



## **REVISED TECHNICAL MEMORANDUM**

**To:** The City of Woodland

**Cc:** Woodland Research Park Owners Group

**From:** Steve Greenfield, PE - Cunningham Engineering Corporation

**Date:** ~~31 January 2020~~ 12 July 2023

**Subject:** Woodland Research and Technology Park  
Stormwater Management

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### **INTRODUCTION:**

The proposed Woodland Research and Technology Park (WRTP) will comprise 349 developable acres, to be annexed into the City of Woodland. Previous planning documents have identified the area as a portion of the Spring Lake Master Plan Remainder Area and as SP-1A in the 2017 General Plan Update. The property is generally bounded by SR113 on the west, Harry Lorenzo Ave on the east, the westerly projection of Farmers Central Road on the north and CR 25A on the south (with the exception of 48 acres located south of CR 25A). The proposed land-use plan is included herein as Attachment 1.

### **EXECUTIVE SUMMARY:**

The proposed onsite drainage system will consist of a system of collection and conveyance facilities, which will carry stormwater via gravity generally from west to east through the SLSP area. Wherever feasible storm drain pipes have been designed to flow full under gravity in the 10-year storm; however, if the flows rise above the pipe soffit, designs maintain at least 1 foot below finish grade. Based on peak flow in the major storm drain pipes during a 10-year storm, the existing downstream conveyance system has adequate capacity to accept the stormwater generated from the WRTP.

### **EXISTING CONDITIONS:**

#### **Existing Site Storm Drainage Patterns and Facilities**

The WRTP Project Site (Site) is relatively flat, with an elevation drop of about 10 feet west-to-east and a negligible elevation change north-to-south. West-to-east ground slopes range from 0.2% to 0.4%. The

overall existing drainage patterns are depicted in Attachment 2: Existing General Drainage Patterns. There are no natural streams or waterways on the Site, nor is there currently a developed onsite drainage system capable of managing future flows from development of the Site. Existing minor roadside ditches accept runoff from existing county roadways, and minor agricultural ditches and culverts currently manage local agricultural runoff within the Site. Overall, agricultural drainage follows the fall of the existing topography from west to east.

Along the east boundary of the Site, an existing north-to-south channel runs along the west side of Harry Lorenzo Avenue from Diggs Street to Marston Drive. This channel was constructed to intercept and convey agricultural runoff around the Solara Ranch development. The channel terminates in a culvert, outflowing to a channel on the western boundary of the Oyang South development, and eventually connecting to the unlined channel along the CR 25A corridor.

The *South Urban Growth Area Storm Drain Facilities Master Plan (SUGASDFMP)*, prepared by Wood Rodgers and dated March 2018, identifies two offsite sheds west of SR 113 - 'HW20' (north of CR25A) and Shed 'SB1C1' (south of CR25A) - that drain to the WRTP site, see Attachment 9. The highway embankment of SR 113 forms a north-south barrier to agricultural drainage runoff originating from the west. Cross-culverts under that highway are shown in Attachment 2 and convey drainage from west-to-east. As development of the WRTP proceeds, existing agricultural flows from west of SR 113 will, in general, continue to be routed around the south side of the Site along CR25A. As upstream existing agricultural areas are gradually replaced by development, agricultural drainage will diminish. Upstream developed drainage, attenuated to pre-existing flows, from Sheds HW20 and SB1C1 will be collected and conveyed through the Site via channels and pipe conveyances, discharging to the CR25A drainage corridor as shown in Attachment 4.

The Federal Emergency Management Agency (FEMA) delineates the boundaries of the FEMA 100-year floodplain based on hydrology, topography, and modeling of flows during specified design rainstorms. FEMA has identified areas of special flood hazard in Woodland and the vicinity. These areas are designated as flood zones on published Flood Insurance Rate Maps (FIRM). Per Attachments 7 and 8, the maps indicate that the Site is located in Zone X, which depicts areas determined to be outside the 0.2% chance annual floodplain. As such, there are presently no special development considerations or insurance requirements affecting the site.

According to the Natural Resources Conservation Service (NRCS) Soils Survey, the site area contains soils classified as Hydrologic Soil Group (HSG) 'B' (56% of site area) and HSG 'C' (41%), together with a small pocket of HSG 'A' (3%). North of Parkland Avenue, virtually all the site area is mapped as having HSG 'B' soils. South of Parkland, HSG 'B' predominates on the western portion of the site; HSG 'C' on the easterly portion.

Standard design infiltration rates for HSG 'C' soils range from 0.17 - 0.27 inches/hour. For HSG 'B' soils, design rates range from 0.50 - 1.00 inches/hour (City of Woodland, 2006). Based these standard values, for design purposes the site can be expected to exhibit low to moderate infiltration potential.



### **Adjacent/Downstream Drainage Facilities**

Downstream existing drainage facilities in the general vicinity of the Site include the following:

- 60” to 72” west-to-east storm drain pipe in Farmers Central Road corridor, from SR 113 to the head of the Farmers Central Channel (FCC) near Pioneer Avenue.
- 30” to 48” south-to-north storm drain pipe in Harry Lorenzo Avenue (HLA), draining to the above-referenced 72” pipe.
- 60” to 66” south-to-north storm drain in Pioneer Avenue, draining to FCC (with an upstream 48” to 60” pipe proposed between HLA and Pioneer).
- 48” to 2-66” west-to-east storm drain pipe in Heritage Parkway, plus a 30” west-to-east storm drain pipe extension which may be installed prior to SP-1A. If it is not constructed by others prior to SP-1A, then an easement will need to be reserved for a proposed 30” storm drain pipe extending from Heritage Parkway.
- 42” north-to-south storm drain within the existing right-of-way of HLA extending from the south side of CR25A approximately 40 feet north of the northern 25A right-of-way. Said pipe outfalls into an unlined channel located along the south side of CR 25A (see next item below).
- West-to-east unlined channel along the south side of the CR 25A corridor, beginning east of HLA and continuing east.

### **PROPOSED CONDITIONS:**

#### **Overall Onsite Drainage Patterns**

Under developed conditions, the drainage from the proposed Site can be divided into six main sheds, as shown in Attachment 3: Proposed General Drainage Patterns.

The limit lines of the six proposed sheds are generally consistent with the shed limits originally identified in the 2004 Spring Lake Specific Plan (SLSP) Infrastructure Study Report (ISR) and reflected in subsequent updates to the City’s SUGASDFMP. However, it is noted that there are some minor differences in shed limits due to changes in land-use plans that have arisen since the ISR was generated.

#### **Shed 1**

That portion of the Site located north of Parkland Avenue, draining generally north and east to the Farmers’ Central Road corridor. This area falls within SUGASDFMP Shed ‘C4B’ as delineated in the ~~February 2017~~ March 2018 update to the City SUGASDFMP.



### Shed 2

The northwestern part of that portion of the Site located south of Parkland Avenue. This shed drains generally north and east to Parkland Avenue, which in turn drains east to Pioneer Avenue and thence north to the Farmers' Central corridor. The majority of this area substantially falls within SUGASDFMP Shed 'C4B', with a small portion of SUGASDFMP Shed C2B (10.2 acres).

### Shed 3

The northeastern part of that portion of the Site located south of Parkland Avenue. This shed drains generally east to Hunt Street, which in turn drains east to Heritage Parkway. This shed encompasses a small portion (15.6 acres) of SUGASDFMP Shed C3 west of HLA.

### Sheds 4 and 5A/5B

The southwestern part of the Site, draining via the proposed South Regional Pond (SRP) to the proposed westerly extension of the existing CR25A channel. Shed 4 and 5A generally corresponds to SUGASDFMP Shed 'C2A'; and Shed 5B to SUGASDFMP Sheds 'SB1D1' and 'SB2A1'.

### Shed 6

The southeastern part of the Site, draining south and east to the proposed westerly extension of the existing CR25A channel. This area essentially consists of that part of SUGASDFMP Shed 'C2B' lying west of HLA, plus a relatively small portion of SUGASDFMP Shed 'C3' (west of HLA).

## **Proposed Conveyance System**

Attachment 4: Proposed Site Drainage Layout, indicates the components of the proposed onsite drainage infrastructure plan, depicting preliminary sizing and general locations of major onsite storm drain facilities.

As indicated on Attachment 4, the proposed onsite drainage system will consist of a system of collection and conveyance facilities, which will carry stormwater via gravity generally from west to east towards HLA. From there, existing offsite facilities will convey runoff to the east through the SLSP area.

Major constraints affecting storm drainage for the Site include limited fall for gravity drainage, (particularly in a north/south direction), and a significant upstream area discharging agricultural runoff through the development area.

The major parameters to be used in the design of storm drainage facilities for the Site will include the computed peak flow rates and runoff volumes for selected design. For the onsite conveyances, the key parameter is the peak runoff rate (10-year for pipes, 100-year for channels and overland release). For offsite conveyances (such as the CR25A channel), the key parameter is the 100-year peak runoff rate. For regional detention facilities (such as the SRP), key sizing parameters are the 100-year peak flow and runoff volume.



### **10-Year Storm Routing:**

Developed on-site flows will be conveyed generally from west to east through new storm drainage pipes. Pipes will usually be located in public streets or in proposed storm drain easements. Because of the flat topography within the Site, it is expected that grading plans and street profiles will generally be undular, with alternating shallow crests and sags. The sags will be drained by inlets connected to the new storm drain system.

Storm drain pipes will be designed to flow full under gravity in the 10-year storm. In general, the 10-year hydraulic grade line (HGL) will typically be contained within the pipe wherever feasible. If the 10-year HGL rises above the pipe soffit, designs will seek to maintain the HGL at least 1 foot below finish grade. Normally, pipe runs will be designed to match crowns at changes in pipe size. However, because of the grade constraints imposed by the flatness of the site, lack of pipe cover may make matching pipe crowns at changes in pipe size difficult in some areas. In such cases, pipe runs may be designed to match inverts at changes in pipe size, provided that the design 10-year HGL in the pipe remains at least one foot below inlet grate elevations.

The inverts of Lines O and L at the SRP were set to the SRP's 100-yr water surface elevation, as defined by the SUGASDFMP. This ensures that the HGLs will be independent of the tailwater conditions in the pond, and there will not be long-term standing water in the drain lines. It is proposed that soffits match at all pipe junctions, except for a portion of Line O where inverts are matched, to avoid a sanitary sewer conflict and provide adequate cover over the line.

Supporting calculations for the backbone infrastructure pipelines are presented in Attachment 5: Peak Flow Calculations for Major Storm Drain Pipes. Based on these calculations, there appears to be adequate downstream capacity to accommodate the pre-development runoff from the proposed upstream land uses of the WRTP. Future modifications to the internal shed boundaries or significant changes in planned land uses will require new calculations to show that adequate capacity exists within proposed piping.

### **100-Year Storm Routing and Release Point:**

The downstream (east) edge of the overall Site shed lies along the HLA corridor. As such, the 100-year release points from the overall shed are in general expected to be along HLA between CR 25A and the FCC.

Within the Site itself, on-site flows in excess of pipe capacities (i.e. in excess of the 10-year flows) will be conveyed overland via collector and arterial streets, and in greenbelt corridors. Release points for the 100-year storm will be provided for all onsite developed drainage sub-areas. It is expected that the overland flow patterns will generally follow the direction of piped (10-year) flows. The overall flow directions and sub-basin typical release points are depicted in Attachments 3 and 4.

In general, local street profiles are expected to be designed such that low points overflow when the water depth reaches a maximum of 1 foot. Overflows should be able to “cascade” over successive local street high-points to an outlet downstream. Successive downstream high-points in streets will decrease in elevation, with a desirable minimum projected slope of -0.0005 ft/ft between successive high-points



going downstream. Building pad elevations will be at least 1 foot above the 100-year estimated maximum standing water elevation in the adjacent street.

Individual development sites (such as single-family subdivisions, multifamily apartment sites, or portions of the research park/business park element) should typically be designed such that their 100-year release points discharge to an abutting collector or arterial street, such streets will have an overland flow path to the downstream end of the Site. Overland release may also be to an abutting channel, sized for the 100-year/24-hour peak flow with one foot of freeboard. Alternatively, overland flow may be conveyed in greenbelts provided that (i) the greenbelt connects directly to a downstream channel or arterial street, (ii) the greenbelt can be shown to have sufficient hydraulic capacity to carry the 100-year flow from its ultimate developed contributing area, and (iii) frequent flows will not compromise the primary function of the greenbelt as an amenity.

Runoff from offsite shed HW20, located west of SR 113 and north of CR 25A, will be intercepted by a proposed onsite interceptor/conveyance channel to run along the east side of SR 113 and then for about 500 LF along the north side of CR25A. This channel is anticipated to consist of an unlined trapezoidal section with a 6-foot (minimum) bottom width and side-slopes at 2H:1V or flatter. It will be sized for the estimated 100-year peak discharge from the existing (undeveloped agricultural land use) HW20 shed, assuming zero flow attenuation due to any incidental surface storage within HW20 and/or due to the capacity limits of the existing culverts under SR113. It is assumed that when HW20 develops in the future, its developed peak flows will be ~~limited-attenuated~~ to existing rates or less, per the South Regional Pond analysis in the SUGASDFMP via implementation of detention facilities to be located west of SR 113. One foot of freeboard will be provided for the channel. Allowance will be made on one side of the channel for a 12-foot maintenance/access road. The downstream segment of the swale along CR 25A will discharge to the proposed 54”60” storm drain pipe, of Line L, just west of the proposed intersection of CR25A with WRTP Road ‘A’. The pipe, to be sized for the 100-year peak flow from HW20 plus the 10-year peak flow from the contributing areas in the WRTP, will cross onto the south side of CR 25A and continue east. Once combined with flows from Road B, the pipe will be upsized to a 60” diameter and then discharge in-to the proposed SRP.

A similar situation is present with the SB1C1 shed, located west of SR 113 and south of CR 25A, which will drain to a proposed onsite interceptor/conveyance channel to run along the east side of SR 113 and then connecting to Line O. This channel is anticipated to consist of an unlined trapezoidal section with a 3-foot (minimum) bottom width and side-slopes at 2H:1V or flatter. It will be sized for the estimated 100-year peak discharge from the existing (undeveloped agricultural land use) SB1C1 shed, assuming zero flow attenuation due to any incidental surface storage within SB1C1 and/or due to the capacity limits of the existing culverts under SR113. It is assumed that when SB1C1 develops in the future, its developed peak flows will be limited to existing rates or less, per the SRP analysis in the SUGASDFMP. One foot of freeboard will be provided for the channel. The downstream segment of the swale will discharge to the proposed 36” storm drain pipe, of Line O, just west of the SRP. The pipe, to be sized for the 100-year peak flow from SB1C1 plus the 10-year peak flow from the contributing areas in the WRTP, will continue east, increasing segmentally to a 54” pipe as developed flows are added to the pipeline, prior- to discharging into the proposed SRP.



At the time of their design, ~~t~~The facilities currently connecting the West Regional Pond (WRP) to the ERP, (a 60” culvert beneath SR113, a 60” and subsequent 72” pipeline between SR 113 and Pioneer Avenue, two 6’ x 6’ concrete box culverts immediately east of Pioneer, the Farmers Central Channel (FCC), the bypass culvert at the Spring Lake Wastewater Pump Station locating in line with the FCC, and the box culvert connecting the FCC to the ERP), were all sized ~~for~~ assuming a maximum flow of 55 cfs discharging from the WRP. The 55 cfs was a parameter provided for the Spring Lake Infrastructure Design.

Master planning for storm drainage runoff for properties within the FC drainage corridor shed east of SR 113 has relied on 10-year capacity in the corridor pipelines and 100-year overland capacity in the channel and downstream. ~~Hence, this study continues to rely upon the 55 cfs assumption for the maximum WRP discharge.~~ The 2018 SUGASDFMP, indicates the planned maximum WRP discharge to be approximately 109 cfs which is based upon the capacity of the 60” culvert beneath SR113. cannot be accommodated in the Farmers Central drainage corridor and is inconsistent with the downstream assumption. The WRP capacity should be reanalyzed independent of this WRTP stormwater study to determine required expansion to continue to restrict the maximum discharge from the pond to 55 cfs. Wood Rodgers analyzed the pipeline capacity in this corridor for the 10-year storm event to verify that there was adequate capacity to convey 109 cfs from the WRP plus developed flows within Spring Lake and future developed flows from shed C4B (the northern portion of the WRTP). The analysis used InfoWorks ICM, a 2D hydraulic modeling software to assess the available capacity. The results indicate that the hydraulic grade line during the 10-year peak flow conditions is located below the soffit of the pipes in this corridor. Hence, the corridor is able to accommodate 109 cfs from the WRP in addition to developed flows within the relevant sheds east of SR113. The results of this analysis are part of a memo entitled *Farmer Central Drainage (10-year) and Woodland Research and Technical Park Development Triggers*, dated January 17, 2022.

### **Stormwater Quality, Low Impact Development (LID) and Hydromodification Considerations**

Based on the requirements of the State Water Resources Control Board (SWRCB) NPDES General Permit, water quality (WQ) treatment design for the Site will be addressed by implementing a combination of LID measures, standard Treatment Control BMPs, and ‘end-of-pipe’ WQ storage within existing and proposed detention basins. The NPDES General Permit also contains requirements for Hydromodification Mitigation, which calls for matching post-project 2-year/24-hour peak flows to pre-project levels. It is intended that this be accomplished via a combination of upland LID-style runoff-reduction measures and end-of-pipe detention storage within existing and/or proposed detention basins.

For the Site as a whole, key LID elements will include the following:

#### **1. At-source drainage management approach:**

This entails integration of small-scale distributed drainage management features such as shallow, decentralized surface detention areas and/or infiltration areas that are consciously designed into streetscapes and individual site landscapes throughout the project area. An at-source drainage management approach encourages the use of drainage as a design element, rather than solely as a



functional requirement. In order to implement this, landscape and engineering designs for proposed developments within the Site project should be developed collaboratively from the outset.

## **2. Reduction of new impervious areas:**

This can be accomplished with compact building footprints, alternative driveway layouts and/or materials, narrower roadway cross-sections (as appropriate), pervious pavement and efficient parking layouts.



For all sites that will have parking lots, the following elements can help reduce impervious areas:

- Efficient layouts that seek to minimize the overall area of the lot on a per-parking-space basis.
- Examination of parking minima/maxima, with the intention of not ‘overparking’ site designs.
- Construction of parking areas from pervious materials.
- Exploration of shared parking opportunities for adjacent non-concurrent uses.
- Use of tree canopies for runoff interception.

### **3. Disconnection of new impervious areas:**

This can be accomplished through judicious site design that seeks to place pervious areas (landscaping and/or pervious pavement) downstream of a site’s impervious surfaces (roofs and conventional pavement), with site grading/landscaping designs that provide for sheet flow from those impervious surfaces onto the pervious surface areas.

It is recommended that all site designs within the project area seek to implement drainage designs that avoid direct connection of roof downspouts to the receiving storm drain pipe system, and that provide landscape areas immediately upstream of DI’s receiving runoff from new pavement areas.

Disconnection of impervious areas usually slows down runoff, which in turn tends to reduce peak flow rates. It also increases opportunities for stormwater filtration and infiltration, which improve stormwater quality and reduce runoff volume.

Treatment Control BMP’s will typically include the following:

#### **1. Vegetated swales:**

Swales can be readily integrated into most site developments provided they are planned for at an early stage of the site design. The key is in integrated planning and design collaboration between all members of the site design team.

#### **2. Stormwater planters/rain gardens:**

Similarly, integrated design of site improvements can allow for the incorporation of rain gardens into planned low points in the site landscape areas.

#### **3. Pervious pavements:**

These can be well-suited to parking lots and access drives. They may consist of pervious asphalt, pervious concrete or pavers.



#### **4. End-of-Pipe Water Quality Storage:**

As a supplement to LID features and distributed water-quality BMPs, the proposed detention basins serving the Site will include a water quality component. This will typically comprise a shallow (roughly 1' to 3' deep) water-quality retention pool below the detention storage pool.

In-situ infiltration testing has not been performed within the Site. However, as noted earlier, the NRCS Soils Survey Map suggests that HSGs 'B' and 'C' predominate. Assuming a maximum allowable drawdown time of 72 hours, and standard design infiltration rates of 0.17"/hr (HSG 'C') and 0.50"/hr (HSG 'B'), the design depth of a WQ pool would be limited to about 1 foot for areas having HSG 'C' and about 3 feet for HSG 'B'.

#### **Shed-Specific Requirements relating to WQ and Hydromodification**

The disposition and locations of the various WQ and hydromodification measures vary for Sheds 1 through 6, largely depending on the availability of existing downstream facilities to provide water quality treatment and 2-year peak flow attenuation. Proposed measures are described on a shed-by-shed basis below.

##### **Sheds 1, 2 and 3:**

In the SLSP ISR, the area that comprises the northerly portion of the Site (corresponding to proposed Sheds 1, 2, and 3) was master-planned to drain to the East Regional Pond (ERP). Sheds 1 and 2 drain to the ERP via the Farmers Central Road corridor, which includes approximately  $\frac{3}{4}$  mile of unlined, low-velocity, naturalistic channel that outlets to the northwest corner of the ERP. Shed 3 drains to the ERP initially via the Heritage Parkway Corridor, which drains to the ERP Inlet Channel at CR 102.

The ERP includes a water quality pool below the flood pool that was designed and constructed to provide the necessary WQ storage for both the Spring Lake Specific Plan area and the Master Plan Remainder Area (*Preliminary Engineering Report – Draft, City of Woodland, South Urban Area Regional Storm Drainage Facilities (SLSPA Phase 1)*, by Wood Rodgers, March 11, 2003). Therefore, the ERP will provide the primary WQ treatment for Sheds 1, 2 and 3. In addition, supplemental upland LID features will be incorporated, to the extent feasible, into the design of "in-tract" onsite improvements within those Sheds. In particular, designs will seek to 'disconnect' new impervious areas, such as roof downspouts and parking areas.

In addition to providing WQ treatment, the ERP was designed and constructed to attenuate post-development peak flows for events as large as the 100-year storm, with the 100-year/10-day event being the governing design storm for sizing purposes. Examination of design documentation for the ERP (Wood Rodgers, April 2003) indicates peak 100-year inflows of up to approximately 1,430 cfs, with peak design outflow of approximately 270 cfs. The corresponding ratio of peak outflow to peak inflow is just under 0.2. This relatively low numerical value of outflow/inflow ratio is indicative of a high degree of flow attenuation in the pond.



Given the large overall flood storage capacity of the ERP (333 acre-feet) and the substantial degree of attenuation ( $Q_{out}/Q_{in} < 0.2$ ) that it provides in the design event, it is reasonable to expect that the ERP could provide a significant degree of peak flow attenuation in lesser storms (such as the 10-year and 2-year events). Significant attenuation in lesser storms would indicate that the ERP meets the intent of hydromodification mitigation for its tributary area, including WRTP Sheds 1, 2, and 3. Hydromodification mitigation via the ERP was confirmed in 2019 via an analysis by Rick Engineering and a subsequent review by the Regional Water Quality Control Board. The approval of said analysis was documented in a letter from the City to the Regional Water Quality Control Board, dated May 28, 2019 (Reference 4).

#### **Sheds 4 and 5A/5B:**

Sheds 4 and 5A/5B are planned to drain to the CR 25A corridor via the proposed SRP. The SRP was sized and its general location determined as part of the SUGASDFMP update.

Sizing of the SRP was based on attenuating 100-year post-development peak flows from a 342-acre shed, including SUGASDFMP sheds 'C2A' (corresponding to Shed 4 and 5A) and 'SB1D1'/'SB2A1' (corresponding to Shed 5B). In addition, the SUGASDFMP indicated flows from offsite sheds HW20 and SB1C1 draining east via the planned SRP. The sizing was then calculated to limit the peak outflow from the SRP to 118.7 cfs, which was based on the available capacity of the existing downstream facilities.

As noted above, SR 113 presents an existing barrier to flows originating from the west. In light of that, and given that lands west of SR113 are not anticipated to develop soon, but at some-an unknown future date yet to be determined, it is planned herein that the SRP be phased into multiple basins as follows (and as shown on Attachment 4):

- **SRP #1 (concurrent with WRTP):** Basin located east of SR113, just south of CR 25A. Adequate storage should be provided to manage development from that part of the shed located east of SR 113. The shed area east of SR 113's centerline is approximately 46% of the SUGASDFMP SRP's overall shed area, and includes WRTP Sheds 4, 5A and 5B. Accordingly, Attachment 4 depicts a footprint for SRP#1 that is on the order of 50% of the SUGASDFMP's planned 8-acre footprint. An additional ½-acre has been included in the sizing to provide for a less steep side slope along 25A to provide access in the event that the pond is designed to be utilized as an amenity during ~~the~~ less rainy seasons. This sizing is preliminary and will be refined in conjunction with the design of backbone infrastructure for the southern portion of the WRTP.
- **SRP #2 (future):** Basin located west of SR 113, north of CR 25A. Adequate additional storage should be provided to manage future development from SUGASDFMP Shed HW20 (approx. 41% of the SUGASDFMP SRP's overall shed area). Further detailing of size and location of basin to be completed when development is proposed in Shed HW20.
- **SRP #3 (future):** Basin located west of SR 113, south of CR 25A. Adequate additional storage should be provided to manage future development from SUGASDFMP Shed SB1C1 (approx. 13% of SUGASDFMP SRP's overall shed area). Further detailing of size and location of basin to be



completed when development is proposed in Shed SB1C1.

At full buildout of the SUGA, it is intended that the combined 100-year peak flow attenuation provided by the three SRP basins proposed above would be equivalent to that provided at the outlet of the single 8-acre SRP basin indicated in the SUGASDFMP. In the future, final determination of the respective footprints and depths for SRP #1, #2 and #3 will require an update to the regional hydrology/hydraulics model that was used to size the single 8-acre basin.

As was the case with the ERP, the SRP #1 presents an opportunity to incorporate WQ treatment into a regional stormwater facility. Accordingly, WQ treatment for at least a portion of Sheds 4, 5A and 5B could be provided by a WQ pool integrated into the bottom of the SRP #1. SRP#1 is subject to hydromodification review by the Central Valley Regional Water Quality Control Board. It is acknowledged that analysis of hydromodification and WQ capabilities of the SRP#1 is pending, and will require future approval by the Board.

For the SRP #1, the extent of the shed area that such WQ pool can serve will depend on the SRP #1's bottom area (estimated at around 2.6 acres for the ±4.5-acre pond footprint) and the allowable design depth of the WQ pool. Assuming a maximum allowable drawdown time of 72 hours, and minimum design infiltration rates associated with HSG 'C' (0.17"/hr.), the design depth of the WQ pool would be limited to about 1 foot. Applying this design depth to the SUGASDFMP's SRP #1 bottom footprint of 2.6 acres, the resulting available WQ storage volume would be 2.6 acre-ft.

Attachment 6 contains WQV calculations for those WRTP sheds not draining to the ERP. This includes Sheds 4, 5A/5B and 6. In the calculations, for Sheds 5A/5B it is assumed that 70% of the 'in-tract' WQ treatment requirements will be addressed onsite, with the remaining 30% and master plan streets receiving treatment in an end-of-pipe basin. It is estimated that Shed 5A/5B's end-of-pipe WQS requirement would be  $(1.25 + 1.22) = 2.47$  ac-ft, which could be provided within the SRP #1.

The large open-space/park area that is proposed for the central portion of the Site could potentially be utilized to site a WQ basin to serve the abutting Shed 4 area. However, to increase the value of the central park to the community, detention facilities within this space are discouraged. Therefore, it is proposed Shed 4 will meet 100% of its WQ requirements within its own development footprint, using upland LID measures and distributed water quality BMP's. The area hatched on Attachment 4 will carry a development condition requiring that 100% of the WQ treatment/storage be located on-site.

Further, while the SRP #1 is primarily intended as a high-flow attenuation basin, it could be configured to provide 2-year attenuation in keeping with hydromodification mitigation requirements. As with the ERP, there is a relatively low outflow/inflow ratio indicating a high degree of attenuation in the pond, which suggesting that the SRP#1's outlet works might be readily configured to also provide 2-year peak flow attenuation with little or no increase in overall basin size (compared with a design intended solely for 100-year attenuation). Accordingly, it is proposed that hydromodification mitigation for Sheds 4 and 5A/5B be built into the final SRP design.

#### **Shed 6:**



Shed 6 is planned to drain to the head of the channel (aka The Upper South Canal) located along the south side of the CR 25A corridor, bypassing the SRP #1. Water quality and hydromodification mitigation facilities ~~may~~ shall be provided ~~either~~ entirely onsite, ~~or via a combination of onsite and offsite facilities~~. Water quality and hydromodification volume calculations are provided in Attachment 6. As with Sheds 5A/5B, it is proposed that 70% of the water quality requirements be integrated into the site design, using upland LID features and distributed water quality BMPs, with the remainder handled via end-of-pipe storage within a combination WQ/hydromodification basin. For the onsite-only option, the basin has been shown to be located near the southeast corner of the shed, just north of CR25A. The sizing, shape, and location for this option can be modified in the future as development proposals for that shed are advanced. ~~However, note that there is a 300' residential setback from adjacent agriculture land and the Shed 6 basin provides said setback. For the onsite/offsite option, the onsite LID features would remain but the proposed combination WQ/hydromodification basin would not be constructed within Shed 6. Rather, the proposed Oyang South WQ/hydromodification basin could be expanded to accommodate the additional storage needed to accommodate Shed 6.~~

#### **PHASING OF DRAINAGE FACILITIES:**

Phasing of drainage facilities within the Site will be mostly guided by the development phasing. However, installation of major facilities is expected to proceed from downstream to upstream i.e. east-to-west from HLA towards SR113.

Regarding development of the lands west of SR 113 (SP-1B and 1C), downstream infrastructure will be designed to accept pre-development flows generated by this area. It has been assumed that the SRP #2 and #3 will be implemented to reduce future post-development flows to their respective pre-development flows. Issues arise when sizing downstream facilities for uncertain future land uses and shed boundaries. An additional concern is of the potential long-term financial burden placed on the developers of the WRTP, while waiting for reimbursement from future developers. A way to help alleviate these pressures, would be to phase the storage volume in SRP #1, but the entire land dedication would still need to be made. As suggested above, a more logical approach would be for the future developer of SP-1B and 1C to take on the drainage modeling requirements for the land they are developing and its conveyance across SR 113. Due to the shallow nature of the existing culverts under SR113, a pumping station can be implemented on the north and/or south sides of CR25A to lift the water from SRP #2 and/or #3 to their respective existing culverts. These pumps would allow total flexibility in the shed and associated depth of the future basins.

Regional downstream improvements identified in the SUGASDFMP Update include a new pump station to be constructed near the site of the existing South Canal Pump Station, ~~the latter being which is currently~~ nonoperational. The ultimate pumping capacity that ~~will be needed~~ was identified to be needed to serve the City's storm runoffs needs ~~is was determined to be~~ 120 cfs. Additional improvements identified included the North regional Detention Pond and improvements to the Yolo Bypass Outfall. Wood Rodgers previously estimated that without the above improvements development in the WRTP would be required to initially be limited to 80 acres. Since completion of the SUGASDFMP Update in



~~2018 the new pump station has been constructed with an interim pumping capacity of 60 cfs. In addition, the North Regional Ponds have been constructed and the Yolo Bypass Outfall improvements are under construction. However, due to downstream constraints associated with the East Main Channel and the Yolo Bypass Outfall the first operational phase of the pump station, is planned to consist of 30 cfs of pumping capacity. The SUGASDFMP estimates that 30 cfs of pumping and construction of the North Regional Pond will accommodate the buildout of the SLSP plus approximately 80 additional acres of currently unbuilt residential development, flowing to the existing Farmers Central Channel, in addition to the SLSP. Wood Rodgers prepared an updated analysis of the benefits of the new downstream facilities as well as updated modeling of the amount of water that flows over the High Line Ditch during significant storm events. The results indicate that there need not be any restrictions on the pace of the WRTP development due to the status of downstream facilities (Reference No. 3). Since these downstream improvements also benefit other properties, the WRTP will be required to contribute a pro rata financial share toward the construction of these regional facilities. It is assumed that non-residential development could alternatively be accommodated, as long as the developed acreage is hydrologically equivalent to 80 acres of residential use. Development of more than the equivalent of 80 acres within the WRTP will trigger further improvements to the new pump station, the East Main Channel and the Yolo Bypass Outfall.~~

It is proposed that SRP #1 and associated facilities be built in a single phase. Construction will be timed to coincide with initial development within the project's southwesterly quadrant (i.e. within WRTP Sheds 4 and/or 5A/5B). SRP #2 and SRP #3 will be built in the future, coinciding with development of SUGASDFMP sheds HW20 and SB1C1 respectively.

#### **LAND ACQUISITION AND EASEMENTS:**

Land acquisition or easement requirements for ~~regional~~ WRTP drainage facilities are expected to consist of:

- ~~Land acquisition of a portion of~~ An easement on the Beeman property south of CR25A for the proposed SRP.
- Easement for a north-to-south interceptor/conveyance and gravel access road along the east side of SR 113, and a west-to east conveyance and gravel access road along CR25A to convey runoff from SUGASDFMP subshed 'HW20' to the SRP.
- Easement for a west-to-east conveyance south of CR 25A to convey runoff from SUGASDFMP subshed 'SB101' to the SRP.
- ~~An easement or land acquisition will be required for the combination onsite/offsite Shed 6 detention option, if this option is selected by Shed 6 property owners. Said easement/acquisition would be for the purpose of enlarging the Oyang South detention pond located south of CR25A approximately 1/2 mile east of HLA.~~



**ATTACHMENTS:**

1. Proposed Land Use Plan
2. Existing General Drainage Patterns
3. Proposed General Drainage Patterns (Sheds 1 through 6)
4. Proposed Site Drainage Layout
5. Peak Flow Calculations for Major Storm Drain Pipes
6. Water Quality/Hydromodification Calculation Table
7. FEMA FIRM (Panel 445)
8. FEMA FIRM (Panel 465)
9. City of Woodland Storm Drainage Facilities Master Plan – SUGA Ultimate Conditions Watersheds

**REFERENCES:**

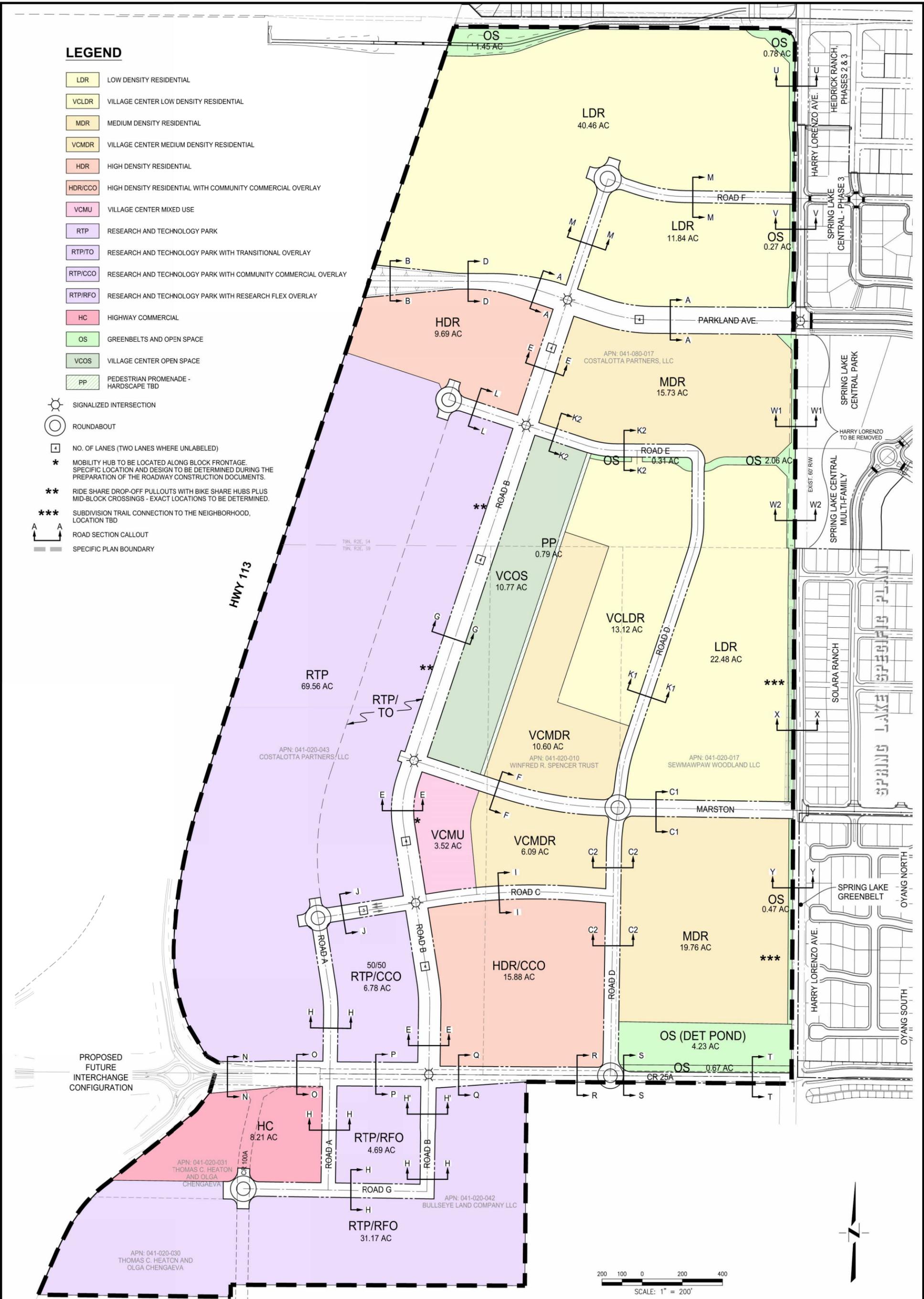
1. Update to South Urban Growth Area Storm Drain Facilities Master Plan (Wood Rodgers, January 2015; revised March 2018)
2. Infrastructure Study Report (ISR) for Spring Lake Specific Plan (CEC, June 2004).
3. Farmer Central Drainage (10-year) and Woodland Research and Technical Park Development Triggers (Wood Rodgers, January 2022).
- 2.4. City of Woodland’s Hydromodification A=Management Plan and Conclusion Regarding the Alternative Hydromodification Standard Request, Phase II Small MS4 General Permit 2013-001-DWQ, Section E.12.F.ii.

S:\Projects\1500\1593 Spring Lake Master Plan Remainder Area\Memos, Meeting Minutes, Agendas\Infrastrucutre Report Memos\Drainage\Current Report\WRTP Drainage Memo 2020-01-31 rev 2023-07-12 (FINAL).docx



**LEGEND**

- LDR LOW DENSITY RESIDENTIAL
  - VCLDR VILLAGE CENTER LOW DENSITY RESIDENTIAL
  - MDR MEDIUM DENSITY RESIDENTIAL
  - VCMDR VILLAGE CENTER MEDIUM DENSITY RESIDENTIAL
  - HDR HIGH DENSITY RESIDENTIAL
  - HDR/CCO HIGH DENSITY RESIDENTIAL WITH COMMUNITY COMMERCIAL OVERLAY
  - VCMU VILLAGE CENTER MIXED USE
  - RTP RESEARCH AND TECHNOLOGY PARK
  - RTP/TO RESEARCH AND TECHNOLOGY PARK WITH TRANSITIONAL OVERLAY
  - RTP/CCO RESEARCH AND TECHNOLOGY PARK WITH COMMUNITY COMMERCIAL OVERLAY
  - RTP/RFO RESEARCH AND TECHNOLOGY PARK WITH RESEARCH FLEX OVERLAY
  - HC HIGHWAY COMMERCIAL
  - OS GREENBELTS AND OPEN SPACE
  - VCOS VILLAGE CENTER OPEN SPACE
  - PP PEDESTRIAN PROMENADE - HARDSCAPE TBD
- SIGNALIZED INTERSECTION
  - ROUNDABOUT
  - NO. OF LANES (TWO LANES WHERE UNLABELED)
  - MOBILITY HUB TO BE LOCATED ALONG BLOCK FRONTAGE. SPECIFIC LOCATION AND DESIGN TO BE DETERMINED DURING THE PREPARATION OF THE ROADWAY CONSTRUCTION DOCUMENTS.
  - RIDE SHARE DROP-OFF PULLOUTS WITH BIKE SHARE HUBS PLUS MID-BLOCK CROSSINGS - EXACT LOCATIONS TO BE DETERMINED.
  - SUBDIVISION TRAIL CONNECTION TO THE NEIGHBORHOOD, LOCATION TBD
  - ROAD SECTION CALLOUT
  - SPECIFIC PLAN BOUNDARY



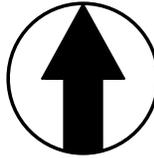
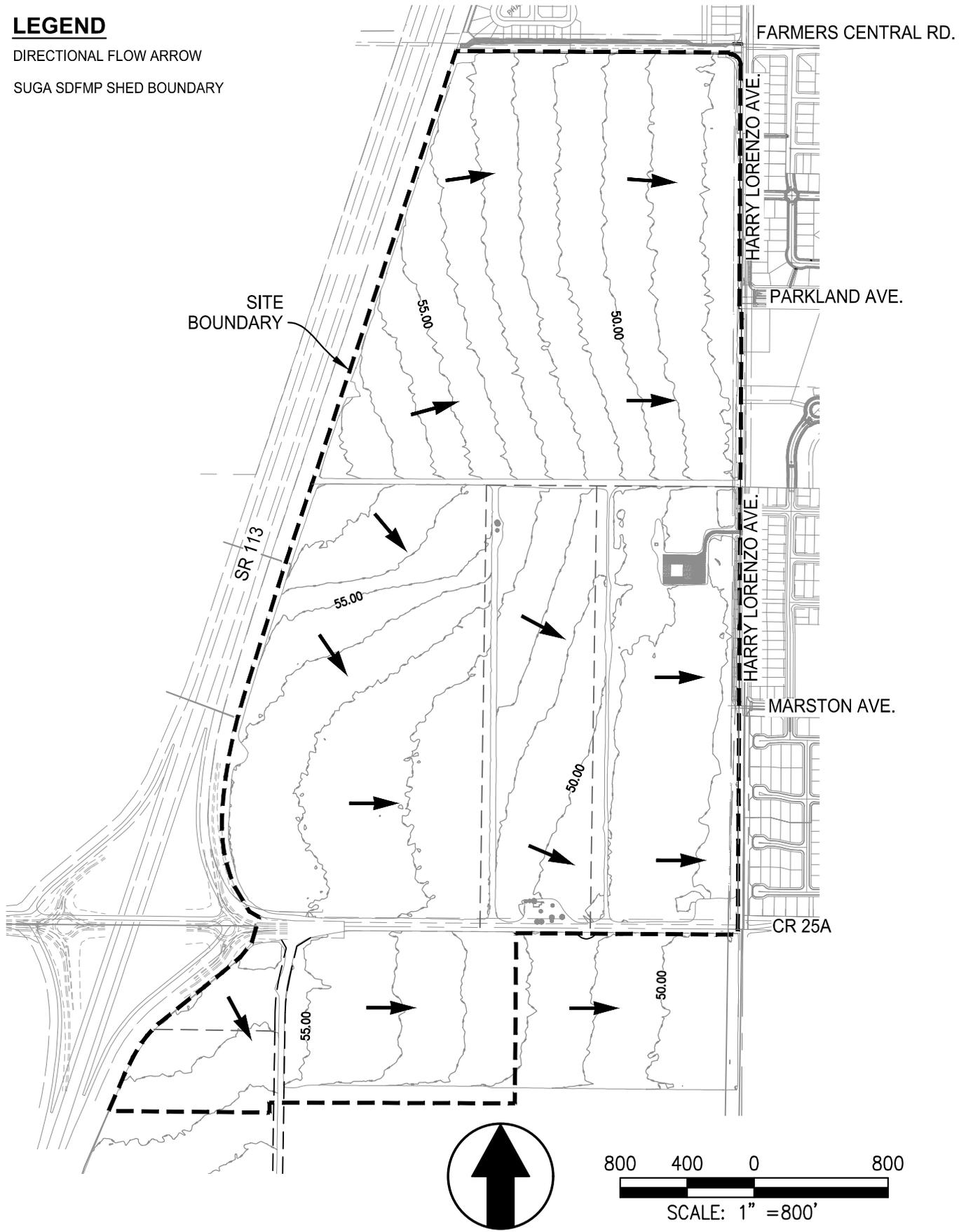
DESIGNED BY: SG DRAWN BY: LE CHECKED BY: SG	<h2 style="margin: 0;">WOODLAND RESEARCH AND TECHNOLOGY PARK</h2> <h3 style="margin: 0;">LAND USE PLAN LAYOUT</h3>	 Project Planning ■ Civil Engineering ■ Landscape Architecture Sacramento Office: 2120 20th Street, Suite Three, Sacramento, CA 95818 (916) 455-2026 Davis Office: 2940 Spafford Street, Suite 200, Davis, CA 95618 (530) 758-2026	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>NO.</th> <th>DATE</th> <th>REVISIONS</th> <th>BY</th> <th>APPD.</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>	NO.	DATE	REVISIONS	BY	APPD.																SHEET <b>1</b> OF <b>1</b> DATE: 11/15/2019 PROJECT NO: 1593.03
NO.	DATE	REVISIONS	BY	APPD.																				

**LEGEND**



DIRECTIONAL FLOW ARROW

SUGA SDFMP SHED BOUNDARY



SCALE: 1" = 800'

DESIGNED	ML
DRAWN	LE
CHECKED	ML
DATE:	2/14/20
JOB No:	1593.00.03

CITY OF WOODLAND

**WOODLAND RESEARCH  
AND TECHNOLOGY PARK  
ATTACHMENT 2: EXISTING GENERAL  
DRAINAGE PATTERNS**

CALIFORNIA



Project Planning ■ Civil Engineering ■ Landscape Architecture  
 ■ Sacramento Office ■ Davis Office  
 2120 20th Street, Suite Three 2940 Spafford Street, Suite 200  
 Sacramento, CA 95818 Davis, CA 95618  
 (916) 455-2026 (530) 758-2026

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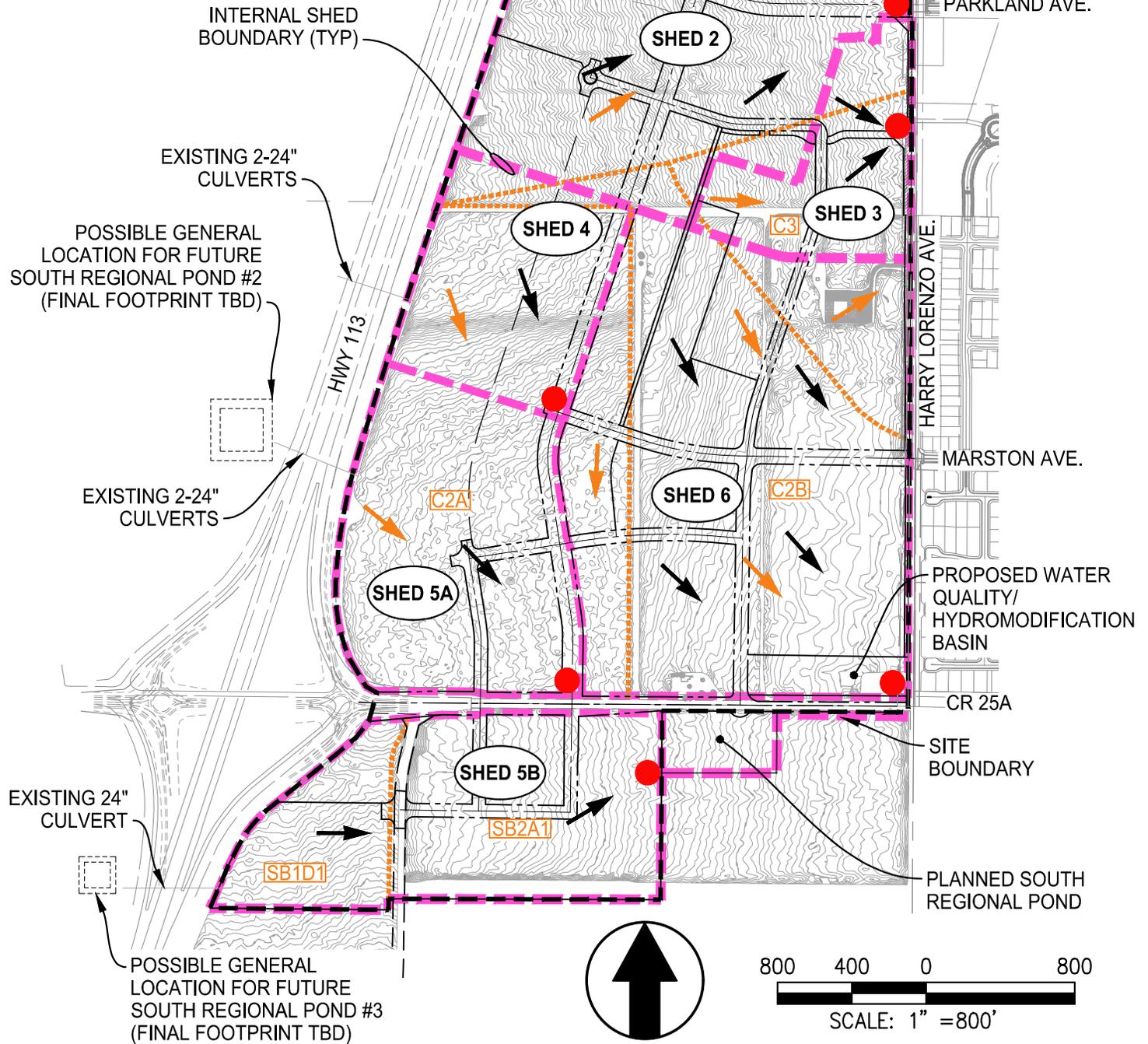
SCALE  
1" = 800'

**LEGEND**

-  DIRECTIONAL FLOW ARROW
-  SUGA SDFMP DIRECTIONAL FLOW ARROW
-  OVERLAND RELEASE POINT

**SHED 1** DRAINAGE SHED ID

-  INTERNAL SHED BOUNDARY
-  SUGA SDFMP SHED BOUNDARY



DESIGNED ML  
 DRAWN LE  
 CHECKED ML  
 DATE: 2/14/20  
 JOB No: 1593.00.03

CITY OF WOODLAND

**WOODLAND RESEARCH AND TECHNOLOGY PARK  
 ATTACHMENT 3: PROPOSED GENERAL DRAINAGE PATTERNS**

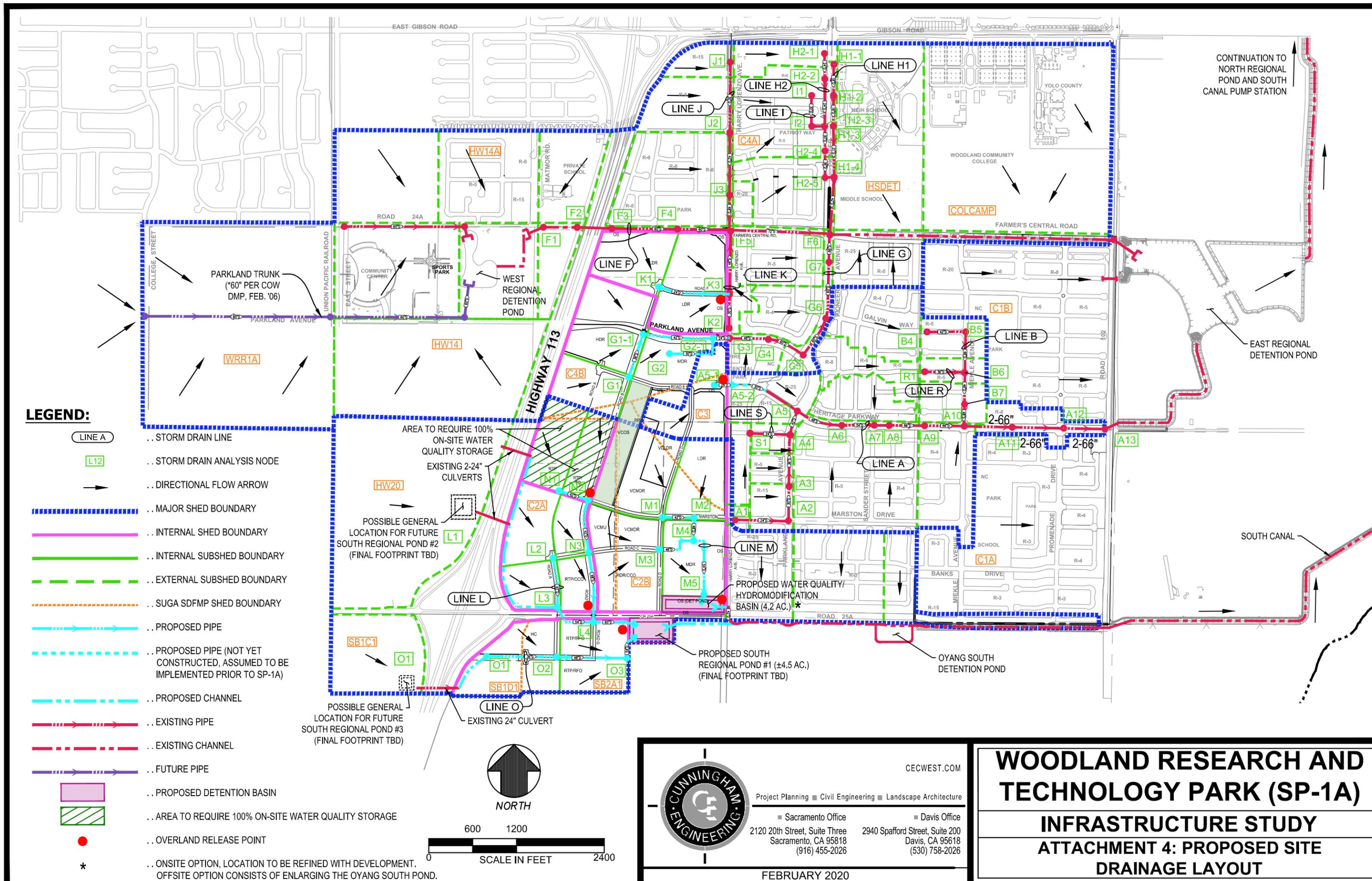
CALIFORNIA



Project Planning ■ Civil Engineering ■ Landscape Architecture  
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 Davis Office 2940 Spafford Street, Suite 200 Davis, CA 95618 (530) 758-2026

CECWEST.COM

SCALE  
 1" = 800'



**LEGEND:**

- LINE A .. STORM DRAIN LINE
- L12 .. STORM DRAIN ANALYSIS NODE
- .. DIRECTIONAL FLOW ARROW
- MAJOR SHED BOUNDARY
- INTERNAL SHED BOUNDARY
- INTERNAL SUBSHED BOUNDARY
- EXTERNAL SUBSHED BOUNDARY
- SUGA SDFMP SHED BOUNDARY
- PROPOSED PIPE
- PROPOSED PIPE (NOT YET CONSTRUCTED, ASSUMED TO BE IMPLEMENTED PRIOR TO SP-1A)
- PROPOSED CHANNEL
- EXISTING PIPE
- EXISTING CHANNEL
- FUTURE PIPE
- .. PROPOSED DETENTION BASIN
- .. AREA TO REQUIRE 100% ON-SITE WATER QUALITY STORAGE
- .. OVERLAND RELEASE POINT
- \* .. ONSITE OPTION, LOCATION TO BE REFINED WITH DEVELOPMENT. OFFSITE OPTION CONSISTS OF ENLARGING THE OYANG SOUTH POND.



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Project Planning ■ Civil Engineering ■ Landscape Architecture

<p>■ Sacramento Office 2120 20th Street, Suite Three Sacramento, CA 95818 (916) 455-2026</p>	<p>■ Davis Office 2940 Spafford Street, Suite 200 Davis, CA 95618 (530) 758-2026</p>
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FEBRUARY 2020

## WOODLAND RESEARCH AND TECHNOLOGY PARK (SP-1A)

### INFRASTRUCTURE STUDY

#### ATTACHMENT 4: PROPOSED SITE DRAINAGE LAYOUT

S:\Projects\1500\1593 Spring Lake Master Plan Remainder Area\AutoCAD\1593-03 PRELIMINARY ENGINEERING\INFRASTRUCTURE STUDY\SHEETS\1593-03-STORM LAYOUT.dwg - STRM 2/14/2020 - 10:11AM Plotted by: Niki

WOODLAND RESEARCH & TECHNOLOGY PARK																												Date: January 17, 2018 Revised: January 31, 2020																																			
PEAK FLOW CALCULATIONS FOR MAJOR STORM DRAIN PIPES																												Calc. By: S. Braun/N. Crucillo																																			
LOCATION:		City of Woodland, CA										NOTES:		n= 0.015														10-Year Return Interval:																																			
RETURN INTERVAL:		10 year, UNO										Vmin= 2.0		Zoning														Low		Med		High																															
FLOW CALC. METHOD:		City of Woodland Rational Method										i=		As noted, per City of Woodland Drainage Design Guidelines														Soil Type		R-3		R-4		R-5		R-8		R-15		R-20		R-25		NC		ROADS		PUBLIC		PARKS		OS		BP		Industrial		VC		HC		Ag	
PIPE CALC. METHOD:		Manning Formula for full pipe flow										C=		As noted, per City of Woodland Drainage Design Guidelines														A		0.3		0.34		0.42		0.5		0.58		0.66		0.74		0.82		0.86		0.82		0.12		0.12		0.82		0.78		0.86		0.82		0.26	
B		0.3		0.34		0.42		0.5		0.58		0.66		0.74		0.82		0.86		0.82		0.12		0.12		0.82		0.78		0.86		0.82		0.26																													
C		0.41		0.45		0.52		0.58		0.64		0.71		0.77		0.84		0.87		0.84		0.26		0.26		0.84		0.8		0.87		0.84		0.41																													
D		0.49		0.52		0.58		0.63		0.68		0.74		0.79		0.85		0.87		0.85		0.36		0.36		0.85		0.82		0.87		0.85																															
Area East of SR 113																																																															
*no data provided in city of woodland standards for A, so used B																																																															
-----MATCHING SOFFITS-----																																																															
STORM DRAIN ID	TRIBUTARY AREA	INLET FROM	INLET TO	AREA (SF)	AREA (AC.)	C	CA	CUM AREA	SUM CA	Tcum (min.) Tcond.	Tc	i (in/hr)	Q=CiA (cfs)	Split Flow Q/2:	CONDUIT Qcap.	Scand.	D	V	L	Tcond.	Shgl	HGLUp	HGLdn	Grup	HGLUp	CHECKS V	Q	INVERT INVup	INVdn	SOFFIT SOFFup	SOFFdn	Grup-SOFFup	Grup-SOFFdn																														
Line A (Heritage) 10 yr	1	1	2	105275	2.4	0.52	1.24	2.4	1.24	0.0	9.0	2.29	2.9		9.2	0.0022	24	2.9	543	3.1	0.0002	40.6	40.3	48.3	7.8	OK	OK	38.6	37.4	40.6	39.4	7.8																															
	2	2	3	385242	8.8	0.64	5.66	11.3	6.90	3.1	12.1	1.93	13.4		16.7	0.0022	30	3.4	436	2.1	0.0014	40.3	39.7	43.9	3.6	OK	OK	36.9	35.9	39.4	38.4	4.5																															
	3	3	4	243673	5.6	0.52	2.88	16.9	9.79	5.2	14.2	1.76	17.2		23.1	0.0016	36	3.3	553	2.8	0.0009	39.7	39.2	42.3	2.6	OK	OK	35.4	34.5	38.4	37.5	3.9																															
	4	4+S	5	608650	14.0	0.52	7.20	30.8	16.98	8.0	17.0	1.59	27.0		38.0	0.0019	42	4.0	197	0.8	0.0010	39.2	39.0	41.5	2.3	OK	OK	34.0	33.6	37.5	37.1	4.0																															
	5-1	5-1	5-2	875247	20.1	0.49	9.86	20.1	9.86	0.0	9.0	2.29	22.6	11.3	7.6	0.0015	24	2.4	240	1.7	0.0033	39.8	39.0	48.3	8.5	OK	SRCHG	37.2	36.9	39.2	38.9	9.1																															
	5-2	5-2	5	0	0.0	0.00	0.00	20.1	9.86	1.7	10.7	2.08	22.6		13.8	0.0015	30	2.8	1140	6.8	0.0041	41.9	37.3	47.7	5.8	OK	SRCHG	36.4	34.6	38.9	37.1	8.9																															
	5	5	6	804364	18.5	0.71	13.14	69.4	39.98	8.9	19.5	1.47	58.7		48.2	0.0015	48	3.8	761	3.3	0.0022	39.0	37.3	41.1	2.1	OK	SRCHG	33.1	32.8	37.1	36.8	4.0																															
	6	6	7	0	0.0	0.00	0.00	69.4	39.98	12.2	21.9	1.37	55.0		53.9	0.0010	54	3.4	451	2.2	0.0010	37.3	36.8	39.6	2.3	OK	SRCHG	32.3	31.9	36.8	36.4	2.8																															
	7	7	8	3262413	74.9	0.50	37.40	144.3	77.38	14.4	24.1	1.30	100.6		92.0	0.0010	66	3.9	131	0.6	0.0012	36.8	36.7	40.0	3.2	OK	SRCHG	30.9	30.7	36.4	36.2	3.6																															
	8	8	9	0	0.0	0.00	0.00	144.3	77.38	15.0	24.7	1.28	99.3		92.0	0.0010	66	3.9	551	2.4	0.0012	36.7	36.0	38.9	2.2	OK	SRCHG	30.7	30.2	36.2	35.7	2.6																															
	9	9	10	0	0.0	0.00	0.00	144.3	77.38	17.3	27.0	1.22	94.2		100.8	0.0012	66	4.2	464	1.8	0.0010	36.0	35.5	38.5	2.5	OK	OK	30.2	29.6	35.7	35.1	2.8																															
	10	10+B	11	4220618	96.9	0.50	48.83	241.2	126.22	19.2	28.9	1.17	148.0	74.0	92.0	0.0010	66	3.9	586	2.5	0.0006	35.1	34.6	37.2	2.1	OK	OK	29.6	29.0	35.1	34.5	2.1																															
	11	11	12	225432	5.2	0.63	3.26	246.3	129.48	21.7	31.4	1.12	144.6	72.3	92.0	0.0010	66	3.9	738	3.2	0.0006	34.6	34.2	36.3	1.7	OK	OK	29.0	28.3	34.5	33.8	1.8																															
	12	12	13	358295	8.2	0.58	4.73	254.6	134.21	24.8	34.5	1.06	141.8	70.9	92.0	0.0010	66	3.9	590		0.0006	34.2	33.8	36.5	2.3	OK	OK	28.3	27.7	33.8	33.2	2.7																															
-----MATCHING SOFFITS-----																																																															
STORM DRAIN ID	TRIBUTARY AREA	INLET FROM	INLET TO	AREA (AC.)	C	CA	CUM AREA	SUM CA	Tcum (min.) Tcond.	Tc	i (in/hr)	Q=CiA (cfs)	CONDUIT Qcap.	Scand.	D	V	L	Tcond.	Shgl	HGLUp	HGLdn	Grup	HGLUp	CHECKS V	Q	INVERT INVup	INVdn	SOFFIT SOFFup	SOFFdn	Grup-SOFFup	Grup-SOFFdn																																
Line S 10 yr	1	1	A4	362382	8.3	0.58	4.83	8.3	4.83	0.0	12.0	1.94	9.4		7.6	0.0015	24	2.4	459	3.2	0.0023	40.2	39.2	48.0	7.8	OK	SRCHG	36.2	35.5	38.2	37.5	9.8																															
-----MATCHING SOFFITS (INV MATCHED @ L3)-----																																																															
STORM DRAIN ID	TRIBUTARY AREA	INLET FROM	INLET TO	AREA (AC.)	C	CA	CUM AREA	SUM CA	Tcum (min.) Tcond.	Tc	i (in/hr)	Q=CiA (cfs)	CONDUIT Qcap.	Scand.	D	V	L	Tcond.	Shgl	HGLUp	HGLdn	Grup	HGLUp	CHECKS V	Q	INVERT INVup	INVdn	SOFFIT SOFFup	SOFFdn	Grup-SOFFup	Grup-SOFFdn																																
Line L 100 yr	1	1	3	4986295	114.5	0.31	35.96	114.5	35.96	0	62.7	1.18	42.4		(Channel flow to node L3)																																																
10 yr	2	2	3	678707	15.6	0.82	12.78	15.6	12.78	0	12	1.94	24.8		33.8	0.0015	42	3.5	680	3.2	0.0008	51.8	51.3	52.7	0.9	OK	OK	47.8	46.8	51.3	50.3	1.4																															
10 yr	3	3	4	491258	11.3	0.82	9.25	141.3	57.98	3.2	65.9	0.73	42.2		66.0	0.0015	54	4.2	620	2.5	0.0006	51.3	50.3	52.7	1.4	OK	OK	46.8	45.8	51.3	50.3	1.4																															
10yr	4+N	4	SRP	378788	8.7	0.84	7.30	186.5	95.31	7.4	73.2	0.69	65.3		87.4	0.0015	60	4.5	560	2.1	0.0008	50.3	49.5	53.5	3.2	OK	OK	45.3	44.5	50.3	49.5	3.2																															
-----MATCHING SOFFITS-----																																																															
STORM DRAIN ID	TRIBUTARY AREA	INLET FROM	INLET TO	AREA (AC.)	C	CA	CUM AREA	SUM CA	Tcum (min.) Tcond.	Tc	i (in/hr)	Q=CiA (cfs)	CONDUIT Qcap.	Scand.	D	V	L	Tcond.	Shgl	HGLUp	HGLdn	Grup	HGLUp	CHECKS V	Q	INVERT INVup	INVdn	SOFFIT SOFFup	SOFFdn	Grup-SOFFup	Grup-SOFFdn																																
Line B 10 yr	4	4	5	1114956	25.6	0.50	12.71	25.6	12.71	0.0	22.1	1.37	17.4		27.6	0.0010	42	2.9	259	1.5	0.0004	36.0	35.9	39.0	2.9	OK	OK	31.6	31.3	35.1	34.8	3.9																															
	5	5	6	478698	11.0	0.52	5.73	36.6	18.44	1.5	23.6	1.32	24.3		39.4	0.0010	48	3.1	499	2.7	0.0004	35.9	35.7	39.7	3.8	OK	OK	30.8	30.3	34.8	34.3	4.9																															
	6	6+R	7	962075	22.1	0.54	11.97	58.7	30.42	4.2	26.3	1.24	37.6		48.2	0.0015	48	3.8	269	1.2	0.0009	35.7	35.5	39.6	3.8	OK	OK	30.3	29.9	34.3	33.9	5.2																															
	7	7	A10	507717	11.7	0.56	6.55	70.3	36.96	5.3	27.4	1.21	44.6		39.4	0.0010	48	3.1	300	1.6	0.0013	35.5	35.1	37.9	2.4	OK	SRCHG	29.9	29.6	33.9	33.6	4.0																															
-----MATCHING SOFFITS-----																																																															
STORM DRAIN ID	TRIBUTARY AREA	INLET FROM	INLET TO	AREA (AC.)	C	CA	CUM AREA	SUM CA	Tcum (min.) Tcond.	Tc	i (in/hr)	Q=CiA (cfs)	CONDUIT Qcap.	Scand.	D	V	L	Tcond.	Shgl	HGLUp	HGLdn	Grup	HGLUp	CHECKS V	Q	INVERT INVup	INVdn	SOFFIT SOFFup	SOFFdn	Grup-SOFFup	Grup-SOFFdn																																
Line R 10 yr	1	1	2	661021	15.2	0.55	8.38	15.2	8.38	0.0	12.0	1.94	16.3		20.0	0.0012	36	2.8	657	3.9	0.0008	35.1	34.3	39.6	4.5	OK	OK	32.1	31.3	35.1	34.3	4.5																															
-----MATCHING SOFFITS-----																																																															
STORM DRAIN ID	TRIBUTARY AREA	INLET FROM	INLET TO	AREA (AC.)	C	CA	CUM AREA	SUM CA	Tcum (min.) Tcond.	Tc	i (in/hr)	Q=CiA (cfs)	CONDUIT Q tot	Qcap.	Scand.	D	V	L	Tcond.	Shgl	HGLUp	HGLdn	Grup	HGLUp	CHECKS V	Q	INVERT INVup	INVdn	SOFFIT SOFFup	SOFFdn	Grup-SOFFup	Grup-SOFFdn																															
Line F FCC	1	1	2	999863	23.0	0.12	2.75	23.0	2.75	0.0	12.0	1.94	5.4	60.4																																																	
	2	2	3	527690	12.1	0.42	5.09	35.1	7.84	0.0	12.0	1.94	15.2	75.6	123.6	0.0030	60	6.3	475	1.3	0.0011	48.7	47.2	57.0	8.3	OK	OK	43.7	42.2	39.5	47.2	17.5																															
E of 113	3	3	4	0	0.0	0.00	0.00	35.1	7.84	1.3	13.3	1.83	15.2	75.6	123.6	0.0030	60	6.3	895	2.4	0.0011	47.2	44.5	53.4	6.2	OK	OK	42.2	39.5	36.7	44.5	16.8																															
100 yr/10yr	4	4	5	0	0.0	0.00	0.00	35.1	7.84	2.4	15.6	1.67	15.2	90.8	144.5	0.0041	60	7.4	705	1.6	0.0016	44.5	42.1	49.4	4.9	OK	OK	39.5	36.7	44.5	41.7	4.9																															
	5	5+J+K	6	0	0.0	0.00	0.00	160.7	61.89	1.6	17.2	1.58																																																			

-----MATCHING SOFFITS-----																																
STORM DRAIN ID	TRIBUTARY AREA	INLET FROM TO		AREA (AC.)	C	CA	CUM AREA	SUM CA	Tcum (min.) Tcond. Tc		i (in/hr)	Q=CiA (cfs)	Q/4	CONDUIT Qcap. Sccond. D V L					HGL CALCS. Tcond. Shgl. HGLup HGLdn			Grup-HGLup	CHECKS V Q		INVERT INVup INVdn		SOFFIT SOFFup SOFFdn		Grup-SOFFup			
Line G 10 yr	1	1	1-1	624655	14.3	0.82	11.76	14.3	11.76	0.0	12.0	1.94	22.8		22.4	0.0015	36	3.2	620	3.3	0.0016	47.6	46.6	53.4	5.8	OK	SRCHG	43.9	43.0	46.9	46.0	6.5
	1-1	1-1	2-1	1138945	26.1	0.58	15.19	37.9	26.95	3.3	15.3	1.69	45.6		33.8	0.0015	42	3.5	960	4.6	0.0027	46.6	44.0	51.6	5.0	OK	SRCHG	42.5	41.0	46.0	44.5	5.6
	2	2	2-1	951577	21.8	0.49	10.66	21.8	10.66	0.0	12.0	1.94	20.7		13.8	0.0015	30	2.8	800	4.8	0.0034	46.7	44.0	50.3	3.6	OK	SRCHG	41.7	40.5	44.2	43.0	6.1
	2-1	2-1	3	0	0.0	0.00	0.00	62.3	37.60	3.3	18.5	1.51	56.9	14.2	6.2	0.0010	24	2.0	230	1.9	0.0053	44.0	42.8	48.1	4.1	OK	SRCHG	41.0	40.8	43.0	42.8	5.1
	3	3	4	951078	21.8	0.49	10.78	84.2	48.38	14.5	26.5	1.23	59.5		62.2	0.0025	48	5.0	600	2.0	0.0023	42.8	41.3	47.9	5.1	OK	OK	38.8	37.3	42.8	41.3	5.1
	4	4	5	340908	7.8	0.64	4.98	92.0	53.36	16.5	28.5	1.18	63.0		78.2	0.0012	60	4.0	701	2.9	0.0008	41.3	40.5	44.2	2.9	OK	OK	36.3	35.5	41.3	40.5	2.9
	5	5	6	225531	5.2	0.64	3.32	97.2	56.67	19.5	31.5	1.12	63.2		78.2	0.0012	60	4.0	587	2.5	0.0008	40.5	39.7	43.8	3.3	OK	OK	35.5	34.7	40.5	39.7	3.3
6	6	7	773908	17.8	0.44	7.73	114.9	64.40	21.9	33.9	1.07	68.8		87.4	0.0015	60	4.5	598	2.2	0.0009	39.7	38.9	43.4	3.6	OK	OK	34.7	33.9	39.7	38.9	3.6	
7	7	F6	101415	2.3	0.57	1.32	117.3	65.72	24.2	36.2	1.03	67.7		100.8	0.0012	66	4.2	351		0.0005	38.9	38.4	43.0	4.1	OK	OK	33.4	32.9	38.9	38.4	4.1	
-----MATCHING SOFFITS-----																																
Line M 10 yr	1	1	2	1171795	26.9	0.44	11.83	26.9	11.83	0.0	12.0	1.94	23.0		33.8	0.0015	42	3.5	430	2.0	0.0007	43.9	43.3	50.4	6.5	OK	OK	40.4	39.8	43.9	43.3	6.5
	2	2	4	785914	18.0	0.52	9.29	44.9	21.12	2.0	14.0	1.77	37.5		48.2	0.0015	48	3.8	320	1.4	0.0009	43.3	42.8	48.5	5.2	OK	OK	39.3	38.8	43.3	42.8	5.2
	3	3	4	1276761	29.3	0.77	22.71	29.3	22.71	0.0	12.0	1.94	44.1		48.2	0.0015	48	3.8	600	2.6	0.0013	42.2	41.3	49.9	7.7	OK	OK	38.2	37.3	42.2	41.3	7.7
	4	4	5	900963	20.7	0.64	13.24	94.9	57.1	4.0	18.0	1.54	87.7		66.0	0.0015	54	4.2	870	3.5	0.0026	46.3	44.0	48.2	1.9	OK	SRCHG	39.7	38.4	44.2	42.9	4.0
-----MATCHING SOFFITS-----																																
Line N 10 yr	1	1	2	709024	16.3	0.82	13.35	16.3	13.35	0.0	12.0	1.94	25.9		33.8	0.0015	42	3.5	420	2.0	0.0009	52.5	52.1	54.0	1.5	OK	OK	48.3	47.7	51.8	51.2	2.2
	2	2	3	497972	11.4	0.82	9.37	27.7	22.72	2.0	14.0	1.78	40.4		33.8	0.0015	42	3.5	720	3.4	0.0021	52.1	50.6	53.8	1.7	OK	SRCHG	47.7	46.6	51.2	50.1	2.6
	3	3	L4	383373	8.8	0.83	7.30	36.5	30.03	3.4	17.4	1.57	47.1		48.2	0.0015	48	3.8	950	4.1	0.0014	50.6	49.2	51.9	1.3	OK	OK	46.1	44.7	50.1	48.7	1.8
-----MATCHING SOFFITS-----																																
Line H 10 yr	1	2-1	2-2	481630	11.1	0.50	5.53	11.1	5.53	0.0	20.0	1.45	8.0		7.6	0.0015	24	2.4	167	1.2	0.0017	43.6	43.3	45.5	1.9	OK	SRCHG	39.9	39.6	41.9	41.6	3.7
	2	2-2	2-3	32501	0.7	0.86	0.64	11.8	6.17	1.2	21.2	1.40	8.6		7.6	0.0015	24	2.4	450	3.1	0.0019	43.3	42.4	45.3	1.9	OK	SRCHG	39.6	38.9	41.6	40.9	3.6
	3	2-3	2-4	1531203	35.2	0.44	15.44	47.0	21.61	4.3	24.3	1.30	28.0		13.8	0.0015	30	2.8	172	1.0	0.0062	42.4	41.4	45.1	2.7	OK	SRCHG	38.4	38.2	40.9	40.7	4.2
	4	2-4	2-5	23102	0.5	0.86	0.46	47.5	22.06	5.3	25.3	1.27	27.9		22.4	0.0015	36	3.2	370	1.9	0.0023	41.4	40.5	45.3	3.9	OK	SRCHG	37.7	37.1	40.7	40.1	4.6
	5	2-5	1-4	1037611	23.8	0.42	10.00	71.3	32.07	7.2	27.2	1.21	38.9		33.8	0.0015	42	3.5	240	1.1	0.0020	40.5	40.0	45.3	4.8	OK	SRCHG	36.6	36.3	40.1	39.8	5.2
	6	1-4	F6	193939	4.5	0.86	3.83	75.8	35.90	8.4	28.4	1.18	42.5		39.0	0.0020	42	4.1	681	2.8	0.0024	40.0	38.4	42.7	2.7	OK	SRCHG	36.3	34.9	39.8	38.4	2.9
-----MATCHING SOFFITS-----																																
Line I 10 yr	1	1	2	487201	11.2	0.42	4.70	11.2	4.70	0.0	18.0	1.54	7.2		11.2	0.0010	30	2.3	358	2.6	0.0004	43.2	43.0	44.6	1.4	OK	OK	38.3	38.0	40.8	40.5	3.8
	2	2	H2-3	1044001	24.0	0.42	10.07	35.2	14.76	2.6	20.6	1.42	21.0		19.5	0.0030	30	4.0	176		0.0035	43.0	42.4	44.9	1.8	OK	SRCHG	38.0	37.4	40.5	39.9	4.4
-----MATCHING SOFFITS-----																																
Line J 10 yr	1	1	2	371106	8.5	0.58	4.94	8.5	4.94	0.0	12.0	1.94	9.6		13.8	0.0015	30	2.8	750	4.5	0.0007	42.3	41.1	49.0	6.7	OK	OK	39.8	38.6	42.3	41.1	6.7
	2	2	3	883508	20.3	0.42	8.52	28.8	13.46	4.5	16.5	1.62	21.8		33.8	0.0015	42	3.5	533	2.5	0.0006	41.1	40.6	48.8	7.7	OK	OK	37.6	36.8	41.1	40.3	7.7
	3	3	F5	1962132	45.0	0.44	19.80	73.8	33.26	7.0	19.0	1.49	49.6		41.3	0.0011	48	3.3	435		0.0016	40.6	39.9	48.9	8.3	OK	SRCHG	36.3	35.9	40.3	39.9	8.5
-----MATCHING SOFFITS-----																																
Line K 10 yr	1	1	3	778242	17.9	0.39	6.89	17.9	6.89	0.0	12.0	1.94	13.4		7.6	0.0015	24	2.4	980	6.8	0.0047	49.0	44.4	50.3	1.3	OK	SRCHG	45.7	44.2	47.7	46.2	2.6
	2	2	3	169124	3.9	0.50	1.94	3.9	1.94	0.0	12.0	1.94	3.8		11.2	0.0010	30	2.3	460	3.3	0.0001	44.4	44.0	47.8	3.4	OK	OK	41.9	41.5	44.4	44.0	3.4
	3	3	F5	1310348	30.1	0.40	11.95	51.8	20.78	10.1	22.1	1.37	28.4		64.1	0.0027	48	5.1	860	2.8	0.0005	44.0	41.7	48.0	4.0	OK	OK	40.0	37.7	44.0	41.7	4.0
-----MATCHING SOFFITS-----																																
Line O 10 yr	1	1	2	1345735	30.9	0.29	8.97	30.9	8.97	0.0	73.5	1.07	9.6		22.4	0.0015	36	3.2	960	5.0	0.0003	52.2	50.8	55.5	3.3	OK	OK	49.2	47.8	52.2	50.8	3.3
	2	2	3	1142029	26.2	0.83	21.72	57.1	30.69	5.0	78.5	0.66	20.2		48.2	0.0015	48	3.8	960	4.2	0.0003	50.8	49.4	54.6	3.8	OK	OK	46.8	45.4	50.8	49.4	3.8
	3	3	SRP	942233	21.6	0.84	18.17	78.7	48.86	9.2	82.7	0.64	31.2		66.0	0.0015	54	4.2	240	1.0	0.0003	49.4	49.0	52.3	2.9	OK	OK	44.9	44.5	49.4	49.0	2.9

<b>Woodland Research and Technology Park</b>											
<b>Estimate of Water Quality Storage (WQS) and Hydromodification Mitigation Storage (HMS)</b>											
<b>WRTP Sheds 4, 5A, 5B and 6</b>											
<b>(1) Estimate required WQS and HMS for developable areas net of master plan streets</b>											
Shed ID	Gross Shed Area (ac)	Streets 26% (ac)	Net Site Area (ac)	Onsite WQ Treatment Factor	Untreated Site Area (ac)	C Site	Unit WQV Site (in)	Req'd EOP WQS Site (ac-ft)	Unit HMS Site (in)	HMS Site (ac-ft)	Tot EOP Vol Site (ac-ft)
4	36	9.5	26.5	100%	0.0	0.79	0.58	0.00	0.36	1.08	1.08
5A	48	12.7	35.3	70%	10.6	0.80	0.58	0.51	0.36	1.44	1.95
5B	47.8	12.6	35.2	70%	10.6	0.80	0.58	0.51	0.36	1.44	1.95
6	75.2	19.9	55.3	70%	16.6	0.60	0.44	0.61	0.36	2.26	2.86
<b>(2) Estimate required WQS and HMS for Master Plan street areas</b>											
Shed ID	Area Street (ac)	C Street	Unit WQV Street (in)	WQS Street (ac-ft)	Unit HMS Street (in)	HMS Street (ac-ft)	Tot Vol Street (ac-ft)				
4	9.5	0.95	0.70	0.55	0.36	0.29	0.84				
5A	12.7	0.95	0.70	0.74	0.36	0.38	1.12				
5B	12.6	0.95	0.70	0.74	0.36	0.38	1.12				
6	19.9	0.95	0.70	1.16	0.36	0.60	1.75				
<b>(3) Combine end-of-pipe WQV+ HMV for site areas and streets, and estimate basin footprint</b>											
Allowable WQS Depth	1 ft (HSG 'C' assumed)										
Overall Basin Depth	12 ft (assumed)										
Basin side-slope	3										
	End-of-Pipe WQS red'd (ac-ft)	Total EOP Vol (ac-ft)	Basin Btm Area (ac)	Basin Btm Dim (ft)	Basin Top Dim (ft)	Basin Top Area (ac)					
4	0.55	1.92	0.55	155	227	1.19					
5A	1.25	3.07	1.25	233	305	2.14					
5B	1.25	3.06	1.25	233	305	2.14					
6	1.77	4.62	1.77	277	349	2.80					
<b>Notes:</b>											
(1) For Shed 4, 100% WQV to be managed onsite via upland LID/BMPs integrated into site plans.											
(2) For Sheds 5A, 5B and 6, 70% of WQV to be managed onsite via upland LID/BMPs (with remainder managed via EOP WQ storage)											
(3) Master Plan streets estimated to occupy approximately 26% of WRTP's gross area											
(4) Unit HMS estimated to be 0.36", based on HEC-HMS computation for a prototypical 50-acre shed (post-dev % imp = 80%) and hydromod detention basin.											
(5) Total EOP Vol = Portion of WQS not addressed within site + total HMS requirement											

**NOTES TO USERS**

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

**Coastal Base Flood Elevations** shown on this map apply only to landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 10. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov/> or contact the National Geodetic Survey at the following address:

NGS Information Services  
NOAA, NNGS12  
National Geodetic Survey  
SSMCO-3, #3202  
1315 East-West Highway  
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov/>.

**Base map** transportation information shown on this FIRM was provided in digital format from Sacramento Area Council of Governments (SACOG). These data were developed in conjunction with the tax assessor's parcel base map and published by SACOG in June 2005.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at <http://mfc.fema.gov/>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

**LEGEND**

**SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**

- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

**FLOODWAY AREAS IN ZONE AE**

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

**OTHER FLOOD AREAS**

- ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

**OTHER AREAS**

- ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D** Areas in which flood hazards are undetermined, but possible.

**COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**

**OTHERWISE PROTECTED AREAS (OPAs)**

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- Base Flood Elevation line and value; elevation in feet\* (EL 887)
- Base Flood Elevation value where uniform within zone; elevation in feet\*

\* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

⊕ Cross section line

⊕ Transsect line

Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

1000-meter Universal Transverse Mercator grid ticks, zone 10

5000-foot grid ticks: California State Plane coordinate system, II zone (FIPSZONE 0402), Lambert Conformal Conic

Bench mark (see explanation in Notes to Users section of this FIRM panel)

• M1.5

MAP REPOSITORIES

Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

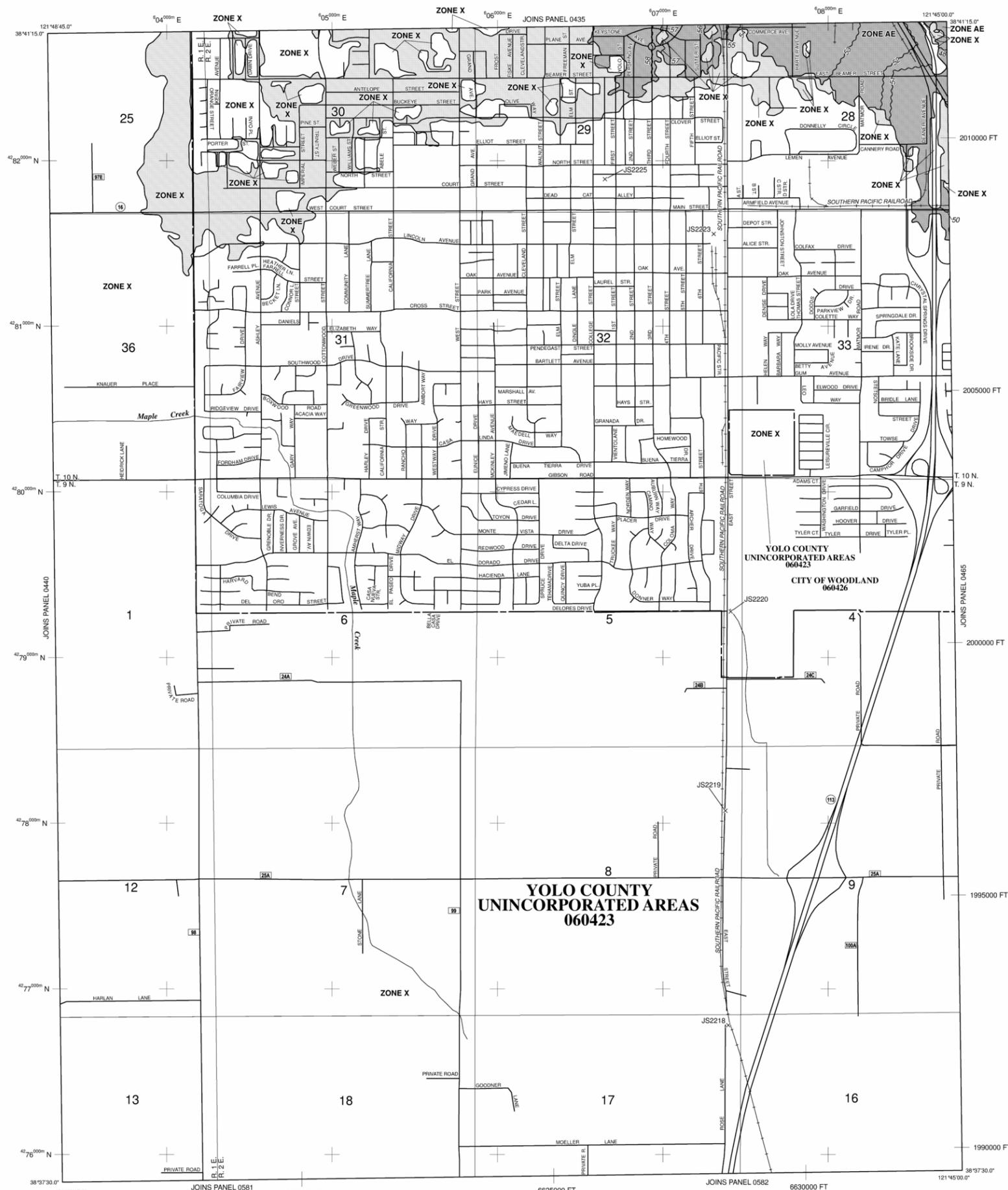
June 18, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

May 16, 2012 - to change Base Flood Elevations, to add Base Flood Elevation, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to delete Special Flood Hazard Areas, to reflect updated topographic information, and to advance suffix.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



**NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 0445H**

**FIRM FLOOD INSURANCE RATE MAP**

**YOLO COUNTY, CALIFORNIA AND INCORPORATED AREAS**

**PANEL 445 OF 785**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
YOLO COUNTY	060423	0445	H
WOODLAND, CITY OF	060426	0445	H

Notice to User: The **Map Number** shown should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

**MAP NUMBER 06113C0445H**

**MAP REVISED MAY 16, 2012**

Federal Emergency Management Agency

**NOTES TO USERS**

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

**Coastal Base Flood Elevations** shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 10. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov/> or contact the National Geodetic Survey at the following address:

NGS Information Services  
NOAA, NNGS12  
National Geodetic Survey  
SSMCO-3, #9202  
1315 East-West Highway  
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov/>.

**Base map** transportation information shown on this FIRM was provided in digital format from Sacramento Area Council of Governments (SACOG). These data were developed in conjunction with the tax assessor's parcel base map and published by SACOG in June 2005.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the **FEMA Map Service Center** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the **FEMA Map Service Center** website or by calling the FEMA Map Information eXchange.

**LEGEND**

**SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

**FLOODWAY AREAS IN ZONE AE**  
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

**OTHER FLOOD AREAS**  
**ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

**OTHER AREAS**  
**ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.  
**ZONE D** Areas in which flood hazards are undetermined, but possible.

**COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**

**OTHERWISE PROTECTED AREAS (OPAs)**

- CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- Base Flood Elevation line and value; elevation in feet\* (EL 887)
- Base Flood Elevation value where uniform within zone; elevation in feet\*

\* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

⊕ Cross section line  
⊕ Transect line  
97°07'30" 32°22'30"  
42°75'00"N  
1000-meter Universal Transverse Mercator grid ticks, zone 10  
5000-foot grid ticks; California State Plane coordinate system, II zone (FIPSZONE 0402), Lambert Conformal Conic

DX5510  
M1.5  
Bench mark (see explanation in Notes to Users section of this FIRM panel)

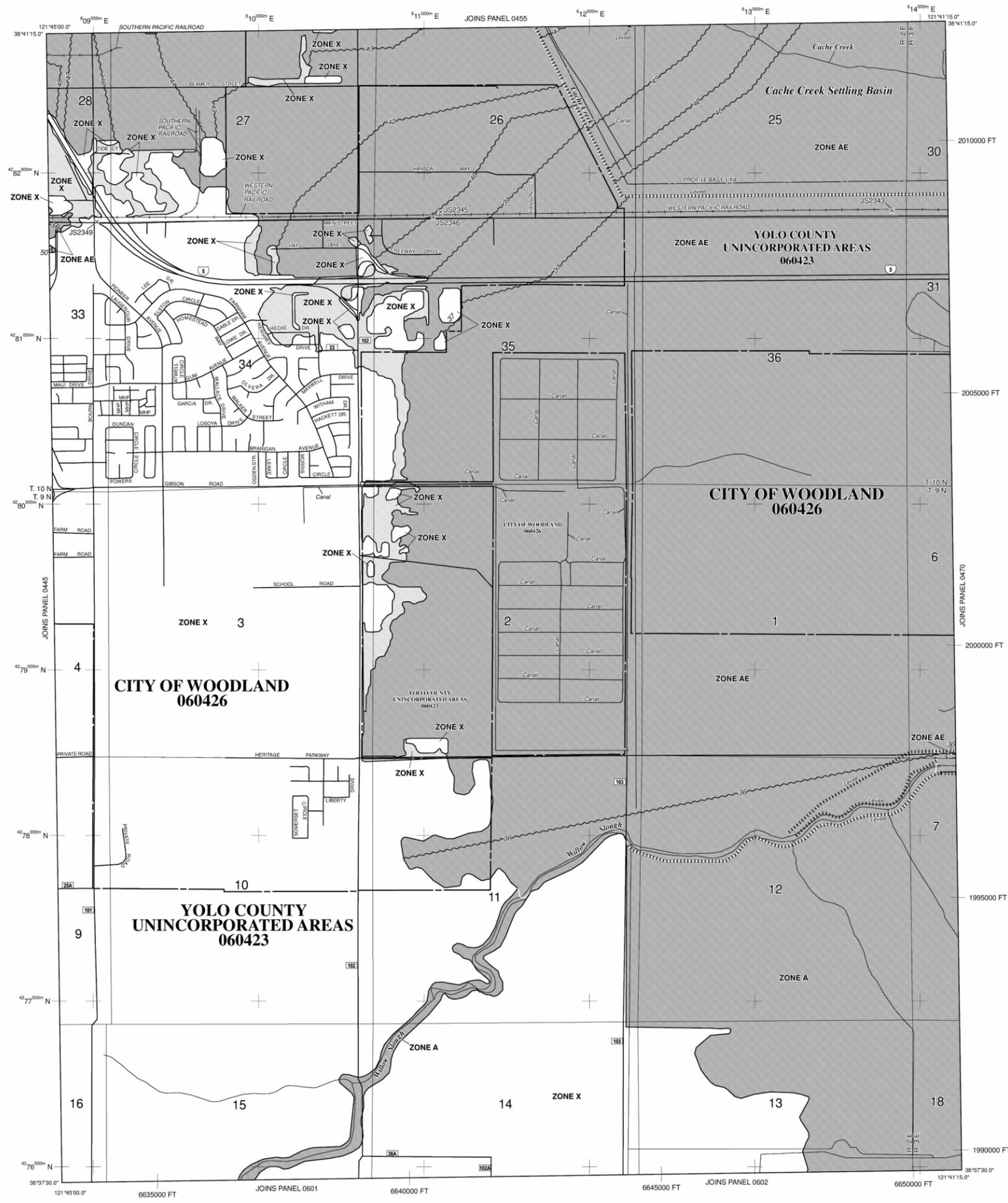
MAP REPOSITORIES  
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP  
June 18, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL  
May 16, 2012 - to change Base Flood Elevations, to add Special Flood Hazard Areas, to add Special Flood Hazard Areas, to delete Special Flood Hazard Areas, to reflect updated topographic information, and to advance suffix.

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**NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 0465H**

**FIRM FLOOD INSURANCE RATE MAP**

**YOLO COUNTY, CALIFORNIA AND INCORPORATED AREAS**

**PANEL 465 OF 785**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
YOLO COUNTY	060423	0465	H
WOODLAND, CITY OF	060426	0465	H

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

**MAP NUMBER 0613C0465H**

**MAP REVISED MAY 16, 2012**

Federal Emergency Management Agency

