PRELIMINARY ENGINEERING REPORT

FOR

OLOWALU TOWN

Olowalu, Maui, Hawaii

T.M.K.: (2) 4-8-003: 84, 98 - 118, 124

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1.0 BACKGROUND

The Olowalu Town (OT) Master Plan is proposing to establish a community at Olowalu, located on the west side of the island of Maui (See Exhibits 1 and 2). The subject property encompasses the lower coastal reaches of Olowalu ahupua'a; between the base of the south-west facing slopes of West Maui Mountains and the shoreline of Olowalu. OT will be a small-scale and mixed-use community designed to be a pedestrian-friendly community which will allow residents to live within walking distance of corner stores, schools, parks, employment opportunities, community centers, beaches, and social and civic resources, ultimately reducing reliance on automobiles. The Master Plan is guided by values and principles of sustainability by balancing the needs of Maui's growing population; yet maintaining and respecting our cultural, historical and natural resources.

At final build-out, OT will consists of approximately 1,500 residential dwelling units to be built concurrent with appropriate infrastructure in phases spread out over a period of approximately 10 years. There will be a wide variety of single-family and multi-family dwelling types, including houses, apartments, live-work units, townhomes, cottages, rural homes and farmsteads, to be offered at a wide-range of income levels, including both rental and fee-ownership. A substantial portion of the homes are planned for much-needed affordable housing and senior living.

The design of OT incorporates smart growth and sustainable land use principles of New Urbanism. As a result, OT's spatial layout of land uses, varying density, connective transportation, parks/greenways, civic/social facilities, housing, employment and other land uses are balanced to create a mixed-use community. Neighborhood town centers provide economic sustainability with a range of business and employment opportunities. OT is also designed to meet the certification requirements of Leadership in Energy and Environmental Design for Neighborhood Development (LEED ND). As such, the Master Plan will be

built using strategies aimed at improving performance in regards to energy savings, water efficiency, reducing CO2 emissions, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

2.0 INTRODUCTION

The purpose of this Preliminary Engineering Report is to provide information on the existing infrastructure systems in Olowalu; assess future infrastructure needs, demands, and requirements for the proposed OT Master Plan; and describe the proposed innovative and sustainable infrastructure systems which will be built to support OT.

The subject properties are identified as T.M.K.: (2) 4-8-003: 084, 98-118, 124, which contains a total of approximately 636 acres. The properties are bordered by vacant/unused State conservation lands to the north, State agricultural lands to the east and west, and the Pacific Ocean to the south. The project area is divided by the existing Honoapiilani Highway and several existing, privately owned agricultural parcels and subdivisions located within and abutting to the project limits. The combined area of the subject properties and some of the privately owned parcels and subdivisions immediately adjacent to the project, which totals approximately 790 acres, will be included in some sections of the project analysis.

OT's proposed infrastructure improvements will be constructed concurrently with the project and will incorporate innovative, efficient, and sustainable technology to minimize adverse impacts upon the natural environment. OT's transportation system includes the relocation of the existing high speed/high volume Honoapiilani Highway away from the coastal resources to a new mauka alignment, which will be designed to accommodate mass transit or light rail, if needed in the future. The existing highway corridor with monkey-pod trees will be incorporated into OT's master plan and converted to a low speed/low volume coastal roadway. The project will include an internal roadway network, as well as an assortment of interconnected greenways and bikeways throughout the community that supports the overall well-being and health of residents by reducing the dependency on automobiles.

Additionally, other infrastructure system improvements will require an expansion of both the existing potable and non-potable water system, additional ground water wells to supplement the existing well, and an extensive drainage system to capture storm-water runoff. The project will also include the construction of an onsite wastewater treatment facility, which will include an R-1 water storage tank, constructed vertical flow wetlands, and a soil aquifer treatment system. Additionally, the project is proposing to incorporate the use of renewable energy systems to help generate electricity for the Master Plan.

3.0 EXISTING INFRASTRUCTURE

3.1 ROADWAYS

Honoapiilani Highway is the major arterial highway which links Wailuku and West Maui. It is a two-way roadway with varying widths of two and four lanes. In the vicinity of the project site, Honoapiilani Highway is a two-lane highway aligned in generally the southeast-northwest direction following the coastline.

There are several minor roads connecting to Honoapiilani Highway fronting the project site providing access to the existing subdivisions in the area such as Luawai Street which provides access to Kapaiki and the Olowalu Mauka Subdivision. There are also several access driveways on both the mauka (north) and makai (south) side of the existing highway which provides access to the Olowalu Makai Komohana Subdivsion and Olowalu Makai Hikina Subdivision, as well as the Olowalu General Store.

3.2 DRAINAGE

The subject property is situated along the base of the southwest facing slopes of the West Maui Mountains, along the lower portions of Olowalu Valley. The steep and rugged mountain slopes and ridges of the West Maui Mountains dramatically rise upwards above the project site in excess of 4,000 feet above mean sea level. The upper most project limits (mauka) along the northeastern section of the property is at approximately 500 feet above mean sea level. From this mauka section, the land slopes downward to the southwest to the coastline along its makai boundary at near sea level.

The subject property is well-defined by significant land and natural topographic

features; including the lower sections of Olowalu Valley's sloping ridges, the prominent land feature of Pu'u Kaiwaloa, the Olowalu Stream corridor, the near-level interior portion of the property, and the coastal/shoreline section. The topography or slope of the property ranges from between 5%-15% slope near the mauka limits, to 3% to 5% slope near the mid-section of the property, to near-level to 3% along the coastal portions of the property.

According to the "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii (August, 1972)," prepared by the United States Department of Agriculture Soil Conservation Service, the soils within the project site are classified as Ewa silty clay loam (EaA), Jaucas sand (JaC), Kealia Silt Loam (KMW), Wainee extremely stony silty clay (Wyc), Pulehu silt loam, 0 to 3% slopes (PpA), Pulehu clay loam (PsA), Pulehu cobbly clay loam (PtA, PtB), Rock Land (rRK), Rock Outcrop (rRO), Rough Broken and Stony Land (rRS), and Stony Alluvial Land (rSM) (See Exhibit 3). Ewa silty clay loam has runoff that is very slow and the erosion hazard is no more than slight. Jaucas sand is characterized as having rapid permeability, very slow to slow runoff, a slight water erosion hazard, and a severe wind erosion hazard. Kealia silt loam is characterized as having moderately rapid permeability, slow to very slow runoff, the hazard of water erosion is no more than slight, but the hazard of wind erosion is severe when the soil is dry. Wainee extremely stony silty clay is characterized as having moderately rapid permeability, slow to medium runoff and slight to moderate erosion hazard. Pulehu silt loam is characterized as having slow runoff and a slight erosion hazard and is similar to the Pulehu clay loam except for the silty loam texture. Pulehu clay loam is classified as having moderate permeability, slow runoff, and an erosion hazard no more than slight. Pulehu cobbly clay loam is similar to Pulehu clay loam except that it is cobbly. It is classified as having slow runoff and slight erosion hazard. Rock land is made up of areas where exposed rock covers 20 to 90 percent of the surface and consist of rock outcrops and very shallow soils. Rock Outcrop consists of areas where exposed bedrock covers more than 90 percent of the surface. This land type is gently sloping to precipitous. Rough Broken and Stony Land is characterized as having rapid runoff with very steep and stony gulches. Stony Alluvial Land consists of stones, boulders, and soil deposited by streams along the bottoms of gulches and on alluvial fans. Improvements of this land is difficult because of the stones and boulders.

According to Panel Number 150003 0531E of the Flood Insurance Rate Map, September 25, 2009, prepared by the United States Federal Emergency Management Agency (FEMA), a majority of the subject parcel is situated in Flood Zone X (shaded and unshaded). There are also areas of Flood Zone AE, AO, A, which mainly occur along the existing Olowalu Stream, and Flood Zone VE along the shoreline (See Exhibit 4). Flood Zone X (unshaded) represents areas outside the 0.2% annual chance flood plain and is not considered a special flood hazard area. The shaded Flood Zone X region are the areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood. Flood Zone AE represents special flood hazard areas subject to inundation by the 1% annual chance flood with base flood elevations determined. Flood Zone AO represents special flood hazard areas subject flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities are also determined. Flood Zone A represents special flood hazard areas subject to inundation by the 1% annual chance flood with no base flood elevations determined. Flood Zone VE represents coastal flood zone areas with velocity hazard (wave action). Base flood elevations have been determined for this zone. Development is allowed within the special flood hazard areas (Flood Zones AE, AO, A, VE) but may require additional flood hazard permitting prior to development at which time any specific requirements and restrictions for development within these areas will be determined. Flood development permits are reviewed by the County of Maui Department of Planning and FEMA, as required.

There are no existing drainage improvements within the project site, however there are several unnamed drainageways that traverse the site in the northeast to southwest direction, including Olowalu Stream which direct both onsite and offsite surface runoff towards Honoapiilani Highway. At the existing highway there are several drainage culverts which convey surface runoff from the mauka side of Honoapiilani Highway to the makai side to allow runoff to continue downstream. There are also several retention basins and drainage culverts within the surrounding existing subdivisions and improved areas that have been developed. The existing retention basins were designed to accommodate only

the increase in surface runoff due to the development of those areas.

There are four distinct drainage areas within the project site and extend mauka (See Exhibits 5 & 6). It is estimated that the present onsite runoff for a 100-year, 24-hour storm from the four drainage areas within the entire project area is approximately 1,010 cfs and approximately 322 acre-ft. of runoff volume (See Appendix A). As previously mentioned, onsite and offsite runoff sheet flows in the northeast to southwest direction across the project site. The existing Honoapiilani Highway which is near the makai or western boundary of the project acts as a berm and retains much of the runoff that sheet flows mauka of the highway. When the runoff reaches the highway, it follows existing swales along the highway and enters the State Department of Transportation (DOT) drainage system at various locations. The DOT drainage system consists of grated inlet catch basins and inlet headwall structures which intercept surface runoff along the highway shoulder and conveys it under the highway via several drainage culverts to allow the runoff to continue downstream.

3.3 WASTEWATER

There are no existing wastewater systems on the subject property. The existing Olowalu community residences are serviced by independent private wastewater facilities. The residences at Kapaiki have individual cesspools.

3.4 WATER

The Olowalu area is not serviced by the County of Maui water system, but the various existing users on the project site as well as the surrounding existing subdivisions are serviced by an existing Public Utilities Commission (P.U.C.) regulated private water system operated by the Olowalu Water Company (State of Hawaii, Department of Health Public Water System No. 209 and State Well No. 4937-02). The existing system includes a well capable of pumping approximately 250 gpm and a 500,000 gallon storage tank located above the Olowalu Mauka Subdivision. Current demand of the existing system is approximately 75,000 gpd. This system also provides fire protection to the existing Olowalu Mauka and Makai subdivisions.

The subject property and surrounding lands are also serviced by an existing P.U.C. regulated non-potable water system also operated by the Olowalu Water

Company. Non-potable water for the system is provided by an existing stream diversion in Olowalu Stream which was previously used by the former plantation companies for growing sugar cane in Olowalu. (See Impact on Water Resources of the Olowalu Town Project, prepared by Tom Nance Water Resource Engineering)

3.5 ELECTRIC, TELEPHONE AND CABLE TV

Maui Electric Company has large 69 Kv transmission lines which go over the West Maui Mountains delivering electric power from their Maalaea Power station to West Maui. These large lines traverse the upper mauka portions of the subject property through an existing utility easement. There are overhead electrical and telephone lines along Honoapiilani Highway which extend mauka to service the existing subdivisions. The area is currently not serviced by local cable television service.

Historically, the previous sugar plantation companies operating in Olowalu had utilized water from the Olowalu stream to generate hydro-electricity for various plantation needs. This hydro-electric facility has been out of use for several decades.

4.0 ANTICIPATED INFRASTRUCTURE IMPROVEMENTS

4.1 ROADWAYS

The Master Plan proposes the realignment of the existing Honoapiilani Highway to a more mauka route. Access to the project from the new highway will be via two (2) primary access points, as well as a limited right-in/right-out access point. The new highway alignment will consist of a 200' wide right-of-way containing four lanes with deceleration and acceleration lanes as required. The highway will also incorporate O-turns to eliminate the need for signalized intersections at the projects access points. The existing highway will be preserved and utilized as a low speed scenic drive. (See Olowalu Town - Preliminary Traffic Impact Analysis Report, prepared by Roger D. Dyar)

The project's interior streets will have right-of-way widths between 60 ft. to 20 ft. depending on the classification and proposed use, and will be improved to standards set forth in the proposed smart code. Streets will be designed to be

pedestrian-friendly and accommodate bicycles, therefore accordingly the streets will be narrower, slower moving streets, with on-street parking, landscaped medians and tree-lined sidewalks. Appropriate striping and signage will be installed in accordance with the Department of Public Works standards. Access to the existing subdivisions and residences within the project area will continue to be provided by means of the proposed roadway system.

4.2 DRAINAGE

It is estimated that the post development runoff from the built out project site for a 100-year 24-hour design storm will be approximately 1,710 cfs and approximately 395 acre-feet of runoff volume, creating an increase of 700 cfs and 73 acre-feet of runoff volume. (See Appendix A)

The project will not involve significant alterations to the existing drainage pattern. Runoff from the project site will be collected by various methods, such as curb and grated inlet catch basins and conveyed by an underground drainage system to onsite retention basins and underground retention systems at various locations of the property. The retention basins will generally be located within the parks and green space areas throughout the project site and will have a total storage volume of approximately 105 acre-feet for surface runoff. The development plan proposes approximately 140 acres of green space which includes parks, open space, landscape medians and grassed swales along roadways, and large lawns at public and civic facilities which could be utilized as part of the drainage system. The Master Plan was designed such that approximately 15% - 20% of these green areas would be used for storm water retention. The proposed total retention basin storage volume of 105 acre-feet will accommodate the increase in surface runoff volume due to the proposed development as well as reduce the existing surface runoff volume by at least 10%. The retention basins will be located in areas to minimize direct release of surface runoff into downstream properties. Overflow from the retention basins will be allowed to continue downstream along the existing drainage patten at no greater than pre-development rates therefore will not have an adverse effect to downstream properties.

During development of the individual transects and parcels such as the larger parking areas in the commercial zones, additional stormwater retention will be

incorporated in the project plan further reducing post development runoff continuing downstream.

The design intent of the development plan will be to utilize the existing topography as much as possible and limit the need for extensive grading. Development of the project will include implementation of site specific best management practices (BMP's) during construction to provide erosion control and minimize impacts to downstream properties. Further, Brown and Caldwell prepared a project specific Stormwater Quality Enhancement Report which describes post construction structural BMP's which will also be implemented to improve the quality of stormwater runoff in order to reduce the impact to downstream properties due to runoff from the proposed development of the project.

The existing drainageways, including Olowalu Stream, which traverses the project site will remain generally in the naturally occurring conditions except at road crossings where appropriate sized drainage culverts will be installed to allow runoff to continue downstream. The area around the drainageways will be graded and vegetated such that it will not have the existing runoff rates increased by the addition of runoff from the project improvements.

The proposed drainage system will be designed in accordance with Chapter 4, "Rules for the Design of Storm Drainage Facilities in the County of Maui."

4.3 WASTEWATER

The proposed project consisting of 1,500 dwelling units, commercial, educational facilities and park areas will generate an average dry weather flow of approximately 533,000 gallons per day of wastewater (See Olowalu Town Wastewater Management Plan, prepared by Brown and Caldwell). The onsite wastewater collection system will consist of gravity sewer lines which will collect and convey the wastewater to the proposed wastewater treatment plant to be constructed at the northern end of the project site. Pump stations may be required to service the lower elevations of the project site to pump wastewater to the treatment facility.

The proposed treatment facility will utilize an innovative and advanced treatment

process to produce R-1 recycled water. The recycled treated water will be pumped back across the project site to a storage tank to distribute the reclaimed water to irrigate parks, landscaping, open-space areas, and certain agricultural crops throughout the project site. Unutilized recycled water (generated mainly during the wet weather periods) will be diverted to a constructed wetland and soil aquifer treatment system which will be sized to allow disposal of 100 percent of the peak day wet weather flow from the treatment plan. The constructed wetland and soil aquifer treatment system will provide additional treatment of the recycled water prior to percolation.

4.4 WATER

The proposed plan is to expand the existing private water system, in accordance with the State of Hawaii, Department of Health standards, to provide the necessary domestic and fire flow demands for the project as well as continue to service the surrounding area. The average daily potable demand for the proposed project is approximately 672,300 gallons per day, which includes the new residential and commercial users, as well as the adjacent users on the existing water system (See Appendix B). The water system will include the existing well adjacent to Olowalu Stream at approximately elevation 350 feet which will be one of the sources of water for the system. Currently, the water from the well is pumped to the existing 500,000 gallon storage tank located above the existing Olowalu Mauka Subdivision. The project will require the installation of a second well to meet the increased demand and a third well for back-up purposes. A new storage tank will also be constructed near the existing storage tank to meet the storage requirements of the project. Distribution lines will be installed from the storage tanks throughout the project site to service each lot and will also include the installation of fire hydrants at appropriately spaced intervals.

The maximum fire flow demand for the project will be based on the business commercial and multi-family portions of the development at 2,000 gallons per minute for a 2 hour duration with a maximum fire hydrant spacing of 250 feet. County of Maui, Department of Water Supply Standards also requires a minimum flow of 500 gallons per minute with 500 foot hydrant spacing for agricultural use, 1,000 gallons per minute with 500 foot hydrant spacing for rural use, and 1,000 gallons per minute with 350 foot hydrant spacing for single family

use. The existing water system includes fire protection to service the existing Olowalu Mauka and Makai subdivisions, but there are no existing fire hydrants within the project perimeter which can provide fire protection for the proposed development, therefore all fire protection requirements will be met by the expansion of the existing water system within the project boundaries.

The existing non-potable water system will also be expanded to service the proposed project. The system will utilize the existing sources and storage facilities as well as include the use of the R-1 water generated by the wastewater system to service appropriate areas allowed by the Department of Health regulations. Additional storage and distribution lines will be constructed as part of the project infrastructure to provide non-potable water throughout the project as necessary (See Exhibit 7).

4.5 ELECTRIC, TELEPHONE AND CABLE TV

The proposed electrical distribution system for the subject project will be extended from the existing facilities along Honoapiilani Highway or the adjacent developments. Coordination with the utility companies will be made so the system will be able to provide adequate service to the project.

A significant component of OT's use of integrated Resource Planning is the proposal to incorporate the use of renewable energy systems to help generate electricity for the project. The conceptual renewable energy plan at this time proposes to integrate a combination of several forms of non-fossil fuel energy systems, including but not limited to, hydro-power, photovoltaic, wind and solar. The Master Plan's natural resource engineers will work with Maui Electric Company to insure that the proposed renewable energy systems are designed to maintain reliability and high power quality, as well as provide a firm energy source to meet OT's energy needs.

Existing phone services will be expanded, and cable television likely added to supply the Master Plan with adequate phone and TV services.

5.0 SUMMARY

The proposed project will encompass approximately 636 acres and develop up

to 1,500 dwelling units in a combination of agricultural, rural, and urban land uses. The proposed project will also include commercial areas, open space and conservation areas, educational facilities and other community oriented uses.

The proposed roadway system to service the area will include a realigned Honoapiilani Highway further mauka than the existing highway. The existing highway will then be utilized as a minor road as part of the projects improvements to service the community on the makai side of the new highway. The project will include narrower streets designed to slow vehicle speed and increase pedestrian safety. This will also reduce the amount of impervious surfaces which reduces storm runoff.

The project drainage plan will be to construct a comprehensive drainage system to collect and convey surface runoff to onsite retention basins and underground retention systems at various locations throughout the project site. The proposed retention areas will retain the increase in surface runoff due to the development of the project as well as reduce the existing surface runoff volume by at least 10%. Innovative drainage improvements will meet or exceed government requirements for storm water runoff quantity and quality to prevent adverse impacts to the pristine coastal resources.

The existing topography across the project site generally provides adequate but not excessive slopes for the purposes of roadway and utility design. Therefore the design intent will be to utilize the topography as much as possible and limit the need for extensive grading. Improvements will conform to the existing topography and the natural drainage patterns will be retained to the extent practicable. Part of the proposed plan to minimize grading during development of the project is to retain the existing topography across the proposed agricultural and rural lots , as well as some of the open space and park areas. Only the proposed roadways and areas such as for drainage purposes would be graded within these land uses.

All land disturbance greater than one acre or part of a larger common plan of development will require a National Pollutant Discharge Elimination System (NPDES) permit issued by the State Department of Health. Part of the permit application will be to outline the proposed Best Management Practices (BMPs)

to minimize erosion and discharge of non-storm water pollutants from continuing downstream. BMPs will be implemented to all areas of disturbance during construction of the development to provide erosion control and minimize any potential impacts. Detailed site specific plans will be prepared as the project prepares for development.

The project will construct an onsite wastewater treatment plant to accommodate all of the wastewater produced by the development. The treatment plant will produce R-1 quality recycled water which will be utilized throughout the project site for irrigation, which will significantly reduce the demand for ground water resources ensuring the sustainable use of the water resources. The proposed plan will also include a constructed wetland and storage facilities to accommodate the R-1 water during wet weather periods.

The Olowalu area is currently serviced by a private water company which provides both potable and non-potable water. The proposed development includes the expansion of the existing water systems to service all of the parcels to be developed. The proposed expansion includes the development of two additional wells and storage tank for the potable system, and a storage tank for the non-potable system. These improvements will provide a sufficient and reliable water supply to meet all of the potable, non-potable and fire protection needs for the proposed project and existing users.

EXHIBITS

1 Location Map

2 Vicinity Map

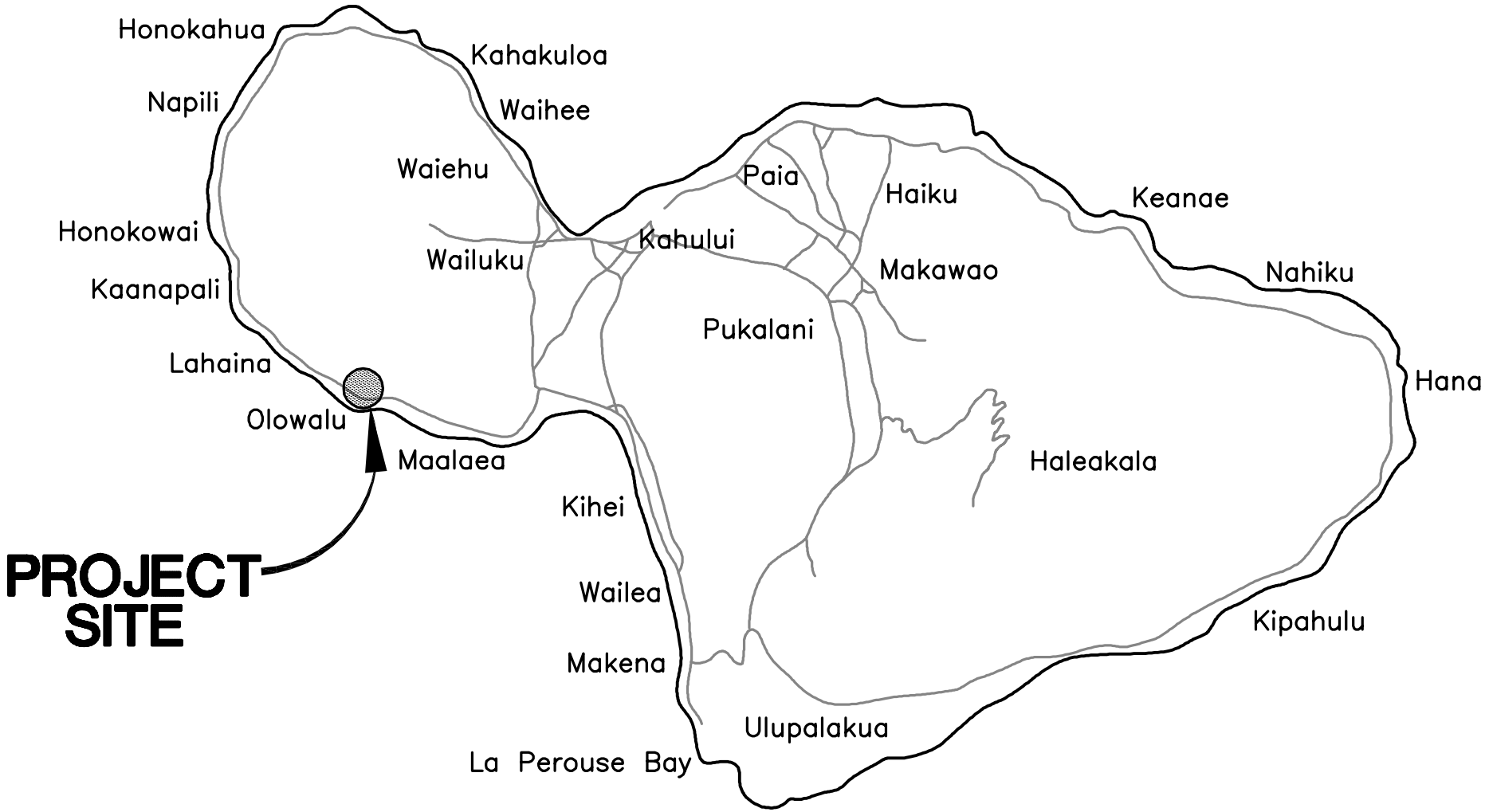
3 Soil Survey Map

4 Flood Insurance Rate Map

5 Preliminary Drainage Area Map

6 Onsite Drainage Area Map

7 Schematic Water System Map


Honokahua
Kahakuloa
Napili
Waihee
Waiehu
Paia
Haiku
Keanae
Honokowai
Kahului
Wailuku
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Nahiku
Kaanapali
Pukalani
Lahaina
Hana
Olowalu
Maalaea
Haleakala
Kihei
PROJECT SITE
Wailea
Kipahulu
Makena
Ulupalakua
La Perouse Bay
N
ISLAND OF MAUI
NOT TO SCALE

EXHIBIT 1

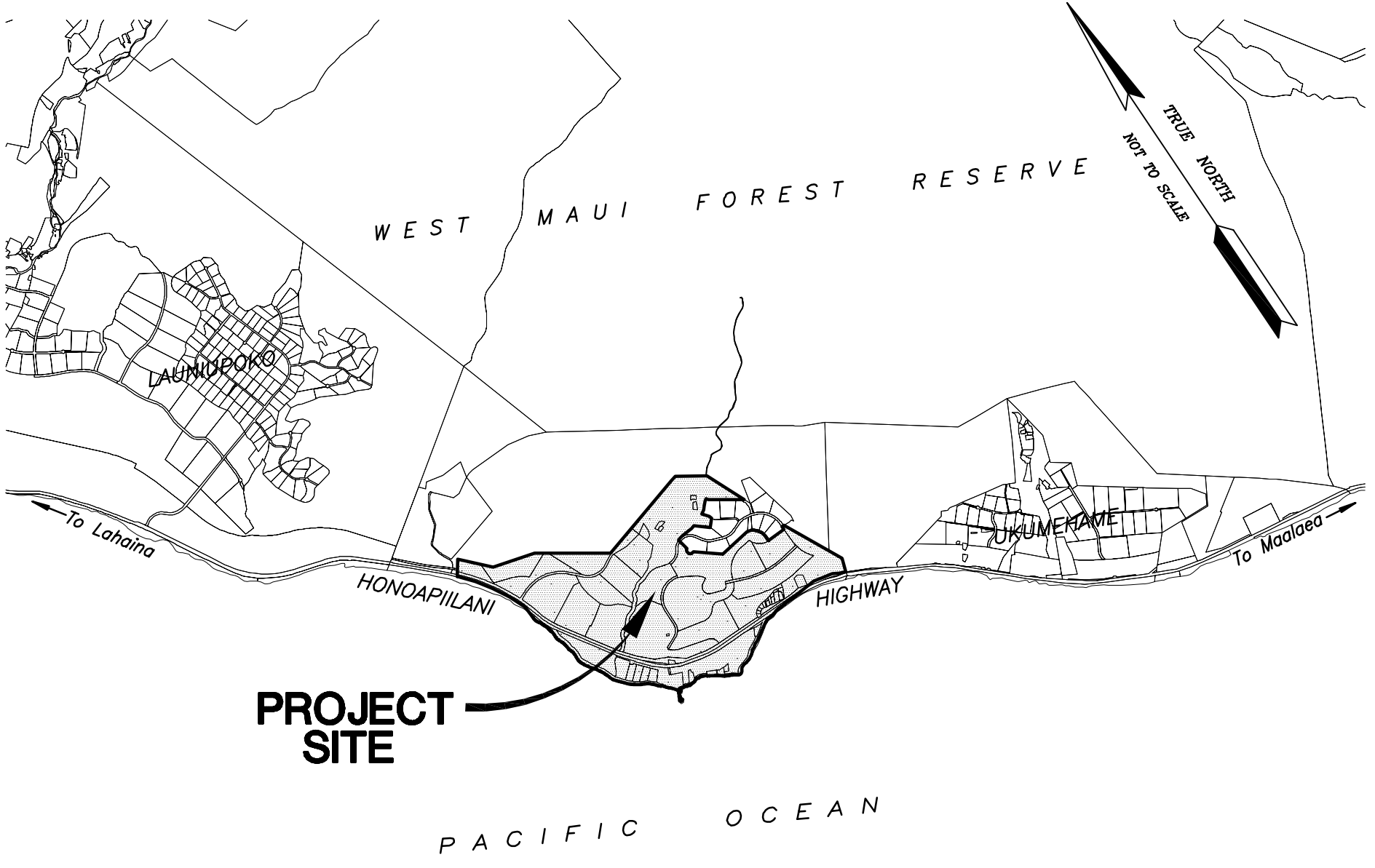


EXHIBIT 2
LOCATION MAP

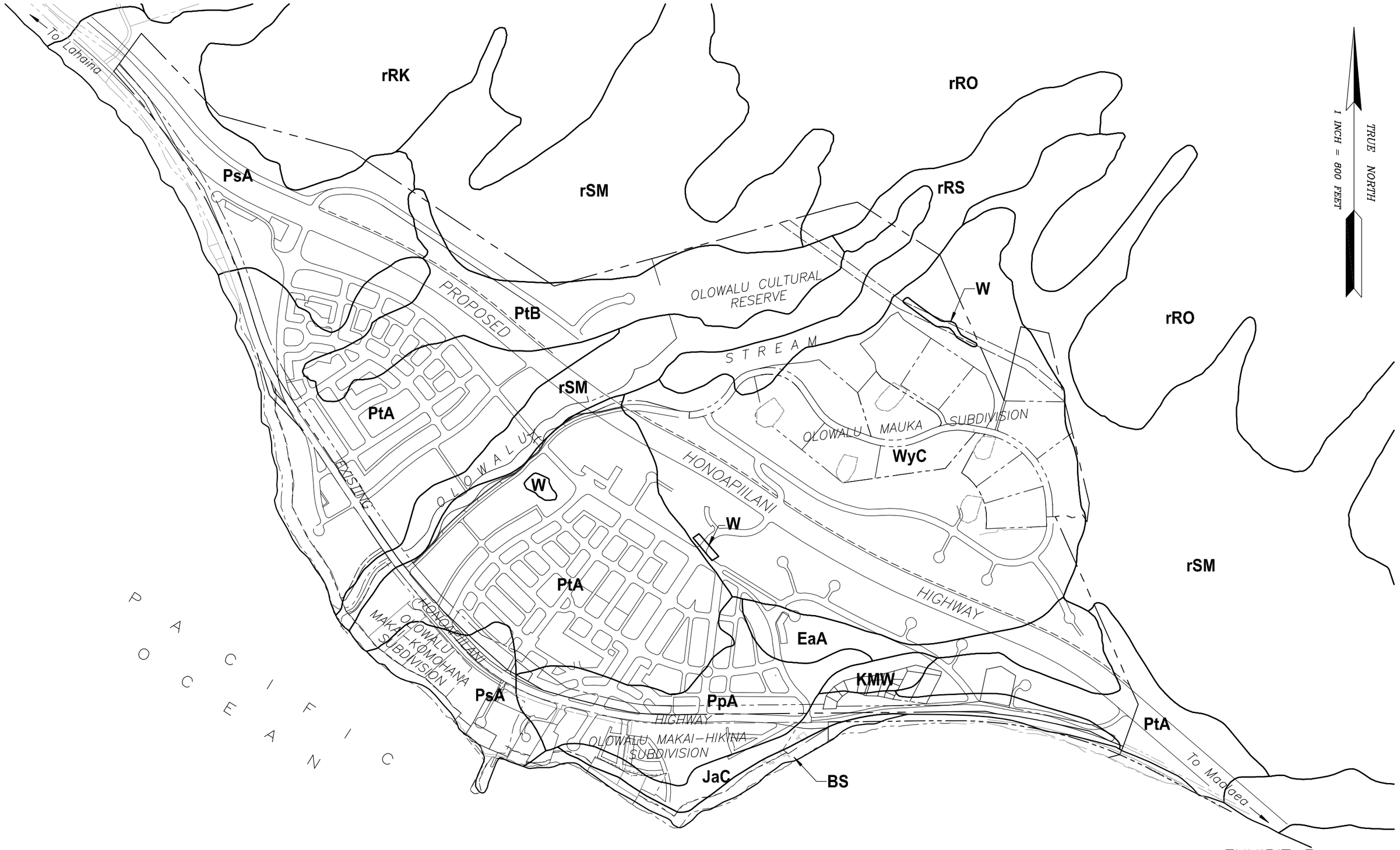


EXHIBIT 3
SOIL SURVEY MAP

TRUE NORTH

1 INCH = 800 FEET

To Lahaina

AE

VE

X

PROPOSED

EXISTING

OLOWALU CULTURAL RESERVE

STREAM

A

AE

OLOWALU MAUKA SUBDIVISION

X

X

X

HONOAPIILANI

AO

AE

HONOAPIILANI

OLOWALU MAKAI-KOMOHANA SUBDIVISION

HIGHWAY

AO

VE

HIGHWAY

OLOWALU MAKAI–HIKINA SUBDIVISION

A

To Maalaea

AE

P A C I F I C O C E A N

EXHIBIT 4
FLOOD INSURANCE RATE MAP

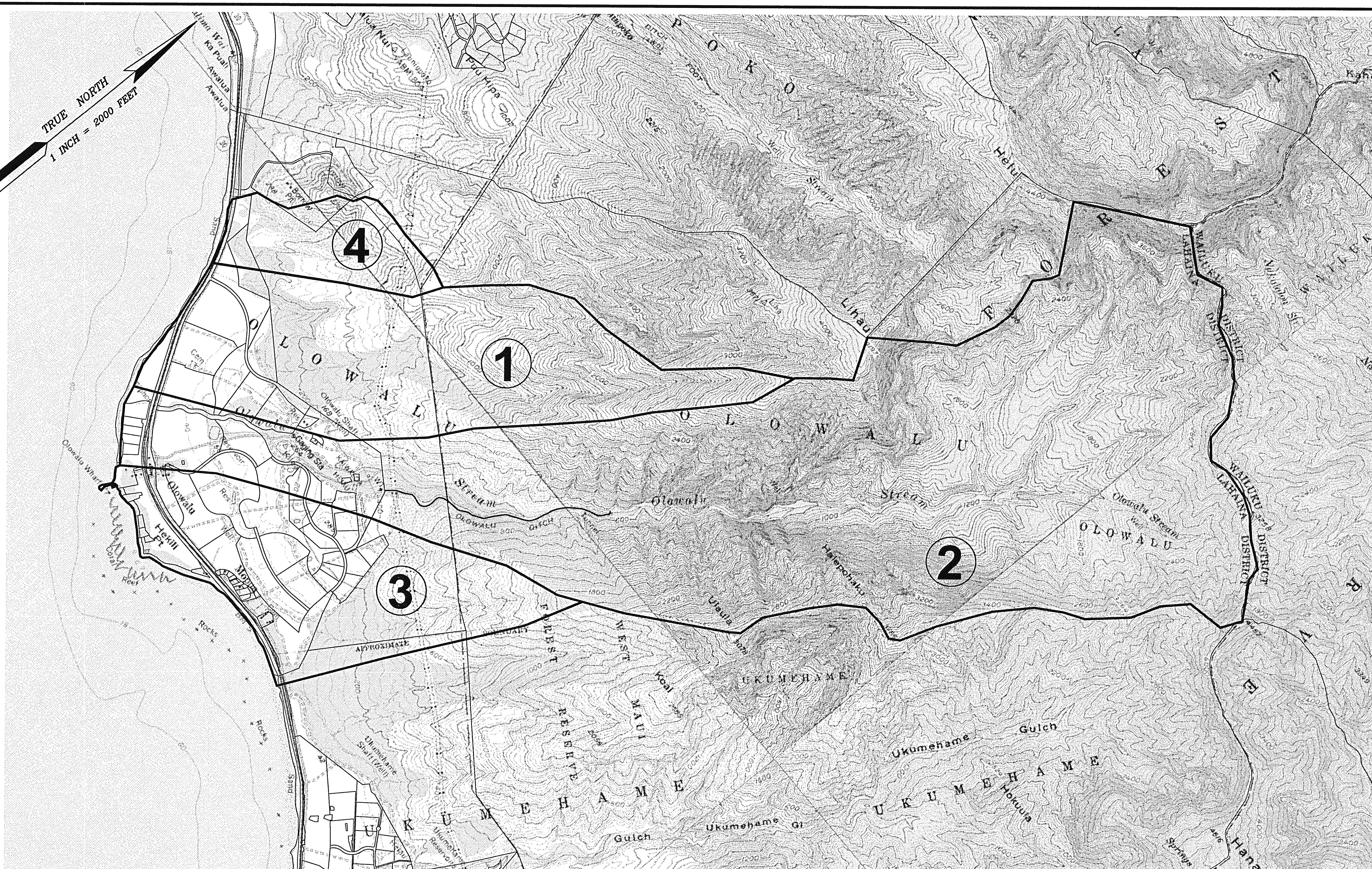


EXHIBIT 5
DRAINAGE AREA MAP

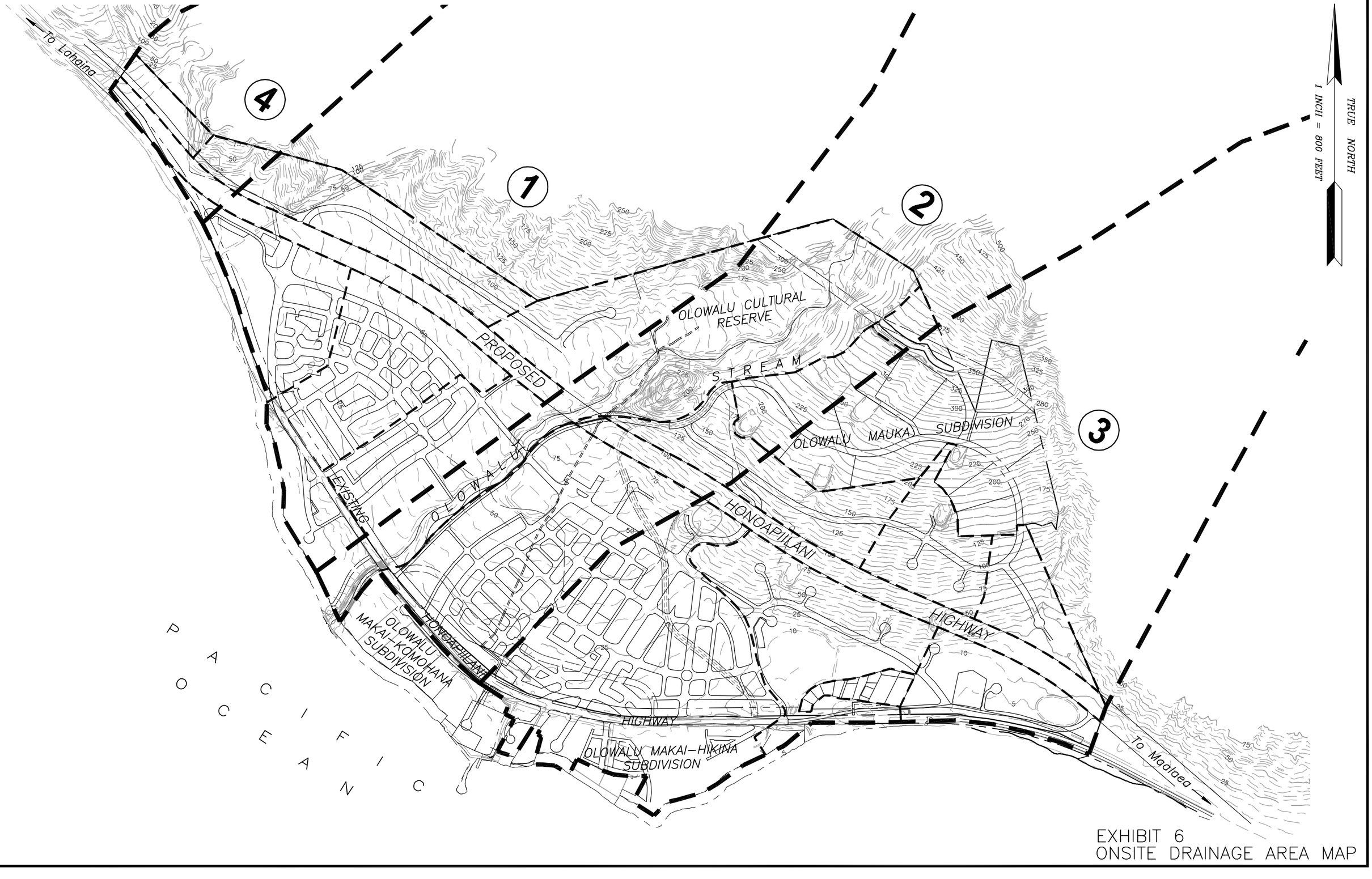
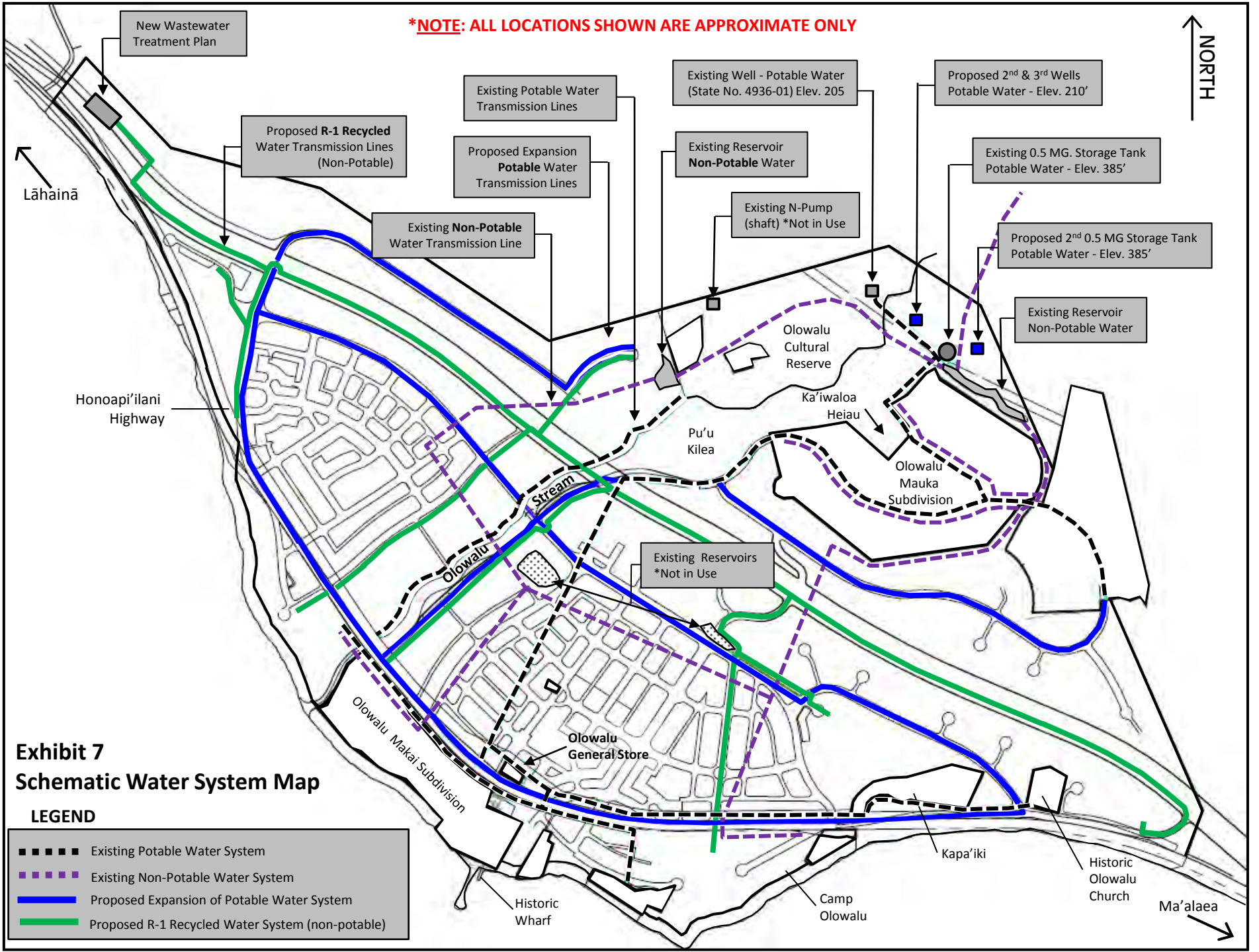


EXHIBIT 6
ONSITE DRAINAGE AREA MAP


*NOTE: ALL LOCATIONS SHOWN ARE APPROXIMATE ONLY
NORTH
New Wastewater Treatment Plan
Existing Potable Water Transmission Lines
Existing Well - Potable Water (State No. 4936-01) Elev. 205
Proposed 2nd & 3rd Wells Potable Water - Elev. 210'
Proposed R-1 Recycled Water Transmission Lines (Non-Potable)
Proposed Expansion Potable Water Transmission Lines
Existing Reservoir Non-Potable Water
Existing 0.5 MG. Storage Tank Potable Water - Elev. 385'
Lāhainā
Existing N-Pump (shaft) *Not in Use
Existing Non-Potable Water Transmission Line
Proposed 2nd 0.5 MG Storage Tank Potable Water - Elev. 385'
Existing Reservoir Non-Potable Water
Olowalu Cultural Reserve
Honoapi'ilani Highway
Ka'iwaloa Heiau
Pu'u Kilea
Olowalu Mauka Subdivision
Stream
Olowalu
Existing Reservoirs *Not in Use
Olowalu Makai Subdivision
Olowalu General Store
Kapa'iki
Historic Olowalu Church
Historic Wharf
Camp Olowalu
Ma'alaea
Exhibit 7
Schematic Water System Map
LEGEND
Existing Potable Water System
Existing Non-Potable Water System
Proposed Expansion of Potable Water System
Proposed R-1 Recycled Water System (non-potable)

APPENDIX A
HYDROLOGIC CALCULATIONS

Hydrologic Calculations

Purpose: Determine the storage volume required to mitigate the increase in runoff due to the proposed improvements for a 100-year, 24-hour storm. See attached hydrograph calculations.

Runoff created by pre-development conditions = 1,010 cfs
Runoff Volume created by pre-development conditions = 322 acre-feet

Runoff created by post-developed conditions = 1,710 cfs
Runoff Volume created by post-development conditions = 395 acre-feet

Runoff increase due to the development of the project is 700 cfs
Required storage volume for the project is 73 acre-feet

Approximately 105 acre-feet of storage is intended to be provided by the onsite retention basins located within the proposed green space areas. The proposed total retention basin storage volume will accommodate the increase in surface runoff volume due to the proposed development as well as reduce the existing surface runoff volume by at least 10%.

OLOWALU TOWN - TOTAL RUNOFF

PRE DEVELOPMENT (TOTAL)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
1	852	24.38%	73	1,926	545
2	2788	15.61%	83	5,609	2,038
3	565	25.06%	70	1,434	327
4	184	18.90%	81	769	132
	4,389				3,043

100 year - 24 hour Rainfall = 11 inches

PRE DEVELOPMENT (ONSITE)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
	636	4.96%	62	883	322
1	185	4.46%	62	350	93
2	180	4.96%	64	265	96
3	251	8.51%	61	338	124
4	20	4.71%	62	55	10
	636			1,008	322

100 year - 24 hour Rainfall = 11 inches

Hydrograph Plot

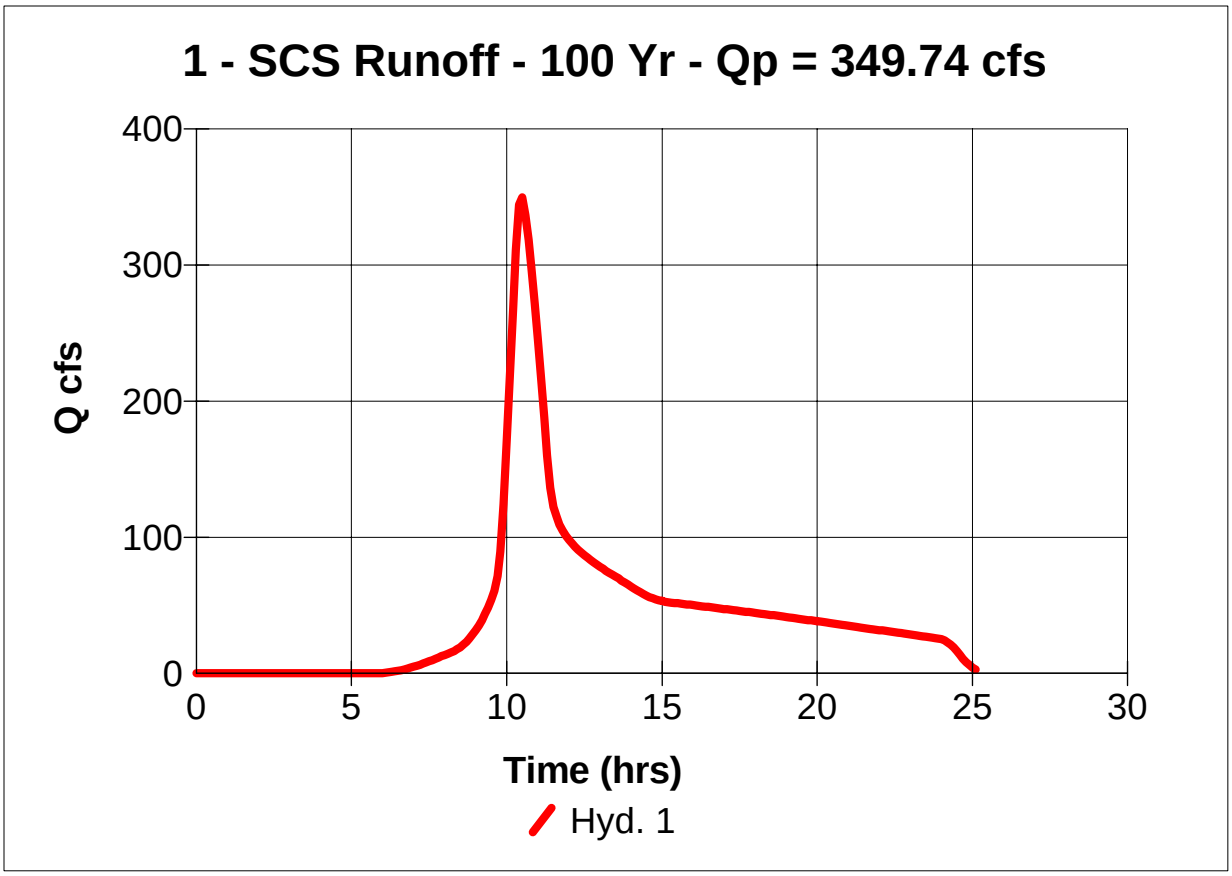
English

Hyd. No. 1

AREA 1 (PRE)

Hydrograph type	= SCS Runoff	Peak discharge	= 349.74 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 185.00 ac	Curve number	= 62
Basin Slope	= 4.5 %	Hydraulic length	= 2690 ft
Tc method	= LAG	Time of conc. (Tc)	= 54.5 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 4,034,177 cuft



Hydrograph Plot

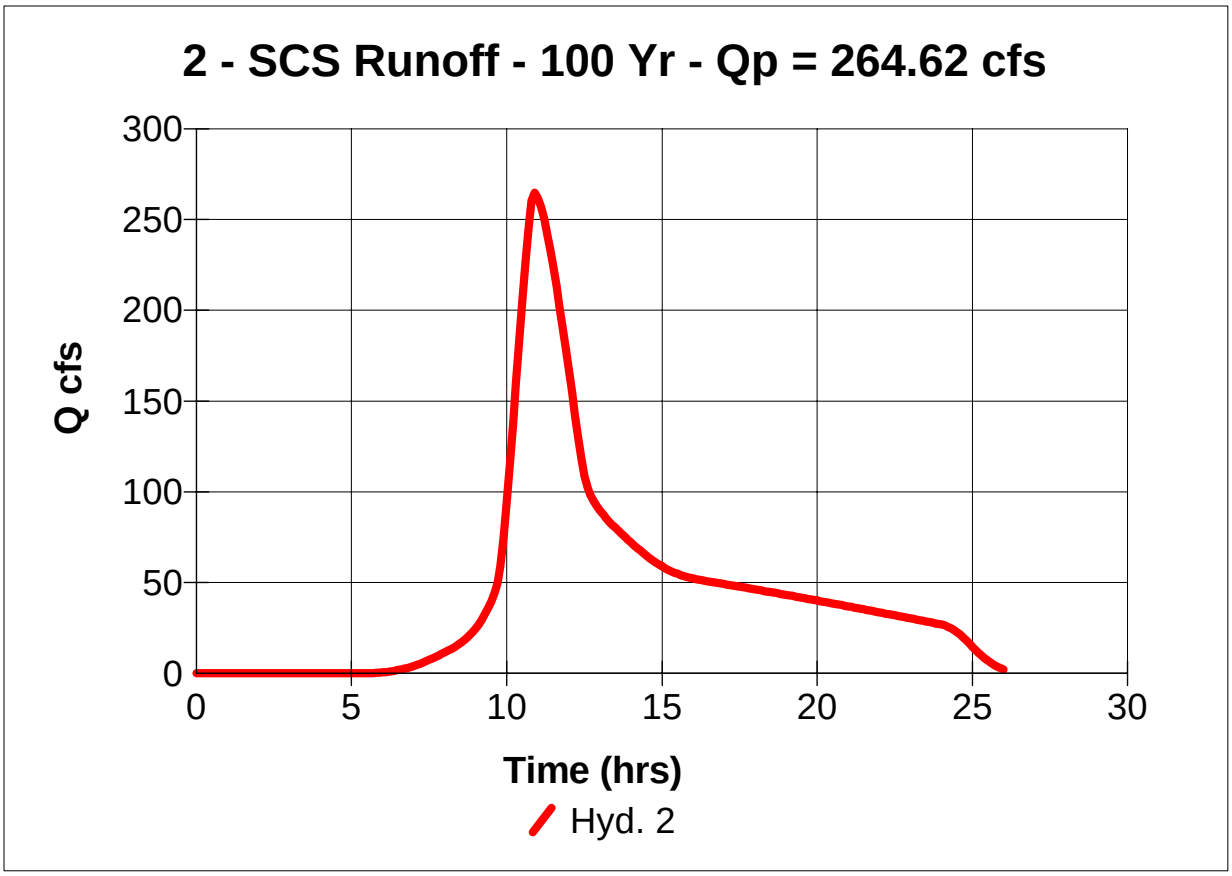
English

Hyd. No. 2

AREA 2 (PRE)

Hydrograph type	= SCS Runoff	Peak discharge	= 264.62 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 180.00 ac	Curve number	= 64
Basin Slope	= 5.0 %	Hydraulic length	= 6050 ft
Tc method	= LAG	Time of conc. (Tc)	= 93.9 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 4,162,139 cuft



Hydrograph Plot

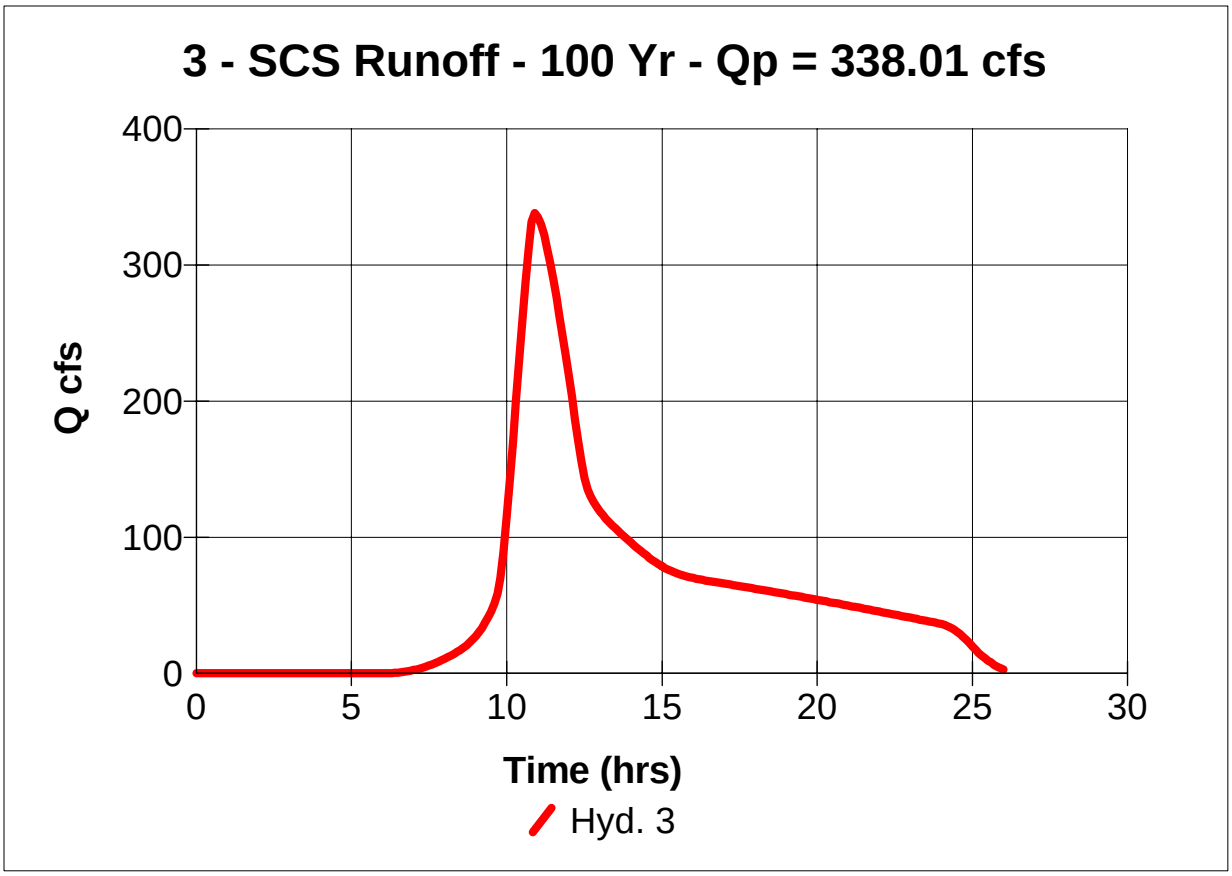
English

Hyd. No. 3

AREA 3 (PRE)

Hydrograph type	= SCS Runoff	Peak discharge	= 338.01 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 251.00 ac	Curve number	= 61
Basin Slope	= 8.5 %	Hydraulic length	= 7582 ft
Tc method	= LAG	Time of conc. (Tc)	= 93.2 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 5,410,055 cuft



Hydrograph Plot

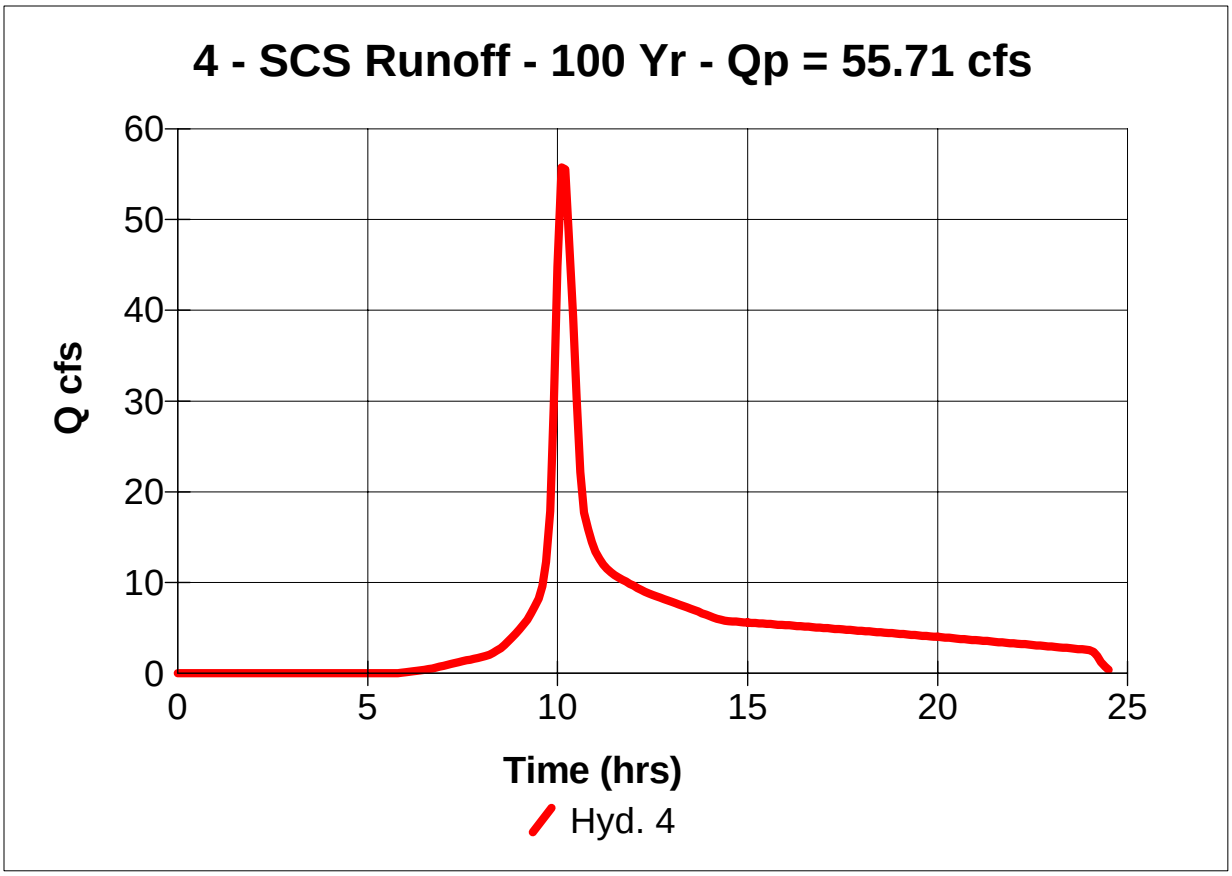
English

Hyd. No. 4

AREA 4 (PRE)

Hydrograph type	= SCS Runoff	Peak discharge	= 55.71 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 20.00 ac	Curve number	= 62
Basin Slope	= 4.7 %	Hydraulic length	= 850 ft
Tc method	= LAG	Time of conc. (Tc)	= 21.2 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 436,127 cuft



OLOWALU TOWN - TOTAL RUNOFF

POST DEVELOPMENT (TOTAL)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
1	852	24.38%	76	2,036	574
2	2788	15.61%	84	5,683	2,068
3	565	25.06%	74	1,803	373
4	184	18.90%	82	780	134
	4,389				3,149

100 year - 24 hour Rainfall = 11 inches

POST DEVELOPMENT (ONSITE)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
	636	4.96%	73	1,311	393
1	185	4.46%	75	602	124
2	180	4.96%	72	364	109
3	251	8.51%	72	664	151
4	20	4.71%	69	81	11
	636			1,711	395

100 year - 24 hour Rainfall = 11 inches

Hydrograph Plot

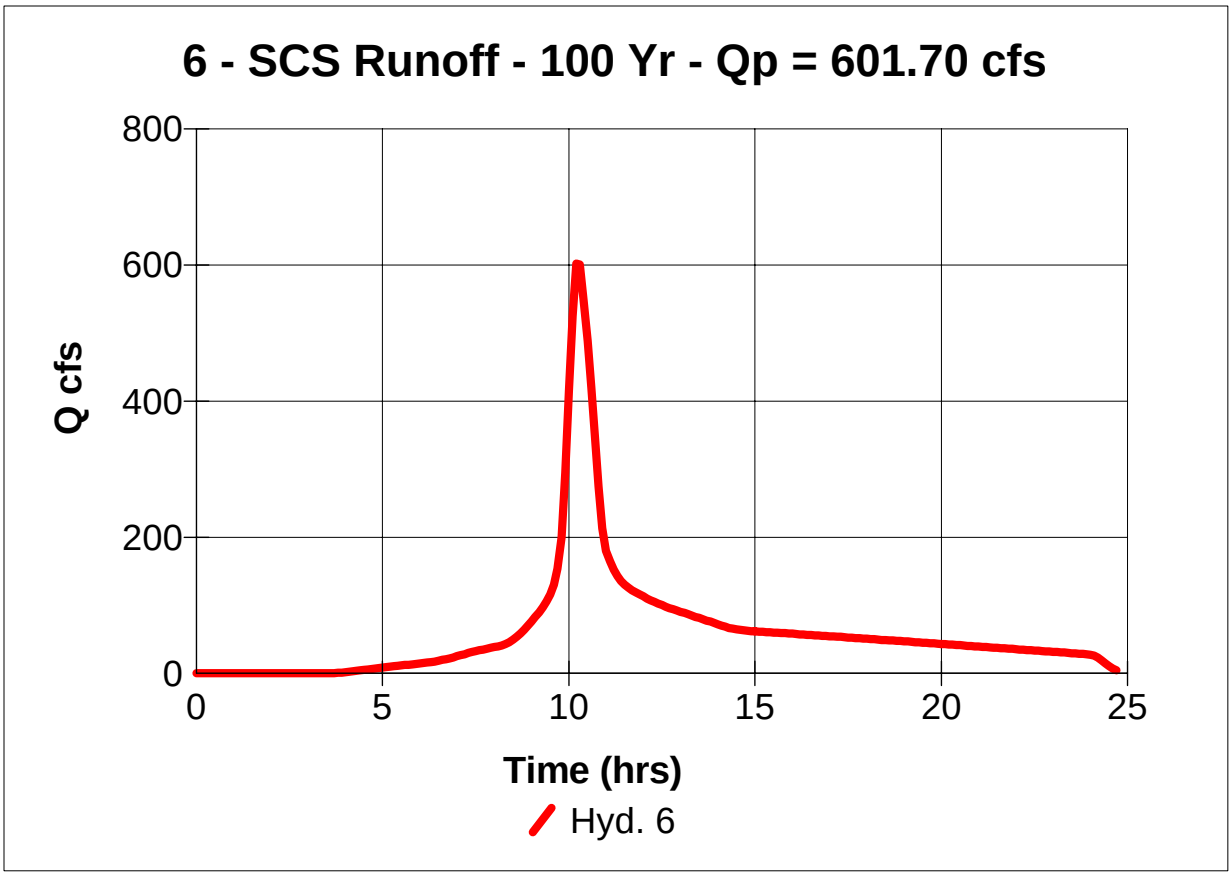
English

Hyd. No. 6

AREA 1 (POST)

Hydrograph type	= SCS Runoff	Peak discharge	= 601.70 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 185.00 ac	Curve number	= 75
Basin Slope	= 4.5 %	Hydraulic length	= 2690 ft
Tc method	= LAG	Time of conc. (Tc)	= 38.4 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 5,410,788 cuft



Hydrograph Plot

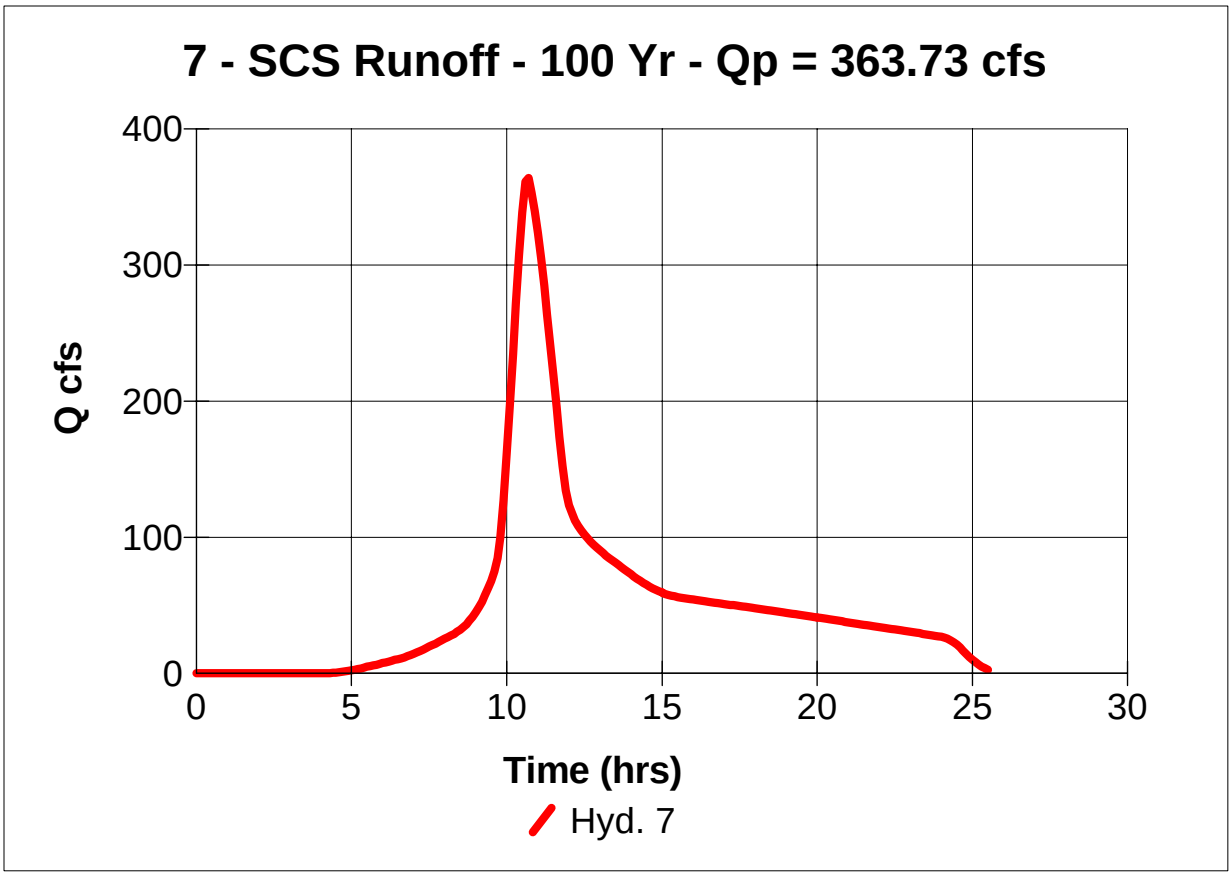
English

Hyd. No. 7

AREA 2 (POST)

Hydrograph type	= SCS Runoff	Peak discharge	= 363.73 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 180.00 ac	Curve number	= 72
Basin Slope	= 5.0 %	Hydraulic length	= 6050 ft
Tc method	= LAG	Time of conc. (Tc)	= 75.9 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 4,762,875 cuft



Hydrograph Plot

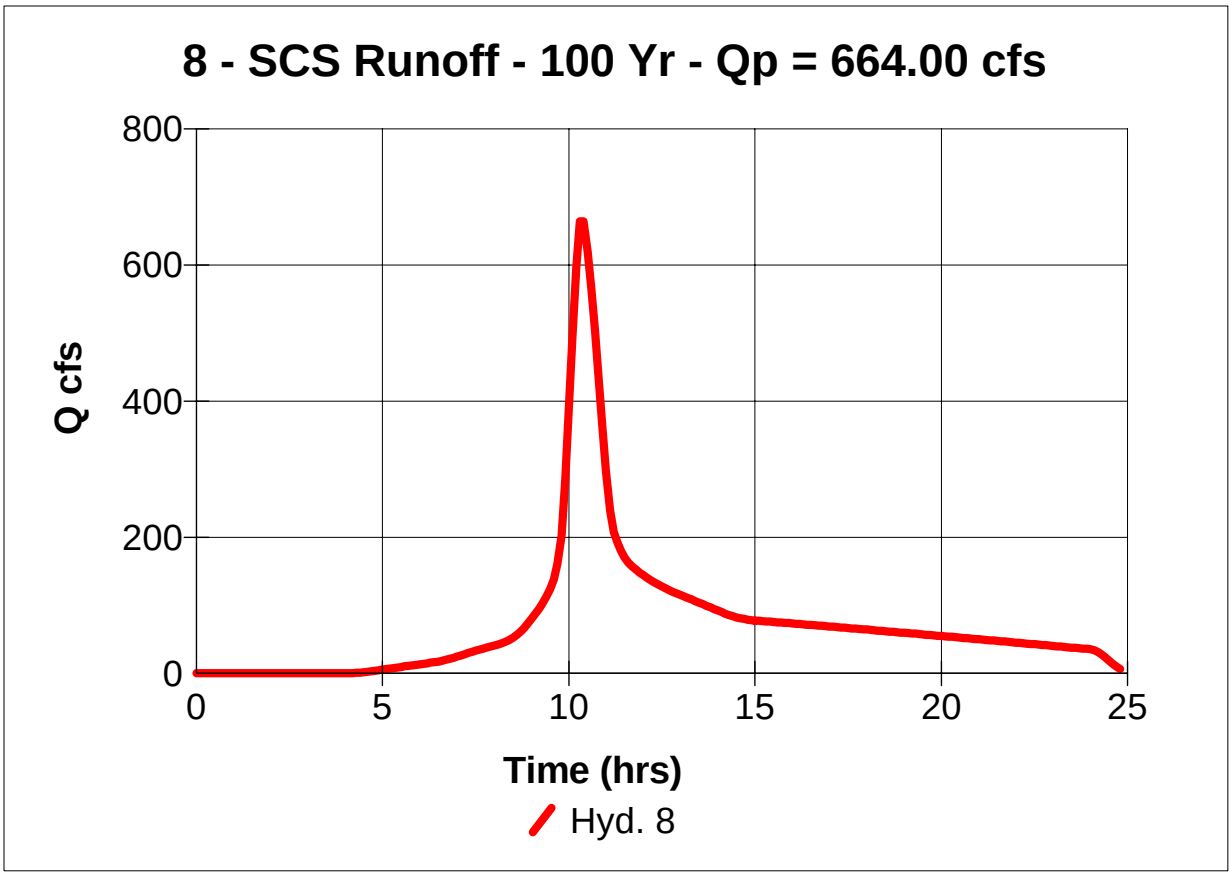
English

Hyd. No. 8

AREA 3 (POST)

Hydrograph type	= SCS Runoff	Peak discharge	= 664.00 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 251.00 ac	Curve number	= 72
Basin Slope	= 8.5 %	Hydraulic length	= 4700 ft
Tc method	= LAG	Time of conc. (Tc)	= 47.5 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 6,578,314 cuft



Hydrograph Plot

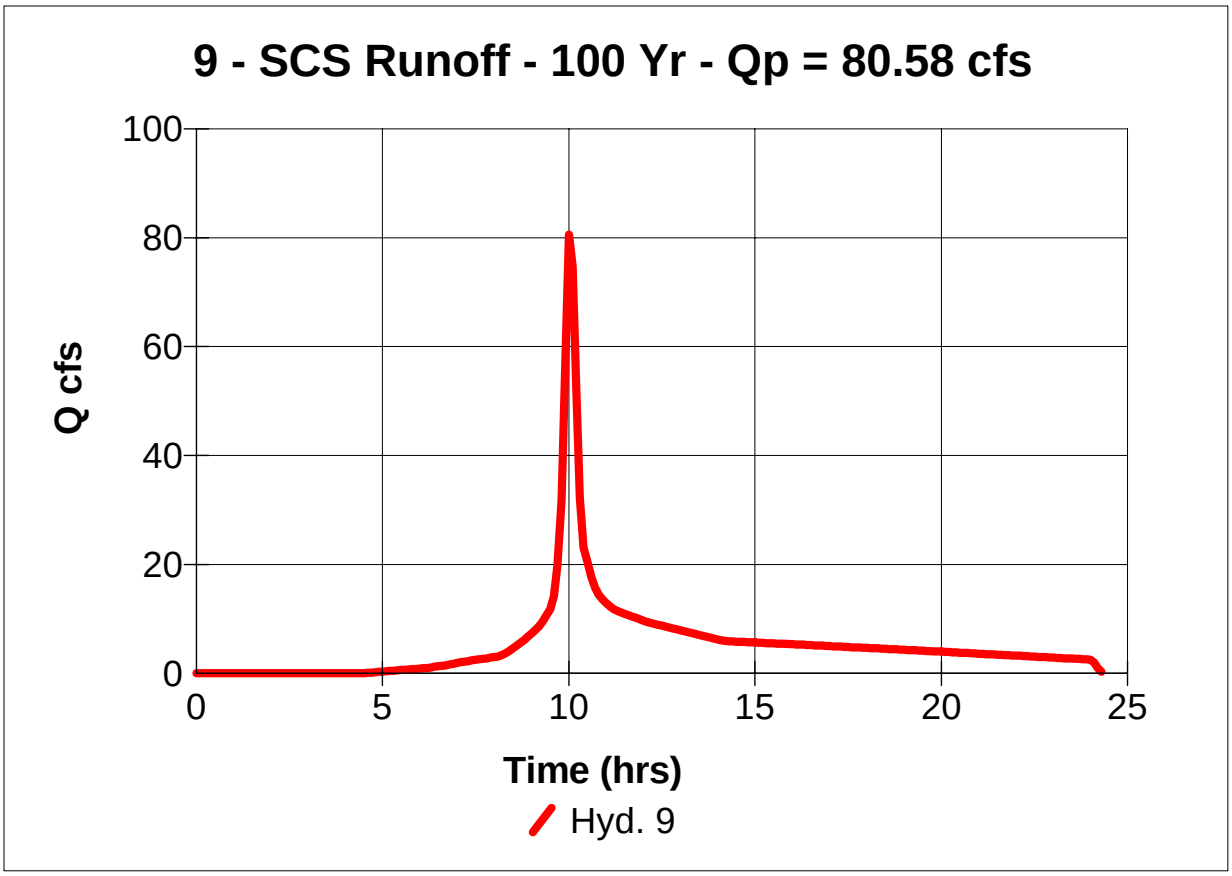
English

Hyd. No. 9

AREA 4 (POST)

Hydrograph type	= SCS Runoff	Peak discharge	= 80.58 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 20.00 ac	Curve number	= 69
Basin Slope	= 4.7 %	Hydraulic length	= 850 ft
Tc method	= LAG	Time of conc. (Tc)	= 17.6 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 475,877 cuft



APPENDIX B
WATER DEMAND CALCULATIONS

POTABLE WATER DEMAND CALCULATIONS

Project Data:

900 Single Family Residential Units, including Rural (223 acres)
580 Multi Family Residential Units (70 acres)
20 Agriculture Units (32 acres)
24 acres Commercial
75 acres Open Space/Parks
25 acres Public/Quasi-Public

Domestic Consumption Guidelines:

Single Family Residential	= 550 gallons/unit (w/o non-potable service) or
	= 275 gallons/unit (w/ non-potable service)
Multi Family Residential	= 400 gallons/unit (w/o non-potable service) or
	= 225 gallons/unit (w/ non-potable service)
Agriculture	= 275 gallons/unit (w/ non-potable service)
Commercial	= 1,200 gallons/acre (w/ non-potable service)
Open Space/Parks	= 250 gallons/acre (w/ non-potable service)
Public/Quasi-Public	= 1,200 gallons/acre (w/ non-potable service)

Average Daily Demand (ADD) =

Single Family Residential	= 550 x 400 units = 220,000 gallons
	= 275 x 500 units = 137,500 gallons
Multi Family Residential	= 400 x 150 units = 60,000 gallons
	= 225 x 430 units = 96,750 gallons
Agriculture	= 275 x 20 units = 5,500 gallons
Commercial	= 1,200 x 24 acres = 28,800 gallons
Open Space/Parks	= 250 x 75 acres = 18,750 gallons
Public/Quasi-Public	= 1,200 x 25 acres = 30,000 gallons
Existing Users	= 75,000 gallons

Total Average Daily Demand = 672,300 gpd
Max. Daily Demand (1.5 x ADD) = 1.5 x 672,300 = 1,008,450 gpd

Max. Fire Flow = 1,000 gpm (Single Family & Rural)
500 gpm (Agriculture)
2,000 gpm (Multi Family, Commercial)

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