3. PROFILE OF THE PUNA REGION

This section presents an overview of the planning region including its community character, physical characteristics, natural hazards, and archaeological resources. Several elements of the region were selected as growth indicators and are discussed in more detail in Section 4, Growth Projections and Indicators. These elements include lava hazards, flooding, and infrastructure.

3.1. Rural or Suburban? Puna is Something Else!

The Puna District is a unique place. Many describe it as a "rural" community for its agricultural activities, open space, and the absence of "urban" infrastructure. However the district is also considered "suburban" due to widespread residential development, the absence of local jobs and services, and commute patterns to Hilo. The Puna District can neither be characterized akin to rural areas of middle America nor classic suburb neighborhoods complete with sidewalks. Puna is something else!

Rural means a land use, transportation, and economic pattern characterized by locally balanced land uses and largely self-sufficient small towns, surrounded by agricultural lands. In more self-sufficient rural communities, local jobs and services, along with homes and farms, mean that there is almost no commuting to distant employment centers. This is somewhat different from what Puna is. As a result, some have characterized Puna as "large-lot suburban" or "semi-rural." People who travel to Hilo only once every week and make their entire living within Puna are truly rural. Yet, most Puna residents commute daily, if not more, with two or more commuters per household.

Nevertheless, most of the lots in Puna are at least one-acre with generous open space and vegetation that buffer homes. It is understandable that some residents oppose small local employment and service centers in an effort to protect the existing quality of life, whether it is called rural, semi-rural, or large-lot suburban.

A resident's backyard in Orchidland Estates illustrates open space and livestock not commonly found in suburbs.

Noni trees at Paradise Farms in Hawaiian Paradise Park.

Residents with this perspective feel very strongly about protecting their community and way of life. They enjoy Puna's natural landscape, open space, rough infrastructure, distance from business activity, and quiet environment. Farms, livestock, and other rural activities, not allowed in classic suburbs, are found throughout Puna. Many people move there precisely because of these qualities. Moreover, any kind of development, even at the village level, can seem like a very slippery slope towards urban living. Many residents have fought hard to maintain the "agricultural" land use allocation as opposed to "rural."

However interestingly, past surveys conducted by community associations found that the divide between those in favor of Puna as "wild" versus "more development" was evenly split 50/50. The absence of urban development can be desirable for those who know they can easily travel to the regional center of Hilo for work, goods, and services. The area's sense of place is "preserved" by distancing homes and farms from jobs and services. The difficulty is that this distance preserves an auto-dependent pattern, denies equity for low-income residents, and increases traffic congestion and environmental impacts.

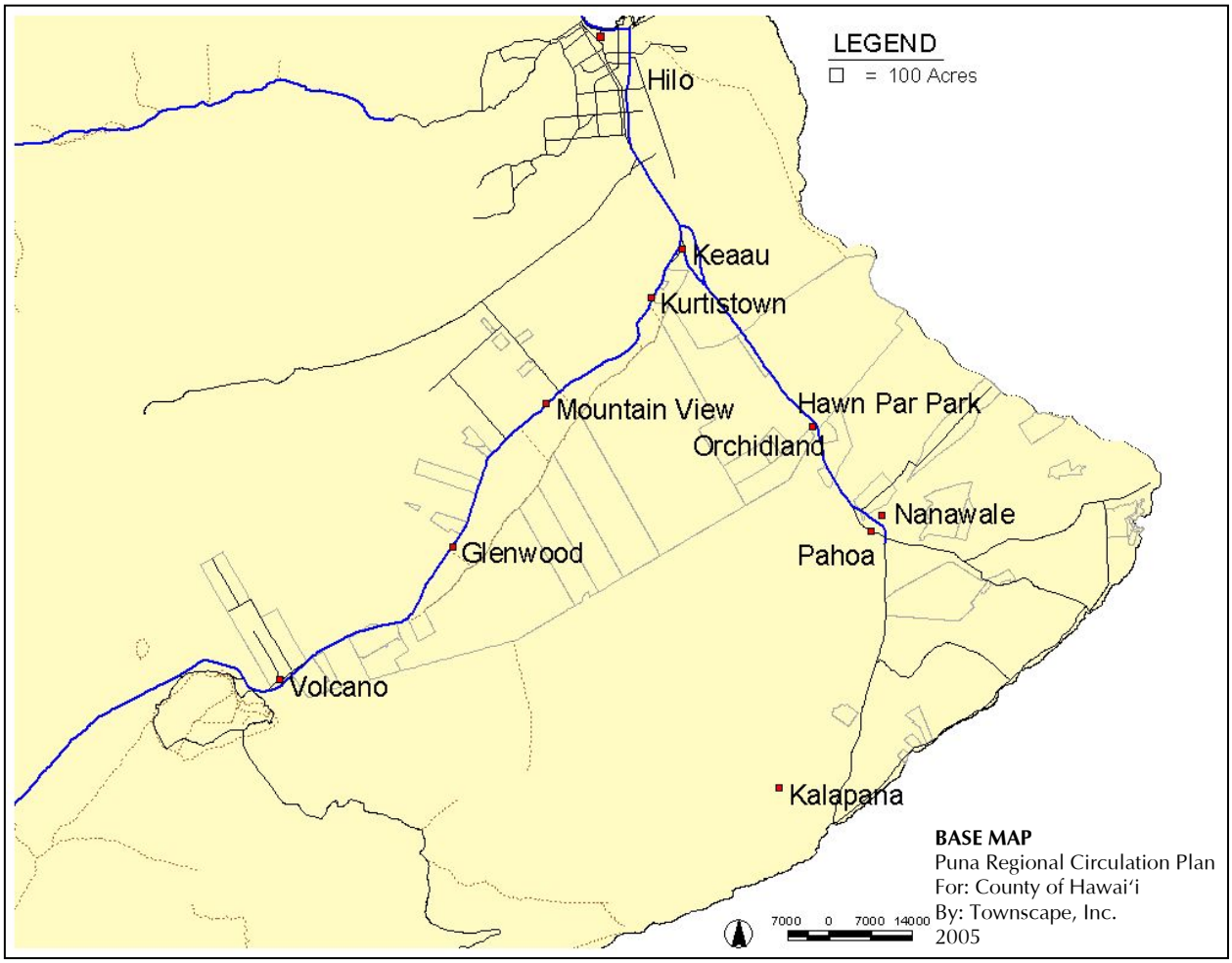
There are also residents of Puna who have a desire for village development that provides access to more local jobs, goods, and services. Implementation of village centers could create sustainable patterns that remove the need for regular commutes. A truly rural, locally balanced, land use pattern can lower transportation costs and provide economic and lifestyle improvements and choices for all types of residents. This group includes minorities such as the elderly, disabled, and youth. The "rural" approach of multiple smaller "villages" with low-density areas in between offers multiple economic, ecological, social and cultural benefits.

So what does this all mean for planning Puna's transportation systems for the next 25 years? If development of village centers does not occur, the increasing population will continue to commute to Hilo for jobs, goods, and services. Therefore, major increases in infrastructure will be needed, including highways. Transit, bikeways, and paths may provide some relief and equity for low-income residents.

On the other hand, if residents allow limited and planned mixed use development, better outcomes can occur. This development can take time, and roads and transit will continue to be needed. However, village centers can eventually shorten trips, decrease commutes, and facilitate the use and necessity of more bike and pathways. The community will have to decide if they can tolerate the long commutes, major highway development, and social inequity needed to preserve their distance from mixed uses. The option is to accept some neighborhood level development in exchange for decreased highway development, equal access, and overall environmental benefits.

Residential development in the Hawaiian Shores subdivision.

FIGURE 3.1: PROJECT AREA



3.2. Physical Description

3.2.1. Location

The Puna District encompasses 499.5 square miles or 319,680 acres. It is bound to the north by the Hilo District and to the west by the Ka'u District. Primary access to the district is from an east-west roadway (Volcano Road) that runs parallel to the northern boundary of the District. A main branch road at Kea'au runs south to access the southern and eastern portions of the District.

3.2.2. Terrain and Climate

The majority of the terrain in Puna is characterized by broad and gentle slopes with no defined waterways. The Puna landscape is formed of porous volcanic rock and soils from Mauna Loa and Kīlauea eruptions. An extensive network of subterranean lava tubes runs throughout much of the District and are accessible through collapsed openings.

The climate is tropical with temperatures averaging 67 degrees Fahrenheit in Mountain View at the 1,530-foot elevation and daily temperatures range between 10 and 20 degrees. August and September are the warmest months; January, February, and March are the coolest. Rainfall averages 100 inches per year; June is usually the driest month; and December is the wettest. However, monthly and annual rainfalls are very unpredictable and rainfall in East Hawai'i can vary by a factor of three from year-to-year (60 to 180 inches a year). Rainfall averages are higher at upper elevations and range from 50 inches a year along the southwestern coast to 300 inches in the northern extent of the district.

3.2.3. Soils

According to the U.S. Department of Agriculture *Soil Conservation Service Soils Report* (1973), there are over 20 soil types found in the area. The three major soil associations are:

Kekake-Ke'ei-Kīloa – Described as very shallow, gently sloping to steep, well-drained organic soils over 'A'ā or pāhoehoe lava; on uplands.

Akaka-Honokaa-Kaiwiki – Deep gently sloping to steep, moderately well drained and well drained soils that have a moderately fine textured subsoil, high in organic matter, very porous and continuously wet; on uplands.

Lava Flows - Gently sloping to steep, excessively drained, nearly barren lava flows; on uplands.

There are no major development constraints caused by area soils.

3.2.4. Geology

The region was formed as part of the shield volcano mountain-building process of Mauna Loa and Kīlauea. Kīlauea is currently active and lava has covered numerous acres of developed lands within the Puna District in the last thirty years. Recent eruptions have generally been limited to the National Park lands. The lava tubes and cave systems of the Puna area are an integral and common element of extrusive volcanic landscapes in shield volcanoes such as Kīlauea and Mauna Loa. Although exact numbers cannot be determined, it is certain that thousands of lava tubes lie within the pāhoehoe lava flows. According to the Hawai'i Speleology Survey (HSS), most of these caves are too small to be an important concern in land planning.

Important sites include several named lava tube caves, including Kazumura, Keala, and Lower U`ilani Caves. Kazamura Cave is internationally recognized as the world's largest lava tube cave. The Puna area is broadly considered to be the world's leading area for scientific study of lava tubes large enough to be caves.

According to representatives of the HSS, distribution of specific data regarding caves requires approval of their board. The HSS can review requests for information on a project-by-project basis. Lava tube caves are valuable resources based on their geology, recreation quality, biology, and Hawaiian cultural significance. Transportation improvement projects have the potential to disturb lava tube caves, moreover, the caves are also a potential hazard to the projects. As noted, the HSS should be consulted in future planning and engineering to assure that negative impacts to important caves and transportation projects are avoided.

3.2.5. Topography

The region gently slopes in a radial pattern from the high western mountains of Kīlauea and Mauna Loa. The slope is predominately gentle but includes small hillocks, swales, and broken land resultant from the volcanic geology and subsequent weathering. The area slopes from an elevation of 5,000 feet to sea level along the coastal boundary. No major development constraints are caused by topography.

3.2.6. Flora and Fauna

Dominant vegetation types in the region range from rain forest to desert scrub and coastal strand. Under the Endangered Species Act, the U.S. Fish and Wildlife Service is charged with designating critical habitats for threatened and endangered species whenever it is determined to be prudent and determinable. There are over 100,000 acres of land within the region which are designated as critical habitat areas.

Researchers have grouped the flora of the Puna region into nine ecosystem categories depending on rainfall, stage of succession from bare lava, elevation, and penetration of exotics into the native ecosystem. Area ecosystems include:

- Lava
- ʻŌhiʻa woodland
- ʻŌhiʻa forest
- Dry forest
- Dry scrub community
- Dry grassland
- Mixed lowland forest
- Scrub
- Agricultural lands

Some forests in the upper elevations are maintained as extensive ecosystems. However, lower elevation lands used as agricultural and residential areas have allowed the spread of exotics and "domestics" such as mango, coconut, bamboo, rose apple, eucalyptus, Christmasberry, kukui, and milo. Other species that have proliferated include myrica faya, ginger, tibouchina, strawberry guava, banana poka, palm grass, and yellow Himalayan raspberry. Rare, threatened, and endangered plant species reported in the Puna area include:

- Alphitonia ponderosa var kauila
- Adenopherous periens, (Fern, pendant kihi)
- Bidens skottsbergii var. conglutinate
- Clermontia hawaiiensis
- Clermontia peleana (ʻOha wai)
- Cyanea tritiomantha
- Cyrtandra ramosissima, Hedyotis hedyosmifolia var. magnifolia
- Labordia baillonii
- Nathocestrum longifolium var. rufipilosum
- Peperomia lilifolia va. Obtusata (ʻalaʻala-wai-nui)
- Phyllostegia brevidens var. heterodoxa
- Sterogyne macrantha
- Stenogyne scrophularioides
- Tetraplasnadra kavaiensis var. dipyrena
- Xylosma hawaiiensis var. hillebrandii
- Zanthoxylum dipetelaum var. gemenicarppum
- Zanthoxylum glandulosum

Endangered animals that may be found in the Puna region include the following:

- Buteo solitarius (I'o), Hawaiian Hawk,
- Hemignathus wilsoni ('Akiapolaau)
- Lasiurus cinereus semotus ('Ope'ape'a), Hawaiian Hoary Bat.

Early identification of endangered species sites is helpful in planning projects. Specific improvement projects should address this to avoid costly changes to engineering plans.

3.2.7. Natural Hazards

The Overall Hazard Assessment (OHA) identified in the *Atlas of Natural Hazards in the Hawaiian Coastal Zone* (2002) is ranked moderate-to-high to very high for the Puna region. The overall rating considers the weighted individual assessments of the following variables: tsunami, stream flooding, high waves, storms, erosion, sea level, and volcanic/seismic activity with consideration of the coastal slope. There are development constraints in coastal areas and lava hazard zones 1 and 2. For more information, see Section 4.

3.2.8. Groundwater

Parts of the following aquifers are in the Puna District: Northeast Mauna Loa Sector, Southeast Mauna Loa Sector, and the Kīlauea Sector. The estimated combined total yield within the District is 1 billion gallons per day. Puna's abundant rainfall and the absence of sediment load create high-quality groundwater. There are six hydrologic units identified in the region: Kea'au, 'Ōla'a, Pāhoa, Kalapana, Hilina, and Keiwa. According to the Department of Land and Natural Resources (DLNR) Commission on Water Resource Management, the aquifers have a combined sustainable groundwater yield of 1,154 million gallons per day (MGD). There are approximately 23 existing wells located in the area including the Hawaiian Shores, Keonepoko, Kapoho, and Pāhoa wells. There are no direct development constraints caused by Puna groundwater conditions.

3.2.9. Conservation Reserves

There are four forest reserves in the Puna District including Nānāwale, 'Ōla'a, Keauohana, and Malama-kī. These reserves total over 13,000 acres. There are two natural area reserves in the region. Pu'u Maka'ala contains 12,106 acres of montane wet 'ohi'a and koa forests. Kahauale'a Natural Area Reserve represents volcanic activity with fresh lava fields as a blank slate where plants and animals re-colonize cooled lava flows. The Reserve's 16,726 acres include wet 'ōhi'a (Metrosideros polymorpha) forests. The natural area reserves include both endemic and endangered species.

Hawai'i Volcanoes National Park was established in 1916. The Park encompasses 333,000 acres and ranges from sea level to the summit of the volcano, Mauna Loa, at 13,677 feet. Over half of the Park is designated wilderness and provides recreational opportunities. Conservation areas protect watersheds, endangered species, and open space. Transportation projects planned near or through forest reserves should carefully consider negative impacts.

3.3. Socioeconomic Characteristics

3.3.1. Demographics

The Puna region is rural. According to the U.S. Census, the Puna population was 31,335 in year 2000. The project area grew by nearly 20,000 people from 1980 to 2000. This equates to growth of 1,000 people a year. There are over 13,000 households in Puna with an average household size of 2.79.

TABLE 3.1: PUNA DISTRICT POPULATION 1960 TO 2000

	1960	1970	1980	1990	2000
Puna Dist.	5,030	5,154	11,751	20,781	31,335

Source: County of Hawai'i General Plan 2005.

The ethnic composition of the District is similar to the County. About one-third of the District population is of Caucasian ancestry, slightly more than the County-wide percentage. Residents with Asian ancestry represent one-fifth of the District, also slightly lower than the County. The number of Native Hawaiian and other Pacific Islanders is proportionately the same in Puna as in the County. These categories, however, inadequately address the ethnic makeup as perceived by Hawai'i residents, who distinguish among Native Hawaiians, Samoans, Japanese, Chinese, Koreans, and Filipinos. In addition, many births since 1970 have involved parents of different or mixed ethnic backgrounds.

3.3.2. Employment and Income

The median household income of Puna residents is $30,821, about $10,000 below County-wide levels. The per capita income for the District is $14,000, compared to a County-wide income of $19,000 (U.S. Census, 2000).

Generally, the unemployment rate in Puna is greater than the County rate. The 2000 Census reported a 12.2 percent rate for the Puna District compared to 8 percent for the County. The mean travel time to work exceeds the County average by about seven minutes and about five percent more Puna residents participate in carpooling than the County residents in general. Data illustrates a correlation between low to median household income residents and need for alternative modes of travel. This community can be assisted by efficient, affordable, and convenient busing systems.

TABLE 3.2: LABOR FORCE/TRAVEL CHARACTERISTICS, COUNTY AND DISTRICT - 2000*

Census Tract	% (percent)			Mean Travel time to work (minutes)
	Unemployed	Car-pools	Public Transportation	
210.01	11.4	25.8	0.9	30.4
210.02	8.6	22.1	0.5	31.1
211	16.7	24.6	0.4	31.5
Puna District	12.2	24.1	0.6	31.0

*Workers 16 years and over. *Source: U.S. Census 2000 Summary File 3.*

3.3.3. Economic Base

The region's main economic base is agriculture. Crops include vegetables, fruits, macadamia nuts, ornamental flowers, and foliage. Flowers, primarily orchids and anthuriums, are grown throughout Puna. Tourism is a growth industry in the region as tourists visit Hawai'i Volcanoes National Park and seek accommodations at bed and breakfast establishments. The region has several parks, natural area reserves, and other places of interest. A significant portion of Puna residents work in home-based businesses and cottage industries. Many of these jobs are possible due to telecommuting. Transportation choices and amenities could improve business and the economic diversity of Puna. Access by regular bus service and pathways such as the Railroad Path and the Old Volcano Trail, would provide increased options for tourists to travel throughout Puna.

3.4. Historic and Cultural Resources

Puna meaning "spring" has many historic sites, including ancient trails, burial caves, habitation sites, fishponds, and heiau. The Puna District has rich cultural landscapes including the Mahina Akaaka Heiau, Nuikūkahi Heiau, Kohelele o Pele, and Kūki'i Heiau. The Waha'ula Heiau was a significant archeological temple site located within the Puna area of Hawai'i Volcanoes National Park. Sites such as this heiau were destroyed by recent lava flows.

3.4.1. Archaeological Sites

The majority of the archaeological sites located along the coast indicate a settlement pattern associated with ocean resources. Numerous agricultural features indicate extensive cultivation of taro, sweet potato, and other traditional crops. The easternmost region of Puna is the sacred site known as Kumukahi. This locality receives the first light of dawn and was a place of healing and power. The ancient landscape of Puna was covered with forest, brush, and vegetation prior to being transformed into ranchland and sugar cane fields. In between historic lava flows, Puna vegetation began with lichens, ferns, and shrubs. William Ellis[4] described Puna in 1850 with thick verdant soils, grass, trees, and taro. Historically, the region supported wet and dry taro planting, banana, sugar cane, sweet potato, coconut groves, and breadfruit trees.

[4] Handy, E.S. Craighill, and Elizabeth Green Handy, with Mary Kawena Pukui. *Native Planters in Old Hawai'i: Their Life, Lore, and Environment.* Bishop Museum Press, 1991.

3.4.2. Historic Sites

Numerous historic sites are also located within the District. Table 3.3 lists these sites.

TABLE 3.3: SITES LISTED ON STATE AND NATIONAL REGISTER OF HISTORIC PLACES

Site	Tax Map Key	Ahupua'a or Region	Hawai'i Register	National Register
Johnson Summer Home/Hale 'Ōhia Cottages	1-1-05:19,42	Kea'au	x	
Hale 'Ōhia Tract Historic District	1-1-05: 24-26; 29-33	Volcano	x	
Star of the Sea Catholic Church, Kalapana Painted Church	1-2-06:81	Kaimū	x	x
Ala Loa	1-2-09:3	Kehena	x	
Keauohana Ahupua'a Archaeological District	1-2-09:3	Kehena	x	
''Opihikao Evangelical Church Residence	1-3-04:18	'Opihikao	x	
King's Highway	1-3-07:26	Malama Kī	x	
MacKenzie Petroglyphs	1-3-07:26 1-3-08:1	Malama Kī	x	
Mountain View Theater	1-8-02:1	'Ōla'a	x	

3.4.3. Ahupua'a

An ahupua'a is a land division usually extending from the uplands to the sea. Ahupua'a within in the Puna District include:

Kea'au	Lae'apuki	Makua
Waikahekahe nui	Pānau iki	'Opihikao
Waikahekahe iki	Pānau nui	Ula
Keonepoko	Kealakomo	Kapaahu
Waiakahiula	Kahue	Kupahua
Wa'a Wa'a	'Āpua	Kalapana
Keahialaka	Pūlama	Kaimū
Kapoho	Poapoa	Kikala
Kahauale'a	Alaa	Kēōkea
Kamoamoa	Hālona	Kaueleau

Thorough investigation and early identification of archaeology is very important in planning new transportation infrastructure. A project's feasibility and route can be impacted by the existence of such sites.