**LAGI 2025 Fiji Narrative**

**1. Concept Narrative**

* Discuss materials, design concept, visitor and community experience, co-benefits, shared land uses, and any other important aspects of your design.

Land Sails celebrates Fiji’s sailing culture and local knowledge to create an installation of solar sails above Marou Village. Located in a remote archipelago with limited contribution to modern carbon production, Marou nevertheless finds itself on the front lines of the climate crisis—facing intensified storms, rising sea levels, and ocean acidification. Land Sails bridges old and new ways of knowing offering a regenerative paradigm for progress, through solar electrification, water and habitat creation.

Building on local knowledge of sailing vessels, Land Sails is a string of cloth solar sails, arranged lightly on the land in a series of modular units. The sail references the triangular shape of Camakau and Drua vessels arranged as migratory birds in flight. The supporting structure is inspired by Mangrove roots and animal vertebrae. Each unit is human scaled to be compatible with the uneven terrain and sensitive to the building sizes in traditional Fijian villages and modern Marou. Together Land Sails form a string of sails like sea birds flying in formation following the solar path.

The main solar media is flexible cloth thin film solar power arrays which have been used on sail boats and in military and aerospace applications making them uniquely suitable to harsh conditions. The modular units are designed to be maneuvered by one or two people familiar with sailing vessels, lowering the sails for storms or manipulating them to respond to seasonal sun angles.

The triangular shape of traditional Fijian sails allows both light and shadow to interplay at the ground plane so plants can thrive under the solar installation. The design site will become an environment for a new seasonal wetland park with walking trails and agriculture plots. The space under the sails creates informal shady gathering spots for activities such as biochar workshops converting abundant coconut waste into a valuable soil amendment. The wetland park will be engineered to fan out and slow the flow of water coming down Vatu Rua during the rainy season. Planted bioswales of native plants adapted to fluctuations in rain fall will create habitat for pollinators and birds. Slow water stops erosion, keeping precious topsoil on land where it is beneficial for agriculture while mitigating algae blooms and coral bleaching in the ocean. Percolating freshwater on island recharges the unconfined aquifer tying into the existing bore hole infrastructure while also protecting the water reservoir from mosquitos and evaporation. Recharging the unconfined aquifer also keeps differential pressure to rising ocean water so that the existing boreholes are not infiltrated with salt water. With solar power, pumps can now be electrified and withdraw water from below ground bore holes to be filtered/treated and stored in enclosed storage tanks at point of use in the Village.

Sitting quietly on the hillside above Marou Village, Land Sails is based on traditional sailing knowledge and land practices, using science and research together for the creation of energy, water and habitat for humans and all creatures.

**2. Technical Narrative**

* What technologies does your design incorporate? Why did you choose them?
* How much energy and water does your installation generate each year?
* What are the system inputs? (for example, sunlight or rainwater)
* What are the system outputs? (for example, electricity or clean drinking water)

Land Sails utilizes flexible cloth thin film CIGS (Copper, Indium, Gallium, Selenide) solar power arrays with the following technical advantages:

* Best power to weight ratio, 2x - 5x lighter than conventional silicon solar panels.
* Shock, shadow and dirt proof - flexible PV panels have 60 diodes/1.8m2 panel vs
3 diodes for silicone panels.
* Heat resistant, only about 10% loss of efficiency at 55-60C and no air cushion required.
* Operational from dawn to dusk even in cloudy skies.
* No micro cracks, which can happen on shipment, installation and over time on silicon panels.
* Ultra-low carbon footprint, 10-15 gr of CO2/kWh, 3X lower than silicon panels.
* Light Weight 1.9kg/m2 for maneuverability/shipping.
* Easily installed/ deinstalled for storm events.
* Regional engineering services with Cat 5 cyclone experience.

**Solar Area Calculation**

(75,000Wp) / (260Wp /panel) = 288.46

288.46 / 23 sails = 12.54 or 13 panels/sail

(13) x (20.2 ft.2/panel) = 262.6 ft.2/sail

(23 sails) x (13 panels/sail) x (260Wp/panel) = 77,740Wp

Note: Range of efficacy is 260-280 Wp/panel

Land Sails will feed into an affordable carbon-based sustainable battery whose cost/kWh is 1.8 times lower than lithium. LiFePO4 is an alternate readily available battery option.

Land Sails will be installed on Bitu Dina native or naturalized bamboo frames. Working with the community we will identify the type of local bamboo most suitable for the proposed structure.

Our design approach took inspiration from the following natural systems:

* Animal vertebrae to design a linked structure creating stability for a larger framework while using an articulating base that responds to the topology.
* Black Mangrove/Dogo to firmly root the base with a bottom-heavy structure holding the conduit preventing chances of toppling or being blown free in the wind, along with a flexible frame with multiple spread base points.
* Migratory birds flying formation to position the modular units slightly to the side and behind the previous frame reducing drag with a co-benefit of limiting shadows on the solar array.

Surrounding Land Sails will be an engineered native plant wetland that will allow the two primary stormwater runoff channels to be “fanned” out so that both rainwater and topsoil remain on island.

 **Watershed Area Calculation**

(1,303,250 ft.2 approx.) x (6.29 ft. annual rainfall 2020-2024) x (7.48 gal/ft.3) = 61,316,870 gallons/year

 **Competition Area Wetland Calculation**

 (157,405 ft.2) x (6.29 ft. annual rainfall 2020-2024) x (7.48 gal/ft.3) = 7,405,779 gallons/year

Water percolates to the aquifer and withdrawals are from bore holes with treatment at point-of-source. Pump houses will provide protection for equipment and house water treatment modules. Additionally, water storage could be increased through adding new bore holes, re-installation of gutters and rain barrels damaged in 2020 and alternative freshwater production (i.e. Desalination RO or atmospheric water harvesting).

Water Treatment includes:

* Testing and treatment at boreholes.
* TSS removal with bag filter and sorption media for arsenic removal below W.H.O. standards.
* 254nm UV for pathogen (bacteria, virus and protozoa) deactivation.
* Pressure gauges and flow meter with Totalizer to track water transferred from bore hole(s) to storage tanks.
* Rain gauge measure actual rainfall.

**3. Prototyping and Pilot Implementation Statement**

How will your team approach the prototyping process and full-scale pilot implementation process and how will you collaborate with the local community in both of those efforts?

The prototype design team will include:

* Community
* Architect
* Landscape Architect
* Engineer located in the region that works with flexible solar cloth panels as well as construction/installation to ensure meeting Cat 5 requirements.
* Biologist and Native Wetland Ecologist
* Water Quality Scientist
* Mosquito Born Disease Expert

Prototyping will start with the Community to determine capacity for rigging the sails and frame assembly. This will inform the final design details so that ongoing care is possible locally. We propose native bamboo for the frames, but they can also be made with other locally sourced native or naturalized wood. The prototype can be a mechanism for job training. Local maintenance of the frames will include folding and lashing them to the ground, de-installing solar cloth and if needed rebuilding frames that are damaged in a storm. The Community will also inform the final programmatic design components for the structures housing the batteries, pumps and filtration system. For instance, the battery storage may be a simple shed or expanded as a pavilion for a ticket booth, maintenance equipment, restrooms and other amenities if needed.

The solar cloth panels for both the prototype and full system design will be made and commissioned in France, including all interconnecting materials to fully assemble the sails. These components will be shipped to Fiji.

Water filtration will be piloted to demonstrate the selected pumps capability as well as the treatment system’s performance for removing TSS, ionized naturally occurring arsenic and the 254 nm UV portion for pathogen deactivation. The full system water treatment design will be assembled in California, commissioned (no water treatment), and packed for shipment to Fiji.

**4. Operations and Maintenance Statement**

* How will your design be operated and maintained during its life? How will the local community contribute to operations and maintenance?

Land Sails are made to be easily maneuverable by one or two people and can be folded or stored in a storm event. The frames can be site built and added onto as needs in the Village change. The system might need periodic cleaning to keep fully functional.

The carbon based battery requires water to be added.

The wetland will require monitoring and maintenance to keep the physical, chemical and biological aspects fully functional. The pumping system will require maintenance such as pump lubrication and repairing any breaks that might develop in the piping system. The plants and agricultural plots will need tending.

Training in water treatment will be a transferable job skill for the community. TSS removal is through a bag filter that can be emptied and rinsed out and brought back online. Pressure gauges will determine when the TSS filter needs maintenance. The arsenic sorption filter will require a manual field test kit for the discharge side to determine when it is “exhausted” or spent and needs to be replaced. The sorption filter media can safely be “landfilled” or disposed of as it does not leach and is not hazardous. In addition, the 254nm UV unit will require “cleaning” the glass and changing the bulb after a certain number of hours of use.

Land Sails provides an opportunity for community education leveraging existing skills in sailing and agriculture while adding capacity for specialized local construction, solar PV maintenance, water treatment, wetlands and mosquito and water borne disease training.

**5. Environmental Impact Assessment**

* What effects might your installation have on natural ecosystems and what steps can be taken to mitigate any foreseeable issues?

The proposed flexible cloth solar 75kW PV system that will be assembled into “sails”, are mounted on a “frame system” that is installed by securing the base of the flexible frame into the ground with an anchor point that can resist a Cat 5 storm. This approach has a minimal footprint on the ground.

The proposed wetland will require local experts versed in native fauna and flora on Naviti Island, as well as constructed wetland designers and an already identified mosquito breeding prevention expert. Additionally, our team reached out to the National Mosquito Program that implemented a mosquito program in Fiji with success.

A well-managed wetland sequesters carbon, enables water capture, improves soil health and prevents invasive species from getting a foothold. The water and soil capture in the stormwater watershed is crucial to managing both the local and larger environmental impact of global soil and fresh water loss as storms intensify with climate change.

Arsenic, which is poisonous and bioaccumulates leading to arsenosis could be prevalent given the volcanic formation of the island. Children who have lower body masses bioaccumulate arsenic at higher concentrations.

The battery is metal free, 0% environmental impact, 100% from regenerable materials, compostable at end-of-life cycle, resistant to mechanical damage, non-flammable, non-explosive, has no problem with overcharging and has a thermal runaway. The main component of the battery is ultra-porous carbon, the raw material is agricultural residues.

Components of the system will be shipped to Marou and have a transportation carbon footprint. We have chosen light materials and a system where the frame components can be sourced locally. We can consider carbon offsets for shipping and once the wetland is functional the community may be able to sell carbon credits.

Our goal is “The Ripple Effect”, creating a bio-regional coastal community prototype for regenerative solar energy with a minimal land footprint, resistant to severe storm events while preserving rainwater and soil that supports a community’s food shed, and ensures safe drinking water.

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