Appendix H:
Hydrology and Water Quality Supporting Information

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WOOD RODGERS

TECHNICAL MEMORANDUM

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FROM: Mr. Harvey Oslick, PE, CFM, CPSWQ, EnvSP, Wood Rodgers, Inc.

DATE: January 13, 2021

SUBJECT: Flood Protection at the Tracy Alliance Project Site

PURPOSE

The purposes of this Technical Memorandum (TM) are to:

1. Provide an estimate of the 200-year (0.5% annual chance) flood elevation on the Tracy Alliance project site (Site); and
2. Consider what, if any, special criteria might be appropriate for a stormwater detention basin placed within the 100-year (1.0% annual chance) floodplain.

This TM provides background information that explains why the project is subject to floodplain management criteria that are more stringent than those based on Federal Emergency Management Agency (FEMA) 100-year floodplain elevations. Then, the process used to estimate the 200-year floodplain elevation is presented.

CRITERIA

The California Legislature passed Senate Bill 5 (SB 5) in 2007, requiring all new projects or reconstruction projects constructed in urban areas within the Sacramento-San Joaquin Valley to achieve an urban level of flood protection by 2025. An urban level of flood protection is defined as the level of flood protection necessary to withstand flooding that has a 1-in-200 chance of occurring in any given year. Senate Bill 5 and Assembly Bill 162 (AB 162) as amended by SB 1278, also required cities and counties to amend their General Plans and Zoning Ordinances by no later than July 2, 2016 in order to address 200-year flooding by requiring that certain findings be made as part of the development review process. The City of Tracy (City) fulfilled the requirement to amend their General Plans and Zoning Ordinances with the adoption of Resolution 2016-126 on June 21, 2016. The ordinance requires that the City not approve a project located in a flood hazard zone without conditions to provide an urban level of flood protection.

A portion of the Site is in the 100-year floodplain of the San Joaquin River according to the FEMA SFHA shown on the FEMA Flood Insurance Rate Map (FIRM) Panel 06077C0595 with an effective date of October 16, 2009. The flood zone designation for the SFHA is Zone AE (Elevation 24) for the area of concern, which is east of Paradise Road and south of Interstate 205 (I-205). The elevations are on North American Vertical Datum of 1988 (NAVD 88).

Project approval for the Tracy Alliance requires that the 200-year flood level at the project area be determined and used for project design. The 200-year flood level at the Site would result from a 200-year discharge along the San Joaquin River or Paradise Cut (a distributary from the San Joaquin River). The levees along the San Joaquin River and Paradise Cut near the city of Tracy do not meet Urban Level of Flood Protection (ULOP) criteria. Therefore, the analysis to determine the flood levels must consider failure of the levees along the river. The new structures within the Tracy Alliance project area will need to have a lowest finished floor elevation at least one foot above the 200-year flood level that considers levee failure. Although the FEMA SFHA only covers a portion of the Site, the same minimum finished floor elevation should apply to all of it.

200-YEAR FLOODPLAIN ELEVATION ESTIMATION

The 2017 Central Valley Flood Protection Plan (CVFPP) Update was reviewed in order to obtain relevant information from it. The 2017 CVFPP Update used hydrologic information from the Central Valley Hydrology Study (CVHS) and updated hydraulic modeling tools based on the San Joaquin River System model developed as part of the Central Valley Floodplain Evaluation and Delineation (CVFED) Program to evaluate various scenarios. One scenario was for 2017 conditions; another scenario was for projected 2067 conditions which can be used to consider resiliency to climate change.

The CVFPP states:

> *CVFPP climate change analysis indicates that climate change impacts on the San Joaquin River Basin would be much greater than on the Sacramento River Basin. This is because most of the watersheds in the San Joaquin River Basin are at higher elevations and dominated by snow accumulation and snowmelt. Large storms with rainfall at the top of the San Joaquin River watersheds (above 10,000 feet) have not been experienced historically. By the late twenty-first century, flood magnitudes in some San Joaquin River watersheds are expected to increase by 60 to 80% relative to historical conditions. Over the same period, flood magnitudes in the Sacramento River Basin are expected to increase by 10 to 20%.*
>
> *It should also be noted that the 2067 scenarios do not include the potential effects of deterioration of flood control facilities that could occur in the future if O&M investments are not increased beyond current funding levels (continued growth of deferred maintenance). If deferred maintenance continues to grow, then the flood risk results in the future (2067 Without Project Scenario) may be greater than projected here.*

Map 3-9 from the CVFPP, titled *Flow and Stage Results at Key Locations in the San Joaquin River Basin* (included below as **Exhibit 1**), lists data for an analysis point at Vernalis. The Vernalis analysis point is located north of Stanislaus River and south of the city of Tracy. Map 3-9 lists a 0.5% annual chance (200-year) San Joaquin River flow at Vernalis of 101,300 cubic feet per second for the 2017 scenario. This flow is projected to increase to over 300,000 cfs by the year 2067 as a result of climate change.

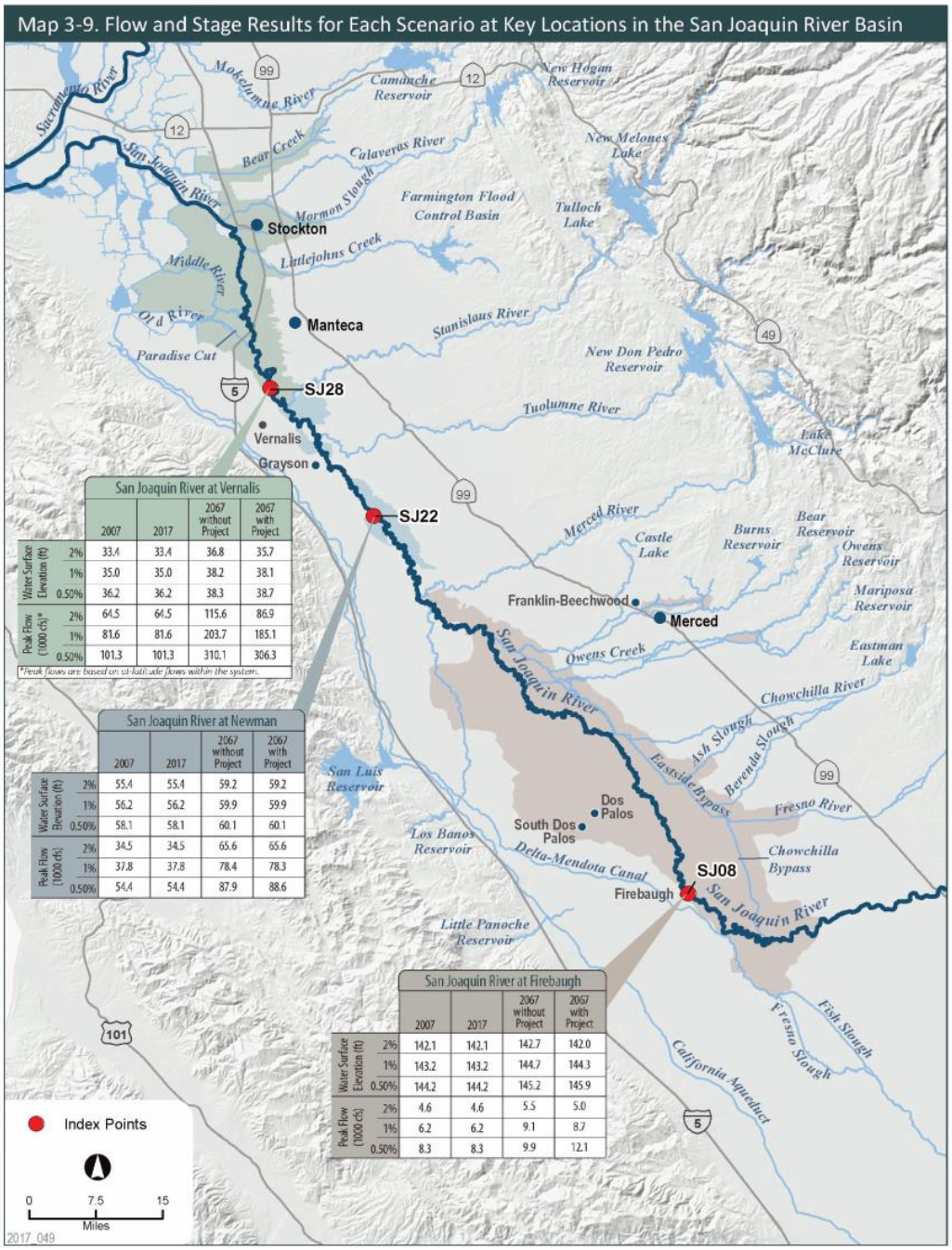

Exhibit 1: Map 3-9 from the CVFPP

It is important to consider uncertainty in the presentation and use of extreme event evaluations. The precision indicated by the flow and stage values listed in the tables on Map 3-9 do not reflect the uncertainty in them. In reality, there are many uncertainties involved in producing flow and stage values for extreme events. There is uncertainty in the reported conditions for historical events. There is also uncertainty regarding how to extrapolate data from the relatively short period of record to the extreme events of interest. Assumptions must be made for reservoir conditions.

One major area of uncertainty that is highly significant to the determination of flood conditions is how and when levees would fail. It is appropriate to apply engineering judgement and to consider physical constraints in the process of making assumptions and drawing conclusions about extreme event flood conditions.

Hydraulic simulation models are used to evaluate riverine systems, including the impacts of levee failures. The San Joaquin River system model was developed using HEC-RAS, a U.S. Army Corps of Engineers (USACE) computer program. The HEC-RAS model represents flows along the river using cross sections, with levees along the banks modeled using lateral structures that act as weirs that can change shape to simulate levee failures. Overbank areas are represented by storage areas bounded by lateral structures along the streams and weir connections to other storage areas. The weir connections to other storage areas follow high ground such as roadway and railroad embankments. The connections between storage areas can include culverts and be configured to simulate failure. **Exhibit 2** (below) shows the HEC-RAS storage areas (randomly assigned colors) in the vicinity of Tracy Alliance which is outlined in red within storage area 1PSC20.

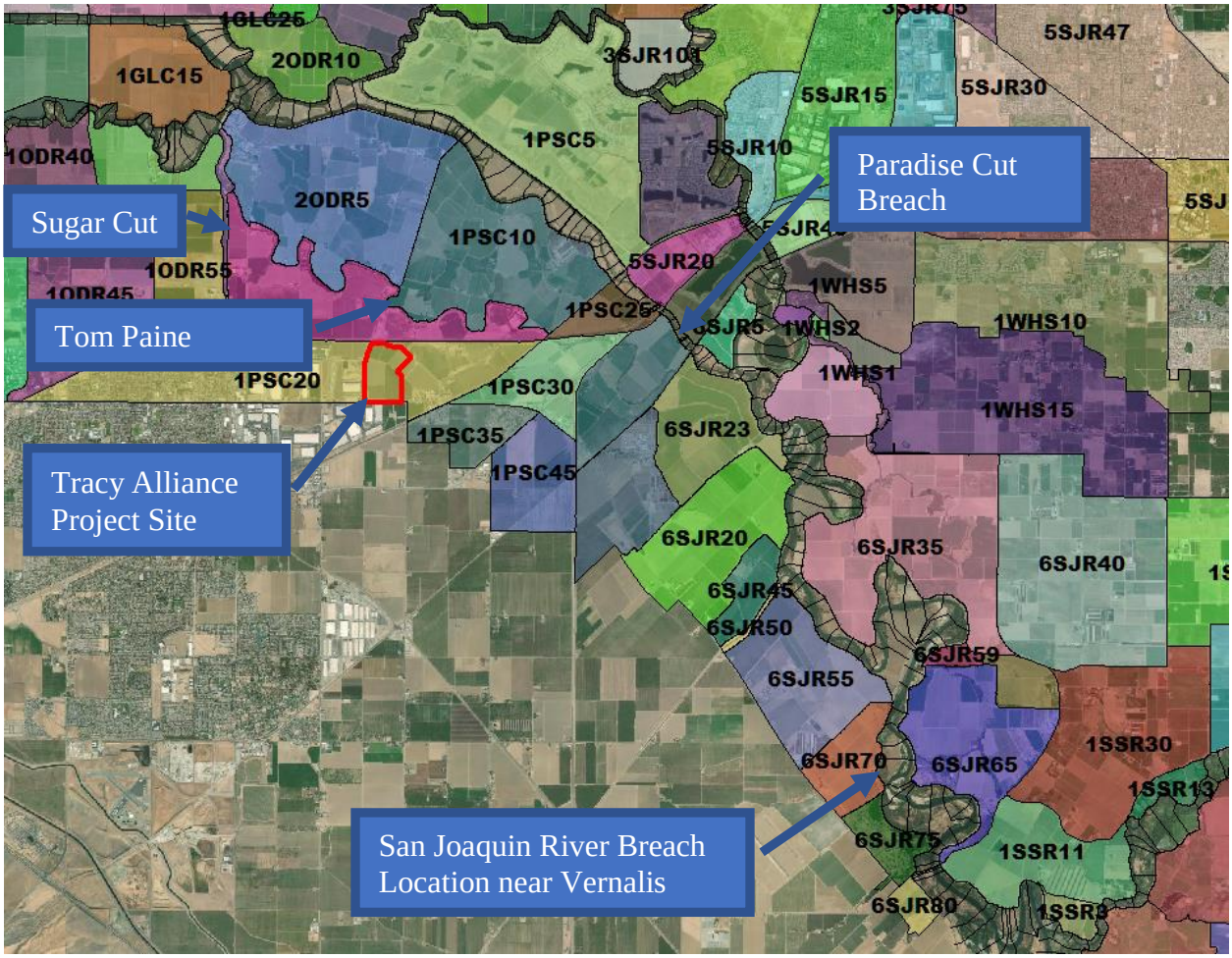

Exhibit 2: HEC-RAS Cross-sections and Storage Areas near Tracy Alliance

The HEC-RAS (version 5.0) hydraulic model with the 1997 storm scaled by 115% provides a simulation of a potential 200-year flood. The model provided by the California Department of Water Resources (DWR) included numerous levee breaches (95) throughout the system. Cross section 29.949 presented in **Exhibit 3** (below) is located near Vernalis and has a peak water surface elevation of 36.1 feet (Map 3-9 lists a 200-year water surface elevation of 36.2 feet at Vernalis). The peak flow through the cross section is less than 100,000 cubic feet per second because some of the flows are routed through storage areas to the east of the river due to upstream levee failures.

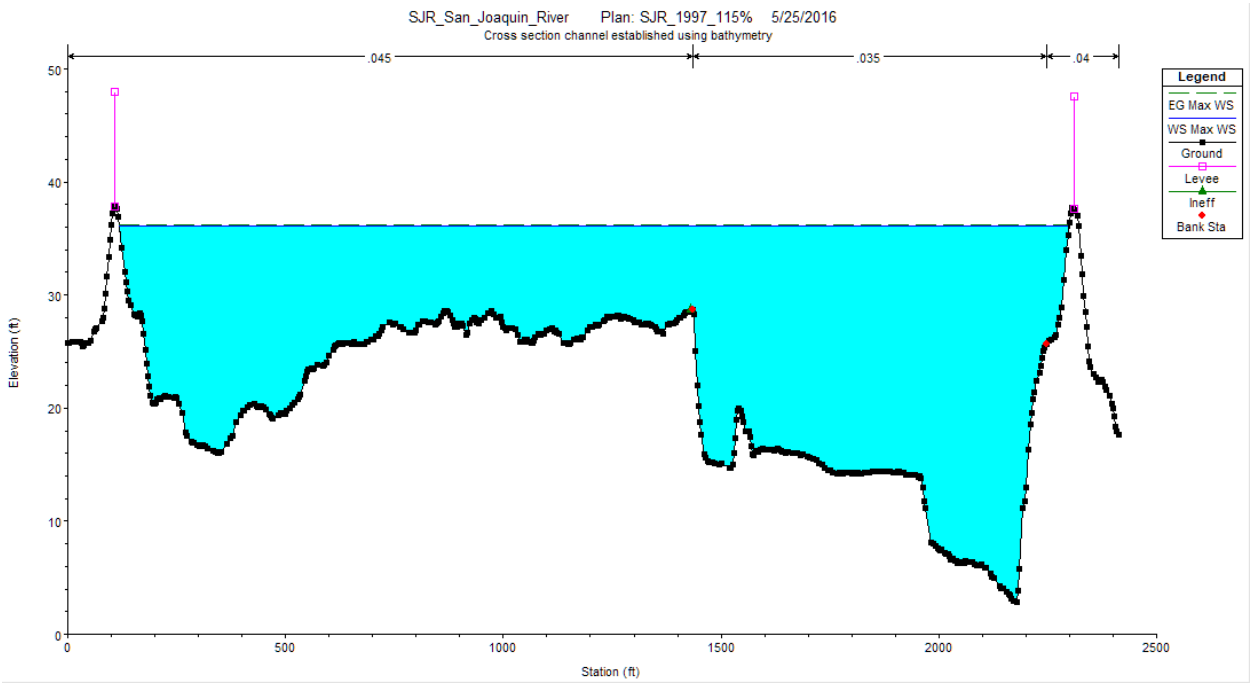

Exhibit 3: San Joaquin River Cross Section near Vernalis

Various scenarios were considered to determine a maximum credible 200-year flood elevation at the Site. Considering that the FEMA 1% annual chance flood elevation is 24 feet, only scenarios that could potentially generate a water level higher than 24 feet were considered. One scenario considered a levee breach on the left (western) bank of Paradise Cut, located approximately one-half of a mile to the south of I-5. Another scenario considered a breach on the San Joaquin River left bank levee near Vernalis.

The Paradise Cut levee failure scenario would result in breach flows reaching Tom Paine Slough. Without the breach, the 200-year water surface elevation in Paradise Cut is approximately 26.5 feet. With a breach, the peak water level within Paradise Cut drops to approximately 25.5 feet. Tom Paine Slough provides a flow path under I-5 and under I-205 which would direct breach flows to the north of I-205. The Maple Avenue underpass provides a flow path between the north and south sides of I-205. The HEC-RAS model erroneously simulates the entire storage area with the Site draining through the City's Eastside Channel into the Sugar Cut channel that connects the City's drainage system to Tom Paine Slough. This error is due to the model not simulating the

high ground between Paradise Road and the Eastside Channel. As a result, the modeled flood level of approximately 20 feet at the Site from this scenario in HEC-RAS underestimates the potential 200-year flood elevation.

A detailed review of the topography in the area was conducted in order to better understand the constraints on flooding. It appears that the maximum credible depth in the vicinity of the Tracy Alliance would be controlled by breach flows reaching the southern end of the Sugar Cut channel near Arbor Avenue to the west of MacArthur Drive. The ground elevations that would limit flows entering the southern end of the Sugar Cut channel are at 21.2 feet. The 200-year flood level in the Old River to which this area drains is less than 17 feet. Therefore, downstream flood levels in the Old River would not be expected to impact flood levels at the southern end of the Sugar Cut channel, or the Site. Based on the controlling ground elevations, it does not seem credible that the 200-year flood level at the Site resulting from a Paradise Cut levee failure could be much higher than 24 feet. More detailed modeling would be required to provide a realistic simulation that presents a credible flood condition at the Site.

If the left bank levee Vernalis were to fail, the flows might reach the city of Tracy, depending on the size of the breach, the duration of high flows in the river after the breach, and whether or not a railroad embankment holds back flood flows. A breach near cross section 29.949 into SA 6SJR70 was used to evaluate a potential 200-year flood condition. No breach of the railroad embankment to the south of the I-5/I-205 Interchange was modeled, and flooding did not reach the Site. Flooding on the south side of the railroad embankment south of I-205 would be limited to approximately 27 feet due to return flow to the San Joaquin River, over the levee. It is unlikely that a breach to the south of I-205 could cause flooding at the Site because the resulting maximum water level close to the Site would be similar to that produced by a levee failure along Paradise Cut.

For planning purposes, it would seem reasonable to assume that the 200-year flood level at the Site is slightly higher than the FEMA 100-year flood level. Because the FEMA 100-year flood level is at an elevation of 24 feet, and it does not appear that the 200-year flood level could be much higher (if it could be higher at all), it would be reasonable to plan for a 200-year flood elevation of 25 feet. This would place the minimum finished flood elevation at 26 feet. Detailed modeling of realistic breach flows towards the area of the Site could be used to simulate conditions with flows reaching the Sugar Cut channel. The results of detailed analysis might support a determination of a lower 200-year water surface elevation at the Site. Detailed analysis is not in Wood Rodgers' current scope of work. Detailed analysis that may show that the 200-year flood elevation is lower than 25 feet could be provided as an additional task. The effort to perform detailed analysis may be worthwhile if the developer would want to show that a lower finished floor elevation would be adequate. Otherwise, the project could be designed with a minimum finished floor elevation of 26 feet without more detailed flood modeling.

DETENTION BASIN CRITERIA

The 2012 Citywide Storm Drainage Master Plan (CSDMP) calls for runoff from the Site to be diverted from its current release point to the northeast into a basin that will be pumped to the west. The low point of the Site is at approximately elevation 17.5 feet, 6.5 feet below the FEMA 100-year floodplain elevation. The Site currently drains into a ditch that discharges into a tributary to Tom Pain Slough. The 2012 CSDMP calls for the detention basin that will serve the Tracy Alliance project to be located at the Site low point; and for a pump to be included in order to allow discharge into another detention basin, DET NEI, which will be pumped into the City's Eastside Channel. Supplement No. 2 to the 2012 CSDMP, dated June 2018, calls for DET 16 to have a storage capacity of 37.8 acre-feet and a pump capacity of one cubic foot per second (cfs). The 2012 CSDMP sized DET 16 based on a 24-hour storm, even though it would take nearly 19 days to drain at one cfs. As a result, DET 16 (as planned according to Supplement No. 2 to the 2012 CSDMP) would probably be overtopped in a 100-year storm event for a longer duration.

The FEMA 100-year floodplain on the Site would only result from a levee failure along the San Joaquin River or Paradise Cut. The volume of the breach flow would need to be sufficient to inundate over 10 square miles prior to flows reaching the Site. The downstream inundation area is illustrated below on **Exhibit 4**. If the flood level were to reach DET 16, any available storage in it below the flood level would be filled from the breach flows. The only impact of DET 16 flooding from a breach is that some additional volume may end up being pumped into the Eastside Channel. DET 16 is only intended to divert runoff away from the area that would be inundated in a regional 100-year event. Therefore, it would not matter whether or not DET 16 capacity is available in the event of regional flooding due to a levee breach because runoff from the area upstream from DET 16 would not make regional flooding worse. The impact of additional volume being pumped into the Eastside Channel in the event of a levee failure can be considered to be less than significant.

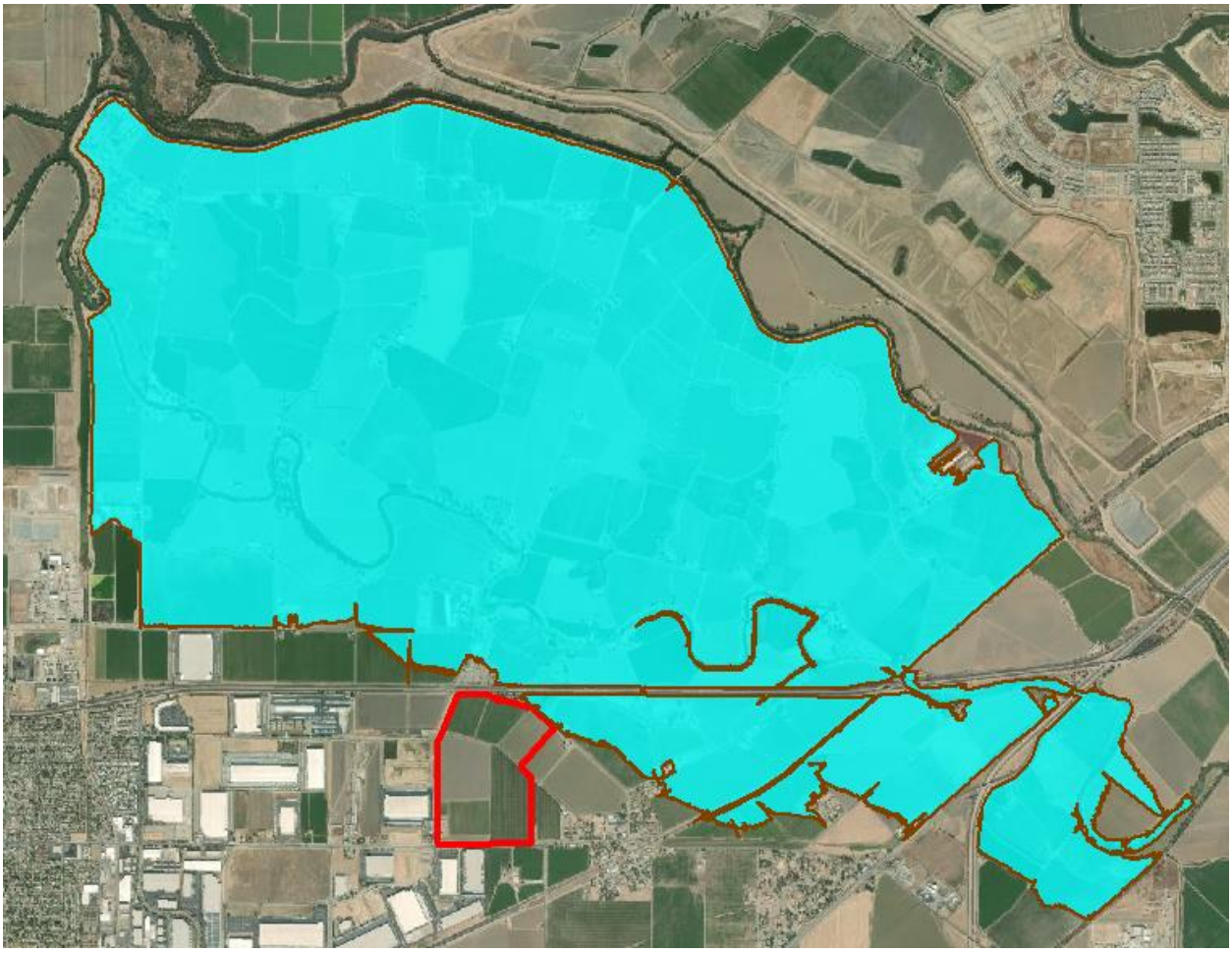

Exhibit 4: Regional Flooding below Project Site

The Draft CSDMP Update (Wood Rodgers, March 2020) calls for DET 16 to have a peak storage volume of 45.4 acre-feet, not including freeboard. The Draft CSDMP Update calls for more capacity than the 2012 CSDMP because the 2012 CSDMP only used a 24-hour storm for design even though the basin would take many days to drain. Additionally, the 2012 CSDMP overestimated the effectiveness of Low Impact Development measures at reducing runoff volumes. A significant amount of excess excavation will be required above the design water surface elevation due to the slope across the Site. Groundwater will limit the depth of excavation and, therefore, dictate the area that would be necessary to obtain the design volume. The Draft CSDMP Update calls for a pumping capacity of three cfs in order for the basin to have capacity for a longer duration 100-year event.

It may be worth investigating whether or not there could be an opportunity to modify the design criteria for DET 16. Unlike most other areas of the City, the location of DET 16 has a defined existing conveyance downstream from it. Although it may be reasonable to pump all of the increased runoff from the area tributary to DET 16 into the City's Eastside Channel drainage system, it may be feasible to discharge some runoff (possibly up to the pre-project runoff volume)

into the existing downstream system. Any allowable discharge into the Tom Paine Slough system could reduce the capacity required for DET 16. The downstream drainage system is shown on **Exhibit 5**.

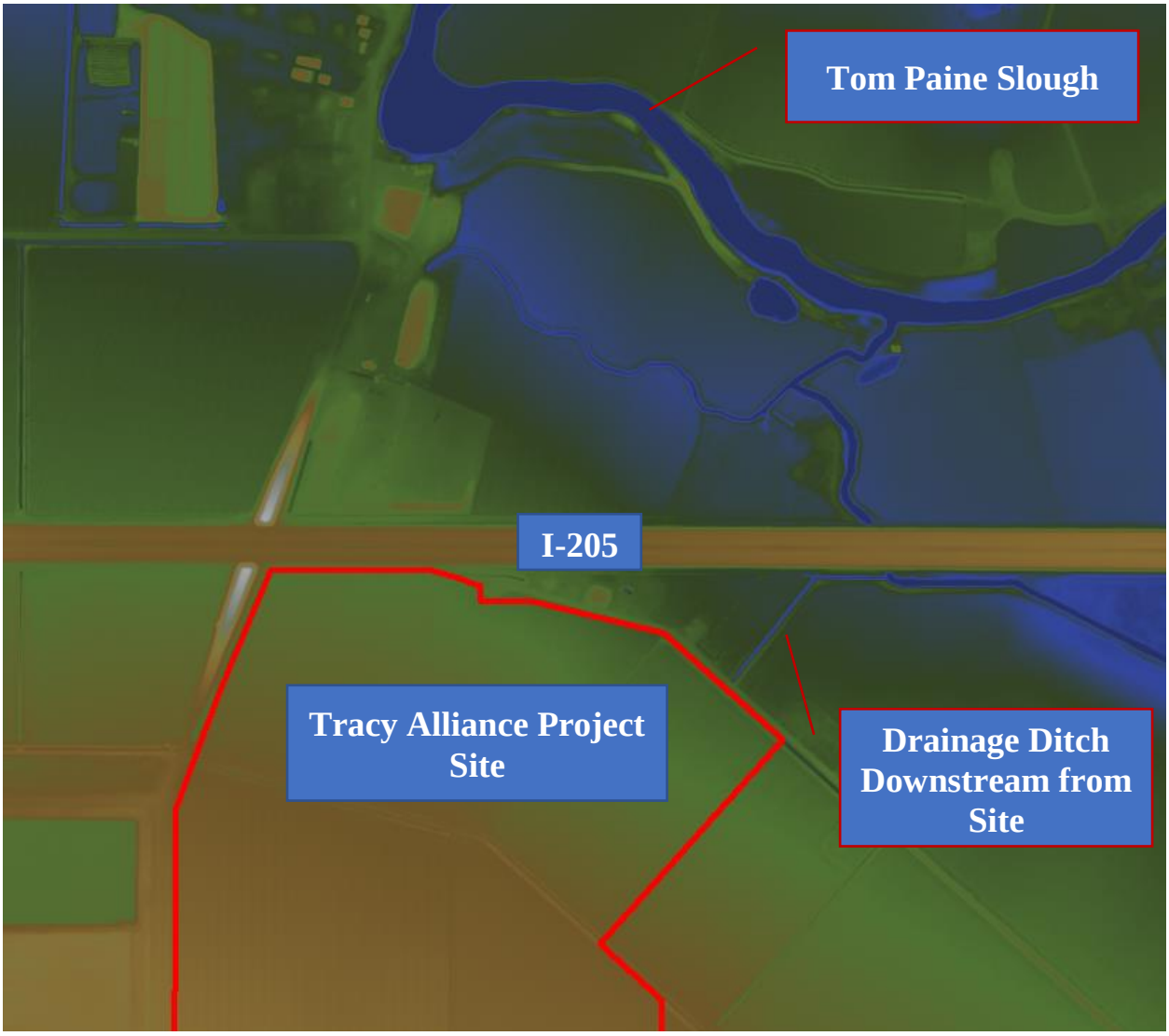

Exhibit 5: Drainage Downstream from Site

CONCLUSIONS

1. An elevation of 25 feet (NAVD) is provided as an estimate for the 200-year floodplain at the Site. Therefore, a minimum finished flood elevation of 26 feet should be used for design unless additional detailed analysis demonstrates that a lower elevation could provide an urban level of flood protection.

2. No issues were identified that were associated with placement of DET 16 for detention of local runoff within the regional 100-year floodplain.
3. The review conducted for this TM did not identify any new issues or potential impacts to DET NEI or the Eastside Channel that would require mitigation.
4. It may be beneficial to determine if discharge of pre-project runoff rates and/or volumes into the Tom Paine Slough drainage area can continue after project construction. This could change the planning criteria for DET 16 and potentially reduce project construction costs.