ENVIRONMENTAL ASSESSMENT

AMERICAN SAMOA GOVERNMENT
DEPARTMENT OF PUBLIC WORKS
OFU-OLOSEGA ROAD UPGRADE PROJECT
AS-F-ER-020(2)

PREPARED FOR
HASTINGS ASSOCIATES INC.
AMERICAN SAMOA

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SUMMARY

The Department of Public Works of the Government of the Territory of American Samoa intends to upgrade approximately 8 miles of existing road on the islands of Ofu and Olosega, American Samoa. This report provides an environmental assessment of the proposed upgrade.

The primary objective is to construct the new road pavement without impacting on or altering the present marine or terrestrial environment in any way. Environmental impacts likely to occur during and post construction can be mitigated during the construction phase of the road upgrade.

Sources of likely environmental impacts consist primarily of:

- During construction  - sedimentation
  - erosion
  - operations impacts, e.g. fuel handling
  - social/village impacts

- Post construction  - erosion of poorly stabilised slopes
  - freshwater runoff
  - social/village impacts

To minimise and eliminate environmental impacts, the constructor must prevent sediment from reaching the sea, mitigate against land slippage and erosion, comply with all Federal and American Samoa Government regulations applicable to construction activities, minimise social impacts, and implement a non-point road drainage system where possible, otherwise drainage should consist of multiple low volume outfalls. Drainage design must also take into account the volumes of runoff likely to be generated by storm events.

The constructor should be ultimately responsible for any environmental impacts induced by construction operations or activities.

To achieve a Finding of No Significant Impact (FONSI), mitigation measures summarised under Recommendations (Chapter 4) should be implemented.

There is currently no 4(f) designated land in Ofu-Olosega.
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S. de C. Cook
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1.0 INTRODUCTION

1.1 Background Information

This report provides an environmental assessment of the proposed road upgrade on the islands of Ofu and Olosega (169° 39' E, 14° 10.7' S) in the Manu'a Islands, American Samoa (Figure 1). The report follows guidelines prescribed by the Federal Highway Administration (FHWA) (Technical Advisory T6640.8A).

Ofu and Olosega are characterized by steep, volcanic mountain sides, small valleys and a narrow coastal fringe (Photo 1). Both islands are surrounded by a single coral reef, generally less than a quarter mile wide.

PHOTO 1: View of Ofu taken from road end, southwest Olosega. Illustrates narrow coastal fringe, steep cliffs and narrow coral reef. The low waipali 1/4 inches from the right hand side of the photo is where the road crosses from the southern rim of Ofu to the northern shore, as it passes around Samoanapea Peak. The Ofu-Olosega roadway is located out of the photo to the right. The proposed National Park unit covers approximately four-thirds of the coastline in the photo, including Samoanapea Peak.

There are two main villages, each bearing the name of the island on which it is located. There is also the small village of Sili, situated on the northwestern shore of Olosega. All villages are connected by an unpaved road (Figure 2).
FIGURE 1: OFU-OLOSEGA - LOCALITY MAP
There is a small harbor at the northwest corner of Ofu (Figure 2) offering limited shelter to small boats and provided a loading and off loading point for the regular sea freight and passenger service from Tutuila. Air Samoa operates a daily air service from Tutuila carrying passengers and freight to Ofu-Olosega, utilizing the concrete airstrip at Vaoto (Figure 2). The service also connects Ofu-Olosega with Tū'a.

Along the southeast coast of Ofu is a proposed Unit of the National Park of American Samoa. Essentially a marine park, this unit encompasses approximately two and a half miles of forested, beach and coral reef, extending seawards to just beyond the reef edge (Photo 1). The beach within the proposed National Park boundary has been described as one of the most beautiful beaches in the South Pacific. The new road and drainage system will be located outside the landward boundary of the proposed park (Figure 2).

The islands of Ofu and Olosega support a population of 500-600, mostly older people and children. The majority of Ofu-Olosega’s working population live on Tutuila or in the United States. Some of the money earned is passed on to their extended families or aiga on Ofu-Olosega. The local population relies heavily on subsistence fishing and food crops, e.g. bananas, taro, breadfruit and coconuts.

The average rainfall is 150-250 inches per annum, with a rainy season from January to March sometimes including November and December. There are an estimated 30 vehicles on these two islands. The islands are subject to low key tourism and weekend visitors, who usually stay at Vaoto Lodge, adjacent to the airstrip. There is the possibility of a future increase in tourist activity on Ofu-Olosega, e.g. ecotours.

There is currently no 4(f) evaluated land on Ofu-Olosega, as defined in FHWA T6640.8A. The proposed National Park unit will constitute 4(f) land once it becomes established. This assessment takes the proposed National Park into account, incorporating mitigation measures to prevent environmental impacts on future 4(f) land.

1.2 Present Road

An unpaved road (Photo 2) runs from Tauga Point on the northwest corner of Ofu, around the southern coast of Ofu, crossing briefly to the northern coast as it passes around Sunu’i’iaoa Peak and across the causeway (Photo 3) to Olosega (Figure 2). The road then divides; one road follows the northwest coast to the village of Sili and the other follows the southeast coast to the village of Olosega (Figure 2). On the northwest coast of Olosega the road terminates approximately one half mile before reaching the northern most point of the island, Leamasili Point. Similarly, on the southwest side where the road passes two rubbish dumps and terminates approximately one half mile from the southern most point of the island, Maga Point. There is approximately one thousand feet of concrete paved road on the steepish grade section around Sunu’i’iaoa Peak.
There is also a rough dirt road continuing from the harbor at Tauga Point (Photo 4) (northwest Ofu), climbing the inside of Tia Ridge, where the road is cut into the hillside, and continuing up to the TV tower on Tumuauma Mountain (Figure 2).

The existing road surface between Ofu Harbor and Vaote airstrip consists of compacted sand and crushed coral through the village, changing to a soil-rock matrix near the airstrip. From Ofu village the road runs parallel to the sea with a strip of vegetation (c.5-30 feet) between the road and the shore. The road continues alongside Vaote airstrip (separated by 6-20 feet of grass) becoming slightly wider (c.15-25 feet) as it follows the coast to Sunu’i Lake Peak. This section of road consists of compacted coral sand, is situated 5 to 70 feet from the shore, with a buffer of vegetation in between, e.g. bananas, coconuts, pandanus, and constitutes the best section of road on Ofu.

The road crossing from the southern shore to the northern shore of Ofu consists of c.1000 feet of recently constructed concrete road and associated drainage. This road, from Sunu’i Lake Peak to the causeway, has been cut, in places, from the hillside. The road surface is a soil-rock matrix or rock with a sand cover. The road varies from 15 to 20 feet wide.

The remainder of the existing road between the causeway and the village of Sili traverses a very narrow coastal fringe and has had to be cut into the hillside or built up along the
forshore. The road consists of a soil-rock matrix, or coral-basalt rubble and sand where the road encroaches onto the beach. The road width varies from 8 to 12 feet.

Successive hurricanes, Tusi (1987), Ola (1990) and recently Val (1991), have heavily damaged the northern shores of Ofu-Olosega. With reference to this project, the road to Sili in the vicinity of the causeway and the road along the northern side of Sunu’i’ao Peak suffered wave damage induced by hurricane force winds and heavy seas.

The road surface from the causeway to Olosega varies from a soil-rock matrix near the causeway, to compacted sand and crushed coral in and around the village of Olosega. The road varies in width, from 15 to 25 feet. The road is adjacent to the sea, with a vegetated buffer in between, except in the village itself where the road moves inland, allowing houses to be built between the road and the sea.

Sloping sections of the present road suffer from erosion and rutting (Photo 5), due to surface water runoff. The TV tower road is inaccessible after rain by virtue of its steepness, road surface erosion and rutting (Photo 6).

The road is currently maintained (with limited resources) by the Ofu office of the Department of Public Works. The road is graded or scraped periodically, larger ruts are filled with sand and roadside vegetation is trimmed.

PHOTO 9: The causeway crossing Asega Stream, joining Ofu and Olosega. Some revetment around the causeway will need to be re-established to repair hurricane damage.
PHOTO 4: Example of present road - bottom of TV' outer road, northwest Ofo, in a usable condition. Colour of soil illustrates different soil type (Oos silty clay) compared to that in photo 2 (Aaus stony silty clay loam). There is minor rutting on this section of the road (not detectable in photo) where runoff water runs down the length of the road.

PHOTO 5: Typical section of road, taken just before entering Ofo village from the south. Foreground of photo shows water erosion, the extent of which is difficult to see from photo. Road runoff runs down this section of road to where it runs across the beach to the sea. Surface runoff from the road was observed to locally discolor the sea during and after heavy rain, here and at other localities.
PHOTO 6: Section of TV tower road showing how it is cut into the hillside and minor road surface ruts, caused by water erosion. This road is still in a usable condition as photographed. Runoff flows down the road and off to the side at corners, dissipating into roadside vegetation.
2.0 PROPOSED ACTION

2.1 Proposed Road Upgrade

It is proposed to construct a paved road over the existing dirt/zoral road from Tauaga Point on northwest Ofu, to the villages of Sili and Olosega. The new pavement will be laid to the end of the Sili road and approximately 50 yards past the garbage dumps on the southern outskirts of Olosega village. Fifteen hundred feet of the TV tower road will also be paved, as a continuation of the road end at Tauaga Point. Approximately 25% of the road will need to be widened to comply with Federal Highway Administration regulation minimum road width of eighteen feet.

At this time it is not intended for the road to be paved through the villages of Ofu and Olosega. However, the possibility of pavement extension through the villages has been taken into account. At the present time the surface of village roads will be graded while road upgrade construction is in progress, to remove potholes and rutting. The causeway between Ofu and Olosega will remain unmodified (Photo 3), except for reestablishment of hurricane damage to approaches and revetment. The road upgrade is estimated to take nine to fifteen months to complete, once construction is underway.

This is the only proposed action, as the position of the road is constrained by the sea, steep cliffs, steep grade and a lack of alternative routes. The only other alternative considered is no action (§2.3). Potential environmental impacts associated with the proposed road upgrade do exist and these are discussed in sections 3.1 to 3.11.

2.2 Justification

The condition of the present road surface increases vehicle maintenance costs, particularly tires and vibration associated problems. Due to a lack of existing roadside drainage, any inclines on the road are subject to water erosion. This leads to rutting, creating a road safety hazard as vehicles often use the whole road width to avoid the worst cutting and potholes (Photo 5). Vehicle access to the TV tower and plantations along the same road, is limited to dry weather or 4WD vehicles. In very wet conditions 4WD access is also limited. This road requires regular maintenance to remove rutting, to permit access during dry weather.

Prolonged heavy rain generates sediment loaded stormwater runoff, eroded primarily from road surfaces. Runoff follows navigable slopes and depressions along the road until it runs over the edge of the road and onto the beach or into roadside vegetation (Photo 3, 5). Some runoff reaches the sea causing discoloration and potential sedimentation along the shore. Dry weather induces a minor dust hazard, e.g. eye and nose irritation, a problem only in the vicinity of housing.
The road to Sili village was partially destroyed by Hurricane Tusi (1987) and Hurricane Ofa (1990) and has undergone only limited repair to make it useable (Photos 7, 8). It is still uneven, has large rocks protruding from the road and occasionally incorporates the cobble beach that dominates the shore. This section of road has recently been damaged further by Hurricane Val (1991).

Upgrading to a pavement road will reduce vehicle maintenance costs, eliminate any dust hazard and eliminate regular sediment input into the marine environment. Road maintenance costs of a paved road will also be reduced as potholes and ruts will no longer need to be topped up with sand after each rain. In addition, it will eliminate the need to remove the sand from beaches and foredune areas, that is used to fill potholes and ruts.

PHOTO 7: Section of hurricane damaged Sili road. Note uneven boulders, uneven surface and that the road is only wide enough for one vehicle, for most of its length.
2.3 No Action Alternative

If the road upgrade does not proceed, current problems associated with the present road, discussed above (§2.2), would remain unchanged and will continue to impact on the environment, e.g. water clarity.

With no upgrade, there would be no construction associated impacts and no construction costs.

As more vehicles are brought to Ofu-Olosega, road usage and therefore road maintenance is likely to increase, if the road is not upgraded.
3.0 ENVIRONMENTAL EFFECTS

3.1 Social

During Construction.
There would be a temporary increase in dust generation and noise during road construction, therefore, the construction crew must minimise distraction and disruption normally caused by trucks and machinery moving through village centres, and the use of explosives. Ideally, water should be sprayed onto road surfaces when necessary to suppress dust, and the need for construction vehicles to pass through villages should be minimised. Public and pedestrian safety must be taken into account while construction is in progress. If rock quarrying for road materials is necessary on Ofu-Olosega, a rock crushing plant will be required. These plants also generate noise and dust. Such plants should be established in areas that will minimise disturbance to nearby inhabitants. Any activities requiring the use of explosives is subject to safety procedures and requirements as per the Occupational Safety and Health Act (OSHA).

Normal road use is likely to be disrupted during road construction. However, most of the local people are looking forward to the new road and will not be unduly concerned by the inconvenience. A small amount of roadside vegetation, e.g. Hibiscus, may be removed by construction activities. This will be minor and vegetation can easily be replaced.

Potential erosion of any cut (battered) slopes must be mitigated during construction, e.g. vegetation, low retaining walls, to prevent post construction subsidence on to the road and causing a potential road safety hazard, as well as generating a cost to clear any soil subsidence. Refer to White & Stearn (1990) for appropriate mitigation options.

Post Construction
A paved road would reduce vehicle and road surface maintenance costs. Vehicles would be able to travel faster and may lead to an increase in motor vehicle and pedestrian accidents where few, if any, presently occur. The new road may also induce an increase in the number of vehicles on the two islands. There are currently about 30 vehicles on Ofu-Olosega. By questioning local residents it was ascertained that five years ago there were no more than 10 vehicles on the islands. Ofu and Olosega do not have a large cash economy, as there are limited opportunities for employment. Local people rely on subsistence fishing and plantation crops. However, most aiga or extended families have people working in Tutuila and the United States. These people may supply the necessary finance to purchase and transport vehicles to the islands. If there was, for example, a 100% increase in the number of vehicles on Ofu-Olosega there would be little or no additional impact. An increase in vehicle numbers may also induce the establishment of a gas station, increasing the risk of potential fuel spill impacts. The safe construction and operation of such an installation is subject to stringent Environmental Protection Agency regulations.

A paved road would eliminate any dust hazard that is associated with the present unpaved road and would facilitate quieter travel on the road.
There are a small number of people employed by the Department of Public Works, Ofu office, to maintain the present road surface as best they can, with very limited resources. Road maintenance consists of filling the worst ruts and pot holes with sand, occasional grading and trimming roadside vegetation. A new paved road would require much less surface maintenance and may lead to a loss of some jobs, unless alternative work can be assigned, e.g. trash collection, clearing drains, maintaining roadside vegetation and slope stabilisation maintenance.

3.2 Land Tenure

During Construction
The proposed road upgrade is intended to follow the centre-line (horizontal alignment) of the existing road. The TV tower road may be moved very slightly to remove some small, unnecessary corners and projections along the roadside. Cutting (fattening) of roadside slopes may encroach minimally onto communal land. However, there should be no problems with land tenure or ownership as local people want the new road.

3.3 Land Use

During Construction
The present road will require some widening to accommodate the Federal Highway Administration minimum road width of eighteen feet, e.g. the stretch of road between Stumiao Peak and the Ofu-Olosega causeway. Road widening may result in the loss of some roadside vegetation. This is considered negligible as roadside vegetation, e.g. guava tree (fu'a fu'a) (Kleinhovia hospita) and beach hibiscus tree (fu) (Pariticia dillenii), has been severely modified from its natural state. In addition, loss of food plants, e.g. bananas, will be minimal and can easily be replanted. Despite this, it is preferable to maintain as much vegetation as possible between the beach and the road to act as a buffer to road runoff and potential sediment loss during construction. Where the option is available, road widening should extend landwards rather than seawards.

Post Construction
Access up the lower section of the TV tower road (Photo 4, 6) will be facilitated by the fifteen hundred feet of paved road covering the initial steep climb. The impact of improved access to Tumonbualu Mountain is unknown. However, easier access may lead to increased land clearance for horticulture and house building, particularly on the flat section of land at the top of the new paved road, and provide easier initial access for hunters to bat and bird populations in the vicinity of the road. It should be noted there is a further steep section of road beyond the end of the proposed paved section. This may continue to limit access to the TV tower itself and plantations further up the road, by virtue of its steepness and water erosion problems of the road surface.
3.4 Wetland

During Construction

There are two wetland areas on Ofo-Olosega (R. Hansen: pers. comm.). The present road passes between the airstrip and Vauto Marsh, a small wetland on the southernmost point of Ofo. A second wetland area is located on the landward side of Olosega village, and will be unaffected by the road construction (Figure 2).

While construction is in progress appropriate mitigation measures must be taken to avoid upsetting historical stormwater drainage into Vauto Marsh, to avoid altering the present plant and animal community. Stormwater runoff from the stretch of road running parallel to the airstrip could be drained into the marsh, provided water percolated into the marsh from numerous points, as opposed to two or three large point outlets. Such a drainage system would simulate present natural drainage patterns. Wetland systems are also recognised as valuable groundwater recharge systems (Wakamura 1984), and Ofo-Olosega local water supply is from groundwater.

During construction the use of heavy equipment may cause some noise and vibration disturbance to animal species using the Vauto wetland area near the roadside, particularly the purple swamp hen or manuili (Porphyrio porphyrio samamensis). However, Vauto Marsh is large enough that disturbed species could move away from the road and remain within the marsh area. The swamp hen is not an endangered or threatened species.

3.5 Coastal Zone

During Construction

The most likely source of environmental impact during construction is from sediment being eroded from exposed soil surfaces by stormwater runoff, e.g. the road or cut slopes, and being transported to the sea. The impact of increased sedimentation is probably the most common and serious human induced influence on coral reefs (Grigg and Dollar 1990). Excess silt and sediment can be detrimental to the health of a range of marine organisms, e.g. coral, tube worms and molluscs, in addition to reducing water clarity. There are no recorded fine sediment tolerance levels for marine organisms, as tolerance varies among species and is generally unknown due to a lack of field research. Typically clean water species are intolerant to fine suspended sediment, or silt settling onto the seafloor or reef, and large areas of coral have been killed simply by increases in sedimentation (Grigg and Dollar 1990), though the amount of sediment required to adversely influence coral is related to a variety of other physical factors, e.g. tidal currents.

Where construction activities disturb the soil, or generate fine sediment such as initial road preparation, laying base course, cut and fill, quarrying, aggregate fines, slope cutting and construction of gullies, bike lanes, truck stops and turnmounds, the constructor must implement mitigation measures to prevent sediment entering the marine environment. Excess fill must not be dumped over the side of the road to prevent damage to archaeological sites (§ 3.8) or interference with potential turtle nesting sites. Excess fill must be moved to dump sites specified by the project engineer and approved by the Environmental Protection Agency,
where it will not constitute an environmental impact hazard or inconvenience, e.g. old garbage dumps.

Several areas on Ofu-Olosega are susceptible to severe water erosion, based on Soil Conservation Service data, e.g. TV tower road area. The soil survey (Nakamura 1984) tabulates and discusses other soil parameters pertinent to this project including fine particle component, erosion factors, suitability for road fill and organic content and should be consulted in relation to construction.

Construction must include appropriate mitigation measures to ensure land slippage and erosion does not occur once the road upgrade has been completed. A study on Tutuila indicated that soil units 2 and 4 were the most susceptible to erosion, usually in association with slopes greater than 60% and natural vegetation disturbance (White & Stearns 1990). Such areas occur on Ofu-Olosega, e.g. Sunu’iao Peak, and the TV tower road. Slippage or erosion may create a road safety hazard and a potential sediment hazard. A suitable program should be initiated whereby slopes and cuts along the road are stabilised during construction, to avoid water erosion damage. Establishment of native and non-invasive vegetation on cut slopes, etc., should prevent future erosion problems. Only that part of the site used in construction should be disturbed as approximately 30% of soils through which the road passes are susceptible to moderate or severe water erosion. (Nakamura 1984).

Alternative mitigation measures can be found in the Tutuila landslide mitigation study (White & Stearns 1990). Since the paved road is in place, and slopes have been stabilised, sediment runoff from the road surface would be negligible.

There are some naturally occurring streams on Ofu-Olosega (Figure 2) but these only carry water after prolonged heavy rain. These should be left untouched by construction to avoid altering the present natural drainage system.

Pest Construction

Stormwater runoff currently flows off the road at many points, i.e. a non-point source. A proportion is absorbed naturally into the road surface, the volume absorbed varying according to soil type and soil saturation. The new paved road will collect and accumulate freshwater runoff in its drainage system. In designing the new road drainage, high volume point outfalls, e.g. large culverts, should be avoided. High volume freshwater inputs to the sea may alter salinity by dilution, and can induce beach erosion, by sand scouring, in the vicinity of the outfall. Typically, many marine species are unable to tolerate even minor salinity fluctuations, for example, Jokiel (1985) found that various environmental disturbances, including lowered salinity, induced abortion of developing larvae of the coral *Pocillopora damicornis* in Hawaii. The effect of lowered salinity is most obvious where natural openings in coral reefs occur adjacent to river mouths, where coral is unable to tolerate the local drop in salinity induced by outflowing freshwater. As with sediments, salinity tolerance varies among marine species and is generally unknown for natural populations.

The most preferred drainage system is one where the road surface is sloped landwards and surface runoff either percolates naturally into roadside soil, or is led into some type of diffusion system, e.g. rock filled trenches, vegetated buffer zones, energy absorbing devices, allowing water to eventually percolate naturally out of the beach. If a diffusion system is not
employed, e.g. where the landward side of the road shuts a steep cliff, it is preferable to maximize the vegetation buffer between outfalls and the beach to reduce stormwater outflow speed, giving it more time to percolate naturally into the soil. If outflow speed is not reduced, stormwater will tend to pick up soil and is more likely to reach the sea carrying sediment, a situation that should be prevented by appropriate drainage design. Where outfalls are used, multiple, low volume outfalls are preferable as they spread freshwater output, create less scouring problems and are easier to deal with aesthetically, in terms of disguising the outfalls.

In a community where seafood is an important part of the diet, the reef system around Ofu-Olosega is an irreplaceable resource, and should be protected at all costs.

3.6 Water Quality

During Construction

Local freshwater supply for residential use is from groundwater. Depending on construction methods, e.g. concrete production, a large quantity of freshwater may be required. If construction demands for freshwater in any way alters or disrupts local supply, e.g. water quality and volume, alternative arrangements should be instigated either in terms of methodology or freshwater source. Refer Appendix II.

Post Construction

There are approximately 30 vehicles on Ofu-Olosega. Based on published data the toxicity of pavement surface runoff caused by vehicles (Carlin 1990) will be negligible, taking into account the possible increase in the number of vehicles on Ofu-Olosega and potential increased road usage.

3.7 Threatened and Endangered Species

During Construction

There is potential for the threatened green (or black) turtle (Chelonia mydas) and the endangered hawkbill turtle (Eretmochelys imbricata) to use the beaches around Ofu-Olosega for egg laying (T. Mooteil, pers. comm.). The green turtle has previously nested in small numbers on the beaches of Ofu (ASCR1 1989). Road construction activities must not affect nesting sites on Ofu or Olosega that could be used by turtles, i.e. beaches of sand or coral rubble which extend above the high tide mark. These two turtle species are protected under the Endangered Species Act 1973, United States Federal Government.

Post Construction

The 1500 feet of all weather road at the start of the TV tower road (northwest Ofu) will improve hunter access to Tamaitimu Mountain. Increased hunting could affect the population status of the two species of fruit bat on Ofu, the Samoan fruit bat (Pteropus samoensis) and the Tongan fruit bat (Pteropus tonganus). The Samoan fruit bat has been listed as a
"threatened species" and the Tongan fruit bat has been listed as a "species of special concern" by the American Samoa Natural Resources Commission.

Improved hunter access may also influence the population status of the lupe or pacific pigeon (Ducula pacifica), the manuatu or many-colored fruit dove (Philinopus persnalli), and the purple-capped fruit dove (Philinopus porphyrocerus). The sheath-tailed bat (Emballonura semifusca) has been known to occur on Ofu-Olosega but has not been officially sighted since Hurricane Ofa (1990) (T. Morell, pers. comm.). The sheath-tailed bat is pending classification as a "threatened species" by the American Samoa Natural Resources Commission. These species of pigeon, dove, and bat are not listed under the US Federal Endangered Species Act.

On the reefs around Ofu-Olosega grow blue coral (Heliopora coerulea). This is the most eastern known occurrence of blue coral in the Pacific (B. Ponwith - pers. comm.). The reefs around Ofu-Olosega, particularly along the proposed National Park unit, have been described as one of the most pristine in American Samoa (B. Ponwith, P. Craig - pers. comm.).

3.8 Archaeological

The road construction may encounter and disturb archaeological sites (e.g. Photo 9), located in or alongside the road. A separate report has been compiled dealing specifically with archaeological problems associated with this project. Refer Appendix III.

PHOTO 9: Example of a prehistoric site; this photo shows the top of a grinding rock, c. 4'6" (on top), standing c. 3' high (approximately 9 tons). The depressions in the rock surface were made by early Samoan people as they ground their foodstuffs to shape with hand and water. This particular rock would not be affected by the road upgrade, but there are others that may be damaged or disturbed.
3.9 Visual

During Construction

The road drainage system should be constructed such that it works effectively and efficiently while remaining hidden. Drainage systems that avoid compromising visual values should be employed, e.g., French drains, sloped road, infiltration pits and trenches, and paved furrows. This is particularly important alongside the proposed National Park area, but is also important along the rest of the road. Large outfall pipes are visually hideous (Photo 10) and alternatives should be used, e.g., French drains or the outfall ends suitably concealed.

Construction of pullouts and lookouts, particularly along the proposed National Park area, should avoid altering the natural aspect of the coast.

PHOTO 10: Stream outfall pipe which empties onto the beach, just south of Ojo village. This photo highlights the unsightly nature of large visible outfalls.
Construction

Red hibiscus (*Hibiscus rosa-sinensis*) and spider lily (*lantalotao*) (*Crinum asiaticum*), or other suitable plants grown along the roadside would serve to camouflage roadside drainage systems and the Ofu-Olosega garbage dumps, which are visible from the road.

Trash is a problem in Ofu-Olosega (Photos 10, 11), particularly aluminum cans. Culverts and drains act as trash traps, making them more unsightly and eventually allowing trash to be washed onto the beach. If culverts and drains are avoided in the design of drainage systems, the road and its associated drainage will be less inclined to accumulate trash.

**PHOTO 1**: It is not uncommon to find household garbage dumped into roadside vegetation, highlighting the trash disposal problems on Ofu-Olosega.

3.10 Construction

**During Construction**

Construction activities which may have an effect on the environment are discussed in relation to their specific areas of impact. Refer sections 3.1 to 3.9.

The pavement itself may be constructed of concrete, asphalt or chipseal. Details of each of these materials and their relative advantages and disadvantages will be discussed in a separate road engineering report. In general, concrete is the preferred pavement material as it has a longer life expectancy, greater impact strength, i.e. impact from falling rocks, and requires
little, any maintenance. Concrete is chemically stable when set, is physically stable on steep slopes and ages to an aesthetically benign grey. In contrast, asphalt and chipseal are less easily repaired when potholes develop as specialised materials, e.g. a supply of asphalt, are not readily available on Ofu-Olosega. Asphalt and chipseal require a binder to be sprayed onto the basecourse, prior to laying the pavement material, or aggregate. If there is any rainfall after the binder has been laid and before the next surface preparation can be laid, the binder may wash off the road surface into adjacent vegetation or the sea. Asphalt and chipseal may also have a shorter life expectancy. The prime disadvantage with concrete is it requires a large supply of freshwater during construction for concrete production (refer §3.6, Appendix II).

If crushed coral aggregate is used in making concrete, the aggregate will need to be washed with freshwater to remove salt, as salt is detrimental to the long term integrity of concrete. The freshwater supply on Ofu-Olosega has already been discussed (§3.6). There would also be potential problems associated with the disposal of salt contaminated freshwater. If coral aggregate was used in concrete, waste water from aggregate washing operations should be drained into infiltration pits near the shore and well away from any vegetation that would be adversely affected by salt contaminated water. An alternative form of aggregate that does not require washing is preferable.

There are two possible quarry sites on Ofu-Olosega (Figure 2). The site situated near Tauga Point, northeast Ofu, would create the least environmental impact of the two sites, by virtue of its location in relation to housing and plantation areas, but would disrupt Ofu village win trucks driving through the village. The contractor also has the option of importing cinder sand and crushed/graded rock aggregate from Tutuila. Coral aggregate may possibly be obtained from dredgings on Tutuila or possible future dredging of Ofu Harbor.

The Sili road and causeway approach road from Ofu, will require some earthworks and pavement to repair damage caused by Hurricanes Tusi (1987) and Ofa (1990) (Photos 7, 8), and recently by Hurricane Val (December 1991).

Fill material, including rock must not be taken from any beach or shore to avoid disturbing intertidal organisms and animals which may use the beach, e.g. turtles, coconut crabs. It is suggested that where the road is widened to the required eighteen feet, any rocks and gravel removed should be used as roadfill.

Drainage systems should remove and disperse rainwater from the road as quickly as possible to reduce the possibility of serious flood damage or water erosion during severe storms and excessive rainfall.

Sedimentation and erosion during construction will be reduced if the road is constructed during the dry season. Slope stabilisation must be established and road grading operations completed, with the surface stabilised, outside of the expected rainy season. This would facilitate mitigation of any environmental impacts induced by stormwater runoff during road construction.

Fuel will be transported to Ofu-Olosega to operate construction vehicles. Fuelling points should not be located too close to the shore or wetland areas, or near any natural drainage
areas to avoid potential environmental impacts, as petroleum products are toxic to many living organisms. Appropriate mitigation measures must be implemented, e.g. secondary containment, floating booms, to deal with a possible fuel spill or leakage, on land or on the water, and while fuel is unloaded in Ofu Harbor.

The constructor and project engineer should ensure that construction vehicles and equipment are used only for official construction work. There is the possibility of local people approaching construction crew to push through tracks for them or clear vegetation etc., in return for various gratuities. Clearing of vegetation etc., without taking precautions against slippage and water erosion, is a prime environmental hazard, and should be prevented.

The existing main power cable is suspended on poles along the side of the road. It has been suggested that the power cable be buried alongside the road while the road upgrade is in progress, particularly along the proposed National Park boundary, on aesthetic grounds. This would involve digging a trench, 2-3' deep and burying the cable in a concrete conduit. Laying the cable would have no additional impact on the environment, except in relation to subsurface archaeological sites. Where subsurface excavation occurs care must be taken to ensure recovery of any archaeological artifacts or information that may be unearthed by the excavation. Refer to the separate archaeological report (Best 1992) for recommendations with respect to subsurface excavations, and Appendix III.

3.11 Summary Table

This is a tabulated summary of potential environmental consequences as listed in FHWA T6640.8A and their applicability to this project. Environmental impacts and mitigation measures are discussed more fully in the text of chapter three and listed in the recommendations of chapter four. N/A = not applicable.

<table>
<thead>
<tr>
<th>Environmental Consequences</th>
<th>Environmental Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>- temporary dust and noise hazard; reduced by new road, to less than present road.</td>
</tr>
<tr>
<td></td>
<td>- temporary disruption of normal road use.</td>
</tr>
<tr>
<td></td>
<td>- minor loss of roadside vegetation; easily re-established.</td>
</tr>
<tr>
<td></td>
<td>- road safety hazard associated with land slippage onto road; mitigated by slope stabilization.</td>
</tr>
<tr>
<td></td>
<td>- reduced vehicle and road surface maintenance and associated costs.</td>
</tr>
<tr>
<td></td>
<td>- potential increase in road accidents.</td>
</tr>
<tr>
<td></td>
<td>- potential increase in number of vehicles.</td>
</tr>
<tr>
<td></td>
<td>- possible loss of jobs, primarily road maintenance crew; re-assign road maintenance tasks.</td>
</tr>
<tr>
<td>Land Tenure</td>
<td>- road follows present road; no problems with land tenure</td>
</tr>
<tr>
<td>Farm Land</td>
<td>- minor loss of roadside vegetation; vegetation not virgin and easily re-established.</td>
</tr>
<tr>
<td></td>
<td>- improved access to lower Tumutum Mountain, possibly leading to more forest clearance and habitat loss.</td>
</tr>
<tr>
<td>Relocation</td>
<td>Refer Land Use</td>
</tr>
<tr>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Economic</td>
<td>Refer Social</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>J oint Developm ent</td>
<td>N/A</td>
</tr>
<tr>
<td>Pedestrians/Cyclists</td>
<td>Refer Social</td>
</tr>
<tr>
<td>Air Quality</td>
<td>Refer Social</td>
</tr>
<tr>
<td>Noise</td>
<td>Refer Social</td>
</tr>
</tbody>
</table>
| Water Quality  | - construction demands for freshwater may influence residential supply (see Appendix II).
|                | - no toxic road runoff.                         |
| Permits        | Appropriate permits to be applied for by Department of Public Works, American Samoa Government. |
| Wetland        | - new road pavement drainage should emulate historical drainage patterns into Votu, Marsh to avoid any changes in species composition. |
| Water Body Modification and Wildlife | N/A                              |
| Floodplain     | N/A                                              |
| Wet and Scenic Rivers | N/A                        |
| Coastal Barriers | N/A                                              |
| Coastal Zone   | - sediment loaded stormwater should be prevented from reaching the sea; mitigate prior to and during construction, e.g. no dumping of fill or spoil on beaches, slope stabilization.  
|                | - negligible sediment runoff when completed road is in place.  
|                | - large volume of freshwater entering marine environment may alter salinity levels near outfall; encourage natural drainage or multiple, low volume outfalls. |
| Threatened and Endangered Species | - potential for some impact, refer §3.7 and recommendations. |
| Historical and Archaeological Preservation | - refer separate report (Ran 1992) and Appendix III. |
| Hazardous Waste Sites | N/A                                           |
| Visual         | - road drainage systems are visually unappealing and should be camouflaged.  
|                | - avoid imposing on natural aspect of proposed National Park area.  
|                | - concrete is more aesthetically neutral than, for example, asphalt. |
| Energy         | N/A                                              |
| Construction   | - pavement material has some environmental implications (refer discussion §3.10).  
|                | - if crushed coral aggregate is used in concrete, there are problems associated with washing and disposal of waste water; use alternative type of aggregate.  
|                | - quarrying activities on Ofu Or Otoga may disturb or distract local residents.  
|                | - removal of fill from any beach may enhance beach erosion and disturb organisms which use the beach.  
|                | - construction will have greater impact if undertaken in the wet season.  
|                | - potential hazards associated with transport, storage and handling of fuel and explosives. |
4.0 RECOMMENDATIONS

The following mitigation plan is recommended to minimise or nullify potential environmental impacts. Figures in brackets relate to pertinent discussion sections.

4.1 Village Areas

○ Dust suppression in villages by spraying water on the road as required during construction (§3.1).

○ Consideration of pedestrian safety, particularly by adherence to Federal Highway Administration road safety construction regulations (§3.1).

○ Any night construction activities must be negotiated/cleared by the constructor with village authorities, including construction vehicle traffic through village centres (§3.1/3.10).

4.2 Construction - Material

○ No road fill material should be removed from any sea shore or beach (§3.5/3.7/3.10).

○ No road fill material should be removed from the road or adjacent to the road, without confirming the absence of sub-surface archaeological sites by a qualified archaeologist, and until data recovery is completed. Refer Appendix III.

○ Where freshwater is required for construction purposes, e.g. concrete batching plants, washing coral aggregate, washing equipment, the constructor must coordinate with the water supply authority, American Samoa Power Authority (ASPA). The quantity and supply rate of freshwater for construction activities, and the disposal of waste water, requires ASPA coordination (§3.6/3.10). Refer Appendix II.

○ Construction demands for freshwater must not be detrimental to the quality and quantity of local residential or existing groundwater supply, e.g. salinity levels (§3.6). Refer Appendix II.

○ Crushed coral aggregate for concrete production is not desirable as it requires freshwater washing to remove salt (see above recommendations). An alternative type of aggregate is preferable, e.g. crushed rock (§3.6/3.10).

○ Concrete is the most suitable pavement material by virtue of its durability and aesthetics, and is chemically stable when set (§3.10).
Storage of road building materials, e.g. briquettes, cement, etc., must include measures to mitigate any potential impacts, e.g. secondary containment around drums containing liquids (§3.10).

4.3 Construction - Operations

Construction crews must, where possible, avoid damage to vegetation and the environment in general. Any damage must be repaired or rectified at the time of construction, to return the damaged area to at least its original condition, e.g. roadside vegetation (§3.9/3.10).

Road grading and cutting of slopes (battering) should be initiated during the dry season (approximately April to October), and completed before the start of the following wet season (November-December) to minimize sediment loads in stormwater runoff and water erosion (§3.5/3.10).

Any cutting, excavating and levelling operations on the road surface must confirm the absence of sub-surface archaeological sites by consultation with a qualified archaeologist. Refer Appendix III (§3.6/3.10).

Roadside slopes must be mitigated, e.g. planting native vegetation, to minimize erosion and slope subsidence, as soon as possible after cutting slopes (§3.1/3.5/3.10).

Where vegetation is used for long term slope stabilisation, it is preferable to use native plant species which occur on Osi-Ologea (§3.1/3.5/3.10).

Fuel handling and storage is subject to United States Coast Guard (USCG) and Environmental Protection Agency (EPA) codes and regulations, as the road is close to the sea and fuel spillage is likely to have a negative impact on marine and terrestrial flora and fauna (§3.10).

Explosives transport, handling and storage is subject to USCG and Occupational Safety and Health Act (OSHA) safety codes and regulations.

Under no circumstances must any spoil or excess fill be dumped over the sea side of the road, or onto the beach (§5.5/3.7).

Under no circumstances must any spoil or excess fill be dumped unless the dump site has been designated by a qualified archaeologist or project engineer (§3.5/3.7). Refer Appendix III. Contractor may require permitting for each dump site.

Stockpile areas for construction materials must be designated by a qualified archaeologist or the project engineer to prevent any impacts on sensitive areas, e.g. archaeological sites. Refer Appendix III.

Under no circumstances must any other construction work be undertaken, e.g. vegetation clearance, private work, etc., other than work directly related to the Osi-Ologea road upgrade project, unless cleared by project engineer, and subject to appropriate permitting authority.
Transportation of equipment and personnel to and from Ofu-Olosega must not disrupt local usage of the regular sea and air service to and from Ofu-Olosega.

Project engineer should consider periodic monitoring by a qualified biologist to ensure compliance with mitigation recommendations.

All construction activities are subject to appropriate United States Federal and American Samoa Government statutes and regulations (§3.10).

4.4. Construction - Methods

Drainage systems must employ techniques which encourage non-point drainage or utilise multiple low volume outfalls. Drainage systems that do not compromise aesthetic values should be used wherever possible, otherwise drainage components should be camouflaged, e.g. native vegetation (§3.4/3.5/3.6/3.7/3.9/3.10).

Drainage of road surface runoff into Va'oto Marsh should emulate current natural drainage patterns to avoid any alteration of wetland ecology, subject to Environmental Protection Agency and Development Planning Office/American Samoa Coastal Management Plan regulations (§3.4).

Any construction activities which disturb soil, e.g. road surface preparation, must incorporate sediment management techniques to prevent sediment entering the marine environment (§3.5).

Once the sub-base of the road has been graded, in preparation for laying basecourse, sub-base surface must be stabilised, e.g. compacted, to prevent water erosion of sub-base surface (§3.5/3.10).

4.5 Conclusion

Provided the above mitigation measures are implemented for the Ofu-Olosega road upgrade project, there should be no adverse impact on the marine or terrestrial environment of Ofu-Olosega. Refer Appendix IV.
REFERENCES


ESTIMATION OF THE FRESHWATER DEMANDS FOR CONCRETE PRODUCTION

Mr. Lee Hastings

An estimation of construction water demands for concrete batching operations has been determined. Water demand can be divided into volume and rate of usage.

The amount of concrete laid each day is assumed to be similar, if not the same, to a recent concrete road construction at Oneno, eastern Tutuila (American Samoa).

Amount of Water per Cubic Yard of Concrete

This is directly related to the amount of cement required per cubic yard of concrete. Concrete for 28 days (at 3000 psi), with five eighths of an inch of aggregate, the following calculations can be performed (Merritt 1983).

One bag of cement = 94 lbs, and 8 bags of cement are required per cubic yard of concrete. Hence, one cubic yard of concrete requires 94 x 8 = 752 lbs of cement.

With a water/cement ratio of 0.55 by weight (Merritt 1983 - Table 8.2), the weight of water per cubic yard = 752 lbs x 0.55 = 413.6 lbs (US gallon = 8.35 lbs).

Therefore, volume of water (gallons) per cubic yard = 413.6 lbs/8.35 lbs = 49.5 gallons per cubic yard.

Hence, one cubic yard of concrete uses approximately 50 gallons for any batching operation.

Volume of Water Required for Concrete Road

The contractor on the Oneno road project laid between 100 and 150 feet of concrete road per day, with a road cross section of 10 square feet. The volume of concrete per linear foot of road = 10 cubic feet = 0.37 cubic yards.

If the contractor places 150 feet of road per day, the following quantity of water would be required.

Volume of water per linear foot of road length = 0.37 x 50 = 18.5 gallons.

Therefore, volume of water for 150 feet of concrete road = 18.5 x 150 = 2775 gallons.

Hence, assume contractor will require 3000 gallons per 150 foot length of road (i.e. one day of laying concrete road), allowing for water for washing and wetting of basecourse etc.
Allowable Water Usage on Ofu-Olosega

Based on a water usage of approximately 3000 gallons per day, the American Samoa Power Authority was consulted and indicated that contractor demands would not effect residential supply and groundwater salinity levels would not be affected by contractors water requirements.

Summary of Discussion with Jim Allison (Dec 13, 91) on Aspects of Fresh-Water Usage on Ofu-Olosega.

Reservoirs
Ofu 65 000 gallons (one reservoir).
Olosega 65 000 gallons (one reservoir).

Wells
Ofu Two active wells, both in use.
Olosega Two active wells, one in use.

Pumping Rates from Wells to Reservoirs
Ofu 80 gallons per minute.
Olosega 50 gallons per minute.

Residential Usage
Ofu 660 000 gallons per month.
Olosega 580 000 gallons per month.
Average of 20 000 per month per household, assuming six persons per household.

Salinity of Existing Water Supply
Ofu < 50 parts per million.
Olosega < 700 parts per million.
Salt can be traced at 200 parts per million.

Construction Water Requirements
Usage of 3000 gallons per day would not have an appreciable effect on salinity levels in residential water supply on either Ofu or Olosega. Water could be replaced by extra pumping. For each island, this would take:
- Ofu = 3000 gallons/80 gpm = 37.5 minutes.
- Olosega = 3000 gallons/50 gpm = 60 minutes.

Water could be pumped at night. As concrete would probably be laid from Olosega, towards Ofu harbor, most if not all freshwater for construction would have to be obtained from Ofu. This would be acceptable if the contractor coordinates with the American Samoa Power Authority.

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APPENDIX III

ARCHAEOLOGICAL REPORT - SUMMARY AND RECOMMENDATIONS
Dr Simon Best

The Ofu-Olosega Highway Archaeological Survey located 23 sites close to the road. These were described, their importance evaluated, the likelihood of adverse effects from the road construction assessed and recommendations made for mitigation.

Four sites were recognised as warranting preservation, due to their value in illustrating aspects of prehistoric Samoan life.

Recommendations were made both for archaeological and construction activities.

Summary of Recommendations
1. Protection of archaeological sites during construction work.
2. Archaeological awareness program for all construction personnel.
3. Coordination of the four main parties in the project on aspects of mitigation.
4. Mitigation between constructor, American Samoa Government archaeologist and local people on any archaeological excavation or relocation of archaeological features, e.g. graves, grinding stones.
5. Attention concerning archaeological sensitivity of Toaga flat area.
6. Toaga rubbish dump: feasibility as an off-road construction facility.
7. Recommendations for underground power cables in the proposed National Park.
8. Attention concerning archaeological sensitivity of the Va'atoi flats.

Refer to the archaeological report for further details.
HURRICANE VAL

Hurricane Val struck American Samoa on December 7, 1991. On the islands of Ofu and Olosega there was reported damage to Ofu Harbor and the northern shores of both islands, in addition to road and property damage. A section of road on the Ofu side of the causeway and revetment around the shore abutments was removed or displaced. When the causeway was built (1981), it was constructed one span short on the Ofu side, due to a structural member being broken. The lost span length was made up by extending and building up the road on the Ofu side. Hurricane Val has effectively removed the road and causeway revetment on the Ofu side, rendering the causeway unusable. Consequently, the approach to the causeway and associated revetment and shore protection will need to be re-established.

Suitable consideration should be given to determine if the original lost span should be rebuilt and replaced to maintain the channel as wide as it is now or whether the road be reestablished, as it was prior to Hurricane Val. This section of the causeway approach road has suffered hurricane damage before, e.g. Ofa (1990). It is possible that potential storm damage would be reduced if the lost span is replaced, thereby maintaining Asua Strait at its natural width.

Despite the option taken, recommendations applied to the road upgrade project should be enforced in relation to necessary road rebuilding, revetment, etc., e.g. no fill of rock removal from any beach. Any construction materials must be obtained from an approved source, designated and/or cleared by appropriate authorities.