

# **Ecological site QX190X01X501**

## **Aquic**

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### **General information**

**Provisional.** A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

### **MLRA notes**

Major Land Resource Area (MLRA): 190X–Stratovolcanoes of the Mariana Islands

This MLRA occurs on the Northern Islands group of the Commonwealth of the Northern Mariana Islands. It consists of the islands of Pagan, Anatahan, Agrigan, Alamagan, Sarigan, and five smaller islands. The islands are largely unpopulated due to volcanic activity. The islands are cone-shaped stratovolcanoes covered with volcanic ash and cinder deposits on steep and very steep slopes. Agrigan has the highest elevation, ranging from sea level to 3,185 feet (970 meters). Average annual precipitation is about 80 inches (2,030 millimeters). Rainfall decreases northwards and increases slightly with elevation. Two-thirds of the precipitation falls between July and November. Average annual temperature is 79 degrees F (26 degrees C). The cooler dry season is between January and May. Trade winds blow from the northeast and east-northeast. Typhoons are frequent. Soils are Andisols, Inceptisols, or Entisols. The soil moisture regime is mostly ustic. The soil temperature regime is isohyperthermic. Abandoned coconut plantations occur on low elevation coastal sites. Areas above 330 feet (100 meters) are dominated by Pacific Island silvergrass or swordgrass (*Miscanthus floridulus*). Forest species are mixed tropical hardwoods. Large numbers of feral cows, pigs, and goats are on some of the islands (USDA-NRCS, 2006).

### **Classification relationships**

This ecological site occurs within Major Land Resource Area (MLRA) 190 – Stratovolcanoes of the Mariana Islands.

### **Ecological site concept**

This ecological site occurs on the island of Anatahan in the Mariana Islands. It occurs on nearly level to gently sloping (0 to 8 percent slopes) sites in broad depressional basins of stratovolcanic islands at elevations ranging from 190 to 210 feet (60 to 65 meters).

Soils are very deep, somewhat poorly drained Inceptisols (Aquandic Endoaquepts) that formed in basaltic and andesitic volcanic ash. Soil temperature regimes are isohyperthermic; soil moisture regimes are aquic. Average annual precipitation is about 80 inches (2,030 millimeters). Water runoff is low; permeability is slow. Effective rooting depth is greater than 72 inches (183 centimeters). Available water holding capacity is very high (7 to 11 inches). The water table is at the soil surface. Ponding is occasional during the rainy season. Where the land is not used for betelnut plantation or agroforestry crops, the vegetation consists of sea hibiscus (*Hibiscus tiliaceus*) and grasses (Carlisle et al., 2001; Fosberg, 1960; USDA-Natural Resources Conservation Service, 2001; Soil Survey Staff, 2025).

## Associated sites

QX190X01X001	<p><b>Very Shallow</b></p> <p>Soils of QX190X01X001 (The Very Shallow Ecological Site) occur on steeper slopes surrounding QX190X01X501 (The Aquic Ecological Site), which is in depressional basins. Water will move from the Very Shallow Ecological Site, which has very slow permeability and high or very high runoff, into the Aquic Ecological Site. Soils in both sites developed from basaltic and andesitic ash. Soils in the Very Shallow Ecological Site have effective rooting depths of about 5 inches, very low available water holding capacity, and support mostly Pacific Island silvergrass (swordgrass). Soils in the Aquic Ecological Site have effective rooting depths of about 60 inches, very high water holding capacity, a water table as shallow at the soil surface, are frequently ponded, can support trees and crops, and may be swampy during the rainy season.</p>
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**Table 1. Dominant plant species**

Tree	(1) <i>Hibiscus tiliaceus</i> (2) <i>Pandanus tectorius</i>
Shrub	Not specified
Herbaceous	(1) <i>Phragmites karka</i>

## Legacy ID

F190XY501MP

## Physiographic features

This ecological site occurs in broad depressional basins of stratovolcanic islands (USDA-Natural Resources Conservation Service, 2001).

**Table 2. Representative physiographic features**

Landforms	(1) Island > Basin floor (2) Island > Depression
Runoff class	Low
Flooding frequency	None
Ponding frequency	Occasional
Elevation	58–64 m
Slope	0–8%
Water table depth	0 cm
Aspect	Aspect is not a significant factor

## Climatic features

Mean annual precipitation in this ecological site is about 80 inches (2,030 millimeters) and ranges from 70 to 90 inches (1,780 to 2,285 millimeters). Rainfall likely decreases northwards and slightly increases with elevation. Climate data are scarce for these remote islands. About two-thirds of the precipitation falls between July and November. Mean annual temperature is about 83 degrees F (28 degrees C) and ranges from 79 to 86 degrees F (26 to 30 degrees C). The cooler dry season is between January and May. It is enhanced by persistent trade winds from the northeast and east-northeast. Typhoons frequently pass close to the Northern Mariana Islands. Typhoons are less common in the north than on the more southerly Marianas islands that are severely impacted by large storms about once every 8 years on average. This area is freeze-free (Fosberg, 1960; USDA-Natural Resources Conservation Service, 2001).

Observations made on the Northern Stratovolcano Islands suggest that there are local climate differences among islands and at various elevations. Based on observations of frequent clouds and fog at the highest elevations and their apparent correlation with more luxuriant vegetation, fog drip can add significant moisture to the soil in some locations (Fosberg, 1960; USDA-Natural Resources Conservation Service, 2001).

**Table 3. Representative climatic features**

Frost-free period (actual range)	
Freeze-free period (actual range)	
Precipitation total (actual range)	1,778-2,286 mm
Frost-free period (average)	365 days
Freeze-free period (average)	365 days
Precipitation total (average)	2,032 mm

## Influencing water features

The basins that make up this ecological site are occasionally ponded with fresh water (USDA-Natural Resources Conservation Service, 2001). Detailed information is not available about depth and duration of ponding. In the Cowardin system, these basins would probably be classified as palustrine, broad leaf evergreen, intermittently flooded, with mineral soil (USDI-Fish and Wildlife Service, 1979).

## Soil features

Benedicto is the only soil component associated with this ecological site. Soils are very deep, somewhat poorly drained Inceptisols (Aquandic Endoaquepts) that formed in basaltic and andesitic volcanic ash. Soil temperature regimes are isohyperthermic; soil moisture regimes are aquic. Permeability is slow. Effective rooting depth is greater than 72 inches (183 centimeters). Available water holding capacity is very high. The water table is at the soil surface. Ponding is occasional during the rainy season (Soil Survey Staff, 2025: USDA-Natural Resources Conservation Service, 2001).

**Table 4. Representative soil features**

Parent material	(1) Basaltic volcanic ash (2) Andesitic volcanic ash (3) Cinders
Surface texture	(1) Silt loam
Family particle size	(1) Fine
Drainage class	Somewhat poorly drained
Permeability class	Slow
Depth to restrictive layer	183 cm
Soil depth	183 cm
Surface fragment cover ≤3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	18.29–27.69 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	Not specified

Soil reaction (1:1 water) (0-25.4cm)	5.4–6.7
Subsurface fragment volume <=3" (0-101.6cm)	0%
Subsurface fragment volume >3" (0-101.6cm)	0%

## Ecological dynamics

The main natural disturbance is strong storms that can damage or kill vegetation by high wind speeds. The main human-related disturbances are clearing of native vegetation for agriculture and grazing, browsing, and hoof compaction of soils by feral ungulates (Liske-Clark, 2015).

Information on current plant species is minimal.

## State and transition model

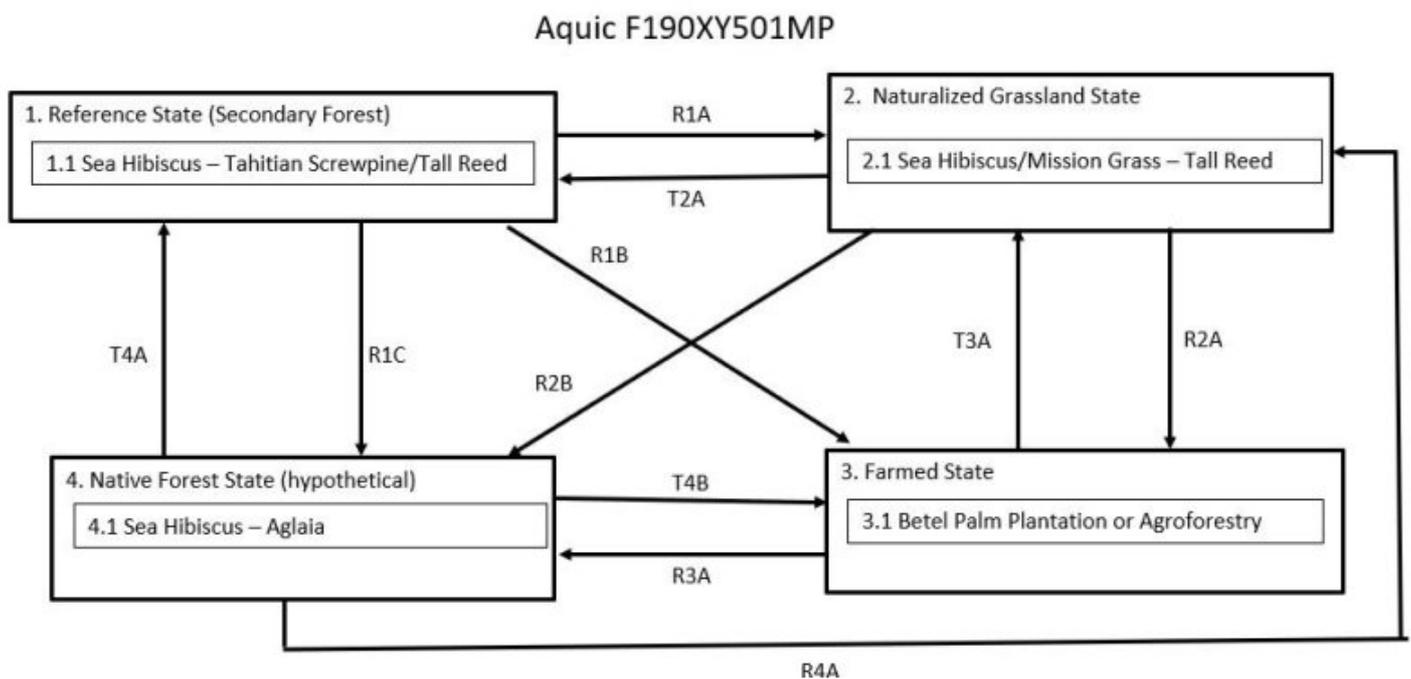


Figure 1. State-and-Transition Model (STM) for F190XY501MP (The Aquic Ecological Site).

## State 1

### Reference State (Secondary Forest)

The Reference State (1) has one community phase consisting of a variable array of native and introduced tree species dependent on the species existing in the local area.

## Community 1.1

### Sea Hibiscus – Tahitian Screwpine/Tall Reed

This community phase is often dominated by native sea hibiscus (*Hibiscus tiliaceus*). Tahitian screwpine (*Pandanus tectorius*) is also common. Tall reed (*Phragmites karka*) is likely to be found where the tree canopy is open. Non-native trees are likely to be remnants of agroforests, including breadfruit (*Artocarpus* spp.), citrus (*Citrus* spp.), and mango (*Mangifera* spp.) (Fosberg, 1960; Liske-Clark, 2015; Marshall et al., 2020; Stemmermann, 1981); USDA-Natural Resources Conservation Service, 2001).

### **Dominant plant species**

- sea hibiscus (*Hibiscus tiliaceus*), tree
- Tahitian screwpine (*Pandanus tectorius*), tree
- tall reed (*Phragmites karka*), grass

## **State 2**

### **Naturalized Grassland State**

The Naturalized Grassland State (2) is naturalized grassland with scattered trees. There is one community phase.

### **Community 2.1**

#### **Sea Hibiscus/Mission Grass – Tall Reed**

Dominant grass species are mission grass (*Pennisetum polystachion*) and tall reed (*Phragmites karka*). The scattered trees are likely to be individuals or small thickets of sea hibiscus (*Hibiscus tiliaceus*) and individual Tahitian screwpines (*Pandanus tectorius*) (Fosberg, 1960; Liske-Clark, 2015; Marshall et al., 2020; Stemmermann, 1981); USDA-Natural Resources Conservation Service, 2001).

### **Dominant plant species**

- sea hibiscus (*Hibiscus tiliaceus*), tree
- mission grass (*Pennisetum polystachion*), grass
- tall reed (*Phragmites karka*), grass

## **State 3**

### **Farmed State**

The Farmed State (3) consists of one community phase dominated by crops.

### **Community 3.1**

#### **Various Crops**

A wide variety of crops are grown on these soils. Betel palm plantation or agroforestry are or were common.

## State 4

### Native Forest State

The Native Forest State (4) consists of one community phase. Hypothetically, this state was originally vegetated by forest. The species composition is not known. However, some native tree species still commonly inhabit these sites.

### Community 4.1

#### Sea Hibiscus – Aglaia

Existing forest sites typically have thickets of sea hibiscus (*Hibiscus tiliaceus*) and some Tahitian screw pine (*Pandanus tectorius*). It is likely that the original forest was much more diverse, with species like those occurring in what is often referred to as Aglaia – Elaeocarpus forest. The common species in this forest type include *Aglaia mariannensis*, fig (*Ficus prolixa*), fig (*F. tinctoria*), *Pipturus argenteus*, yellow-boxwood (*Planchonella obovata*), sea hibiscus (*Hibiscus tiliaceus*), *Elaeocarpus joga*, *Melanolepis multiglandulosa*, *Guamia mariannae*, wild coffee (*Psychotria* spp.), Oriental tremora or gunpowder tree (*Trema orientalis* var. *argentea*), and grand devil's-claws (*Pisonia grandis*). Undergrowth is generally very sparse. The two most important components are monarch fern (*Phymatosorus scolopendria*), and Hawai'i bird's nest fern (*Asplenium nidus*). Other possible fern species are giant brake (*Pteris tripartita*) and the tree fern *Sphaeropteris aramaganensis* (Syn. *Cyathea aramaganensis* or Syn. *Alsophila aramaganensis*). Possible vine species are rosarypea (*Abrus precatorius*), St. Thomas lidpod (*Operculina turpethum*), and *Freycinetia reineckei* (Fosberg, 1960; Liske-Clark, 2015; Marshall et al., 2020; Stemmermann, 1981; USDA-Natural Resources Conservation Service, 2001).

#### Dominant plant species

- sea hibiscus (*Hibiscus tiliaceus*), tree
- (*Aglaia mariannensis*), tree

### Restoration pathway R1A

#### State 1 to 2

The Reference State (1) can be restored to the Naturalized Grassland State (2) by burning or mechanically clearing trees, shrubs, and undesirable forbs. Heavy use by introduced ungulates may inhibit tree reproduction enough to eventually open up the vegetation and allow for increased open areas dominated by grasses.

### Restoration pathway R1B

#### State 1 to 3

The Reference State (1) can be restored to The Farmed State (3) by burning or mechanically clearing trees, shrubs, and undesirable forbs and then cultivating the soil and

planting crops.

## **Restoration pathway R1C**

### **State 1 to 4**

The Reference State (1) may be restored to The Native Forest State (4) by selectively removing or killing introduced species and replanting native species. Removal of feral ungulates would be necessary.

## **Transition T2A**

### **State 2 to 1**

The Naturalized Grassland State (2) transitions to the Reference State (1) by removal of grazing and browsing ungulates, allowing colonization by local tree species.

## **Restoration pathway R2A**

### **State 2 to 3**

The Naturalized Grassland State (2) transitions to the Farmed State (3) by plowing and then planting crops.

## **Restoration pathway R2B**

### **State 2 to 4**

The Naturalized Grassland State (2) may be restored to the Native Forest State (4) by removing ungulates, controlling grasses and introduced plant species, and planting native trees and other plants.

## **Transition T3A**

### **State 3 to 2**

The Farmed State (3) will transition the Naturalized Grassland State (2) by abandonment.

## **Restoration pathway R3A**

### **State 3 to 4**

The Farmed State (3) may be restored to the Native Forest State (4) by ceasing agricultural activities, controlling weeds, excluding ungulates, and planting native species.

## **Transition T4A**

### **State 4 to 1**

The Native Forest State (4) can transition to the Reference State (1) by partial clearing for agriculture, heavy selective wood removal, and/or extremely heavy soil compaction,

browsing, and grazing by introduced ungulates.

## **Restoration pathway R4A**

### **State 4 to 2**

The Native Forest State (4) may be converted to the Naturalized Grassland State (2) by frequent intentional burning during the dry season, a combination of heavy ungulate damage and occasional intentional burning, or by mechanical clearing and abandonment.

## **Transition T4B**

### **State 4 to 3**

The Native Forest State (4) will transition to the Farmed State (3) by burning or mechanical followed by cultivation and planting crops.

## **Additional community tables**

### **Other references**

QX190X01X501 Aquic Annotated References

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## **Contributors**

David Clausnitzer PhD

John Proctor

Ann Tan

Daniel Bowman

Amy Koch

Kendra Moseley

Jill Ficke-Beaton

Daniel Block

Sarah Quistberg

Brendan Breeze

Curtis Talbot

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## **Rangeland health reference sheet**

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
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Contact for lead author	
Date	03/12/2026
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

**1. Number and extent of rills:**

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**2. Presence of water flow patterns:**

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**3. Number and height of erosional pedestals or terracettes:**

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**4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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**5. Number of gullies and erosion associated with gullies:**

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**6. Extent of wind scoured, blowouts and/or depositional areas:**

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**7. Amount of litter movement (describe size and distance expected to travel):**

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**8. Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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**9. Soil surface structure and SOM content (include type of structure and A-horizon color**

**and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**
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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**
- 

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

Dominant:

Sub-dominant:

Other:

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**
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14. **Average percent litter cover (%) and depth ( in):**
- 

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**
- 

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that**

**become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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**17. Perennial plant reproductive capability:**

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