Appendix L
Castellina Specific Plan Infrastructure Master Plan

ESA

County of Madera

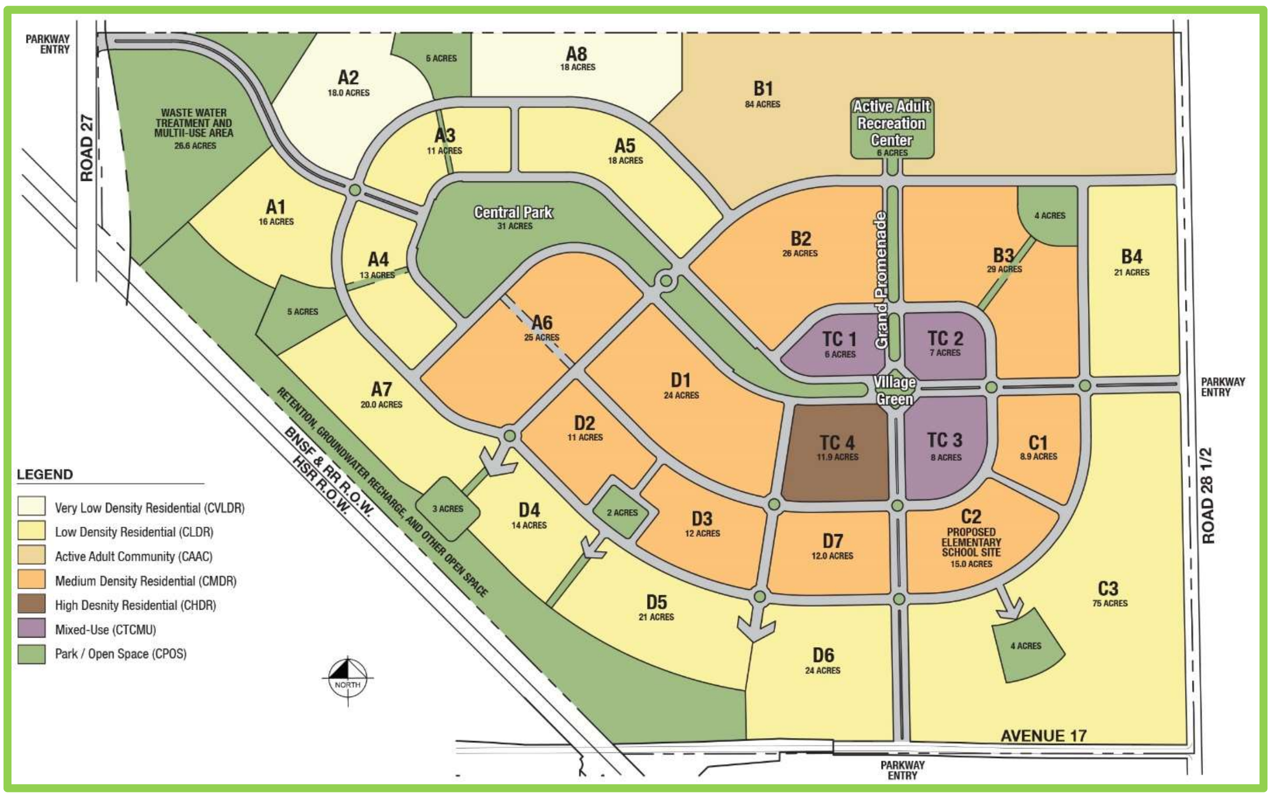
Castellina Specific Plan Area

Infrastructure Master Plan

Prepared for Castellina, LLC

and the County of Madera

APRIL 2019



Castellina, LLC

and

County of Madera

Infrastructure Master Plan

APRIL 2019

Prepared By:

Kimley-Horn and Associates, Inc.

In Association with:

Wood Rodgers, Inc.

House Moran Consulting Engineers, Inc.

Tully & Young

Water Works Engineers

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I. INTRODUCTION

Castellina, LLC, as the Applicant to the County of Madera, proposes the development of a master-planned community located on approximately 794 acres in Madera County (County). The project location in relationship to the general regional vicinity of the area is depicted on Exhibit 1.

As part of the proposed project, the applicant is preparing a specific plan for the project, entitled, "Castellina Specific Plan." The purpose of the Specific Plan is to regulate and provide development guidance for the development of the proposed project. The area included within the Castellina Specific Plan is depicted on Exhibit 2.

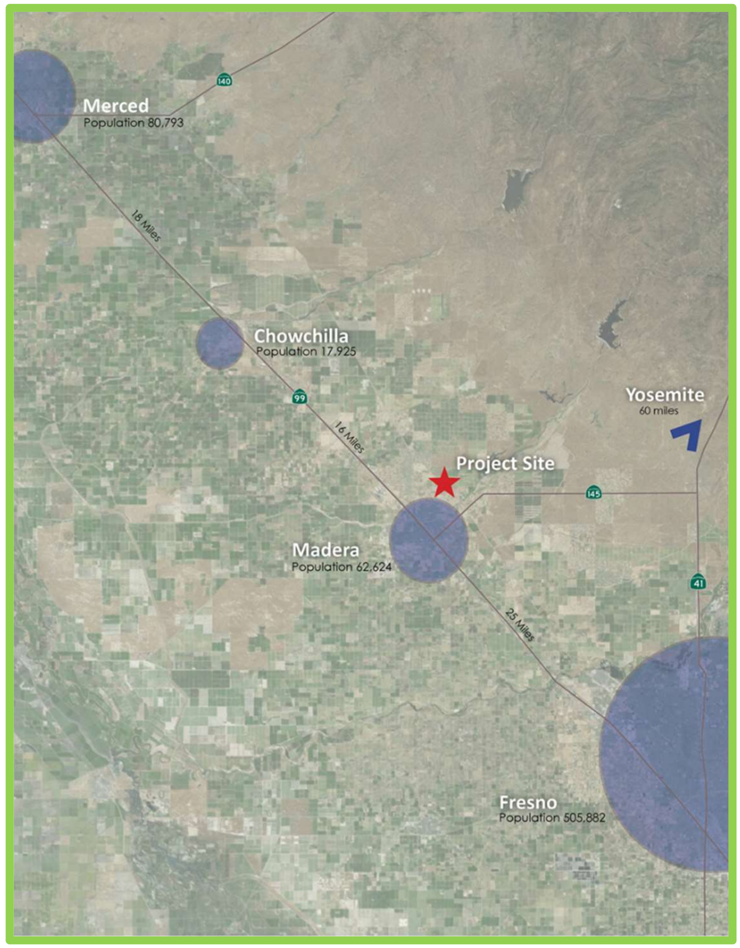


Exhibit 1 - Regional Vicinity

The project as currently contemplated proposes up to 3,072 residential units, comprised of single- and multi-family, and mixed-use residential units along with commercial mixed-uses, a proposed elementary school site, and recreational facilities, including parks, play fields, trails, plazas, community gardens, and other open space. The proposed land plan for the development is depicted on Exhibit 3.

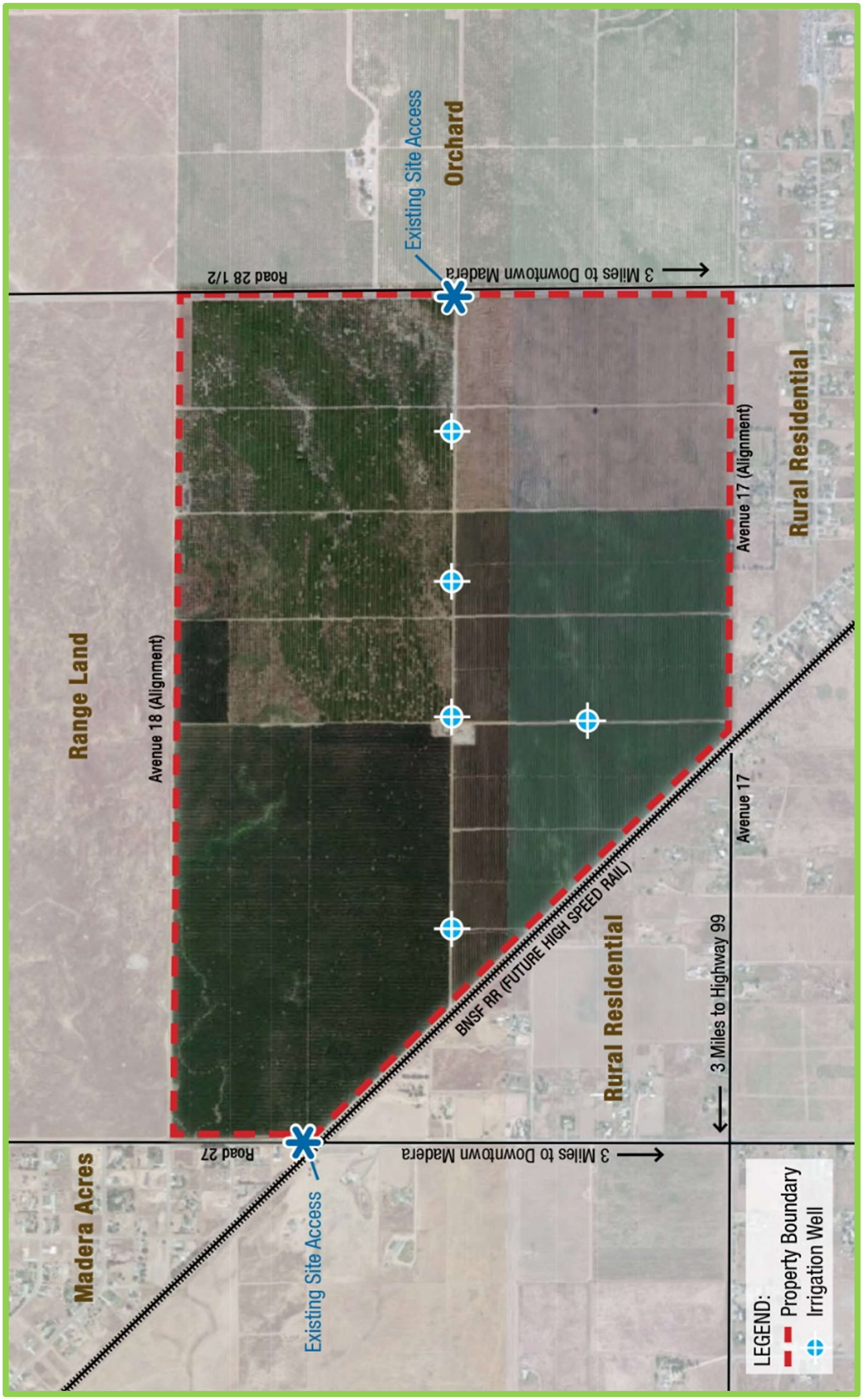


Exhibit 2 - Castellina Specific Plan Area

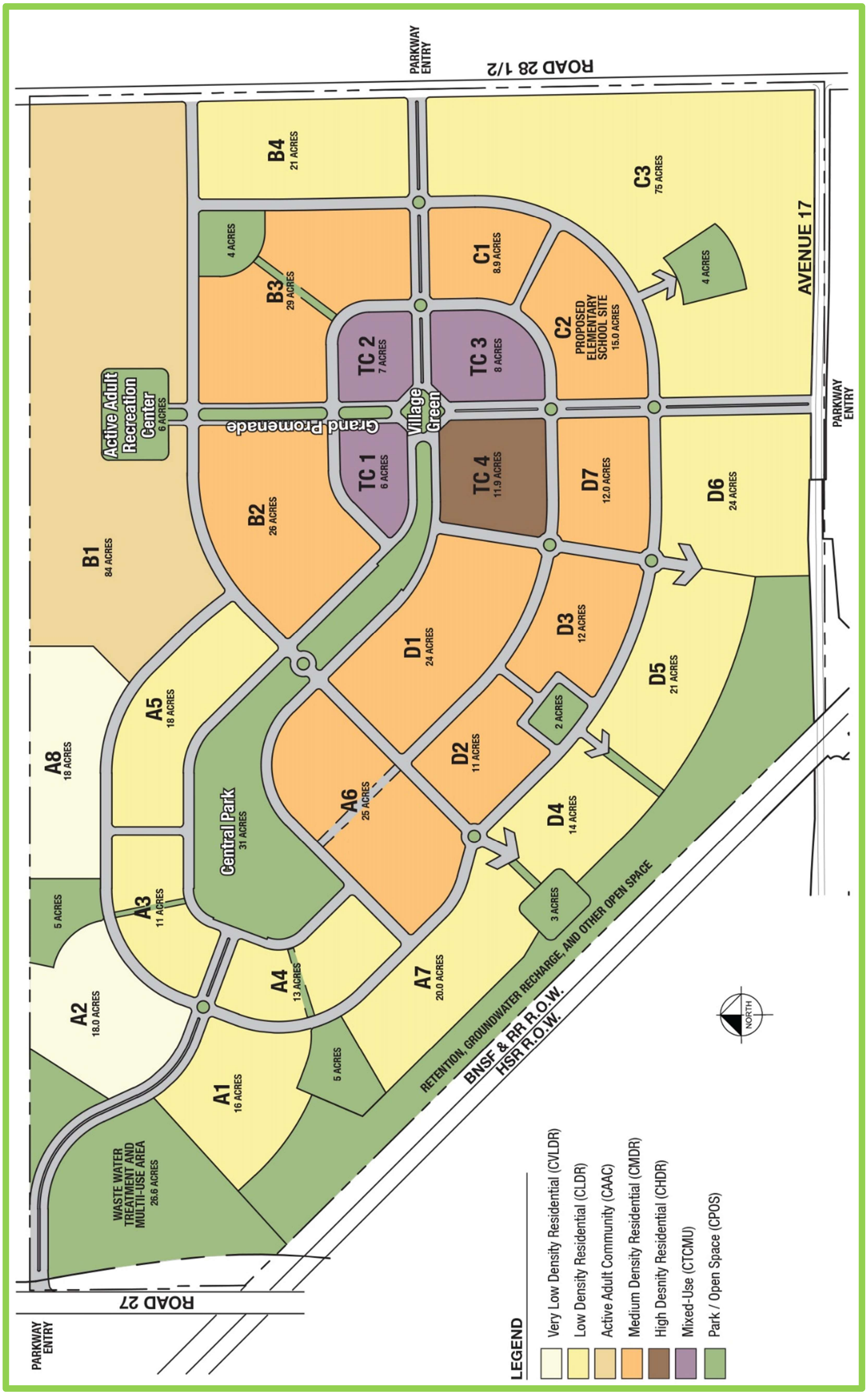
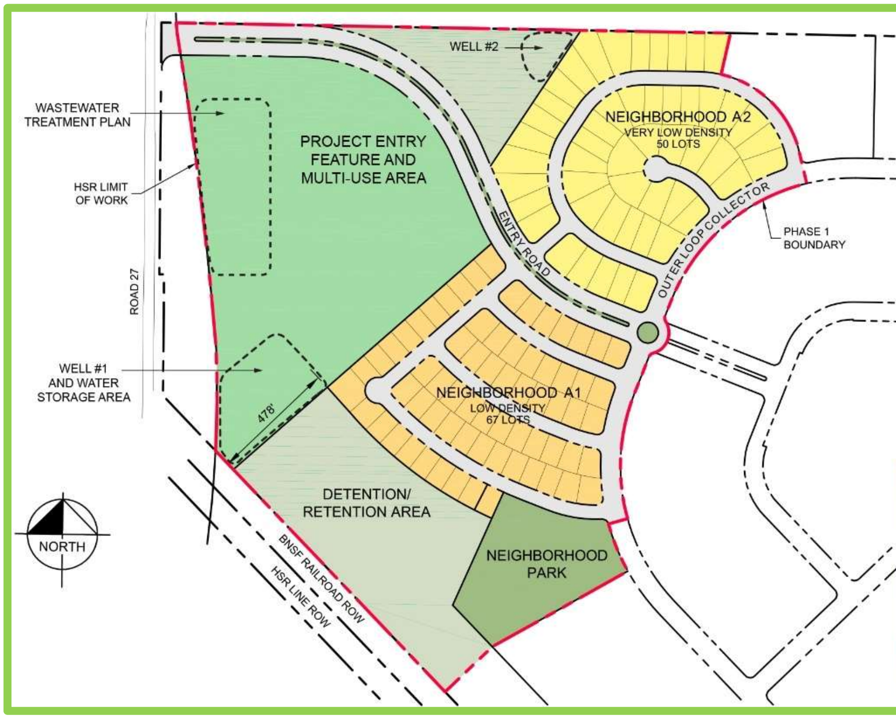


Exhibit 3 - Castellina Land Use Plan

Development of the proposed project will occur over multiple phases, depending on market demand, and the ability to provide adequate infrastructure. The overall proposed project includes requests for various approvals, which include the following: General Plan Amendment; Castellina Area Plan (Area Plan); Specific Plan; Amendments to the County Code and Zoning Code and Map (to be addressed in the Specific Plan); Large Lot Tentative Map; Development Agreement; and Tentative Map for Phase I.

As noted, Phase I of the project is proposed to move forward with approvals of a Tentative Map concurrent with the other overall discretionary approvals. The proposed Phase I development is depicted on Exhibit 4. It should be noted that subsequent phases of development within the Specific Plan Area will require additional approvals.



	ACREAGE	UNIT COUNT
NEIGHBORHOOD A1 LOW DENSITY	16.6 AC	67 LOTS
NEIGHBORHOOD A2 VERY LOW DENSITY	18.0 AC	50 LOTS
ENTRY & COLLECTOR ROADS	9.4 AC	–
NEIGHBORHOOD PARKS	5.0 AC	–
DETENTION/ RETENTION AREA	16.3 AC	–
W.W.T.P. & STORMWATER MANAGEMENT AREA	26.6 AC	–
TOTAL	91.9 AC	117 LOTS

Exhibit 4 - Castellina Phase I Land Use Plan

INFRASTRUCTURE MASTER PLAN PURPOSE

This Infrastructure Master Plan (Master Plan) has been prepared under a contract between Castellina, LLC and Kimley-Horn and Associates, Inc. In addition, the following firms have contributed to the analysis and content of this Master Plan: Wood Rodgers, Inc.; House Moran Consulting Engineers, Inc.; Tully & Young; and Water Works Engineers.

This Master Plan defines and coordinates public infrastructure for the Castellina Specific Plan area and provides a guide to the County for conditioning of land use entitlements for the community-wide infrastructure described within this Master Plan. This Master Plan is a dynamic document and the facilities and requirements identified within this report may be amended as the development plan evolves and infrastructure needs are further quantified over time. The infrastructure serving the project will be implemented concurrent with need, and conforming to the master plan studies.

PROJECT VICINITY

The proposed project is located in Madera County, in the Central Valley region of California (Refer to Exhibit 1). The project area is located approximately one-mile north of the City of Madera, three miles east of Highway 99, and roughly 16 miles south of the City of Chowchilla. Specifically, the Specific Plan Area is bound by the Avenue 18 alignment to the north, Road 28½ to the east, the alignment of Avenue 17 to the south, Road 27 to the west, and the Burlington Northern Santa Fe (BNSF) railroad line to the southwest (Refer to Exhibit 2).

PRE-DEVELOPMENT CONDITIONS

The Specific Plan Area is relatively flat ranging in elevation from approximately 280 feet, National Geodetic Vertical Datum (NGVD), in the northwest corner to approximately 310 feet NGVD at the east end of the Specific Plan Area. Currently, the Specific Plan Area is used for agricultural production and contains almond and fig orchards, related agricultural support facilities (e.g., equipment storage), wells, and unimproved dirt roadways. There are five wells located within the Specific Plan Area that draw groundwater from the Madera groundwater basin. Based on data provided by the property owners and engineering estimates, the existing agricultural operations pump approximately 2,800 acre-feet per year (AFY) of groundwater, which is equivalent to nearly 912 million gallons. The Specific Plan Area is designated as a New Growth Area (NGA) in the County's General Plan.

SURROUNDING LAND USES

Similar to the Specific Plan Area, many of the surrounding lands have been highly modified for agricultural purposes or otherwise developed as roads, individual residences, residential subdivisions, and commercial centers. Adjacent land uses to the Specific Plan Area include rangelands to the north, orchards to the east, and rural residential land uses to the south and west.

PROJECT OBJECTIVES

The primary objectives for the overall proposed project are to:

1. Provide a master planned community with residential and commercial of sufficient scale to permit master-planning of infrastructure, parks, open space, and public services to achieve efficiencies and synergies to create a community that can provide for the special social, recreational, and housing needs of its residents, visitors, and employees.

2. Provide a village and neighborhood-oriented community designed to encourage an active and healthy quality of life.

3. Plan for the inclusion of a proposed elementary school site that is integrated into the overall land plan and is readily accessible via non-vehicular pathways to residential neighborhoods and parks.

4. Provide a transportation and circulation network designed to accommodate all modes of transportation.

5. Establish a mixed-use Town Center to serve as land uses that provide an activity hub to enhance the community experience and support the residents, visitors, and employees within the overall project.

6. Provide employment opportunities to assist in meeting the Madera County's employment goals.

7. Provide a broad mix of housing to contribute to meeting the housing demand in Madera County.

8. Provide a range of housing types within the Specific Plan Area.

9. Establish one or more Community Facilities Districts (CFD) or other similar financing mechanisms to develop and maintain the necessary infrastructure (e.g., water, sewer,

storm drain, parks, open space, and roadways) to create a fiscally neutral project for Madera County.

10. Plan to extract no more groundwater than is recharged to the aquifer each year, consistent with Madera County goals and sound water conservation practices.

These objectives are important to the development of the overall project and influenced the analysis and recommendations regarding the infrastructure proposed for the Castellina Specific Plan Area.

LAND USE PLAN

The project proposes development of up to 3,072 residential units, approximately 21 acres of commercial mixed-use, and approximately 131 acres of parks, trails, plazas, community gardens, and other open space across the 794-acre Specific Plan Area. Residential development is divided across five villages, including a centralized commercial mixed-use Town Center. The residential villages are designed around a framework of parks and recreation facilities to encourage a walkable community and active community interaction. Each village is organized in a traditional modified grid roadway pattern, with a minimal number of cul-de-sacs.

Due to the rural setting of the Specific Plan Area, development under the Specific Plan requires the construction of new utilities, such as a new wastewater treatment plant (WWTP) and storm drain system, a new water supply system, and provide additional public services, including a proposed elementary school, to serve the new population. Exhibit 3 shows the conceptual land use plan.

The Specific Plan includes a variety of land use designations and zoning districts, consisting of residential and commercial uses as well as open space and recreational uses. Further, the project includes improvements to some off-site areas related to infrastructure improvements. A summary of proposed land uses within the 794-acre Specific Plan Area are included in Tables I-1 and I-2.

Table I-1
Castellina Infrastructure Master Plan
Land Use Summary

Land Use District	Gross Acres	Total (du or sf)
Residential		
Residential Subtotal	***513***	**3,072 du**
Commercial		
Village Center (mixed-use)	21	Up to 134,000 sf.
Commercial Subtotal	***21***	***Up to 134,000 sf.***
Other		
Neighborhood Parks	20	
Community Garden	3	
Central Park	31	
Grand Promenade	3	
Linear Pathways	6	
Village Green	2	
Active Adult Amenity Center	6	
Detention, WWTP and Other Open Space	67	
Parks and Open Space Subtotal	***138***	
Elementary School	***12***	
Roads & Other Miscellaneous Areas	***110***	
Total	**794**	**3,072 dwelling units** **Up to 134,000 sf. Commercial**

Table I-2
Castellina Infrastructure Master Plan
Residential Types and Densities

Residential Type	Gross Acres [1]	Net Acres [2]	Allowable Net Density Range (du/ac)	Target Net Density (du/ac)	Estimated Maximum Dwelling Units [3]
Very Low Density Residential	**36**	**30**	**3.0 - 5.0**	**3.0**	**90**
Low Density Residential	**230**	**184**	**5.0 - 7.0**	**6.0**	**1104**
Active Adult	**84**	**67**	**5.0 - 7.0**	**6.0**	**402**
Medium Density Residential	**151**	**114**	**6.0 - 15.0**	**9.0**	**1026**
High Density Residential	**12**	**12**	**15.0 - 25.0**	**20.0**	**248**
Mixed Use (Residential Component)	**21**	**21**	**Up to 10.0 (10.0)**	**10.0**	**202**
Total	***513 [4]***	***407 [4]***	**--**	***7.5 du/ac***	***3072***

Notes:

1. Gross acres includes all land (including streets and rights-of-way) within a parcel designated for a particular residential type.
2. Net acres excludes streets and rights-of-way for Very Low, Low, and Medium Density parcels. "Net" and "Gross" acreages for High Density uses are shown as equivalent, without internal local street systems.
3. Unit counts may vary between residential categories; however, the total number of dwelling units may not exceed total shown.
4. Excludes Mixed-Use to avoid duplication with Commercial – Village Center.

II. UTILITY SERVICE PROVIDERS

The Castellina Development will require a number of “dry” utility suppliers, in addition to the traditional wet utilities (water, wastewater and recycled water). The dry utilities that will be provided to the development include the following:

- Telephone
- Cable
- Internet
- Gas
- Electric

A number of contacts were made with the potential utility service providers in the area. These include the following:

- Comcast (cable/internet)
- Century Link (internet)
- Vast Networks (internet/cable)
- Pacific Gas & Electric (PG&E) (gas and electric)
- AT&T (telephone and fiber)

Only AT&T was willing to provide a will serve letter at this point. A copy is shown at right.

PG&E acknowledged the request for service connections and has indicated that they are able to serve the project. They have indicated that they will provide copies of their plans with the points of nearest service connections. However, the plans have not been received to date and a follow up request has been made. This section of the Master Plan will be once the information is received from PG&E.

Pacific Telephone
5555 E OLIVE AVE
Suite E100
FRESNO, CA 93727

T: 5594516342
F: 5592511876
www.att.com

October 23, 2018

Tasha Hengle
Kimley-Horn
RD 27 & RD 28 1/2 BETWEEN AVE 17 & AVE 18
Madera, California 93638

Re: Will Serve Letter, Non-Interference Letter.

Dear Tasha:

This letter is written to confirm that the proposed project NEW DEVELOPMENT MADERA RD 28 1/2 to RD 27 btwn AVE 17 & AVE 18, California is within the Base Rate Area of the AT&T California serving area in the MADRCA11 Exchange. AT&T expects to be in a position to provide telephone service to applicants in the above-referenced development upon request in accordance with requirements of, and at the rates and charges specified in, its Tariffs that are on file with the California Public Utilities Commission.

This offer to provide service will terminate 24 months after the date of this letter unless both of the following first occur:

1. you, in your capacity as the developer, enter into a written service agreement with AT&T; and,
2. you, in your capacity as developer, pay all charges you are required by AT&T's Tariffs to pay.

If you have any questions I can be contacted on 559-454-3724.

Sincerely,

Brian Weldon
OSP Engineer

III. CIRCULATION

A Transportation Impact Analysis (TIA) has been developed for the project and has been submitted as a separate comprehensive document to the County of Madera. At buildout, the project will make roadway (including pedestrian and bicycle) improvements along the project frontages on Road 27, Road 28½, and Avenue 17. The Project will construct full site access via four intersections including:

- Study Intersection #1: Avenue 18 / Road 27
- Study Intersection #2a: Avenue 17½ / Road 28½
- Study Intersection #2b: Secondary Entry / Road 28½
- Study Intersection #3: Primary Entry / Avenue 17

Frontage, roadway, and intersection improvements/construction will be made according to maintaining agency standards (i.e. Caltrans, Madera County, or City of Madera). Refer to the TIA for the comprehensive analysis.

INTERNAL ROADWAY NETWORK

The Roadways shown within the project will be improved and constructed per the applicable road cross sections included in the Specific Plan. This includes paving for sidewalks, paths, and travel lanes, landscaping, lane and crosswalk striping, traffic signals, roundabouts, and street furnishings. Where roadways terminate at a phase boundary, appropriate barricades and signage, as approved by the Madera County Public Works Director, would be installed to alert roadway users of the street termination. All temporary turn-arounds, if necessary, would be constructed per Madera County Code requirements.

The internal circulation plan is comprised of a series of entry roads, collector and connector roadways as shown on Exhibit 5.

LOCAL ROADWAYS

The locations of local streets within specific land use areas (e.g. MDR, LDR, and Active Adult) are not known at this time. Local streets must be designed along with the respective tentative subdivision maps and be constructed as part of the development process. The land use plan for Phase I, shown on Exhibit 4, depicts the local roadway concept. Development planning and engineering must consider the alignments of master-planned utilities outside the backbone network and coordinate alignments of local roads to coincide with these utilities.

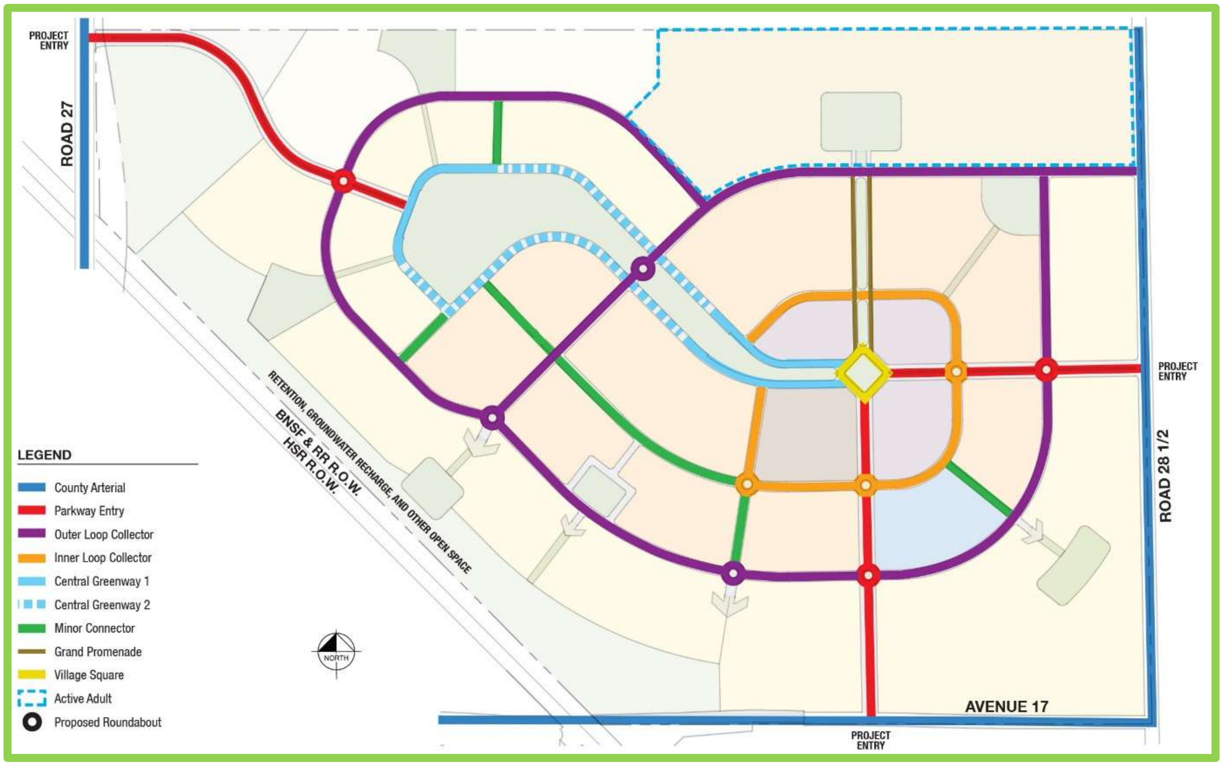


Exhibit 5 - Proposed Internal Circulation Plan

IV. SITE DEVELOPMENT GRADING

In order to accommodate development of the site, it will be necessary to perform mass grading operations. The initial mass grading will be completed to create development "super pads" and to contour the site for the efficient design of the gravity utility systems, including the wastewater and drainage systems. The grading operations are anticipated to be phased, similar to the development phasing. Exhibit 6, included within Appendix A, depicts the existing topography of the site.

EXISTING SITE CONDITIONS

The Specific Plan Area is relatively flat ranging in elevation from approximately 280 feet National Geodetic Vertical Datum (NGVD) in the northwest corner to approximately 310 feet NGVD at the east end of the Specific Plan Area. Currently, the Specific Plan Area is used for agricultural production and contains almond and fig orchards, related agricultural support facilities (e.g., equipment storage), wells, and unimproved dirt roadways.

All lots, roadways, and other improved areas within a phase are proposed to be graded sufficiently to accommodate development. A grading borrow/stockpile area may be established in a future phase area, if necessary, to accommodate design grades for the project. All grading activities will be required to comply with Madera County Municipal Code. All temporary borrow/stockpile areas would be treated with the appropriate erosion control measures as appropriate.

PROPOSED GRADING

The proposed grading plan for the overall development is depicted on Exhibit 7. In general, the site will be contoured to drain from the east to the west, accommodating both the drainage system and the wastewater collection system. Through the contour grading of the site, the need for pumping stations for these two utility systems can be eliminated.

Exhibit 7 - Proposed Grading Plan

GRADING – CUT AND FILL

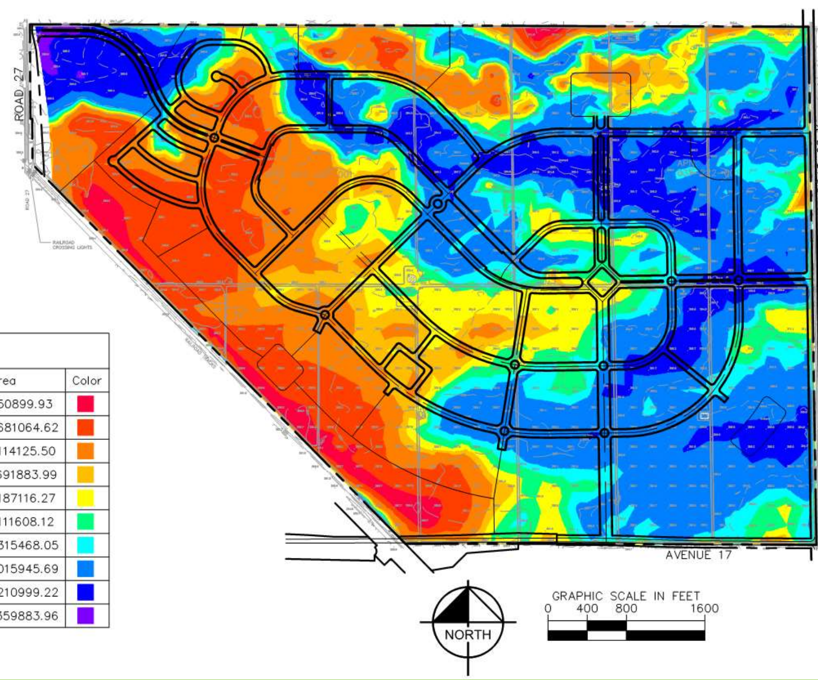
An analysis of the proposed site grading was completed including development of a cut – fill map for the overall grading. As previously noted, it may be necessary to stockpile and/or create borrow sites within the development boundaries to accommodate the grading for individual phases.

As shown on Exhibit 8, the Cut-Fill Map, there will be approximately 2.1 million cubic yards of earth moved over the course of the project. Based on the raw cut and fill quantities, the site is “balanced” regarding the earthwork, with no anticipation of offsite borrow or spoils of material.

RAW CUT/FILL SUMMARY			
AREA	CUT	FILL	NET
788 ACRES	2,135,000 CY	2,337,500 CY	202,500 CY (FILL)

NOTES:

- ASSUMING 1–FT THICK PAVEMENT SECTION
- RAW QUANTITIES DO NOT INCLUDE SHRINKAGE OR SWELL.
- ADDITIONAL CUT FROM LOT GRADING AND UTILITY SPOILS = 202,500 CY (CUT)



Elevations Table

Number	Minimum Elevation	Maximum Elevation	Area	Color
1	−16.00	−10.00	650899.93	
2	−10.00	−5.00	3681064.62	
3	−5.00	−2.00	4114125.50	
4	−2.00	−1.00	1691883.99	
5	−1.00	0.00	2187116.27	
6	0.00	1.00	3111608.12	
7	1.00	2.00	3315468.05	
8	2.00	5.00	7015945.69	
9	5.00	10.00	7210999.22	
10	10.00	15.00	1359883.96	

Exhibit 8 - Proposed Cut - Fill Quantity Map

V. WATER SYSTEM

The water supply goal for Castellina is to provide a safe and reliable supply of potable water to the area in accordance with existing regulatory requirements. Water conservation and reclamation shall be emphasized in order to meet the water use goals. Water conserving fixtures (shower heads, toilets, etc.) and the resulting reduced water demands are central to the design objectives. In addition, all water services will be metered. Although the primary purposes of metering are cost recovery, allocation of cost based on usage, and monitoring water consumption, one of the residual benefits of metering is reduced water consumption. Experience in the San Joaquin Valley indicates that metered water systems use as much as 30% less water per capita than unmetered systems. Water reclamation is addressed in more detail in a subsequent section of this Master Plan.

This section identifies key water supply requirements that are proposed for implementation to provide adequate water supply and distribution systems for fire protection and domestic use.

EXISTING SYSTEM

The site currently is utilized for agricultural purposes and has a series of five wells (4 irrigation wells and 1 domestic well) located throughout the site. The locations of the existing wells are shown on Exhibit 9.

As the project develops, the property will be systematically transitioned from agricultural use to the proposed land use identified through the Specific Plan process.

Exhibit 9 - Existing Irrigation Wells

As a result, the irrigation wells will remain in operation within areas of agricultural use, until the land is transferred to the ultimate use within specific development phases. The wells will be abandoned in accordance with State and County requirements.

WATER SUPPLY

The overall water supply and distribution system serving the Castellina Specific Plan Area will be a new, self-contained water system. Castellina, LLC contracted with Water Works Engineers to develop the Draft *"Castellina Community Water and Wastewater Facility Plan,"* dated October 24, 2018. A copy of this report is included within Appendix B to this Master Plan.

Additionally, the proposed onsite water supply and distribution system was modeled and sized through collaboration between Kimley-Horn and Associates, Inc. and Wood Rodgers, Inc. A copy of the Water Distribution System Technical Memorandum, dated October 31, 2018 is included in Appendix C of this Master Plan.

PROJECTED WATER DEMANDS

The water demand factors per land use category used to calculate the average daily water demand (ADD) are summarized in Table V-1.

Table V-1
Castellina Infrastructure Management Plan
Domestic Water System Demand Factors

Land Use Category	Land Use Category	Demand Factor (GPD/DU)
Residential		
Very Low Density	VLDR	527
Low Density Residential	LDR	330
Medium Density Residential	MDR	241
High Density Residential	HDR	116
Active Adult Low Residential	AALDR	241
Mixed Use	MU	107
Parks and Open Space		
Neighborhood Parks	PARK	[1]
Community Garden	PARK	[1]
Central Park	PARK	[1]
Grand Promenade/Paseo	PARK	[1]
Linear Pathways	ACTIVE OPEN	[1]

Land Use Category	Land Use Category	Demand Factor (GPD/DU)
Village Green/Square	PARK	[1]
Open Space	ACTIVE OPEN	[1]
Active Adult Amenity Center	ACTIVE OPEN	[1]
Other		
Elementary School	SCHOOL	[1]
Roads and Other Miscellaneous Areas	MISC	N/A

[1] Parks and Open Space and School will be irrigated with Recycled Water. Domestic water demands were accounted for using the WSA estimates.

The Average Day Demand (ADD) for the buildout of the development was calculated by multiplying the proposed land use by the water demand factors identified in Table V-1. A summary of the buildout ADD is depicted in Table V-2. A detailed breakdown of the ADD by village is included in Appendix C.

Table V-2
Castellina Infrastructure Management Plan
Domestic Water System - Average Day Demand Summary

Land Use	Gross Acres	Estimated Net Acres	Dwelling Units	Usage Rates (gpd/du)	ADD (gpd)	ADD (gpm)
Very Low Density	36	30	90	527	47,400	33
Low Density Residential	234	184	1,100	330	364,000	253
Active Adult Low Residential	84	67	402	241	96,900	67
Medium Density Residential	151	114	1,030	241	247,000	172
High Density Residential	12	12	248	116	28,700	20
Residential Subtotal	516	407	2,870	0	785,000	545
Mixed Use	22	20	202	107	21,600	15

Land Use	Gross Acres	Estimated Net Acres	Dwelling Units	Usage Rates (gpd/du)	ADD (gpd)	ADD (gpm)
Mixed Use Subtotal	22	20	202	0	21,600	15
Neighborhood Parks	20	15	N/A	N/A	893	1
Community Garden	3	2	N/A	N/A	0	0
Central Park	31	25	N/A	N/A	1,790	1
Grand Promenade	3	2	N/A	N/A	0	0
Linear Pathways	6	4	N/A	N/A	0	0
Village Green	2	6	N/A	N/A	0	0
Open Space	67	67	N/A	N/A	0	0
Active Adult Amenity Center	6	2	N/A	N/A	4,460	3
Parks and Open Space Subtotal	138	123	0	0	7,140	5
Elementary School	12	12	N/A	N/A	7,140	5
Roads and Other Miscellaneous Areas	110	110	N/A	N/A	0	0
Other Subtotal	122	122	0	0	7,140	5
OVERALL TOTAL	**798**	**672**	**3,070**		**821,000**	**570**

The domestic water ADD for the development is projected to be 570 gpm. To be consistent with the WSA, and for the purposes of sizing the facilities and analyzing the distribution system, a 10% water loss factor was applied to the ADD, resulting in an ADD of 627 gpm.

PEAKING FACTORS

The peaking factors utilized in this analysis are consistent with the WSA, and are as follows:

- Maximum Day Demand (MDD) = 2.25 x ADD
- Peak Hour = 1.5 x MDD

DEMAND PROJECTIONS

The ultimate buildout domestic water demands for the Castellina Specific Plan area are estimated to be:

- ADD = 627 gpm
- MDD = 1,411 gpm
- Peak Hour = 2,116 gpm

Per the project Water Supply Assessment (WSA), prepared by Tully & Young, January 2018, the full build-out domestic water demand is projected to be:

- Average Day = 0.99 MGD (686 gpm)
- Maximum Day = 2.22 MGD (1,523 gpm)
- Peak Hour = 3.33 MGD (2,315 gpm)

As mentioned previously, the demand projections developed herein are slightly less than the WSA projections due to slight variances in the land use acreages and demand factors. It is deemed acceptable since the WSA used more conservative numbers.

The fire flow requirement for the development is 2,500 gpm for 2 hours at a minimum of 20 psi.

PROPOSED WATER SYSTEM FACILITIES

WATER SUPPLY

The project is proposed to be supplied domestic water from two (2) new on-site wells. Per state regulations, the wells shall be designed to supply the full build-out maximum day demand with one well out of service. Therefore, each well shall be designed with a capacity of 1,600-gpm. The well pumps shall be equipped with a variable frequency drive to provide flexibility during the early phases of the project and periods of low demand.

The wells are proposed to be located approximately 1,500 feet apart from each other. The wells will deliver water directly to the new on-site storage tanks through 12-inch diameter transmission mains.

STORAGE

On-site storage is required to provide the development with operational and emergency (fire flow) storage volumes. For developments with less than 1,000 connections, the operational storage volume shall equal the maximum day demand. For developments with greater than 1,000 connections, the operational storage volume shall equal four (4) hours of the peak hour demand. The fire flow storage volume shall be equivalent to the maximum fire flow requirement and duration within the development.

Per the WSA, the full-build our maximum day demand is 2.22 MGD, and the peak hour demand is 3.33 MGD. At 1,000 units, the operational storage volume requirement is approximately 710,000 gallons. However, the operational storage volume decreases to 555,000 gallons at full build-out. The fire flow requirement of 2,500-gpm for a 2-hour duration equates to a storage volume of 300,000 gallons.

In order to provide the minimum required storage volume throughout the phased construction and operational flexibility, it is recommended to construct two (2) equally sized tanks of 555,000-gallons each. The first tank will be required immediately, prior to first occupancy. The second tank will be required prior to the 300th dwelling unit being occupied.

PUMP STATION

The water stored in the on-site storage tanks needs to be boosted to provide adequate pressure to the residents and customers within the development area to meet normal demands plus fire flow requirements. Since gravity storage is not available, the booster station shall be sized to provide the peak hour demand plus the fire flow demand. The pump station shall include at least one (1) back-up pump.

The fire flow requirement of 2,500-gpm is proposed to be supplied by three (3) equally sized pumps with a capacity of 1,250-gpm each. The peak hour demand will vary as the phased construction progresses, therefore it is recommended to install smaller pumps to serve the initial phase(s) of the development, and replace the smaller pumps with larger pumps once the demand exists. It is recommended to initially install two (2) 150-gpm pumps to serve the normal demands and peak hour demands. As demand increases, the 150-gpm pumps will be replaced by 1,250-gpm pumps to meet the ultimate demands. It is recommended to phase the installation of the larger pumps, installing one prior to the 850th dwelling unit and the second prior to ultimate build-out. At ultimate build-out of the development, the booster station will include five (5) 1,250-gpm pumps to provide normal demand, peak hour demand and fire flow protection.

The booster pump station will include a hydropneumatic (surge) tank to provide operational flexibility and consistent pressure. The pumps shall all be equipped with variable frequency drives (VFDs) and shall include on-site back-up power generation. The pump station is anticipated to be housed in a block building with architectural treatment to match the development.

DISTRIBUTION SYSTEM PIPELINES

A hydraulic model of the on-site water distribution system was developed to size the distribution pipeline and ensure minimum pressure and flow requirements were met. The hydraulic model analysis is discussed in the following section. The model results determined that the backbone on-site pipe distribution system will consist primarily of 12-inch and 8-inch looped pipelines. The discharge pipeline from the booster station shall be a minimum of 18-inch diameter pipe to meet the peak hour plus fire flow demand. The backbone pipe network is displayed on Exhibit 10. The summary of linear footages per diameter are included below:

- 8-inch: 24,600 feet
- 10-inch: 2,600 feet
- 12-inch: 20,800 feet
- 18-inch 2,200 feet
- **Total: 51,000 feet**

WATER TREATMENT

In 2017, water samples obtained from the existing agricultural wells located on-site were tested and analyzed for the complete Title 22 drinking water constituents to determine the likely water quality of the proposed wells. The sampling results indicated that no contaminants were detected that would pose a health risk. One of the well samples showed levels of manganese that slightly exceeded the secondary MCL, which is not a public health risk, only a consumer acceptance level. Based on the Well Sampling Results letter, prepared by McCloskey Consultants, dated July 18, 2017, the groundwater appears to be acceptable for the proposed use, and water treatment is not anticipated at this time.


AVENUE 18
AVENUE 17
ROAD 27
ROAD 28 1/2
BURLINGTON NORTHERN SANTA FE RAILROAD LINE
NEW WELL (PUMP 2) REFER TO SEPARATE EXHIBIT
NEW WELL (PUMP 1) REFER TO SEPARATE EXHIBIT
LEGEND
8" WATER LINES
12" WATER LINES
CITY LIMITS
WATER FACILITIES REFER TO SEPARATE EXHIBIT
PROPOSED WELL AND PUMP REFER TO SEPARATE EXHIBIT
NORTH
GRAPHIC SCALE IN FEET
0 150 300 600
CASTELLINA MASTER PLAN
EXHIBIT 10 - OVERALL WATER DISTRIBUTION SYSTEM
OCTOBER 2018

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Initial water sampling data indicated that the water quality is better at levels approximately 500-feet below the surface than the water quality at the lower levels. The well water will be chlorinated prior to entering the storage tank(s) in order to provide disinfection. Although groundwater treatment is not anticipated at this time, space should be provided at the site of the booster pump station and tanks to allow for water treatment if required in the future.

Prior to constructing the wells, it is highly recommended to engage a hydrogeologist to locate and drill pilot holes and perform zone sampling to gauge the water quality and the water availability at the potential well sites.

WATER SUPPLY AND STORAGE SCHEMATIC

The water supply system is proposed to include two new wells, each sized at 1,600 gallons-per-minute (gpm), a chlorination facility, supply storage of approximately 1.1 million gallons and a series of supply and fire flow booster pumps that supply the development. A schematic of the supply and storage system is depicted on Exhibit 11.

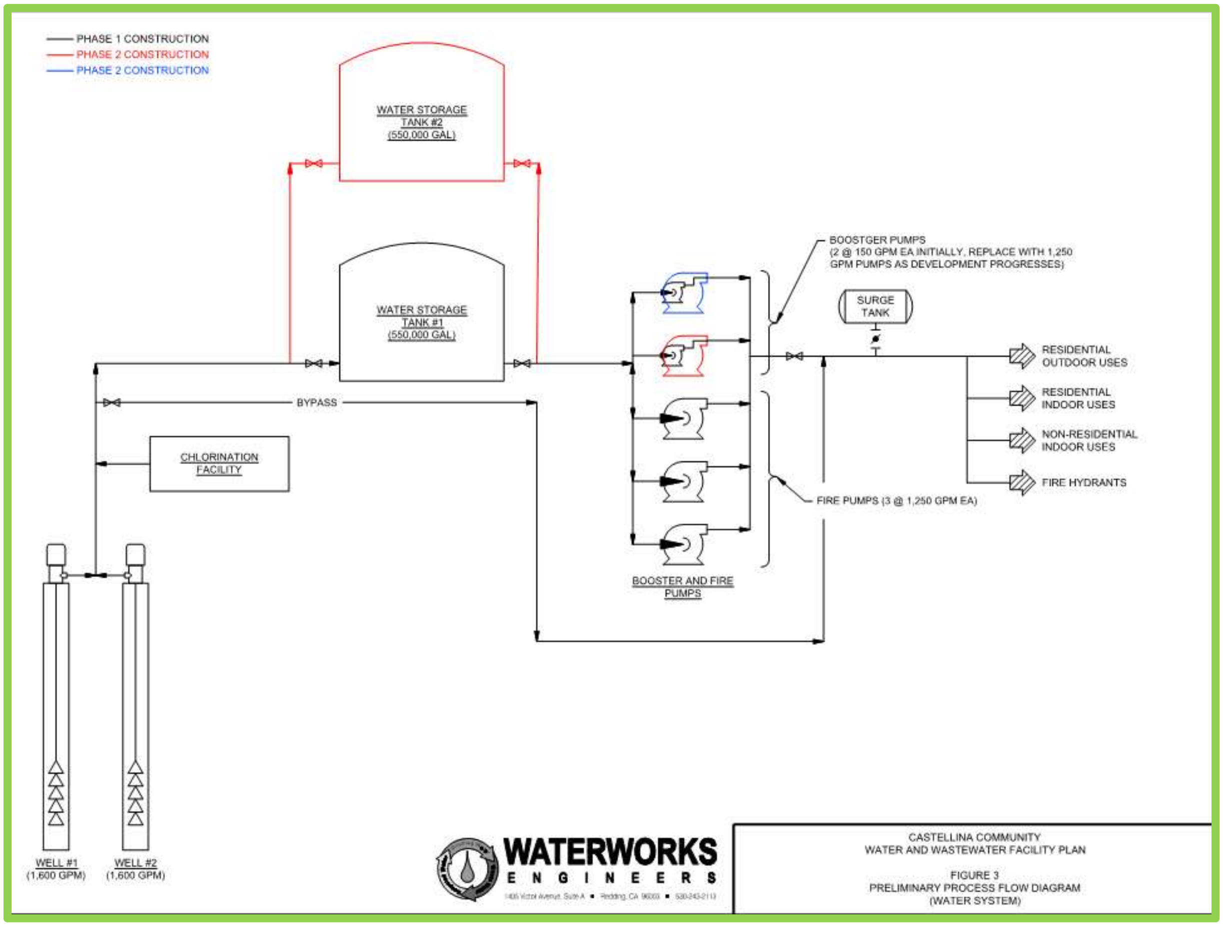

Exhibit 11 - Water Supply and Storage Schematic

INITIAL DEVELOPMENT WATER FACILITIES

As previously discussed within this Master Plan, there is an initial development phase for the project that consists of approximately 117 lots (refer to Exhibit 4). A layout of the water supply, storage and distribution system to serve this initial Phase I development is depicted on Exhibit 12.

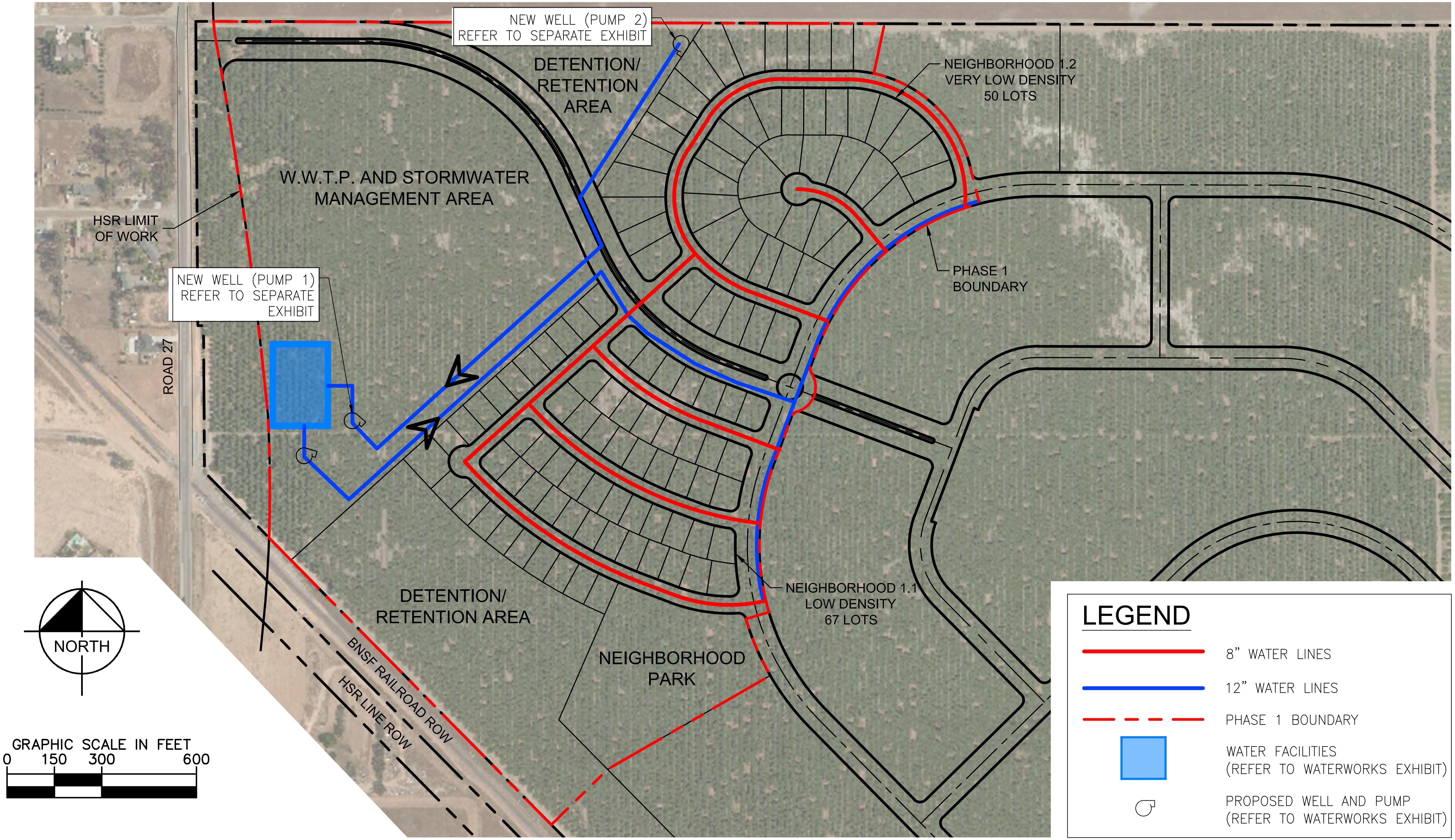

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EXHIBIT 12 - PHASE 1 WATER SYSTEM

CASTELLINA

October 23, 2018

Plotted By: Torres, Stephani Sheet Set: Kha Layout: Layout1 October 23, 2018 07:04:50pm \\Plsfp01\ca_pls\Project\SAC_LDEV\097846003 Castellina\08 CADD\Exhibits\2018.02.14 Phase 1 Boundary Exhibit\Phase 1 Water Exhibit.dwg

VI. WASTEWATER SYSTEM

The wastewater system proposed to serve Castellina will include a series of gravity sewer mains to convey wastewater from the community to an onsite wastewater treatment and reclamation facility that will ultimately produce Title 22 compliant recycled water for beneficial reuse within the community. This section of the Master Plan includes a discussion of the wastewater generation rates for the development area and the corresponding sanitary sewer system infrastructure that will be required to conveys the projected flows to the wastewater treatment plant.

The results and conclusions of the wastewater modeling were developed to configure the backbone wastewater collection system for the proposed development area. It is understood that additional in tract wastewater collection system piping will be required within each of the development areas to serve the individual uses.

A detailed discussion of the wastewater system, including the results of the sewer system modeling is located within Appendix D of this Master Plan document.

LAND USE AND WASTEWATER GENERATION

The Castellina Development is proposed to be divided into five major development areas: Village A, B, C, D, and the Town Center. The areas will be developed with a variety of land uses including residential, active adult community, mixed use, open space, and parks. The total gross area is 615.6 acres. The amount of developed land within the area (net) is approximately 509.4 acres. Each land use generates wastewater flow based on unit flow factors, either with GPD/DU for Residential Units, or GPD/Acre for Active Open space and Schools. The Average Daily Flow (ADF) Unit Flow Factors that are used for the Area are shown below in Table VI-1.

Table VI-1
Castellina Infrastructure Master Plan
Wastewater System
Average Dry Weather Unit Flow Factors

Land Use Category	Development Flow Factor (GPD/DU) or (GPD/ac)
Residential	
Very Low Density	210
Low Density Residential	210
Medium Density Residential	210
High Density Residential	110
Mixed Use	210
Active Adult Amenity Center	110
Parks and Open Space	
Active Open	680
Other	
School	1,000

A summary of the proposed land use acreages and residential unit counts that generate wastewater flows for the planned development are shown in Table VI-2. Residential Average Daily Flow is calculated by multiplying the unit flow factor by the net units. The Active Open land use category and School land use category are calculated by multiplying the unit factor flow by net acres. All Peak Hourly Flow is calculated with a peaking factor of 3.

Table VI-2
Castellina Infrastructure Master Plan
Wastewater System
Wastewater Generation by Land Use

Land Use	Unit Flow Factor (GPD/unit) or (GPD/ac)	Net Area (Acres)	Net Units	Average Daily Flow (GPD)	Peak Hourly Flow (GPD)
Residential					
Very Low Density	210	N/A	95	19,950	59,850
Low Density Residential	210	N/A	1,105	232,050	696,150
Medium Density Residential	210	N/A	402	84,420	253,260
High Density Residential	110	N/A	1,035	113,850	341,550
Mixed Use	210	N/A	240	50,400	151,200
Active Adult Amenity Center	110	N/A	402	44,220	132,660
Parks and Open Space					
Active Open	680	66	N/A	45,152	135,456
Other					
School	1,000	12	N/A	12,000	36,000

HYDRAULIC MODEL ANALYSIS

A hydraulic model of the proposed wastewater collection and conveyance system was developed for the project. The following are the criteria that were utilized in the development of the model.

- The primary wastewater generation areas within the proposed development were delineated by sewer basins.
- The land use areas, with their respective generation rates, were assigned a manhole node to tie into the trunk system.
- Proposed land use acreages and wastewater generation for each manhole point of connection were tabulated and allocated.

- Wastewater flows, including average dry weather flows and factored peak flows were calculated and allocated at each node point.

- Average dry weather flows were calculated using the Average Dry Weather Unit Flow Factors for the land use types within each wastewater shed.

- Factored flows were calculated by multiplying average dry weather flows by a peaking factor of 3.0.

- Pipe sizes were initially sized based on peak buildout flows and pipe capacities based on minimum pipe slopes.

PIPELINE SIZING CRITERIA

The proposed pipe size diameters were selected using the following pipe criteria:

- Minimum pipe diameter is 8-inches.

- Pipes 15-inches and less in diameter are designed to have a maximum depth of flow of 50% of the pipe diameter.

- Pipes larger than 15-inches in diameter are designed to have a maximum depth of flow of 75% of the pipe diameter.

- Pipe sizes have been selected assuming pipes will be installed at minimum slopes: 0.0035 ft/ft for 15-inch diameter and less; 0.0010 ft/ft for larger than 15-inch.

- The minimum slope for a pipe is a slope that yields a minimum 2 feet per second velocity when flowing at design capacity for 15-inch diameter and less, and 1.75 feet per second for pipes larger than 15-inch.

MODELING SCENARIOS

A hydraulic model of the skeletonized system (backbone system) representing the proposed collection pipe network was developed utilizing the SewerCAD hydraulic modeling software by Bentley. A static model was developed to analyze average daily flow and peak hourly flow. Both model input and output data were reviewed for consistency with the standards listed above as well as industry standard criteria and design standards.

MODELING RESULTS

The hydraulic model was analyzed under the average daily flow and peak hourly flow. The peak hourly flow model scenario was used to identify the sewer system required to serve the area.

PROPOSED IMPROVEMENTS

Based on the currently available land use plans for the development, the wastewater collection and conveyance system required to provide service to the area includes:

- One (1) Wastewater Treatment Plant
- Approximately 41,000 LF of 8" – 18" gravity sewer main, comprised of the following:
  - Approximately 20,300 LF of 8" gravity sewer main
  - Approximately 9,000 LF of 10" gravity sewer main
  - Approximately 5,900 LF of 12" gravity sewer main
  - Approximately 2,200 LF of 15" gravity sewer main
  - Approximately 3,600 LF of 18" gravity sewer main

The proposed layout of the sewer improvements is depicted on Exhibit 13, which includes the development broken out by the different sewersheds.

WASTEWATER TREATMENT

A new wastewater treatment plant will be constructed to treat the domestic wastewater generated within the new development, and recycled water will be used for non-residential outdoor irrigation. See Exhibit 14 for a preliminary process flow diagram of the proposed wastewater and recycle water systems at Castellina. The new WWTP and associated facilities will be located at the northeast corner of the development, south of the main entrance to the site and east of the proposed high-speed rail system embankment. The WWTP will be set back from the main development access road centerline by approximately 270 ft, and there will likely be commercial approximately 1 acre lots separating the WWTP from the main access road. There will also be approximately 14.2 acres of existing almond orchards to remain between the WWTP access road and the development access road and the southern half of the Phase 1 development. These features will effectively shield the WWTP from view from either the main access road or nearest homes. See Figure 2 for a preliminary site plan for the proposed water system and Figure 4 for the preliminary process flow diagram.


AVENUE 18
AVENUE 17
ROAD 27
ROAD 28 1/2
BURLINGTON NORTHERN SANTA FE RAILROAD LINE
A
B
C
D
E
LEGEND
8" SEWER LINE
10" SEWER LINE
12" SEWER LINE
15" SEWER LINE
18" SEWER LINE
CITY LIMITS
WASTEWATER TREATMENT PLANT REFER TO SEPARATE EXHIBIT
PROPOSED LIFT STATION
MANHOLE
SEWER BASIN A
SEWER BASIN B
SEWER BASIN C
SEWER BASIN D
SEWER BASIN E
NORTH
GRAPHIC SCALE IN FEET
0 150 300 600
CASTELLINA MASTER PLAN
EXHIBIT 13 - OVERALL WASTEWATER COLLECTION SYSTEM
NOVEMBER 2018

Kimley»Horn

The treated wastewater (effluent) requirements are anticipated to be per Title 22, Division 4, Chapter 3, Section 60301 etc. of the CCR (Title 22). In addition to the tertiary filtration and disinfection requirements of Title 22, nitrogen limitations are anticipated to minimize any impact to groundwater.

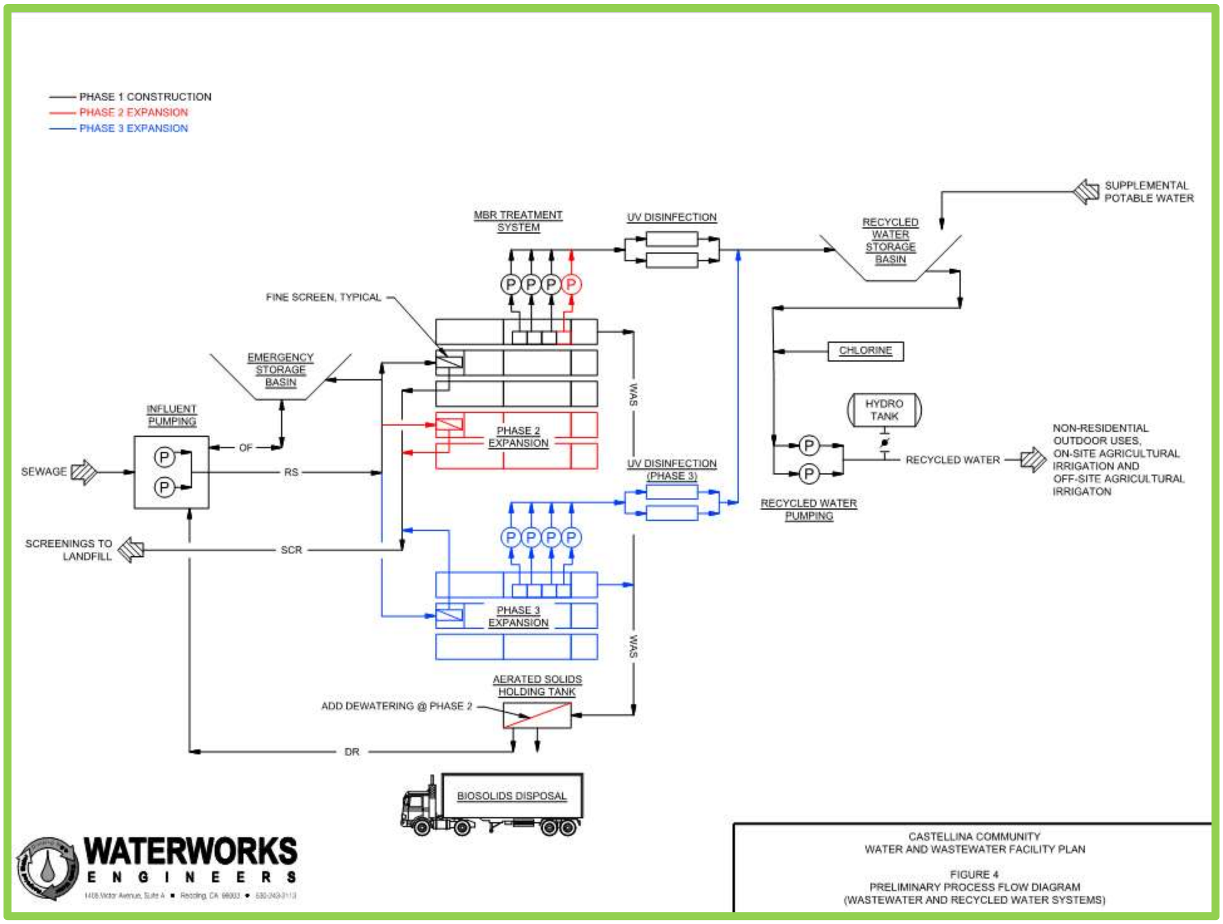

Exhibit 14 - Wastewater Treatment System Schematic

BENEFICIAL REUSE

Per the Water Supply Assessment (WSA), recycled water is planned to initially be used for construction water and non-residential outdoor irrigation. Additionally, it is anticipated that portions of the existing almond and fig orchards will be irrigated year-round within the development’s property to dispose of excess recycled water. To accomplish this, the new recycled water distribution system will be tied into the existing almond and fig irrigation systems as necessary to balance irrigation needs with excess recycled water disposal requirements. As development progresses and existing crops are removed to make way for homes, commercial facilities, school, etc., excess recycled water is anticipated to be conveyed offsite for agricultural irrigation of adjacent farmlands. Space is reserved at the WWTP site for construction of a larger recycled water reservoir for long-term storage (in addition to the 2.3-million-gallon basin to be added in Phase 1 of the project for short-term storage) in the event that year-round irrigation is not feasible and recycled water must be held for several months.

WASTEWATER TREATMENT AND RECYCLED WATER FACILITIES

During the initial phases of development, when only a few houses are constructed, wastewater would likely need to be temporarily stored and hauled to the City of Madera WWTP, approximately 12 miles away from the development.

As homes are constructed and occupied, and daily average wastewater flows reach approximately 5,000 gallons per day (approx. 30 units), wastewater will be treated onsite at the new facilities.

The anticipated wastewater and recycled water systems include the following main unit treatment processes and ancillary systems.

- Influent Pumping
- Influent Screening
- Emergency Storage
- Influent Flow Equalization
- Packaged Biological Treatment and Tertiary Filtration
- Disinfection
- Recycled Water Storage
- Recycled Water Pumping
- Residuals Handling
- Odor Control

- Operations Building
- Site Piping
- Electrical and Controls

The report contained in Appendix B describes each of the treatment processes and ancillary systems in more detail.

INITIAL DEVELOPMENT WASTEWATER FACILITIES

As previously discussed within this Master Plan, there is an initial development phase for the project that consists of approximately 117 lots (refer to Exhibit 4). A layout of the wastewater collection, conveyance and treatment system to serve this initial Phase I development is depicted on Exhibit 15.

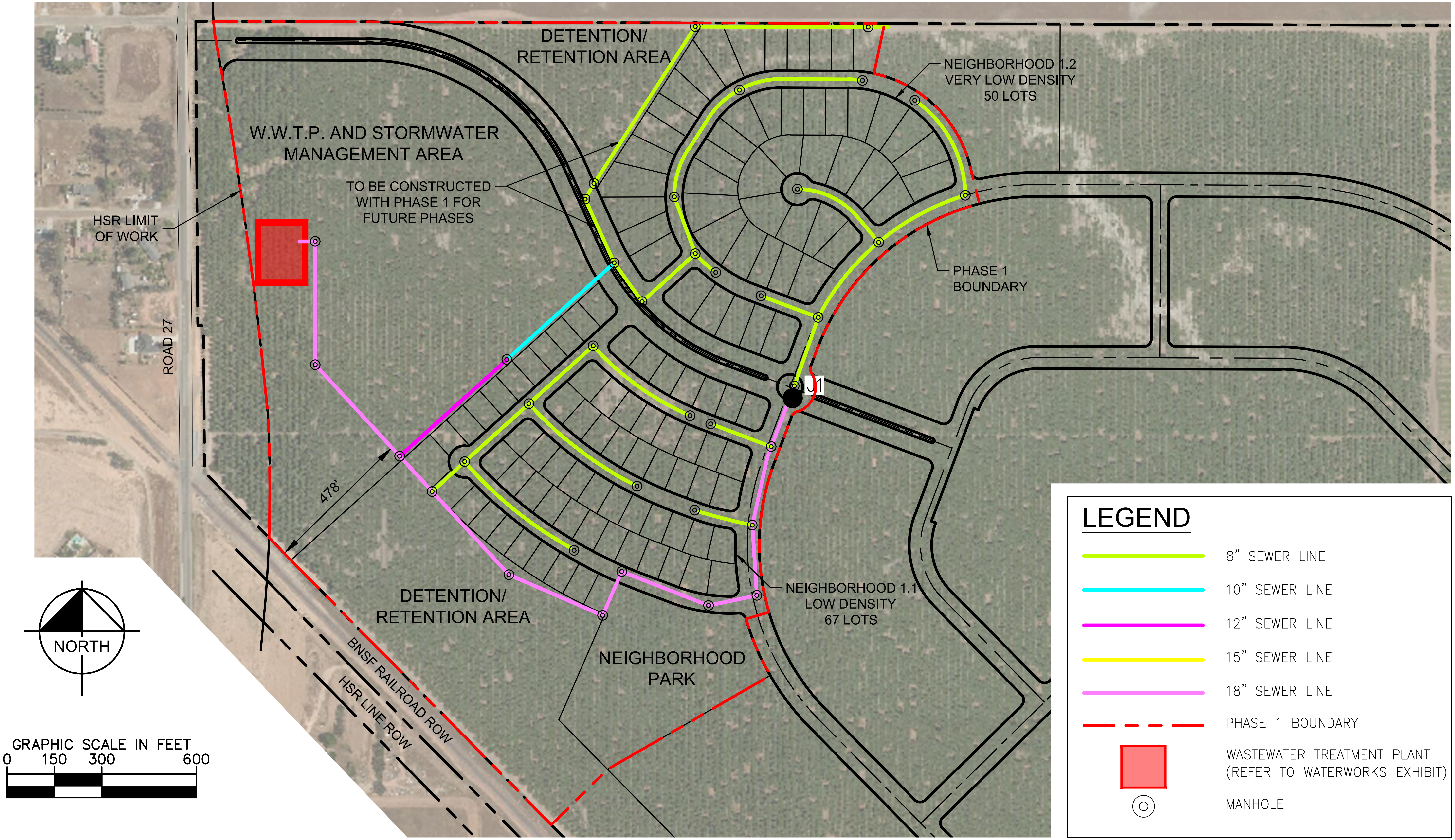

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EXHIBIT 15 - PHASE 1 WASTEWATER COLLECTION SYSTEM

CASTELLINA

October 23, 2018

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VII. RECYCLED WATER SYSTEM

RECYCLED WATER SYSTEM OVERVIEW AND DEMANDS

A recycled water system is proposed for the Castellina Development. A preliminary analysis has been completed for the recycled water system that will serve the development area, including the following:

- On-Site Recycled Water production;
- Recycled water demand projections for the development area;
- Recycled water infrastructure that delivers the projected flows to the proposed recycled water users

The results and conclusions of the recycled water modeling are based on a backbone system serving recycled water to all parks and irrigated areas throughout the proposed development area. It is understood that additional in tract recycled water piping may be required within each of the development areas to serve the individual users. Appendix E includes the Technical Memorandum for the Recycled Water System.

RECYCLED WATER DEMAND

The Castellina Development recycled water demand table is shown in detail in Appendix E. The proposed landscaped areas are calculated by multiplying the gross area of the land use category by the percent area irrigated. The flow demand is calculated with an equation developed by the Model Water Efficient Landscape Ordinance (MWELO) developed by the California Department of Water Resources. For the MWELO calculations, demand is weighted according to the amount of turf area, hydroseed area, and remaining landscape area, and a Maximum Applied Water Allowance (MAWA) is determined as 55 percent of the reference evapotranspiration[1]. Based on the MWELO calculation, the average daily on-site recycled water demand is projected to be 266 gpm at build-out, excluding any agricultural uses. A summary of the land uses, landscaped areas and recycled water demand are included on Table VII-1.

---

[1] *Castellina Water Supply Assessment. County Review Draft*. Tully & Young. December 2016

Table VII-1
Castellina Infrastructure Management Plan
Recycled Water System - Demand by Land Use Category

Land Use Category	Gross Acres	Landscape Area (acres)	Turf Area (acres)	Hydroseed Area (acres)	Remaining Landscape Area (acres)	Recycled Water Demand (gpm)
Active Open Space	6	2	0	1	1	5
Central Park	30	24	14	2	7	113
Comm. Garden	3	2	-	-	2	14
Grand Promenade	2	1	1	-	0	7
High Density Residential	1	0	-	0	0	0
Low Density Residential	50	2	-	2	0	12
Medium Density Residential	37	2	-	1	1	8
Neighborhood Park	15	11	6	-	6	47
Open Space	9	9	-	9	0	49
School	12	4	1	1	3	9
Village Square	1	0	0	-	0	1
Very Low Density	6	0	-	0	0	1
Total	**172**	**57**	**22**	**15**	**20**	**266**

RECYCLED WATER SYSTEM CONSIDERATIONS

The wastewater generated on-site by the development will be collected and treated at a proposed on-site wastewater treatment plant. The treatment plant is proposing to utilize a packaged membrane bioreactor (MBR) process to produce a tertiary treated effluent. The MBR facility will initially be sized to handle 0.25 mgd, with two (2) planned expansions of 0.25 mgd each, for a total build-out capacity of 0.75 mgd. The tertiary treated effluent will be disinfected and utilized as recycled water throughout the development to irrigate the various landscaped areas, as well as potentially some agricultural uses. The facilities required to store and deliver the recycled water are described below.

RECYCLED WATER SYSTEM INFRASTRUCTURE

Storage

A recycled water storage basin will be constructed at the site of the WWTP to receive the treated effluent following disinfection. The basin will be sized to contain four (4) days of effluent for the peak day demand condition at the ultimate buildout of the development. This results in a required storage volume of 2.3 million gallons (MG). The basin is proposed as an open-air earthen basin with a flexible HDPE liner. The basin will include floating aerators to control algae growth and minimize odors. The storage basin is proposed to be constructed in its entirety as a part of Phase 1.

Pumping

From the storage basin, the recycled water will be delivered throughout the development via a new recycled water pump station. The recycled water pump station is proposed to be constructed adjacent to the storage basin. The pump station will initially include two (2) 200-gpm pumps with variable frequency drives to provide recycled water to the development. As the development grows and the recycled water production increases, the pumps are planned to be replaced with two (2) 800-gpm pumps.

Distribution

A hydraulic model was developed and analyzed to determine the size of the on-site distribution system piping (see next section). The recycled water pump station discharge pipeline is proposed as an 8-inch diameter pipe. The on-site recycled water distribution system piping will consist of a 6-inch looped system, with smaller branches coming off the loop to deliver water to the end users.

Phasing

Per the WSA, recycled water is planned to initially be used for construction water and non-residential outdoor irrigation. Additionally, it is anticipated that portions of the existing almond and fig orchards will be irrigated year-round within the development’s property to dispose of excess recycled water as construction is phased. To accomplish this, the new recycled water distribution system will be tied into the existing almond and fig irrigation systems as necessary to balance irrigation needs with excess recycled water disposal requirements. As development progresses and existing crops are removed to make way for homes, commercial facilities, school, etc., excess recycled water is anticipated to be conveyed offsite for agricultural irrigation of adjacent farmlands.

PROPOSED IMPROVEMENTS

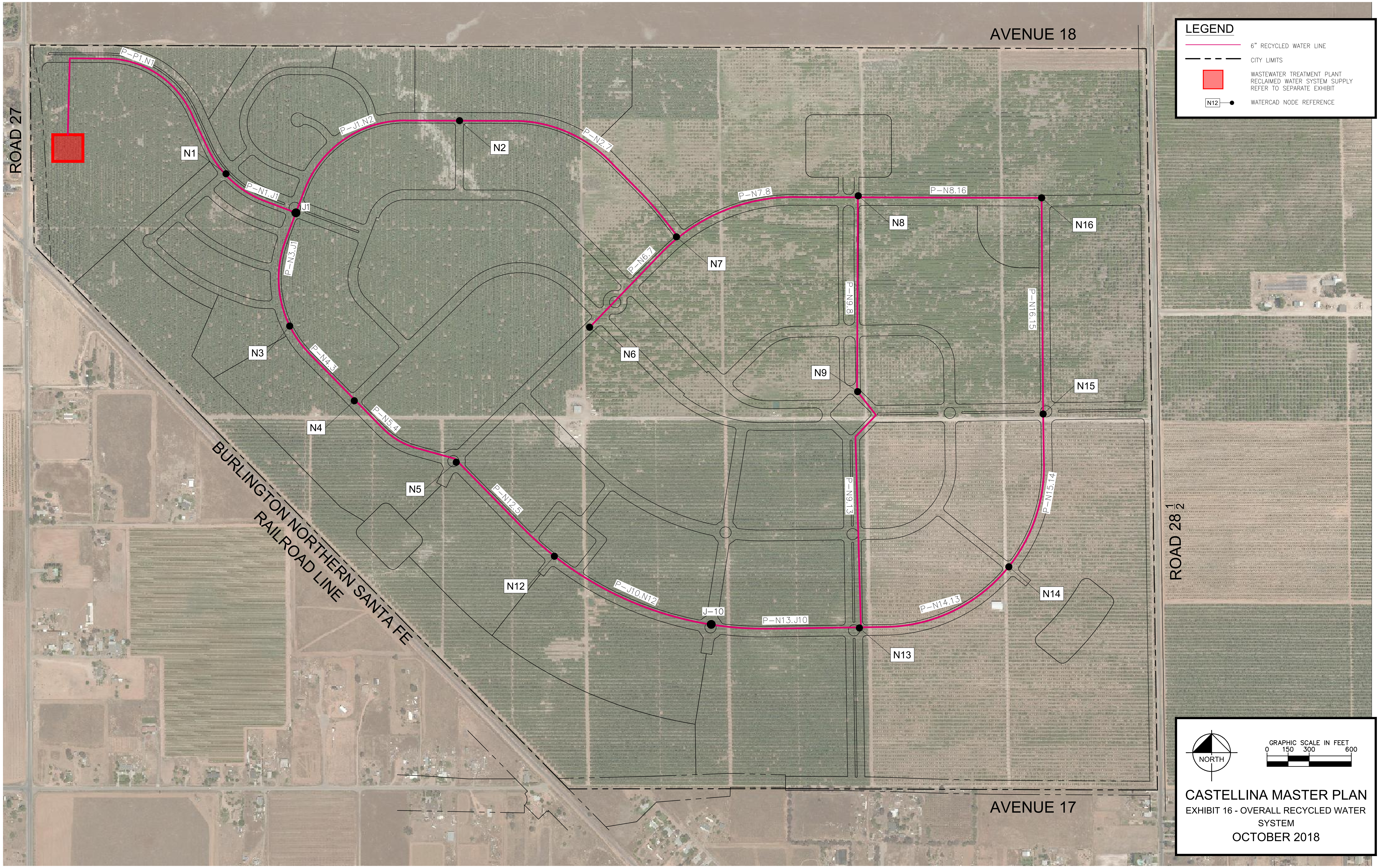
Based on the current land use plan for the development, the recycled water system required to provide service to the area includes:

- 2.3 MG Recycled Water Storage Basin
- Recycled Water Pump Station (2 – 200 gpm pumps)
- Ultimately Upgrade Recycled Water Pump Station (2 – 800 gpm pumps)
- Approximately 20,000 LF of 6” Recycled Water Main
- Approximately 3,000 LF 8-inch water main from the pump station

The improvements proposed for the overall recycled water system are depicted on Exhibit 16.

INITIAL DEVELOPMENT RECYCLED WATER FACILITIES

As previously discussed within this Master Plan, there is an initial development phase for the project that consists of approximately 117 lots (refer to Exhibit 4). A layout of the recycled water conveyance and distribution system to serve this initial Phase I development is depicted on Exhibit 17.



CASTELLINA MASTER PLAN

EXHIBIT 16 - OVERALL RECYCLED WATER SYSTEM

OCTOBER 2018

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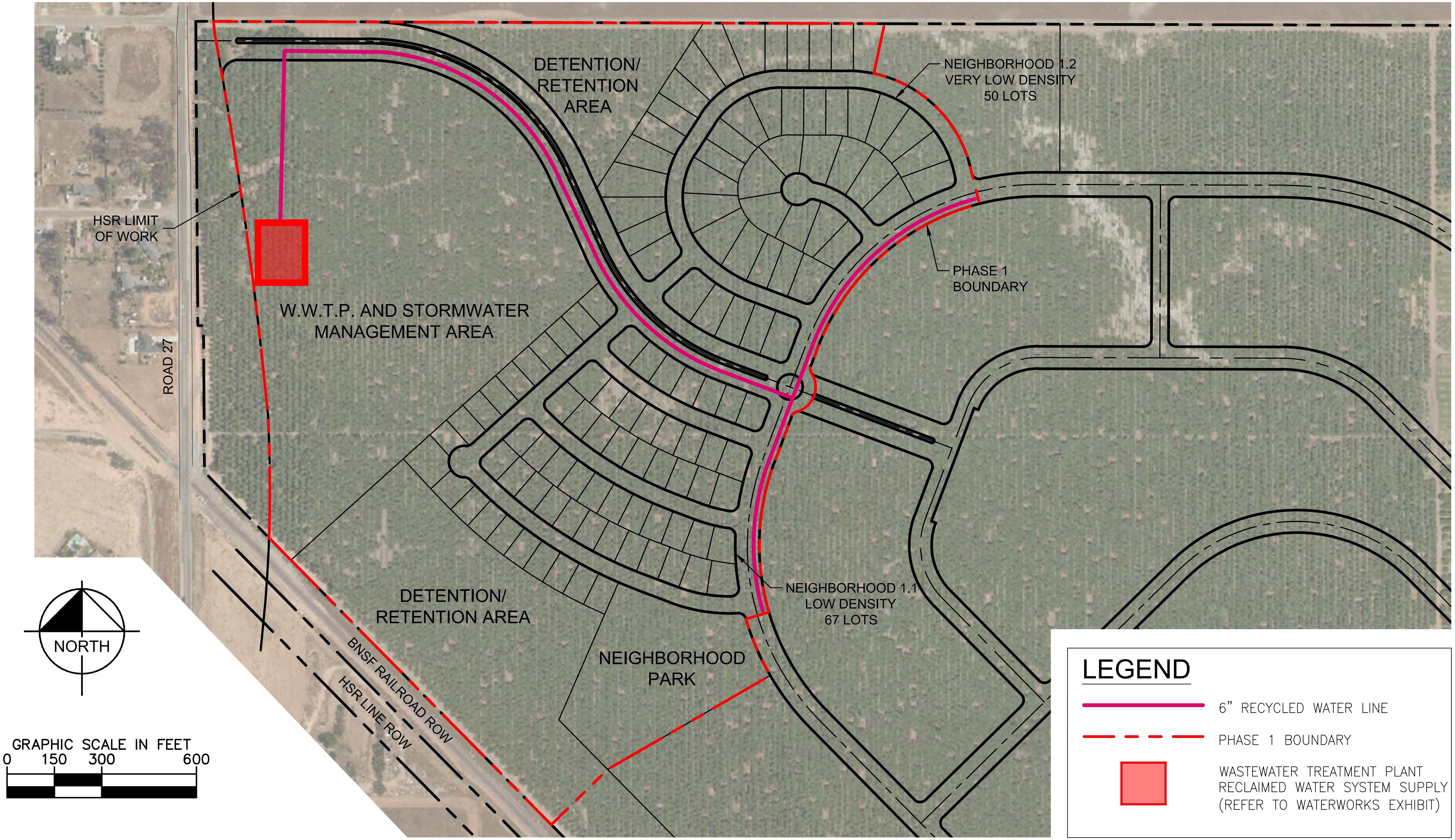

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EXHIBIT 17 - PHASE 1 RECYCLED WATER SYSTEM

CASTELLINA

October 23, 2018

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VIII. DRAINAGE

A comprehensive water management plan for the Castellina Specific Plan has been developed by House Moran Consulting Engineering, Inc. Their report titled, *"Castellina Water Management Plan"* (CWMP), will be submitted as a standalone document.

In general, the purpose of the CWMP is to develop a planning level backbone stormwater masterplan for the Castellina Specific Plan Area. The design constraints that have been identified for the Castellina project are the following:

- Size backbone infrastructure to pass the 25-year design storm event (Source: Caltrans Hydrologic Design Manual, Chapter 380 and County of Madera Master Drainage Plan for Madera Ranchos, Bonadelle Ranchos, and Root Creek, dated June 1984);

- Flow depth less than or equal to 0.5-feet, within the backbone street system, for the 100-year design storm;

- Size Managed Aquifer Recharge (MAR's) areas to contain volume equal to that produced by the 100-year runoff produced by two, three-hour, 100-year rainfall storms and mitigate post-project peak flows to at or below pre-project peak flows;

- Three-hour precipitation distribution provided in the County of Madera Master Drainage Plan for Madera Ranchos, Bonadelle Ranchos, and Root Creek, dated June 1984;

- In each MAR, a single 100-year event should drain within 72-hours; and

- MARs constructed such that stormwater is recharged to the aquifer.

Offsite flows generated to the north of Castellina were estimated using HEC-HMS. Exhibit 18 depicts the existing drainage patterns within the area. Onsite flows were estimated using PCSWMM. It is assumed that offsite flows generated to the east of Castellina will be routed south, within drainage ditches along Road 28½, into the existing drainage network.

Ultimately, all flows within Castellina are routed to the northwestern corner of Castellina at the intersection of Avenue 18 with Road 27 where they are collected into a pipe and routed into the 10-foot by 6-foot culvert under Road 27 proposed as part of the High Speed Rail project. The proposed drainage is depicted on Exhibit 19.

MAR's have been designed such that the post-project peak flows are less than the pre-project peak flows up to and including the 100-year design storm event and infiltrate stormwater into the local aquifer. Using average monthly precipitation and evaporation for Madera County,

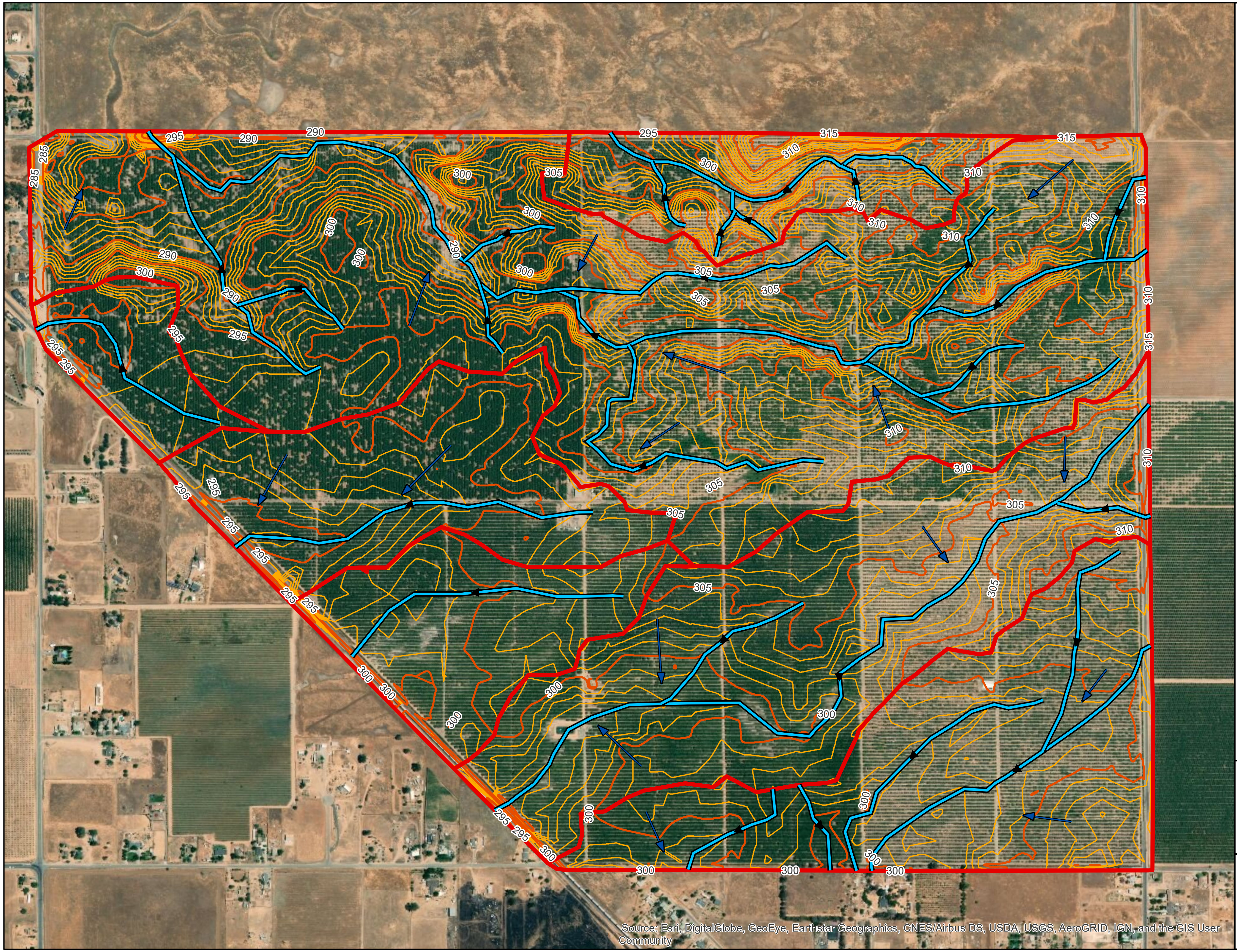
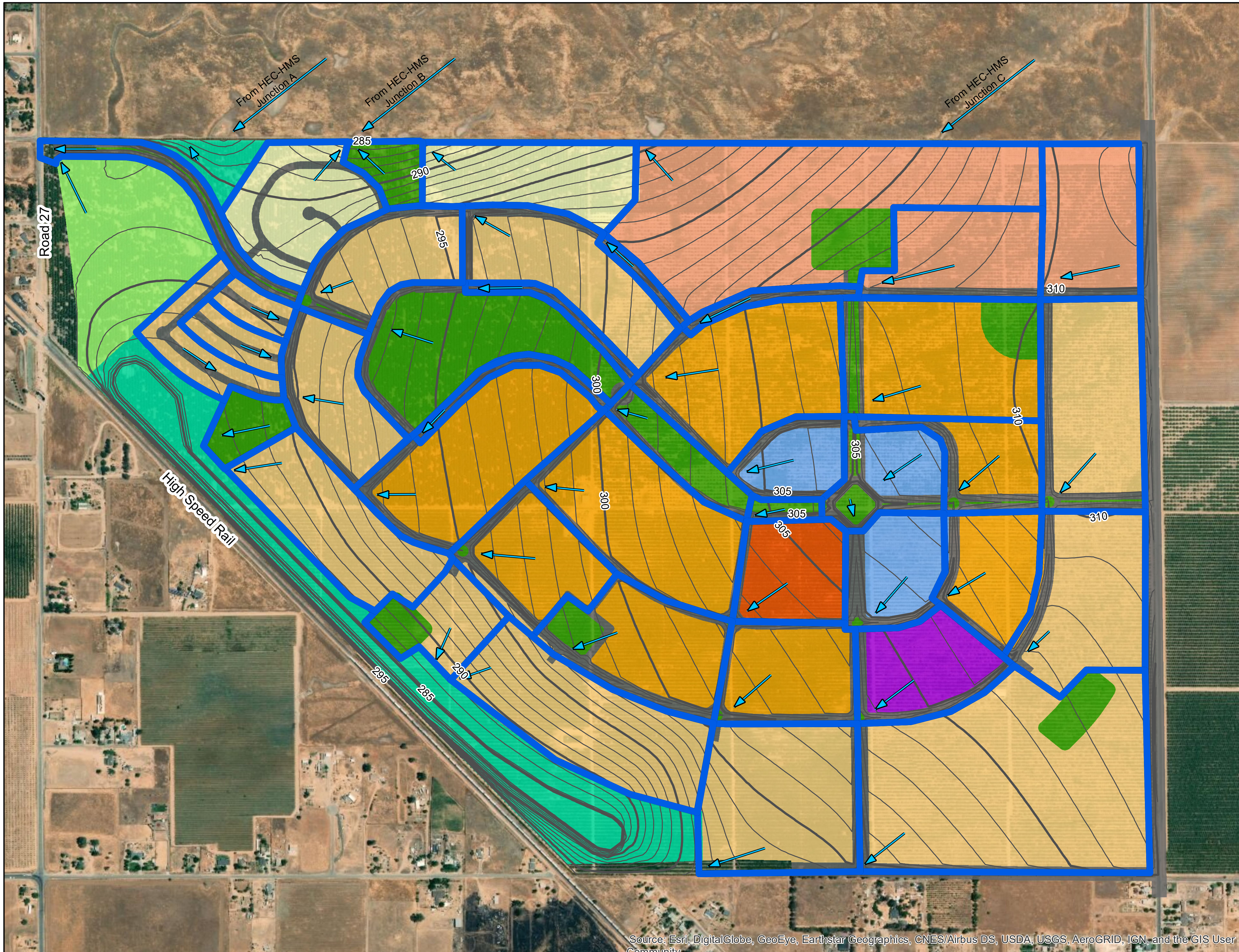


Exhibit 18
Castellina IMP Report
Existing Drainage Patterns

Prepared By:
House Moran Consulting, Inc.
Water Resources and Environmental Engineering
10399 Double R Boulevard Suite 110
Reno, NV 89521
Office: (775) 293-4000
Prepared On: 10/24/2018



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Proposed Flow Direction
- Subcatchments
- Major Contours
- Minor Contours

LandUse

- Active Adult
- High Density Residential
- Landscape
- Low Density Residential
- Medium Density Residential
- Multi Use
- Open Space
- Road
- School
- Very Low Density Residential
- Waste Water Teatment

0 500 1,000

1 in = 4,000 ft

Exhibit 19
Castellina IMP Report
Proposed Drainage

Prepared By:
House Moran Consulting, Inc.
Water Resources and Environmental Engineering
10399 Double R Boulevard Suite 110
Reno, NV 89521
Office: (775) 293-4000

Prepared On: 10/29/2018

the annual average infiltration for Castellina, excluding offsite flows, is about 560 acre-feet. The sizing of the MAR's is shown on Table VIII-1.

Table VIII-1
Castellina Infrastructure Master Plan
Managed Aquifer Recharge (MAR's) Sizing

Basin	Side	Buffer	Minimum Freeboard	Length	Width		Depth	Surface Area	Volume
					B1	B2			
ID	Slope	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(AC)	(AC-FT)
MAR #1	3:1	30	1	420	325	n/a	25	3.1	40.9
MAR #2	3:1	30	1	380	300	n/a	25	2.6	31.9
MAR #3	3:1	30	1	258	188	n/a	8	1.1	5.1
MAR #4	3:1	30	1	310	410	125	9	1.9	11.1
							Total	**8.8**	**89.0**

The internal drainage system has been conceptually developed based on the land plan and the proposed site grading plan. Exhibit 20 depicts the proposed storm drain piping system for the Castellina Specific Plan area.

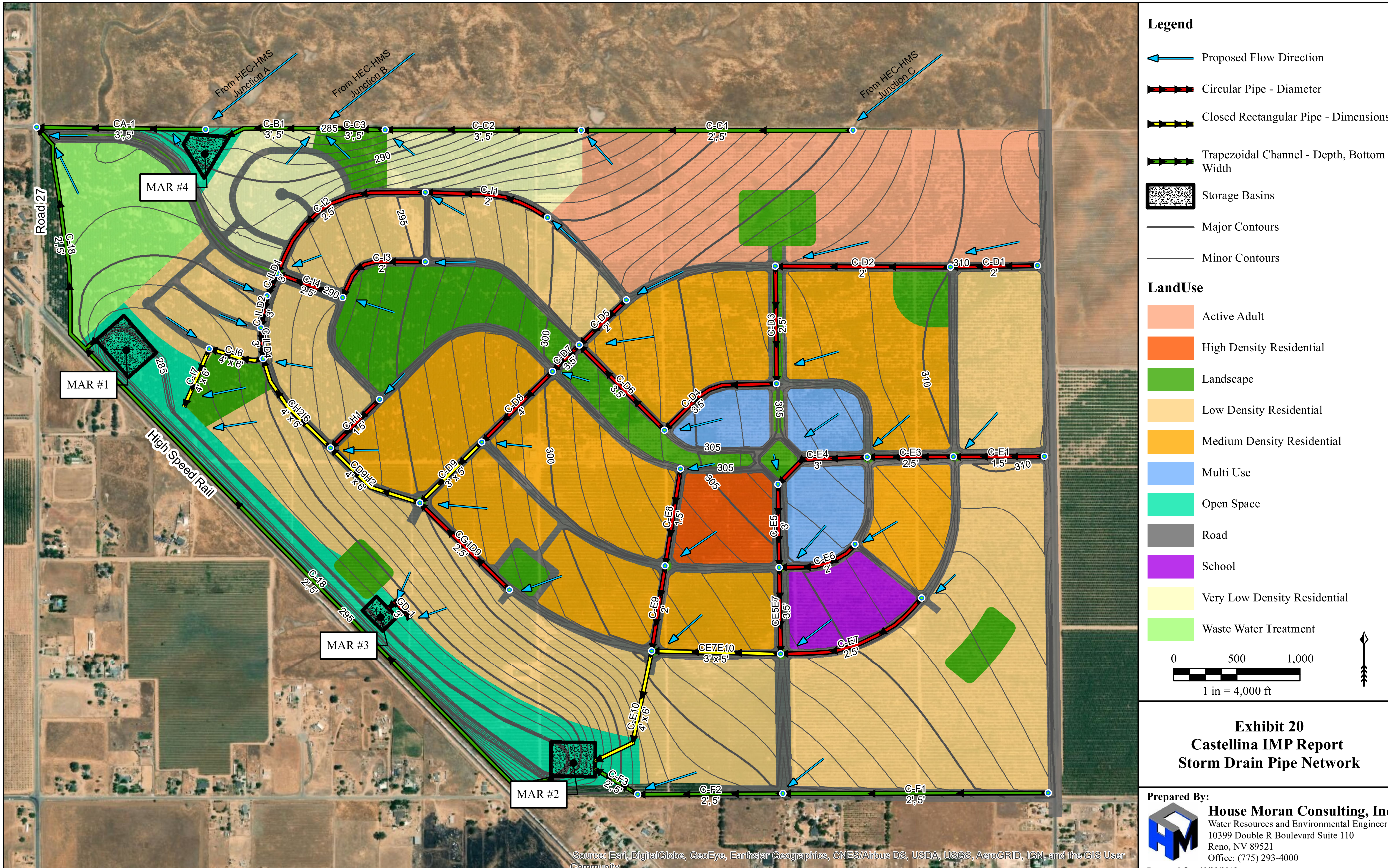


Exhibit 20
Castellina IMP Report
Storm Drain Pipe Network

IX. OVERALL FACILITIES LAYOUT

The preceding sections of this Master Plan describe the proposed water, wastewater and recycled water facilities that will be required for the project. The treatment, pumping and storage facilities are proposed to be located on the western edge of the Specific Plan Area. Exhibit 21 depicts the proposed layout of the facilities within the overall development area.

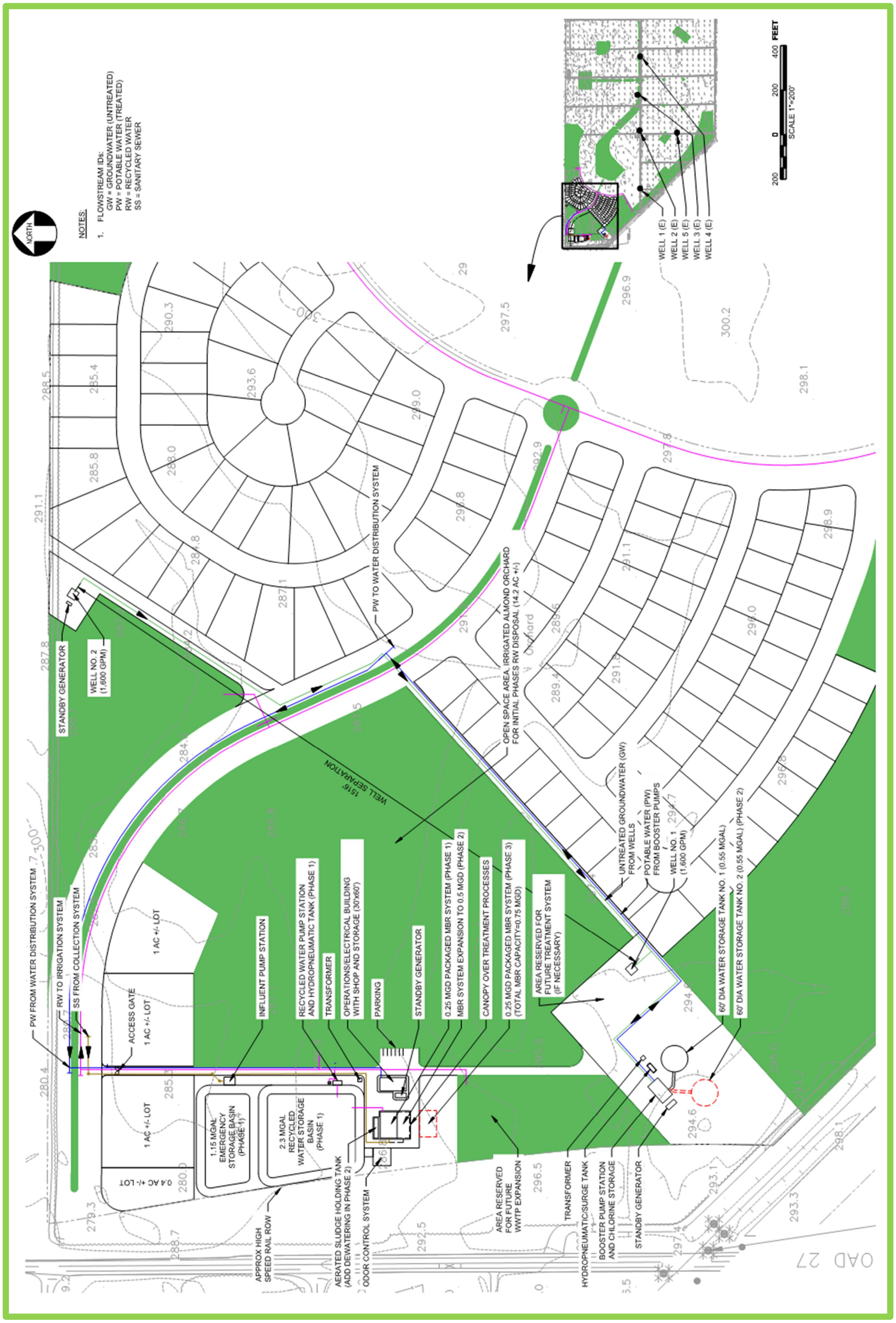


Exhibit 21 - Overall Facilities Layout

Infrastructure Master Plan

APPENDIX A

Existing Site Topography

(Exhibit 6)

Kimley»Horn

EXHIBIT 6 - EXISTING TOPOGRAPHY
CASTELLINA MASTER PLAN
OCTOBER 26, 2018

Infrastructure Master Plan

APPENDIX B

Draft

“Castellina Community Water and Wastewater Facility Plan”

By Water Works Engineers

Castellina Community
Water and Wastewater Facility Plan

DRAFT

October 24, 2018

Prepared for:
Castellina, LLC

Prepared by:
Joe Riess, P.E.
760 Cypress Ave., Suite 201
Redding, CA 96001

WATERWORKS ENGINEERS

CONTENTS

TABLES

FIGURES

ABBREVIATIONS

ADD	average day demand
ADMMF	average day maximum month flow
ADWF	average dry weather flow
af	acre-ft
CCR	California Code of Regulations
CVRWQCB	Central Valley Regional Water Quality Control Board
DDW	Division of Drinking Water
EIR	environmental impact report
ft	foot
gpd	gallons per day
gpm	gallons per minute
HDPE	high density polyethylene
hp	horsepower
IMP	Infrastructure Master Plan
MBR	membrane bioreactor
MCL	maximum contaminant limit
MDD	maximum day demand
MDD	maximum day demand
mgd	million gallons per day
NFF	needed fire flow
PHD	peak hour demand
PHF	peak hour flow
PLC	programmable logic controller
RAS	return activated sludge
RTU	remote telemetry unit
SCADA	supervisory control and data acquisition
UV	ultraviolet
VFD	variable frequency drive
WAS	waste activated sludge
WSA	Water Supply Assessment
WWTP	wastewater treatment plant
yr	year

1 PURPOSE

Water Works Engineers, LLC was retained by Castellina, LLC (Developer) to provide facility plans for water storage and booster pumping facilities, and wastewater treatment and reuse/disposal at the planned Castellina development in Madera County. Castellina is a master-planned community to be located on approximately 794 acres approximately one mile north of the City of Madera, California. The Castellina Specific Plan (Administrative Draft, November 2016 by Kimley Horn) calls for development of up to 3,072 single-family, multi-family and mixed-use residential units; approximately 21 acres of commercial mixed-use; and approximately 131 acres of parks, play fields, trails, plazas, community gardens, and other open space. The first phase of the project will include development of 117 residential lots (Phase 1), with subsequent phases initiated to keep pace with forecasted lot sales. See Figure 1 for a location map of the proposed development.

The purpose of this report is to provide conceptual-level facility plans for the necessary water and wastewater systems, to support the development of the project Environmental Impact Report (EIR) and Infrastructure Master Plan (IMP).

2 CONSOLIDATION FEASIBILITY

A detailed consolidation feasibility analysis is not part of the scope of this plan. However, discussions with the Developer's project team indicate that it is not feasible to connect to any adjacent public water or wastewater system. Detailed consolidation analyses will be included in separate technical reports to meet the permitting requirements of the California Division of Drinking Water (DDW) and Central Valley Regional Water Quality Control Board (CVRWQCB) for the new systems.

3 WATER SYSTEM FACILITIES PLANNING

The following section describes the requirements for potable water source capacity, forecast water demands, and anticipated water supply wells, water treatment, fire flows, water storage, booster pumps and fire pumps. See Figure 2 for a preliminary site plan and Figure 3 for a preliminary process flow diagram for the proposed water system.

3.1 Source Capacity Requirements

Section 64554 of Title 22 of the California Code of Regulations (CCR) requires the following for source water capacity:

> *(a) At all times, a public water system's water source(s) shall have the capacity to meet the system's maximum day demand (MDD). MDD shall be determined pursuant to subsection (b).*
>
> > *(1) For systems with 1,000 or more service connections, the system shall be able to meet four hours of peak hourly demand (PHD) with source capacity, storage capacity, and/or emergency source connections.*
> >
> > *(2) For systems with less than 1,000 service connections, the system shall have storage capacity equal to or greater than MDD, unless the system can demonstrate that it has an additional source of supply or has an emergency source connection that can meet the MDD requirement.*
> >
> > *(3) Both the MDD and PHD requirements shall be met in the system as a whole and in each individual pressure zone.*
>
> *(b) A system shall estimate MDD and PHD for the water system as a whole (total source capacity and number of service connections) and for each pressure zone within the system (total water supply available from the*

water sources and interzonal transfers directly supplying the zone and number of service connections within the zone), as follows:

(1) If daily water usage data are available, identify the day with the highest usage during the past ten years to obtain MDD; determine the average hourly flow during MDD and multiply by a peaking factor of at least 1.5 to obtain the PHD.

(2) If no daily water usage data are available and monthly water usage data are available:

(A) Identify the month with the highest water usage (maximum month) during at least the most recent ten years of operation or, if the system has been operating for less than ten years, during its period of operation;

(B) To calculate average daily usage during maximum month, divide the total water usage during the maximum month by the number of days in that month; and

(C) To calculate the MDD, multiply the average daily usage by a peaking factor that is a minimum of 1.5; and

(D) To calculate the PHD, determine the average hourly flow during MDD and multiply by a peaking factor that is a minimum of 1.5.

(3) If only annual water usage data are available:

(A) Identify the year with the highest water usage during at least the most recent ten years of operation or, if the system has been operating for less than ten years, during its years of operation;

(B) To calculate the average daily use, divide the total annual water usage for the year with the highest use by 365 days; and

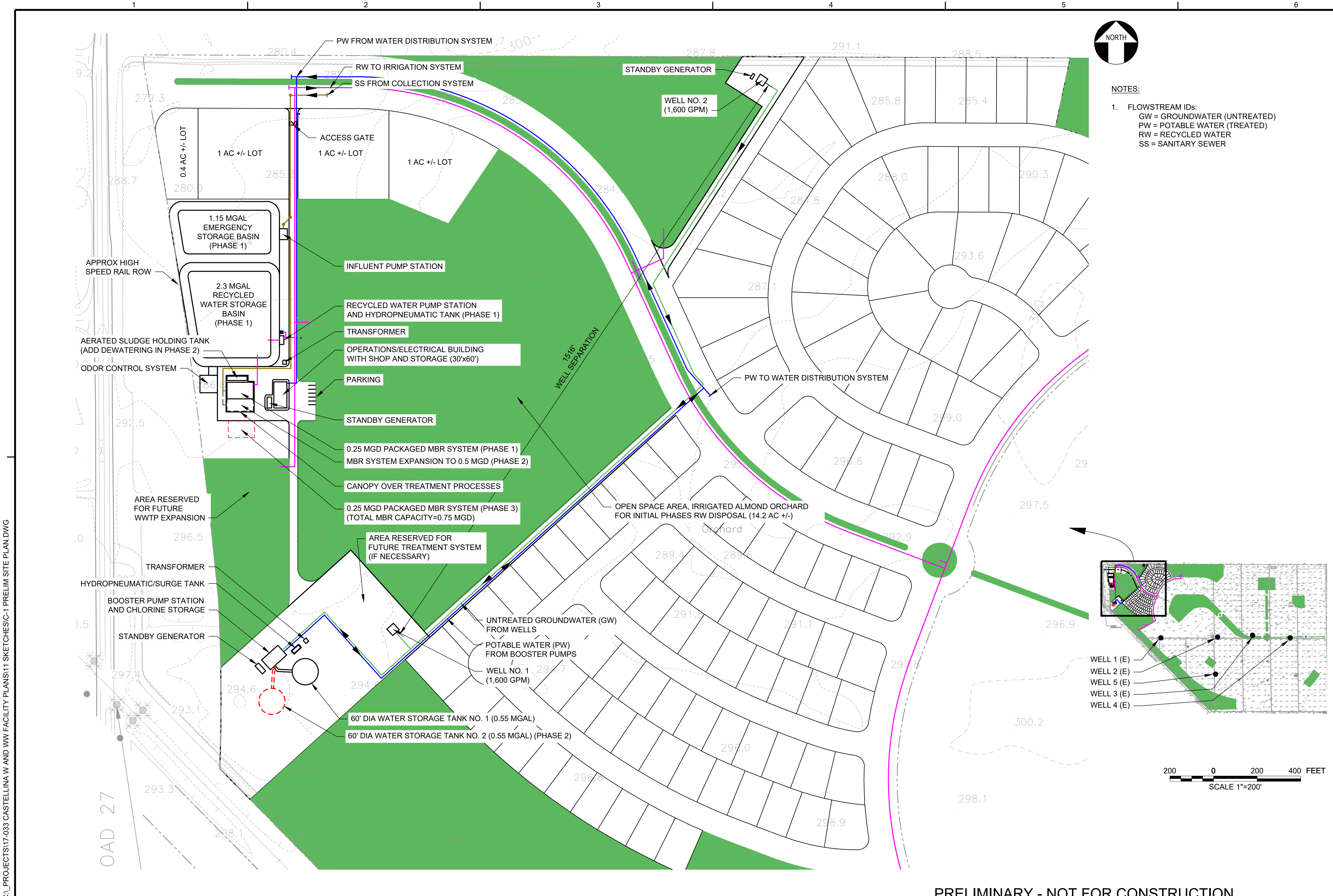
(C) To calculate the MDD, multiply the average daily usage by a peaking factor of 2.25.

(D) To calculate the PHD, determine the average hourly flow during MDD and multiply by a peaking factor that is a minimum of 1.5.

(4) If no water usage data are available, utilize records from a system that is similar in size, elevation, climate, demography, residential property size, and metering to determine the average water usage per service connection. From the average water usage per service connection, calculate the average daily demand and follow the steps in paragraph (3) to calculate the MDD and PHD.

(c) Community water systems using only groundwater shall have a minimum of two approved sources before being granted an initial permit. The system shall be capable of meeting MDD with the highest-capacity source off line.

Figure 1: Location Map



NOTES:

1. FLOWSTREAM IDs:
   - GW = GROUNDWATER (UNTREATED)
   - PW = POTABLE WATER (TREATED)
   - RW = RECYCLED WATER
   - SS = SANITARY SEWER

PRELIMINARY - NOT FOR CONSTRUCTION

DESIGN J RIESS | DRAWN J RIESS | CHECKED J RIESS | APPROVED J RIESS

WATERWORKS ENGINEERS
1405 Victor Avenue, Suite A • Redding, CA 96003 • 530-243-2113

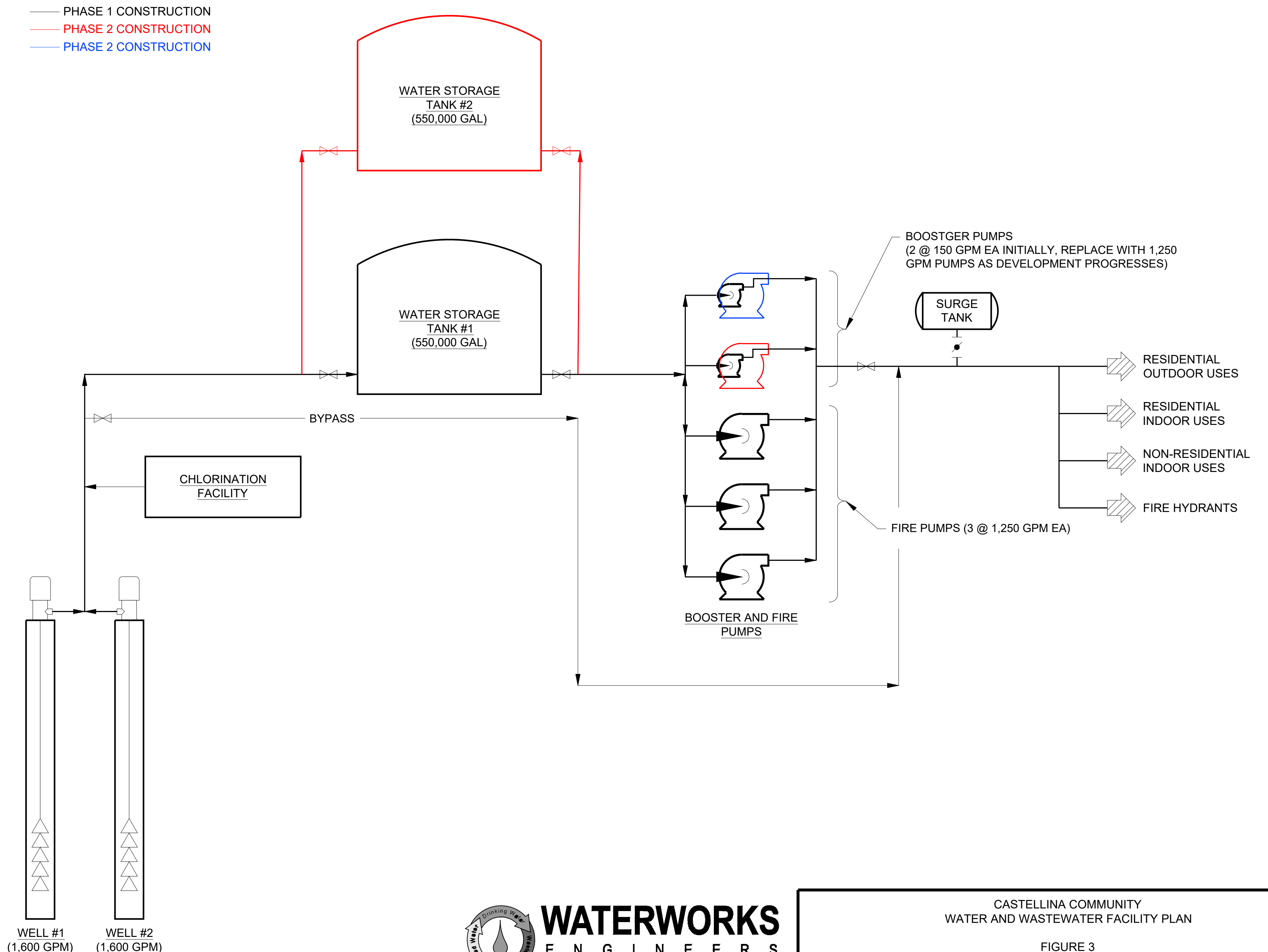
CASTELLINA, LLC
WATER AND WASTEWATER
FACILITIES PLAN
MADERA COUNTY, CALIFORNIA

FIGURE 2
PRELIMINARY SITE PLAN

DATE SEPT 2018
PROJECT NUMBER 17-033
DRAWING NUMBER C-1
SHEET NUMBER 1

JOB NUMBER: 17-033 FILENAME: C-1 PRELIM SITE PLAN.DWG PLOT DATE: 10/23/18 PLOT TIME: 15:41:19

C:_PROJECTS\17-033 CASTELLINA W AND WW FACILITY PLANS\11 SKETCHES\C-1 PRELIM SITE PLAN.DWG



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CASTELLINA COMMUNITY
WATER AND WASTEWATER FACILITY PLAN

FIGURE 3
PRELIMINARY PROCESS FLOW DIAGRAM
(WATER SYSTEM)

Oct 21, 2018 - 6:58pm

3.2 Potable Water Demands

The forecast annual potable water demand was provided in Table 2-3 of the project's Water Supply Assessment (WSA) (Tully and Young), listed in acre-ft per year (af/yr) for planning years 2020 through 2040 in 5-year increments. These annual values were converted to million gallons per day (mgd) for the Average Day Demand (ADD). The Maximum Day Demand (MDD) and Peak Hour Demand (PHD) were estimated per Section 64554(b)(3) of Title 22 of the CCR for new source capacity. Phase 1 water demands were estimated by pro-rating the 2020 water demand by the Phase 1 and 2020 number of units. This results in the following forecast potable water design flows as shown in Table 1.

Table 1: Forecast Potable Water Demands

		Planning Year					
Item	**Unit**	**Phase 1**	**2020**	**2025**	**2030**	**2035**	**2040**
No. Units		117	294	842	1,683	3,072	3,072
Total Potable Demand (w/Loss)[1]	af/yr	47	118	297	603	1,107	1,107
Average Day Demand (ADD)	mgd	0.04	0.10	0.27	0.54	0.99	0.99
	gpm	29	73	184	374	686	686
Maximum Day Demand (MDD=2.25xADD)[2]	mgd	0.09	0.24	0.60	1.21	2.22	2.22
	gpm	65	164	415	841	1,543	1,543
Peak Hour Demand (PHD=1.5xMDD)[2]	mgd	0.14	0.35	0.90	1.82	3.33	3.33
	gpm	98	246	622	1,261	2,315	2,315

[1] Per Table 2-3 of SB 610 Water Supply Assessment by Tully & Young, January 2018

[2] In accordance with Title 22 of the 2017 California Code of Regulations, Section 64554

3.3 Needed Fire Flows

Needed fire flows (NFF) were provided in Section 4.7.1 of the Castellina Specific Plan (Specific Plan), Administrative Draft (November 2016, Kimley Horn), at 2,500 gpm for two hours (or greater) at 20 psi. This results in a minimum fire flow volume of 300,000 gallons. This plan assumes that this fire flow requirement must be met in the first phase of development and remains constant throughout the development's planning period.

3.4 Water Supply, Treatment, Storage and Pumping Facilities

3.4.1 Water Supply Wells

There are four (4) existing agricultural wells and one (1) residential well on the development property. The construction of the agricultural wells does not meet State standards for domestic wells and the residential well is of low capacity. Therefore, none of these wells can be used to meet potable water demands of the development.

Potable water is planned to be provided by new groundwater extraction wells within the development area. Per Section 64554(b)(3) of Title 22 of the CCR, a minimum of two (2) wells are required to be capable of meeting MDD at all times with one well out of service. To accommodate planned development, two wells each with a capacity of at least 1,600 gallons per minute (gpm) should be constructed during Phase 1. Each well would be equipped with a 1,600 gpm pump (approx. 300 hp) which would operate intermittently to fill the storage tanks(s) and alternated between pumps to achieve equal runtime. Alternatively, the wells may initially be equipped with smaller pumps (700 gpm, approx. 150 hp) to reduce initial capital cost, or if it's determined that additional treatment is needed, and a lower flow rate is desired for system sizing. These pumps would be replaced with larger pumps (1,600 gpm) as development approaches 1,000 units. Each well pump will be equipped with a variable frequency drive (VFD) and flowmeter to allow the operators to set the desired flow as necessary to meet water demands and minimize water age in the storage tanks.

New well buildings would be constructed around each well to house the piping, valves, electrical equipment and controls. Since Well No. 1 will be located near the booster pump station and tanks it would likely share a generator with those facilities for backup power. Well No. 2 will include a dedicated permanently installed diesel standby generator for backup power. Discharge piping (approx. 12-inch diameter) from each well will be routed to the new tank and booster pump station site, where the piping will combine before entering the new tank(s). Chlorine will be added to the common tank fill line for disinfection.

See Figure 2 for the approximate/desired location of the existing and proposed wells. Well No. 1 is located adjacent to the storage tanks and pump station at the southeast corner of the Phase 1 project area. Well No. 2 is located at the northern edge of the Phase 1 development area. For planning purposes, it was recommended that the new wells be located a minimum of 0.25 miles apart (1,320 ft). The proposed locations of the two wells result in a separation of approximately 1,500 feet. The exact location of the wells and well construction details will need to be determined by subsequent hydrogeological investigations, including pilot hole drilling and aquifer assessment.

3.4.2 Water Treatment

In May 2017, agricultural wells #1, #4 and #5 were sampled and analyzed for the complete Title 22 constituents for drinking water, to assess the likely quality of water from the new wells. Based on these sampling results, no contaminants were detected in the groundwater from the agricultural wells sampled in the current investigations at sufficient concentrations that that could pose a health risk. Only manganese slightly exceeded the secondary maximum contaminant limit (MCL) which is for consumer acceptance, not health risks, in the water collected from well #5. Manganese may become noticeable in drinking water by imparting a color, odor or taste but can be treated if it becomes necessary. Based on the sampling results, the groundwater appears to be acceptable for the proposed use. (Source: July 18, 2017 Well Sampling Results letter by McCloskey Consultants).

Although manganese was detected at 0.15 µg/L (vs. the secondary MCL of 0.05 µg/L) in Well 5, it is not anticipated that manganese will be above the secondary MCL in water from the proposed wells since the proposed wells are closer to wells #1 and #4. Additionally, well #4 is reported at approximately 505 feet deep and Well #5 is reported at approximately 960 ft deep. Groundwater in the area is reported at between 260 and 300 feet below ground surface. Therefore, the proposed wells will likely be closer to 500 feet deep where water quality appears to be better than at lower depths. Pilot holes should be drilled, and zone sampling performed prior to construction of the wells to confirm well design and expected water quality.

Although groundwater treatment is not anticipated at this time, a small chlorine storage and feed facility (using liquid sodium hypochlorite) will be provided to meet any disinfection requirements and to provide the required minimum chlorine residual in the potable water distribution system. The chemical system will include two chemical metering pumps drawing from drums or totes of sodium hypochlorite and delivering chemical to the tank fill piping to dose the water from the wells. A secondary chlorine injection point will be provided on the suction side of the booster pumps to provide booster chlorination if necessary.

3.4.3 Water Storage

Water storage volume is estimated as the sum of operational volume (to meet domestic demands) plus fire flow volume. For phases of the development when there are less than 1,000 service connections, a minimum operational storage volume of MDD is required to meet Section 64554(a)(2). For phases when there are more than 1,000 service connections, a minimum operational storage volume of four hours of PHD is required to meet Section 64554(a)(1). This results in an Phase 1 operational storage volume requirement of approximately 94,000 gallons. At 1,000 connections, the operational storage volume required is about 710,000 gallons. However, the operational storage requirement decreases after there are more than 1,000 service connections, resulting in approximately 555,600 gallons at 3,072 connections.

In addition to the operational storage volume requirement is the volume required for fire flows, which is assumed to be 300,000 gal for all phases of the project. Therefore, the Phase 1 total storage volume required is approximately 394,000 gallons and the storage volume required at development buildout (3,072 units) is about 856,000 gallons.

For planning purposes, two (2) 550,000-gallon tanks are recommend. The first tank will be required for the initial phase of construction and will accommodate development up to approximately 300 units. The second tank may be added as development proceeds and should be installed before 300 units are anticipated to be occupied. Note that fire flow requirements may be less during early phases of the development when there are only residential units which typically require lower fire flows. For example, the fire flow for a development with only 1- or 2-family dwellings equipped with automatic fire sprinkler systems may actually be as low as 500 gpm for 1 hour (30,000 gallons total). The higher fire flows described in the Specific Plan are associated with commercial and retail construction. Therefore, it may be possible to install a smaller storage tank to accommodate initial phases of development when there are no commercial or retail facilities to accommodate only up to Phase 1 (117 units), and phase in multiple tanks to pace development. However, it is likely more cost effective for from a constructability and reliability standpoint to install two equal-sized tanks as recommended above. See

Table 2, for a summary of volume requirements and proposed tank sizing.

Table 2: Estimated Water Storage Requirements

		Planning Year					
Item	**Unit**	**Phase 1**	**2020**	**2025**	**2030**	**2035**	**2040**
No. Units	ea	117	294	842	1,683	3,072	3,072
Maximum Day Demand (MDD)	gal	93,981	236,156	597,512	1,210,647	2,222,698	2,222,698
Peak Hour Demand (PHD)	gpm	98	246	622	1,261	2,315	2,315
Fire Storage	gal	300,000	300,000	300,000	300,000	300,000	300,000
Operational Storage per CCR	gal	93,981	236,156	597,512	302,642	555,639	555,639
Total Storage Required	gal	393,981	536,156	897,512	602,642	855,639	855,639
Number of Storage Tanks	ea	1	1	2	2	2	2
Tank Diameter	ft	60	60	60	60	60	60
Tank Max Water Height	ft	26	26	26	26	26	26
Tank Capacity, ea	Mgal	0.55	0.55	0.55	0.55	0.55	0.55
Total Storage Capacity Provided	Mgal	0.55	0.55	1.10	1.10	1.10	1.10

For planning and cost estimating purposes, it is assumed that the new storage tanks will be welded steel on ring-wall foundations. Other alternatives included bolted steel (less costly than welded steel) and pre-stressed concrete tanks (more costly than welded steel). The tank type and final sizing will be determined during design activities.

3.4.4 Booster and Fire Pumps

A booster pump station will be constructed to deliver water from the storage tank(s) to the distribution system to meet operational and fire demands. Initially, water demands will be low and will be met with two small booster pumps sized at approximately 150 gpm (approx. 15 hp) each to meet peak hour demands. As development progresses and water demands increase, these small booster pumps will be replaced with larger 1,250 gpm (approx. 100 hp) booster pumps. A surge/hydropneumatic tank will be provided to address surge issues and accommodate low water demands in the early years of development and for times when the demand is less than the minimum capacity of a single pump operating.

The anticipated fire flow requirement is 2,500 gpm for two hours per the Specific Plan. To meet this flow requirement, lesser fire flows, and provide firm pumping capacity for the booster pumping system in general, three (3) 1,250 gpm (approx. 100 hp) pumps will be installed in parallel with the booster pumps. These three pumps would all be installed during the initial construction. The fire pumps and larger booster pumps would be identically sized allowing one of the larger pumps to be backup pump, rather than have two backup pumps; one each for booster and fire pumping. All pumps will be equipped with VFDs and controlled to maintain system pressure (assumed to be 90 psi for this analysis).

The new booster and fire pumps will either be multi-stage vertical pumps, or vertical turbine pumps with suction cans, as determined during subsequent design activities. The chlorine storage and feed system will be housed inside the pump building, along with the electrical and controls associated with the booster pumps, chemical systems, tanks and Well No. 1. Water will be conveyed from the booster pumps to the distribution system at the access road via a 20-inch (approximate) water main, which must be sized for peak hour demand plus fire flows of approximately 5,000 gpm (2,315 gpm + 2500 gpm). For the purposes of cost estimating in this plan, the pump station building is assumed to be of concrete masonry unit block construction with moderate architectural treatments. The final architectural design for the new building will be determined during subsequent design efforts.

Space should be allocated at the storage and booster pump station site for potential future water treatment and pipe stub-outs provided to accommodate possible water treatment requirements that are determined during subsequent hydrogeological investigations (pilot holes and zone sampling).

3.4.5 Electrical and Controls

A new electrical service will be provided to the storage tank site, likely via underground conduit and power conductors from the access road to a new transformer. The power conductors and transformer will be sized to accommodate the buildout condition for 3,072 units.

The new water system will be fully automated with local and remote controls. A main programmable logic controller (PLC) will be installed in the booster pump building to monitor all equipment and instrumentation, and to control the well and booster pumps. Each well site will be equipped with a remote telemetry unit (RTU) for local control of each well and communication with the water system PLC. The RTUs and PLC will be tied into the SCADA system at the wastewater treatment plant (WWTP) to provide local and remote monitoring and control of the equipment, in addition to historical logging of operating data and local and off-site alarming via an autodialer system.

3.4.6 Site Security

New security fencing will be provided to surround each well site and the storage tank site to prevent unauthorized access and vandalism. Access to the site will be via an automated gate with card reader and fire department KNOX box. Security cameras may be added at minimal cost to provide visual monitoring and motion-detect alarming since the site will likely not be staffed continuously.

3.5 Water System Phasing Plan

The first phase of the water system will need to be able to meet the Phase 1 (117 units) water storage, maximum day demand and fire flows as described above. Additionally, the system should be designed to accommodate anticipated growth as development proceeds. The proposed phasing plan assumes that development will continue to occur beyond Phase 1 and will generally follow the growth assumed in the Specific Plan, up to 3,072 units by 2035. Therefore, rather than sizing the initial system to only accommodate 117 units which would result in the lowest initial capital cost, a plan is presented to expand to pace development as efficiently as possible with lowest likely overall capital cost. As a result, the initial water system will have capacity to accommodate up to approximately 300 units but result in more economical water system for long-term planning. The proposed water system phasing plan is presented in Table 3, below.

Table 3: Proposed Water System Phasing

	Planning Year					
Item	**Phase 1**	**2020**	**2025**	**2030**	**2035**	**2040**
No. Units	117	294	842	1,683	3,072	3,072
Construct Wells No. 1 and 2 (1,600gpm ea)[1]	X					
Construct Tank No. 1 (0.55 Mgal)	X					
Construct Booster Pump Station	X					
Construct Tank No. 2 (0.55 Mgal)		X				
Upgrade Booster Pumps			X		X	

[1] The phasing and cost estimates presented in this plan assumes 1,600 gpm pumps are installed initially. Smaller pumps may be installed initially if desired but would result in higher overall capital cost over the life of the project.

3.6 Preliminary Cost Estimate for Water System

Preliminary capital cost estimates were prepared for the proposed water supply, storage, treatment and pumping facilities to support the first phase of development and additional phases to project buildout of 3,072 units. Included in this estimate are costs for engineering, construction and construction administration, as presented in Table 4, below. **This estimate does not include costs for land acquisition, planning, permitting, water distribution system infrastructure (design, construction and construction administration), or other unidentified costs. These costs are assumed to be provided by others as part of the overall planning effort.** The estimated cost for each water service connection (connection fee) will need to account for all of these costs and is beyond the scope of this plan.

Table 4: Preliminary Cost Estimate for Water Supply, Storage, Treatment and Pumping Facilities

Item	Phase 1	Phase 2	Phase 3	Phase 4
No. Units	117	294	842	3,072
Construct Wells No. 1 and 2 (1,600gpm ea)	$3,235,000			
Construct Tank No. 1 (0.55 Mgal)	$1,241,000			
Construct Booster Pump Station	$2,826,000			
Construct Tank No. 2 (0.55 Mgal)		$1,233,000		
Upgrade Booster Pumps			$174,500	$174,500
Estimated Construction Cost per Phase	$7,302,000	$1,233,000	$174,500	$174,500
	Total Estimated Construction Cost all Phases			$8,884,000
Land Acquisition				
Planning	*Costs not included in this plan*			
Permitting				
Water Distribution System				
Engineering	$730,000	$123,000	$17,500	$17,500
Construction Administration	$584,000	$99,000	$14,000	$14,000
Total Estimated Cost per Phase	$8,616,000	$1,455,000	$206,000	$206,000
			Total Estimated Cost all Phases[1]	$10,483,000
			Estimated Cost per Connection[1]	*TBD*

[1] Total does not include costs for land acquisition, planning, permitting and water distribution system.

4 WASTEWATER AND RECYCLED WATER SYSTEM FACILITIES PLANNING

A new wastewater treatment plant will be constructed to treat the domestic wastewater generated within the new development, and recycled water will be used for non-residential outdoor irrigation. See Figure 3 for a preliminary process flow diagram of the proposed wastewater and recycle water systems at Castellina. The new WWTP and associated facilities will be located at the northeast corner of the development, south of the main entrance to the site and east of the proposed high-speed rail system embankment. The WWTP will be set back from the main development access road centerline by approximately 270 ft, and there will likely be commercial approximately 1 acre lots separating the WWTP from the main access road. There will also be approximately 14.2 acres of existing almond orchards to remain between the WWTP access road and the development access road and the southern half of the Phase 1 development. These features will effectively shield the WWTP from view from either the main access road or nearest homes. See Figure 2 for a preliminary site plan for the proposed water system and Figure 4 for the preliminary process flow diagram.

The planning and proposed layout of the wastewater collection system is being performed by others and is not part of this analysis. The scope of this plan is from the point that wastewater enters the new WWTP to the discharge points for recycled water to the existing and new irrigation distribution systems.

4.1 Wastewater Flows

Influent wastewater flows are estimated based on indoor potable water demands from the 2016 WSA, minus estimated losses. See Table 5 for a summary of assumed wastewater flow rates for the development, with assumptions for flow peaking factors based on similar, typical residential developments. As development progresses, actual peaking factors should be determined for use in future phases of system expansion.

Table 5: Assumed Wastewater Flows

		Planning Year					
Item	**Unit**	**Phase 1**	**2020**	**2025**	**2030**	**2035**	**2040**
No. Units	ea	117	294	842	1683	3072	3072
Total Indoor Potable Demand[1]	af/yr	29	73	192	391	719	719
System Loss (10%)[1]	af/yr	3	7	19	39	72	72
Total Annual Wastewater Production	af/yr	26	66	172	352	647	647
	Mgal/yr	8.5	21.4	56.2	115	211	211
Average Dry Weather Flow (ADWF)	mgd	0.022	0.056	0.147	0.299	0.550	0.550
Average Annual Flow (AAF)[2]	mgd	0.023	0.059	0.154	0.314	0.578	0.578
Avg. Day Max. Month Flow (ADMMF)[3]	mgd	0.033	0.084	0.220	0.449	0.825	0.825
Peak Day Flow (PDF)[4]	mgd	0.045	0.112	0.293	0.598	1.10	1.10
Peak Hour Flow (PHF)[5]	mgd	0.089	0.224	0.586	1.20	2.20	2.20
	gpm	62	155	407	831	1,528	1,528

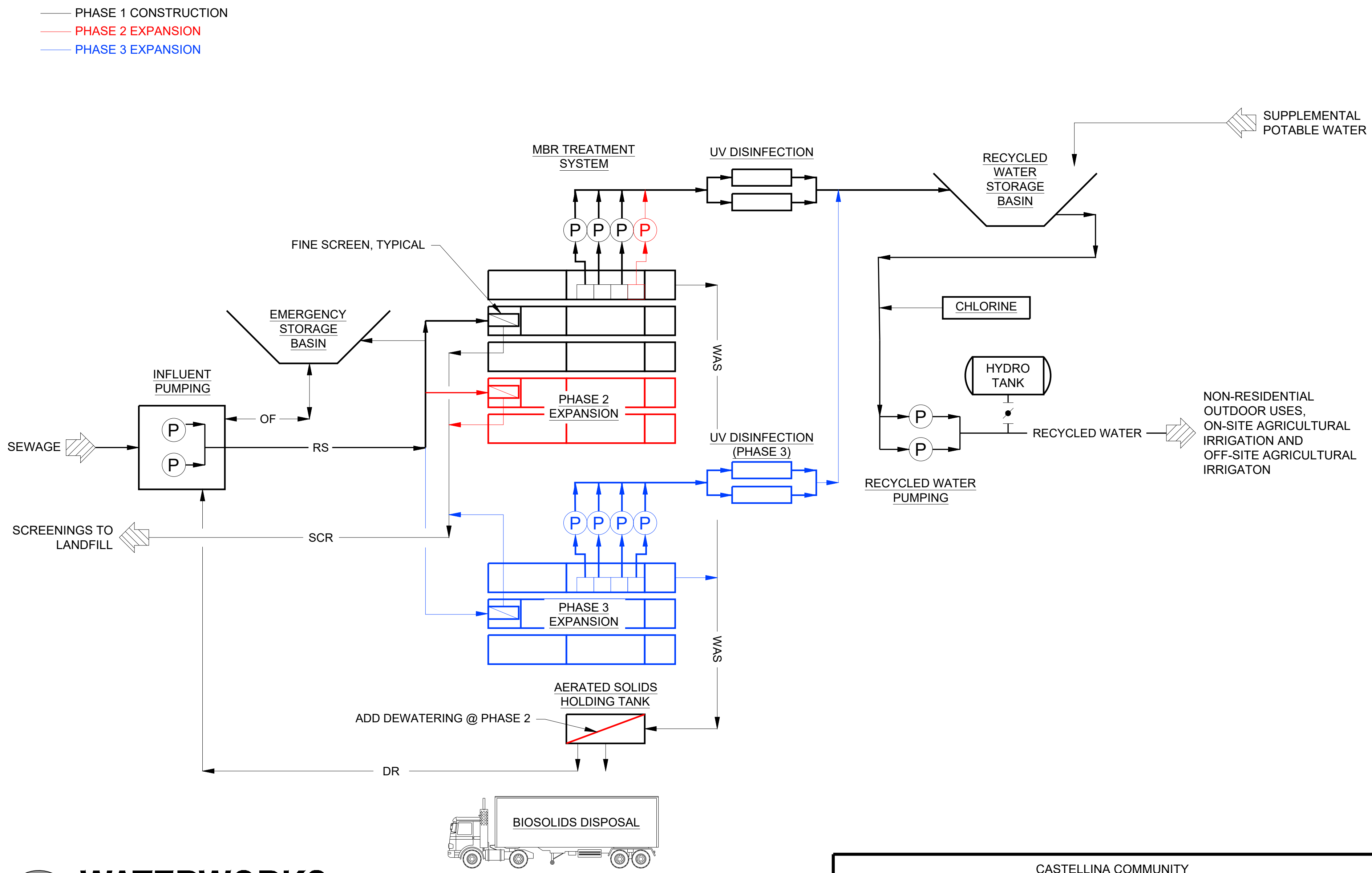
[1] Per Table 2-3 of SB 610 Water Supply Assessment by Tully & Young, January 2018

[2] AAF:ADWF Peaking Factor = 1.05

[3] ADMF:ADWF Peaking Factor = 1.05

[4] PDF:ADWF Peaking Factor = 1.05

[5] PHF:ADWF Peaking Factor = 1.05



CASTELLINA COMMUNITY
WATER AND WASTEWATER FACILITY PLAN

FIGURE 4
PRELIMINARY PROCESS FLOW DIAGRAM
(WASTEWATER AND RECYCLED WATER SYSTEMS)

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Since this will be a new development and no wastewater constituent strength data are available yet, typical domestic wastewater characteristics were assumed, as presented in Table 6. As the development progresses, actual wastewater characteristics should be determined for use in future phases of system expansion.

Table 6: Assumed Wastewater Characteristics

Parameter	Unit	Value
BOD Concentration	mg/L	300
COD Concentration	mg/L	540
TSS Concentration	mg/L	300
VSS Concentration	mg/L	255
Ammonia Concentration	mg/L	25
TKN Concentration	mg/L as N	40
Design Temperature	deg C	15 to 25

4.2 Effluent Requirements

The treated wastewater (effluent) requirements are anticipated to be per Title 22, Division 4, Chapter 3, Section 60301 etc. of the CCR (Title 22). In addition to the tertiary filtration and disinfection requirements of Title 22, nitrogen limitations are anticipated to minimize any impact to groundwater. The anticipated effluent requirements are presented in Table 7.

Table 7: Anticipated WWTP Effluent Requirements

Parameter	30-Day Average (Mean)	7-Day Average (Mean)	Daily Maximum
BOD5, mg/L	10	15	20
TSS, mg/L	10	15	20
Turbidity			
Settleable Solids, mL/L	0.5	--	1.0
Total Nitrogen, mg/L	10	--	--
Total Coliform, MPN/100 mL	23	2.2	240
Turbidity, NTU	• 2 NTU, as a daily average • 5 NTU, more than 5% of the time within a 24-hour period; • 10 NTU, at any time.		

4.3 Effluent Disposal

Per the WSA, recycled water is planned to initially be used for construction water and non-residential outdoor irrigation. Additionally, it is anticipated that portions of the existing almond and fig orchards will be irrigated year-round within the development's property to dispose of excess recycled water. To accomplish this, the new recycled water distribution system will be tied into the existing almond and fig irrigation systems as necessary to balance irrigation needs with excess recycled water disposal requirements. As development progresses and existing crops are removed to make way for homes, commercial facilities, school, etc., excess recycled water is anticipated to be conveyed offsite for agricultural irrigation of adjacent farmlands. Space is reserved at the WWTP site for construction of a larger recycled water reservoir for long-term storage (in addition to the 2.3 million gallon basin to be added in Phase 1 of the project for short-term storage) in the event that year-round irrigation is not feasible and recycled water must be held for several months.

4.4 Wastewater Treatment and Recycled Water Facilities

During the initial phases of development when only a few houses are constructed, wastewater would likely need to be temporarily stored and hauled to the City of Madera WWTP, approximately 12 miles away from the development. As homes are constructed and occupied, and daily average wastewater flows reach approximately 5,000 gallons per day (approx. 30 units), wastewater will be treated onsite at the new facilities.

The anticipated wastewater and recycled water systems include the following main unit treatment processes and ancillary systems, as shown on Figure 4:

- Influent Pumping
- Influent Screening
- Emergency Storage
- Influent Flow Equalization
- Packaged Biological Treatment and Tertiary Filtration
- Disinfection
- Recycled Water Storage
- Recycled Water Pumping
- Residuals Handling
- Odor control
- Operations Building
- Site Piping
- Electrical and Controls

The following sections describe each of the treatment processes and ancillary systems.

4.4.1 Influent Pumping

At the time this plan was prepared, details of the wastewater collection system were still under development by others. However, the proposed location of the WWTP is at a low-point in the development area and it is assumed that wastewater will be conveyed by gravity to this location. The gravity sewer at this point may be more than 15 feet deep. Therefore, an influent pump station is expected to be required to lift the wastewater up the treatment processes.

The new influent pump station will likely be a cast-in place concrete self-cleaning wetwell with submersible pumps and an adjacent valve and flowmeter vault. The wetwell will be sized for buildout of the development. Initially, wastewater flows will be low and will be met with two small pumps sized at approximately 200 gpm (approx. 5 hp) each to pass the peak hour demand flow. As development progresses and wastewater flows increase, these small pumps will be replaced with larger 800 gpm (approx. 10 hp) pumps. The pumps would be equipped with VFDs and controlled to maintain level in the wetwell, or possibly to operate at a constant flow rate if the upstream collection system can be surcharged for daily flow equalization. At any time, the largest installed pump will have capacity to pass the peak day flow. When one small pump and one large pump are installed at about midway through development, redundancy for the large pump will be met by the Emergency Storage Basin plus an on-the-shelf spare pump. In the event of a pump station failure, wastewater from the wetwell will overflow to the adjacent Emergency Storage Basin.

The VFDs and controls for the influent pumps will be installed in the Operations Building. Backup power will be provided by the WWTP's main standby generator.

4.4.2 Influent Screening

Wastewater flow from the influent pump station will be passed through a self-cleaning fine screen. The influent screening system could be located upstream of the influent pumps and incorporated into the wetwell design. However, the incoming sewer piping is anticipated to be relatively deep which would result in a tall screen that is difficult to access for maintenance. For the purposes of this plan, the influent screening system is assumed to be incorporated into the front-end of the biological treatment system (as discussed below). The influent screen would likely include a 2-mm perforated screen, which is required to remove large materials and to protect downstream processes from damage. The screen would include an integrated washer and compactor and have a manually cleaned bypass screen for use if the automatic screen fails. Screenings would be deposited into a dumpster and periodically hauled offsite to landfill. A single screening system will be installed during the initial WWTP construction. A second and third screening system would be installed when the WWTP is expanded to 500,000 gpd and 750,000 gpd, respectively.

4.4.3 Emergency Storage

An emergency storage basin will be constructed adjacent to the influent pump station to receive overflows from the influent pump station and biological treatment system in the event of system failures. The basin will be sized to contain 24 hours of flow for the peak day condition at development buildout. This results in a required storage volume of 1.15 million gallons. The basin will be constructed during Phase 1 of the project and consist of an earthen basin with flexible liner (e.g. HDPE). The bottom of the basin will be sloped to a drain connection and piping will be provided back to the influent pump station to pump out of the basin back to the treatment process. An overflow pipe will be provided between the recycled water and emergency storage basins to provide protection from a spill in the even that that either basin becomes overfilled.

See Table 8 for storage available in the basin at each phase of the project.

Table 8: Emergency Storage Basin Storage Summary

		Planning Year					
Item	**Unit**	**Phase 1**	**2020**	**2025**	**2030**	**2035**	**2040**
Emergency Storage at AAF	days	49.2	19.6	7.5	3.7	2.0	2.0
Emergency Storage at PDF	days	25.8	10.3	3.9	1.9	1.0	1.0

4.4.4 Influent Flow Equalization

Influent flows from the development will vary throughout the day (i.e. diurnal variation) and will likely be highest in the morning and evenings when residents prepare for and return home from work. Flows will be lowest in the middle of the night and during the day when less houses are occupied. The variable flows, particularly during the initial phases of development when flows are low overall, are not desirable with respect to biological treatment and disinfection performance. Therefore, the influent flow variations will need to be equalized to a relatively constant rate for smooth treatment process operability and performance.

During initial phases of the project, it may be possible to utilize the incoming collection piping and manholes to equalize flows, since the collection system will likely be oversized to accommodate buildout flows. Alternatively, the biological treatment system could be designed to use installed tankage volume not necessary for treatment of initial phase flows for equalization.

4.4.5 Packaged Biological Treatment and Tertiary Filtration

The proposed development is starting from the ground up and there are currently no wastewater flows to be incorporated at the time the first houses are constructed. Therefore, careful consideration must be given to sizing and phasing of the biological treatment and tertiary filtration systems. If too large of a system is initially installed, it will not only carry a higher capital cost but also be difficult to operate at a very low turndown when few homes are occupied. Alternatively, if too small of a system is initially installed, although it would carry a smaller capital cost, the next expansion would likely be required immediately after the first phase is constructed. Additionally, the overall system would end up being comprised of several small systems that ultimately result in a higher overall capital cost.

For this project, a packaged membrane bioreactor (MBR) treatment system is recommended for initial and likely subsequent phases of expansion. Packaged systems may be sized to handle initial low flows at lower capital costs than treatment systems utilizing cast-in-place concrete tanks. Additionally, MBR systems are becoming increasingly commonplace for domestic wastewater treatment due to their compact footprint, incorporated filtration system, ease of operation and high-quality effluent. Initially, sequencing batch reactors were considered for this project with cloth filters in a combination of packaged and concrete layouts. However, it was determined the an MBR system would be more appropriate for this project from a cost, layout and operational standpoint.

For this project, the proposed MBR system is based on Cloacina LLC's packaged MEMPAC-M MBR system. Cloacina is a manufacturer of packaged MBR systems, located in Arroyo Grande, CA. A similar development (Tesoro Viejo) near this project recently installed a Cloacina system, and there are several other systems in Madera county that are in the process of installing Cloacina systems. The Cloacina systems are unique to other packaged systems in that the process tanks are fabricated completely out of stainless steel, rather than painted carbon steel which is typical of many other systems. Also, Cloacina systems are available in capacities up to 250,000 gpd with provisions to expand to 500,000 gpd. Other systems considered had maximum capacities of 85,000 gpd which would require either several units or switching a conventional MBR system design using concrete tanks to treat flows greater than 85,000 gpd to be cost effective. An additional reason Cloacina is being recommended is that it is likely that the entity selected to own and operate the Castellina wastewater system currently owns and operates other Cloacina systems nearby (one system constructed, several more in the planning phases).

The MBR system will likely include integral fine screening (as described above), anoxic chambers with submersible mixers, aeration chambers with submerged fine bubble diffusers, membrane chambers with submerged membranes, permeate pumps, recycled activated sludge (RAS) pumps, waste activated sludge (WAS) pumps, a clearwell, and associated electrical, instrumentation and controls. Overflow piping from the screening chamber of the MBR system to the Emergency Storage Basin to convey flow in the event that the permeate pumps fail and the influent pumps continue to run or if there is a blockage downstream of the inlet chamber.

The system would be completely fabricated and tested in Cloacina's facility, shipped to the site and installed on a concrete slab. A metal canopy will be provided over the system to provide shade and weather protection. All equipment associated with the MBR system comes skid-mounted and in weatherproof outdoor enclosures.

The Phase 1 MBR system will be sized to treat 250,000 gpd with the ability to initially treat as little as 5,000 gallons. A system of this size is cable of treating wastewater from approximately 1,400 units. As development proceeds, an expansion module would be added in Phase 2 to increase the capacity to 500,000 gpd, to provide treatment for approximately 2,800 units. The expansion module would include additional screening system, anoxic chambers, aeration chambers and associated equipment and controls. Additional membranes would be added to the Phase 1 MBR system membrane chamber. As development continues to proceed, an additional 250,000 gpd MBR system identical to the Phase 1 system would be installed in Phase 3. This will provide treatment for approximately 4,200 units and will accommodate the buildout of 3,072 units plus provide additional redundancy. Note, actual wastewater flows should be evaluated prior to each expansion for proper system sizing rather than basing expansion and sizing based on number of units as described herein. It's possible that per unit wastewater generation will be less than estimated and as a result, only the first and second phases of MBR may be necessary.

4.4.6 Disinfection

Disinfection will be provided by an ultraviolet (UV) disinfection system. The UV system may either "in-channel" or "in-pipe." An in-channel UV system would require a break in hydraulic head and flow through a concrete channel with submerged UV lamps. An in-pipe UV system would not require a break in hydraulic head and would use UV lamps installed in-line with the effluent piping. For this project, in-pipe UV is recommended. For the system sizes considered, in-pipe systems are more typical and more economical than in-channel systems. Additionally, a separate structure and pumps would not be required.

For Phase 1, two in-pipe UV reactors are recommended for redundancy, either as part of the Cloacina MBR system skid or mounted separately. The reactors will be sized to treat peak day flows from the Phase 2 system (1 mgd, 694 gpm). The Phase 3 system would match the Phase 1 system with 2 in-pipe reactors (1 mgd, 694 gpm).

4.4.7 Recycled Water Storage

A recycled water storage basin will be constructed between the emergency storage basin and MBR system to receive treated effluent following UV disinfection. The basin will be sized to contain 4 days of effluent for the peak day condition at development buildout. This results in a required storage volume of 2.3 million gallons. The basin will be constructed during Phase 1 of the project and consist of an earthen basin with flexible liner (e.g. HDPE). The bottom of the basin will be sloped to a drain connection and piping will be provided to the recycled water pump station. An overflow pipe will be provided between the recycled water and emergency storage basins to provide protection from a spill in the even that that either basin becomes overfilled. Two or three floating aerators will be installed in the basin to control algal growth and minimize odor generation.

See Table 9 for storage available in the basin at each phase of the project.

Table 9: Recycled Water Storage Basin Storage Summary

		Planning Year					
Item	**Unit**	**Phase 1**	**2020**	**2025**	**2030**	**2035**	**2040**
Recycled Water Storage at AAF	days	98.4	39.1	14.9	7.3	4.0	4.0
Recycled Water Storage at PDF	days	51.6	20.5	7.8	3.8	2.1	2.1

4.4.8 Recycled Water Pumping

A new recycled water pump station will be constructed adjacent to the recycled water storage basin in Phase 1. The pump station will consist of a concrete wetwell that is either piped or directly connected to the recycled water reservoir. Two 200 gpm (approx. 20 hp) vertical turbine pumps will be installed with associated valves and controls. A flowmeter will be installed on the common discharge line for flow monitoring. A surge/hydropneumatic tank will be provided to address surge issues and accommodate low water demands in the early years of development and for times when the irrigation demand is less than the minimum capacity of a single pump operating. An 8-inch diameter recycled water pipeline will be extended from the pump station to point of connection with the recycled water distribution system at the access road. The pumps will be equipped with VFDs and controlled to maintain system pressure (assumed to be 90 psi for this analysis). A supplemental water (potable water) connection will be provided to the reservoir to provide water for irrigation during times when there is insufficient recycled water.

As development progresses towards buildout and wastewater flows increase, the two pumps will be replaced with larger 800 gpm (approx. 75 hp) pumps.

4.4.9 Residuals Handling

Periodically, biological solids generated in the MBR treatment process must be wasted (waste activated sludge or WAS) to maintain a steady biomass concentration. These solids are generally captured in a tank and stabilized either by aeration or anaerobic processing prior to subsequent disposal. For this project, an aerated solids holding tank will be installed adjacent to the MBR system during Phase 1. Blowers and submerged diffusers will be used to aerate the solids to reduce the volatile solids and control odors. The tank will be periodically decanted back to the MBR system (or influent pump station) to concentrate the solids in the tank. During initial phases of development when solids production is low, the stabilized solids be hauled offsite by a tanker truck to an approved disposal location. As development proceeds and solids generation increases and hauling costs increase, a dewatering system will be added to the process to reduce the water content. The dewatered solids will be conveyed to a roll-off container for landfill disposal or land application.

For this project, the DRYPAC solids handling system by Cloacina is recommended due to its compact size and integration with the Cloacina system. The DRYPAC system is essentially a rectangular stainless-steel tank, similar to the tanks used in the MEMPAC system, with a blower and diffusers. An elevated platform may be added later to accommodate the dewatering equipment (volute dewatering press likely).

4.4.10 Odor Control

The WWTP is sited at the northwest corner of the development. Winds are reportedly predominantly from the northwest, so odors from the treatment plant may be carried to the development which is located east of the WWTP. Although there is a moderate land buffer between he WWTP and nearest residential lot (the nearest lot is approx. 650 ft from the MBR system), odor control provisions are recommended. For this project, odor control will be provided for the influent pump station wetwell and for the anoxic chambers of the MBR process. These areas typically generate odors with the highest complaint potential. The aeration chambers and aerated solids tanks are typically low in odors and are not likely to require odor control. The influent pump station wetwell and anoxic chambers will be covered and ducted to foul air fans which will convey the foul air to an odor control system (e.g. biofilter, carbon scrubber). As development proceeds, if it is determined that other process units should be treated for odors, those units should be covered and ducted to the odor control system.

4.4.11 Operations Building

A new operations building will be constructed at the WWTP site. Although this building will be located at the WWTP site, it is expected that one entity will ultimately own and operate the water and wastewater systems and this building would be used to support both systems. For the purposes of cost estimating in this plan, the pump station building is assumed to be of concrete masonry unit block construction with moderate architectural treatments. The final architectural design for the new building will be determined during subsequent design efforts.

The building will include the following features:

- Approximate footprint of 30 ft x 60 ft (1,800 sq. ft)
- Control room with desk and supervisory control and data acquisition (SCADA) terminal
- Laboratory for water quality analyses
- ADA restroom with shower
- Storage for spare parts/equipment, tools, etc.
- Electrical room for WWTP equipment (e.g. motor control center, main plant control system, influent pump station VFDs, etc.)

4.4.12 Site Piping

All Phase 1 and subsequent phase buried site piping will be sized to accommodate buildout flows. The piping will generally be sized to operate at a minimum of 2 ft/s to reduce potential for solids deposition, and a maximum of 8 ft/s to minimize headloss. The major site piping includes raw sewage from the influent pumps, recycled water from the MBR systems, recycled water from the recycled water pumps, and potable water for water service to the Operations Building and site fire hydrants. These pipes are preliminarily sized as follows:

- Raw sewage forcemain: 10-inch diameter
- Recycled water from MBR system: 8-inch diameter
- Recycled water from recycled water pumps: 8-inch diameter
- Potable water: 8-inch diameter

4.4.13 Electrical and Controls

A new electrical service will be provided to the treatment plant, likely via underground conduit and power conductors from the access road to a new transformer. The power conductors and transformer will be sized to accommodate the buildout condition for 3,072 units.

The new wastewater treatment system will be fully automated with local and remote controls. A main programmable logic controller (PLC) will be installed in the Operations Building to monitor all equipment and instrumentation, and to control the influent pumps, recycled water pumps, recycled water basin aerators and odor control blowers. Each MBR system unit (Phases 1, 2 and 3) will be provided with an independent PLC which will communicate with the main plant PLC. A SCADA system will be provided to provide local and remote monitoring and control of the treatment equipment, in addition to historical logging of operating data and local and off-site alarming via an autodialer system.

A diesel standby generator will be installed adjacent to the Operations Building to provide standby power to all essential pumping, treatment, controls and monitoring systems.

4.4.14 Site Security

New security fencing will be provided to surround the wastewater treatment site to prevent unauthorized access and vandalism. Access to the site will be via an automated gate with card reader and fire department KNOX box. Security cameras may be added at minimal cost to provide visual monitoring and motion-detect alarming since the site will likely not be staffed continuously.

4.5 Wastewater System Phasing Plan

The first phase of the wastewater system will need to be treat the wastewater produced by Phase 1 (117 units) of the development, as described above. Additionally, the system should be designed to accommodate anticipated growth as development proceeds. The proposed phasing plan assumes that development will continue to occur beyond Phase 1 and will generally follow the growth assumed in the Specific Plan, up to 3,072 units by 2035. Therefore, rather than sizing the initial system to only accommodate 117 units which would result in the lowest initial capital cost, a plan is presented to expand to pace development as efficiently as possible with lowest likely overall capital cost. As a result, the initial wastewater treatment system will have capacity to accommodate up to approximately 1,400 units but result in more economical water system for long-term planning. The proposed wastewater system phasing plan is presented in Table 10, below.

Table 10: Proposed Wastewater System Phasing

	Planning Year					
Item	**Phase 1**	**2020**	**2025**	**2030**	**2035**	**2040**
No. Units	117	294	842	1,683	3,072	3,072
WWTP Sitework and Yard Piping	X					
Construct Influent Pump Station (2@200 gpm pumps)	X					
Construct Emergency Storage Basin (1.15 Mgal)	X					
Install Phase 1 0.25 mgd Packaged MBR/UV System	X					
Construct Recycled Water Storage Basin (2.3 Mgal)	X					
Construct Recycled Water P.S. (2@200 gpm pumps)	X					
Install Aerated Solids Holding Tank	X					
Install Odor Control System	X					
Construct Operations Building	X					
Construct Electrical, Controls, Site Security	X					
Replace small influent pump with 800 gpm pump		X				
Replace small influent pump with 800 gpm pump				X		
Install Phase 2 0.25 mgd Packaged MBR Expansion				Note 1		
Install Solids Dewatering System				X		
Install Phase 3 0.25 mgd Packaged MBR Expansion					Note 2	
Replace recycled water pumps with 800 gpm pumps					X	

[1] Expansion of MBR system to 500,000 gpd required before development reaches 1,400 units.

[2] Expansion of MBR system to 750,000 gpd required before development reaches 2,800 units.

4.6 Preliminary Cost Estimate for Wastewater System

Preliminary capital cost estimates were prepared for the proposed wastewater treatment facilities to support the first phase of development and additional phases to project buildout of 3,072 units. Included in this estimate are costs for engineering, construction and construction administration, as presented in Table 11, below. **This estimate does not include costs for land acquisition, planning, permitting, wastewater collection infrastructure (design, construction and construction administration), or other unidentified costs. These costs are assumed to be provided by others as part of the overall planning effort.** The estimated cost for each sewer connection (connection fee) will need to account for all of these costs and is beyond the scope of this plan.

Table 11: Preliminary Cost Estimate for Wastewater Treatment Facilities

Item	Phase 1	Phase 2	Phase 3	Phase 4
No. Units	117	294	1683	3,072
WWTP Sitework and Yard Piping	$777,000			
Construct Influent Pump Station (2@200 gpm pumps)	$378,000			
Construct Emergency Storage Basin (1.15 Mgal)	$354,000			
Install Phase 1 0.25 mgd Packaged MBR/UV System	$5,286,000			
Construct Recycled Water Storage Basin (2.3 Mgal)	$758,000			
Construct Recycled Water P.S. (2@200 gpm pumps)	$411,000			
Install Aerated Solids Holding Tank	$379,000			
Install Odor Control System	$503,000			
Construct Operations Building	$604,000			
Construct Electrical, Controls, Site Security	$1,131,000			
Replace small influent pump with 800 gpm pump		$92,000		
Replace small influent pump with 800 gpm pump			$92,000	
Install Phase 2 0.25 mgd Packaged MBR Expansion			$3,418,000	
Install Solids Dewatering System			$330,000	
Install Phase 3 0.25 mgd Packaged MBR Expansion				$4,857,000
Replace recycled water pumps with 800 gpm pumps				$218,000
Estimated Construction Cost per Phase	$10,581,000	$92,000	$3,840,000	$5,075,000
	Total Estimated Construction Cost all Phases			$19,588,000
Land Acquisition				
Planning		*Costs not included in this plan*		
Permitting				
Water Distribution System				
Engineering	$1,058,000	$9,000	$384,000	$508,000
Construction Administration	$846,000	$7,000	$307,000	$406,000
Total Estimated Cost per Phase	$12,485,000	$108,000	$4,531,000	$5,989,000
			Total Estimated Cost all Phases[1]	$23,113,000
			Estimated Cost per Connection[1]	*TBD*

[1] Total does not include costs for land acquisition, planning, permitting and wastewater collection system.

Infrastructure Master Plan

APPENDIX C

Draft

Technical Memorandum

Domestic Water System

APPENDIX C

TECHNICAL MEMORANDUM

DOMESTIC WATER SYSTEM

APRIL 2019

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EXHIBITS

APPENDIX

INTRODUCTION

This Technical Memorandum has been prepared as an Appendix to the Infrastructure Master Plan to describe the domestic water system proposed to serve the residents and businesses within the Castellina Specific Plan.

Castellina, LLC proposes the development of a master-planned community located on approximately 794 acres in Madera County (County). The proposed project is located approximately one-mile north of the City of Madera, three miles east of Highway 99, and roughly 16 miles south of the City of Chowchilla. Specifically, the Specific Plan Area is bound by the Avenue 18 alignment to the north, Road 28½ to the east, the alignment of Avenue 17 to the south, Road 27 to the west, and the Burlington Northern Santa Fe (BNSF) railroad line to the southwest.

Due to the rural setting of the Specific Plan Area, development under the Specific Plan requires the construction of new utilities, such as a new wastewater treatment plant (WWTP), recycled water system, storm drain system, and a new water supply system.

This Technical Memorandum has been prepared by Wood Rodgers, Inc. with hydraulic modeling and analysis support from Kimley-Horn and Associates, Inc. and water facility sizing by Water Works Engineers. Water Works Engineers prepared the "Castellina Community – Water and Wastewater Facility Plan - Draft Report," dated October 24, 2018, included as Appendix B of the Infrastructure Master Plan. This Technical Memorandum will reference the Draft Report for the size of the major domestic water facilities.

A Water Supply Assessment (WSA) for the Castellina Specific Plan was prepared to comply with the requirements of Senate Bill 610. This Technical Memorandum will reference data included in the Administrative Draft of the WSA, prepared by Tully & Young (January 2018). It is noted that the water demand projections developed for the WSA will vary slightly from the demand projections referenced herein. The variance is due to slight changes in land use data and differences in the demand factors utilized and calculation methodology. The water demands used for the development used in WSA are slightly more conservative than the demands used for the system analysis discussed herein.

EXISTING CONDITIONS

LAND USE

The Specific Plan Area is relatively flat ranging in elevation from approximately 280 feet National Geodetic Vertical Datum (NGVD) in the northwest corner to approximately 310 feet NGVD at the east end of the Specific Plan Area. Currently, the Specific Plan Area is used for agricultural production and contains almond and fig orchards, related agricultural support facilities (e.g., equipment storage), wells, and unimproved dirt roadways. The Specific Plan Area is designated as a New Growth Area (NGA) in the County's General Plan.

Similar to the Specific Plan Area, many of the surrounding lands have been highly modified for agricultural purposes or otherwise developed as roads, individual residences, residential subdivisions, and commercial centers. Adjacent land uses to the Specific Plan Area include rangelands to the north, orchards to the east, and rural residential land uses to the south and west.

WATER SYSTEM

There are five existing wells located within the Specific Plan Area that draw groundwater from the Madera groundwater basin, four (4) agricultural wells and one (1) residential well. Based on data provided by the property owners and engineering estimates, the existing agricultural operations pump approximately 2,800 acre-feet per year (AFY) of groundwater, which is equivalent to nearly 912 million gallons. The existing residential well is a low capacity well, and the agricultural wells do not meet State standards for domestic usage, therefore none of the existing wells can be used to meet the water demands of the proposed development.

PROPOSED LAND USE

The project proposes development of up to 3,072 residential units, approximately 21 acres of commercial mixed-use (134,000 square feet), and approximately 131 acres of parks, trails, plazas, community gardens, and other open space across the 794-acre Specific Plan Area. The residential development will include a broad mix of densities, from very low density to high density and mixed use. Residential development is divided across five villages, including a centralized commercial mixed-use Town Center. The residential villages are designed around a framework of parks and recreation facilities to encourage a walkable community and active community interaction. Each village is organized in a traditional modified grid roadway pattern, with a minimal number of cul-de-sacs. The total gross area is approximately 790 acres.

The Specific Plan includes a variety of land use designations and zoning districts, consisting of residential and commercial uses as well as open space and recreational uses. Further, the project includes improvements to some off-site areas related to infrastructure improvements. A summary of proposed land uses within the 794-acre Specific Plan Area are included in Tables 1 and 2 of the Infrastructure Master Plan.

WATER DEMAND PROJECTIONS

WATER DEMAND FACTORS

The water demand factors per land use category used to calculate the average daily water demand (ADD) are summarized in Table C-1.

Table C-1
Castellina Development
Domestic Water System
Demand Factors

Land Use Category	Land Use Category	Demand Factor (GPD/DU)
Residential		
Very Low Density	VLDR	527
Low Density Residential	LDR	330
Medium Density Residential	MDR	241
High Density Residential	HDR	116
Active Adult Low Residential	AALDR	241
Mixed Use	MU	107
Parks and Open Space		
Neighborhood Parks	PARK	[1]
Community Garden	PARK	[1]
Central Park	PARK	[1]
Grand Promenade/Paseo	PARK	[1]
Linear Pathways	ACTIVE OPEN	[1]
Village Green/Square	PARK	[1]
Open Space	ACTIVE OPEN	[1]
Active Adult Amenity Center	ACTIVE OPEN	[1]
Other		
Elementary School	SCHOOL	[1]
Roads and Other Miscellaneous Areas	MISC	N/A

[1] Parks and Open Space and School will be irrigated with Recycled Water. Domestic water demands were accounted for using the WSA estimates.

WATER DEMANDS

The Average Day Demand (ADD) for the buildout of the development was calculated by multiplying the proposed land use by the water demand factors identified in Table C-1. A summary of the buildout ADD is depicted in Table C-2. A detailed breakdown of the ADD by village is included as Table C-3.

Table C-2
Castellina Development
Domestic Water System
Average Day Demand Summary

Land Use	Gross Acres	Estimated Net Acres	Dwelling Units	Usage Rates (gpd/du)	ADD (gpd)	ADD (gpm)
Very Low Density	36	30	90	527	47,400	33
Low Density Residential	234	184	1,100	330	364,000	253
Active Adult Low Residential	84	67	402	241	96,900	67
Medium Density Residential	151	114	1,030	241	247,000	172
High Density Residential	12	12	248	116	28,700	20
Residential Subtotal	516	407	2,870	0	785,000	545
Mixed Use	22	20	202	107	21,600	15
Mixed Use Subtotal	22	20	202	0	21,600	15
Neighborhood Parks	20	15	N/A	N/A	893	1
Community Garden	3	2	N/A	N/A	0	0
Central Park	31	25	N/A	N/A	1,790	1
Grand Promenade	3	2	N/A	N/A	0	0
Linear Pathways	6	4	N/A	N/A	0	0
Village Green	2	6	N/A	N/A	0	0
Open Space	67	67	N/A	N/A	0	0

Land Use	Gross Acres	Estimated Net Acres	Dwelling Units	Usage Rates (gpd/du)	ADD (gpd)	ADD (gpm)
Active Adult Amenity Center	6	2	N/A	N/A	4,460	3
Parks and Open Space Subtotal	138	123	0	0	7,140	5
Elementary School	12	12	N/A	N/A	7,140	5
Roads and Other Miscellaneous Areas	110	110	N/A	N/A	0	0
Other Subtotal	122	122	0	0	7,140	5
OVERALL TOTAL	**798**	**672**	**3,070**		**821,000**	**570**

Table C-3
Castellina Development
Domestic Water System
Average Day Demand by Village

CASTELLINA DOMESTIC WATER DEMAND							
Village and Planning Area	Land Use Density Category	Gross Acres*	Estimated Net Acres**	Number of Dwelling Units	Usage Rates (gpd/DU) (gpd/ac)	Avg. Daily Flow (gpd)	ADD (gpm)
VILLAGE ONE							
1.1	LDR	17	13	78	330	25,700	18
1.2	VLDR	18	15	45	527	23,700	17
1.3	LDR	12	9	54	330	17,800	12
1.4	LDR	13	10	60	330	19,800	14
1.5	LDR	18	14	83	330	27,500	19
1.6	MDR	25	19	169	241	40,800	28
1.7	LDR	20	16	95	330	31,300	22
1.9	VLDR	18	15	45	527	23,700	17
Sub Total Residential		139	111	629	-	210,000	146
NP.1	Neighborhood Park	5	5	-	-	893	1
OP.1	Open Space	4	4	-	-	-	-
OP.2	Open Space	5	5	-	-	-	-
CG.1	Community Garden	3	3	-	-	-	-

CASTELLINA DOMESTIC WATER DEMAND							
Village and Planning Area	Land Use Density Category	Gross Acres*	Estimated Net Acres**	Number of Dwelling Units	Usage Rates (gpd/DU) (gpd/ac)	Avg. Daily Flow (gpd)	ADD (gpm)
CP.1	Central Park	23	23	-	-	893	1
Sub Total Other		40	40	-	-	1,790	1
SUBTOTAL VILLAGE ONE		**180**	**151**	**629**	-	**212,000**	**147**
VILLAGE TWO							
2.1	MDR	26	19	173	241	41,600	29
2.2	MDR	29	22	198	241	47,700	33
2.3	LDR	21	17	99	330	32,700	23
Sub Total Residential		76	58	470	-	122,000	85
MU-1	MU	6	6	59	107	6,310	4
MU-2	MU	6	6	59	107	6,310	4
NP.2	Neighborhood Park	4	4	-	-	-	-
GP.1	Grand Paseo	2	2	-	-	-	-
VS.1	Village Square	1	1	-	-	-	-
CP.2	Central Park	7	7	-	-	893	1
Sub Total Other		26	25	118	-	13,500	9
SUBTOTAL VILLAGE TWO		**102**	**83**	**588**	-	**136,000**	**94**

CASTELLINA DOMESTIC WATER DEMAND							
Village and Planning Area	Land Use Density Category	Gross Acres*	Estimated Net Acres**	Number of Dwelling Units	Usage Rates (gpd/DU) (gpd/ac)	Avg. Daily Flow (gpd)	ADD (gpm)
VILLAGE THREE							
3.1	MDR	12	9	81	241	19,500	14
3.2	LDR	75	60	357	330	118,000	82
Sub Totals Village Three		87	69	438	-	137,000	95
MU-3	MU	9	8	84	107	8,990	6
NP.3	Neighborhood Park	4	4	-	-	-	-
SCH	School	12	12	-	-	7,140	5
Sub Total Other		25	24	84	-	16,100	11
SUBTOTAL VILLAGE THREE		**112**	**93**	**522**	**-**	**153,000**	**107**
*15gal/day per student, est student body of 700. Outdoor fields to be irrigated by reclaimed system							
VILLAGE FOUR							
4.1	MDR	24	18	162	241	39,000	27
4.2	MDR	11	9	77	241	18,400	13
4.3	MDR	13	10	86	241	20,600	14
4.4	LDR	14	11	66	330	21,800	15
4.5	LDR	21	17	101	330	33,500	23

CASTELLINA DOMESTIC WATER DEMAND							
Village and Planning Area	Land Use Density Category	Gross Acres*	Estimated Net Acres**	Number of Dwelling Units	Usage Rates (gpd/DU) (gpd/ac)	Avg. Daily Flow (gpd)	ADD (gpm)
4.6	LDR	24	18	110	330	36,400	25
4.7	MDR	12	9	81	241	19,500	14
Sub Totals Village Four		118	91	683	-	189,000	131
NP.3	Neighborhood Park	2	2	-	-	893	1
Sub Total Other		2	2	-	-	893	1
SUBTOTAL VILLAGE FOUR		**120**	**93**	**683**	**-**	**190,000**	**132**
VILLAGE FIVE							
5.1	HDR	12	12	248	116	28,700	20
SUBTOTAL VILLAGE FIVE		**12**	**12**	**248**	**-**	**28,700**	**20**
VILLAGE SIX							
6.1	AALDR	84	67	402	241	96,900	67
Sub Totals Village Six		84	67	402	-	96,900	67
AAAC	Active Open Space	6	6	-	-	4,460	3
Sub Total Other		6	6	-	-	4,460	3

CASTELLINA DOMESTIC WATER DEMAND							
Village and Planning Area	Land Use Density Category	Gross Acres*	Estimated Net Acres**	Number of Dwelling Units	Usage Rates (gpd/DU) (gpd/ac)	Avg. Daily Flow (gpd)	ADD (gpm)
SUBTOTAL VILLAGE SIX		**90**	**73**	**402**	-	**101,000**	**70**
Remainder Lots							
WWTP	Treatment Plant	27	27	-	-	N/A	N/A
OP.3	Detention	49	49	-	-	N/A	N/A
SUBTOTAL VILLAGE THREE		75	75	-	-	N/A	N/A
Overall Residential Totals		**516**	**407**	**3,070**	**-**	**785,000**	**545**
OVERALL TOTALS		**616**	**505**	**3,070**	**-**	**821,000**	**570**

The domestic water ADD for the development is projected to be 570 gpm. To be consistent with the WSA, and for the purposes of sizing the facilities and analyzing the distribution system, a 10% water loss factor was applied to the ADD, resulting in an ADD of 627 gpm.

PEAKING FACTORS

The peaking factors utilized in this analysis are consistent with the WSA, and are as follows:

Maximum Day Demand (MDD) = 2.25 x ADD
Peak Hour = 1.5 x MDD

DEMAND PROJECTIONS

The ultimate buildout domestic water demands for the Castellina Specific Plan area are estimated to be:

ADD	= 627 gpm
MDD	= 1,411 gpm
Peak Hour	= 2,116 gpm

Per the project Water Supply Assessment (WSA), prepared by Tully & Young, January 2018, the full build-out domestic water demand is projected to be:

Average Day	= 0.99 MGD (686 gpm)
Maximum Day	= 2.22 MGD (1,523 gpm)
Peak Hour	= 3.33 MGD (2,315 gpm)

As mentioned previously, the demand projections developed herein are slightly less than the WSA projections due to slight variances in the land use acreages and demand factors. It is deemed acceptable since the WSA used more conservative numbers.

The fire flow requirement for the development is 2,500 gpm for 2 hours at a minimum of 20 psi.

PROPOSED WATER SYSTEM FACILITIES

WATER SUPPLY

The project is proposed to be supplied domestic water from two (2) new on-site wells. Per state regulations, the wells shall be designed to supply the full build-out maximum day demand with one well out of service. Therefore, each well shall be designed with a capacity of 1,600-gpm. The well pumps shall be equipped with a variable frequency drive to provide flexibility during the early phases of the project and periods of low demand.

The wells are proposed to be located approximately 1,500 feet apart from each other. The wells will deliver water directly to the new on-site storage tanks through 12-inch diameter transmission mains.

STORAGE

On-site storage is required to provide the development with operational and emergency (fire flow) storage volumes. For developments with less than 1,000 connections, the operational storage volume shall equal the maximum day demand. For developments with greater than 1,000 connections, the operational storage volume shall equal four (4) hours of the peak hour demand. The fire flow storage volume shall be equivalent to the maximum fire flow requirement and duration within the development.

Per the WSA, the full-build our maximum day demand is 2.22 MGD, and the peak hour demand is 3.33 MGD. At 1,000 units, the operational storage volume requirement is approximately 710,000 gallons. However, the operational storage volume decreases to 555,000 gallons at full build-out. The fire flow requirement of 2,500-gpm for a 2-hour duration equates to a storage volume of 300,000 gallons.

In order to provide the minimum required storage volume throughout the phased construction and operational flexibility, it is recommended to construct two (2) equally sized tanks of 555,000-gallons each. The first tank will be required immediately, prior to first occupancy. The second tank will be required prior to the 300th dwelling unit being occupied.

PUMP STATION

The water stored in the on-site storage tanks needs to be boosted to provide adequate pressure to the residents and customers within the development area to meet normal demands plus fire flow requirements. Since gravity storage is not available, the booster station shall be sized to provide the peak hour demand plus the fire flow demand. The pump station shall include at least one (1) back-up pump.

The fire flow requirement of 2,500-gpm is proposed to be supplied by three (3) equally sized pumps with a capacity of 1,250-gpm each. The peak hour demand will vary as the phased construction progresses, therefore it is recommended to install smaller pumps to serve the initial phase(s) of the development, and replace the smaller pumps with larger pumps once the demand exists. It is recommended to initially install two (2) 150-gpm pumps to serve the normal demands and peak hour demands. As demand increases, the 150-gpm pumps will be replaced by 1,250-gpm pumps to meet the ultimate demands. It is recommended to phase the installation of the larger pumps, installing one prior to the 850th dwelling unit and the second prior to ultimate build-out. At ultimate build-out of the development, the booster station will include five (5) 1,250-gpm pumps to provide normal demand, peak hour demand and fire flow protection.

The booster pump station will include a hydropneumatic (surge) tank to provide operational flexibility and consistent pressure. The pumps shall all be equipped with variable frequency drives (VFDs) and shall include on-site back-up power generation. The pump station is anticipated to be housed in a block building with architectural treatment to match the development.

DISTRIBUTION SYSTEM PIPELINES

A hydraulic model of the on-site water distribution system was developed to size the distribution pipeline and ensure minimum pressure and flow requirements were met. The hydraulic model analysis is discussed in the following section. The model results determined that the backbone on-site pipe distribution system will consist primarily of 12-inch and 8-inch looped pipelines. The discharge pipeline from the booster station shall be a minimum of 18-inch diameter pipe to meet the peak hour plus fire flow demand. The backbone pipe network is displayed on Exhibit 10. The summary of linear footages per diameter are included below:

8-inch:	24,600 feet
10-inch:	2,600 feet
12-inch:	20,800 feet
18-inch	2,200 feet
Total:	**51,000 feet**

WATER TREATMENT

In 2017, water samples obtained from the existing agricultural wells located on-site were tested and analyzed for the complete Title 22 drinking water constituents to determine the likely water quality of the proposed wells. The sampling results indicated that no contaminants were detected that would pose a health risk. One of the well samples showed levels of manganese that slightly exceeded the secondary MCL, which is not a public health risk, only a consumer acceptance level. Based on the Well Sampling Results letter, prepared by McCloskey Consultants, dated July 18, 2017, the groundwater appears to be acceptable for the proposed use, and water treatment is not anticipated at this time.

Initial water sampling data indicated that the water quality is better at levels approximately 500-feet below the surface than the water quality at the lower levels. The well water will be chlorinated prior to entering the storage tank(s) in order to provide disinfection. Although groundwater treatment is not anticipated at this time, space should be provided at the site of the booster pump station and tanks to allow for water treatment if required in the future.

Prior to constructing the wells, it is highly recommended to engage a hydrogeologist to locate and drill pilot holes and perform zone sampling to gauge the water quality and the water availability at the potential well sites.

The proposed layout of the domestic water facilities is included as Figure 2 – Preliminary Site Plan in the Water Works Report.

HYDRAULIC MODELING ANALYSIS

A hydraulic model of the backbone domestic water system was developed using the WaterCAD modeling software by Bentley. The purpose of the hydraulic model is to determine the minimum pipe sizes required to meet the various flow conditions, while providing minimum system pressure.

HYDRAULIC MODEL ANALYSIS CRITERIA AND ASSUMPTIONS

The model was evaluated based on the following criteria:

- Minimum system pressure under ADD, MDD and PHD = 40 psi
- Minimum system pressure under Fire Flow = 20 psi
- Maximum Fire Flow Requirement = 2,500 gpm
- Maximum pipeline velocity = 10 fps
- Static model condition
- Minimum pipe diameter = 8-inches

MODELING SCENARIOS

Four scenarios were developed and analyzed in the model under the ultimate build-out demand conditions, as follows:

- ADD
- MDD
- Fire Flow
- PHD

MODELING RESULTS

The pipelines depicted on Exhibit 10 are the minimum required for the backbone system to meet the minimum design criteria. The hydraulic model result tables are attached as Appendix 1.

Technical Memorandum
Domestic Water System

APPENDIX 1

Water Modeling Results

Castellina Water Master Plan Average Day Demand Node Summary 10/26/2018					
Node	**Elevation (ft)**	**Pressure Zone**	**Demand (gpm)**	**Hydraulic Grade (ft)**	**Pressure (psi)**
J3	291.0	Zone - 1	0.0	563.7	118.0
J4	292.6	Zone - 1	0.0	563.7	117.0
J5	295.9	Zone - 1	0.0	563.6	116.0
J6	296.2	Zone - 1	0.0	563.6	116.0
J7	297.1	Zone - 1	0.0	563.6	115.0
J8	298.1	Zone - 1	0.0	563.6	115.0
J9	298.6	Zone - 1	0.0	563.6	115.0
J10	299.2	Zone - 1	0.0	563.6	114.0
J11	299.9	Zone - 1	0.0	563.6	114.0
J12	301.0	Zone - 1	0.0	563.5	114.0
J13	301.0	Zone - 2	0.0	563.5	114.0
J14	302.2	Zone - 1	0.0	563.6	113.0
J15	302.6	Zone - 1	0.0	563.5	113.0
J16	305.0	Zone - 1	0.0	563.5	112.0
J17	305.1	Zone - 1	0.0	563.5	112.0
J18	305.2	Zone - 1	0.0	563.5	112.0
J19	306.8	Zone - 1	0.0	563.5	111.0
J20	307.6	Zone - 1	0.0	563.5	111.0
J21	308.0	Zone - 1	0.0	563.5	111.0
J22	308.1	Zone - 1	0.0	563.5	110.0
J23	308.6	Zone - 1	0.0	563.5	110.0
J24	311.0	Zone - 1	0.0	563.5	109.0
J25	311.1	Zone - 1	0.0	563.5	109.0
N1	291.0	Zone - 1	20.0	564.0	118.0
N2	296.0	Zone - 1	29.0	563.6	116.0
N3	292.5	Zone - 1	11.0	563.7	117.0
N4	293.9	Zone - 1	14.0	563.6	117.0
N5	295.4	Zone - 1	26.0	563.6	116.0
N6	301.0	Zone - 1	38.0	563.6	114.0
N7	304.0	Zone - 1	0.0	563.6	112.0
N8	308.3	Zone - 1	59.0	563.5	110.0
N9	308.0	Zone - 1	18.0	563.5	111.0
N10	308.0	Zone - 1	31.0	563.5	111.0
N11	300.5	Zone - 1	24.0	563.6	114.0
N12	298.9	Zone - 1	24.0	563.6	114.0
N13	304.0	Zone - 1	28.0	563.5	112.0
N14	308.2	Zone - 1	61.0	563.5	110.0
N15	310.5	Zone - 1	12.0	563.5	109.0
N16	310.5	Zone - 1	45.0	563.5	109.0

Castellina Water Master Plan
Average Day Demand Pipe Summary
10/26/2018

Pipe ID	Length (ft)	Start Node	Stop Node	Dia. (in)	Material	Flow (gpm)	Velocity (fps)	Headloss Gradient (ft/ft)
P-1	190.0	Booster Pump	J2	12.0	PVC	440.0	1.3	0.0
P-2	101.0	Well 1	Well Pump 1	12.0	PVC	2314.0	6.6	0.0
P-3	240.0	T-1	Booster Pump	12.0	PVC	440.0	1.3	0.0
P-4	214.0	Well 2	Well Pump 2	12.0	PVC	2252.0	6.4	0.0
P-6	1012.0	Well Pump 2	J1	12.0	PVC	2252.0	6.4	0.0
P-7	64.0	Well Pump 1	J1	12.0	PVC	2314.0	6.6	0.0
P-8	1163.0	J1	T-1	18.0	PVC	4566.0	5.8	0.0
P-J10.11	471.0	J10	J11	8.0	PVC	-7.0	0.0	0.0
P-J10.N12	197.0	J10	N12	12.0	PVC	-53.0	0.2	0.0
P-J11.N11	402.0	J11	N11	8.0	PVC	13.0	0.1	0.0
P-J12.10	1022.0	J12	J10	12.0	PVC	-60.0	0.2	0.0
P-J14.N7	495.0	J14	N7	8.0	PVC	-11.0	0.1	0.0
P-J15.11	850.0	J15	N11	8.0	PVC	-21.0	0.1	0.0
P-J15.12	694.0	J15	J12	8.0	PVC	3.0	0.0	0.0
P-J15.18	714.0	J15	J18	8.0	PVC	-4.0	0.0	0.0
P-J16.15	930.0	J16	J15	8.0	PVC	-23.0	0.1	0.0
P-J16.N13	685.0	J16	N13	12.0	PVC	7.0	0.0	0.0
P-J17.14	970.0	J17	J14	8.0	PVC	-37.0	0.2	0.0
P-J18.N6	1296.0	J18	N6	8.0	PVC	-28.0	0.2	0.0
P-J19.16	628.0	J19	J16	8.0	PVC	-12.0	0.1	0.0
P-J2.N1)	1077.0	J2	N1	12.0	PVC	440.0	1.3	0.0
P-J20.N10	285.0	J20	N10	12.0	PVC	6.0	0.0	0.0
P-J20.N9	291.0	J20	N9	12.0	PVC	-18.0	0.1	0.0
P-J21.17	758.0	J21	J17	8.0	PVC	-18.0	0.1	0.0
P-J21.18	620.0	J21	J18	8.0	PVC	-24.0	0.2	0.0
P-J21.N10	307.0	J21	N10	8.0	PVC	22.0	0.1	0.0
P-J21.N9	289.0	J21	N9	8.0	PVC	21.0	0.1	0.0
P-J22.17	1077.0	J22	J17	8.0	PVC	-19.0	0.1	0.0
P-J22.N9	415.0	J22	N9	12.0	PVC	15.0	0.0	0.0
P-J23.19	642.0	J23	J19	8.0	PVC	4.0	0.0	0.0
P-J23.20	466.0	J23	J20	8.0	PVC	-12.0	0.1	0.0
P-J23.22	1168.0	J23	J22	8.0	PVC	-9.0	0.1	0.0
P-J3.4	493.0	J3	J4	8.0	PVC	84.0	0.5	0.0
P-J3.N2	1480.0	J3	N2	12.0	PVC	158.0	0.5	0.0
P-J3.N3	816.0	J3	N3	12.0	PVC	178.0	0.5	0.0
P-J4.5	988.0	J4	J5	8.0	PVC	47.0	0.3	0.0
P-J4.6	867.0	J4	J6	8.0	PVC	36.0	0.2	0.0
P-J5.7	403.0	J5	J7	8.0	PVC	58.0	0.4	0.0
P-J5.N4	489.0	J5	N4	8.0	PVC	-11.0	0.1	0.0
P-J6.14	1469.0	J6	J14	8.0	PVC	47.0	0.3	0.0
P-J6.N2	499.0	J6	N2	8.0	PVC	-10.0	0.1	0.0
P-J7.N6	1271.0	J7	N6	8.0	PVC	27.0	0.2	0.0
P-J8.7	761.0	J8	J7	8.0	PVC	-31.0	0.2	0.0
P-J8.N6	715.0	J8	N6	8.0	PVC	18.0	0.1	0.0
P-J9.11	480.0	J9	J11	8.0	PVC	20.0	0.1	0.0
P-J9.N5	783.0	J9	N5	12.0	PVC	-97.0	0.3	0.0
P-N1.J3	605.0	N1	J3	12.0	PVC	420.0	1.2	0.0
P-N10.J16	612.0	N10	J16	12.0	PVC	-4.0	0.0	0.0
P-N11.J8	904.0	N11	J8	8.0	PVC	-32.0	0.2	0.0
P-N12.J9	215.0	N12	J9	12.0	PVC	-78.0	0.2	0.0
P-N13.14	1224.0	N13	N14	12.0	PVC	42.0	0.1	0.0
P-N13.J12	1018.0	N13	J12	12.0	PVC	-63.0	0.2	0.0
P-N13.J13	1086.0	N13	J13	8.0	PVC	0.0	0.0	0.0
P-N14.J19	704.0	N14	J19	8.0	PVC	-16.0	0.1	0.0
P-N14.J23	685.0	N15	J23	8.0	PVC	-17.0	0.1	0.0

Pipe ID	Length (ft)	Start Node	Stop Node	Dia. (in)	Material	Flow (gpm)	Velocity (fps)	Headloss Gradient (ft/ft)
P-N15.14	1127.0	N15	N14	12.0	PVC	3.0	0.0	0.0
P-N15.J25	713.0	N15	J25	8.0	PVC	0.0	0.0	0.0
P-N16.15	1541.0	N16	N15	12.0	PVC	-2.0	0.0	0.0
P-N16.J25	717.0	N16	J24	8.0	PVC	0.0	0.0	0.0
P-N3.4	733.0	N3	N4	12.0	PVC	167.0	0.5	0.0
P-N4.5	814.0	N4	N5	12.0	PVC	142.0	0.4	0.0
P-N5.J8	685.0	N5	J8	8.0	PVC	18.0	0.1	0.0
P-N6.J14	324.0	N6	J14	8.0	PVC	-21.0	0.1	0.0
P-N7.2	1876.0	N7	N2	12.0	PVC	-119.0	0.3	0.0
P-N8.16	1313.0	N8	N16	12.0	PVC	43.0	0.1	0.0
P-N8.7	1332.0	N8	N7	12.0	PVC	-107.0	0.3	0.0
P-N8.J22	943.0	N8	J22	12.0	PVC	5.0	0.0	0.0

Castellina Water Master Plan

Fire Flow Summary

10/26/2018

Location	Pressure Zone	Satisfies Fire Flow Constraints	Fire Flow Run Balanced	Flow Needed (gpm)	Flow Avaible (gpm)	Residual Pressure at Fire Flow Required (psi)	Pipe w/ Max Velocity	Velocity of Max Pipe (fps)	Zone Junction w/ Minimum Pressure	Zone Minimum Pressure (psi)
J1	Null Zone	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J2	Null Zone	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J3	Zone - 1	TRUE	TRUE	1000	2000	91	P-1	8.9	J25	50
J4	Zone - 1	TRUE	TRUE	1000	2000	89	P-1	8.9	J25	49
J5	Zone - 1	TRUE	TRUE	1000	2000	87	P-1	8.9	J25	48
J6	Zone - 1	TRUE	TRUE	1000	2000	87	P-1	8.9	J25	48
J7	Zone - 1	TRUE	TRUE	1000	2000	86	P-1	8.9	J25	48
J8	Zone - 1	TRUE	TRUE	1000	2000	86	P-1	8.9	J25	47
J9	Zone - 1	TRUE	TRUE	1000	2000	86	P-1	8.9	J25	47
J10	Zone - 1	TRUE	TRUE	1000	2000	86	P-1	8.9	J25	47
J11	Zone - 1	TRUE	TRUE	1000	2000	85	P-1	8.9	J25	47
J12	Zone - 1	TRUE	TRUE	1000	2000	85	P-1	8.9	J25	46
J13	Zone - 1	TRUE	TRUE	1000	2000	82	P-1	8.9	J25	46
J14	Zone - 1	TRUE	TRUE	1000	2000	84	P-1	8.9	J25	47
J15	Zone - 1	TRUE	TRUE	1000	2000	84	P-1	8.9	J25	46
J16	Zone - 1	TRUE	TRUE	1000	2000	83	P-1	8.9	J25	46
J17	Zone - 1	TRUE	TRUE	1000	2000	82	P-1	8.9	J25	46
J18	Zone - 1	TRUE	TRUE	1000	2000	82	P-1	8.9	J25	46
J19	Zone - 1	TRUE	TRUE	1000	2000	82	P-1	8.9	J25	46
J20	Zone - 1	TRUE	TRUE	1000	2000	82	P-1	8.9	J25	46
J21	Zone - 1	TRUE	TRUE	1000	2000	81	P-1	8.9	J25	46
J22	Zone - 1	TRUE	TRUE	1000	2000	81	P-1	8.9	J25	46
J23	Zone - 1	TRUE	TRUE	1000	2000	81	P-1	8.9	J25	46
J24	Zone - 1	TRUE	TRUE	1000	2000	78	P-1	8.9	N16	45
J25	Zone - 1	TRUE	TRUE	1000	2000	78	P-1	8.9	N15	45
N1	Zone - 1	TRUE	TRUE	1052	2052	93	P-1	8.9	J25	53
N2	Zone - 1	TRUE	TRUE	1075	2075	88	P-1	8.9	J25	48
N3	Zone - 1	TRUE	TRUE	1029	2029	89	P-1	8.9	J25	49
N4	Zone - 1	TRUE	TRUE	1036	2036	88	P-1	8.9	J25	48

Location	Pressure Zone	Satisfies Fire Flow Constraints	Fire Flow Run Balanced	Flow Needed (gpm)	Flow Avaible (gpm)	Residual Pressure at Fire Flow Required (psi)	Pipe w/ Max Velocity	Velocity of Max Pipe (fps)	Zone Junction w/ Minimum Pressure	Zone Minimum Pressure (psi)
N5	Zone - 1	TRUE	TRUE	1068	2068	87	P-1	8.9	J25	47
N6	Zone - 1	TRUE	TRUE	1098	2098	85	P-1	8.9	J25	47
N7	Zone - 1	TRUE	TRUE	1000	2000	84	P-1	8.9	J24	47
N8	Zone - 1	TRUE	TRUE	1152	2152	81	P-1	8.9	J24	46
N9	Zone - 1	TRUE	TRUE	2046	2637	47	P-1	10.58	J25	20
N10	Zone - 1	TRUE	TRUE	2081	2671	47	P-1	10.57	J25	20
N11	Zone - 1	TRUE	TRUE	1061	2061	85	P-1	8.9	J25	47
N12	Zone - 1	TRUE	TRUE	1063	2063	86	P-1	8.9	J25	47
N13	Zone - 1	TRUE	TRUE	1072	2072	83	P-1	8.9	J25	46
N14	Zone - 1	TRUE	TRUE	2658	2729	24	P-1	10.52	J25	20
N15	Zone - 1	TRUE	TRUE	1031	2031	80	P-1	8.9	J25	45
N16	Zone - 1	TRUE	TRUE	1117	2117	80	P-1	8.9	J24	44

Castellina Water Master Plan Max Day Demand Node Summary 10/26/2018					
Node	Elevation (ft)	Pressure Zone	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J3	291.0	Zone - 1	0.0	547.8	111.0
J4	292.6	Zone - 1	0.0	547.4	110.0
J5	295.9	Zone - 1	0.0	547.1	109.0
J6	296.2	Zone - 1	0.0	547.2	109.0
J7	297.1	Zone - 1	0.0	546.9	108.0
J8	298.1	Zone - 1	0.0	546.8	108.0
J9	298.6	Zone - 1	0.0	546.7	107.0
J10	299.2	Zone - 1	0.0	546.7	107.0
J11	299.9	Zone - 1	0.0	546.7	107.0
J12	301.0	Zone - 1	0.0	546.6	106.0
J13	301.0	Zone - 1	0.0	546.6	106.0
J14	302.2	Zone - 1	0.0	546.8	106.0
J15	302.6	Zone - 1	0.0	546.6	106.0
J16	305.0	Zone - 1	0.0	546.6	105.0
J17	305.1	Zone - 1	0.0	546.6	105.0
J18	305.2	Zone - 1	0.0	546.7	104.0
J19	306.8	Zone - 1	0.0	546.6	104.0
J20	307.6	Zone - 1	0.0	546.6	103.0
J21	308.0	Zone - 1	0.0	546.6	103.0
J22	308.1	Zone - 1	0.0	546.6	103.0
J23	308.6	Zone - 1	0.0	546.6	103.0
J24	311.0	Zone - 1	0.0	546.5	102.0
J25	311.1	Zone - 1	0.0	546.5	102.0
N1	291.0	Zone - 1	52.0	549.2	112.0
N2	296.0	Zone - 1	75.0	547.2	109.0
N3	292.5	Zone - 1	29.0	547.4	110.0
N4	293.9	Zone - 1	36.0	547.1	110.0
N5	295.4	Zone - 1	68.0	546.9	109.0
N6	301.0	Zone - 1	98.0	546.8	106.0
N7	304.0	Zone - 1	0.0	546.8	105.0
N8	308.3	Zone - 1	152.0	546.6	103.0
N9	308.0	Zone - 1	46.0	546.6	103.0
N10	308.0	Zone - 1	81.0	546.6	103.0
N11	300.5	Zone - 1	61.0	546.7	107.0
N12	298.9	Zone - 1	63.0	546.7	107.0
N13	304.0	Zone - 1	72.0	546.6	105.0
N14	308.2	Zone - 1	158.0	546.5	103.0
N15	310.5	Zone - 1	31.0	546.5	102.0
N16	310.5	Zone - 1	117.0	546.5	102.0

Castellina Water Master Plan

Max Day Demand Pipe Summary

10/26/2018

Pipe ID	Length (ft)	Start Node	Stop Node	Dia. (in)	Material	Flow (gpm)	Velocity (fps)	Headloss Gradient (ft/ft)
P-1	190.0	Booster Pump	J2	12.0	PVC	1137.0	3.2	0.0
P-2	101.0	Well 1	Well Pump 1	12.0	PVC	2314.0	6.6	0.0
P-3	240.0	T-1	Booster Pump	12.0	PVC	1137.0	3.2	0.0
P-4	214.0	Well 2	Well Pump 2	12.0	PVC	2252.0	6.4	0.0
P-6	1012.0	Well Pump 2	J1	12.0	PVC	2252.0	6.4	0.0
P-7	64.0	Well Pump 1	J1	12.0	PVC	2314.0	6.6	0.0
P-8	1163.0	J1	T-1	18.0	PVC	4566.0	5.8	0.0
P-J10.11	471.0	J10	J11	8.0	PVC	-17.0	0.1	0.0
P-J10.N12	197.0	J10	N12	12.0	PVC	-138.0	0.4	0.0
P-J11.N11	402.0	J11	N11	8.0	PVC	34.0	0.2	0.0
P-J12.10	1022.0	J12	J10	12.0	PVC	-155.0	0.4	0.0
P-J14.N7	495.0	J14	N7	8.0	PVC	-30.0	0.2	0.0
P-J15.11	850.0	J15	N11	8.0	PVC	-55.0	0.4	0.0
P-J15.12	694.0	J15	J12	8.0	PVC	7.0	0.1	0.0
P-J15.18	714.0	J15	J18	8.0	PVC	-11.0	0.1	0.0
P-J16.15	930.0	J16	J15	8.0	PVC	-59.0	0.4	0.0
P-J16.N13	685.0	J16	N13	12.0	PVC	19.0	0.1	0.0
P-J17.14	970.0	J17	J14	8.0	PVC	-96.0	0.6	0.0
P-J18.N6	1296.0	J18	N6	8.0	PVC	-73.0	0.5	0.0
P-J19.16	628.0	J19	J16	8.0	PVC	-30.0	0.2	0.0
P-J2.N1)	1077.0	J2	N1	12.0	PVC	1137.0	3.2	0.0
P-J20.N10	285.0	J20	N10	12.0	PVC	15.0	0.0	0.0
P-J20.N9	291.0	J20	N9	12.0	PVC	-47.0	0.1	0.0
P-J21.17	758.0	J21	J17	8.0	PVC	-48.0	0.3	0.0
P-J21.18	620.0	J21	J18	8.0	PVC	-62.0	0.4	0.0
P-J21.N10	307.0	J21	N10	8.0	PVC	56.0	0.4	0.0
P-J21.N9	289.0	J21	N9	8.0	PVC	54.0	0.4	0.0
P-J22.17	1077.0	J22	J17	8.0	PVC	-48.0	0.3	0.0
P-J22.N9	415.0	J22	N9	12.0	PVC	38.0	0.1	0.0
P-J23.19	642.0	J23	J19	8.0	PVC	11.0	0.1	0.0
P-J23.20	466.0	J23	J20	8.0	PVC	-32.0	0.2	0.0
P-J23.22	1168.0	J23	J22	8.0	PVC	-23.0	0.2	0.0
P-J3.4	493.0	J3	J4	8.0	PVC	216.0	1.4	0.0
P-J3.N2	1480.0	J3	N2	12.0	PVC	409.0	1.2	0.0
P-J3.N3	816.0	J3	N3	12.0	PVC	460.0	1.3	0.0
P-J4.5	988.0	J4	J5	8.0	PVC	122.0	0.8	0.0
P-J4.6	867.0	J4	J6	8.0	PVC	94.0	0.6	0.0
P-J5.7	403.0	J5	J7	8.0	PVC	151.0	1.0	0.0
P-J5.N4	489.0	J5	N4	8.0	PVC	-29.0	0.2	0.0
P-J6.14	1469.0	J6	J14	8.0	PVC	121.0	0.8	0.0
P-J6.N2	499.0	J6	N2	8.0	PVC	-27.0	0.2	0.0
P-J7.N6	1271.0	J7	N6	8.0	PVC	71.0	0.5	0.0

Pipe ID	Length (ft)	Start Node	Stop Node	Dia. (in)	Material	Flow (gpm)	Velocity (fps)	Headloss Gradient (ft/ft)
P-J8.7	761.0	J8	J7	8.0	PVC	-80.0	0.5	0.0
P-J8.N6	715.0	J8	N6	8.0	PVC	45.0	0.3	0.0
P-J9.11	480.0	J9	J11	8.0	PVC	51.0	0.3	0.0
P-J9.N5	783.0	J9	N5	12.0	PVC	-252.0	0.7	0.0
P-N1.J3	605.0	N1	J3	12.0	PVC	1086.0	3.1	0.0
P-N10.J16	612.0	N10	J16	12.0	PVC	-10.0	0.0	0.0
P-N11.J8	904.0	N11	J8	8.0	PVC	-82.0	0.5	0.0
P-N12.J9	215.0	N12	J9	12.0	PVC	-201.0	0.6	0.0
P-N13.14	1224.0	N13	N14	12.0	PVC	109.0	0.3	0.0
P-N13.J12	1018.0	N13	J12	12.0	PVC	-162.0	0.5	0.0
P-N13.J13	1086.0	N13	J13	8.0	PVC	0.0	0.0	0.0
P-N14.J19	704.0	N14	J19	8.0	PVC	-41.0	0.3	0.0
P-N14.J23	685.0	N15	J23	8.0	PVC	-44.0	0.3	0.0
P-N15.14	1127.0	N15	N14	12.0	PVC	8.0	0.0	0.0
P-N15.J25	713.0	N15	J25	8.0	PVC	0.0	0.0	0.0
P-N16.15	1541.0	N16	N15	12.0	PVC	-5.0	0.0	0.0
P-N16.J25	717.0	N16	J24	8.0	PVC	0.0	0.0	0.0
P-N3.4	733.0	N3	N4	12.0	PVC	432.0	1.2	0.0
P-N4.5	814.0	N4	N5	12.0	PVC	367.0	1.0	0.0
P-N5.J8	685.0	N5	J8	8.0	PVC	47.0	0.3	0.0
P-N6.J14	324.0	N6	J14	8.0	PVC	-55.0	0.4	0.0
P-N7.2	1876.0	N7	N2	12.0	PVC	-307.0	0.9	0.0
P-N8.16	1313.0	N8	N16	12.0	PVC	112.0	0.3	0.0
P-N8.7	1332.0	N8	N7	12.0	PVC	-278.0	0.8	0.0
P-N8.J22	943.0	N8	J22	12.0	PVC	13.0	0.0	0.0

Infrastructure Master Plan

APPENDIX D

Draft

Technical Memorandum

Wastewater System

APPENDIX D

TECHNICAL MEMORANDUM

WASTEWATER SYSTEM

APRIL 2019

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INTRODUCTION

The Castellina Wastewater System Technical Memorandum has been prepared as part of overall infrastructure studies for the proposed Castellina Development. Castellina, LLC proposes the development of a master-planned community located on approximately 794 acres in Madera County (County). The Castellina Development is located within Madera County, just north of the City of Madera, three miles east of Highway 99, and roughly 16 miles south of the City of Chowchilla, as shown on Figure 1.

The proposed Castellina Development property includes a comprehensive land use and regulatory framework to guide the development of approximately 616 gross acres located northeast of the City of Madera.

It is anticipated that development could occur in the near future. Prior to a comprehensive development plan being adopted for the area it has been requested that a study of infrastructure and associated facilities be completed.

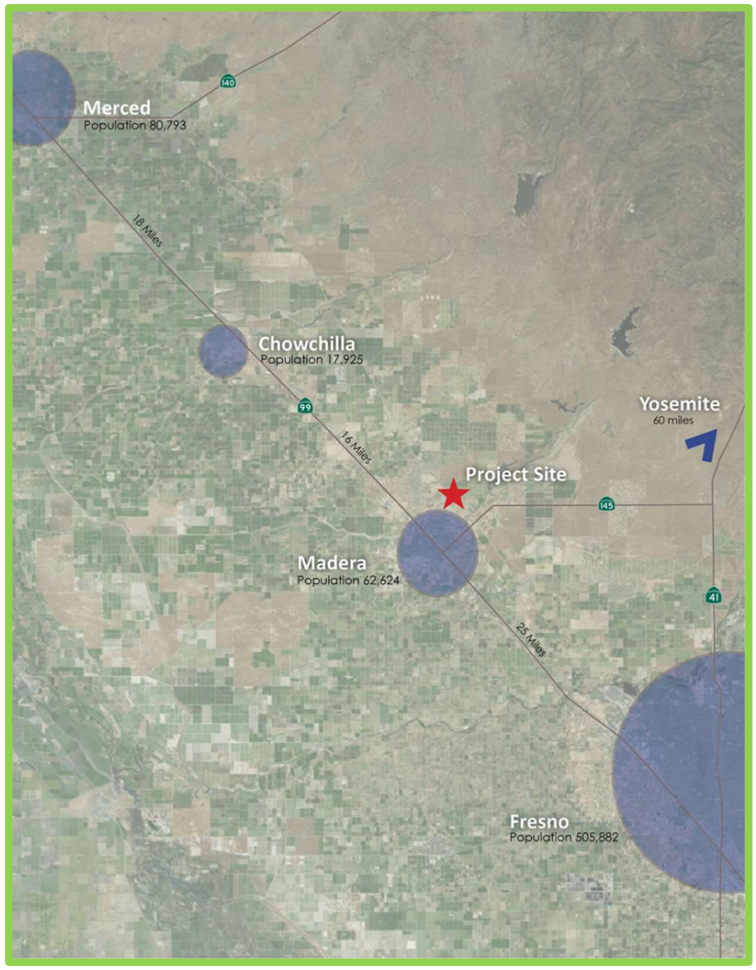

Figure 1 - Location Map

WASTEWATER TECHNICAL MEMORANDUM PURPOSE

The purpose of this Wastewater System Technical Memorandum is to provide preliminary analysis for the wastewater collection and treatment system that will serve the Castellina development area.

As part of this Wastewater System Technical Memorandum, the following items are presented:

- The wastewater generation rates for the development area
- The sanitary sewer system infrastructure that conveys the projected flows to the proposed wastewater treatment plant

The results and conclusions of the wastewater modeling are based on serving the wastewater collection system for the proposed development area. It is understood that additional in tract wastewater collection system piping will be required within each of the development areas to serve the individual users.

DEVELOPMENT LOCATION AND DESCRIPTION

The Castellina Development area consists of approximately 616 gross[1] acres and 510 net[2] acres located north of the City of Madera. The area and the proposed land use are depicted on Figure 2.

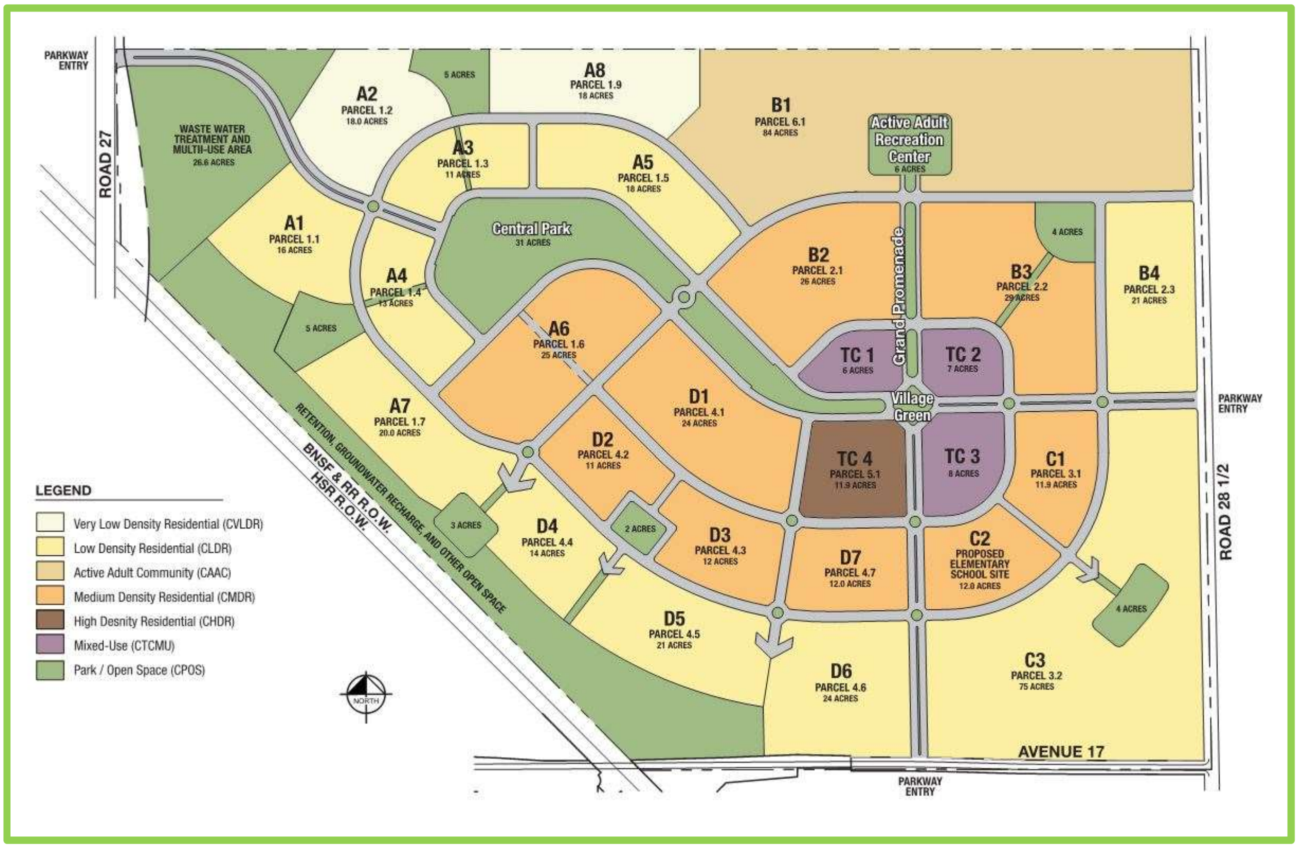

Figure 2 – Land Use Plan with Acreages

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[1] Gross Acreage, as defined by the Madera County General Plan, "includes all land (including streets and rights-of-way) designated for a particular residential use" (i.e., development parcel, not including main collector roads)
[2] Net acreage, as defined by the Madera County General Plan, "excludes streets and rights-of-way…Net acreage is the standard typically used in zoning, while gross acreage is more commonly used in General Plan designations." From this definition, net densities were calculated.

WASTEWATER STUDY PROCESS

This Plan consists of an analysis of the proposed wastewater infrastructure necessary to serve the development area. A hydraulic model was developed to analyze the improvements required to accommodate the growth of the development area.

LAND USE AND WASTEWATER GENERATION

The Castellina Development is proposed to be divided into five major development areas: Village A, B, C, D, and the Town Center. The areas will be developed with a variety of land uses including residential, active adult community, mixed use, open space, and parks. The total gross area is approximately 790 acres. Each land use generates wastewater flow based on unit flow factors, either with GPD/DU for Residential Units, or GPD/Acre for Active Open space and Schools. The Average Daily Flow (ADF) Unit Flow Factors that are used for the Area are shown below in Table 1.

Table 1
Castellina Development
Wastewater System
Average Dry Weather Unit Flow Factors

Land Use Category	Development Flow Factor (GPD/DU) or (GPD/ac)
Residential	
Very Low Density	210
Low Density Residential	210
Medium Density Residential	210
High Density Residential	110
Mixed Use	210
Active Adult Amenity Center	110
Parks and Open Space	
Active Open	300
Other	
School	1,000

A summary of the proposed land use acreages and residential unit counts that generate wastewater flows for the planned development are shown in Table 2. Residential Average Daily Flow is calculated by multiplying the unit flow factor by the net units. The Active Open land use category and School land use category are calculated by multiplying the unit factor flow by net acres. All Peak Hourly Flow is calculated with a peaking factor of 3. The detail for the calculated flows for each village can be found in Appendix 1.

Table 2
Castellina Development
Wastewater System
Wastewater Generation by Land Use

Land Use	Unit Flow Factor (GPD/unit) or (GPD/ac)	Net Area (Acres)	Net Units	Average Daily Flow (GPD)	Peak Hourly Flow (GPD)
Residential					
Very Low Density	210	N/A	95	19,950	59,850
Low Density Residential	210	N/A	1,105	232,050	696,150
Medium Density Residential	210	N/A	1,035	217,350	652,050
High Density Residential	110	N/A	240	26,400	79,200
Mixed Use	210	N/A	195	40,950	122,850
Active Adult Amenity Center	110	N/A	402	44,220	132,660
Parks and Open Space					
Active Open	300	66	N/A	19,920	59,760
Other					
School	1,000	12	N/A	12,000	36,000

HYDRAULIC MODELING ANALYSIS

This section of the Technical Memorandum summarizes the procedures, criteria and assumptions used in the hydraulic modeling analyses and presents the conclusions developed from review of the model output data.

HYDRAULIC MODEL ANALYSIS CRITERIA

The following procedure was used for the hydraulic model analysis of the sanitary sewer system.

- The primary wastewater generation areas within the proposed development were delineated by sewer basins.
- The land use areas, with their respective generation rates, were assigned a manhole node to tie into the trunk system.
- Proposed land use acreages and wastewater generation for each manhole point of connection were tabulated and allocated.
- Wastewater flows, including average dry weather flows and factored peak flows were calculated and allocated at each node point.
- Average dry weather flows were calculated using the Average Dry Weather Unit Flow Factors for the land use types within each wastewater shed.
- Factored flows were calculated by multiplying average dry weather flows by a peaking factor of 3.0.

Pipe sizes were initially sized based on peak buildout flows and pipe capacities based on minimum pipe slopes. The hydraulic modeling results can be found in the Appendix to this memorandum.

PIPELINE SIZING CRITERIA

The proposed pipe size diameters were selected using the following pipe criteria:

- Minimum pipe diameter is 8-inches.
- Pipes 15-inches and less in diameter are designed to have a maximum depth of flow of 50% of the pipe diameter.
- Pipes larger than 15-inches in diameter are designed to have a maximum depth of flow of 75% of the pipe diameter.
- Pipe sizes have been selected assuming pipes will be installed at minimum slopes: 0.0035 ft/ft for 15-inch diameter and less; 0.0010 ft/ft for larger than 15-inch.

- The minimum slope for a pipe is a slope that yields a minimum 2 feet per second velocity when flowing at design capacity for 15-inch diameter and less, and 1.75 feet per second for pipes larger than 15-inch.

The following are the assumptions that were utilized in the preparation and analysis of the hydraulic models for the proposed wastewater system

- The minimum pipeline diameter for modeling purposes is 8-inches.

MODELING SCENARIOS

A hydraulic model of the skeletonized system representing the proposed collection system was developed utilizing the SewerCAD hydraulic modeling software by Bentley. A static model was developed to analyze average daily flow and peak hourly flow. Both model input and output data were reviewed for consistency with industry standard criteria and design standards.

MODELING RESULTS

The hydraulic model was analyzed under the average daily flow and peak hourly flow. The peak hourly flow model scenario was used to identify the sewer system required to serve the area. The model results included in the Appendix 2 and Appendix 3 to this memorandum present the results of the proposed land use flows.

PROPOSED IMPROVEMENTS

Based on the currently available land use plans for the development, the sewer system construction required to provide service to the area includes:

- One (1) Wastewater Treatment Plant
- Approximately 41,000 LF of 8" – 18" gravity sewer main
  - Approximately 20,300 LF of 8" gravity sewer main
  - Approximately 9,000 LF of 10" gravity sewer main
  - Approximately 5,900 LF of 12" gravity sewer main
  - Approximately 2,200 LF of 15" gravity sewer main
  - Approximately 3,600 LF of 18" gravity sewer main

The proposed layout of the sewer improvements is depicted on Figure 3, which includes the development broken out by different sewersheds.

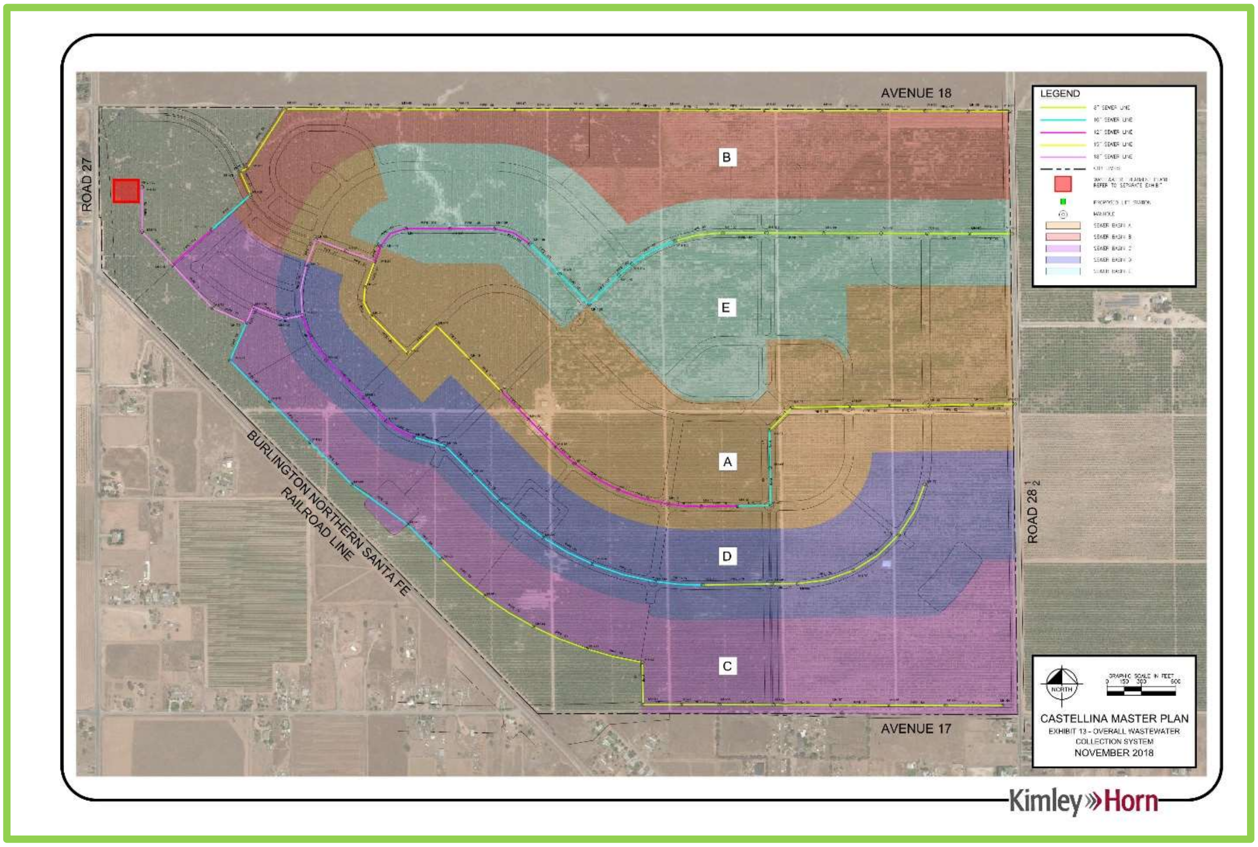

Figure 3 – Overall Collection System Layout

The initial phase of the project is shown in Figure 4.

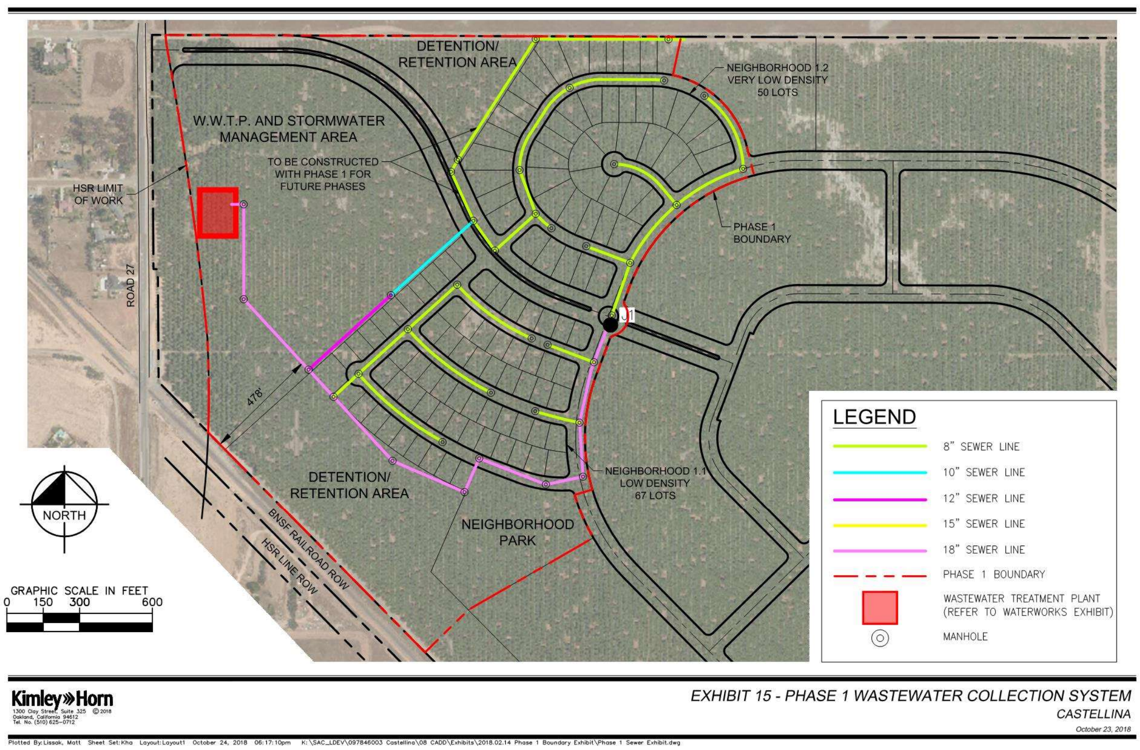

Figure 4 – Phase 1 Sewer System

WASTEWATER TREATMENT PLANT

A new wastewater treatment plant will be constructed to treat the domestic wastewater generated within the new development, and recycled water will be used for non-residential outdoor irrigation. See Figure 5 for a preliminary process flow diagram of the proposed wastewater and recycled water systems at Castellina.

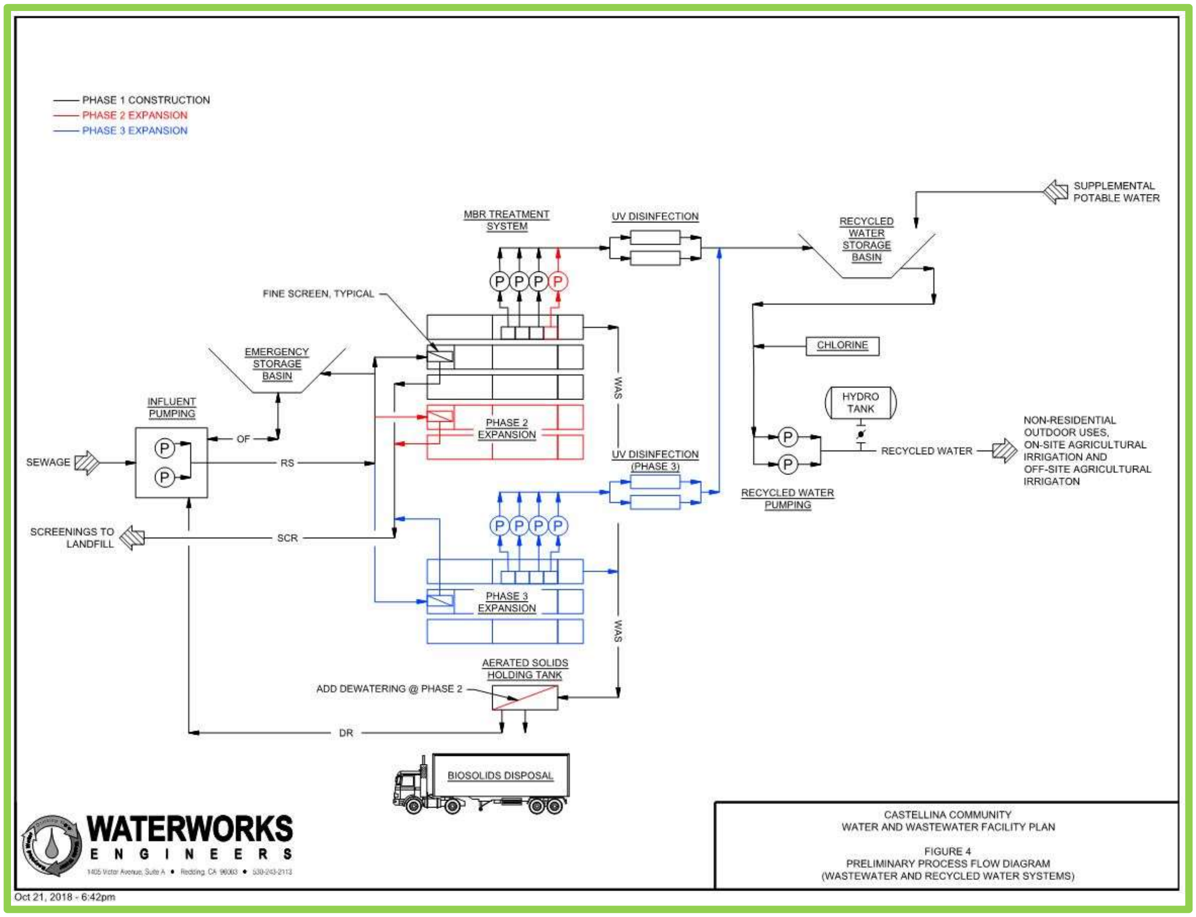

Figure 5 – Wastewater and Recycled Water Facility Process Flow Diagram

According to the "Castellina Community – Water and Wastewater Facility Plan - Draft Report," dated October 24, 2018 by Water Works Engineers, influent wastewater flows are estimated based on indoor potable water demands from the 2016 Water Supply Assessment, minus estimated losses. Peak Hour Flow Rates were determined as 62 gpm (0.089 mgd) for Phase 1 and 1,528 gpm (2.20 mgd) for Planning Year 2040. The report gives a detailed table for wastewater flow rates for the development, with assumptions for flow peaking factors based on similar, typical residential developments. As development progresses, actual peaking factors should be determined for use in future phases of system expansion.

The anticipated wastewater and recycled water systems include the following main unit treatment processes and ancillary systems, as shown on Figure 5:

- Influent Pumping – Two small pumps (approx.. 5 hp amd 200 gpm each) to be replaced by two larger pumps (approx.. 10hp and 800 gpm)
- Influent Screening – Self Cleaning Fine Screen
- Emergency Storage – 1.15 million gallons

- Influent Flow Equalization – During initial phases of the project, it may be possible to utilize the incoming collection piping and manholes to equalize flows.
- Packaged Biological Treatment and Tertiary Filtration – packaged membrane bioreactor (MBR) system
- Disinfection – UV System
- Recycled Water Storage – 2.3 million gallons
- Recycled Water Pumping - Two small pumps (approx.. 5 hp amd 200 gpm each) to be replaced by two larger pumps (approx.. 10hp and 800 gpm)
- Residuals Handling – An aerated solids holding tank installed adjacent to the MBR system during Phase 1.
- Odor control – influent pump station wetwell and anoxic chambers covered and ducted to foul air fans, which will convey to an odor control system
- Operations Building – 1,800 sq. ft building at the WWTP site with a SCADA control room, laboratory for water quality analysis, ADA restroom, storage area, and electrical room
- Site Piping
  - Raw sewage forcemain: 10-inch diameter
  - Recycled water from MBR system: 8-inch diameter
  - Recycled water from recycled water pumps: 8-inch diameter
  - Potable water: 8-inch diameter
- Electrical and Controls
  - Service likely through underground conduit and power conductors from the access road to a new transformer.
  - Wastewater treatment system fully automated with local and remote controls. Main programmable logic controller (PLC) for all equipment. PLC for each MBR system unit. SCADA system and diesesl standby generator at the WWTP site.

EFFLUENT DISPOSAL

Per the WSA, recycled water is planned to initially be used for construction water and non-residential outdoor irrigation. Additionally, it is anticipated that portions of the existing almond and fig orchards will be irrigated year-round within the development's property to dispose of excess recycled water. To accomplish this, the new recycled water distribution system will be tied into the existing almond and fig irrigation systems as necessary to balance irrigation needs with excess recycled water disposal requirements. As development progresses and existing crops are removed to make way for homes, commercial facilities, school, etc., excess recycled water is anticipated to be conveyed offsite for agricultural irrigation of adjacent farmlands. Space is reserved at the WWTP site for construction of a larger recycled water reservoir for long-term storage (in addition to the 2.3 million gallon basin to be added in Phase 1 of the project for short-term storage) in the event that year-round irrigation is not feasible and recycled water must be held for several months.

PHASE 1

During the initial phases of development when only a few houses are constructed, wastewater would likely need to be temporarily stored and hauled to the City of Madera WWTP, approximately 12 miles away from the development. As homes are constructed and occupied, and daily average wastewater flows reach approximately 5,000 gallons per day (approx. 30 units), wastewater will be treated onsite at the new facilities.

Technical Memorandum
Wastewater System

APPENDIX 1

Castellina Flow Generation Tables

CASTELLINA FLOW GENERATION TABLES

	Village and Planning Area	Land Use Density Category	Gross Acres*	Estimated Net Acres**	Allowable Net Density Range	Net Density Target (du/ac)	Number of Dwelling Units	Usage Rates (gpd/DU) (gpd/ac)	Avg. Daily Flow (gpd)	Peak Hourly Flow (gpd)
	VILLAGE A									
A1	1.1	LDR	16.6	11.0	4.0-7.0 du/ac	6.0	67	210	14,070	42,210
A2	1.2	VLDR	18.0	16.0	2.0-4.0 du/ac.	3.0	50	210	10,500	31,500
A3	1.3	LDR	11.5	9.0	4.0-7.0 du/ac	6.0	54	210	11,340	34,020
A4	1.4	LDR	12.9	11.0	4.0-7.0 du/ac	6.0	60	210	12,600	37,800
A5	1.5	LDR	17.6	15.0	4.0-7.0 du/ac	6.0	90	210	18,900	56,700
A6	1.6	MDR	24.8	19.0	7.0-15.0 du/ac	9.0	171	210	35,910	107,730
A7	1.7	LDR	20.1	16.0	4.0-7.0 du/ac	6.0	96	210	20,160	60,480
A8	1.9	VLDR	17.9	15.0	2.0-4.0 du/ac.	3.0	45	210	9,450	28,350
	Sub Total Residential		139.4	112.0			633		132,930	398,790
	NP.1	Neighborhood Park	5.0	5.0	-	-	-	680	3,400	10,200
	OP.1	Open Space	4.4	4.4	-	-	-	680	2,992	8,976
	OP.2	Open Space	4.8	4.8	-	-	-	680	3,264	9,792
	CG.1	Community Garden	3.0	3.0	-	-	-	680	2,040	6,120
	CP.1	Central Park	23.0	23.0	-	-	-	680	15,640	46,920
	Sub Total Other		40.2	40.2					27,336	82,008
	SUBTOTAL VILLAGE A		179.6	152.2			633		160,266	480,798
	VILLAGE B									
B1	6.1	AALDR	83.7	67.0	5.0-7.0 du/ac	6.0	402	110	44,220	132,660
B2	2.1	MDR	25.6	20.0	7.0-15.0 du/ac	9.0	180	210	37,800	113,400
B3	2.2	MDR	29.2	22.0	7.0-15.0 du/ac	9.0	198	210	41,580	124,740
B4	2.3	LDR	21.1	17.0	4.0-7.0 du/ac	6.0	102	210	21,420	64,260
	Sub Total Residential		159.6	126.0			882		145,020	435,060
	GP.1	Grand Paseo	1.5	1.5	-	-	-	680	1,020	3,060
	NP.2	Neighborhood Park	4.0	4.0	-	-	-	680	2,720	8,160
	AAAC	Active Open Space	6.0	6.0	-	-	-	680	4,080	12,240
	CP.2	Central Park	7.0	7.0	-	-	-	680	4,760	14,280
	Sub Total Other		18.5	18.5			0		12,580	37,740
	SUBTOTAL VILLAGE B		178.1	144.5			882		157,600	472,800
	VILLAGE C									
C1	3.1	MDR	11.9	9.0	7.0-15.0 du/ac	9.0	81	210	17,010	51,030
C3	3.2	LDR	74.8	60.0	4.0-7.0 du/ac	6.0	360	210	75,600	226,800
	Sub Total Residential		86.7	69.0			441		92,610	277,830
	NP.3	Neighborhood Park	4.0	4.0	-	-	-	680	2,720	8,160
C2	SCH	School	12.0	12.0	-	-	-	1000	12,000	36,000
	Sub Total Other		16.0	16.0			0		14,720	44,160
	SUBTOTAL VILLAGE C		102.7	85.0			441		107,330	321,990
	VILLAGE D									
D1	4.1	MDR	23.8	18.0	7.0-15.0 du/ac	9.0	162	210	34,020	102,060
D2	4.2	MDR	10.9	9.0	7.0-15.0 du/ac	9.0	81	210	17,010	51,030
D3	4.3	MDR	12.5	9.0	7.0-15.0 du/ac	9.0	81	210	17,010	51,030
D4	4.4	LDR	14.0	11.0	4.0-7.0 du/ac	6.0	66	210	13,860	41,580
D5	4.5	LDR	21.4	16.0	4.0-7.0 du/ac	6.0	96	210	20,160	60,480
D6	4.6	LDR	23.7	19.0	4.0-7.0 du/ac	6.0	114	210	23,940	71,820
D7	4.7	MDR	12.0	9.0	7.0-15.0 du/ac	9.0	81	210	17,010	51,030
	Sub Totals Village Four		118.2	91.0			681		143,010	429,030
	NP.4	Neighborhood Park	2.0	2.0	-	-	-	680	1,360	4,080
	Sub Total Other		2.0	2.0					1,360	4,080
	SUBTOTAL VILLAGE D		120.2	93.0			681		144,370	433,110
	TOWN CENTER									
TC1	MU-1	MU	6.4	6.0	Up to 10 du/ac	10.0	56	210	11,760	35,280
TC2	MU-2	MU	7.0	7.0	Up to 10 du/ac	10.0	63	210	13,230	39,690
TC3	MU-3	MU	8.0	8.0	Up to 10 du/ac	10.0	76	210	15,960	47,880
TC4	5.1	HDR	12.0	12.0	15.0-25.0 du/ac	20.0	240	110	26,400	79,200
	Sub Totals Village Six		33.4	33.0			435		67,350	202,050
	VS.1	Village Square	1.1	1.1	-	-	-	680	748	2,244
	GP.2	Grand Paseo	0.6	0.6	-	-	-	680	408	1,224
	Sub Total Other		1.7	1.7					1,156	3,468
	SUBTOTAL VILLAGE SIX		35.1	34.7			435		68,506	205,518
	Remainder Lots									
	WWTP	Treatment Plant	26.6	26.6	-	-	-	-	N/A	N/A
	OP.3	Detention	48.6	48.6	-	-	-	-	N/A	N/A
	SUBTOTAL REMAINDER LOTS		75.2	75.2					N/A	N/A
	Overall Residential Totals		537.2	431.0			3072		580,920	1,742,760
	OVERALL TOTALS		615.6	509.4			3,072		638,072	1,914,216

Technical Memorandum Wastewater System

APPENDIX 2

Hydraulic Model Results

Average Daily

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Avg)

Executive Summary

Scenario	
Label	Base Avg

Computation Results	
Subnetwork Results	Number of Gravity Subnetworks: 1 Number of Pressure Subnetworks: 0 >>>> Info: Gravity subnetwork draining to: O-1 >>>> Info: Convergence was achieved.

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Avg)

Calculation Options

<General>

Time Analysis Type	Steady State	Calculation Type	Analysis

Gravity Hydraulics

Maximum Network Traversals	5	Governing Upstream Pipe Selection Method	Pipe with Maximum QV
Flow Convergence Test	0.001	Structure Loss Mode	Hydraulic Grade
Tractive Stress (Global Minimum)	0.000 lbs/ft²	Report Hydrologic Time Step?	True
Flow Profile Method	Backwater Analysis	Save Detailed Headloss Data?	False
Number of Flow Profile Steps	5	Gravity Friction Method	Manning's
Hydraulic Grade Convergence Test	0.00 ft	Liquid Label	Water at 20C(68F)
Average Velocity Method	Actual Uniform Flow Velocity	Use Explicit Depth and Slope Equations?	False
Minimum Structure Headloss	0.00 ft		

Pressure

Peak Flow Ratio	75.0 %	Pattern Setup	<None>
Extreme Flow Setup	<None>	Steady State Hydrograph Equivalent	Peak

Pressure Hydraulics

Use Controls During Steady State?	True	Use Linear Interpolation For Multipoint Pumps?	False
Wet Well Convergence Increment	0.5 ft	Use Controls During Steady State?	True
Use Pumped Flows?	True	Liquid Specific Gravity	0.998
Pressure Subnetwork Accuracy	0.001	Pressure Subnetwork Minimum Possible Pressure	-14 psi
Pressure Subnetwork Trials	40	Pressure Friction Method	Hazen-Williams

SWMM Hydrology

Default Infiltration Method	Horton	SWMM Hydrologic Increment	0.250 hours

<General>

Label	Base Calculation Options

Headloss (AASHTO)

Expansion, Ke	0.350	Shaping Adjustment, Cs	0.500
Contraction, Kc	0.250	Non-Piped Flow Adjustment, Cn	1.300

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Avg)

Bend Angle vs. Bend Loss Curve

Bend Angle (degrees)	Bend Loss Coefficient, Kb
0.00	0.000
15.00	0.190
30.00	0.350
45.00	0.470
60.00	0.560
75.00	0.640
90.00	0.700

HEC-22 Energy Losses

Consider Non-Piped Plunging Flow?	True

HEC-22 Energy Losses (Second Edition)

Elevations Considered Equal Within	0.50 ft	Half Bench Submerged Factor	0.950
Flat Unsubmerged Factor	1.000	Full Bench Unsubmerged Factor	0.070
Flat Submerged Factor	1.000	Full Bench Submerged Factor	0.750
Depressed Unsubmerged Factor	1.000	Improved Bench Unsubmerged Factor	0.035
Depressed Submerged Factor	1.000	Improved Bench Submerged Factor	0.375
Half Bench Unsubmerged Factor	0.150		

HEC-22 Energy Losses (Third Edition)

Flat Submerged Coefficient	-0.050	Half Bench Unsubmerged Coefficient	-0.850
Flat Unsubmerged Coefficient	-0.050	Full Bench Submerged Coefficient	-0.250
Depressed Submerged Coefficient	0.000	Full Bench Unsubmerged Coefficient	-0.930
Depressed Unsubmerged Coefficient	0.000	Improved Submerged Coefficient	-0.600
Half Bench Submerged Coefficient	-0.050	Improved Unsubmerged Coefficient	-0.980

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Avg)

Calculation Summary (1: Base Avg)

Time (hours)	Balanced?	Trials	Relative Flow Change

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Avg)

Pipe Report

Subnetwork Summary	
Subnetwork	Gravity Subnetwork

Pipe Report

Label	Time (Maximum Flow) (hours)	Flow (Maximum) (gpd)	Velocity (Maximum Calculated) (ft/s)	Depth (Maximum) / Rise (%)
PIPE - 52	0.000	1,564.72	0.57	3.5
PIPE - 53	0.000	10,168.07	1.00	8.8
PIPE - 54	0.000	19,062.74	1.21	11.9
PIPE - 55	0.000	26,665.13	1.33	14.1
PIPE - 56	0.000	33,649.26	1.43	15.8
PIPE - 57	0.000	38,773.71	1.50	16.9
PIPE - 58	0.000	44,455.31	1.55	18.1
PIPE - 59	0.000	44,455.31	1.55	18.1
PIPE - 60	0.000	49,669.90	1.61	19.2
PIPE - 61	0.000	54,929.77	1.66	20.1
PIPE - 62	0.000	60,189.65	1.70	21.1
PIPE - 63	0.000	65,431.61	1.75	22.0
PIPE - 64	0.000	70,226.70	1.54	17.8
PIPE - 65	0.000	77,291.29	1.59	18.7
PIPE - 66	0.000	81,622.53	1.61	19.2
PIPE - 67	0.000	85,962.42	1.64	19.7
PIPE - 68	0.000	88,092.24	1.65	20.0
PIPE - 69	0.000	90,927.38	1.66	29.7
PIPE - 01	0.000	9,643.39	0.99	8.5
PIPE - 02	0.000	20,007.78	1.23	12.2
PIPE - 03	0.000	34,356.19	1.44	15.9
PIPE - 04	0.000	51,938.17	1.63	19.6
PIPE - 05	0.000	74,828.55	1.82	23.6
PIPE - 06	0.000	82,919.28	1.87	24.8
PIPE - 07	0.000	82,919.28	1.62	19.4
PIPE - 08	0.000	82,919.28	1.62	19.4
PIPE - 09	0.000	95,214.43	1.69	20.8
PIPE - 10	0.000	108,705.38	1.59	18.0
PIPE - 11	0.000	117,471.84	1.62	18.8
PIPE - 12	0.000	128,336.89	1.67	19.6
PIPE - 13	0.000	140,472.00	1.71	20.5
PIPE - 14	0.000	158,238.83	1.77	21.8
PIPE - 15	0.000	158,238.83	1.77	21.8
PIPE - 16	0.000	168,675.19	1.80	22.5
PIPE - 17	0.000	180,975.52	1.62	18.1
PIPE - 18	0.000	196,153.41	1.66	18.9
PIPE - 19	0.000	200,609.85	1.67	19.1
PIPE - 20	0.000	204,277.48	1.68	19.2
PIPE - 21	0.000	209,180.88	1.69	19.5
PIPE - 22	0.000	209,180.88	1.69	19.5

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Avg)

Pipe Report

Label	Time (Maximum Flow) (hours)	Flow (Maximum) (gpd)	Velocity (Maximum Calculated) (ft/s)	Depth (Maximum) / Rise (%)
PIPE - 92	0.000	4,049.83	0.75	5.6
PIPE - 93	0.000	8,365.73	0.95	7.9
PIPE - 94	0.000	12,363.78	1.06	9.6
PIPE - 95	0.000	20,753.64	1.24	12.4
PIPE - 96	0.000	38,168.56	1.49	16.8
PIPE - 97	0.000	49,391.61	1.61	19.1
PIPE - 98	0.000	59,416.90	1.70	21.0
PIPE - 99	0.000	72,465.34	1.56	18.1
PIPE - 100	0.000	72,465.34	1.56	18.1
PIPE - 101	0.000	95,309.51	1.69	20.8
PIPE - 102	0.000	99,924.23	1.71	21.3
PIPE - 103	0.000	107,399.89	1.74	22.1
PIPE - 104	0.000	116,180.52	1.62	18.6
PIPE - 105	0.000	123,045.51	1.65	19.2
PIPE - 106	0.000	133,353.26	1.69	20.0
PIPE - 107	0.000	133,353.26	1.69	20.0
PIPE - 108	0.000	133,353.26	1.69	20.0
PIPE - 23	0.000	342,534.17	1.92	19.7
PIPE - 24	0.000	350,288.26	1.93	19.9
PIPE - 91	0.000	350,288.26	1.93	19.9
PIPE - 90	0.000	354,614.25	1.93	20.0
PIPE - 74	0.000	25,300.15	1.32	13.7
PIPE - 75	0.000	39,950.47	1.51	17.2
PIPE - 76	0.000	49,959.04	1.61	19.2
PIPE - 77	0.000	49,959.04	1.61	19.2
PIPE - 78	0.000	61,946.34	1.72	21.4
PIPE - 79	0.000	69,842.11	1.54	17.8
PIPE - 80	0.000	79,402.15	1.60	19.0
PIPE - 81	0.000	87,556.86	1.65	19.9
PIPE - 82	0.000	90,982.71	1.66	20.3
PIPE - 83	0.000	100,067.87	1.71	21.3
PIPE - 84	0.000	105,809.29	1.74	21.9
PIPE - 85	0.000	113,139.02	1.77	22.6
PIPE - 86	0.000	116,419.92	1.62	18.7
PIPE - 87	0.000	120,287.02	1.63	19.0
PIPE - 88	0.000	124,998.22	1.65	19.3
PIPE - 89	0.000	128,909.61	1.67	19.6
PIPE - 111	0.000	483,523.86	4.54	18.2
PIPE - 110	0.000	483,523.86	4.54	18.2
PIPE - 109	0.000	483,523.86	4.54	18.2
PIPE - 70	0.000	580,674.70	2.23	25.7
PIPE - 71	0.000	580,674.70	2.62	24.2
PIPE - 36	0.000	3,198.37	0.70	5.0
PIPE - 37	0.000	6,723.27	0.88	7.2
PIPE - 38	0.000	10,558.09	1.01	8.9

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Avg)

Pipe Report

Label	Time (Maximum Flow) (hours)	Flow (Maximum) (gpd)	Velocity (Maximum Calculated) (ft/s)	Depth (Maximum) / Rise (%)
PIPE - 39	0.000	15,318.13	1.15	10.6
PIPE - 40	0.000	18,825.25	1.38	11.3
PIPE - 41	0.000	28,140.30	1.57	13.8
PIPE - 42	0.000	31,514.80	1.61	14.6
PIPE - 43	0.000	35,395.93	1.66	15.5
PIPE - 44	0.000	38,949.00	1.51	16.9
PIPE - 45	0.000	45,362.45	1.65	18.0
PIPE - 46	0.000	48,911.88	1.60	19.0
PIPE - 47	0.000	51,571.11	1.63	19.5
PIPE - 48	0.000	52,673.33	1.64	19.7
PIPE - 49	0.000	61,701.82	1.72	21.4
PIPE - 50	0.000	61,701.82	1.72	21.4
PIPE - 51	0.000	64,574.44	1.74	21.9
PIPE - 28	0.000	64,574.44	1.74	21.9
PIPE - 112	0.000	64,574.44	1.69	16.4
PIPE - 113	0.000	67,664.75	1.68	23.8
PIPE - 72	0.000	648,339.43	2.30	27.2
PIPE - 73	0.000	648,339.43	2.30	27.2
PIPE - 35	0.000	648,339.43	2.03	27.8

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Avg)

Node Report

Subnetwork Summary

Subnetwork	Gravity Subnetwork

Node Report

Label	Time to Maximum Hydraulic Grade (hours)	Hydraulic Grade (Maximum) (ft)	Depth (Maximum) (ft)	Pressure (Maximum) (psi)
MH-54	0.000	301.30	0.03	(N/A)
MH-55	0.000	299.49	0.06	(N/A)
MH-56	0.000	297.66	0.08	(N/A)
MH-57	0.000	295.83	0.10	(N/A)
MH-58	0.000	293.99	0.11	(N/A)
MH-59	0.000	292.24	0.11	(N/A)
MH-60	0.000	290.98	0.12	(N/A)
MH-61	0.000	289.71	0.12	(N/A)
MH-62	0.000	288.32	0.13	(N/A)
MH-63	0.000	286.48	0.14	(N/A)
MH-64	0.000	284.62	0.14	(N/A)
MH-65	0.000	282.77	0.15	(N/A)
MH-66	0.000	280.93	0.16	(N/A)
MH-67	0.000	279.79	0.16	(N/A)
MH-68	0.000	278.19	0.17	(N/A)
MH-69	0.000	276.79	0.17	(N/A)
MH-70	0.000	275.45	0.17	(N/A)
MH-71	0.000	274.10	0.18	(N/A)
MH-01	0.000	303.73	0.06	(N/A)
MH-02	0.000	302.35	0.08	(N/A)
MH-03	0.000	300.94	0.11	(N/A)
MH-04	0.000	299.67	0.13	(N/A)
MH-05	0.000	298.40	0.16	(N/A)
MH-06	0.000	296.53	0.17	(N/A)
MH-07	0.000	295.45	0.17	(N/A)
MH-08	0.000	294.53	0.17	(N/A)
MH-09	0.000	293.62	0.18	(N/A)
MH-10	0.000	292.81	0.19	(N/A)
MH-11	0.000	292.09	0.20	(N/A)
MH-12	0.000	291.40	0.21	(N/A)
MH-13	0.000	290.41	0.22	(N/A)
MH-14	0.000	289.43	0.23	(N/A)
MH-15	0.000	288.89	0.23	(N/A)
MH-16	0.000	288.12	0.24	(N/A)
MH-17	0.000	287.35	0.25	(N/A)
MH-18	0.000	286.66	0.26	(N/A)
MH-19	0.000	285.96	0.26	(N/A)
MH-20	0.000	285.34	0.26	(N/A)
MH-21	0.000	284.55	0.27	(N/A)
MH-22	0.000	284.04	0.27	(N/A)

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Avg)

Node Report

Label	Time to Maximum Hydraulic Grade (hours)	Hydraulic Grade (Maximum) (ft)	Depth (Maximum) (ft)	Pressure (Maximum) (psi)
MH-96	0.000	303.71	0.04	(N/A)
MH-97	0.000	302.33	0.05	(N/A)
MH-98	0.000	300.94	0.07	(N/A)
MH-99	0.000	299.45	0.08	(N/A)
MH-100	0.000	297.63	0.11	(N/A)
MH-101	0.000	295.80	0.13	(N/A)
MH-102	0.000	294.38	0.14	(N/A)
MH-103	0.000	292.80	0.16	(N/A)
MH-104	0.000	291.63	0.16	(N/A)
MH-105	0.000	291.17	0.18	(N/A)
MH-106	0.000	290.17	0.19	(N/A)
MH-107	0.000	289.15	0.19	(N/A)
MH-108	0.000	288.13	0.20	(N/A)
MH-109	0.000	287.35	0.20	(N/A)
MH-110	0.000	286.48	0.21	(N/A)
MH-111	0.000	285.61	0.21	(N/A)
MH-112	0.000	284.94	0.21	(N/A)
MH-23	0.000	283.64	0.32	(N/A)
MH-24	0.000	283.14	0.32	(N/A)
MH-25	0.000	282.62	0.32	(N/A)
MH-94	0.000	282.16	0.33	(N/A)
MH-77	0.000	302.03	0.09	(N/A)
MH-78	0.000	300.19	0.12	(N/A)
MH-79	0.000	298.34	0.13	(N/A)
MH-80	0.000	296.48	0.13	(N/A)
MH-81	0.000	295.60	0.14	(N/A)
MH-82	0.000	293.40	0.16	(N/A)
MH-83	0.000	292.26	0.17	(N/A)
MH-84	0.000	290.75	0.17	(N/A)
MH-85	0.000	289.44	0.18	(N/A)
MH-86	0.000	288.09	0.19	(N/A)
MH-87	0.000	287.15	0.19	(N/A)
MH-88	0.000	286.22	0.20	(N/A)
MH-89	0.000	285.41	0.20	(N/A)
MH-90	0.000	284.75	0.20	(N/A)
MH-91	0.000	284.08	0.21	(N/A)
MH-92	0.000	283.06	0.21	(N/A)
MH-93	0.000	281.38	0.32	(N/A)
MH-115	0.000	279.25	0.32	(N/A)
MH-114	0.000	275.31	0.32	(N/A)
MH-72	0.000	273.34	0.42	(N/A)
MH-73	0.000	272.71	0.37	(N/A)
MH-37	0.000	304.67	0.04	(N/A)
MH-38	0.000	303.29	0.05	(N/A)
MH-39	0.000	301.91	0.06	(N/A)

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Avg)

Node Report

Label	Time to Maximum Hydraulic Grade (hours)	Hydraulic Grade (Maximum) (ft)	Depth (Maximum) (ft)	Pressure (Maximum) (psi)
MH-40	0.000	300.41	0.07	(N/A)
MH-41	0.000	298.48	0.08	(N/A)
MH-42	0.000	295.80	0.09	(N/A)
MH-43	0.000	293.10	0.10	(N/A)
MH-44	0.000	291.26	0.11	(N/A)
MH-45	0.000	289.45	0.11	(N/A)
MH-46	0.000	287.57	0.12	(N/A)
MH-47	0.000	285.44	0.13	(N/A)
MH-48	0.000	283.59	0.13	(N/A)
MH-49	0.000	281.74	0.13	(N/A)
MH-50	0.000	279.90	0.14	(N/A)
MH-51	0.000	278.05	0.14	(N/A)
MH-52	0.000	275.79	0.15	(N/A)
MH-29	0.000	275.46	0.15	(N/A)
MH-28	0.000	274.57	0.14	(N/A)
MH-116	0.000	272.87	0.13	(N/A)
MH-74	0.000	271.47	0.44	(N/A)
MH-75	0.000	270.78	0.44	(N/A)
MH-35	0.000	270.11	0.46	(N/A)
O-1	0.000	269.97	0.37	(N/A)

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Avg)

Pond Report

Subnetwork Summary

Subnetwork	Gravity Subnetwork

Pond Report

Label	Time to Maximum Hydraulic Grade (hours)	Hydraulic Grade (Maximum) (ft)

Technical Memorandum
Wastewater System

APPENDIX 3

Hydraulic Model Results
Peak Hourly Flow

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Peak

Executive Summary

Scenario	
Label	Base Peak

Computation Results	
Subnetwork Results	Number of Gravity Subnetworks: 1 Number of Pressure Subnetworks: 0 >>>> Info: Gravity subnetwork draining to: O-1 >>>> Info: Convergence was achieved.

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Peak Calculation Options

<General>

Time Analysis Type	Steady State	Calculation Type	Analysis

Gravity Hydraulics

Maximum Network Traversals	5	Governing Upstream Pipe Selection Method	Pipe with Maximum QV
Flow Convergence Test	0.001	Structure Loss Mode	Hydraulic Grade
Tractive Stress (Global Minimum)	0.000 lbs/ft²	Report Hydrologic Time Step?	True
Flow Profile Method	Backwater Analysis	Save Detailed Headloss Data?	False
Number of Flow Profile Steps	5	Gravity Friction Method	Manning's
Hydraulic Grade Convergence Test	0.00 ft	Liquid Label	Water at 20C(68F)
Average Velocity Method	Actual Uniform Flow Velocity	Use Explicit Depth and Slope Equations?	False
Minimum Structure Headloss	0.00 ft		

Pressure

Peak Flow Ratio	75.0 %	Pattern Setup	<None>
Extreme Flow Setup	<None>	Steady State Hydrograph Equivalent	Peak

Pressure Hydraulics

Use Controls During Steady State?	True	Use Linear Interpolation For Multipoint Pumps?	False
Wet Well Convergence Increment	0.5 ft	Use Controls During Steady State?	True
Use Pumped Flows?	True	Liquid Specific Gravity	0.998
Pressure Subnetwork Accuracy	0.001	Pressure Subnetwork Minimum Possible Pressure	-14 psi
Pressure Subnetwork Trials	40	Pressure Friction Method	Hazen-Williams

SWMM Hydrology

Default Infiltration Method	Horton	SWMM Hydrologic Increment	0.250 hours

<General>

Label	Base Calculation Options

Headloss (AASHTO)

Expansion, Ke	0.350	Shaping Adjustment, Cs	0.500
Contraction, Kc	0.250	Non-Piped Flow Adjustment, Cn	1.300

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Peak

Bend Angle vs. Bend Loss Curve

Bend Angle (degrees)	Bend Loss Coefficient, Kb
0.00	0.000
15.00	0.190
30.00	0.350
45.00	0.470
60.00	0.560
75.00	0.640
90.00	0.700

HEC-22 Energy Losses	
Consider Non-Piped Plunging Flow?	True

HEC-22 Energy Losses (Second Edition)			
Elevations Considered Equal Within	0.50 ft	Half Bench Submerged Factor	0.950
Flat Unsubmerged Factor	1.000	Full Bench Unsubmerged Factor	0.070
Flat Submerged Factor	1.000	Full Bench Submerged Factor	0.750
Depressed Unsubmerged Factor	1.000	Improved Bench Unsubmerged Factor	0.035
Depressed Submerged Factor	1.000	Improved Bench Submerged Factor	0.375
Half Bench Unsubmerged Factor	0.150		

HEC-22 Energy Losses (Third Edition)			
Flat Submerged Coefficient	-0.050	Half Bench Unsubmerged Coefficient	-0.850
Flat Unsubmerged Coefficient	-0.050	Full Bench Submerged Coefficient	-0.250
Depressed Submerged Coefficient	0.000	Full Bench Unsubmerged Coefficient	-0.930
Depressed Unsubmerged Coefficient	0.000	Improved Submerged Coefficient	-0.600
Half Bench Submerged Coefficient	-0.050	Improved Unsubmerged Coefficient	-0.980

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Peak

Calculation Summary (245: Base Peak)

Time (hours)	Balanced?	Trials	Relative Flow Change

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Peak

Pipe Report

Subnetwork Summary	
Subnetwork	Gravity Subnetwork

Pipe Report

Label	Time (Maximum Flow) (hours)	Flow (Maximum) (gpd)	Velocity (Maximum Calculated) (ft/s)	Depth (Maximum) / Rise (%)
PIPE - 52	0.000	4,694.15	0.79	6.0
PIPE - 53	0.000	30,504.20	1.39	15.0
PIPE - 54	0.000	57,188.22	1.68	20.6
PIPE - 55	0.000	79,995.38	1.85	24.4
PIPE - 56	0.000	100,947.79	1.98	27.4
PIPE - 57	0.000	116,321.14	2.06	29.5
PIPE - 58	0.000	133,365.91	2.14	31.7
PIPE - 59	0.000	133,365.91	2.14	31.7
PIPE - 60	0.000	149,009.71	2.21	33.6
PIPE - 61	0.000	164,789.32	2.27	35.4
PIPE - 62	0.000	180,568.95	2.33	37.1
PIPE - 63	0.000	196,294.83	2.38	38.8
PIPE - 64	0.000	210,680.10	2.12	31.1
PIPE - 65	0.000	231,873.87	2.17	32.7
PIPE - 66	0.000	244,867.61	2.21	33.7
PIPE - 67	0.000	257,887.24	2.24	34.6
PIPE - 68	0.000	264,276.71	2.25	35.1
PIPE - 69	0.000	272,782.14	2.28	58.2
PIPE - 01	0.000	28,930.17	1.37	14.6
PIPE - 02	0.000	60,023.34	1.70	21.1
PIPE - 03	0.000	103,068.58	1.99	27.7
PIPE - 04	0.000	155,814.53	2.23	34.4
PIPE - 05	0.000	224,485.65	2.47	41.7
PIPE - 06	0.000	248,757.87	2.54	44.1
PIPE - 07	0.000	248,757.87	2.22	34.0
PIPE - 08	0.000	248,757.87	2.22	34.0
PIPE - 09	0.000	285,643.30	2.31	36.5
PIPE - 10	0.000	326,116.12	2.17	31.5
PIPE - 11	0.000	352,415.52	2.22	32.8
PIPE - 12	0.000	385,010.67	2.28	34.4
PIPE - 13	0.000	421,415.98	2.33	36.1
PIPE - 14	0.000	474,716.46	2.41	38.5
PIPE - 15	0.000	474,716.46	2.41	38.5
PIPE - 16	0.000	506,025.58	2.45	39.8
PIPE - 17	0.000	542,926.61	2.22	31.7
PIPE - 18	0.000	588,460.22	2.27	33.1
PIPE - 19	0.000	601,829.53	2.29	33.5
PIPE - 20	0.000	612,832.41	2.30	33.8
PIPE - 21	0.000	627,542.68	2.31	34.2
PIPE - 22	0.000	627,542.68	2.31	37.3

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Peak

Pipe Report

Label	Time (Maximum Flow) (hours)	Flow (Maximum) (gpd)	Velocity (Maximum Calculated) (ft/s)	Depth (Maximum) / Rise (%)
PIPE - 92	0.000	12,149.49	1.06	9.6
PIPE - 93	0.000	25,097.19	1.32	13.6
PIPE - 94	0.000	37,091.34	1.48	16.6
PIPE - 95	0.000	62,260.93	1.72	21.5
PIPE - 96	0.000	114,505.68	2.05	29.3
PIPE - 97	0.000	148,174.85	2.21	33.4
PIPE - 98	0.000	178,250.72	2.32	36.9
PIPE - 99	0.000	217,396.01	2.14	31.6
PIPE - 100	0.000	217,396.01	2.14	31.6
PIPE - 101	0.000	285,928.51	2.31	36.5
PIPE - 102	0.000	299,772.68	2.33	37.5
PIPE - 103	0.000	322,199.68	2.38	39.0
PIPE - 104	0.000	348,541.56	2.22	32.7
PIPE - 105	0.000	369,136.53	2.25	33.6
PIPE - 106	0.000	400,059.79	2.30	35.1
PIPE - 107	0.000	400,059.79	2.30	35.1
PIPE - 108	0.000	400,059.79	2.30	35.1
PIPE - 23	0.000	1,027,602.47	2.62	34.6
PIPE - 24	0.000	1,050,864.73	2.64	35.0
PIPE - 91	0.000	1,050,864.73	2.64	35.0
PIPE - 90	0.000	1,063,842.67	2.64	35.2
PIPE - 74	0.000	75,900.45	1.82	23.7
PIPE - 75	0.000	119,851.42	2.08	30.0
PIPE - 76	0.000	149,877.11	2.21	33.7
PIPE - 77	0.000	149,877.11	2.21	33.7
PIPE - 78	0.000	185,839.00	2.35	37.7
PIPE - 79	0.000	209,526.32	2.12	31.0
PIPE - 80	0.000	238,206.44	2.19	33.2
PIPE - 81	0.000	262,670.57	2.25	35.0
PIPE - 82	0.000	272,948.12	2.28	35.7
PIPE - 83	0.000	300,203.62	2.33	37.5
PIPE - 84	0.000	317,427.86	2.37	38.6
PIPE - 85	0.000	339,417.08	2.41	40.0
PIPE - 86	0.000	349,259.76	2.22	32.7
PIPE - 87	0.000	360,861.03	2.24	33.2
PIPE - 88	0.000	374,994.64	2.26	33.9
PIPE - 89	0.000	386,728.82	2.28	34.5
PIPE - 111	0.000	1,450,571.57	6.26	31.7
PIPE - 110	0.000	1,450,571.57	6.26	31.7
PIPE - 109	0.000	1,450,571.57	6.26	40.8
PIPE - 70	0.000	1,742,024.10	3.01	46.0
PIPE - 71	0.000	1,742,024.10	3.56	45.9
PIPE - 36	0.000	9,595.11	0.99	8.5
PIPE - 37	0.000	20,169.82	1.23	12.2
PIPE - 38	0.000	31,674.25	1.41	15.3

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Peak

Pipe Report

Label	Time (Maximum Flow) (hours)	Flow (Maximum) (gpd)	Velocity (Maximum Calculated) (ft/s)	Depth (Maximum) / Rise (%)
PIPE - 39	0.000	45,954.38	1.60	18.3
PIPE - 40	0.000	56,475.76	1.92	19.5
PIPE - 41	0.000	84,420.90	2.16	23.8
PIPE - 42	0.000	94,544.40	2.22	25.3
PIPE - 43	0.000	106,187.79	2.29	26.9
PIPE - 44	0.000	116,846.99	2.08	29.5
PIPE - 45	0.000	136,087.35	2.27	31.4
PIPE - 46	0.000	146,735.62	2.20	33.3
PIPE - 47	0.000	154,713.32	2.23	34.2
PIPE - 48	0.000	158,019.99	2.24	34.6
PIPE - 49	0.000	185,105.45	2.35	37.6
PIPE - 50	0.000	185,105.45	2.35	37.6
PIPE - 51	0.000	193,723.31	2.38	38.5
PIPE - 28	0.000	193,723.31	2.38	38.5
PIPE - 112	0.000	193,723.31	2.34	28.5
PIPE - 113	0.000	202,994.26	2.32	47.0
PIPE - 72	0.000	1,945,018.37	3.09	50.7
PIPE - 73	0.000	1,945,018.37	3.09	50.4
PIPE - 35	0.000	1,945,018.37	2.69	48.7

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Peak

Node Report

Subnetwork Summary	
Subnetwork	Gravity Subnetwork

Node Report

Label	Time to Maximum Hydraulic Grade (hours)	Hydraulic Grade (Maximum) (ft)	Depth (Maximum) (ft)	Pressure (Maximum) (psi)
MH-54	0.000	301.32	0.04	(N/A)
MH-55	0.000	299.53	0.10	(N/A)
MH-56	0.000	297.72	0.14	(N/A)
MH-57	0.000	295.89	0.16	(N/A)
MH-58	0.000	294.06	0.18	(N/A)
MH-59	0.000	292.32	0.20	(N/A)
MH-60	0.000	291.07	0.21	(N/A)
MH-61	0.000	289.80	0.21	(N/A)
MH-62	0.000	288.42	0.23	(N/A)
MH-63	0.000	286.58	0.24	(N/A)
MH-64	0.000	284.73	0.25	(N/A)
MH-65	0.000	282.89	0.26	(N/A)
MH-66	0.000	281.04	0.27	(N/A)
MH-67	0.000	279.91	0.29	(N/A)
MH-68	0.000	278.31	0.29	(N/A)
MH-69	0.000	276.92	0.30	(N/A)
MH-70	0.000	275.58	0.31	(N/A)
MH-71	0.000	274.23	0.31	(N/A)
MH-01	0.000	303.77	0.10	(N/A)
MH-02	0.000	302.40	0.14	(N/A)
MH-03	0.000	301.02	0.19	(N/A)
MH-04	0.000	299.77	0.23	(N/A)
MH-05	0.000	298.52	0.28	(N/A)
MH-06	0.000	296.66	0.30	(N/A)
MH-07	0.000	295.58	0.30	(N/A)
MH-08	0.000	294.66	0.30	(N/A)
MH-09	0.000	293.76	0.32	(N/A)
MH-10	0.000	292.95	0.34	(N/A)
MH-11	0.000	292.24	0.35	(N/A)
MH-12	0.000	291.55	0.37	(N/A)
MH-13	0.000	290.58	0.39	(N/A)
MH-14	0.000	289.61	0.41	(N/A)
MH-15	0.000	289.07	0.41	(N/A)
MH-16	0.000	288.31	0.43	(N/A)
MH-17	0.000	287.53	0.43	(N/A)
MH-18	0.000	286.85	0.45	(N/A)
MH-19	0.000	286.15	0.46	(N/A)
MH-20	0.000	285.54	0.46	(N/A)
MH-21	0.000	284.75	0.47	(N/A)
MH-22	0.000	284.24	0.47	(N/A)

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Peak

Node Report

Label	Time to Maximum Hydraulic Grade (hours)	Hydraulic Grade (Maximum) (ft)	Depth (Maximum) (ft)	Pressure (Maximum) (psi)
MH-96	0.000	303.73	0.07	(N/A)
MH-97	0.000	302.36	0.09	(N/A)
MH-98	0.000	300.99	0.11	(N/A)
MH-99	0.000	299.51	0.14	(N/A)
MH-100	0.000	297.71	0.20	(N/A)
MH-101	0.000	295.89	0.23	(N/A)
MH-102	0.000	294.48	0.25	(N/A)
MH-103	0.000	292.91	0.28	(N/A)
MH-104	0.000	291.74	0.28	(N/A)
MH-105	0.000	291.31	0.32	(N/A)
MH-106	0.000	290.31	0.33	(N/A)
MH-107	0.000	289.30	0.34	(N/A)
MH-108	0.000	288.28	0.35	(N/A)
MH-109	0.000	287.50	0.36	(N/A)
MH-110	0.000	286.65	0.37	(N/A)
MH-111	0.000	285.78	0.37	(N/A)
MH-112	0.000	285.10	0.37	(N/A)
MH-23	0.000	283.88	0.56	(N/A)
MH-24	0.000	283.39	0.57	(N/A)
MH-25	0.000	282.86	0.57	(N/A)
MH-94	0.000	282.41	0.57	(N/A)
MH-77	0.000	302.10	0.16	(N/A)
MH-78	0.000	300.28	0.20	(N/A)
MH-79	0.000	298.44	0.23	(N/A)
MH-80	0.000	296.58	0.23	(N/A)
MH-81	0.000	295.71	0.25	(N/A)
MH-82	0.000	293.51	0.27	(N/A)
MH-83	0.000	292.39	0.29	(N/A)
MH-84	0.000	290.88	0.30	(N/A)
MH-85	0.000	289.57	0.31	(N/A)
MH-86	0.000	288.23	0.33	(N/A)
MH-87	0.000	287.30	0.34	(N/A)
MH-88	0.000	286.37	0.35	(N/A)
MH-89	0.000	285.56	0.35	(N/A)
MH-90	0.000	284.90	0.35	(N/A)
MH-91	0.000	284.24	0.36	(N/A)
MH-92	0.000	283.22	0.37	(N/A)
MH-93	0.000	281.63	0.57	(N/A)
MH-115	0.000	279.49	0.57	(N/A)
MH-114	0.000	275.56	0.57	(N/A)
MH-72	0.000	273.68	0.76	(N/A)
MH-73	0.000	273.00	0.67	(N/A)
MH-37	0.000	304.70	0.06	(N/A)
MH-38	0.000	303.32	0.08	(N/A)
MH-39	0.000	301.95	0.10	(N/A)

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Peak
Node Report

Label	Time to Maximum Hydraulic Grade (hours)	Hydraulic Grade (Maximum) (ft)	Depth (Maximum) (ft)	Pressure (Maximum) (psi)
MH-40	0.000	300.46	0.12	(N/A)
MH-41	0.000	298.54	0.13	(N/A)
MH-42	0.000	295.87	0.17	(N/A)
MH-43	0.000	293.18	0.17	(N/A)
MH-44	0.000	291.34	0.19	(N/A)
MH-45	0.000	289.53	0.20	(N/A)
MH-46	0.000	287.66	0.21	(N/A)
MH-47	0.000	285.53	0.22	(N/A)
MH-48	0.000	283.69	0.23	(N/A)
MH-49	0.000	281.84	0.23	(N/A)
MH-50	0.000	280.01	0.25	(N/A)
MH-51	0.000	278.16	0.25	(N/A)
MH-52	0.000	275.91	0.26	(N/A)
MH-29	0.000	275.57	0.26	(N/A)
MH-28	0.000	274.67	0.24	(N/A)
MH-116	0.000	272.96	0.23	(N/A)
MH-74	0.000	271.84	0.81	(N/A)
MH-75	0.000	271.15	0.81	(N/A)
MH-35	0.000	270.45	0.80	(N/A)
O-1	0.000	270.26	0.66	(N/A)

Detailed Calculation Summary (Castellina_Sewer_IMP.stsw, Base Peak

Pond Report

Subnetwork Summary	
Subnetwork	Gravity Subnetwork

Pond Report

Label	Time to Maximum Hydraulic Grade (hours)	Hydraulic Grade (Maximum) (ft)

Infrastructure Master Plan

APPENDIX E

Draft

Technical Memorandum

Recycled Water System

APPENDIX E

TECHNICAL MEMORANDUM

RECYCLED WATER SYSTEM

APRIL 2019

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TABLES

FIGURES

APPENDIX

INTRODUCTION

This Technical Memorandum has been prepared as an Appendix to the Infrastructure Master Plan to describe the recycled water system proposed to serve the residents and businesses within the Castellina Specific Plan.

Castellina, LLC proposes the development of a master-planned community located on approximately 794 acres in Madera County (County). The proposed project is located approximately one-mile north of the City of Madera, three miles east of Highway 99, and roughly 16 miles south of the City of Chowchilla, shown in Figure 1. Specifically, the Specific Plan Area is bound by the Avenue 18 alignment to the north, Road 28½ to the east, the alignment of Avenue 17 to the south, Road 27 to the west, and the Burlington Northern Santa Fe (BNSF) railroad line to the southwest.

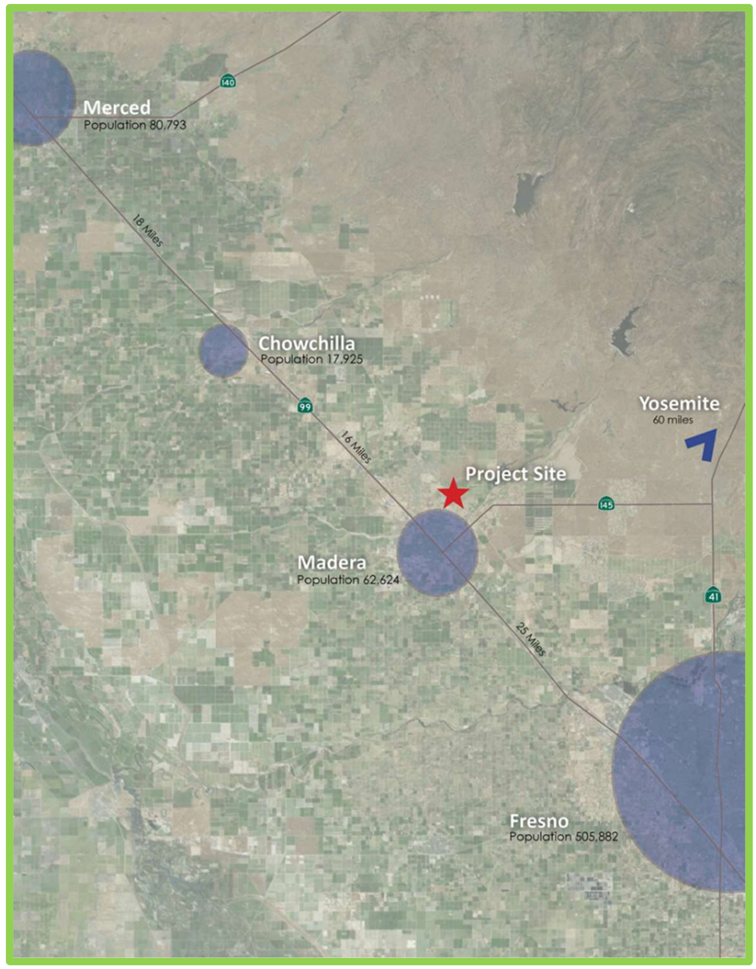

Figure 1 - Location Map

Due to the rural setting of the Specific Plan Area, development under the Specific Plan requires the construction of new utilities, such as a new wastewater treatment plant (WWTP), recycled water system, storm drain system, and a new water supply system.

This Technical Memorandum has been prepared by Wood Rodgers, Inc. with hydraulic modeling and analysis support from Kimley-Horn and Associates, Inc. and water facility sizing by Water Works Engineers. Water Works Engineers prepared the "Castellina Community – Water and Wastewater Facility Plan - Draft Report," dated October 24, 2018, included as Appendix B. This Technical Memorandum will reference the Draft Report for the sizing of the major recycled water facilities.

RECYCLED WATER TECHNICAL MEMORANDUM PURPOSE

The purpose of this Recycled Water System Technical Memorandum is to provide preliminary analysis and discussion for the recycled water system that will serve the Castellina Specific Plan development area.

As part of this Recycled Water System Technical Memorandum, the following items are presented:

- On-Site Recycled Water production;
- The recycled water demand projections for the development area;
- The recycled water infrastructure that delivers the projected flows to the proposed recycled water users

The results and conclusions of the recycled water modeling are based on a backbone system serving recycled water to all parks and irrigated areas throughout the proposed development area. It is understood that additional in tract recycled water piping may be required within each of the development areas to serve the individual users.

LAND USE

EXISTING CONDITIONS

The Specific Plan Area is relatively flat ranging in elevation from approximately 280 feet National Geodetic Vertical Datum (NGVD) in the northwest corner to approximately 310 feet NGVD at the east end of the Specific Plan Area. Currently, the Specific Plan Area is used for agricultural production and contains almond and fig orchards, related agricultural support facilities (e.g., equipment storage), wells, and unimproved dirt roadways. The Specific Plan Area is designated as a New Growth Area (NGA) in the County's General Plan.

Similar to the Specific Plan Area, many of the surrounding lands have been highly modified for agricultural purposes or otherwise developed as roads, individual residences, residential subdivisions, and commercial centers. Adjacent land uses to the Specific Plan Area include rangelands to the north, orchards to the east, and rural residential land uses to the south and west.

PROPOSED LAND USE

The project proposes development of up to 3,072 residential units, approximately 21 acres of commercial mixed-use (134,000 square feet), and approximately 131 acres of parks, trails, plazas, community gardens, and other open space across the 794-acre Specific Plan Area. The residential development will include a broad mix of densities, from very low density to high density and mixed use. Residential development is divided across five villages, including a centralized commercial mixed-use Town Center. The residential villages are designed around a framework of parks and recreation facilities to encourage a walkable community and active community interaction. Each village is organized in a traditional modified grid roadway pattern, with a minimal number of cul-de-sacs.

The Specific Plan includes a variety of land use designations and zoning districts, consisting of residential and commercial uses as well as open space and recreational uses. Further, the project includes improvements to some off-site areas related to infrastructure improvements. A summary of proposed land uses within the 794-acre Specific Plan Area are included in Tables I-1 and I-2 of the Infrastructure Master Plan.

RECYCLED WATER DEMAND PROJECTIONS

RECYCLED WATER DEMAND

The Castellina Development recycled water demand table is shown in detail in Appendix 1. The proposed landscaped areas are calculated by multiplying the gross area of the land use category by the percent area irrigated. The flow demand is calculated with an equation developed by the Model Water Efficient Landscape Ordinance (MWELO) developed by the California Department of Water Resources. For the MWELO calculations, demand is weighted according to the amount of turf area, hydroseed area, and remaining landscape area, and a Maximum Applied Water Allowance (MAWA) is determined as 55 percent of the reference evapotranspiration[1]. Based on the MWELO calculation, the average daily on-site recycled water demand is projected to be 266 gpm at build-out, excluding any agricultural uses. A summary of the land uses, landscaped areas and recycled water demand are included on Table 1.

Table 1
Castellina Development
Recycled Water System
Demand by Land Use Category

Land Use Category	Gross Acres	Landscape Area (acres)	Turf Area (acres)	Hydroseed Area (acres)	Remaining Landscape Area (acres)	Recycled Water Demand (gpm)
Active Open Space	6	2	0	1	1	5
Central Park	30	24	14	2	7	113
Comm. Garden	3	2	-	-	2	14
Grand Promenade	2	1	1	-	0	7
High Density Residential	1	0	-	0	0	0
Low Density Residential	50	2	-	2	0	12
Medium Density Residential	37	2	-	1	1	8

[1] *Castellina Water Supply Assessment. County Review Draft*. Tully & Young. December 2016

Land Use Category	Gross Acres	Landscape Area (acres)	Turf Area (acres)	Hydroseed Area (acres)	Remaining Landscape Area (acres)	Recycled Water Demand (gpm)
Neighborhood Park	15	11	6	-	6	47
Open Space	9	9	-	9	0	49
School	12	4	1	1	3	9
Village Square	1	0	0	-	0	1
Very Low Density	6	0	-	0	0	1
Total	**172**	**57**	**22**	**15**	**20**	**266**

RECYCLED WATER SYSTEM CONSIDERATIONS

The wastewater generated on-site by the development will be collected and treated at a proposed on-site wastewater treatment plant. The treatment plant is proposing to utilize a packaged membrane bioreactor (MBR) process to produce a tertiary treated effluent. The MBR facility will initially be sized to handle 0.25 mgd, with two (2) planned expansions of 0.25 mgd each, for a total build-out capacity of 0.75 mgd. The tertiary treated effluent will be disinfected and utilized as recycled water throughout the development to irrigate the various landscaped areas, as well as potentially some agricultural uses. The facilities required to store and deliver the recycled water are described below.

RECYCLED WATER SYSTEM INFRASTRUCTURE

Storage

A recycled water storage basin will be constructed at the site of the WWTP to receive the treated effluent following disinfection. The basin will be sized to contain four (4) days of effluent for the peak day demand condition at the ultimate buildout of the development. This results in a required storage volume of 2.3 million gallons (MG). The basin is proposed as an open-air earthen basin with a flexible HDPE liner. The basin will include floating aerators to control algae growth and minimize odors. The storage basin is proposed to be constructed in its entirety as apart of Phase 1.

Pumping

From the storage basin, the recycled water will be delivered throughout the development via a new recycled water pump station. The recycled water pump station is proposed to be constructed adjacent to the storage basin. The pump station will initially include two (2) 200-gpm pumps with variable frequency drives to provide recycled water to the development. As the development grows and the recycled water production increases, the pumps are planned to be replaced with two (2) 800-gpm pumps.

Distribution

A hydraulic model was developed and analyzed to determine the size of the on-site distribution system piping (see next section). The recycled water pump station discharge pipeline is proposed as an 8-inch diameter pipe. The on-site recycled water distribution system piping will consist of a 6-inch looped system, with smaller branches coming off the loop to deliver water to the end users.

Phasing

Per the WSA, recycled water is planned to initially be used for construction water and non-residential outdoor irrigation. Additionally, it is anticipated that portions of the existing almond and fig orchards will be irrigated year-round within the development's property to dispose of excess recycled water as construction is phased. To accomplish this, the new recycled water distribution system will be tied into the existing almond and fig irrigation systems as necessary to balance irrigation needs with excess recycled water disposal requirements. As development progresses and existing crops are removed to make way for homes, commercial facilities, school, etc., excess recycled water is anticipated to be conveyed offsite for agricultural irrigation of adjacent farmlands.

HYDRAULIC MODELING ANALYSIS

A hydraulic model of the backbone system representing the proposed recycled water distribution system was developed utilizing the WaterCAD hydraulic modeling software by Bentley. This section of the Technical Memorandum summarizes the procedures, criteria and assumptions used in the hydraulic modeling analyses and presents the conclusions developed from review of the model output data.

HYDRAULIC MODEL ANALYSIS CRITERIA

The following criteria was used to develop the hydraulic model and conduct an analysis of the recycled water distribution system.

- Maintain a minimum pressure above 60 psi.
- Minimum pipe diameter of 6-inch.
- Ultimate average day demand was assumed over an 8-hour period.
- Model does not account for potential agricultural uses outside of the development.
- Static model.
- Model includes backbone system only.

MODELING SCENARIOS

A static model was developed to analyze the ultimate build-out average daily flow condition. A flow of 266 gpm was distributed amongst 14 demand node within the model. Both model input and output data were reviewed for consistency with industry standard criteria and design standards.

MODELING RESULTS

The hydraulic model was analyzed under the ultimate build-out average daily flow condition to identify the minimum pipe diameter required to serve the development and maintain a minimum of 60 psi. The model results are included in the Appendix 2 of this memorandum.

PROPOSED IMPROVEMENTS

Based on the current land use plan for the development, the recycled water system required to provide service to the area includes:

- 2.3 MG Recycled Water Storage Basin
- Recycled Water Pump Station (2 – 200 gpm pumps) –
- Upgrade Recycled Water Pump Station (2 – 800 gpm pumps)
- Approximately 20,000 LF of 6" Recycled Water Main
- Approximately 3,000 LF 8-inch water main from the pump station

The proposed layout of the recycled water improvements is depicted on Figure 2.

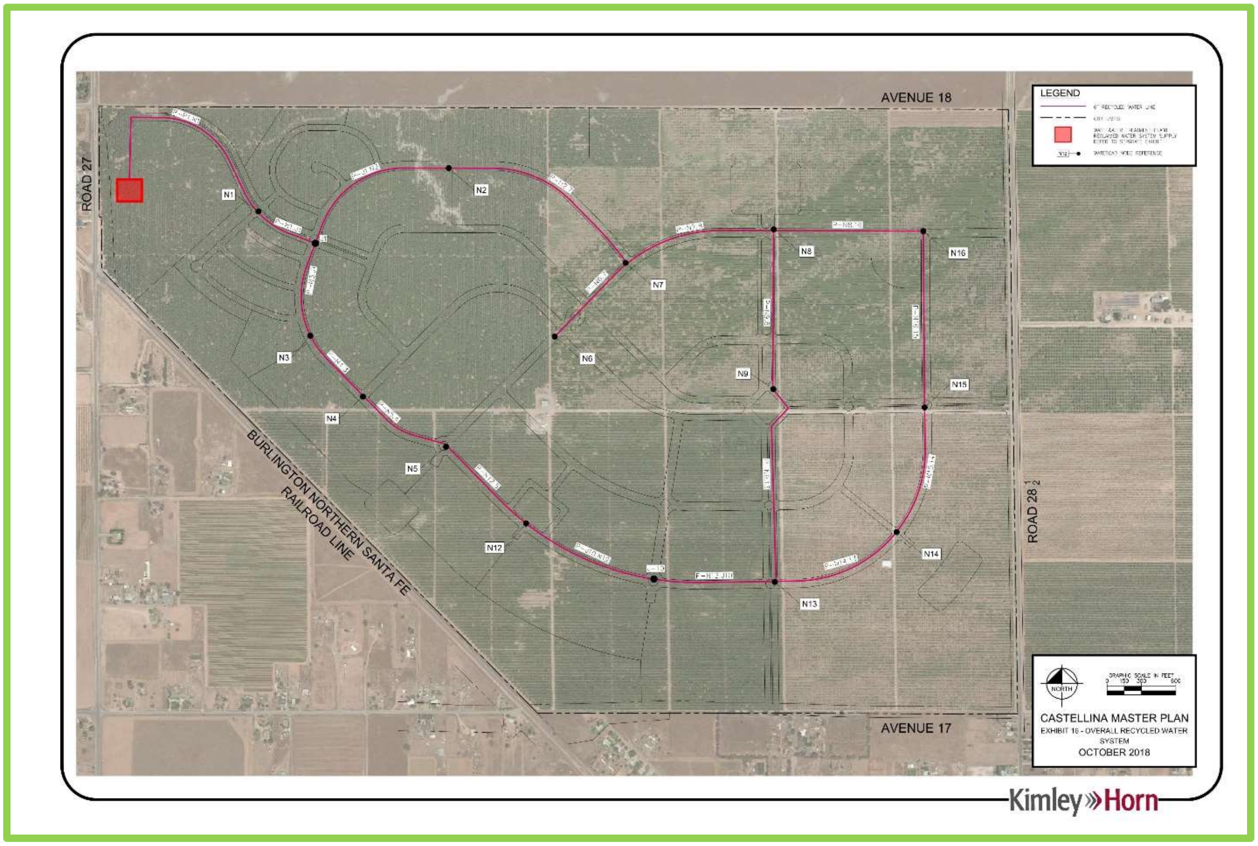

Figure 2 – Overall Recycled Water System Layout

Technical Memorandum
Recycled Water System

APPENDIX 1

Castellina Flow Generation Tables

CASTELLINA RECLAIMED WATER DEMAND TABLE

Village and Planning Area	Land Use Density Category	Gross Acres*	% Area Irrigated	Landscape Area (acres)	%Turf Area	Turf Area (acres)	%Hydroseed Area	Hydroseed Area (acres)	Remaining Landscape Area (acres)	MWELO Demand (gpy)	Demand (gpm)
VILLAGE ONE ROADS											
1.1	LDR	3.6	*5%*	0.18	0%	0.00	80%	0.14	0.04	*195,340.1*	*0.9*
1.2	VLDR	3	*5%*	0.15	0%	0.00	80%	0.12	0.03	*162,783.4*	*0.7*
1.3	LDR	2.5	*5%*	0.13	0%	0.00	80%	0.10	0.03	*135,652.8*	*0.6*
1.4	LDR	2.9	*5%*	0.15	0%	0.00	80%	0.12	0.03	*157,357.3*	*0.7*
1.5	LDR	3.7	*5%*	0.19	0%	0.00	80%	0.15	0.04	*200,766.2*	*0.9*
1.6	MDR	6	*5%*	0.30	0%	0.00	80%	0.24	0.06	*325,566.8*	*1.5*
1.7	LDR	4.25	*5%*	0.21	0%	0.00	80%	0.17	0.04	*230,609.8*	*1.1*
1.9	VLDR	2.9	*5%*	0.15	0%	0.00	80%	0.12	0.03	*157,357.3*	*0.7*
Sub Total Roads		**28.9**		**1.4**				**1.2**	**0.3**	**1565433.7**	**7.1**
NP.1	Neighborhood Park	5.0	*75%*	3.75	50%	1.88	0%	0.00	1.88	*3,412,784.8*	*15.6*
OP.1	Open Space	4.4	*100%*	4.4	0%	0.00	95%	4.18	0.22	*5,160,302.4*	*23.6*
OP.2	Open Space	4.8	*100%*	4.8	0%	0.00	95%	4.56	0.24	*5,629,420.8*	*25.7*
CG.1	Comm. Garden	3.0	*80%*	2.4	0%	0.00	0%	0.00	2.40	*2,967,191.0*	*13.5*
CP.1	Central Park	23.0	*80%*	18.4	60%	11.04	10%	1.84	5.52	*18,893,863.7*	*86.3*
Sub Total Other		**40.2**		**33.8**						**36,063,563**	**164.7**
SUBTOTAL VILLAGE ONE		69.1		35.2		13		13	11	**37,628,996**	**171.8**
VILLAGE TWO ROADS											
2.1	MDR	6.4	*5%*	0.32	0%	0.00	8%	0.03	0.29	*212,758.6*	*1.0*
2.2	MDR	7.2	*5%*	0.36	0%	0.00	80%	0.29	0.07	*390,680.2*	*1.8*
2.3	LDR	4.6	*5%*	0.23	0%	0.00	80%	0.18	0.05	*249,601.2*	*1.1*
Sub Total Residential		**18.2**		**0.9**		**0**		**0.5**	**0.4**	**853,040**	**3.9**
NP.2	Neighborhood Park	4.0	*75%*	3	50%	1.50	0%	0.00	1.50	*2,730,227.9*	*12.5*
GP.1	Grand Promenade	2.1	*70%*	1.47	70%	1.03	0%	0.00	0.44	*1,509,455.4*	*6.9*
VS.1	Village Square	1.1	*30%*	0.33	25%	0.08	0%	0.00	0.25	*252,159.7*	*1.2*
CP.2	Central Park	7.0	*80%*	5.6	60%	3.36	10%	0.56	1.68	*5,750,306.3*	*26.3*
Sub Total Other		**14.2**		**10.4**		**6**				**10,242,149**	**46.8**
SUBTOTAL VILLAGE TWO		32.4		11.3		6				**11,095,189**	**50.7**
VILLAGE THREE ROADS											
3.1	MDR	2.9	*5%*	0.15	0%	0.00	80%	0.12	0.03	*157,357.3*	*0.7*
3.2	LDR	15.3	*5%*	0.77	0%	0.00	80%	0.61	0.15	*830,195.3*	*3.8*
Sub Totals Village Three		**18.2**		**0.9**		**0**				**987,553**	**4.5**
NP.3	Neighborhood Park	4.0	*75%*	3	50%	1.50	0%	0.00	1.50	*2,730,227.9*	*12.5*
SCH	School	12.0	30%	3.6	15%	0.54	15%	0.54	3.06	*2,067,761.3*	*9.4*
Sub Total Other		**16.0**		**6.6**		**2**				**4,797,989**	**21.9**
SUBTOTAL VILLAGE THREE		34.2		7.5		2				**5,785,542**	**26.4**
VILLAGE FOUR ROADS											
4.1	MDR	5.8	*5%*	0.29	0%	0.00	80%	0.23	0.06	*314,714.6*	*1.4*
4.2	MDR	2.37	*5%*	0.12	0%	0.00	80%	0.09	0.02	*128,598.9*	*0.6*
4.3	MDR	2.99	*5%*	0.15	0%	0.00	80%	0.12	0.03	*162,240.8*	*0.7*
4.4	LDR	2.95	*5%*	0.15	0%	0.00	80%	0.12	0.03	*160,070.3*	*0.7*
4.5	LDR	4.5	*5%*	0.23	0%	0.00	80%	0.18	0.05	*244,175.1*	*1.1*
4.6	LDR	5.26	*5%*	0.26	0%	0.00	80%	0.21	0.05	*285,413.6*	*1.3*
4.7	MDR	3	*5%*	0.15	0%	0.00	80%	0.12	0.03	*162,783.4*	*0.7*
Sub Totals Village Four		**26.9**		**1.3**		**0**				**1,457,997**	**6.7**
NP.3	Neighborhood Park	2.0	*75%*	1.5	50%	0.75	0%	0.00	0.75	*1,365,113.9*	*6.2*
Sub Total Other		**2.0**		**1.5**						**1,365,114**	**6.2**
SUBTOTAL VILLAGE FOUR		28.9		2.8		0				**2,823,111**	**12.9**
VILLAGE FIVE ROADS & OPEN SPACE???											
5.1	HDR	0.6	*5%*	0.03	0%	0.00	80%	0.02	0.01	*32,285.4*	*0.1*
SUBTOTAL VILLAGE FIVE		0.6				0				**32,285**	**0.1**
VILLAGE SIX ROADS											
6.1	AALDR		*5%*	0.00	0%	0.00	80%	0.00	0.00	*0.0*	*0.0*
Sub Totals Village Six		**0.0**				**0**				**0**	**0.0**
AAAC	Active Open Space	6.0	*40%*	2.4	15%	0.36	25%	0.60	1.44	*1,100,333.3*	*5.0*
Sub Total Other		**6.0**								**1,100,333**	**5.0**
SUBTOTAL VILLAGE SIX		6.0		2.4		0				**1,100,333**	**5.0**
OVERALL TOTALS		**171.1**		**59.3**	**0%**	**20.9**			**10.8**	**58465456.7**	**267.0**
								Road Subtotal		4,896,308	*22.4*

Notes:

*Gross Acreage, as defined by the Madera County General Plan, "includes all land (including streets and rights-of-way) designated for a particular residential use" (i.e., development parcel, not including main collector roadsNet acreage, as defined by the Madera County General Plan, *"excludes streets and rights-of-way…Net acreage is the standard typically used in zoning, while gross acreage is more commonly used in General Plan designations."* From this definition, net densities were calculated.

NOTE: for the purposes of this density table, net acreages were estimated by assuming:

- Very Low Density--15% of gross acreage taken up in local roads
- Low Density--20% of gross acreage taken up in local roads
- Medium Density--25% of gross acreage taken up in local roads
- High Density--Gross and Net acreages are treated as equivilent

Net acreage figures have been rounded off for that column, but residential unit totals are calculated using net figures extended to nearest tenth of an acre.

Technical Memorandum
Recycled Water System

APPENDIX 2

Hydraulic Model Results

Nodes

Castellina Reclaimed Water Master Plan
Node Summary
10/26/2018

Node	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J1	291.0	0.0	466.8	76.0
J-10	301.0	0.0	463.9	70.0
N1	291.4	25.0	469.9	77.0
N12	297.8	9.0	464.4	72.0
N13	304.0	2.0	463.5	69.0
N14	307.3	26.0	463.3	68.0
N15	310.3	1.0	463.3	66.0
N16	311.1	15.0	463.2	66.0
N2	296.0	27.0	464.8	73.0
N3	292.4	16.0	466.0	75.0
N4	294.1	1.0	465.5	74.0
N5	295.2	15.0	464.9	73.0
N6	301.0	114.0	462.0	70.0
N7	304.0	1.0	463.2	69.0
N8	308.6	6.0	463.2	67.0
N9	308.0	8.0	463.3	67.0

Technical Memorandum Recycled Water System

APPENDIX 3

Hydraulic Model Results

Pipes

Castellina Reclaimed Water Master Plan

Pipe Summary

10/26/2018

Pipe ID	Length (ft)	Start Node	Stop Node	Dia. (in)	Material	Flow (gpm)	Velocity (fps)	Headloss Gradient (ft/ft)
P-J1.N2	1486.0	J1	N2	6.0	PVC	131.0	1.5	0.0
P-J10.N12	1231.0	J-10	N12	6.0	PVC	-69.0	0.8	0.0
P-N1.J1	578.0	N1	J1	6.0	PVC	242.0	2.7	0.0
P-N12.5	990.0	N12	N5	6.0	PVC	-78.0	0.9	0.0
P-N13.J10	1018.0	N13	J-10	6.0	PVC	-69.0	0.8	0.0
P-N14.13	1234.0	N14	N13	6.0	PVC	-40.0	0.5	0.0
P-N15.14	1144.0	N15	N14	6.0	PVC	-14.0	0.2	0.0
P-N16.15	1540.0	N16	N15	6.0	PVC	-13.0	0.2	0.0
P-N2.7	1879.0	N2	N7	6.0	PVC	104.0	1.2	0.0
P-N3.J1	798.0	N3	J1	6.0	PVC	-111.0	1.3	0.0
P-N4.3	739.0	N4	N3	6.0	PVC	-95.0	1.1	0.0
P-N5.4	859.0	N5	N4	6.0	PVC	-94.0	1.1	0.0
P-N6.7	935.0	N6	N7	6.0	PVC	-114.0	1.3	0.0
P-N7.8	1271.0	N7	N8	6.0	PVC	-11.0	0.1	0.0
P-N8.16	1381.0	N8	N16	6.0	PVC	2.0	0.0	0.0
P-N9.13	1844.0	N9	N13	6.0	PVC	-27.0	0.3	0.0
P-N9.8	1366.0	N9	N8	6.0	PVC	19.0	0.2	0.0
P-P1.N1	2140.0	P-1	N1	6.0	PVC	267.0	3.0	0.0