## APPENDIX A. Dams in Faga'alu watershed

Faga'alu stream was dammed at 4 locations above the village: 1) Matafao Dam (elevation 244 m) near the base of Mt. Matafao, draining 0.20 km², 2) Vaitanoa Dam at Virgin Falls (elevation 140 m), draining an additional 0.44 km², 3) a small unnamed dam below Vaitanoa Dam at elevation 100m, and 4) Lower Faga'alu Dam (elevation 48 m), immediately upstream of a large waterfall 30 m upstream of the quarry, draining an additional 0.26 km² (Tonkin & Taylor International Ltd., 1989). A 2012 aerial LiDAR survey (Photo Science, Inc.) indicates the drainage area at the Lower Faga'alu Dam is 0.90 km². A small stream capture/reservoir (~35 m³) is also present on a side tributary that joins Faga'alu stream on the south bank, opposite the quarry. It is connected to a ~6 cm diameter pipe but it is unknown when or by whom it was built, its initial capacity, or if it is still conveying water. During all site visits water was overtopping this small structure through the spillway crest, suggesting it is fed by a perennial stream.

Matafao Dam was constructed in 1917 for water supply to the Pago Pago Navy base, impounding a reservoir with initial capacity of 1.7 million gallons (6,400 m³) and piping the flow out of the watershed to a hydropower and water filtration plant in Fagatogo. In the early 1940's the Navy replaced the original cement tube pipeline and hydropower house with cast iron pipe but it is unknown when the scheme fell out of use (Tonkin & Taylor International Ltd., 1989; URS Company, 1978). Remote sensing and a site visit on 6/21/13 confirmed the reservoir is still filling to the spillway crest with water and routing some flow to the Fagatogo site, though the amount is much less than the 10 in. diameter pipes conveyance capacity and the flow rate variability is unknown. A previous site visit on 2/21/13 by American Samoa Power Authority (ASPA) found the reservoir empty of water but filled with an estimated 3-5 meters of fine sediment (Kearns, 2013). Interviews with local maintenance staff and historical photos confirmed the Matafao Reservoir was actively maintained and cleaned of sediment until the early 70's.

The Vaitanoa (Virgin Falls) Dam, was built in 1964 to provide drinking water but the pipe was not completed as of 10/19/89, and a stockpile of some 40 (8 ft. length) 8 in. diameter asbestos-cement pipes was found on the streambanks. Local quarry staff recall the pipes were removed from the site sometime in the 1990's. The Vaitanoa Reservoir had a design volume of 4.5 million gallons (17,000m³), but is assumed to be full of sediment since the drainage valves were never opened and the reservoir was overtopping the spillway as of 10/18/89 (Tonkin & Taylor International Ltd., 1989). A low masonry weir was also constructed downstream of the Vaitanoa Dam, but not connected to any piping.

The Lower Faga'alu Dam was constructed in 1966/67 just above the Samoa Maritime, Ltd. Quarry, as a source of water for the LBJ Medical Centre. It is unknown when this dam went out of use but in 1989 the 8 in. conveyance pipe was badly leaking and presumed out of service. The 8 in. pipe disappears below the floor of the Samoa Maritime quarry and it is unknown if it is still conveying water or has plugged with sediment. The derelict filtration plant at the entrance to the quarry was disconnected prior to 1989 (Tonkin & Taylor International Ltd., 1989). The original capacity was 0.03 million gallons (114 m³) but is now full of coarse sediment up to the spillway crest. No reports were found indicating this structure was ever emptied of sediment.

## APPENDIX B. Stream gaging in Faga’alu Watershed

Stream gaging sites were chosen to take advantage of an existing control structure at FG1 (Figure B.1) and a stabilized stream cross section at FG3 (Figure B.2)(Duvert and Gratiot, 2010). At FG1 and FG3, Q was calculated from 15 minute interval stream stage measurements, using a stage-Q rating curve calibrated to manual Q measurements made under baseflow and stormflow conditions (Figures B.3 and B.4). Stream stage was measured with non-vented pressure transducers (PT) (Solinst Levelogger or Onset HOBO Water Level Logger) installed in stilling wells at FG1 and FG3. Barometric pressure data collected at Wx were used to calculate stage from the pressure data recorded by the PT. Data gaps in barometric pressure from Wx were filled by data from stations at Pago Pago Harbor (NSTP6) and NOAA Climate Observatory at Tula (TULA) (Figure 1). Priority was given to the station closest to the watershed with valid barometric pressure data. Barometric data were highly correlated and the data source made little (<1cm) difference in the resulting water level. Q was measured in the field by the area-velocity method (AV) using a Marsh-McBirney flowmeter to measure flow velocity and channel surveys measure cross-sectional area (Harrelson et al., 1994; Turnipseed and Sauer, 2010).

AV-Q measurements could not be made at high stages at FG1 and FG3 for safety reasons, so stage-Q relationships were constructed to estimate a continuous record of Q. At FG3, the channel is rectangular with stabilized rip-rap on the banks and bed (Figure B.2). Recorded stage varied from 4 to 147 cm. AV-Q measurements (n= 14) were made from 30 to 1,558.0 L/sec, covering a range of stages from 6 to 39 cm. The highest recorded stage was much higher than the highest stage with measured Q so the rating could not be extrapolated by a power law. Stream conditions at FG3 fit the assumption for Manning's equation, so the stage-Q rating at FG3 was created using Manning's equation, calibrating Manning's n (0.067) to the Q measurements (Figure B.3).

At FG1, the flow control structure is a masonry ogee spillway crest of a defunct stream capture. The structure is a rectangular channel 43 cm deep that transitions abruptly to gently sloping banks, causing an abrupt change in the stage-Q relationship (Figure B.1). At FG1, recorded stage height ranged from 4 to 120 cm, while area-velocity Q measurements (n= 22) covered stages from 6 to 17 cm. Since the highest recorded stage (120 cm) was higher than the highest stage with measured Q (17 cm), and there was a distinct change in channel geometry above 43 cm the rating could not be extrapolated by a power law. The flow structure did not meet the assumptions for using Manning's equation to predict flow so the HEC-RAS model was used (Brunner, 2010). The surveyed geometry of the upstream channel and flow structure at FG1 were input to HEC-RAS, and the HEC-RAS model was calibrated to the Q measurements (Figure B.4). While a power function fit Q measurements better than HEC-RAS for low flow, HEC-RAS fit better for Q above the storm threshold used in analyses of SSY (Figure B.4).

## APPENDIX C. Water discharge during storm events

<Table C.1 here please>

## APPENDIX D. Turbidity-Suspended Sediment Concentration rating curves for turbidimeters in Faga'alu

Turbidity (T) was measured at FG1 and FG3 using three types of turbidimeters: 1) Greenspan TS3000 (TS), 2) YSI 600OMS with 6136 turbidity probe (YSI), and 3) Campbell Scientific OBS500 (OBS). All turbidimeters were permanently installed in protective PVC housings near the streambed where the turbidity probe would be submerged at all flow conditions, with the turbidity probe oriented downstream. Despite regular maintenance, debris fouling during storm and baseflows was common and caused data loss during several storm events. Storm events with incomplete or invalid T data were not used in the analysis. A three-point calibration was performed on the YSI turbidimeter with YSI turbidity standards (0, 126, and 1000 NTU) at the beginning of each field season and approximately every 3-6 months during data collection. Turbidity measured with 0, 126, and 1000 NTU standards differed by less than 10% (4-8%) during each recalibration. The OBS requires calibration every two years, so recalibration was not needed during the study period. All turbidimeters were cleaned following storms to ensure proper operation.

At FG3, a YSI turbidimeter recorded T (NTU) at 5 min intervals from January 30, 2012, to February 20, 2012, and at 15 min intervals from February 27, 2012 to May 23, 2012, when it was damaged during a large storm. The YSI turbidimeter was replaced with an OBS, which recorded Backscatter (BS) and Sidescatter (SS) at 5 min intervals from March 7, 2013, to July 15, 2014 (OBSa), and was resampled to 15 min intervals. No data was recorded from August 2013-January 2014 when the wiper clogged with sediment. A new OBS was installed at FG3 from January, 2014, to August, 2014 (OBSb). To correct for some periods of high noise observed in the BS and SS data recorded by the OBSa in 2013, the OBSb installed in 2014 was programmed to make a burst of 100 BS and SS measurements at 15 min intervals, and record Median, Mean, STD, Min, and Max. All BS and SS parameters were analyzed to determine which showed the best relationship with SSC. Mean SS showed the highest r2 and is a physically comparable measurement to NTU measured by the YSI and TS (Anderson, 2005).

At FG1, the TS turbidimeter recorded T (NTU) at 5 min intervals from January 2012 until it was vandalized and destroyed in July 2012. The YSI turbidimeter, previously deployed at FG3 in 2012, was repaired and redeployed at FG1 and recorded T (NTU) at 5 min intervals from June 2013 to October 2013, and January 2014 to August 2014. T data was resampled to 15 min intervals to compare with SSC samples for the T-SSC relationship, and to correspond to Q for calculating SSY.

The T-SSC relationship can be unique to each region, stream, instrument or even each storm event (Lewis et al., 2001), and can be influenced by water color, dissolved solids and organic matter, temperature, and the shape, size, and composition of sediment. However, T has proved to be a robust surrogate measure of SSC in streams (Gippel, 1995), and is most accurate when a unique T-SSC relationship is developed for each instrument separately, using in situ grab samples under storm conditions (Lewis, 1996). A unique T-SSC relationship was developed for each turbidimeter, at each location, using 15 min interval T data and SSC samples from storm periods only (Figure D.1). A "synthetic" T-SSC relationship was also developed by placing the turbidimeter in a black tub with water, and sampling T and SSC as sediment was added (Figure D.2), but results were not comparable to T-SSC relationships developed under actual storm conditions (Minella et al., 2008) and were not used in further analyses.

The T-SSC relationships varied among sampling sites and sensors but all showed acceptable r2 values (0.79-0.99). Lower scatter was achieved by using grab samples collected during stormflows only. For the TS (not shown) and YSI deployed at FG1, the r2 values were high (0.58, 0.99) but the ranges of T and SSC values used to develop the relationships were considered too small (0-16 NTU) compared to the maximum observed during the deployment period (1,077 NTU) to develop a robust relationship for higher T values. Instead, the T-SSC relationship developed for the YSI turbidimeter installed at FG3 (Figure D.1a) was used to calculate SSC from T data collected by the TS and the YSI at FG1. For the YSI turbidimeter, more scatter was observed in the T-SSC relationship at FG3 than at FG1 (Figure D.1a), which could be attributed to the higher number and wider range of values sampled, and to temporal variability in sediment characteristics. The OBSa and OBSb turbidimeters had high r2 values (0.82, 0.93) and compared well between the two periods of deployment (Figure D.1b).