in **Table C-1** (also **Table 8-10**). Detailed cost breakdown tables are presented for each line item in **Table C-1**. The detailed costs associated with addressing existing collection system deficiencies are presented in Section B.4.

Table C-1 Reconnaissance Opinions of Probable Life Cycle Costs to Implement Plan A or Plan B [(a)]

Infrastructure Components Relevant to Overall Wastewater Utility Costs	Probable Total Project Costs, [(b)]	
	Plan A	**Plan B**
1. Trunk sewers and associated pump stations:		
1.1. North Merced	$17,420,000	$17,420,000
1.2. South Merced	$22,808,000	$22,808,000
1.3. North Merced to WWTRF	$87,318,000	$12,620,000
Pipe and Pump Subtotal	**$127,546,000**	**$52,848,000**
2. WWTRF:		
2.1. New construction at existing WWTRF (Plan A – 22 Mgal/d, Plan B – 8 Mgal/d)	$364,115,000	$122,455,000
2.2. New NMWWTRF (secondary treatment)	$0	$222,248,000
Treatment Subtotal	**$364,115,000**	**$344,703,000**
3. Effluent Storage, Disposal, Reclamation		
3.1. Improvements at NMWWTRF:		
3.1.1. Planning, permitting, CEQA, etc.	$0	$1,000,000 [(c)]
3.1.2. Pump station and forcemain to storage	$0	$6,532,000 [(d)]
3.1.3. Effluent storage (9,300 AF)	$0	$145,080,000 [(e)]
3.1.4. Pump station and forcemains from storage to agricultural fields	$0	$6,532,000 [(d)]
3.1.5. Upgrades to agricultural fields (3,500 acres) for effluent reuse	$0	$30,916,000 [(f)]
3.1.6. Land purchase expenses (Storage and NMWWTRF site)	$0	$2,298,000 [(d)]
Effluent Related Subtotal	**$0**	**$192,358,000**
Subtotal of Infrastructure Costs	**$491,661,000**	**$589,909,000**

(a) Extensive unrestricted effluent reuse (installation of a purple pipe network) in North Merced will not be implemented.

(b) ENR-CCI (20 cities) = 10703, June 2017, an estimate of the construction inflation index at the mid-point of project construction. Construction costs include 20% for Engineering and Administration and a 30% contingency factor.
(c) Assumes $500,000 for new WDRs for NMWWTRF, $200,000 for resource permitting (wetlands, ESA, etc.) and $300,000 for CEQA documentation.
(d) Assumes 3 miles of transmission main total from WWTRF to effluent storage to reclamation area (ag fields).
(e) Assumes $11,000 per AF of storage.
(f) Assumes $5,000 per acre for effluent distribution mains from transmission main and improvements to ag fields, including tailwater return, fencing, signage, laser leveling, etc.
(g) Land purchase includes 35 acres for NMWWTRF and 730 acres for effluent storage (assumed 14 feet effective depth) @ $3,000 per acre. No cost is included for agricultural fields or for right of way acquisition for trunk sewers or pump stations.

C.1 ITEM 1, TRUNK SEWERS AND ASSOCIATED PUMP STATIONS

North Merced

Table C-2 North Merced, Pipeline Costs (Plan A & B)

Pipe Segment		Length of Sewer (ft)	Sewer Diameter (in)	Average Depth (ft)	Baseline Pipe Unit Cost ($/LF)	Approximate Pipe Segment Cost ($)
Upstream MH ID	Downstream MH ID					
Yosemite-6	Thornton-3	6,800	21	15.0	$188	$1,275,068
3009	Cardella-4	5,267	24	9.8	$154	$813,050
Bellevue-1	Bellevue-1A	3,805	24	8.5	$154	$587,289
Bellevue-1A	Cardella-5A	5,291	27	14.1	$227	$1,200,887
Cardella-1	Cardella-2	2,636	24	13.3	$196	$517,305
Cardella-2	Cardella-3	2,526	24	20.3	$237	$597,461
Cardella-3	Cardella-4	2,618	27	15.4	$232	$606,962
Cardella-3	Cardella-4	2,543	27	15.4	$232	$589,571
Cardella-4	Cardella-5	4,295	42	11.6	$294	$1,264,722
Cardella-5	Cardella-5A	3,193	42	15.8	$352	$1,123,284
Cardella-5A	Cardella-6	2,509	48	17.9	$424	$1,064,007
Subtotal Pipe Segments (rounded):						**$9,640,000**

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Table C-3 North Merced, Additional Collection System Items (Plan A & B)

Additional Items	Description	Quantity	Unit Cost	Units	Total Cost
1	Microtunnel Mobilizations	1	$292,094	EA	$292,094
2	21-inch interceptor structure	1	$28,086	EA	$28,086
3	24-inch interceptor structure	1	$56,172	EA	$56,172
4	24-inch Stream/Canal Crossing (Microtunnel)	100	$1,191	LF	$119,084
5	24-inch Stream/Canal Crossing (Microtunnel)	75	$1,191	LF	$89,313
6	42-inch Stream/Canal Crossing (Microtunnel)	200	$1,910	LF	$381,969
Subtotal Additional Items (rounded)					**$967,000**

Table C-4 Item 1.1 North Merced, Total Project Cost (Plan A & B)[(a)]

Item	Description	Cost
1	Pipe Construction Costs	$9,640,000
2	Additional Items	$967,000
	Subtotal	**$10,607,000**
3	5% Mobilization/Demobilization	$558,300
	Estimated Construction Subtotal	**$11,166,000**
4	30% Contingencies for Unknown Conditions	$3,350,000
	Estimated Construction Cost	**$14,516,000**
5	20% Engineering, Environmental, & Admin	$2,904,000
	Total Project Cost	**$17,420,000**

(a) This estimate does not include right of way or easement acquisition costs.

South Merced

Table C-5 South Merced, Pipeline Costs (Plan A & B)

Pipe Segment		Length of Sewer (ft)	Sewer Diameter (in)	Average Depth (ft)	Baseline Pipe Unit Cost ($/LF)	Approximate Pipe Segment Cost ($)
Upstream MH ID	Downstream MH ID					
18721	G	2,679	30	15.5	$259	$692,600
D	E	2,184	18	16.9	$171	$373,505
E	F	7,936	21	19.9	$205	$1,627,246
F	Fa	7,159	27	17.4	$242	$1,730,143
Fa	Fb	8,753	36	12.5	$265	$2,315,036
Fb	G	7,289	36	8.8	$232	$1,690,968
G	H	5,389	36	11.0	$254	$1,366,962
H	I	5,314	36	10.7	$243	$1,290,495
I	J	1,190	36	8.1	$232	$276,082
J	K	2,553	36	24.9	$357	$910,345
K	End	586	36	27.0	$398	$233,289
Subtotal Pipe Segments (rounded):						**$12,507,000**

Table C-6 South Merced, Additional Collection System Items (Plan A & B)

Additional Items	Description	Quantity	Unit Cost	Units	Total Cost
1	Microtunnel Mobilizations	1	$292,094	EA	$292,094
2	21-inch RR Crossing (Microtunnel)	200	$1,191	LF	$238,169
3	27-inch HWY Crossing (Microtunnel)	200	$1,191	LF	$238,169
4	36-inch Stream/Canal Crossing (Microtunnel)	100	$1,393	LF	$139,306
5	36-inch HWY(Microtunnel)	200	$1,393	LF	$278,613
6	36-inch Stream/Canal Crossing (Microtunnel)	100	$1,393	LF	$139,306
7	60-inch influent junction at WWTP	1	$56,172	EA	$56,172
Subtotal Additional Items (rounded):					**$1,382,000**

Table C-7 Item 1.2 South Merced, Total Project Cost (Plan A & B)[(a)]

Item	Description	Cost
1	Pipe Construction Costs	$12,507,000
2	Additional Items	$1,382,000
	Subtotal	**$13,889,000**
3	5% Mobilization/Demobilization	$731,000
	Estimated Construction Subtotal	**$14,620,000**
4	30% Contingencies for Unknown Conditions	$4,386,000
	Estimated Construction Cost	**$19,006,000**
5	20% Engineering, Environmental, & Admin	$3,802,000
	Total Project Cost	**$22,808,000**

(a) This estimate does not include right of way or easement acquisition costs.

North Merced to WWTRF

Table C-8 North Merced to WWTRF, Pipeline Costs (Plan A)

Pipe Segment		Length of Sewer (ft)	Sewer Diameter (in)	Average Depth (ft)	Baseline Pipe Unit Cost ($/LF)	Approximate Pipe Segment Cost ($)
Upstream MH ID	Downstream MH ID					
Cardella-6	Thornton-2 Cardella-7	5,371	54	19.3	$994	$5,336,567
Thornton-2 Cardella-7	Thornton-3	3,629	54	21.8	$1,028	$3,729,122
Thornton-3	Thornton-4	7,227	24	*forcemain*	$399	$2,882,078
Thornton-3	Thornton-4	5,000	24	*forcemain*	$1,191	$5,954,225
Thornton-3	Thornton-4	7,227	36	*forcemain*	$598	$4,323,117
Thornton-3	Thornton-4	5,000	36	*forcemain*	$1,393	$6,965,320
Thornton-4	Thornton-5	10,739	60	11.3	$816	$8,763,893
Thornton-5	End	381	60	13.1	$964	$367,530
Thornton-5	End	6,400	60	13.1	$964	$6,167,266
Subtotal Pipe Segments (rounded):						**$44,490,000**

Table C-9 North Merced to WWTRF, Additional Collection System Items (Plan A)

Additional Items	Description	Quantity	Unit Cost	Units	Total Cost
1	35 Mgal/d Pump Station	1	$7,500,000	EA	$7,500,000
2	Microtunnel Mobilizations	1	$292,094	EA	$292,094
3	60-inch influent junction at WWTP	1	$185,367	EA	$185,367
4	60-inch Stream/Canal Crossing (Microtunnel)	150	$2,354	LF	$353,032
5	60-inch Stream/Canal Crossing (Microtunnel)	150	$2,354	LF	$353,032
Subtotal Additional Items (rounded):					**$8,684,000**

Table C-10 Item 1.3 North Merced to WWTRF, Total Project Costs (Plan A)[(a)]

Item	Description	Cost
1	Pipe Construction Costs	$44,490,000
2	Additional Items	$8,684,000
	Subtotal	**$53,174,000**
3	5% Mobilization/Demobilization	$2,798,650
	Estimated Construction Subtotal	**$55,973,000**
4	30% Contingencies for Unknown Conditions	$16,792,000
	Estimated Construction Cost	**$72,765,000**
5	20% Engineering, Environmental, & Admin	$14,553,000
	Total Project Cost	**$87,318,000**

(a) This estimate does not include right of way or easement acquisition costs.

Table C-11 North Merced to WWTRF, Pipeline Costs (Plan B)

Pipe Segment		Length of Sewer (ft)	Sewer Diameter (in)	Average Depth (ft)	Baseline Pipe Unit Cost ($/LF)	Approximate Pipe Segment Cost ($)
Upstream MH ID	Downstream MH ID					
Thornton-2 Cardella-7	Thornton-3	3,629	21	21.8	$436	$1,581,529
Thornton-4	Thornton-5	10,739	15	11.3	$249	$2,675,459
Thornton-5	End	381	24	13.1	$397	$151,443
Thornton-5	End	6,400	24	13.1	$397	$2,541,250
Subtotal Pipe Segments (rounded):						**$6,950,000**

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Table C-12 North Merced to WWTRF, Additional Collection System Items (Plan B)

Additional Items	Description	Quantity	Unit Cost	Units	Total Cost
1	Microtunnel Mobilizations	1	$292,094	EA	$292,094
2	21-inch interceptor structure	1	$28,086	EA	$28,086
3	24-inch influent junction at WWTP	1	$56,172	EA	$56,172
4	24-inch Stream/Canal Crossing (Microtunnel)	150	$1,191	LF	$178,627
5	24-inch Stream/Canal Crossing (Microtunnel)	150	$1,191	LF	$178,627
Subtotal Additional Items (rounded):					**$734,000**

Table C-13 Item 1.3 North Merced to WWTRF, Total Project Costs (Plan B)[(a)]

Item	Description	Cost
1	Pipe Construction Costs	$6,950,000
2	Additional Items	$734,000
	Subtotal	**$7,684,000**
3	5% Mobilization/Demobilization	$404,450
	Estimated Construction Subtotal	**$8,089,000**
4	30% Contingencies for Unknown Conditions	$2,427,000
	Estimated Construction Cost	**$10,516,000**
5	20% Engineering, Environmental, & Admin	$2,104,000
	Total Project Cost	**$12,620,000**

(a) This estimate does not include right of way or easement acquisition costs.

C.2 WWTRF

New Construction at the Existing WWTRF

An opinion of probable cost was developed for expansions of the existing WWTRF, bringing the facilities to 16 Mgal/d from 12 Mgal/d and to 20 Mgal/d from 16 Mgal/d. These two costs were totaled and considered a reasonable estimate of costs to bring the existing plant to 20 Mgal/d from 12 Mgal/d. It was assumed that this expansion would occur under Plan A or Plan B. Additional costs associated with further expansion of the existing WWTRF under Plan A are presented in **Table C-15**.

Table C-14 Existing WWTRF Expansion Cost Estimates (Plan A & B)

Item	1
Headworks and Primary Treatment Facilities	
Influent Pump Station	
Headworks	
Equalization Basin	
Primary Clarifier	
Secondary Treatment	
Aeration Basin Splitter Box	
Aeration Basins	
Blower Building and Blower	
Secondary Clarifiers	
RAS/WAS Pump Stations	
Tertiary Treatment	
Tertiary Pump Station	
Rapid Mx and Flocculation Basins	
Tertiary Disc Filters	
Disinfection System	
UV Disinfection System	
Effluent Disposal Facilities	
Outfall Structure	
Irrigation System Improvements	
Solids Handling Facilities	
DAFTs	

Item	1
Digester Control Buildings	
Primary Digesters	
Waste Gas Flare	
Solids Dewatering Building	
Active Solar Dryers	
Miscellaneous Structures	
Plant Water Pump Station	
Stormwater Pump Station	
Misc. Yard Structures	
Landscaping	
Overall Items (Subtotal)	
Mobilization, Bonds and Insurance	
Startup, Demobilization, Miscellaneous	
Sitework	
Grading and Paving	
Site Piping	
Electrical	
Change Orders	
Total Construction Cost	
Contingencies @ 30%	
Total Construction Cost w/ Contingencies	
Engineering and Administration @ 20%	
Total Project Cost	

It was determined that expanding the existing WWTRF beyond 20 Mgal/d would require significant construction. The cost of facilities associated with treatment of an additional 14 Mgal/d at the existing location were considered to be equivalent to those needed to construct a new 14 Mgal/d tertiary treatment facility, these costs are presented in Table B-15.

Table C-15 Further Expansion of the Existing WWTRF (Plan A)

Item	New 14 Mgal/d Tertiary Treatment Facility
Headworks and Primary Treatment	
Influent Pump Station	$1,066,000

Item	New 14 Mgal/d Tertiary Treatment Facility
Headworks	$2,179,000
Equalization Basin	$695,000
Primary Clarifiers	$3,931,000
Secondary Treatment	
Aeration Basin Splitter Box	$576,000
Aeration Basins	$15,232,000
Blower Building and Blowers	$7,437,000
Secondary Clarifiers	$10,010,000
RAS/WAS Pump Stations	$2,379,000
Tertiary Treatment	
Tertiary Pump Station	$589,000
Rapid Mx and Flocculation Basins	$993,000
Tertiary Disc Filters	$5,111,000
Disinfection System	
UV Disinfection System	$2,411,000
Effluent Disposal Facilities	
Outfall Structure	$713,000
Solids Handling Facilities	
DAFTs	$2,129,000
Digester Control Building	$6,402,000
Primary Digesters	$9,554,000
Solids Holding Tank	$761,000
Gas Holding System	$425,000
Waste Gas Flare	$416,000
Solids Dewatering Building	$4,813,000
Active Solar Dryers	$10,564,000
Centrate Equalization Tank	$765,000
Centrate Pump Station	$298,000
Miscellaneous Structures	
Operations / Lab / Admin Building (Limited)	$765,000
Generator Building	$438,000
Chemical Storage Facility	$178,000

Item	New 14 Mgal/d Tertiary Treatment Facility
Chemical Building	$397,000
Plant Water Pump Station	$388,000
Stormwater Pump Station	$288,000
Stormwater Detention Basin	$305,000
Overall Items (Subtotal)	**$92,208,000**
Mobilization, Bonds, Insurance, Startup, Misc.	7,838,000
Sitework	7,838,000
Site Piping	15,675,000
Electrical and Instrumentation	31,351,000
Total Construction Cost	**154,910,000**
Contingencies @ 30%	46,473,000
Total Construction Cost w/ Contingencies	**$201,383,000**
Engineering and Administration @ 20%	$40,277,000
Total Project Cost	**$241,660,000**

A summary of the total costs associated with the expansion of the existing WWTRF under Plan A and Plan B are presented in Table 17.

Table C-16 WWTRF Expansion Cost Summary (Plan A & B)

Item	Plan A	Plan B
Expand Existing WWTRF to 20 Mgal/d	$122,455,000	$122,455,000
Further Expand Existing WWTRF to 34 Mgal/d	$241,660,000	NA
Item 2.1 Total Cost	**$364,115,000**	**$122,455,000**

New NMWWTRF

The new North Merced Wastewater Treatment and Reclamation Facility is proposed to be a secondary wastewater treatment facility. The 14 Mgal/d tertiary treatment facility cost estimate presented in Table B-15, was modified to exclude tertiary treatment costs. This revised estimate was scaled from 14 Mgal/d to 4 Mgal/d and used as an estimate of costs for the initial phase of the NMWWTRF. The NMWWTRF costs estimates and associated scaling factors are presented in Table C-17.

Table C-17 NMWWTRF (Plan B)

Item	New 14 Mgal/d Secondary Treatment Facility	Scale Factor	New 4 Mgal/d Secondary Treatment Facility
Headworks and Primary Treatment			
Influent Pump Station	$1,066,000	0.75	$417,000
Headworks	$2,179,000	0.75	$851,000
Equalization Basin	$695,000	0.75	$272,000
Primary Clarifiers	$3,931,000	1.00	$1,123,000
Secondary Treatment			
Aeration Basin Splitter Box	$576,000	0.75	$225,000
Aeration Basins	$15,232,000	1.00	$4,352,000
Blower Building and Blowers	$7,437,000	0.75	$2,906,000
Secondary Clarifiers	$10,010,000	1.00	$2,860,000
RAS/WAS Pump Stations	$2,379,000	0.75	$930,000
Disinfection System			
UV Disinfection System	$2,411,000	0.75	$942,000
Effluent Disposal Facilities	*Included as line item 3 in Table B-1*		
Solids Handling Facilities			
DAFTs	$2,129,000	1.00	$608,000
Digester Control Building	$6,402,000	0.75	$2,502,000
Primary Digesters	$9,554,000	1.00	$2,730,000
Solids Holding Tank	$761,000	0.75	$298,000
Gas Holding System	$425,000	0.75	$166,000
Waste Gas Flare	$416,000	0.75	$163,000
Solids Dewatering Building	$4,813,000	0.75	$1,881,000
Active Solar Dryers	$10,564,000	1.00	$3,018,000

Item	New 14 Mgal/d Secondary Treatment Facility	Scale Factor	New 4 Mgal/d Secondary Treatment Facility
Centrate Equalization Tank	$765,000	0.75	$299,000
Centrate Pump Station	$298,000	0.75	$117,000
Miscellaneous Structures			
Operations / Lab / Admin Building (Limited)	$765,000	0.00	$765,000
Generator Building	$438,000	0.00	$438,000
Chemical Storage Facility	$178,000	0.00	$178,000
Chemical Building	$397,000	0.00	$397,000
Plant Water Pump Station	$388,000	0.00	$388,000
Stormwater Pump Station	$288,000	0.00	$288,000
Stormwater Detention Basin	$305,000	0.00	$305,000
Overall Items (Subtotal)	**$84,802,000**		**$29,419,000**
Mobilization, Bonds, Insurance, Startup, Misc.	$7,208,000	-	$2,501,000
Sitework	$7,208,000	-	$2,501,000
Site Piping	$14,416,000	-	$5,001,000
Electrical and Instrumentation	$28,833,000	-	$10,002,000
Total Construction Cost	**$142,467,000**		**$49,424,000**
Contingencies @ 30%	$42,740,000	-	$14,827,000
Total Construction Cost w/ Contingencies	**$185,207,000**		**$64,251,000**
Engineering and Administration @ 20%	$37,041,000	-	$12,850,000
Total Project Cost	**$222,248,000**		**$77,101,000**

C.3 EFFLUENT STORAGE, DISPOSAL, RECLAMATION

Improvements at NMWWTRF

Planning, permitting, CEQA, etc.

An allowance of 1 million dollars was included to account for planning and permitting needs. These costs may be associated with acquiring a new waste discharge permit from the Regional Water Board and making land use modifications to the existing General Plan.

Pump station and forcemain to storage and Pump station and forcemain from storage to agricultural fields

Table C-18 Effluent Pump Stations and Forcemains, each (Plan B)

Item	Unit Cost	QTY	Cost
Forcemain, 2 X 24-inch	$309	7920	$2,445,172
Pump station, ~30 Mgal/d			$1,741,126
Estimated Construction Subtotal			**$4,186,298**
30% Contingencies for Unknown Conditions			$1,256,000
Estimated Construction Cost			**$5,443,000**
20% Engineering, Environmental, & Admin			$1,089,000
Total Project Cost			**$6,532,000**

Effluent storage (9,300 AF)

Table C-19 Effluent Storage Basin (Plan B)[a]

Item	Unit Cost	QTY (AF)	Cost
Storage Reservoir	$10,000	9,300	$93,000,000
Estimated Construction Subtotal			**$93,000,000**
30% Contingencies for Unknown Conditions			$27,900,000
Estimated Construction Cost			**$120,900,000**
20% Engineering, Environmental, & Admin			$24,180,000
Total Project Cost			**$145,080,000**

(a) This estimate does not include right of way or easement acquisition costs.

Upgrades to agricultural fields (3,500 acres) for effluent reuse

Table C-20 Improvements to Agricultural Fields (Plan B)

Item	Unit Cost	QTY (Acres)	Cost
Site Improvements	$5,000	3,765	$18,826,000
Mobilization, Bonds, Insurance, Startup, Misc. (5%)			$990,850
Estimated Construction Subtotal			**$19,817,000**
30% Contingencies for Unknown Conditions			$5,946,000
Estimated Construction Cost			**$25,763,000**
20% Engineering, Environmental, & Admin			$5,153,000
Total Project Cost			**$30,916,000**

Land purchase expenses (Storage and NMWWTRF site)

Table C-21 Land Purchases (Plan B)

Item	Unit Cost	QTY (Acres)	Cost
Storage Area	$3,000	731	$2,193,000
Treatment Area	$3,000	35	$105,000
Total Cost			**$2,298,000**

C.4 ADDRESSING EXISTING SYSTEM DEFICIENCIES

Table C-22 Existing System Improvements

Location	Sewer Length (ft)	Existing Sewer Diameter (in)	Required Sewer Diameter (in)	Average Depth (ft)	Unit Cost ($/lf)	Surface Restoration ($100/LF)	Cost
Canal Street	3,510	12-inch	15	8	$223	$351,000	$1,133,100
R Street	2,400	12-inch	15	7	$223	$240,000	$774,800
W Olive Avenue	1,040	21-inch	24	10	$334	$104,000	$450,900
Highway-59	2,300	24-inch	27	10	$360	$230,000	$1,058,400
Estimated Construction Subtotal (rounded)							**$3,420,000**
Contingency (30%)							$1,030,000
Estimated Construction Cost							$4,450,000
Engineering, CM, Admin. (20%)							$890,000
Total Project Cost							**$5,340,000**