



## MEMORANDUM

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DATE: 8/30/12

TO: Kathy Chaston, Steve Frano, and Fatima Sauafea-Leau (NOAA); Faamao Asalele, Christianera Tuitele, Kuka Matavao (AS-EPA); Marvis Vaiaga'e (AS DOC); Uso Lago'o (Faga'alu); and George Poysky (Samoa Maritime)

FROM: Horsley Witten Group, Inc. (HW) and the Center for Watershed Protection, Inc. (CWP)

RE: Corrective Action Plan for the Faga'alu Quarry

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This memorandum describes a proposed Erosion and Sediment Control (ESC) Corrective Action Plan to reduce sediment loading associated with groundwater seeps and stormwater runoff at the Faga'alu quarry site. The Faga'alu quarry is located at the upper terminus of the main road serving the Faga'alu Village. Managing runoff from a quarry can be challenging due to constantly changing drainage patterns as different areas of the site are excavated and material stockpiles are relocated. The Faga'alu quarry is further challenged by limited space in which to operate. The quarry is wedged between the steep hillsides being excavated and the stream channel along the site's southern boundary. All the runoff from the quarry eventually enters the stream. Recent monitoring efforts by Curtis et al., (2021) have shown that in-stream turbidity levels are significantly greater below quarry discharge locations than upstream of the operation (Figure 1).

The goal of this Corrective Action Plan is to identify the primary drainage patterns through the quarry and develop erosion and sediment control practices for reducing the sediment loads to the stream. This project is Structural Project ID 16 in the pending *Faga'alu Watershed Plan Implementation Supplement*.

### Proposed Concept

The design concepts presented here are based on observations made during watershed field assessments on July 24-25, 2012, as well as from discussions with Samoa Maritime, AS-EPA, and participants from the post-construction stormwater training workshop. Given the lack of available topographic information, site plans, or high resolution aerial imagery, our conceptual designs at this time are limited to preliminary sketches and photos taken while on site.

Figure 1. Turbidity measurements at eight locations along the main stream (stations 7-9 are above the quarry operation, 6-5 are at the quarry, and 3-1 are downstream towards Faga’alu Bay). All sites below the quarry are above the NTU water quality standard.

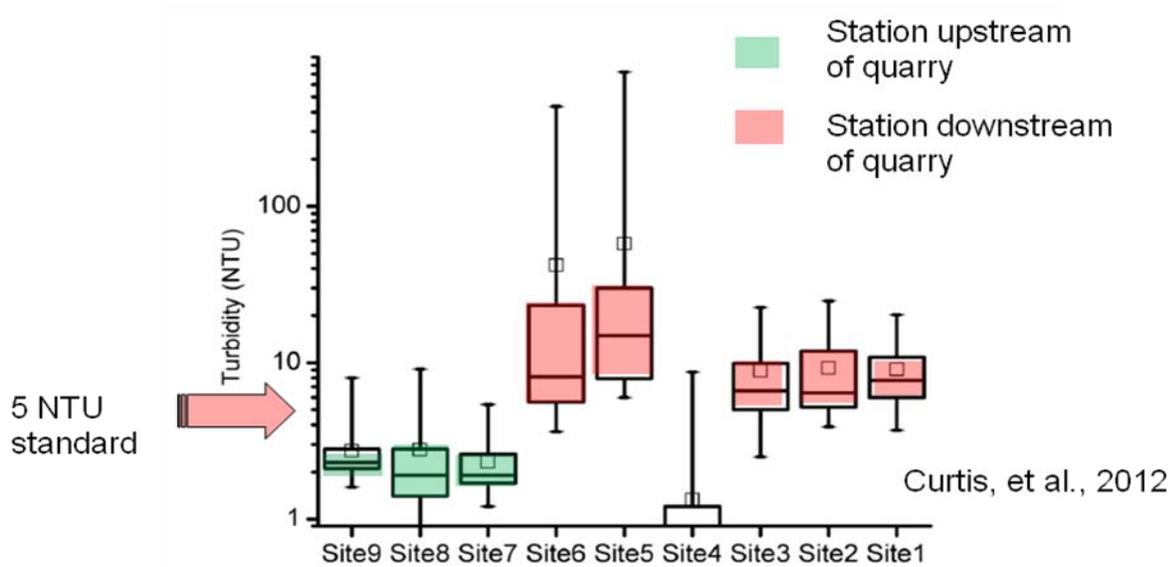


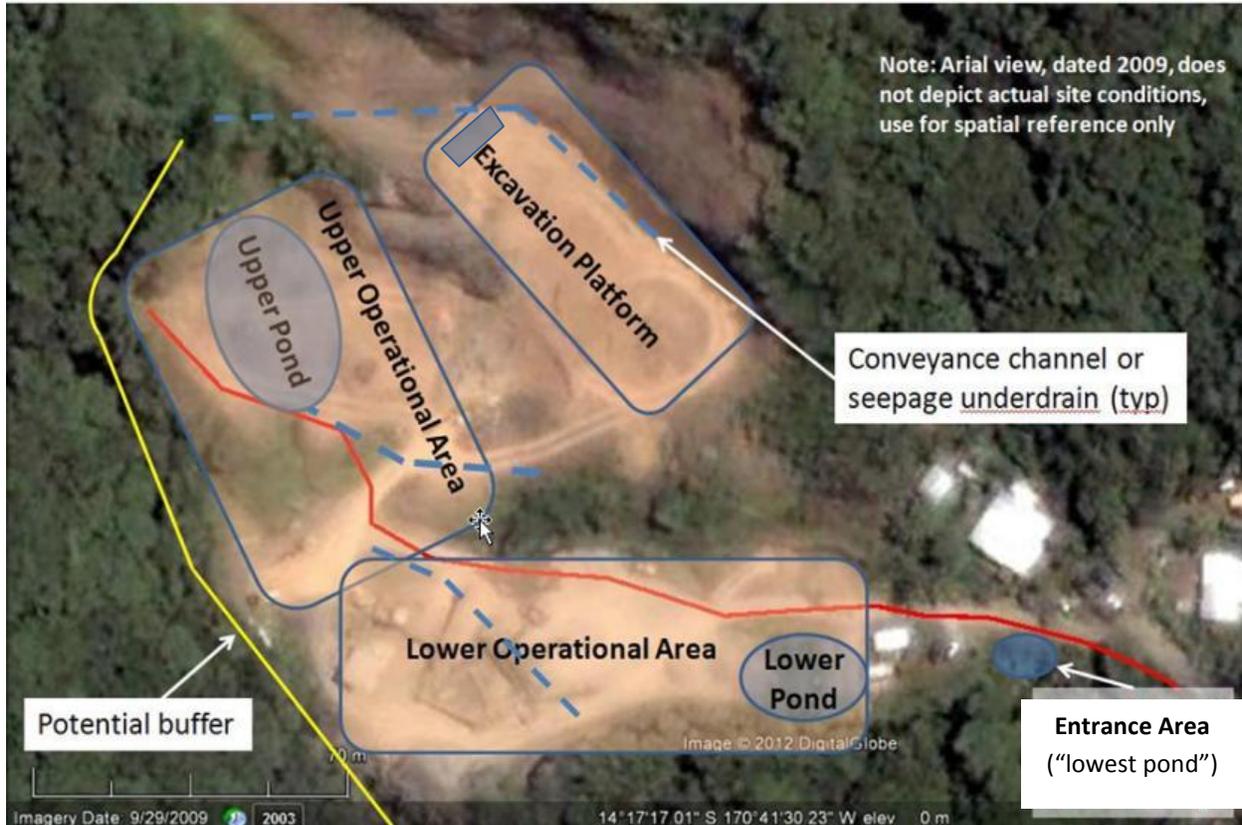
Figure 3. Illustrates the box-and-whisker plots for each sample site. The scale is logarithmic in order to capture entire samples.

The following is a general description of the proposed steps for implementing the Corrective Action Plan at the Faga’alu quarry. The quarry is generally divided into three primary operational areas as follows:

1. **Excavation Platform:** this area is located at the base of the uppermost hillside and serves as a staging area for excavation equipment to travel up a temporary switchback road that accesses the upper elevations of the mining operation. This area is depicted in the lower half of Photo 1B (photo is looking generally south-east from the top of the switchback access road). A small tracked drilling rig is shown on one of the upper switchbacks (lower right in photograph), while the two large tracked excavators are shown in the general vicinity of the excavation platform and the entrance to the switchback access road. A large excavated pit is seen to the middle right of the photograph; this area exposes a sheer rock face (seen in Photo 2).
2. **The “Upper Operations” area:** this area includes the access to the rock crushing equipment hopper, and includes the current location of the explosives shed, fuel storage shed, and miscellaneous equipment storage and material stockpiles.
3. **The “Lower Operations” area:** this area includes the rock crushing operation area, as well as the numerous stockpiles, access drive aisles, and main entrance driveway that serve the lower portion of the quarry.

The proposed corrective actions are likewise developed to address these three operational areas, as well as actions at the entrance gate and along the length of the adjacent stream (Figure 2). Each of these actions is described below in more detail. Concept sketches are provided in Appendix A, and a photo log of the site is provided in Appendix B.

Figure 2. Aerial photo depicting locations of primary operational areas and corrective actions. The red line is an existing road line from GIS.



### *Excavation Platform*

A steady flow of groundwater seeps out of the vertical rock cut at the upper end of the quarry. This seepage ponds in the flat area and eventually drains down the access road where it then travels the full length of the active work area of the quarry. The water combines with flow from other groundwater seeps as well as surface runoff during and shortly after rain events before leaving the site at a single location. Excavation equipment and trucks cross the combined flow in at least three locations.

The following steps are intended to isolate the clean groundwater seepage and convey it to the stream without interacting with active operational areas.

1. Intercept the flow at the base of the rock seep with a rock trench drain and perforated pipe. Sheet 1 of 3 of Concept Sketch and Section A-A on Sheet 3 of 3.

2. Install a small sediment trap at the furthest north-western most portion of the excavated work pad.
3. Grade the excavation platform to drain the western-most third of the platform area to a sediment trap that overflows to the rock trench drain. Grade the remainder to drain out the entrance to the conveyance to the Upper Pond serving the Upper Operations Area.

<b>Groundwater Seepage Collection Channel</b>	
Length of channel – perforated pipe (4" to 6" diameter)	275 ft
Stone (4" to 6")	50 cu yds
Stone (No. 2)	7 cu yds
Filter fabric	150 sq yds

<b>Sediment Trap*</b>	
Approximate Surface Area	150 sq ft
Excavation	30 cu yds
Dry Storage	15 cu yds
Wet Storage	15 cu yds

\*Sediment trap is sized to only capture a small portion of the Excavation Platform as shown on design concept sketch (approximately 4,000 sq.ft.; or 0.1 ac)

### *Upper Operations Area (Upper Pond)*

1. Bench the haul road (towards the mountain) that switchbacks up the hillside above the work area to keep the drainage that comes off the mountain contained in a roadside channel. This should help prevent excessive sediment from washing down the hillside as well as minimize gullying, and rock slides. See Detail on Sheet 3 of 3 of Concept Sketch.
2. Intercept work pad and haul road runoff at the base of the road and direct it across the road through a culvert (so as to minimize disturbance from equipment traffic).
3. Discharge culvert into a stone lined surface channel diversion channel (Design Concept Sketch Sheet 1 of 3, Section B-B). Conveyance channel drains to proposed sediment basin (Upper Pond or settling pond in figure below). (Also reference to Photo 7, and Photo 7A in Photo Album)
4. Relocate the excavation equipment and the port-a-john from the existing location at the top of the stream bank. (Photo 12 in Photo Album).
5. Sediment Basin Design: Typical USDA Sediment Basin design is sized on a 1" depth of runoff per acre of drainage area. Given the rainfall in American Samoa, the sizing for the sediment basin is increased to 1.5" depth of runoff, or 200 cu yds/acre of contributing drainage area. The storage volume is split between wet storage (lower elevations of the basin) and dry storage (storage available for runoff to fill the basin).

<b>Upper Operations Area Culvert*</b>	
Length	60 ft
Diameter	30 in
Slope	1%

\*Culvert size assumes design peak discharge of 26 cfs, 1% slope (DA = 12 acres, 4 acres disturbed, C=0.37, I=6"/hr)

<b>Conveyance Channel*</b>	
Length of Channel	235 ft
Stone (4" to 6")	87 cu yds
Filter Fabric	260 sq yds

\*Channel dimensions based on 26 cfs, 1% slope: 2 ft bottom width, 2:1 side slopes, depth of channel = 2 ft (min), depth of flow=1.4 ft, velocity=4.2 ft/s,

<b>Upper Settling Pond*</b>	
Contributing drainage Area	12 ac
Approximate surface area available	7,000 sq ft
Approximate surface area required (assumes 12 ft depth)	9,600 sq ft
Excavation bottom area (assumes 2:1 side slopes,)	2,500 sq ft
Overflow spillway design capacity (10-year design Storm)	*
Overflow spillway dimensions	*
Overflow spillway stone (avg. 12")	*
Overflow spillway top stone (4" to 6")	*

\*Capacity of basin overflow spillway to be determined using 10-yr design storm criteria (established by ASDPW). Grading plan should account for adequate freeboard (min 1ft) for the design storm to overflow the spillway.

### *Lower Operations Area (Lower Pond)*

1. Collect seepage at the base of the cut slope adjacent to the rock crushing equipment. (Photo 8 Photo Album). The collection channel should be configured similar to Section A-A on Sheet 3 of 3.
2. Seepage is conveyed across the Lower Operations area with a gravel diaphragm (an enclosed stone channel with perforated drain tile); wrapped in filter fabric and covered with a cap layer of crusher-run gravel to serve as a driving surface. Sheet 2 of 3 of Concept Sketch and Section C-C on Sheet 3 of 3 of Concept Sketch.
3. Grade the lower operations area to sheet flow to perimeter conveyance swales to be located away from active drive aisles that are currently acting as channels draining the site. Photos 9 & 10, Photos 5, 6 and 11. Swales should convey flow to Lower Settling Pond (Sheet 2 of 3 of Concept Sketch, Photo 11 A of Photo Album). This area should be cleared of existing gravel stockpiles (west side of channel) and equipment (shipping container and various disabled excavation equipment) as needed so as to install a large sediment basin (Lower Settling Pond) with the discharge at the same location as the current channel outlet.

<b>Groundwater Seepage Collection Channel</b>	
Length of channel – perforated pipe (4" to 6" diameter)	160 ft
Stone (4" to 6")	18 cu yds
Stone (crusher-run)	15 cu yds
Filter fabric	125 sq yds

<b>Lower Settling Pond*</b>	
Contributing drainage Area	1.4 ac
Approximate surface area available	3,500 sq ft
Approximate surface area required (assumes 8 ft depth)	2,600 sq ft
Excavation bottom area (assumes 2:1 side slopes)	250 sq ft
Overflow spillway design capacity (10-year design Storm)	*
Overflow spillway dimensions	*
Overflow spillway stone (avg. 12")	*
Overflow spillway top stone (4" to 6")	*

\*Capacity of basin overflow spillway dimensions to be determined using 10-year design storm criteria as established by ASDPW. Grading plan should also account for adequate freeboard (min 1ft) for the design storm to overflow the spillway.

Remaining corrective actions for other location on the site include:

#### *Entrance Area*

This area is currently located outside the entrance gate and is currently in place primarily due to the excessive amount of drainage that leaves the site. With the installation of the measures described above, the active drainage to this location will be reduced significantly, and sediment loads potentially eliminated with the installation of a stabilized construction entrance. If needed, a small sediment trap can be installed ("Lowest Pond" on Figure 2) once the actual drainage area is determined. Approximately 450 sq ft of space is available.

#### *Stream Buffer*

The designation of a 50 foot stream buffer or an alternative design in lieu of a buffer will require coordination with the minimum requirements for adequate truck traffic movement and access to storage locations. Ideally, any changes in traffic or operational patterns should improve conditions. Several areas noted during the site visit were very well protected even though the 50 foot buffer was not in place.

#### *Dust Control*

To be determined in coordination with available technology and equipment.

### *Good Housekeeping*

Good housekeeping measures should be adopted by the quarry operator to help reduce the sediment load associated with normal operations. These measures include (but are not limited to) stabilized (graveled) drive aisles; oil and hydraulic fluid collection pans in designated vehicle maintenance areas; and perimeter control and/or stabilization for soil stockpiles that will remain dormant for more than 14 days, etc.

### **Next Steps**

The available areas for the proposed settling basins were estimated and the designs included herein were based on assumptions of construction depth and side slopes, the following tasks will need to be completed before moving to construction:

#### Immediate Actions:

1. **Site survey and base map.** The survey/base map should include 1-ft topographic contours; site property boundaries; edge of stream; existing tree line; 50-ft buffer; edge of haul roads; and the locations of permanent equipment and structures, and designated stockpile areas). Ideally, the survey would be completed by a local land surveyor, or possibly another government partner (USACE, AS DPW). The basemap should be provided to the design engineer digitally (e.g., AutoCAD file). This task could be started immediately and would likely take approximately two weeks of combined field and office time to produce an appropriate base map.
2. **Feasibility Assessment of Corrective Action Plan.** Samoa Maritime, AS-EPA and AS DOC at a minimum should review this memorandum and provide comments on the concept design approach. Specifically, operational concerns, practice placement and feasibility of construction and maintenance should be reviewed. How does our initial proposed action plan look? A Webex conference call should be set up to discuss feedback.
3. **Engineer licensing.** Determine if an AS licensed engineer is required to stamp plans.

#### 1 month from completion of previous tasks:

4. **Final design plans for construction.** If the actual conditions vary from our concept design, the designs will be adjusted accordingly in order to still meet the basic sizing criteria. Final design plans to include calculations to confirm practices are big enough and coordination with AS-DWP and AS-EPA to verify appropriate hydrologic design parameters. This will be a few weeks of work.
5. **Permitting.** We would need to identify which permits would need to be submitted. We assume support by AS-EPA or land survey company (perhaps) to assist in the processing of permit applications. We believe the permits will be limited to the basic construction permit,

but also recommend filing an NOI under the NPDES multi-sector general permit for this site. We do not think this corrective activity is within USACE jurisdiction, requiring a 404 permit.

6. Generate a material quantities take-off and unit cost estimate. Cost estimates will need to be done in close coordination with the project partners to reflect local costs for hauling and disposal of excavated materials and equipment and material costs. For funding purposes, if Samoa Maritime provides equipment, rock, etc., the costs could be reduced. Identify any construction materials that will need to be procured off-island.

2-3 months from initial tasks:

7. **Permit Submittal.** Submit completed permit applications. Include Maintenance Plan and Stormwater Pollution Prevention Plan (SWPPP) for submittal with NOI. This will likely involve working closely with Samoa Maritime to develop an Operational Plan. As ongoing quarry operations lead to alterations of sites conditions and drainage patterns, the operational plan or the ESC plan must be properly adapted to the new conditions while still achieving the functional goal of controlling sediment.
8. **Bid Support:** Engineering design firm to provide construction specifications and support AS-EPA or other partners in soliciting contractor.

During Construction:

9. **Construction oversight.** Design engineer, or designated on-the-ground alternate (As-EPA?) should be on site for a pre-construction meeting and at key intervals during the construction process. Construction notes should include required check in with the design engineer, at critical steps in the construction sequence to make sure installation is occurring appropriately. As-built plans should be submitted to AS-EPA before construction is considered complete.

After Construction:

10. **Monitoring.** In-stream turbidity samples should be collected during construction and for a defined period of time after construction is completed in order to quantify effectiveness of corrective actions (e.g., San Diego State University).

# **Appendix A**

Preliminary Sketches





RELOCATE STOCKPILE & EQUIPMENT AS NEEDED TO SIZE & CONSTRUCT SED. BASIN



PHOTO 6  
SURFACE DRAINAGE

CONVEY SEEPAGE THROUGH ACTIVE WORK AREA W/ STONE TRENCH & UNDERDRAIN

ACTIVE WORK AREA - CRUSHING & HAULING

ROCK CRUSHING EQUIPMENT

MAIN ACCESS ROAD

STEEP CUT SLOPE

ROCK CRUSHER HOPPER

PHOTO 8  
INTERCEPT SEEPAGE W/ STONE TRENCH & PER PIPE ALONG BASE OF CUT SLOPE

PHOTO 9

PHOTO 12

DRIVEWAY

EX. JERSEY BARRIER & GRAVEL BERM CONVEYANCE

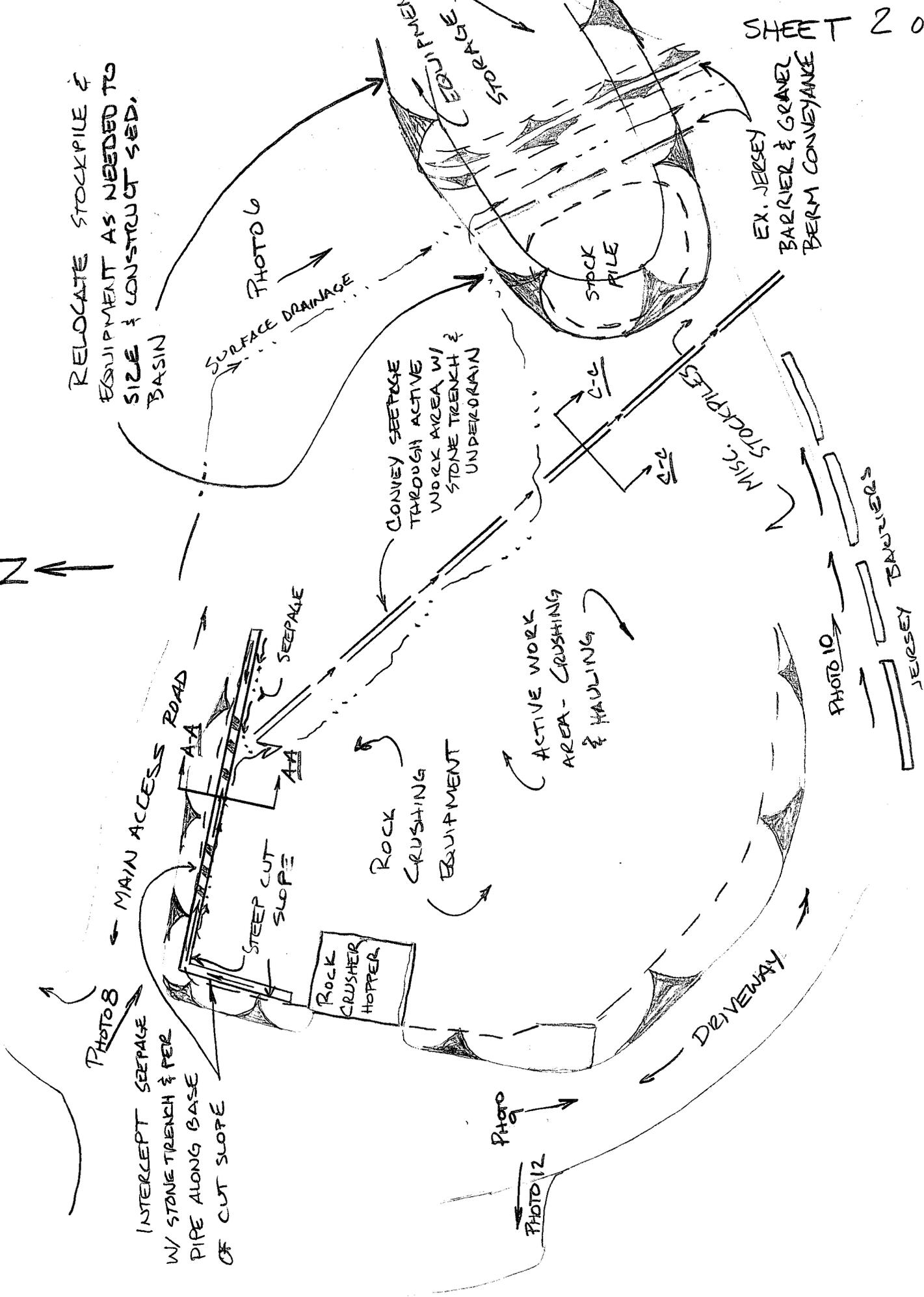
STOCK PILE

MISC. STOCKPILES

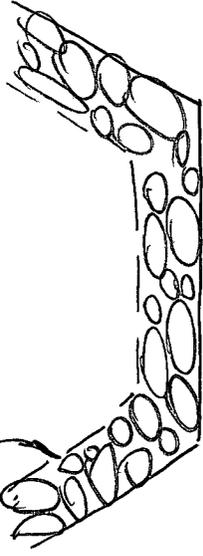
PHOTO 10

BARRIERS

JERSEY

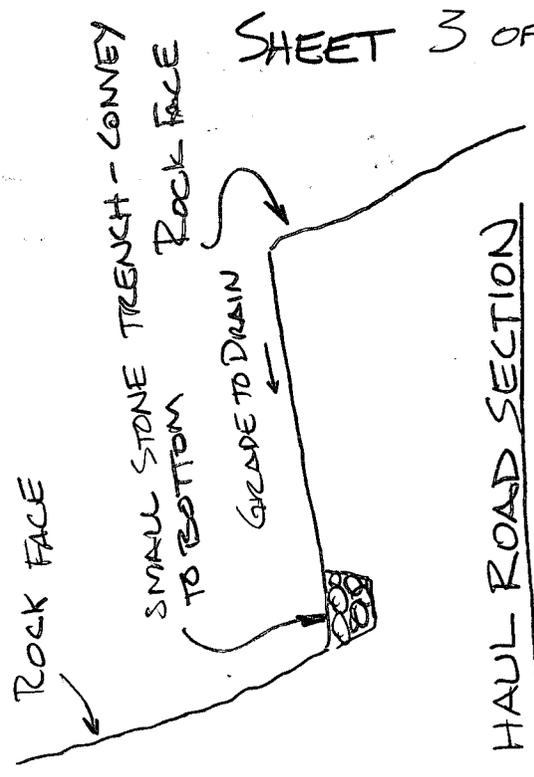


STONE LINED  
SURFACE CONVEYANCE  
WIDTH & DEPTH SIZED  
FOR 2-YR STORM

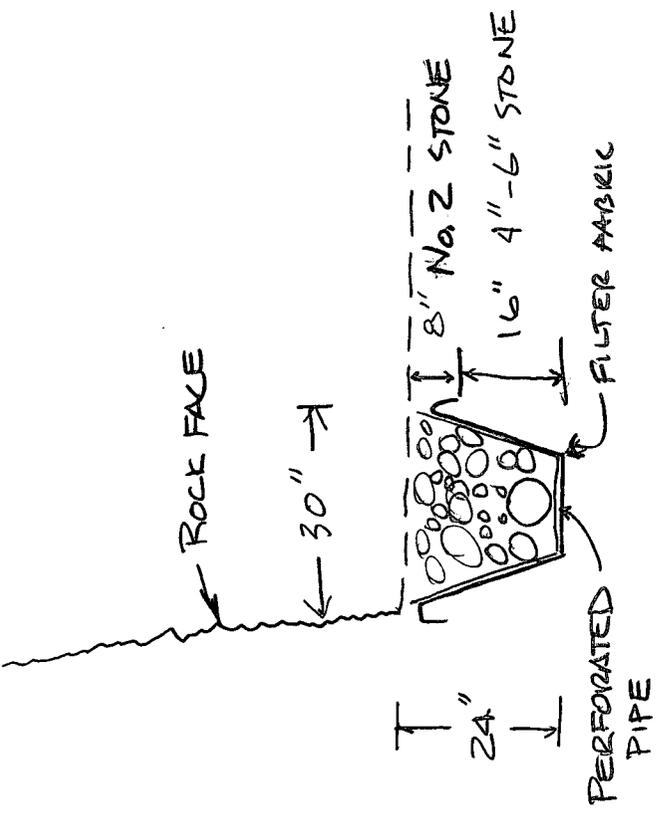


SECTION B-B

NOT TO SCALE

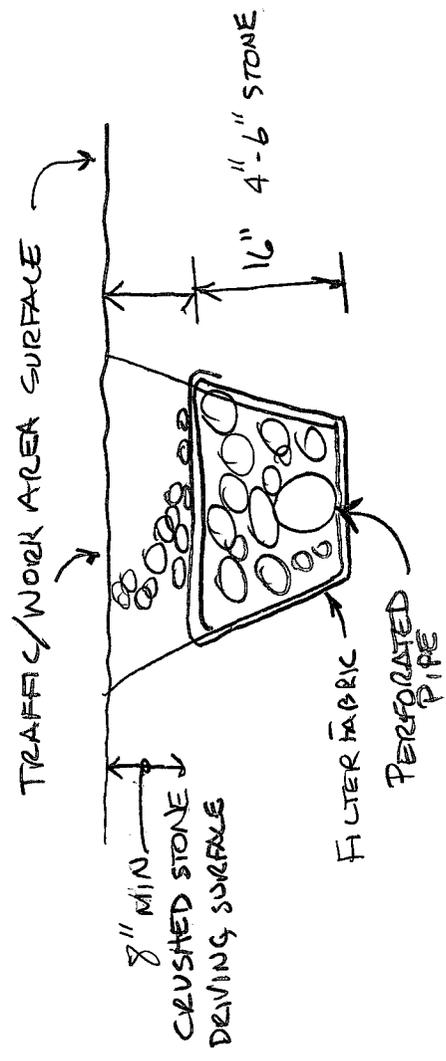


HAUL ROAD SECTION



SECTION A-A

NOT TO SCALE



SECTION C-C

NOT TO SCALE



## **Appendix B**

Photo Log



# Faga'alu Quarry Site Visit Photo Album

## July 22 & 23, 2012

by Horsley Witten Group

&

The Center for Watershed Protection

### Field Data Collection- iPAD: initial area calcs and pipe lengths



#### Upper Pond

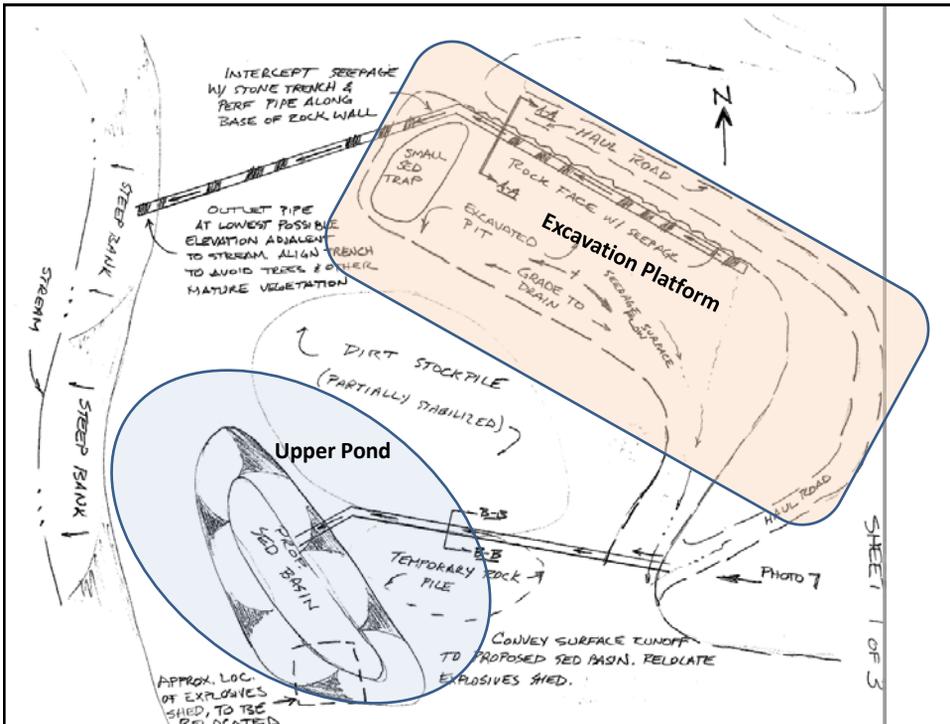
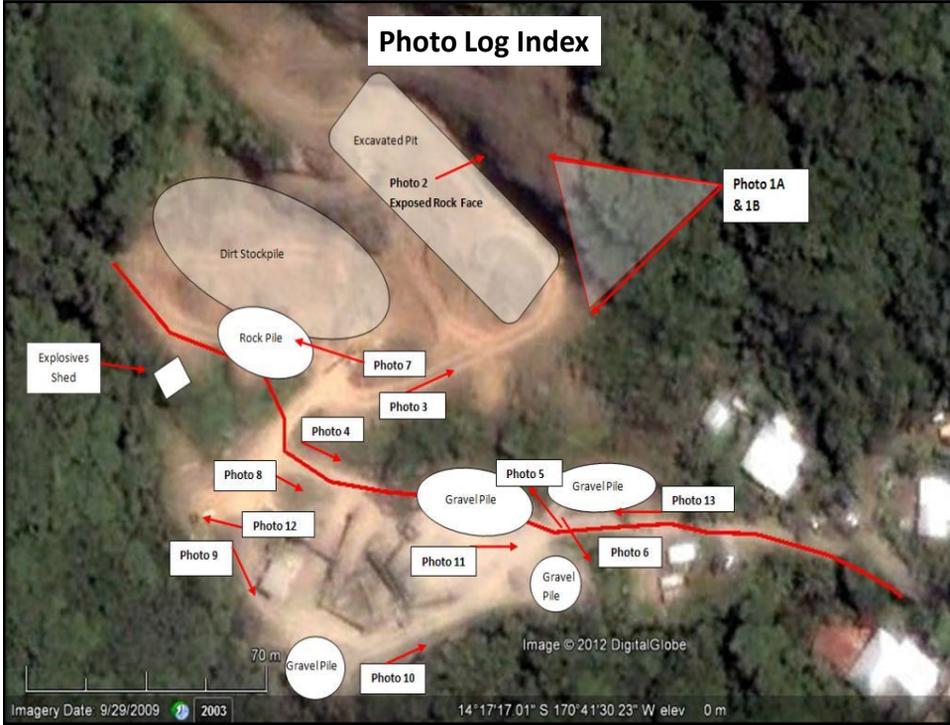
Watershed Area = 11.9 acres  
 Disturbed Area = 4.6 acres  
 Underdrain Pipe = 267 ft  
 Surface Runoff Pipe/Channel to Pond = 295 ft  
 Pond Surface Area = 7,000 sq ft.

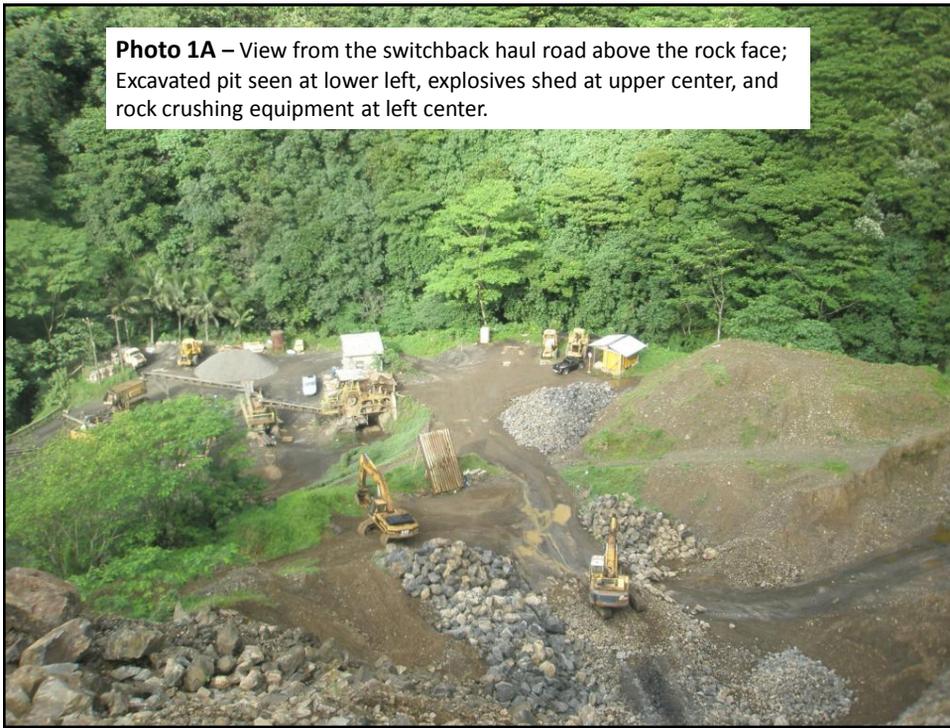
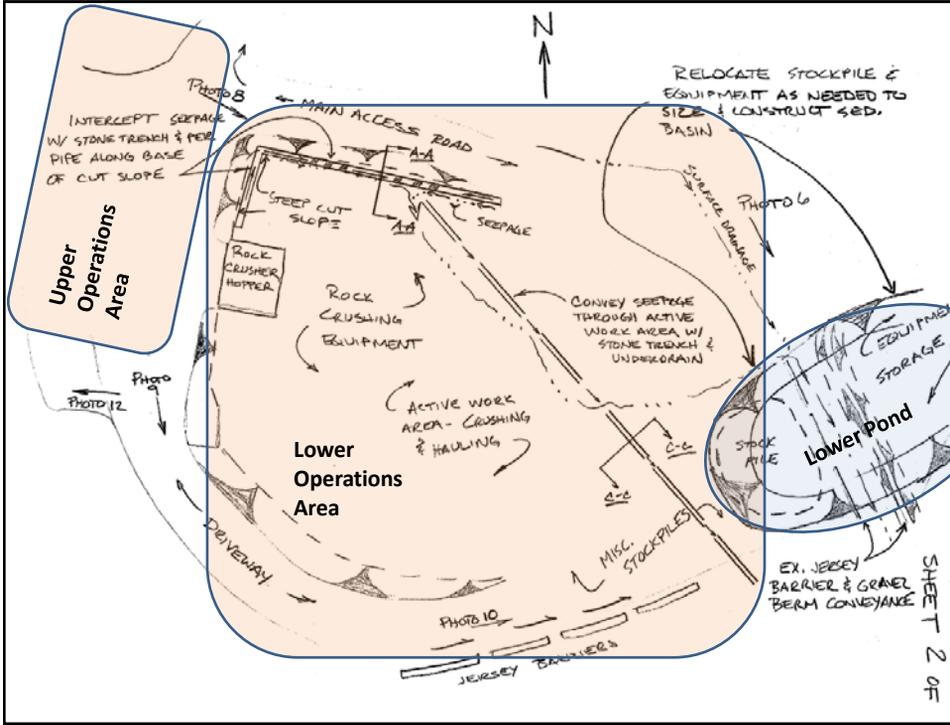
#### Lower Pond – Rock Crushing Area

Watershed Area = 1.4 acres (all assumed to be disturbed)  
 Underdrain pipe length = 160 ft  
 Pond Surface Area = 3,500 sq ft.

#### Lowest Pond (entrance beyond gate)

Watershed Area = 0.13 acres (assume 50% disturbed)  
 Pond Surface Area = 450 sq ft.





**Photo 1A** – View from the switchback haul road above the rock face; Excavated pit seen at lower left, explosives shed at upper center, and rock crushing equipment at left center.

**Photo 1B** – View from the switchback haul road above the rock face; Excavated pit seen at lower left, explosives shed at upper center, and rock crushing equipment at left center.



**Photo 2** – Exposed rock face at bottom of excavation. Continuous seep along the entire toe of the excavation.



**Photo 3** – View looking up at excavator operating at toe of rock face. Switch back haul road (3 turns) is seen winding up the hill side in background .



**Photo 4** – Groundwater seep from excavated area collects and is conveyed down the primary driveway to the site

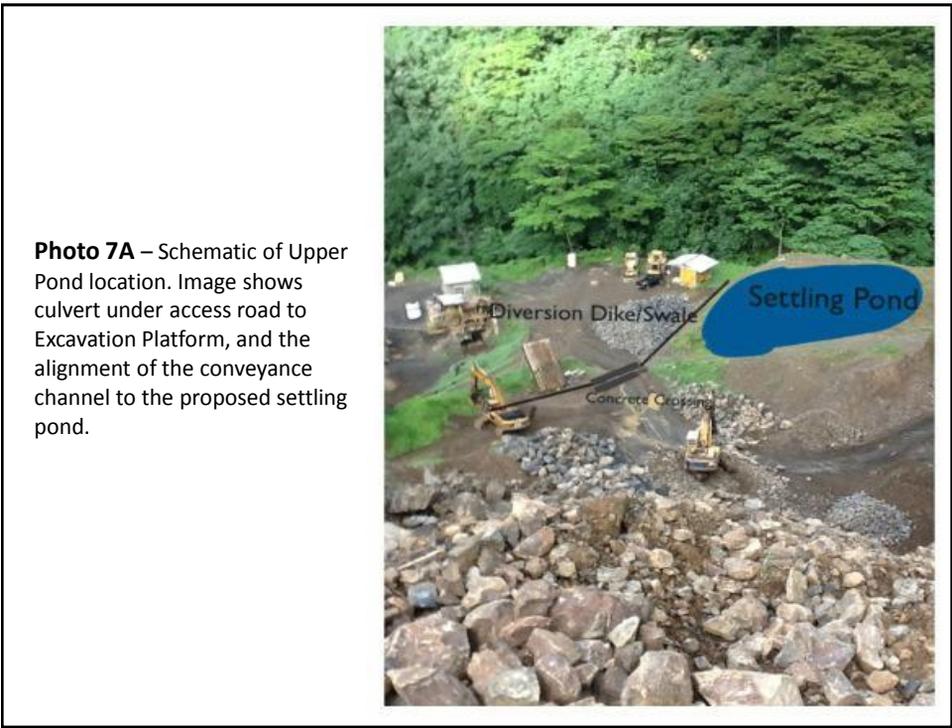


**Photo 5** – View looking back uphill at the seepage after it has traveled down the primary driveway, squeezed between the gravel stockpiles and back across the driveway



**Photo 6** – Groundwater seepage (and runoff during rainfall events) eventually leaves the site through a small channel between jersey barrier and gravel berm, and an undersized sediment trap.

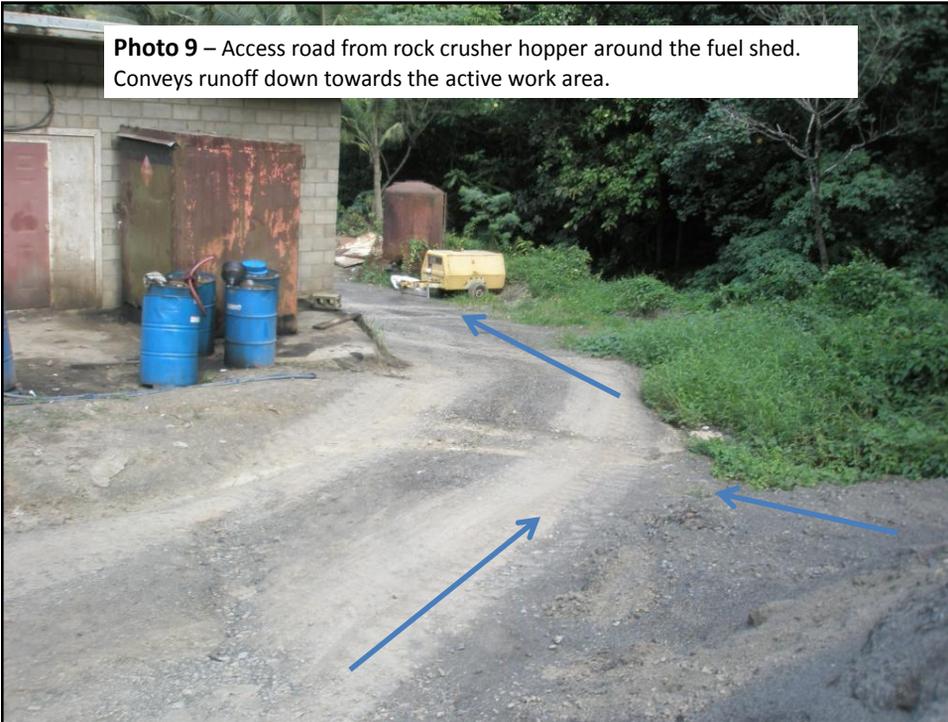




**Photo 8** – View of groundwater seep at edge of cut that creates the rock crushing equipment pad; seepage eventually drains across active work area and combines with runoff before exiting site.



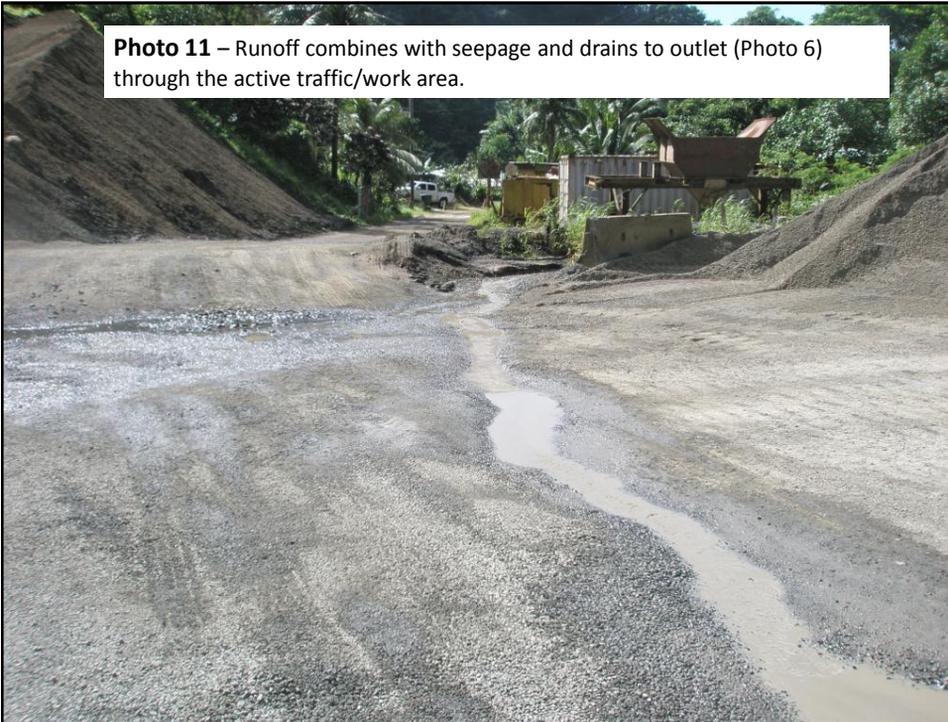
**Photo 9** – Access road from rock crusher hopper around the fuel shed. Conveys runoff down towards the active work area.



**Photo 10** – Runoff continues downhill along edge of roadway (and adjacent to jersey barrier).



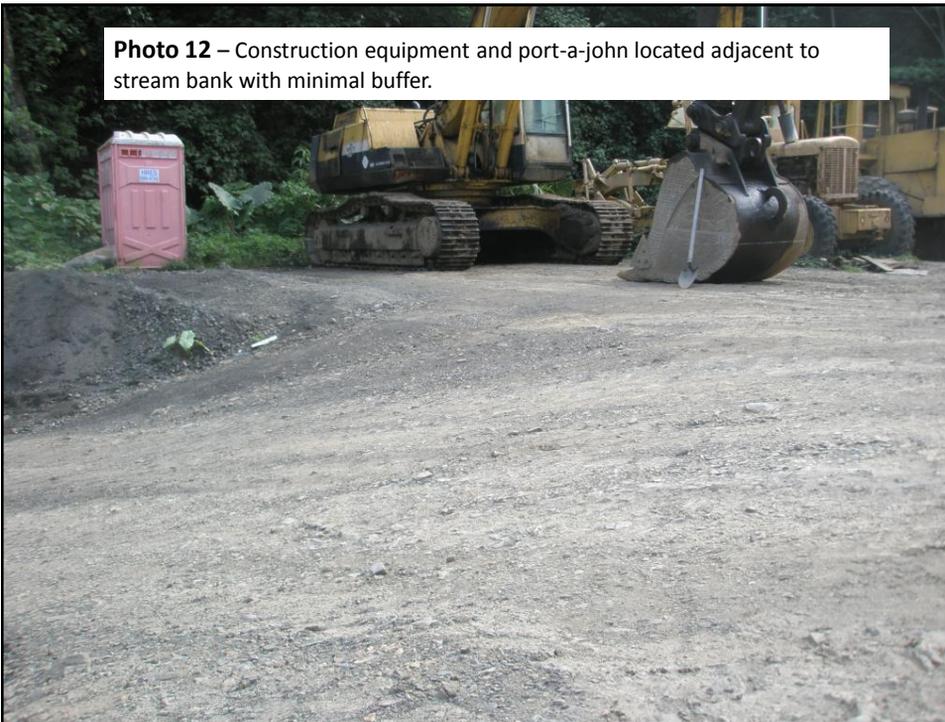
**Photo 11** – Runoff combines with seepage and drains to outlet (Photo 6) through the active traffic/work area.



**Photo 11A** – Gapped panorama of location for Lower Settling Pond. Area to the right is currently a random stockpile area that has been recently cleared. Area to the left contains disabled excavation equipment and a storage container. Center photo shows the channel leaving the site (refer to Photo 11).



**Photo 12** – Construction equipment and port-a-john located adjacent to stream bank with minimal buffer.



**Photo 13** – Stockpile instability immediately adjacent to main driveway

