Morris, Erin

From: WingMate <wingmate@sbcglobal.net>
Sent: Thursday, September 5, 2019 4:28 PM
To: Morris, Erin
Subject: CH Hydrologic and Geomorphic Eval Rpt_ Valle Verde Heritage House Project 9.4.19.pdf
Attachments: CH Hydrologic and Geomorphic Eval Rpt_ Valle Verde Heritage House Project 9.4.19.pdf

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[EXTERNAL]

Erin, please include the attached hydrologist report in the draft EIR for the Gasser project at the end of Valle Verde.

Thank you,

Bill McGuire
2125 Ranch Court
wingmate@sbcglobal.net

Sent from Bill's iPhone

CLEARWATER
HYDROLOGY

Consultants in Hydrology and Water Resources

Watershed Management

Stream and Wetland Restoration

Wetland Delineation and Permit Acquisition

Stormwater Drainage and Flooding

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Sept. 4, 2019

William McGuire
2125 Ranch Court
Napa, CA 94558

RE: Salvador Channel Stability Assessment at the Proposed Valle Verde and Heritag House Continuum of Housing Project, 3700 Valle Verde Drive, Napa, CA

Dear Mr. McGuire,

At your request, Clearwater Hydrology (CH) completed a hydraulic and geomorphic analys of channel and bank stability for the reach of Salvador Channel adjacent to then-proposed Napa Creekside Apartments project in 2014. In Aug. 2019, you retained us to re-inspect th subject reach of Salvador Channel and update our assessment report. William Vandivere, P.E., CH Principal, conducted a follow-up channel inspection on Sept. Sept. 3, 2019 and no current hydrologic and geomorphic conditions. This report describes the methodology and results of our analysis and provides a current, professional opinion as to both the stability o the western streambank that parallels and adjoins the western property boundary and the potential Project impacts on future channel conditions. It also addresses some of the proposed mitigations and project alternatives, including the Zerba Bridge removal.

Overview

According to the project EIR (D. Powers & Assoc. 2019), the project would rehabilitate the vacant Sunrise Napa Assisted Living Facility and convert it to a 66 unit SRO facility. It would also include a new three-story, multi-family apartment building, sited north-northwe of the Sunrise building. In addition, the project could enact the partial removal of the Zerba Bridge that fords Salvador Channel at the end of Ranch Lane. The bridge is currently inactive. The new multi-family apartment building would be setback from Salvador Chann a distance of 100 ft. to comply with the Napa floodplain ordinance and National Flood Insurance Program requirements. The existing three-story structure and its rear parking are are the principal focus of the present hydraulic and geomorphic analysis of channel and ban stability.

Field Inspection, Channel Cross-Section Survey and Hydrogeomorphic Conditions Assessment: Salvador Channel

Total Station Channel Survey and Channel Bank Soil Sampling

CH staff completed a site inspection and cross section topographic survey using our Leica total station on May 23, 2014. Survey control points were set in the parking lot at the rear of the Sunrise building establishing a local vertical datum, and building corners and curb locations were surveyed as spatial reference points. CH surveyed one cross section of the Salvador Channel located near the upstream end of the building, as shown on Figure 2, as well as several thalweg (i.e. channel flow line) points upstream and downstream of the cross section. We also extracted two soil samples from the west bank of Salvador Channel, one located along the cross-section selected for hydraulic scour analysis and the other 50-60 ft. downstream, on another earthen bank section just downstream of a segment of heavily riprapped bank. The soil samples were sent to a geotechnical lab for hydrometer and/or mechanical (i.e., sieve) analysis of particle size distribution and textural characteristics.

Hydrogeomorphic Conditions Assessment

CH inspected the reach of the Salvador Channel extending from the old bridge upstream of the project site to just downstream of the vacant Sunrise assisted living facility building. The existing bridge lies just upstream of the Project boundary, although it has been proposed for partial removal in association with Project implementation. Concrete bridge abutments support the existing bridge, and a 2-3 ft. high grouted rock wall constructed just downstream of the bridge serves as a local grade control to protect the bridge piers and east abutment from excessive channel scour (Photo 1, see attached Photo Log). As can be inferred from Photo 1, the rim of rough grout visible around the piers coincided with the original level of the bridge undercrossing, which probably consisted of a grouted concrete lining that deteriorated and failed at some point in the past. The photo also depicts the severity of the cracking of the east abutment. *Vandivere's Sept. 2019 re-inspection of the channel reach revealed that a portion of the cracked east sidewall below and immediately upstream of the abutment has now broken away from the downstream portion that underlies the east bridge abutment. Once this failed portion of the mortared sidewall fails completely, it will collapse into the channel and will expose the remainder of the downstream portion of the wall to backcutting, which will accelerate the failure of the remaining side wall.*

Downstream of the grade control, both the east and west banks are lined with large 1-3 ft. diameter rip-rap (Photo 2), the placement of which may have been concurrent with the bridge construction, or it was necessitated by increased scour downstream of the concrete armored bridge crossing.

While the actual chronology of the stabilization efforts at and downstream of the bridge are unknown, the downstream extent of the riprap placement (roughly 100 ft. in length) strongly suggests that the riprap was placed in response to local bank failures. This patchwork of riprap installation is typical of incised stream channels in the Bay Area that have undergone significant urbanization since the 1950-60s. Based on the level of the rough ring of grout around the bridge piers, the downstream channel has likely incised 3-4 feet over that time period.

It appears that a portion of the rip-rap placed downstream of the bridge has dislodged and fallen into the center of the channel. Some of this dislodged rock was subsequently transported downstream during major floods and has formed the skeletal elements of a roughly longitudinal and discontinuous mid-channel bar that extends downstream past the northern boundary of the abandoned assisted living building parcel (Photo 3). The larger boulder-sized elements have forced low flows to bi-furcate to either side of the bar.

Immediately downstream of the main riprap installation, portions of the east bank have been severely eroded (Photo 4). West bank erosion is also evident in this reach, which extends onto the channel reach adjoining the vacant Project building. The west bank is higher than the east bank and the erosion that has occurred has produced a more precipitous, near-vertical slope. Several trees have been undermined and have fallen into the channel within this section of bank. It should be noted here that the current project EIR states that the Salvador Channel is less than 8 ft. deep and

The channel cross-section selected for the 2014 stability analysis was taken through this short reach, as shown in Figure 2. Photos 5 and 6 show the local west bank condition. Photo 5 is an oblique view of the west bank that depicts the steep local slope (approx. 0.5:1 H:V) and the proximity of the top of bank to the asphalt parking area. The total station visible at the upper left of the photo was set atop the asphalt adjacent to the curb, about five feet from the fence. The cross-section extended directly across the channel from the set-up position. Photo 6 is a close-up of the bank immediately downstream of the analyzed cross-section, which was unvegetated, but of similar composition to the bank at the section location. The photo shows the low and mid-bank region, including a lens of fine grained sediment infused with gravel and cobble. This lens likely represents a low terrace deposit of alluvium that with incision has been eroded, along with the finer-grained material that overlies it further upslope. The thickness of this lens is approximately 3-4 feet and is underlain by a more resistant claystone. The claystone layer was also observed further downstream where the local west bank is vertical and overlain by similar fine-grained material, as well as across the channel where it forms stable low terraces. The tree rooting evident in Photo 6 is an extension of one of the dead trees visible in Photo 5, and has been lending some stability to the low bank zone. However, as these trees are sufficiently undermined and collapse during significant flood events, the root systems can also be upended and create local obstructions to flow and diversion of these flows onto the exposed banks, resulting in substantial bank erosion and/or slump failures.

Rip-rap has been placed along a 40-50 ft. long section of the right bank, adjacent to and just downstream from the unrocked section that encompasses the analyzed cross-section (Photo 7). It appears that this rock was haphazardly dumped in response to localized bank erosion. Whereas the west bank riprap installed downstream of the bridge was placed with some attention to three-point bearing, a more stable method of placement, this downstream rock revetment is more uneven and no subgrade keying of the revetment is evident. Both lobes of the dumped rock extend out into the low flow channel.

Immediately downstream of the west bank riprap shown in Photo 7, the channel bed form transitions from a very roughened riffle, with a local slope of 2.4 percent, to a long pool (Photo 8) with a milder slope. The pool extends downstream for a distance of 150-200 ft. before the channel enters a bend toward the southern property boundary. Within the pooled reach, the west bank is unarmored and vertical to nearly vertical. Non-native, invasive vines (e.g. ivy) are the dominant vegetal cover, where such cover exists. Some smaller concrete rubble was observed along the channel bottom through the pool reach. The second west bank soil sample was taken in a bare area toward the head of this reach.

Downstream of the pool reach, the west bank forms the outer radius of a channel bend, which is typically more prone to bank erosion. The local west bank has experienced significant erosion through this bend and has undermined the iron property fence, as shown in Photo 9.

Bank Stability Analysis

Methods

CH obtained the 7.5 minute, topographic quadrangle map for Napa, CA from the USGS National Map. The portion of the Salvador Channel watershed tributary to a concentration point located at approximately the downstream property corner was delineated based on the USGS map using Autodesk AutoCAD Civil3D 2014, and is shown on Figure 1.

Peak discharge calculations for the 2-yr. and 100-yr. storm events were performed following the flood frequency analyses as described by Rantz (1971) to determine the peak discharge values used for hydraulic analysis. Discharge calculations included an adjustment of peak flow values to account for the level of urbanization in the watershed. The degree of development within the delineated watershed was based on visual interpretation of the aerial imagery included in the USGS map. It was estimated that 50% of the watershed is urbanized and 10% of channels in the watershed are sewered or lined. Peak discharge calculations are included in the attached Technical Appendix.

The station and elevation of points along the field-surveyed cross section were exported to the FlowMaster hydraulic program (Ver. 6.1, Haested Methods 2000) for hydraulic analysis. The FlowMaster results were used to calculate the mean bed and bank shear stresses and mean flow velocities at the surveyed cross section for the 2-yr. and 100-yr. storm peak discharges.

The shear stress exerted on the channel bed by the conveyed flow was estimated using the simplified shear stress equation:

$\tau_b = \gamma y S$

where, τ_b= bed shear stress, lb/ft^2

γ= specific weight of water, 62.4 lb/ft^3

y= normal depth, ft.

S= water surface slope, ft/ft

Bank shear stresses in unreinforced, earthen channels designed by the US Bureau of Reclamation for irrigation water conveyance are generally equal to 0.75* τ_b (Henderson 1966). However, such earthen channels are designed with stable bank angles, typically 2:1 H:V. For the present west bank, the composite slope is 1:1, and is near vertical over the upper 8 feet. Thus, the proportion used for the bank shear was 0.50, instead of 0.75 to reflect the lesser flow depths and the resulting local shear stress distribution.

The computed flow velocities and bank shear stresses for the 2-yr. and 100-yr. peak discharges were then compared to permissible shear stress and velocity values published in the research literature on river mechanics and sediment transport to determine the vulnerability of the unreinforced sections of the west bank through the Project reach. A graph of the surveyed cross section and the results of the hydraulic analysis are also included in the attached Technical Appendix.

Results

CH estimated the relevant watershed area to be 5.1 mi.^{2} and peak discharges for the 2-yr. and 100-yr. storm events to be 281 cfs and 2,041 cfs, respectively. Hydraulic parameter values applied in the normal depth flow computations presented in the Technical Appendix included a local channel bed slope of 2.4 percent (0.024 ft/ft) and a Manning's roughness of 0.05 for both assessed discharges. The higher Manning's "n" value of 0.05 reflects the strong influence of irregular channel cross-sections, deep pools and widely varying form roughness, which is in part due to the large boulder arrays affecting the hydraulic behavior of floodflows through the Project reach.

Calculated bank shear stresses for the surveyed cross section are 1.9 lb/ft^2 and 4.8 lb/ft^2 for the 2-yr. and 100-yr. storm events, respectively. Corresponding flow velocities for the 2-yr. and 100-yr. peak discharges were computed to be 6.3 and 12.1 ft/sec (fps), respectively. The computed 2-yr. mean velocity is representative of an incised, moderately steep channel. The computed 100-yr. mean velocity could be higher than the actual velocity, even with the relatively high channel roughness (i.e. Manning's "n") value assumed (0.05), given the likelihood of channel backwater effects extending upstream from the Big Ranch Road crossing.

Estimated movable particle sizes for the west bank during the 2-yr. and 100-yr. storm events, were based on the mobile particle size vs. shear stress relationship of (Leopold 1994 and Leopold et al. 1964, see Tech. Appendix). The mobile bank sediment sizes computed for the associated peak discharges were 8 in. (210 mm) and 39+/- in. (1,000+/- mm), respectively. The tested shear stress range for the Leopold relationship extends to approximately 3.0 lb/ft^2. Thus, the 100-yr. mobile sediment sizes for both the bed and bank shear stresses computed for the 100-yr. event discharge must be considered approximate. However, we have personally observed several instances in steep to moderately steep channels wherein less than 100-yr. discharges have instigated dislodging and downslope (via rolling) and/or downstream movement of 2-3 ft. diameter boulders. Thus, the extrapolation of the relationship is supported by field evidence on CH-restored stream reaches in the SF Bay Region (e.g. Codornices Creek in Berkeley, Wildcat Creek in Richmond).

The particle size distribution curves for bank sediments subjected to lab hydrometer and/or sieve analysis are attached in the Technical Appendix. Hydrometer analysis, which enables distinction between silt and clay sub-fractions within the fine material fraction that passes through the #200 sieve, was performed only on the bank sample taken at the analyzed channel cross-section site (i.e. per Figure 2). At the upstream site (at the analyzed cross-section), the sampled soil was categorized as a clayey sand with gravel (SC designation under the Unified Soil Classification System). At the sampled downstream site, the soil was described as a lean clay (CL).

Permissible shear stresses and flow velocities for channels composed of various bed-bank materials, including vegetated and bare native soils, rock reinforcing and bioengineering treatments (e.g. wattles, brush mattresses, live willow stakes, etc.), are listed in Fischenich (Table

2, USAE 2001). For the sampled SC and CL soil types established for the local west bank of Salvador Channel, the corresponding boundary types (i.e. boundary between the flowing water and a confining bed or bank) are "graded loam to cobbles" and "stiff clay", respectively. Table 1 lists the permissible shear and velocity values for these soils/boundary types, as well as a couple of other types presented for purposes of comparison.

Table 1: Permissible Shear Stress and Flow Velocities for Sampled Bank Soils

Soil/Boundary Type	Permissible Shear Stress psf	Permissible Velocity, fps	Reach Values (XS1) Bank Shear psf	Vel. fps
SC (graded loam to cobbles, unvegetated) @XS1	0.38	3.75	1.9 (2-yr.) 4.8 (100-yr.)	6.3 (2-yr.) 12.1 (100-yr.)
CL (stiff clay, unvegetated)	0.26	3.0- 4.5	-	-
Live brush layering (initial/grown)	0.4-6.25	12	-	-
Riprap (18-in, d50)	7.6	12-16	-	-

The shear and velocity values for unvegetated bank soils were used, due to the observed conditions at the sampled bank sites, which were devoid of vegetation. At the XS1 site, some hydrophilic grass was present along the low bank, but the mid-bank region was bare. Likewise, at the downstream sample site some invasive ivy was present atop the undercut ledge at the upper end of the mid-bank zone, but no vegetation was observed on the low and mid-bank zones just downstream of the dumped riprap slope protection. The listed values in Table 1 clearly indicate that even for the much lower 2-yr. peak discharge, the unvegetated west bank is vulnerable to future hydraulic scour and erosion.

Conclusions

Based on our review of the current (2019) Project documentation, the above hydraulic and geomorphic assessment for the Project reach of the Salvador Channel, and our 2019 re-inspection of channel conditions, CH concludes the following:

- The observed existing conditions along the Project reach of Salvador Channel, downstream of the existing bridge crossing, suggest a general geomorphic condition of instability. This instability results from progressive urbanization of the watershed over the past 60 years which has increased peak flow rates, accelerated both the delivery to and conveyance of stormwater runoff in the Channel, and caused both vertical incision and lateral expansion of the flow cross-section. In addition, the combined effect of flood plain fills and channel incision and enlargement has limited overbank floodplain flows to the most severe floods. This has increased the erosivity of floodflows conveyed in the constrained channel.

- The incised channel conditions have created a highly erosive and unstable channel. The response of homeowners and government entities during the last half of the 20th century to this channel instability was the installation of spot stabilization measures that favored a hard, structural approach (e.g. unvegetated riprap revetments), rather than the currently favored biotechnical approach. The discontinuous patchwork of channel stabilization is represented by the concrete grout and riprap treatments through and downstream of the existing bridge.

- As suggested by the values cited in Table 1, the unvegetated soils at two unreinforced sites along the Project reach are vulnerable to future bank erosion, because their permissible shear stresses and flow velocities are significantly lower than those derived for the 2-yr. and 100-yr. peak discharges on Salvador Channel. This vulnerability is greatest in areas adjacent to or opposite riprapped banks, as fully evidenced along the Project channel reach. The erosion risk is heightened by abrupt changes in the pattern of flow and local turbulence between very roughened and resistant (i.e. riprapped) bank segments and unroughened earthen ones.

- Large-scale bank erosion (i.e. bank slumping) is most likely to occur as drawdown failures following the passage of higher recurrence interval floods (e.g. ≥10 yr.), during which prolonged, elevated stream levels produce strong reverse seepage into the bank soils. Relatively rapid recession of stream levels after rainfall tapers off can lead to excessive porepressures within the soil mass, resulting in bank failure. Based on other CH bank stability evaluations assisted by geotechnical modeling under similar conditions, vehicular loading in the vicinity of the top of bank greatly increases the risk of such slump failures. Thus, the maintenance of parking and truck access in the vicinity of the top of the near vertical banks for the Project's renovated structure would present a high risk to local bank instability along the Project reach.

- According to the present project EIR (p. 85 City of Napa Municipal Code- Streambed and Creek Protection, the authors describe Salvador Channel through the project reach as having a depth of less than 8 feet. In such cases a less conservative setback is required (20 ft. from the top of bank). However, the channel is certainly greater than 8 ft. in depth and is closer to 12 ft. or more near the mid-section of the Sunrise Building. Therefore, per the discussion on p. 67, the more conservative City Code setback would apply (i.e. 2:1 from toe of bank plus 20 ft.).

- The proposed stich pier wall would protect the rehabilitated Sunrise facility from encroaching creekbank erosion. However, it would do nothing to improve the long term stability of Salvador Channel, which will continue to erode episodically. Where trees collapse into the channel deflected currents could hasten bank retreat.

- Removal of the Zerba Bridge, which will improve local flood conditions overall, will likely need to include removal of the failing west bank wall that supports the current bridge foundation. Its removal will require provisions for streambank stabilization using biotechnical means and acquisition of regulatory and resource agency permits.

- Maintenance of the existing west bank conditions along the portion of the Project reach that parallels the now vacant assisted living facility would result in periodic bank failures that would trigger requests from the Project owners for emergency permits to install spot riprap stabilization measures- the same discredited measures that have actually exacerbated urban stream instability and riparian corridor degradation during the past 60+ years.

- Instead of implementing a biotechnical approach, including bridge removal, only along the currently undeveloped northern portion of the Project property, CH recommends that biotechnical measures be applied to stabilize the west bank of Salvador Channel throughout the Project reach. This could be done, if the Project parking were accommodated in a different configuration, providing a setback corridor for biotechnical stabilization and riparian corridor enhancement.

I trust that this bank stability risk assessment will assist the homeowners, the City and the Project managers in deriving a Project that works for the principal Project objectives as well as the integrity of the Salvador Channel and its riparian environs.

Yours truly,

William Vandivere, M.S., P.E.
Principal

REFERENCES

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Fischenich, C. 2001. Stability Thresholds for Stream Restoration Materials, ERDC TN-EMRRP-SR-29, USAE Research and Development Center, Environmental Laboratory, Vicksburg, MS.

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Leopold, L.B. 1994. A View of the River. Harvard University Press, Cambridge, Mass.

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Rantz, S.E 1971a. "Suggested Criteria for Hydrologic Design of Storm-Drainage Facilities in the San Francisco Bay Region, California". U.S. Geological Survey Open-File Report, Menlo Park, CA. November 1971.

Photo 1: Downstream oblique view of Salvador Channel at the existing bridge crossing and the severely cracked east abutment. Note the remnant ring of grouted rock on the bridge pier, approximately two feet above the ponded water level.

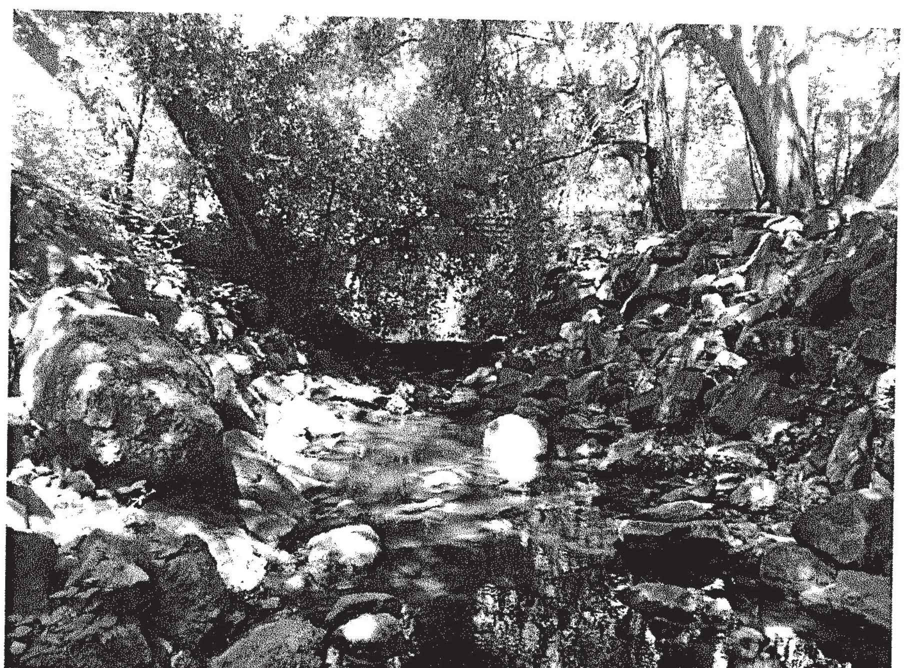

Photo 2: Upstream view along the Channel reach immediately downstream of the existing bridge, which is visible behind the tree foliage. The 2-3 ft. high grouted rock wall/grade control structure crosses the channel at the shaded center of the photo.

Photo 3: Downstream view along the roughly longitudinal and discontinuous mid-channel bar formed by collapsed boulders transported a short distance downstream from the upstream riprap revetments.

Photo 4: View looking upstream from the analyzed cross-section. Note the severe erosion along the east bank (at right), immediately downstream of the riprapped banks.

Photo 5: Oblique upstream view of the west bank- the analyzed cross-section extended as a straight line along the line-of-sight of the total station at top left.

Photo 6: A close-up of the low to mid-bank zone of the west bank, immediately downstream of the analyzed channel cross-section location. Note the patch of still-intact bank soil infused with large gravel and cobble at mid-left under the tree root. Erosion of this lens of material produced the loose gravel and cobble on the lower terrace. The larger gravel-cobble component is absent in the mid-bank soils.


Photo 7: Downstream view along 40-50 ft. riprap treatment of the west bank adjoining the vacant Project building's rear parking area. Note the boulders encroaching on the active flow zone of the channel.


Photo 8: Downstream view of lower end of the long riffle and the transition to the long pool that extends downstream from the lower end of the riprap zone in Photo 7 to roughly the southern property boundary.

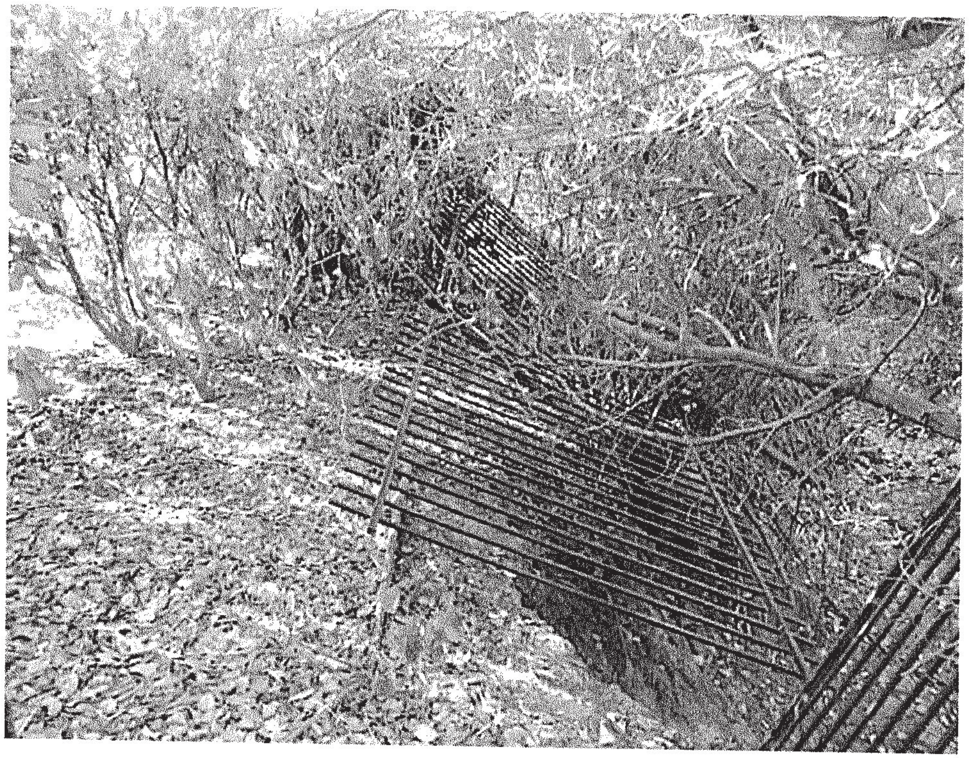

Photo 9 (Couresty of W. McGuire): Upstream view of the eroded west bank through a failed section of the existing property fence.