Project No.
8870.000.011

May 25, 2022

Mr. Nader Salama
Town of Danville
510 La Gonda Way
Danville, CA 94526

Subject: Diablo Road Pedestrian Trail
Danville, California

PRELIMINARY GEOHAZARDS STUDY

References:

1. ENGEO; Preliminary Geotechnical Exploration for Tentative Map, Magee Ranches Project, Danville, California; December 27, 2010, Latest Revision May 1, 2012; Project No. 8889.000.000.

2. Contra Costa County Flood Control and Water Conservation District; Preliminary Upper Green Valley Creek Hydrology Study; Revised April 22, 2021.

Dear Mr. Salama:

We are pleased to prepare this report in regard to the Diablo Road Pedestrian Trail project located in Danville, California. The purpose of this report is to identify potential geologic hazards associated with the development of the trail and to provide preliminary recommendations to mitigate geologic hazards associated with Green Valley Creek which runs adjacent to the currently proposed trail alignment.

PROPOSED PROJECT

Based on a draft plan set you provided, dated December 10, 2021, the subject 12-foot-wide trail is proposed to start from Diablo Road near Fairway Drive and extend approximately 0.9 mile along the south side of Diablo Road to approximately the Alameda-Diablo Culvert over Green Valley Creek as shown Figure 1. The preliminary trial alignment is located in a narrow strip of land between Diablo Road and Green Valley Creek, with much of the trail within 20 feet of the Green Valley Creek top-of-bank. Based on our experience with other projects in the area, several retaining walls will need to be constructed at the outboard of the trail in order to accommodate the trail to remain geotechnically stable given the proximity of the alignment to the creek banks. Based on the detail on the plan set, the trail will have an 8-foot-wide paved section with a 2-foot-wide shoulder along each side of the trail. The paved section of the trail will consist of 2-inch asphalt concrete over 8-inch aggregate base and the shoulders will consist of 8-inch aggregate base. A fence will be constructed at the outboard side of the trail where needed and a guardrail will be constructed at the inboard side of the trail near Diablo Road where necessary.

PREVIOUS EXPLORATION

Our preliminary geotechnical exploration (Reference 1) for Magee Ranch project included drilling one boring at the south side of Green Valley Creek near the beginning of the proposed trail in 2010. The approximate location of the boring is shown in Figure 1, and the boring log is presented in Appendix A.

GEOLOGIC SETTING

As discussed earlier, the proposed trail project is located along a portion of Diablo Road adjacent to Green Valley Creek. Diablo Road within the project limits is located at the edge of a relatively flat alluvial plain, which extends northward towards the base of Mount Diablo. Immediately south of Diablo Road, Green Valley Creek has incised approximately 18 feet vertically into the alluvial plain. The creek banks can be characterized as having near vertical slopes and significant erosional scarps, especially along outer bends of the creek channel. On the opposite bank of Green Valley Creek, a large spur ridge extends approximately 200 feet vertically from the creek bottom at a 2:1(horizontal:vertical) slope.

On March 18, 2022, an ENGEO Engineering Geologist and Geotechnical Engineer, walked the reach of creek immediately adjacent to the proposed trail to provide a reconnaissance of the slopes. Geologic mapping is approximately depicted in Figure 1. In general, the creek banks along Green Valley Creek consist of Tassajara-Green Valley Formation bedrock (Tgvt). Bedrock of the Tassajara-Green Valley Formation typically consists of weakly indurated sandstone, siltstone, and claystone with thin beds of pebble conglomerate. Alluvial deposits (Qoal) are also present along terraced areas of the creek bed. The alluvium generally consist of silty clay with interbedded clayey sand. Areas of over steepened creek bank and localized areas of sloughing on or along portions of the creek bank adjacent to where the trail is proposed were not shown on Figure 1. However, some active landsliding was noted on the opposite bank.

Surficial soil underlying the trail alignment appears to consist of clayey material. The clayey soil found in the site vicinity is typically expansive. Expansive soil shrinks and swells as a result of seasonal fluctuation in moisture content. This can cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations. Damage due to volume changes associated with expansive soil can be reduced through proper foundation design.

Soil creep is a natural process that involves slow downhill movement of soil mantle on a slope. Soil creep consists of lateral extension and vertical settlement. Soil creep results when surficial expansive soil is subjected to wetting and drying cycles caused by seasonal moisture changes, precipitation, and/or long-term landscape irrigation; by the growth of roots; and by burrowing animals. The amounts of vertical and horizontal movement are a function of the soil physical characteristics, such as plasticity, height and gradient of the downhill slope, and the depth of wetting and drying cycles. Improvements constructed on or near downhill slopes will be impacted by soil creep.

HYDROLOGIC SETTING

The path is proposed along a reach of Green Valley Creek immediately downstream of the Alameda Diablo Road culvert. According to the preliminary studies performed by the Contra Costa County Flood Control and Water Conservation District, this reach of Green Valley Creek has a 100-year, 6-hour peak flow rate of approximately 1,879 cubic feet per second (ft^3/s).

ENGEO conducted a fluvial hydraulic analysis of this portion of the Green Valley Creek using the Hydrologic Engineering Center River Analysis System (HEC-RAS) 6.1 computer program published by the United States Army Corps of Engineers (USACE). HEC-RAS enables us to perform one-dimensional hydraulic analyses for natural channels and is intended for calculating water surface profiles and velocities in steady, gradually varied flow conditions. The basic HEC-RAS computational procedure is based on the solution of the one-dimensional energy equation. Energy losses consist of friction losses based on Manning's equation. The development of the HEC-RAS model specific to this study is described in detail below.

Survey data provided by the Town of Danville dated 2022 was used to determine the existing condition cross-sections which were input into the model.

The preliminary analysis shows that 100-year water surface elevations are generally contained within the limits of the banks and would not flood the trail as proposed. However, minor overtopping during 100-year storm events may occur between HEC-RAS stations 11+29.75 and 14+52.05 depending on the final vertical elevation of the trail alignment as shown on Figure 2.

Creek velocities are generally between 5 and 16 feet per second (ft/s) in the area along the bank where the project is proposed. However, in area where 90-degree bends occur in the creek channel (Stations 11+29.75 and 8+97.45), channel velocities may be somewhat higher on the outer bank than as estimate by HEC-RAS. Based on a methodology published by the Natural Resource Conservation Service (NRCS), velocities may increase by a factor of depending of the radius of curvature. We estimate outer bank velocities for these areas to be approximately 9 and 25 feet per second, respectively. These two bend areas will likely require scour countermeasures such as rock rip-rap to provide effective erosion protection to the creek bank to prevent lateral migration of the creek into the proposed trail alignment. Bank stabilization in these areas should be considered in the final design of the wall proposed along these banks. A more detailed hydraulic study can be performed at the time of final design.

HEC-RAS cross sections are shown on Figure 2. The result of the analysis is in Appendix B of this document.

DISCUSSION

Based on our experience with similar projects in the area, where development directly at the top of bank is proposed, we make the following recommendations.

- Areas, where the trail is located beyond a projection of 1:1 (horizontal:vertical) from the toe of creek bank, will likely not require substantial subsurface improvement in order for the trail to be performed adequately over the long term. We do expect the possibility of “creep” movement of the near-surface expansive clayey materials in these areas, which may affect the performance of the trail. As a result, the trail may require periodical monitoring and occasional maintenance of the pavement by the Town of Danville.

- In areas where the trail lies greater than 5 feet from the top-of bank but within the above-mentioned 1:1 projection from the toe of creek bank slope, we would recommend providing some soil reinforcement underneath the area where the trail is proposed. This reinforcement would likely consist of several layers of geogrid underlying the pavement section specified on the plans and may also include a mechanically stabilized earth wall. The geogrid would help resist movement of expansive soil underneath the trail towards direction of the creek bank especially under saturated conditions.

- For areas where the proposed alignment is located less than 5 feet from the top-of-bank, we would recommend the consideration of a retaining wall. The wall would consist of either a soldier pile wall with wood lagging or potentially a sheet pile structure. The retaining walls would need to extend approximately 5 to10 feet below the flowline of the creek and extend upward to the vertical alignment of the trail. We would recommend buried rock toe protection in areas where the walls are proposed in order to prevent scouring of the retaining structure based on velocities determined in our hydraulic analysis.

- An existing 12-foot-diameter culvert is located beneath Diablo Road near Alameda Diablo at Station 10+50 of the proposed trail. Based on a corrosion study of the existing culvert conducted in 2020, the culvert has experienced damage due to corrosion and undermining of bedding under the culvert. Based on the height of the culvert and the shallow backfill from the ground surface, the proposed improvement/retaining wall of the trail will impact on the existing culvert. The evaluation of the integrity of the culvert to receive improvements is not within our scope of services and should be performed by a structural engineer.

If you have any questions regarding the content of this letter, please do not hesitate to contact us.

Sincerely,

ENGEO Incorporated

REGISTERED PROFESSIONAL ENGINEER
JONATHAN BUCK
No. 2958
GEOTECHNICAL
STATE OF CALIFORNIA

Jonathan Buck, GE

Macy Tong, GE

jb/mt/ca

Attachments: Figures 1 and 2
Appendix A – Log of Boring B-5
Appendix B – HEC-RAS Output

FIGURE 1 – Geologic Map
FIGURE 2 – HEC-RAS Existing Conditions

8870.000.011
May 25, 2022

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

Qaf	FILL (UNDOCUMENTED)
Qc	COLLUVIUM
Qhal/Tgvt	HOLOCENE ALLUVIUM OVERLYING BEDROCK IN CREEK CHANNEL
Qoal	OLDER ALLUVIAL TERRACE DEPOSITS
Tgvt	TASSAJARA GROUP BEDROCK
B-5 ●	BORING (ENGEO, 2010)
– – – –	GEOLOGIC CONTACT

BASE MAP SOURCE: BING MAPPING SERVICE

ENGEO
Expect Excellence

GEOLOGIC MAP
DIABLO ROAD PEDESTRIAN TRAIL
DANVILLE, CALIFORNIA

PROJECT NO.: 8870.000.011
SCALE: AS SHOWN
DRAWN BY: JV
CHECKED BY: JDB
FIGURE NO. 1

ORIGINAL FIGURE PRINTED IN COLOR

Existing Conditions HEC-RAS Results		
Cross Section Station	W.S.E. (ft)	Average Velocity (ft/s)
16+96.68	472.9	4.4
16+71.33	472.5	6.5
16+58.48	472.5	6.1
16+17.72	472.5	5
15+90.84	472.5	4.8
15+43.25	472.5	4.6
15+4.01	472.4	4.8
14+83.29	472.2	5.4
14+52.05	472.3	4.6
14+20.04	471.3	8.3
13+63.88	471.2	6.9
13+01.67	471	5.6
12+38.03	470.6	6.2
11+89.74	470.7	5.0
11+29.75	470.7	9.3*
10+87.61	470.6	3.6
10+23.92	470.3	5.4
9+78.46	467.9	12.2
9+40.29	465.1	15.5
8+97.45	466.9	24.7*
8+58.34	465.4	10.4
8+17.54	464.5	11.2
7+41.81	465.3	4.7
6+80.92	465.1	5.1
6+40.35	465.1	4.5
6+02.82	464.8	5.9
5+29.96	464.7	4.4
4+37.14	464.7	3.5
3+43.83	464.7	2.6
1+99.59	464.6	2.6
1+08.35	464.5	3.6

*VELOCITIES ADJUSTED TO ACCOUNT FOR OUTER BEND IN CHANNEL

N

0 50
FEET

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

CREEK FLOWLINE

HEC-RAS CROSS SECTION

100-YR W.S.E. - EXISTING CONDITION

BASE MAP SOURCE: UNKNOWN

ENGEO Expect Excellence

HEC-RAS EXISTING CONDITIONS
DIABLO ROAD PEDESTRIAN TRAIL
DANVILLE, CALIFORNIA

PROJECT NO.: 8870.000.011	FIGURE NO. 2
SCALE: AS SHOWN	
DRAWN BY: JV	CHECKED BY: JDB

ORIGINAL FIGURE PRINTED IN COLOR

ENGEO
Expect Excellence

APPENDIX A
Log of Borings

ENGEO INCORPORATED

LOG OF BORING B-5

Geotechnical Exploration
Magee Ranches
Danville, California
8889.000.000

DATE DRILLED: 9/22/2010
HOLE DEPTH: Approx. 30½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (msl): Approx. 467 ft.

LOGGED / REVIEWED BY: J. White / PJS
DRILLING CONTRACTOR: West Coast Exploration
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Rope and Cathead

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			SILTY CLAY (CL), very dark gray, stiff, trace fine gravel.										
			SILTY CLAY (CL), very dark brown, very stiff, moist, some fine sand, trace fine gravel.										
	1					25					18.7	107.6	4.5*
	2												
10	3		Becomes dark brown, trace coarse gravel.			37							4.5*
	4												
			Few carbonates.			32					23.4	101.6	4*
	5												
20	6		Same as above.			21							
			CLAYEY SAND (SC), dark bluish gray and brown, medium dense, very moist, some roots, some carbonates.										
	7		SANDY CLAY (CL), brown, very stiff, very moist, fine to coarse sand, trace fine gravel, few carbonates.		∇								
						21					27.2	97.7	2.5*
	8												
30	9		Becomes stiff to very stiff.			32							2.5*
			Bottom of boring at 30.5 feet, groundwater encountered at 23 feet.										

APPENDIX B
HEC-RAS Output

8870.000.011
May 25, 2022

HEC-RAS Plan: Plan_01 River: GVTRAIL Reach: GVTRAIL Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
GVTRAIL	1696.68	PF 1	1879.00	460.00	472.93	465.78	473.22	0.001166	4.35	431.64	43.74	0.24
GVTRAIL	1671.33	PF 1	1879.00	460.00	472.47		473.14	0.003812	6.54	287.11	38.93	0.42
GVTRAIL	1658.48	PF 1	1879.00	460.00	472.49		473.06	0.003044	6.08	309.18	41.68	0.39
GVTRAIL	1617.72	PF 1	1879.00	460.00	472.53		472.91	0.001777	4.96	378.85	48.08	0.31
GVTRAIL	1590.84	PF 1	1879.00	460.00	472.51		472.86	0.001502	4.78	397.99	51.65	0.29
GVTRAIL	1543.25	PF 1	1879.00	460.00	472.46		472.78	0.001406	4.57	410.78	45.22	0.27
GVTRAIL	1514.01	PF 1	1879.00	459.95	472.39		472.74	0.001580	4.75	395.41	46.26	0.29
GVTRAIL	1483.29	PF 1	1879.00	459.90	472.21		472.67	0.002233	5.41	347.21	42.11	0.33
GVTRAIL	1452.05	PF 1	1879.00	459.87	472.25		472.57	0.001491	4.57	411.23	50.38	0.28
GVTRAIL	1420.04	PF 1	1879.00	459.85	471.33		472.41	0.007916	8.32	225.83	37.09	0.59
GVTRAIL	1363.88	PF 1	1879.00	459.80	471.24		471.98	0.004437	6.88	273.06	40.40	0.47
GVTRAIL	1301.67	PF 1	1879.00	459.75	470.99		471.47	0.002791	5.58	337.02	50.37	0.38
GVTRAIL	1238.03	PF 1	1879.00	459.70	470.64		471.25	0.004052	6.22	302.08	49.41	0.44
GVTRAIL	1189.74	PF 1	1879.00	459.65	470.65		471.04	0.002343	5.02	374.44	58.92	0.35
GVTRAIL	1129.75	PF 1	1879.00	459.60	470.71		470.88	0.000984	3.33	564.88	94.22	0.24
GVTRAIL	1087.61	PF 1	1879.00	459.55	470.64		470.84	0.001028	3.61	532.44	104.11	0.25
GVTRAIL	1023.92	PF 1	1879.00	459.35	470.25		470.71	0.003157	5.43	356.89	115.28	0.41
GVTRAIL	978.46	PF 1	1879.00	459.25	467.91	467.91	470.22	0.022181	12.20	154.00	33.38	1.00
GVTRAIL	940.29	PF 1	1879.00	459.00	465.14	466.29	468.85	0.051344	15.46	121.53	37.22	1.51
GVTRAIL	897.45	PF 1	1879.00	458.80	466.90	464.95	467.55	0.005328	6.45	291.46	62.59	0.53
GVTRAIL	858.34	PF 1	1879.00	458.00	465.43		467.12	0.014677	10.41	180.51	38.24	0.84
GVTRAIL	817.54	PF 1	1879.00	457.10	464.49	464.29	466.43	0.018208	11.16	168.30	38.66	0.94
GVTRAIL	741.81	PF 1	1879.00	453.91	465.30		465.64	0.001782	4.65	404.36	58.61	0.31
GVTRAIL	680.92	PF 1	1879.00	452.80	465.11		465.51	0.002184	5.08	370.72	56.18	0.34
GVTRAIL	640.35	PF 1	1879.00	452.70	465.08		465.40	0.001857	4.54	413.77	66.59	0.32
GVTRAIL	602.82	PF 1	1879.00	452.58	464.75		465.28	0.004121	5.86	321.66	69.59	0.46
GVTRAIL	529.96	PF 1	1879.00	452.50	464.74		465.04	0.001549	4.40	439.31	90.17	0.30
GVTRAIL	437.14	PF 1	1879.00	452.40	464.69		464.88	0.001237	3.49	548.96	134.20	0.26
GVTRAIL	343.83	PF 1	1879.00	452.30	464.68		464.78	0.000536	2.62	761.67	138.87	0.18
GVTRAIL	199.59	PF 1	1879.00	452.25	464.63		464.71	0.000356	2.58	875.79	135.30	0.15
GVTRAIL	108.35	PF 1	1879.00	452.00	464.47	460.29	464.65	0.001001	3.60	571.61	94.50	0.24