



1243 Alpine Road, Suite 108
Walnut Creek, CA 94596
Phone: 925.941.0017
Fax: 925.941.0018
www.wreco.com

Memorandum

Date: November 9, 2021

To: John Pulliam, PE
Kimley-Horn | 4637 Chabot Drive, Suite 300, Pleasanton, CA 94588

From: Chris Sewell, Jeanette Newmiller, HDR | WRECO

Subject: Draft Santana Ranch Drainage System Peer Review

Summary of Recommendations

HDR | WRECO has reviewed the Storm Drain Calculations Santana Ranch Basin A (April 2019), Storm Drain Calculations Santana Ranch Basin B (April 2020), and supporting documentation from O'Dell Engineering as requested. The following summarizes our findings and recommendations in order of priority to reduce flooding along Fairview Road and the properties to the north of the Santana Ranch Development. Details of the reviewed work can be found in the following sections.

1. Confirm the roadside ditch on the east side of Fairview Road meets the design guidelines.
2. Finalize grading and install interim or final storm drains to collect and drain runoff to basins.
3. Develop new intensity and rainfall depth values based on MAP equal to 13 inches.
4. Develop a composite runoff coefficient, C, based on the values in Table 1 and the site coverage density for the housing areas.
5. Confirm that the discharge for tributary A is less than the capacity of the 36-inch culvert inlet to Basin A.
6. Confirm that there is sufficient head for the 36-inch culvert inlet to Basin A to run at max capacity.
7. Confirm that the channel at the inlet to Basin A has sufficient volume to contain the runoff from tributary A that might be in excess of the capacity of the culvert.
8. Confirm that the inlet to Basin A will not experience pressure flow and if it does recalculate using HDS 5 culvert charts.





Introduction

The Santana Ranch Development Project (Project) is located east of Hollister in San Benito County, California (County). The Project is approximately 290 acres and is bounded on the west by Fairview Road near the intersection with Hillcrest Road. The Project design includes two drainage basins. Basin A is midway through the north edge and Basin B is at the northwest corner. The Project is currently partially built out.

In a letter dated February 3, 2021 from the County it was reported that discharge from Basin A is flooding neighboring properties and was described as “like a river”. Flow from the Basin A area is also flooding Fairview Road at Mansfield Road. Additionally, it was reported that Basin B is flooding the existing drainage ditch on the east side of Fairview Road and encroaching onto the north bound lane.

Purpose

The purpose of this study is to review the criteria and basis of design as well as the hydrologic and hydraulic analysis for the storm drain design calculations contained in the reports prepared by O’Dell Engineering for Basin A (2019) and Basin B (2020) in the Santana Ranch Development Project (hereafter referred to collectively as SD Calculations).

Equations Used

The design is based on County Code of Ordinances hydraulic criteria for improvement designs in subdivisions, Title 23, Chapter 31, Article III (Criteria). With the exception of the riser design calculations, which are found in the *Multi Agency Post-Construction Stormwater Standards Manual* (2015) (Manual) prepared for the cities of Lathrop, Lodi, Manteca, Patterson, and Tracy, and portions of the County of San Joaquin. The Project is not located in the jurisdiction of the Manual however, the Criteria do not specify the method to be used for the riser design calculations.

Peak Flow for Watershed Runoff

Per Criteria § 23.31.041 on Design Storm Runoff, peak flow rates are determined using the Rational Method.

$Q = CIA$ where,

Q = peak rate of flow in cubic feet per second

C = Coefficient of runoff having a value between 0.0 and 1.0 depending on surface characteristics

- I = The average intensity of rainfall in inches per hour for a duration equal to the critical time, usually the time of concentration
- A = The tributary area in acres corresponding to the critical time above

Detention Basins

Per Criteria § 23.31.042 the volume of detention basins is calculated as follows.

$V = CAR/12$ where,

- V = Volume in acre-feet
- C = The runoff coefficient
- A = The contributing area in acres
- R = The total rainfall in inches for the 24-hour storm period, using a 100-year storm frequency

The total detention volume for the basins are calculated using the post-Project 100-year conditions and reduced by the pre-Project 10-year conditions, which is the maximum allowed discharge from each basin.

Riser Outlets

Per Manual Sheet F-77 the discharge from a uniformly perforated riser is calculated as follows.

$Q = C_p \left(\frac{2 A_p}{3 H_s} \right) \sqrt{2g} H^{\frac{3}{2}}$ where,

- Q = Riser discharge rate (cubic feet per second)
- C_p = Discharge coefficient for perforations (use 0.61)
- A_p = Cross-sectional area of all the holes (square feet)
- H_s = Distance from $s/2$ below the lowest row of holes to $s/2$ above the top row of holes (feet)
- s = Center to center vertical spacing between perforations (feet)
- g = Acceleration due to gravity (use 32.2 feet per square second)
- H = Effective head on the orifice - measured from the center of the orifice to water surface (feet)

The equation above can be simplified for iterative calculations as follows.

$Q = k H^{\frac{3}{2}}$ where,

$$k = C_p \left(\frac{2 A_p}{3 H_s} \right) \sqrt{2g}$$

Work Reviewed

Printouts of spreadsheets used to perform the calculations are provided in the SD Calculations Appendix. Values in the spreadsheets were spot checked based on the respective equation used to ensure the spreadsheet was performing correctly. The values checked were all accurate within a reasonable rounding error.

The following sections include information on input parameters that were reviewed.

Intensity, I and Rainfall, R

The intensity and rainfall depth for the Project were determined using the County isohyetal map 23.31.041(1), intensity duration chart 23.31.041(2), and volume chart 23.31.041(5) all provided in the Criteria. A mean annual precipitation (MAP) of 14 inches was used for the SD Calculations, however as seen in Figure 1 the Project is located in an area with a MAP of 13 inches. Decreasing the MAP will increase both the intensity and runoff volume.

Runoff Coefficients

The County provides the basic runoff coefficients, C (see Table 1). There is an additional table of composite coefficients based on housing density. Selected values of composite coefficients can be seen in Table 2. The values of C used in pre-Project SD Calculations are consistent with County guidelines. Post-Project Basin A uses the composite coefficients for low density housing and basic value for streets. Basin B uses a single composite value for medium density housing for the entire residential area including streets. The final composite value for residential areas including streets for Basin A is 0.53 and for Basin B is 0.50. These values are consistent with each other however, considering the site coverage density this value of C is too low. A low estimate for C can contribute to a lower peak flow. Developing a composite value of C based on Table 1 is recommended. Increasing C will increase the peak flow.

Table 1. Basic Runoff Coefficients

Surface	Coefficients, C
Pavement	0.95
Roofs	0.80
Compacted earth or aggregated base without paving	0.75
Hillside areas (based on slope and soil character)	0.30 - 0.50
Lawns, open lands, agricultural fields and orchards	0.20

Source: San Benito County Table 23.31.041(1)

Table 2. Composite Runoff Coefficients (selected)

Land Use	Runoff Minimum
Low Density	0.35
Medium Density	0.50
High Density	0.70

Source: San Benito County Table 23.31.041(2)

Drainage Area

The pre-Project site is divided into areas described as existing agricultural and existing hillside. The post-Project Basin A tributary contains areas described as residential, street, open space, and existing hillside. The Basin B tributary is divided by drainage area. The post-Project areas for Basin A were measured to spot check the Project areas. The areas measured are consistent with the SD Calculations.

There is a portion of the development that is south of the Basin B tributary. According to a storm drainage report dated January 2019 (O’Dell 2019) this area discharges to the City of Hollister storm drain system. A portion via the “linear basin” adjacent to Fairview Road and the remaining portion via a County manhole located on Fairview Road. As designed this area should not contribute to the roadside ditch on the east side of Fairview Road or to either Basin A or Basin B.

Channel

The existing channel was sized to be used as temporary drainage during the build-out of the project. The calculations are included as Appendix C in the Basin A report.

Basin Size

Basins are sized per the Criteria. The basin volume is calculated based on the 100-year post-development runoff volume with a 10-year pre-development runoff volume for the maximum allowable outflow.

Basin Inlet

The temporary inlet to Basin A that is currently in place is a 36-inch, high density polyethylene (HDPE) pipe 383 feet long. The capacity of this pipe was calculated with Manning's Equation for partially full pipes. This equation assumes that the pipe does not flow under pressure. The result is compared to the discharge from the drainage area. It is recommended that this comparison be checked once the drainage discharge calculations are updated. If the channel depth at the inlet to the pipe is expected to exceed the top of the pipe than it is recommended that the capacity of the pipe be calculated using design guidelines in the *Hydraulic Design of Highway Culverts* (2012) from the Federal Highway Administration.

Basin Outlet Risers

The inlet riser for the basin outlet controls the drainage rate of the basin. The same inlet structure is in the plans for both Basin A and Basin B. The structure is a 3-foot tall 24-inch corrugated metal pipe (CMP) with 75 evenly spaced 1-inch diameter perforations. On top of the 24-inch CMP is a 24-inch X 12-inch CMP reducer with a 12-inch trash rack. The top of the is 4 feet above grade. The riser is covered with a 5-foot tall 3-foot diameter debris screen.

There is not an outlet riser calculation included in the provided report for Basin B however, as stated above the dimensions are the same in both sets of plans. There was a sperate calculation for the Basin B riser the modification suggested in the letter from Anderson Homes dated March 3, 2021. The calculation page included with the letter is dated February 2021.

The calculations were performed on spreadsheets and were provided for review by Stone Creek Properties on October 20, 2021.

The discharge rate for the riser is calculated in two parts as the discharge from the perforated riser and the discharge from the top grate. A discharge coefficient of 0.61 was used for both. The area of the perforations is based on 75 1-inch diameter holes and the area of the top grate is based on a 1-foot diameter orifice. These dimensions are consistent with the Project drawings and do not account for a reduction in area due to debris obstruction or the vanes on the top grate and therefor will represent the maximum estimated discharge from the basin by the riser of 25.83 cubic feet per second (cfs).

The suggested modification to the Basin B riser reduces the number of perforations to 15 1-inch holes and the maximum estimated discharge to 10.46 cfs with 1.30 cfs from the perforations and 9.16 cfs from the grate top when the water surface is 14.2 feet above the bottom of the riser.

The calculations have been reviewed and are consistent with the referenced equations.

Field Investigation

A field investigation was conducted on October 27, 2021. The 24-hour rainfall accumulation at the Hollister Airport rain station was recorded as 7.1 inches on October 25, 2019 (WillyWeather, 2021). As of November 9, 2019, the station has accumulated 22.5 inches (WillyWeather, 2021). According to the San Benito County Water District historical data the average annual rainfall is 12.90 inches (2021) (see Figure 2).

Figure 3 and Figure 4 show locations where the following photos were taken from.

The temporary channel that is conveying water from the developed land to Basin A can be seen in Figure 5 and Figure 6. The channel is formed from an existing valley the crosses the previous orchard to a gaddened inlet to Basin A.

From field observation, it appears that much of the proposed grading in the watershed to Basin A has not been completed and much of the flow from the undeveloped area that will ultimately drain to Basin A appears to bypass Basin A in the interim condition. The bypassed flow appears to concentrate in the historic flow path at the downstream side of the Basin A spillway. See Figure 21 for approximate drainage paths.

The property to the north of Basin A has a stock pond (see Figure 7). Wet ponded soil and silt deposits on the outlet riser indicate that Basin A had approximately 6 inches of water (see Figure 8 through Figure 10).

Basin B was drained but had deep clay looking mud. There was debris on top of the riser trash rack and highwater mark that indicate that the basin had approximately 5 to 6 feet of water (Figure 11 and Figure 12). The inlet to Basin B on the south end inside the basin was partially obstructed by soil and grasses (Figure 13).

Similar to Basin A, the runoff from the undeveloped area south and east of Basin B that is ultimately planned to drain into Basin B appears to bypass Basin B in the interim condition. The bypassed flow appears to split around the basin and concentrate on Fairview road. See Figure 21 for approximate drainage paths.



1243 Alpine Road, Suite 108

Walnut Creek, CA 94596

Phone: 925.941.0017

Fax: 925.941.0018

www.wreco.com

The Basin B Drainage Report (2019) includes calculations for the road side ditch on the east side of Fairview Road. From visual inspection there are segments of this ditch that appear to be less than 1 foot deep with a 2-to-3-foot-wide top width (Figure 14 through Figure 20). The calculations for the ditch indicate a final flow capacity of 10 cfs. It is recommended that the roadside ditch be inspected to confirm it meets design guidelines.



References

- ARTICLE III. STORM DRAINAGE DESIGN STANDARDS.* (2021). American Legal Publishing Corporation. Retrieved October 27, 2021, from https://codelibrary.amlegal.com/codes/sanbenitocounty/latest/sanbenito_ca/0-0-0-10825
- Larry Walker Associates. (2015). *Multi-Agency Post-Construction Stormwater Standards Manual*. <http://lodi.gov/DocumentCenter/View/808/Post-Construction-Standards-Manual-PDF>
- Hydraulic Design of Highway Culverts.* (2012). U.S. Department of Transportation Federal Highway Administration. Retrieved October 27, 2021, from https://www.fhwa.dot.gov/engineering/hydraulics/library_arc.cfm?pub_number=7&id=13
- Mike Oersak, P.E. (2020). *Storm Drain Calculations: Santana Ranch Basin B*. O'Dell Engineering.
- Yushin Imura, P.E. (2019a). *Storm Drain Calculations: Santana Ranch*. O'Dell Engineering.
- Yushin Imura, P.E. (2019b). *Storm Drain Calculations: Santana Ranch Basin A*. O'Dell Engineering.
- Rainfall Data | San Benito County Water District.* (2021, September 27). <https://www.sbcwd.com/rainfall-data/>
- Hollister Municipal Airport Rainfall Forecast, CA 95023—WillyWeather.* (2021). Retrieved November 9, 2021, from <https://rainfall.willyweather.com/ca/san-benito-county/hollister-municipal-airport.html>



Attachments

Figure 1. County Isohyetal Map	11
Figure 2. San Benito County Water District Hollister historical rainfall.....	12
Figure 3. Photo Locations Near Basin A	13
Figure 4. Photo Locations Near Basin B	14
Figure 12. Channel-31.jpg - At inlet to Basin A	15
Figure 13. Channel-42.jpg - At orchard crossing.....	16
Figure 7. Basin A-16.jpg - Pond on property to the north of Basin A	17
Figure 8. Basin A-17.jpg – Basin A spillway	18
Figure 7. Basin A-19.jpg – High water mark.....	19
Figure 10. Basin A-23.jpg – Basin A outlet riser	20
Figure 11. Basin B-35.jpg – Basin B outlet Riser.....	21
Figure 12. Basin B-38.jpg – Basin B outlet Riser with high water mark.....	22
Figure 13. Basin B-41.jpg - Inlet to Basin B partially obstructed.....	23
Figure 14. Ditch-48.jpg - Fairview Road east side ditch	24
Figure 15. Ditch-49.jpg - Fairview Road east side ditch	25
Figure 16. Ditch-52.jpg - Fairview Road east side ditch	26
Figure 17. Ditch-53.jpg - Fairview Road east side ditch	27
Figure 18. Ditch-54.jpg - Fairview Road east side ditch	28
Figure 19. Ditch-56.jpg - Fairview Road east side ditch driveway culvert inlet	29
Figure 20. Ditch-58.jpg - Fairview Road east side ditch driveway culvert outlet	30

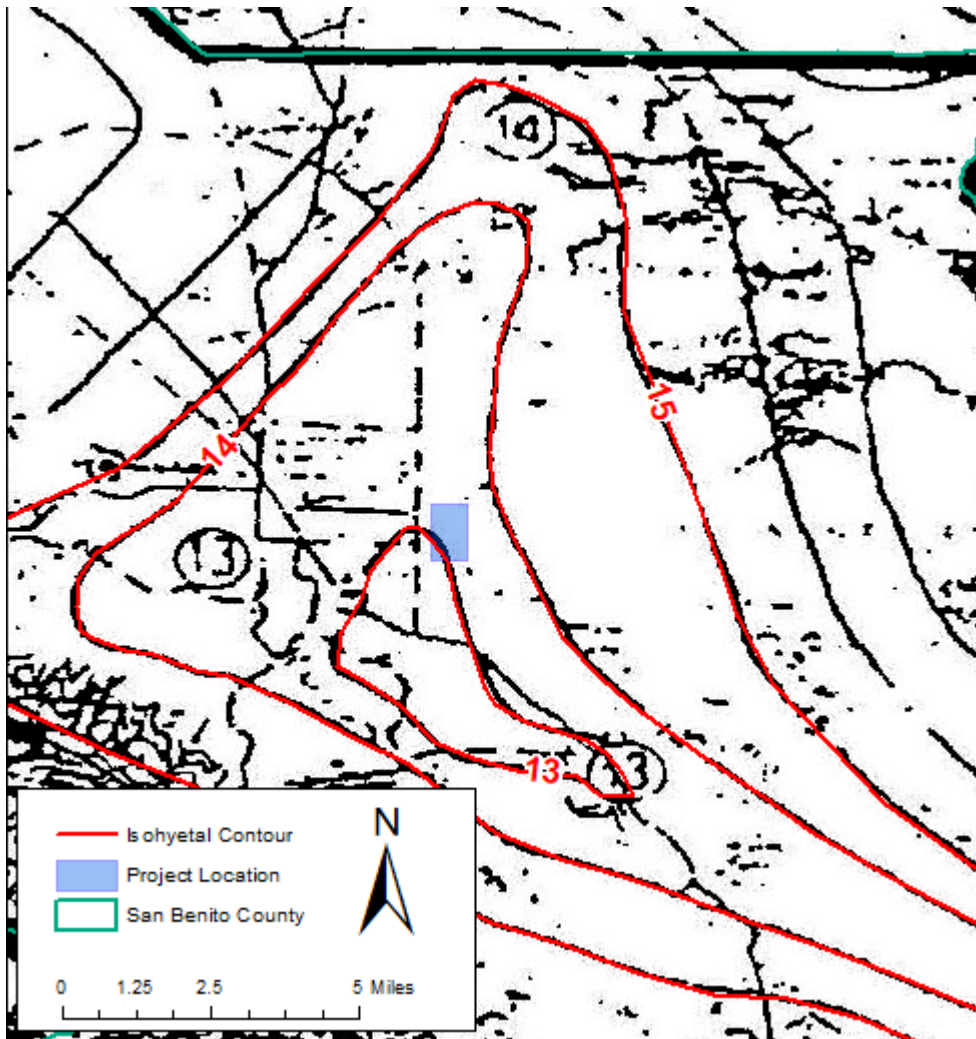


Figure 1. County Isohyetal Map

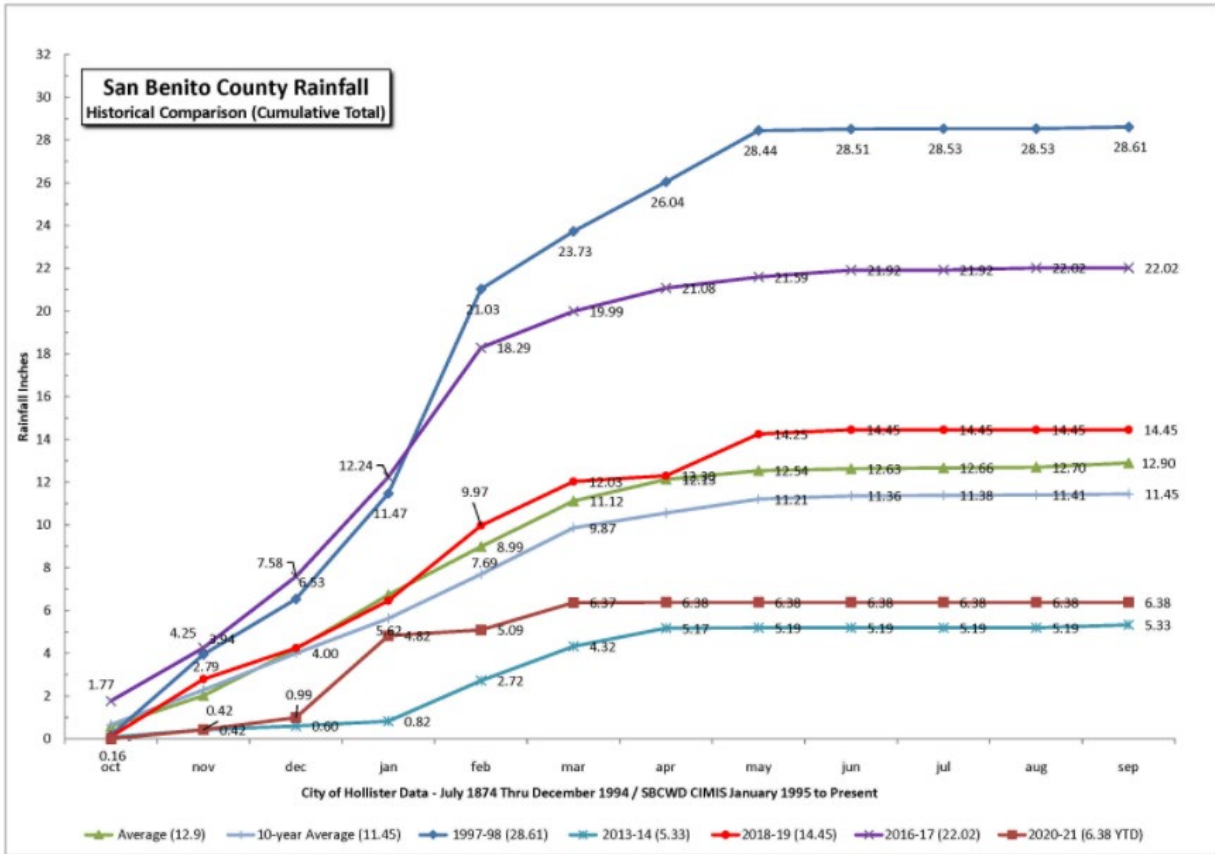


Figure 2. San Benito County Water District Hollister historical rainfall

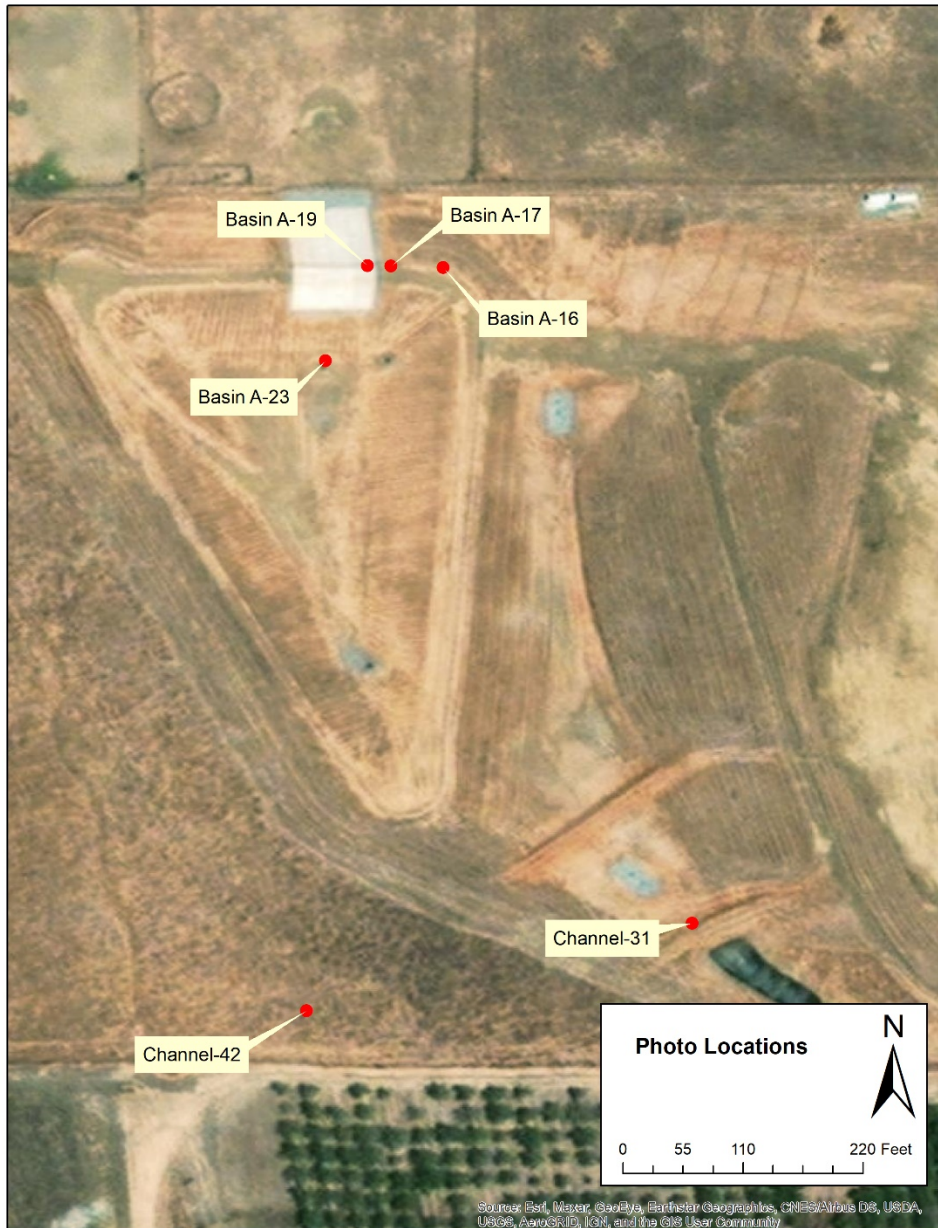


Figure 3. Photo Locations Near Basin A



Figure 4. Photo Locations Near Basin B



Figure 5. Channel-31.jpg - At inlet to Basin A



Figure 6. Channel-42.jpg - At orchard crossing



Figure 7. Basin A-16.jpg - Pond on property to the north of Basin A



Figure 8. Basin A-17.jpg – Basin A spillway



Figure 9. Basin A-19.jpg – High water mark



Figure 10. Basin A-23.jpg – Basin A outlet riser



Figure 11. Basin B-35.jpg – Basin B outlet Riser



Figure 12. Basin B-38.jpg – Basin B outlet Riser with high water mark



Figure 13. Basin B-41.jpg - Inlet to Basin B partially obstructed



Figure 14. Ditch-48.jpg - Fairview Road east side ditch



Figure 15. Ditch-49.jpg - Fairview Road east side ditch



Figure 16. Ditch-52.jpg - Fairview Road east side ditch



Figure 17. Ditch-53.jpg - Fairview Road east side ditch



Figure 18. Ditch-54.jpg - Fairview Road east side ditch



Figure 19. Ditch-56.jpg - Fairview Road east side ditch driveway culvert inlet



Figure 20. Ditch-58.jpg - Fairview Road east side ditch driveway culvert outlet

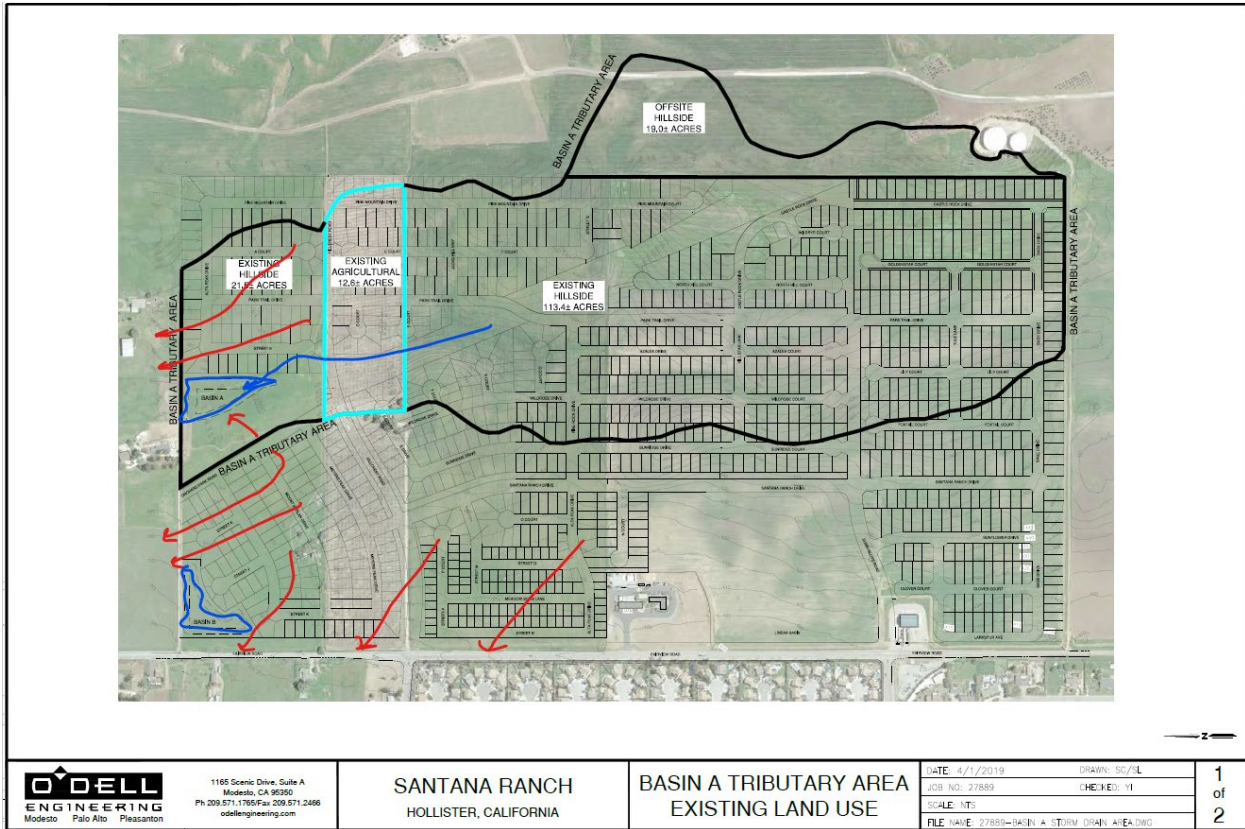


Figure 21. Approximate drainage pattern observed during field investigation