APPENDIX A

Drainage Calculations

APPENDIX A-1

Pre-Development Onsite Surface Runoff (50-yr./1-hr.)

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Area

Description: Pre-development onsite surface runoff

Area (A): 77.59 acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Rolling]	→	0.03
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.28

Time of Concentration

Average Slope: 4.0 %
Time of Concentration (T_c): 19 minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.3 in.
Intensity (I): 3.90 in./hr.

Flow Rate

$$Q = C \cdot I \cdot A$$
$$= 84.7 \text{ ft.}^3\text{/sec.}$$

APPENDIX A-2

Post-Development Onsite Surface Runoff (50-yr./1-hr.) Total

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Area

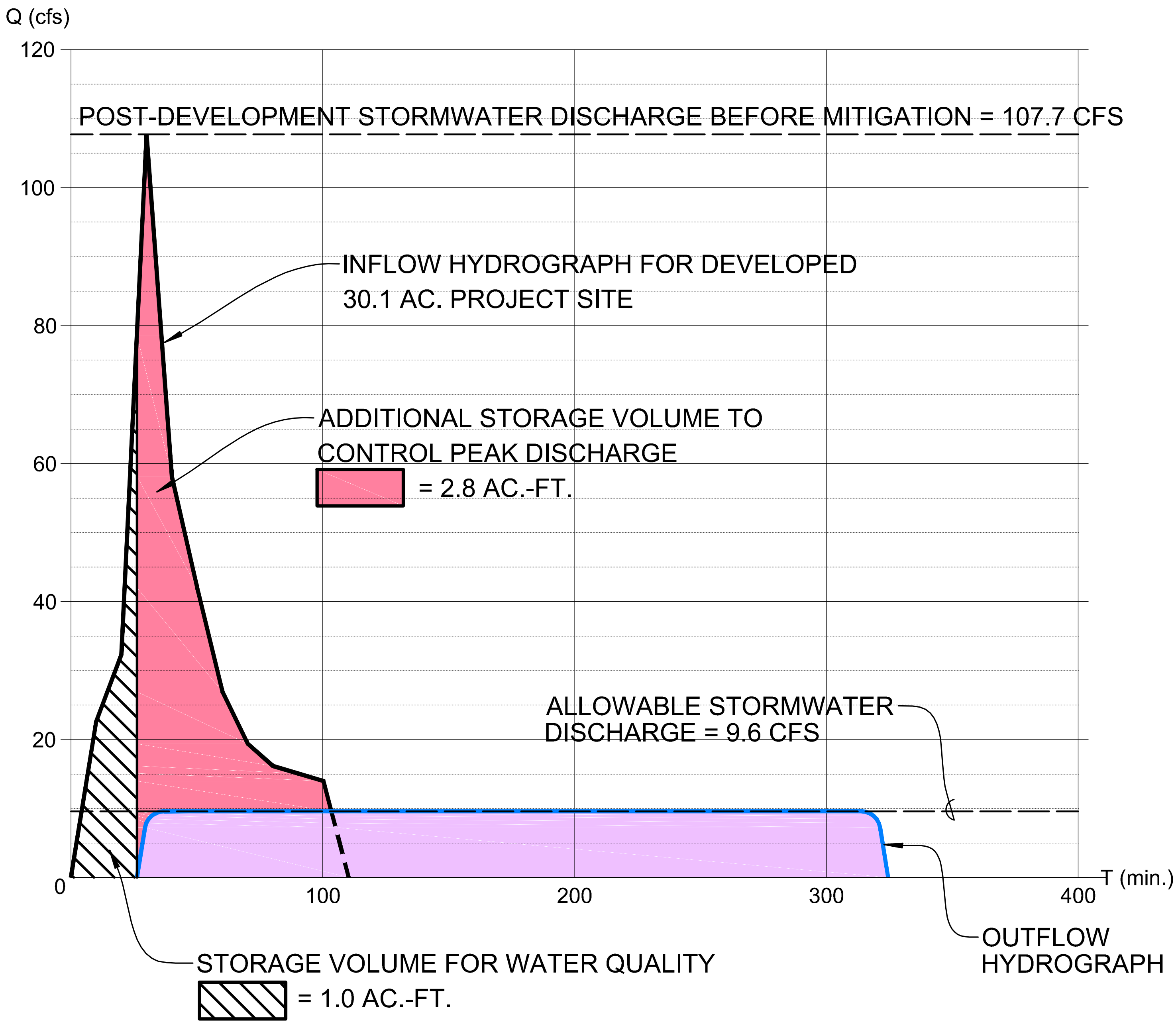
Description: Total post-development onsite surface runoff
Area: 77.59 acres
Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.3 in.

Flow Rate

$$Q = Q_{north} + Q_{south} + Q_{roads,\text{water tank, diversion ditch}}$$
$$= 107.7 + 148.2 + 35.9$$
$$= 291.8 \quad ft.^3/sec.$$

APPENDIX A-3

North Detention Basin Sizing Calculations



NOTE:

1. TOTAL REQUIRED STORAGE VOLUME = [hatched] + [shaded] = 3.8 AC.–FT.
2. BASED ON 50–YR., 1–HR. STORM FOR KIHEI, HI (DEPTH=2.3 IN.)

FIGURE A-3.1

Inflow & Outflow Hydrographs for Piilani Promenade (North)

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APPENDIX A-3.1

Post-Development Onsite Surface Runoff (50-yr./1-hr.) North

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Area

Description: Post-development onsite surface runoff for north portion

Area (A):	30.13	acres
Light Industrial Area:	3.59	acres
Impervious Area:	16.15	acres
Gravel Area:	0.48	acres
Landscaped Area:	9.91	acres
Apartment Area:	14.25	acres
Industrial Area:	15.88	acres

Runoff Coefficient

Light Industrial Runoff Coefficient:	0.80
Impervious Runoff Coefficient:	0.95
Gravel Runoff Coefficient:	0.60
Landscape Runoff Coefficient:	0.15
Weighted Runoff Coefficient:	0.66
Minimum Runoff Coefficient for Apartment Areas:	0.70
Minimum Runoff Coefficient for Industrial Areas:	0.80
Weighted Runoff Coefficient (C):	0.75

Time of Concentration

Time of Concentration (T_c): 10 minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.3 in.
Intensity (I): 4.75 in./hr.

Flow Rate

$$Q = C \cdot I \cdot A$$

$$= 107.7 \text{ ft.}^3\text{/sec.}$$

APPENDIX A-3.2

Post-Development Onsite Surface Runoff (50-yr./1-hr.)

Roads, Water Tank and Diversion Ditch

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Area

Description: Post-development onsite surface runoff for roads, water tank, and diversion ditch

Area (A):	9.40	acres
Impervious Area:	7.69	acres
Landscaped Area:	1.71	acres

Runoff Coefficient

Impervious Runoff Coefficient:	0.95
Landscape Runoff Coefficient:	0.15
Weighted Runoff Coefficient (C):	0.80

Time of Concentration

Time of Concentration (T_c): 10 minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.3 in.
Intensity (I): 4.75 in./hr.

Flow Rate

$$Q = C \cdot I \cdot A$$
$$= 35.9 \text{ ft.}^3\text{/sec.}$$

APPENDIX A-3.3

North Detention Basin Sizing for Water Quality Protection

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Storm Water Treatment (North)

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Purpose: To determine the required volume of the above-ground basin to meet the County of Maui, Department of Public Works' "Rules for the Design of Storm Water Treatment Best Management Practices"

Calculations: The required design volume for detention based control is computed by the MCC §15-111-5.a.1.C formula:

WQDV = C · 1" · A · 3630

where, WQDV = water quality design volume in cubic feet
C = EPA volumetric runoff coefficient
A = gross area of the site in acres = 30.13 ac.
1" = design storm for detention based water quality system
3630 = conversion factor

The EPA volumetric runoff coefficient, C, calculated from the formula given in MCC §15-111-5.a.1.A is:

C = 0.05 + (0.009) · (IMP)

where, IMP = percentage of impervious area
= (impervious area) / (gross area) · 100
= (19.50 ac.) / (30.13 ac.) · 100
= 65

Since IMP = 65, the value of C is:

C = 0.05 + (0.009) · (65)
= 0.64

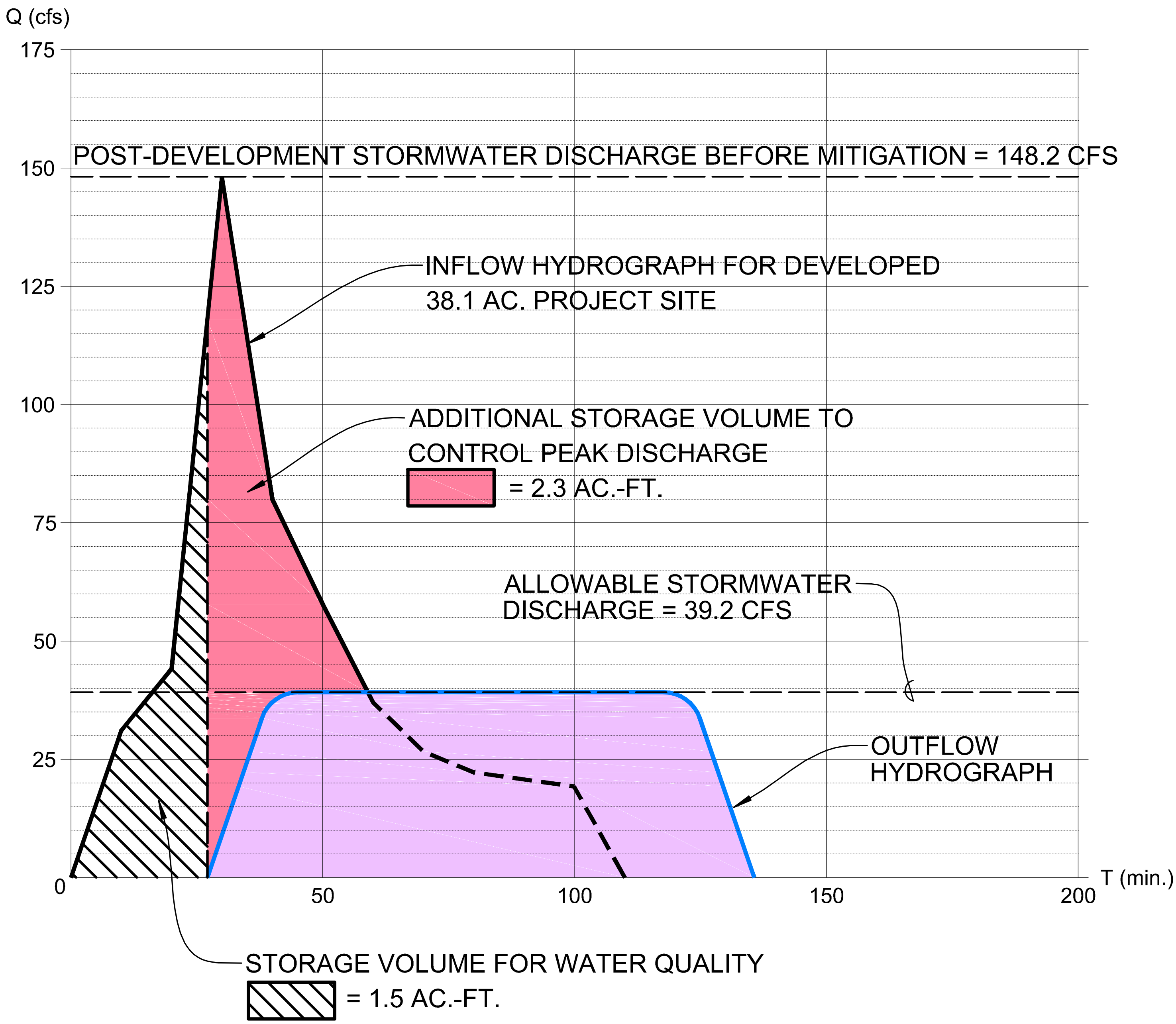
For this project, upstream flow-through treatment (catch basin filter inserts) will be utilitzed in combination with detention based treatment. Thus, the design storm for the combined system may be reduced to 0.6" as allowed in MCC §15-111-5.d.

Compute the required design volume for a 0.6" storm with C = 0.64:

WQDV = C · 0.6" · A · 3630
= 0.64 · 0.6" · 30.13 · 3630
= 41,999 ft^3
= 1.0 ac.-ft.

APPENDIX A-4

South Detention Basin Sizing Calculations



NOTE:

1. TOTAL REQUIRED STORAGE VOLUME = [hatched] + [shaded] = 3.8 AC.–FT.
2. BASED ON 50–YR., 1–HR. STORM FOR KIHEI, HI (DEPTH=2.3 IN.)

FIGURE A-4.1

Inflow & Outflow Hydrographs for Piilani Promenade (South)

APPENDIX A-4.1

Post-Development Onsite Surface Runoff (50-yr./1-hr.) South

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Area

Description: Post-development onsite surface runoff for south portion

Area (A):	38.06	acres
Impervious Area:	31.86	acres
Landscaped Area:	6.20	acres

Runoff Coefficient

Impervious Runoff Coefficient:	0.95
Landscape Runoff Coefficient:	0.15
Weighted Runoff Coefficient (C):	0.82

Time of Concentration

Time of Concentration (T_c): 10 minutes

Intensity

Project Location:	Kihei, Maui, Hawaii	
Design Storm:	50-year recurrence interval, 1-hour duration	
Rainfall Depth:	2.3	in.
Intensity (I):	4.75	in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 148.2$ ft.^{3}/sec.

APPENDIX A-4.2

South Detention Basin Sizing for Water Quality Protection

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Storm Water Treatment (South)

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Purpose: To determine the required volume of the subsurface storage chambers to meet the County of Maui, Department of Public Works' "Rules for the Design of Storm Water Treatment Best Management Practices"

Calculations: The required design volume for detention based control is computed by the MCC §15-111-5.a.1.C formula:

WQDV = C · 1" · A · 3630

where, WQDV = water quality design volume in cubic feet
C = EPA volumetric runoff coefficient
A = gross area of the site in acres = 38.06 ac.
1" = design storm for detention based water quality system
3630 = conversion factor

The EPA volumetric runoff coefficient, C, calculated from the formula given in MCC §15-111-5.a.1.A is:

C = 0.05 + (0.009) · (IMP)

where, IMP = percentage of impervious area
= (impervious area) / (gross area) · 100
= (31.86 ac.) / (38.06 ac.) · 100
= 84

Since IMP = 84, the value of C is:

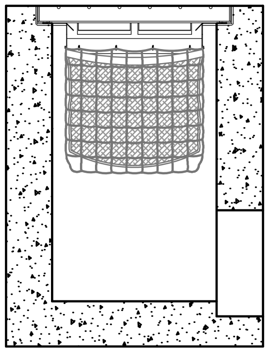
C = 0.05 + (0.009) · (84)
= 0.81

For this project, upstream flow-through treatment (catch basin filter inserts) will be utilitzed in combination with detention based treatment. Thus, the design storm for the combined system may be reduced to 0.6" as allowed in MCC §15-111-5.d.

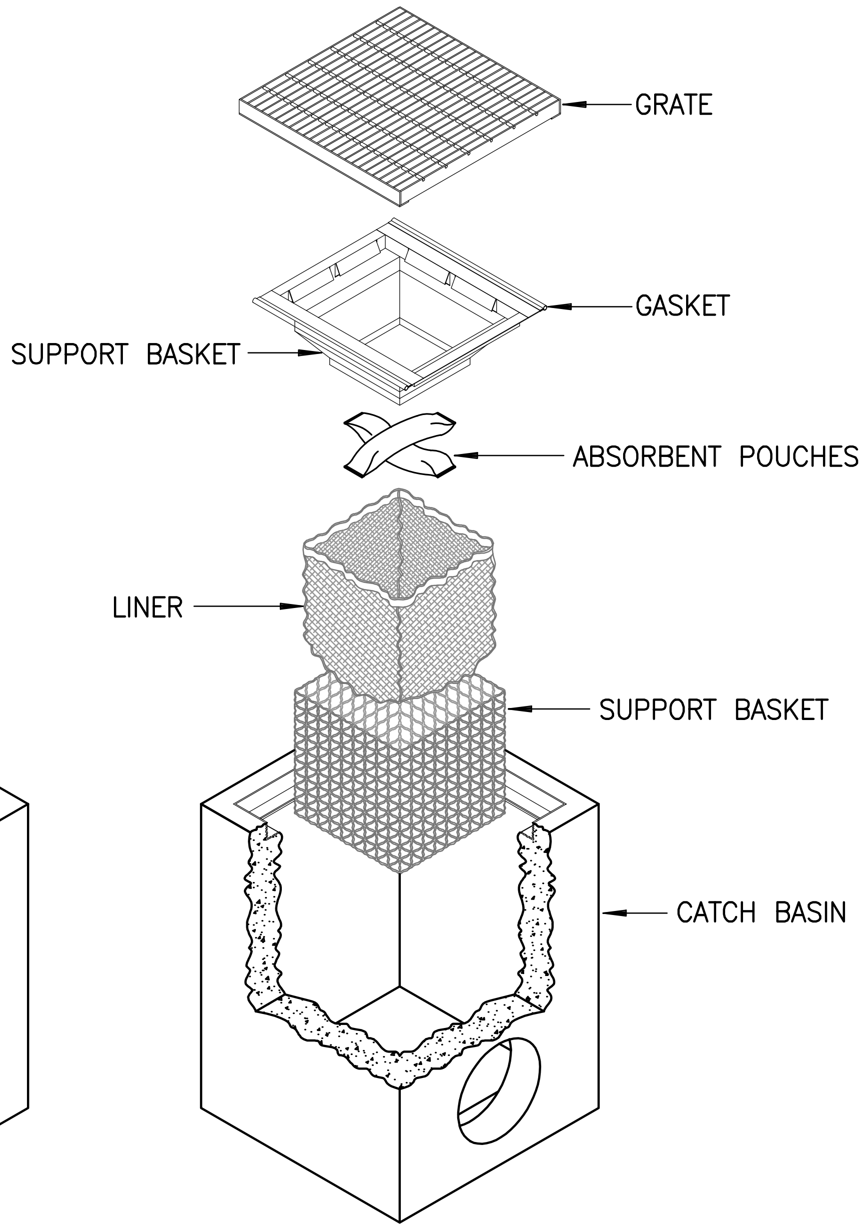
Compute the required design volume for a 0.6" storm with C = 0.81:

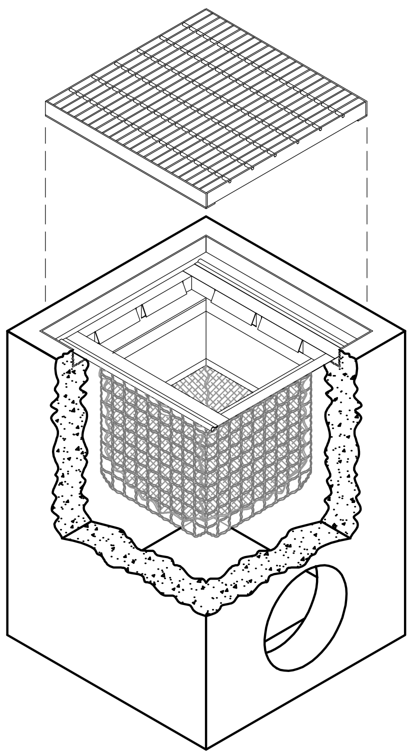
WQDV = C · 0.6" · A · 3630
= 0.81 · 0.6" · 38.06 · 3630
= 66,813 ft^3
= 1.5 ac.-ft.

APPENDIX A-5
Drain Inlet Pollution Filter Details



ELEVATION





ISOMETRIC

EXPLODED VIEW

NOTES:

1. FILTER INSERTS SHALL BE INSTALLED IN ALL CATCH BASINS.
2. FILTER INSERTS TO BE KRISTAR ENTERPRISES, INC. FLOGARD+PLUS OR SIMILAR.

FIGURE A-5.1

Typical Drain Inlet Filter

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KRISTAR

FloGard® +PLUS
Catch Basin Insert Filter

FloGard®+PLUS Catch Basin Insert Filter

GENERAL FILTER CONFIGURATION

FloGard®+PLUS catch basin insert filter shall provide solids filtration through a filter screen or filter liner, and hydrocarbon capture shall be effected using a non-leaching absorbent material contained in a pouch or similar removable restraint. Hydrocarbon absorbent shall not be placed at an exposed location at the entry to the filter that would allow blinding by debris and sediment without provision for self-cleaning in operation.

Filter shall conform to the dimensions of the inlet in which it is applied, allow removal and replacement of all internal components, and allow complete inspection and cleaning in the field.

FLOW CAPACITY

Filter shall provide two internal high-flow bypass locations that in total exceed the inlet peak flow capacity. Filter shall provide filtered flow capacity in excess of the required "first flush" treatment flow. Unit shall not impede flow into or through the catch basin when properly sized and installed.

MATERIALS

Filter support frame shall be constructed of type 304 stainless steel. Filter screen, when used in place of filter liner, shall be type 304 or 316 stainless steel, with an apparent opening size of not less than 4 U.S. mesh. Filter liner, when used in place of filter screen, shall be woven polypropylene geotextile fabric liner with an apparent opening size (AOS) of not less than 40 U.S. mesh as determined by ASTM D 4751. Filter liner shall include a support basket of polypropylene geogrid with stainless steel cable reinforcement.

Filter frame shall be rated at a minimum 25-year service life. All other materials, with the exception of the hydrocarbon absorbent, shall have a rated service life in excess of 2 years.

FloGard®+PLUS TEST RESULTS SUMMARY

Testing Agency	% TSS Removal	% Oil and Grease Removal	% PAH Removal
UCLA	80	70 to 80	
U of Auckland Tonking & Taylor Ltd. (for city of Auckland)	78 to 95		
U of Hawaii (for city of Honolulu)	80		20 to 40

FEATURES

- Easy to install, inspect and maintain
- Can be retrofitted to existing drain catch basins – or used in new projects
- Economical and efficient
- Catches pollutants where they are easiest to catch (at the inlet)
- No standing water – minimizes vector, bacteria and odor problems
- Can be incorporated as part of a "Treatment Train"

BENEFITS

- Lower installation, inspection and maintenance costs
- Versatile installation applications
- Higher return on investment
- Allows for installation on small and confined sites
- Minimizes vector, bacteria and odor problems
- Allows user to target specific pollutants

FloGard® +PLUS Catch Basin Insert Filter

INSTALLATION AND MAINTENANCE

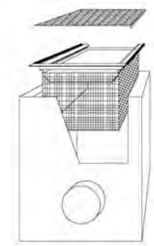
Filter shall be installed and maintained in accordance with manufacturer's general instructions and recommendations.

FloGard+PLUS
Combination Inlet

PERFORMANCE

Filter shall provide 80% removal of total suspended solids (TSS) from treated flow with a particle size distribution consistent with typical urban street deposited sediments. Filter shall capture at least 70% of oil and grease and 40% of total phosphorus (TP) associated with organic debris from treated flow. Unit shall provide for isolation of trapped pollutants, including debris, sediments, and floatable trash and hydrocarbons, from bypass flow such that re-suspension and loss of pollutants is minimized during peak flow events.

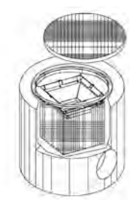
FloGard®+PLUS COMPETITIVE FEATURE COMPARISON



FloGard+PLUS
Flat Grate

Evaluation of FloGard+PLUS Units (Based on flow-comparable units) (Scale 1-10, 10 being best)	**FloGard+PLUS**	**Other Insert Filter Types****
Flow Rate	10	7
Removal Efficiency*	80%	45%
Capacity – Sludge and Oil	7	7
Service Life	10	3
Installation – Ease of Handling / Installation	8	6
Ease of Inspections & Maintenance	7	7
Value	**10**	**2**

*approximate, based on field sediment removal testing in urban street application **average



FloGard+PLUS
Round Gated Inlet

Long-Term Cost Comparison (Scale 1-10, 10 being lowest cost, higher number being best)	**FloGard+PLUS**	**Other Insert Filter Types**
Unit cost — initial ($/cfs treated)	10	4
Installation cost ($/cfs treated)	10	7
Adsorbent replacement (annual avg $/cfs treated)	10	2
Unit materials replacement (annual avg $/cfs treated)	10	10
Maintenance cost (annual avg $/cfs treated)	10	7
Total first yr ($/cfs treated)	10	5
Total Annual Avg ($/cfs treated, avg over 20 yrs)*	**10**	**5**

*assumes 3% annual inflation

Captured debris from
FloGard+PLUS,
Dana Point, CA

KriStar Enterprises, Inc.
360 Sutton Place
Santa Rosa, CA 95407

PH: 800-579-8819
FAX: 707-524-8186
www.kristar.com

FGP-T 05.19.09.1M

APPENDIX B

Drainage Report for Kaonoulu Market Place
(Approved by State of Hawaii Dept. of Transportation
and Maui County Dept. of Public Works in 2009)

Established 1969

Drainage Report

Kaonoulu Market Place

Kihei, Maui, Hawaii

TMK: (2) 2-2-02:Por. of 15
and (2) 3-9-01:16

Prepared For:

Maui Industrial Partners LLC
Kihei, Maui, Hawaii

WARREN S. UNEMORI
LICENSED PROFESSIONAL ENGINEER
NO. 1569-C
HAWAII, U.S.A.

WARREN S. UNEMORI ENGINEERING, INC.
Civil and Structural Engineers - Land Surveyors
Wells Street Professional Center - Suite 403
2145 Wells Street
Wailuku, Maui, Hawaii 96793

Date: October 2008

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TABLE OF CONTENTS

Drainage Report
for
Kaonoulu Market Place

I. INTRODUCTION

This report has been prepared to examine the existing site drainage conditions and the proposed drainage plan for the subject development.

II. PROPOSED PROJECT

A. Site Location:

The project site is located in Kihei, on the island of Maui, in the State of Hawaii. The project encompasses Lot 2 of the Kaonoulu Ranch (Large-Lot) Subdivision. It is situated on the easterly side of Piilani Highway, south of Piilani Business Park, and north of Kulanihakoi Gulch. (see Exhibit 1).

The project site encompasses an area of approximately 88.0 acres.

B. Project Description:

The proposed plan for the Kaonoulu Market Place is to develop the project site into a commercial center consisting of 4 light industrial lots numbered 1 through 4 (see Exhibit 4A). Proposed improvements include asphalt paved roadways, concrete curb and gutter, concrete sidewalks and landscaping. Utility improvements will consist of underground sewer, drainage, water, electrical and telephone distribution systems.

III. EXISTING CONDITIONS:

A. Topography and Soil Conditions:

The project site is presently vacant and not being used for any particular purpose. Natural vegetation includes, but is not limited to, buffelgrass, feather finegrass, ilima, kiawe, uhaloa, and zinnia. The project site generally slopes from an elevation of approx. (+) 124± feet M.S.L. to approx. (+) 31± feet M.S.L. in a northeasterly to southwesterly direction, with an average slope of approx. 4.1%.

According to the *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii* [1], prepared by the United States Department of Agriculture, Soil Conservation Service, the predominant soil classification found on the project site is the Waiakoa extremely stony silty clay loam, 3 to 25 percent slopes, eroded (WID2). The Waiakoa soil is characterized as having medium runoff and a severe erosion hazard. (See Exhibit 2).

B. Drainage:

According to our calculations, the project site lots 1-4 presently generate approximately 31.22, 15.44, 20.22, and 20.79 cfs of onsite surface runoff during a 50-year recurrence interval, 1-hr. duration storm, respectively (see Appendix A). This surface runoff volume presently sheet flows across the project in an easterly to westerly direction, where it either flows directly into Kulanihakoi Gulch or is intercepted by existing drainageways, and eventually discharges into Kulanihakoi Gulch downstream. Kulanihakoi Gulch runs along the southern boundary of the project site.

Offsite surface runoff from the area located immediately mauka of the subject development was estimated to be 498 cfs for a 100 year-24 hour storm and 911 cfs for a 100 year-6 hour storm. (see Appendix A). This runoff presently flows through the project site by means of an existing natural drainageway. According to the "Hydrology Report for Piilani Highway" prepared by Trans-Meridian Engineers and Surveyors, Inc., the drainageway discharges the entire pre-development onsite and offsite design flow of approximately 1,136 cfs for a 100 year-6 hour storm across existing twin 102 inch culverts under Piilani Highway and into an existing gully that ties into Kulanihakoi Gulch approximately 1,000 feet downstream of the makai boundary of the project site.

C. Flood and Tsunami Zone:

According to Panel Number 150003 0265C dated September 6, 1989 of the Flood Insurance Rate Map[2], prepared by the United States Federal Emergency Management Agency, the project site is situated within Zone C. Zone C is designated as an area which is subject to minimal flooding. (See Exhibit 3)

IV. DRAINAGE PLAN

A. General:

The drainage criteria that will be used for the proposed development will be to try and maintain the natural drainage pattern of the onsite surface runoff.

The onsite surface runoff generated by the proposed development of the Kaonoulu Street Extension will be intercepted by new curb inlet type catch basins and conveyed by means of a new underground drainage system located within the subdivision roadway. In the fully built-out industrial condition, the individual commercial lots 1-4 will each retain their own additional post-development runoff and discharge their pre-development flow into stubouts placed at the downstream end of each industrial lot which will tie into the underground drainage system. In the interim, prior to complete industrial development of the 4 lots, a berm will be installed along the western boundary of Lots 1 & 4 to keep the onsite runoff within the property and off the Piilani Highway. The minimal grading being done on the individual lots will not result in any increase in the post development runoff. Lots 3 & 4 will continue to flow to the gulch as it is presently doing and Lots 1 & 2 will tie into the new drainage system.

The offsite surface runoff presently sheet flowing onto the project site will be intercepted by a new drainage diversion ditch that runs along the eastern boundary of the property up to the northern edge of the proposed Kihei Upcountry Highway ROW. The diversion ditch is sized to accommodate both the entire 498 cfs of offsite runoff generated from the 100yr - 24 hr storm flowing into the project site and the 25 cfs of runoff conveyed by the new grassed ditch that runs along the access road from Ohukai Road. (see Appendix A & C). The runoff generated by the existing Ohukai Subdivision is presently conveyed by a grassed swale and discharged into an existing gully that runs through Kaonoulu Market Place. Since this existing gully will be intercepted by the new diversion ditch, a new grassed ditch is to be installed along the access road to route the 25 cfs of existing runoff from the Ohukai Subdivision and to intercept the additional runoff generated by the paved access road. The new grassed ditch is not sized to accommodate the runoff from the mauka ranch. It will convey the 25 cfs to the diversion ditch and allow any additional runoff from the mauka areas to continue to sheet flow onto the downstream properties as it is presently doing. The offsite runoff and the runoff from the access road grassed ditch will be conveyed through the open channel diversion ditch and piped underground to tie into the new underground drainage system and eventually discharge into the existing Kulanihakoi Gulch as it is presently doing. Offsite runoff in excess of this capacity will be intercepted and conveyed to Kulanihakoi Gulch via an overflow ditch that runs along the easterly boundary of the project site.

The combined 523 cfs of offsite surface runoff and runoff from the access road grassed ditch will be added to the 106 cfs generated by the 4 industrial lots and the Kaonoulu Street Extension for a total of 629 cfs. Therefore, one of the existing twin 102 inch culverts presently routing the runoff across the Piilani Highway will be sealed off and the other 102 inch pipe will tie into the new project development drainage system. This existing drainline has adequate capacity to route the 629 cfs of surface runoff within the new drainage system underneath the Highway and into the Kulanihakoi Gulch via an existing gully that runs through several of the downstream properties (see Exhibit 6).

Based on a Flood Inundation Limits Analysis, it was determined that the maximum discharge capacity of the existing gully located makai of Piilani Highway is approximately 640 cfs. The existing twin 8.0' x 6.5' box culverts immediately downstream of the existing gully was similarly analyzed to have a capacity of 800 cfs. Therefore, the discharge capacities of both the existing gully and the twin box culverts are higher than the anticipated discharge from the new subdivision drainage system of 629 cfs.

The existing runoff from the existing drop intake catch basin located at the southwestern corner of Piilani Business Park will be piped underground along its original alignment and continue to the existing outlet located mauka of the Kulanihakoi Bridge as it is presently doing. (see Exhibit 5). Surface runoff generated on the eastern shoulder of Piilani Highway will be intercepted by new concrete swales and directed to grated inlet catch basins that tie into this new underground drainage system.

B. Hydrologic Calculations:

The onsite hydrologic calculations are based on the "Rules for the Design of Storm Drainage Facilities in the County of Maui", Title MC-15, Chapter 4 and the "Rainfall Frequency Atlas of the Hawaiian Islands", Technical Paper No. 43, U. S. Department of Commerce, Weather Bureau.

Rational Formula used:

$$Q = CIA$$

Where
- Q = Rate of Flow (cfs)
- C = Runoff Coefficient
- I = Rainfall Intensity (inches/hour)
- A = Area (Acres)

Rational Method calculations are based on a 50 yr-1 hr storm duration interval. Hydrologic calculations for drainage areas greater than 100 acres are based on procedures developed by the U.S. Department of Agriculture, Soil Conservation Service (SCS). This procedure is described in detail in the SCS National Engineering Handbook, Section 4, Hydrology (NEH-4). Hydrologic calculations were computed by utilizing the "SCS Unit Hydrograph Method " in the PONDPACK computer program, by Haestad Methods, which is based on the procedures outlined in NEH-4. The hydrologic calculations for this project may be found in Appendix A.

C. Conclusion:

In the fully built-out condition, the industrial lots 1-4 will each retain their own additional post-development runoff but discharge of their pre-development runoff into stubouts located at the low end of each lot which will tie into the new underground drainage system. The onsite surface runoff generated by the proposed roadway, Kaonoulu Street Extension, will be intercepted by new curb inlet type catch basins which will be installed as part of the project improvements. The offsite runoff presently flowing onto the project site along with the runoff conveyed by the proposed access road grassed ditch will be intercepted by a new drainage diversion ditch that runs along the eastern boundary of the property until it hits the future Kihei Upcountry Highway ROW where it is piped underground and ties into the new underground drainage system. The new underground drainage system will then convey the intercepted surface runoff underneath Piilani Highway and safely discharge it into the Kulanihakoi Gulch via an existing gully that runs through several of the downstream properties. A Flood Inundation Limits Analysis demonstrated that there will be adequate capacity within the existing downstream gully and twin box culverts to route the runoff from the project drainage system. Therefore, it is our professional opinion that the proposed development will not have any adverse effect on drainage conditions in the area.

Report Prepared By:

Darren K. Okimoto

Darren K. Okimoto

Report Checked By:

Warren S. Unemori

VII. REFERENCES

1. *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii.* August 1972. United States Department of Agriculture, Soil Conservation Service.

2. *Flood Insurance Rate Map, Maui County, Hawaii.* Community-Panel Number 150003 0260 B, June 1, 1981. Federal Emergency Management Agency, Federal Insurance Administration.

3. *Rainfall Frequency Atlas of the Hawaiian Islands, Technical Paper No. 43.* 1962. U.S. Department of Commerce, Weather Bureau.

4. *Rules for the Design of Storm Drainage Facilities in the County of Maui.* July 1995. Department of Public Works and Waste Management, County of Maui.

5. *SCS National Engineering Handbook, Section 4 - Hydrology.* 1969. Soil Conservation Service, U.S. Department of Agriculture.

6. *Hydrology Report for Piilani Highway.* 1978. Trans-Meridian Engineers & Surveyors, Inc.

EXHIBITS

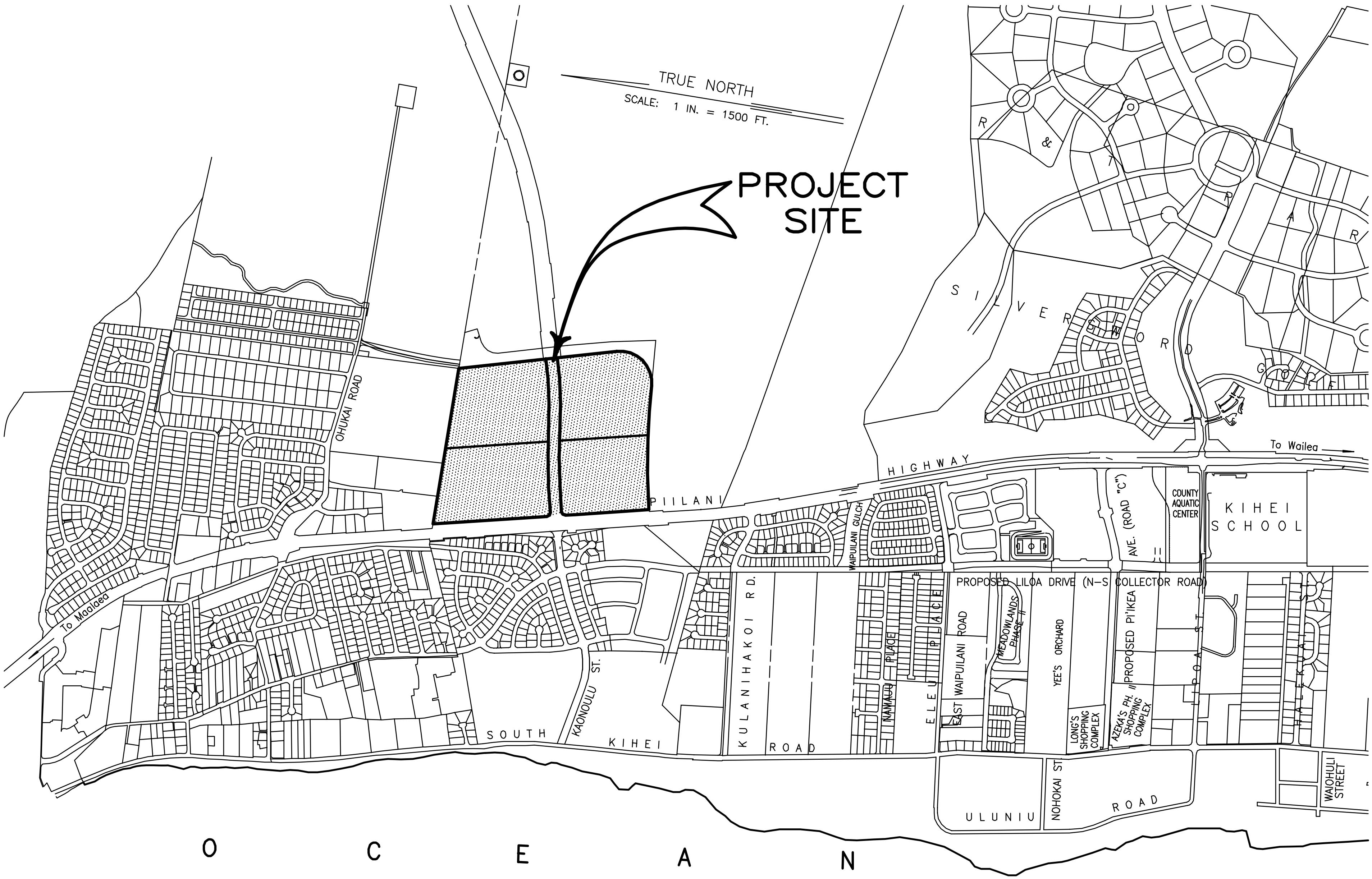


EXHIBIT 1
LOCATION MAP

04proj/04010.10/dwg2004/exhibits/exb-soil.dwg

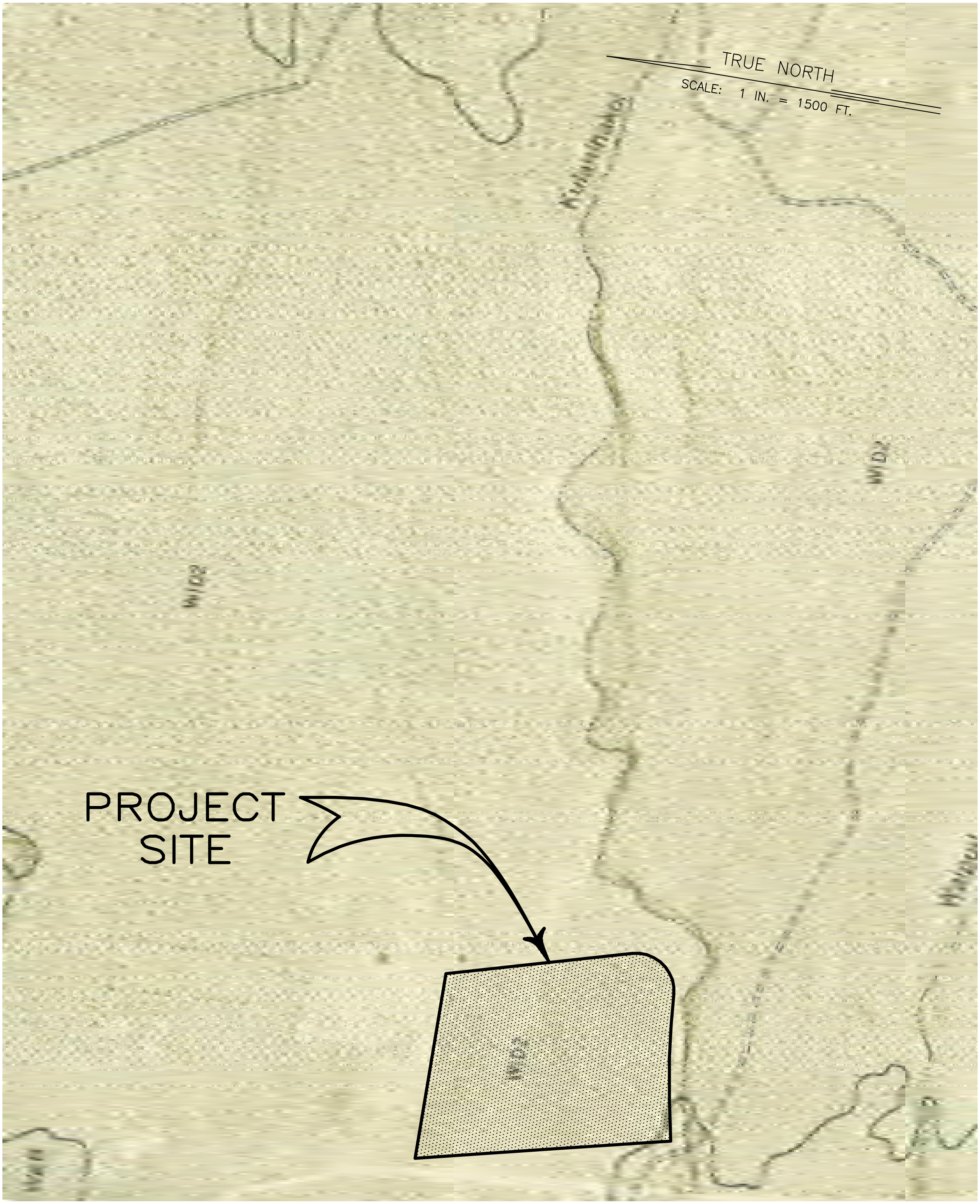


EXHIBIT 2

SITE SPECIFIC SOIL CLASSIFICATION MAP

04proj/04010.10/dwg2004/exhibits/exb-soil.dwg

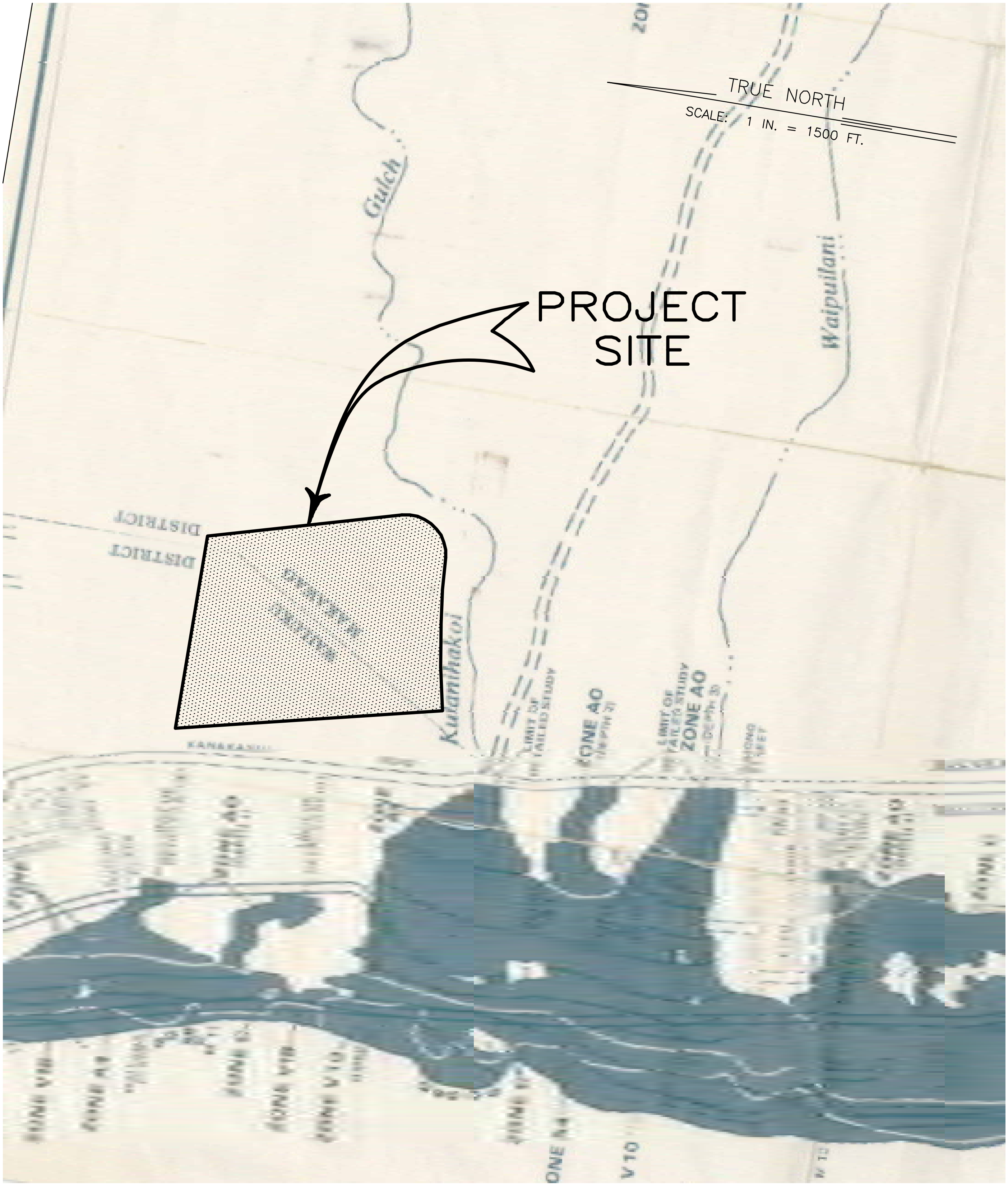
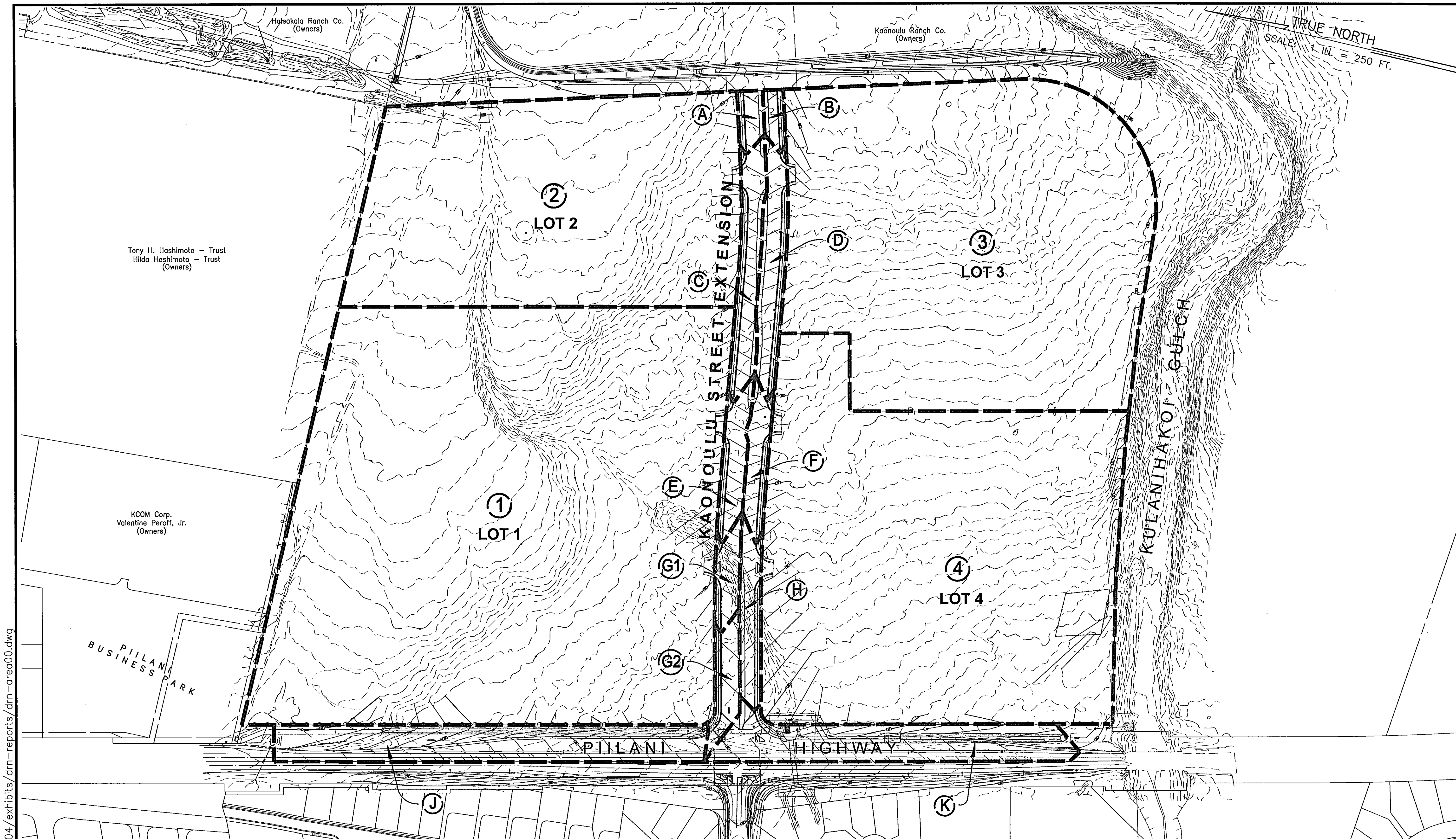


EXHIBIT 3
FLOOD INSURANCE RATE MAP

04proj/04010.10/dwg2004/exhibits/exb-soil.dwg



LEGEND:

1680 FINISH GRADE W/ ELEVATION

1680 EXISTING GRADE W/ ELEVATION

DRAINAGE AREA LIMITS

25 DRAINAGE AREA NUMBER

EXHIBIT 4A

INDIVIDUAL ONSITE DRAINAGE AREA MAP

SCALE: 1 IN. = 250 FT.

WARREN S. UNEMORI ENGINEERING, INC.
CIVIL & STRUCTURAL ENGINEERS / LAND SURVEYORS

October 9, 2006

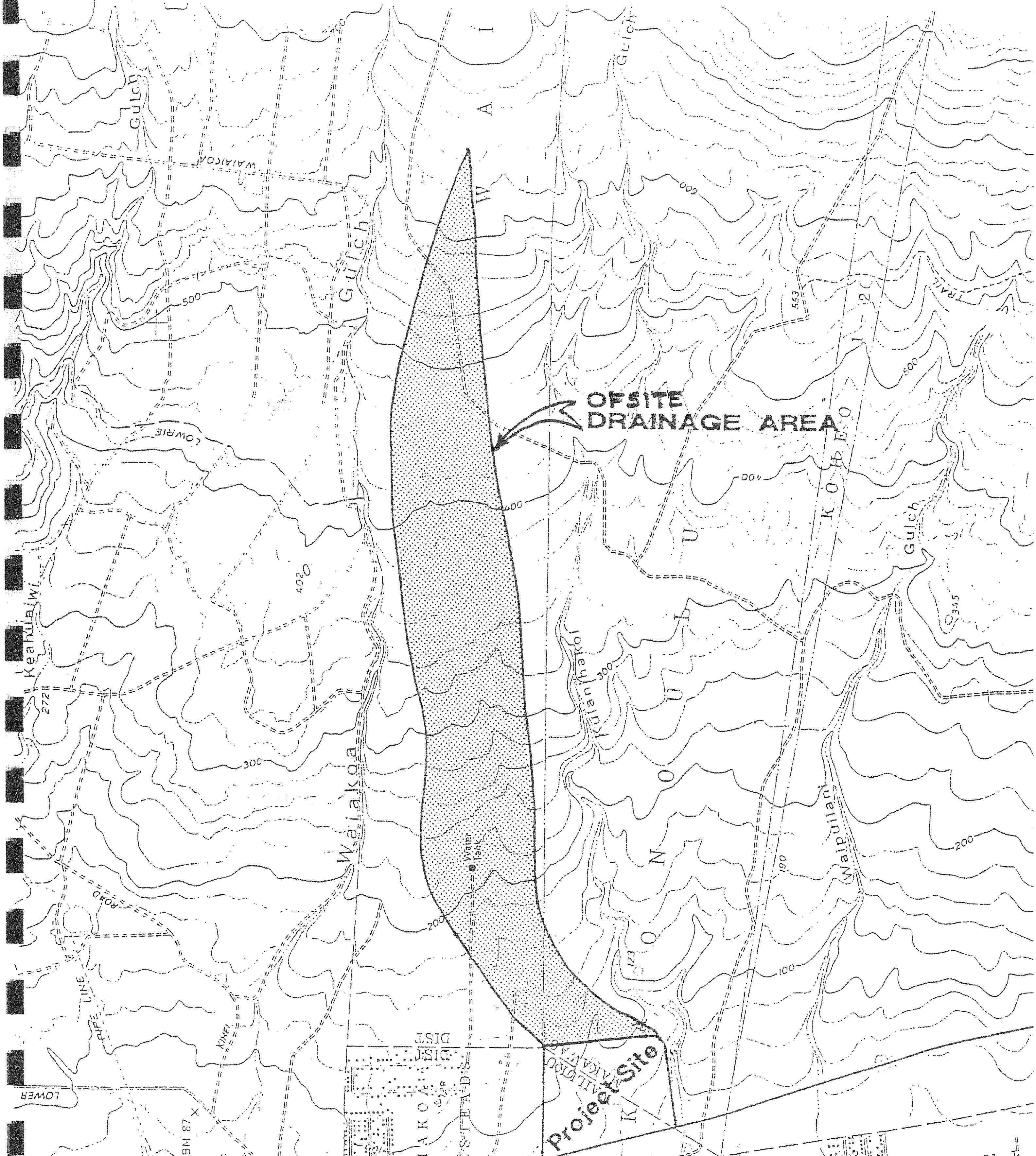


EXHIBIT 4B
OFFSITE DRAINAGE

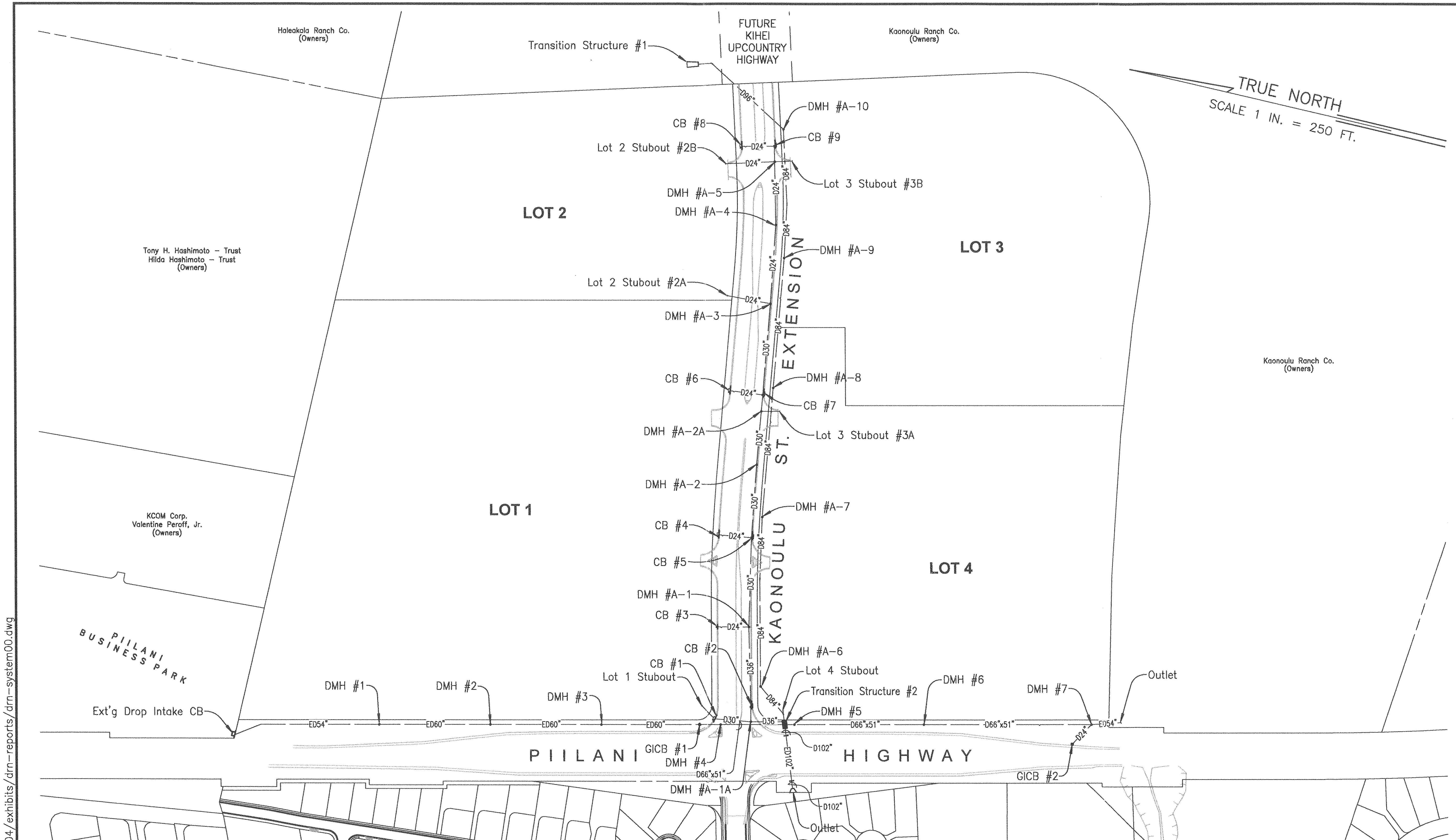


EXHIBIT 5

STORM SEWER SCHEMATIC

SCALE: 1 IN. = 250 FT.

WARREN S. UNEMORI ENGINEERING, INC.
CIVIL & STRUCTURAL ENGINEERS / LAND SURVEYORS

October 22, 2008

04proj/04010.10/dwg2004/exhibits/drn-reports/drn-system00.dwg

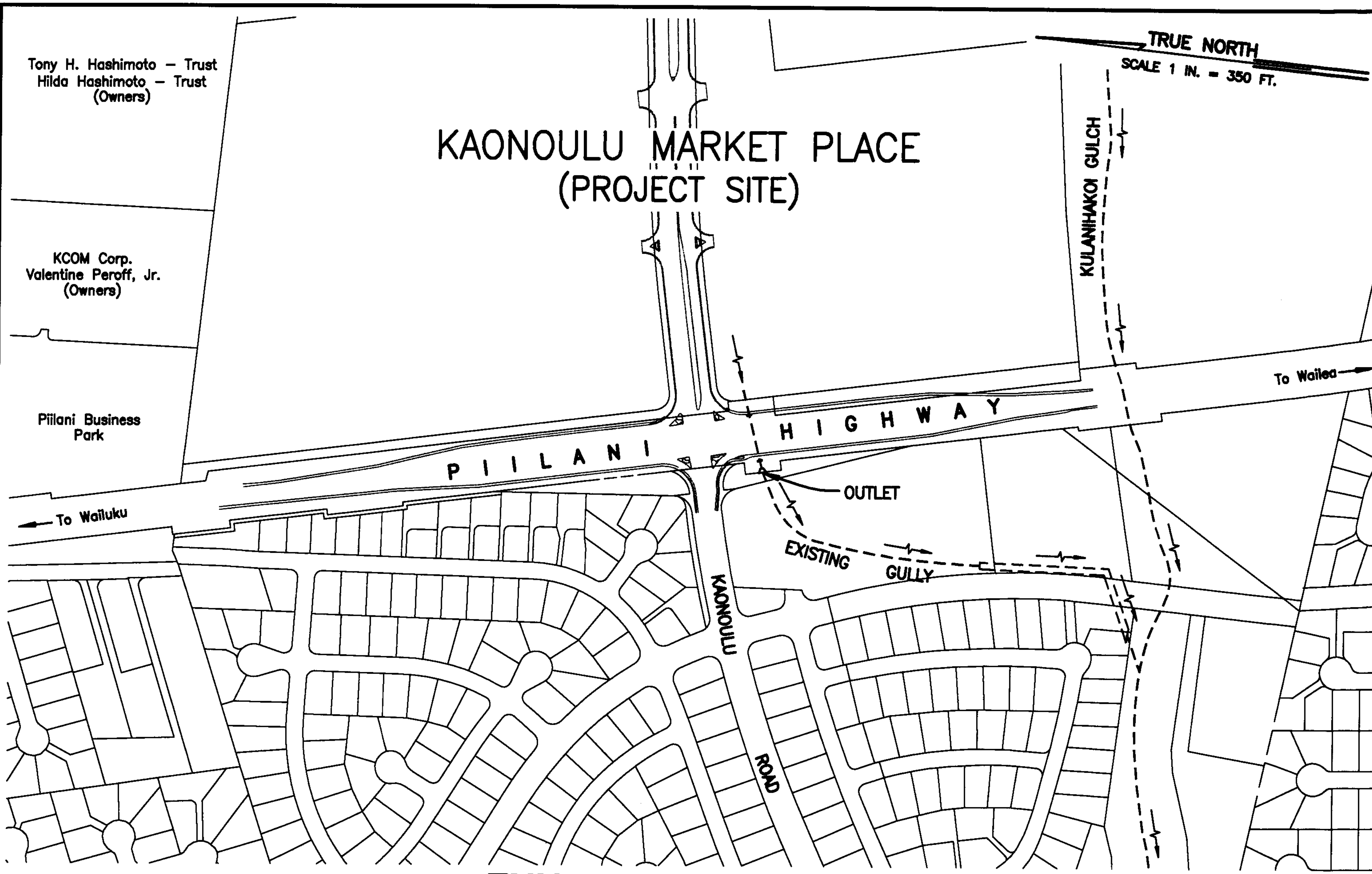


EXHIBIT 6

DRAINAGE FLOW PATH TO KULANIHAKOI GULCH

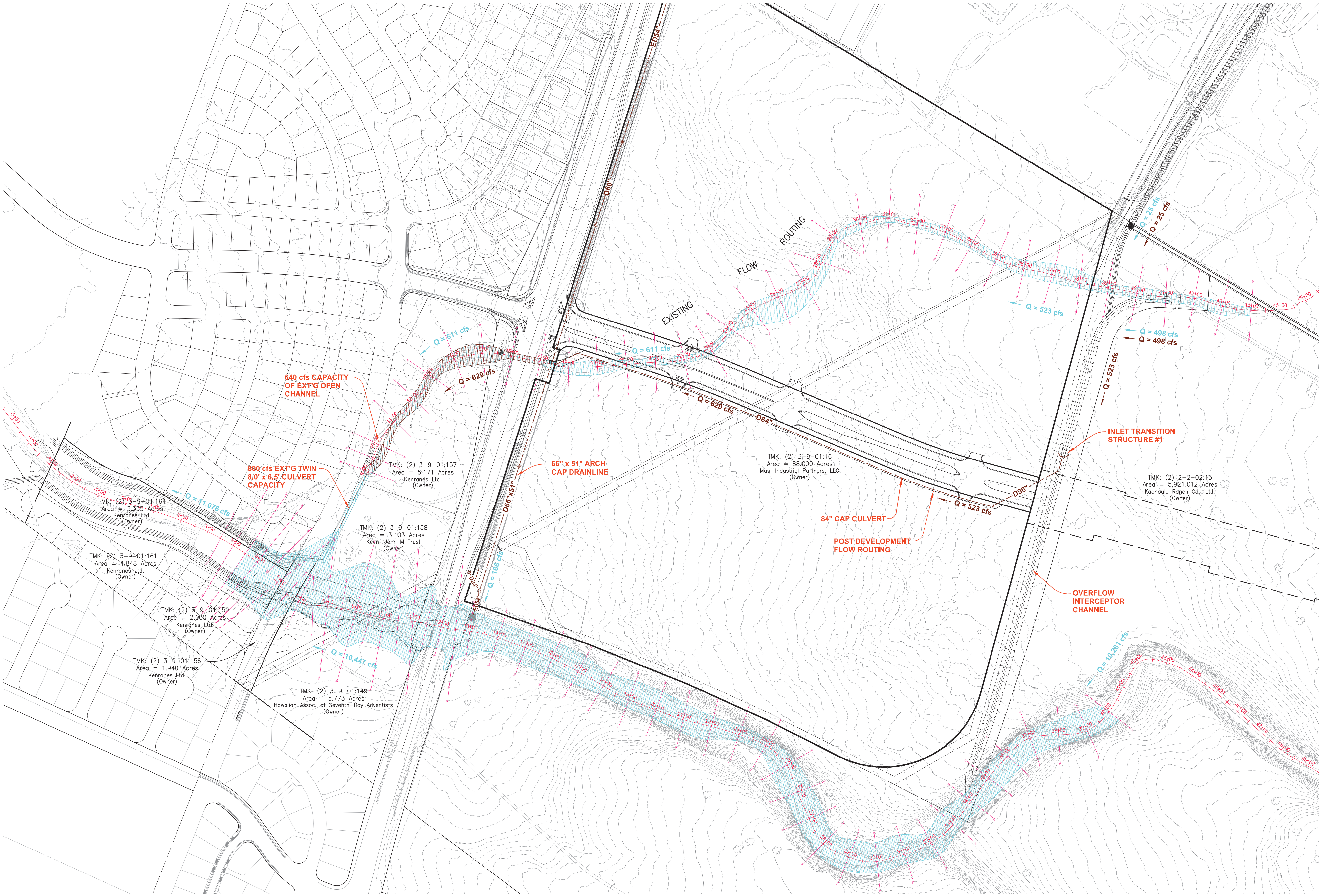
0 350 700 1050 1400

SCALE: 1 IN. = 350 FT.

WARREN S. UNEMORI ENGINEERING, INC.
CIVIL & STRUCTURAL ENGINEERS / LAND SURVEYORS

October 22, 2008

04PROJ\04010.10\DWG2004\EXHIBITS\DRN-REPORTS\FLOW-PATH-GULCH.DWG



EXISTING INUNDATION LIMIT

PROPOSED DEVELOPMENT INUNDATION LIMIT

EXHIBIT 7 - COMPARISON BETWEEN INUNDATION LIMITS OF EXISTING AND PROPOSED DEVELOPMENT

0 150 300 450 600

SCALE: 1 IN. = 150 FT.

WARREN S. UNEMORI - ENGINEERING, INC.
Wells Street Professional Center - Suite 403
2145 Wells Street - Wailuku, Maui, Hawaii 96793
(808)242-4403 FAX: (808)244-4856

October 3, 2008

WSUE #04010.10

24"x36"

APPENDIX A

HYDROLOGIC CALCULATIONS

Warren S. Unemori Engineering, Inc.
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, Hawaii 96793

Date: September 13, 2006

HYDROLOGIC CALCULATIONS: PRE-DEVELOPMENT

Objective: To determine the pre-development runoff for the proposed Kaonoulu Market Place (Area 1)

I. 50-Yr. - 1 Hr. Rainfall:

From "Rainfall Frequency Atlas of the Hawaiian Islands", for Kihei, Maui,
R(50 Yr.-1Hr.) = 2.30 inches

2. Total Area:

Area (Ac.):		30.13

3. Runoff Coefficents:

Infiltration:	Medium	0.07
Relief:	Rolling (5-15%)	0.03
Vegetal Cover:	Good (10-50%)	0.03
Development Type:	Agricultural	0.15
Runoff Coeff't., C:		0.28

4. Time of Concentration:

Approx. Elev. Diff'l. (ft.):		55
Higher Elev. (ft.):	107	
Lower Elev. (ft.):	52	
Approx. Runoff Length (ft.):		1,491
Average Slope:		3.69%
Time of Concentration (min.):		22

5. Intensity:

Intensity (in./hr.):		3.7

6. Total Runoff:

Q = C x I x A (cfs):		**31.22**

Warren S. Unemori Engineering, Inc.
Wells Street Professional Center
2145 Wells Street , Suite 403
Wailuku, Maui , Hawaii 96793

Date: September 13, 2006

HYDROLOGIC CALCULATIONS: PRE-DEVELOPMENT

Objective: To determine the pre-development runoff for the proposed Kaonoulu Market Place (Area 2)

I. 50-Yr. - 1 Hr. Rainfall:

From "Rainfall Frequency Atlas of the Hawaiian Islands", for Kihei, Maui,
R(50 Yr.-1Hr.) = 2.30 inches

2. Total Area:

Area (Ac.):		13.13

3. Runoff Coefficents:

Infiltration:	Medium	0.07
Relief:	Rolling (5-15%)	0.03
Vegetal Cover:	Good (10-50%)	0.03
Development Type:	Agricultural	0.15
Runoff Coeff't., C:		0.28

4. Time of Concentration:

Approx. Elev. Diff'l. (ft.):		30
Higher Elev. (ft.):	121	
Lower Elev. (ft.):	91	
Approx. Runoff Length (ft.):		684
Average Slope:		4.39%
Time of Concentration (min.):		15.5

5. Intensity:

Intensity (in./hr.):		4.2

6. Total Runoff:

Q = C x I x A (cfs):		**15.44**

Warren S. Unemori Engineering, Inc.
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, Hawaii 96793

Date: September 13, 2006

HYDROLOGIC CALCULATIONS: PRE-DEVELOPMENT

Objective: To determine the pre-development runoff for the proposed Kaonoulu Market Place (Area 3)

I. 50-Yr. - 1 Hr. Rainfall:

From "Rainfall Frequency Atlas of the Hawaiian Islands", for Kihei, Maui,
R(50 Yr.-1Hr.) = 2.30 inches

2. Total Area:

Area (Ac.):		18.52

3. Runoff Coefficents:

Infiltration:	Medium	0.07
Relief:	Rolling (5-15%)	0.03
Vegetal Cover:	Good (10-50%)	0.03
Development Type:	Agricultural	0.15
Runoff Coeff't., C:		0.28

4. Time of Concentration:

Approx. Elev. Diff'l. (ft.):		44
Higher Elev. (ft.):	114	
Lower Elev. (ft.):	70	
Approx. Runoff Length (ft.):		985
Average Slope:		4.46%
Time of Concentration (min.):		18

5. Intensity:

Intensity (in./hr.):		3.9

6. Total Runoff:

Q = C x I x A (cfs):		**20.22**

Warren S. Unemori Engineering, Inc.
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, Hawaii 96793

Date: September 13, 2006

HYDROLOGIC CALCULATIONS: PRE-DEVELOPMENT

Objective: To determine the pre-development runoff for the proposed Kaonoulu Market Place (Area 4)

I. 50-Yr. - 1 Hr. Rainfall:

From "Rainfall Frequency Atlas of the Hawaiian Islands", for Kihei, Maui,
R(50 Yr.-1Hr.) = 2.3 inches

2. Total Area:

Area (Ac.):		19.54

3. Runoff Coefficents:

Infiltration:	Medium	0.07
Relief:	Rolling (5-15%)	0.03
Vegetal Cover:	Good (10-50%)	0.03
Development Type:	Agricultural	0.15
Runoff Coeff't., C:		0.28

4. Time of Concentration:

Approx. Elev. Diff'l. (ft.):		53
Higher Elev. (ft.):	86	
Lower Elev. (ft.):	33	
Approx. Runoff Length (ft.):		1,228
Average Slope:		4.32%
Time of Concentration (min.):		20

5. Intensity:

Intensity (in./hr.):		3.8

6. Total Runoff:

Q = C x I x A (cfs):		**20.79**

Warren S. Unemori Engineering, Inc.
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, Hawaii 96793

Date: October 22, 2008

HYDROLOGIC CALCULATIONS: POST-DEVELOPMENT

Objective: To determine the post-development runoff for the proposed Kaonoulu Market Place (Kaonoulu Street Extension).

I. 50-Yr. - 1 Hr. Rainfall:

From "Rainfall Frequency Atlas of the Hawaiian Islands", for Kihei, Maui,
R(50 Yr.-1Hr.) = 2.3 inches

2. Total Area:

Area (Ac.):		4.81

3. Runoff Coefficents:

Area of Paved Road (Ac.):		3.88
Minimum Runoff Coeff't., C, for Asphalt Streets*:		0.95
Landscape Area (Ac.):		0.93
Infiltration:	Medium	0.07
Relief:	Rolling (5-15%)	0.03
Vegetal Cover:	Good (10-50%)	0.03
Development Type:	Agricultural	0.15
Runoff Coeff't., C:		0.28
Weighted Runoff Coeff't., C:		0.82

4. Time of Concentration:

Approx. Elev. Diff'l. (ft.):		71
Higher Elev. (ft.):	110	
Lower Elev. (ft.):	39	
Approx. Runoff Length (ft.):		1,765
Average Slope:		4.02%
Time of Concentration (min.):		10.5

5. Intensity:

Intensity (in./hr.):		4.65

6. Total Runoff:

Q = C x I x A (cfs):		**18.35**

DRAINAGE CALCULATION - INDIVIDUAL POST DEVELOPMENT DRAINAGE AREAS ALONG ROADWAY

Drainage Area	Catch Basin	Total Area (sqft.)	Total Area (acres)	Runoff Coefficient	Time of Conc. (Min.)	Rainfall Intensity (50yr.-1hr.) (in./hr.)	Drainage Area Q (50yr.-1hr.) (cfs)	Q + Bypass Flow (cfs)	Inlet Capacity (cfs)[1]	Bypass Flow (cfs)	Channel Slope	Flooded Width (ft.)[2]
A	CB #8	10092.53	0.232	0.78	5	5.9	1.07	1.07	1.07	0.00	3.24%	3.95
B	CB #9	8345.86	0.192	0.75	5	5.9	0.85	0.85	0.85	0.00	3.24%	3.36
C	CB #6	40936.31	0.940	0.79	7.5	5.3	3.94	3.94	3.94	0.00	4.19%*	7.47
D	CB #7	41252.98	0.947	0.77	7.5	5.3	3.86	3.86	3.86	0.00	4.19%*	7.40
E	CB #4	24916.95	0.572	0.89	6	5.7	2.89	2.89	2.89	0.00	4.12%*	6.47
F	CB #5	22175.12	0.509	0.86	6	5.7	2.50	2.50	2.50	0.00	4.12%*	6.01
G1	CB #3	16560.37	0.380	0.92	5.5	5.8	2.03	2.03	2.03	0.00	2.43%	6.18
G2	CB #1	16336.03	0.375	0.90	6.5	5.5	1.85	1.85	1.85	0.00	2.08%	6.14
H	CB #2	28870.84	0.663	0.75	7.5	5.25	2.60	2.60	2.60	0.00	2.08%	7.24
J	GICB #1	103206.71	2.369	0.68	19	3.85	6.19	6.19	6.19	0.00	2.35%	N/A
K	GICB #2	95415.24	2.190	0.76	16	4.1	6.85	6.85	6.85	0.00	1.11%	N/A

* For grades 4% and greater, 10-foot long deflector inlets shall be used.

Notes: [1] Acceptable Catch Basin Inlet Capacity (Standard 10-foot Curb Inlets) based on Department of Planning and Permitting January 2000 *Rules Relating to Storm Drainage Standards*.
[2] Flooded Width Calculated from Haestad Methods Program FlowMaster 2005

LONGEST RUN CALCULATIONS FOR INDIVIDUAL DRAINAGE AREAS

Drainage Area	Runoff Length (ft.)	High Elev. (ft.)	Low Elev. (ft.)	Elevation Diff. (ft.)	Average Slope
A	200	110	105	5	0.025
B	200	110	105	5	0.025
C	737	106	79	27	0.037
D	721	106	79	27	0.037
E	450	82	62	20	0.044
F	439	81	62	19	0.043
G1	326	66	55	11	0.034
G2	318	55	50	5	0.016
H	557	63	50	13	0.023
J	1208	80	51	29	0.024
K	1029	48	31	17	0.017

MASTER DESIGN STORM SUMMARY

Network Storm Collection: Offsite Runoff

Return Event	Total Depth in	Rainfall Type	RNF ID
Pre100	9.0000	Synthetic Curve	TypeI 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*OUT 10		JCT	100	252.974		11.9000	498.21		
POND 10	IN	POND	100	252.974		11.9000	498.21		
POND 10	OUT	POND	100	252.974		11.9000	498.21		
SUBAREA 10		AREA	100	252.974		11.9000	498.21		

SCS UNIT HYDROGRAPH METHOD
Calc.Method Option = 2
STORM EVENT: 100 year storm
Duration = 24.0000 hrs Rain Depth = 9.0000 in
Rain Dir = V:\Projdata\04PROJ\04010.10\calcs\drainage\offsite areas\
Rain File -ID = - TypeI 24hr
Unit Hyd Type = Default Curvilinear
HYG Dir = V:\Projdata\04PROJ\04010.10\calcs\drainage\offsite areas\
HYG File - ID = - SUBAREA 10 Pre100
Tc = 2.8615 hrs
Drainage Area = 471.000 acres Runoff CN= 79
Calc.Increment= .05020 hrs Out.Incr.= .0500 hrs
HYG Volume = 252.974 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
3.4000	.00	.00	.00	.01	.01
3.6500	.01	.02	.03	.04	.05
3.9000	.07	.09	.11	.14	.17
4.1500	.21	.26	.31	.37	.44
4.4000	.51	.60	.69	.80	.92
4.6500	1.04	1.18	1.34	1.50	1.68
4.9000	1.87	2.08	2.29	2.52	2.77
5.1500	3.03	3.30	3.58	3.88	4.19
5.4000	4.52	4.86	5.21	5.57	5.94
5.6500	6.33	6.72	7.13	7.55	7.98
5.9000	8.41	8.86	9.32	9.79	10.26
6.1500	10.74	11.23	11.73	12.24	12.75
6.4000	13.27	13.80	14.33	14.87	15.42
6.6500	15.98	16.54	17.12	17.70	18.29
6.9000	18.89	19.50	20.12	20.76	21.40
7.1500	22.06	22.73	23.42	24.12	24.84
7.4000	25.57	26.32	27.09	27.87	28.67
7.6500	29.49	30.32	31.18	32.05	32.94
7.9000	33.84	34.76	35.70	36.65	37.62
8.1500	38.61	39.61	40.63	41.66	42.72
8.4000	43.79	44.89	46.01	47.15	48.32
8.6500	49.52	50.75	52.02	53.32	54.66
8.9000	56.05	57.48	58.97	60.51	62.11
9.1500	63.79	65.53	67.36	69.27	71.27
9.4000	73.37	75.58	77.90	80.35	82.95
9.6500	85.74	88.76	92.07	95.75	99.97
9.9000	104.78	110.19	116.24	122.97	130.38
10.1500	138.40	147.03	156.18	165.87	176.08
10.4000	186.89	198.30	210.32	222.94	236.23
10.6500	250.14	264.62	279.59	294.97	310.65

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

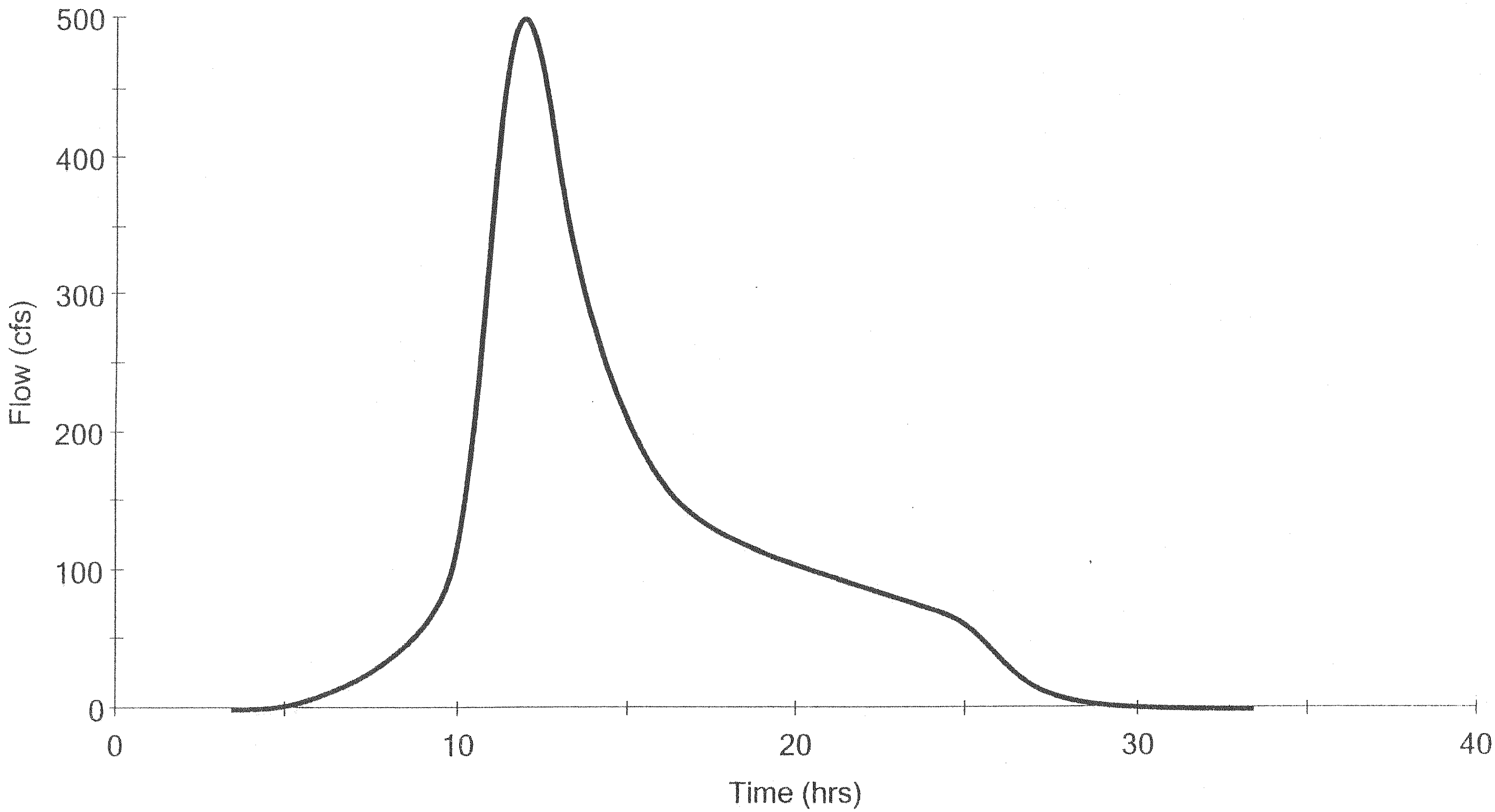
Time hrs					
10.9000	326.44	342.18	357.55	372.41	386.70
11.1500	400.29	413.08	425.01	436.08	446.21
11.4000	455.40	463.63	470.93	477.27	482.66
11.6500	487.18	490.86	493.79	496.00	497.49
11.9000	498.21	498.05	497.04	495.29	492.87
12.1500	489.97	486.63	482.88	478.71	474.14
12.4000	469.15	463.77	457.94	451.65	444.94
12.6500	437.84	430.38	422.60	414.63	406.54
12.9000	398.55	390.76	383.17	375.85	368.84
13.1500	362.12	355.67	349.47	343.43	337.56
13.4000	331.84	326.29	320.91	315.69	310.62
13.6500	305.73	300.99	296.40	291.93	287.57
13.9000	283.29	279.08	274.94	270.85	266.81
14.1500	262.83	258.92	255.11	251.38	247.75
14.4000	244.21	240.76	237.39	234.10	230.87
14.6500	227.70	224.58	221.52	218.52	215.58
14.9000	212.70	209.88	207.11	204.40	201.75
15.1500	199.15	196.62	194.15	191.73	189.36
15.4000	187.03	184.76	182.52	180.35	178.25
15.6500	176.21	174.24	172.31	170.44	168.62
15.9000	166.84	165.11	163.44	161.80	160.22
16.1500	158.68	157.19	155.75	154.34	152.98
16.4000	151.66	150.38	149.13	147.91	146.72
16.6500	145.56	144.44	143.36	142.30	141.28
16.9000	140.28	139.30	138.35	137.43	136.53
17.1500	135.66	134.81	133.98	133.17	132.38
17.4000	131.59	130.83	130.07	129.34	128.61
17.6500	127.91	127.23	126.56	125.91	125.28
17.9000	124.65	124.03	123.42	122.81	122.22
18.1500	121.63	121.04	120.47	119.89	119.33
18.4000	118.76	118.21	117.65	117.10	116.56
18.6500	116.02	115.48	114.95	114.42	113.89
18.9000	113.36	112.84	112.33	111.81	111.30
19.1500	110.79	110.29	109.80	109.31	108.83
19.4000	108.37	107.91	107.47	107.04	106.61
19.6500	106.18	105.75	105.33	104.91	104.50
19.9000	104.08	103.67	103.26	102.85	102.44
20.1500	102.03	101.63	101.22	100.82	100.42
20.4000	100.01	99.61	99.21	98.81	98.41
20.6500	98.02	97.62	97.22	96.82	96.43
20.9000	96.03	95.64	95.24	94.85	94.45
21.1500	94.06	93.67	93.27	92.88	92.49
21.4000	92.10	91.70	91.31	90.92	90.53
21.6500	90.14	89.74	89.35	88.96	88.57
21.9000	88.18	87.79	87.40	87.00	86.61

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
22.1500	86.22	85.83	85.44	85.05	84.66
22.4000	84.27	83.88	83.49	83.09	82.70
22.6500	82.31	81.92	81.53	81.14	80.75
22.9000	80.36	79.96	79.57	79.18	78.79
23.1500	78.40	78.01	77.61	77.22	76.83
23.4000	76.44	76.04	75.65	75.26	74.87
23.6500	74.47	74.08	73.69	73.29	72.90
23.9000	72.51	72.11	71.72	71.32	70.90
24.1500	70.49	70.06	69.61	69.14	68.66
24.4000	68.16	67.63	67.08	66.50	65.90
24.6500	65.27	64.61	63.92	63.18	62.41
24.9000	61.60	60.75	59.85	58.91	57.92
25.1500	56.88	55.81	54.69	53.54	52.36
25.4000	51.16	49.93	48.68	47.41	46.13
25.6500	44.85	43.56	42.26	40.97	39.69
25.9000	38.41	37.15	35.89	34.64	33.41
26.1500	32.19	31.00	29.84	28.70	27.58
26.4000	26.49	25.43	24.39	23.38	22.40
26.6500	21.45	20.53	19.64	18.78	17.96
26.9000	17.17	16.42	15.70	15.03	14.38
27.1500	13.77	13.18	12.63	12.10	11.59
27.4000	11.10	10.63	10.18	9.76	9.35
27.6500	8.96	8.58	8.22	7.87	7.54
27.9000	7.23	6.92	6.63	6.35	6.07
28.1500	5.81	5.56	5.33	5.10	4.88
28.4000	4.67	4.47	4.28	4.10	3.92
28.6500	3.75	3.59	3.44	3.29	3.15
28.9000	3.01	2.88	2.76	2.64	2.52
29.1500	2.41	2.31	2.20	2.11	2.02
29.4000	1.93	1.84	1.76	1.68	1.61
29.6500	1.54	1.47	1.40	1.34	1.28
29.9000	1.22	1.17	1.12	1.07	1.02
30.1500	.97	.93	.88	.84	.80
30.4000	.77	.73	.70	.66	.63
30.6500	.60	.57	.54	.52	.49
30.9000	.47	.44	.42	.40	.38
31.1500	.36	.34	.32	.31	.29
31.4000	.28	.26	.25	.23	.22
31.6500	.21	.19	.18	.17	.16
31.9000	.15	.14	.13	.12	.12
32.1500	.11	.10	.09	.08	.08
32.4000	.07	.06	.06	.05	.05
32.6500	.04	.04	.03	.03	.02
32.9000	.02	.02	.01	.01	.01
33.1500	.01	.01	.00	.00	.00

```
                            HYDROGRAPH ORDINATES (cfs)
   Time   |                 Output Time increment = .0500 hrs
   hrs    |    Time on left represents time for first value in each row.
----------|-----------------------------------------------------------
  33.4000 |         .00
```

SCS Unit Hydrograph - Kaonoulu Market Place
(100 Yr - 24 Hr)



W.S. UNEMORI ENGINEERING, INC.
Wailuku, Maui, Hawaii
MAY 3, 1994

HYDROLOGIC REPORT FOR

KAONOULU BUSINESS PARK

6 HOUR S. C. S. HYDROGRAPH

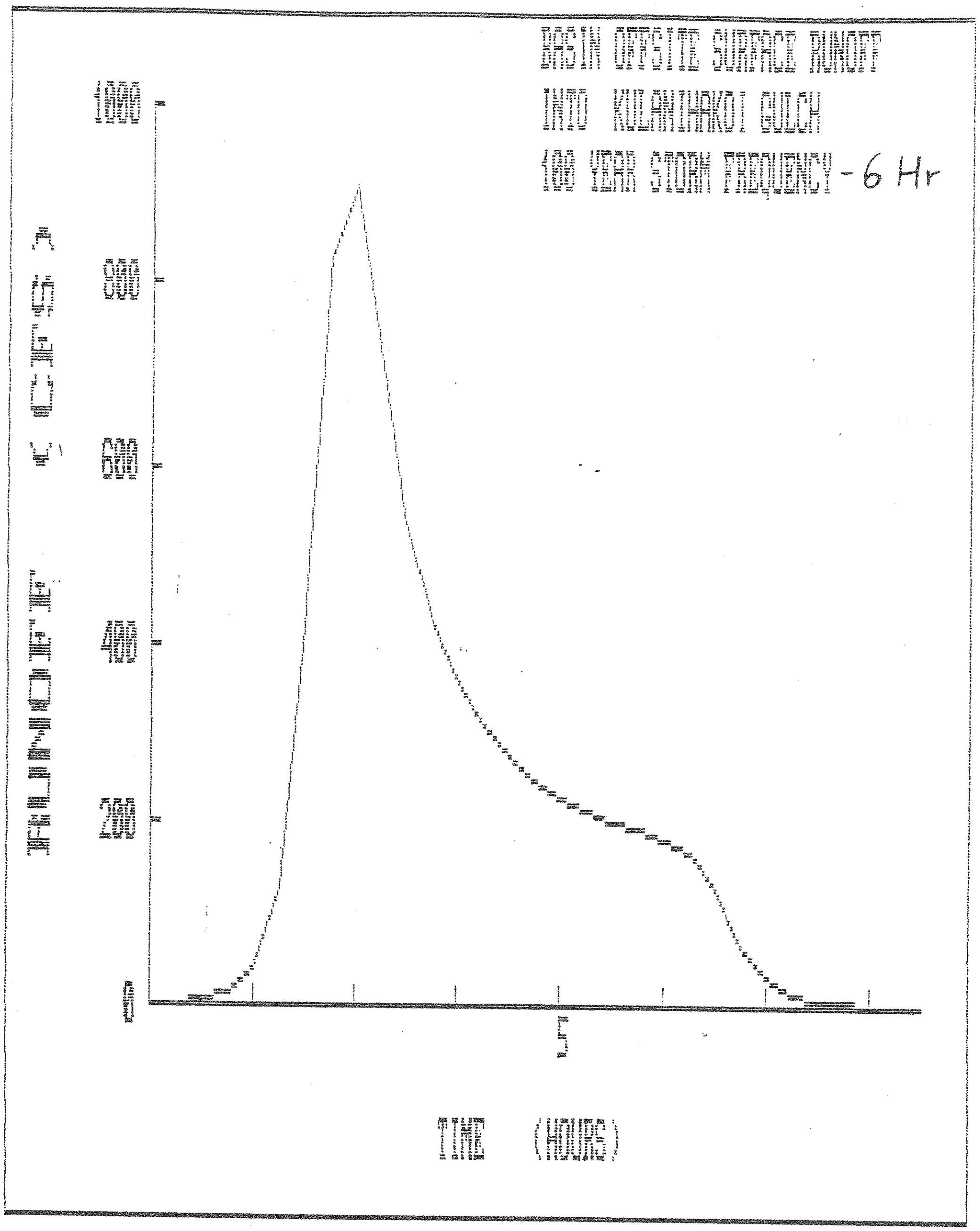
BASIN IDENTIFICATION — OFFSITE SURFACE RUNOFF
BASIN DISCHARGES INTO — KULANIHAKOI GULCH

BASIN AREA	=	471.00	ACRES
BASIN CURVE NUMBER	=	79.00	
6-HOUR PRECIPITATION	=	5.80	INCHES
6-HOUR RUNOFF	=	3.50	INCHES
AVERAGE BASIN SLOPE	=	3.20	%
HYDRAULIC LENGTH	=	16,400.00	FEET
BASIN LAG ,(Tc)	=	0.46	HOURS , 0.77 HOURS
UNITPEAK COEFFICIENT	=	484.00	
RAINFALL DISTRIBUTION	=	6 HR SCS	

HYDROGRAPH RUNOFF VALUES
100 YEAR STORM FREQUENCY

TIME HOUR	RUNOFF C.F.S.	TIME HOUR	RUNOFF C.F.S.	TIME HOUR	RUNOFF C.F.S.	TIME HOUR	RUNOFF C.F.S.
0.00	0.0	0.25	0.0	0.50	0.0	0.75	0.0
1.00	0.0	1.25	0.0	1.50	1.6	1.75	12.1
2.00	41.0	2.25	124.1	2.50	419.2	2.75	827.0
3.00	910.7	3.25	719.6	3.50	537.7	3.75	426.6
4.00	356.6	4.25	310.5	4.50	278.2	4.75	252.8
5.00	231.7	5.25	215.5	5.50	202.8	5.75	192.8
6.00	184.4	6.25	171.4	6.50	125.2	6.75	65.0
7.00	28.9	7.25	12.8	7.50	5.7	7.75	2.4
8.00	1.0	8.25	0.3	8.50	0.0	8.75	0.0
9.00	0.0	9.25	0.0	9.50	0.0	9.75	0.0

TIME TO PEAK = 3.00 HOURS
PEAK RUNOFF = 910.73 C.F.S.


BASIN OFFSITE SURFACE RUNOFF
INTO KULANIHAKOI GULCH
100 YEAR STORM FREQUENCY - 6 Hr
1000
800
600
400
200
0
5
TIME (HOURS)

MASTER DESIGN STORM SUMMARY

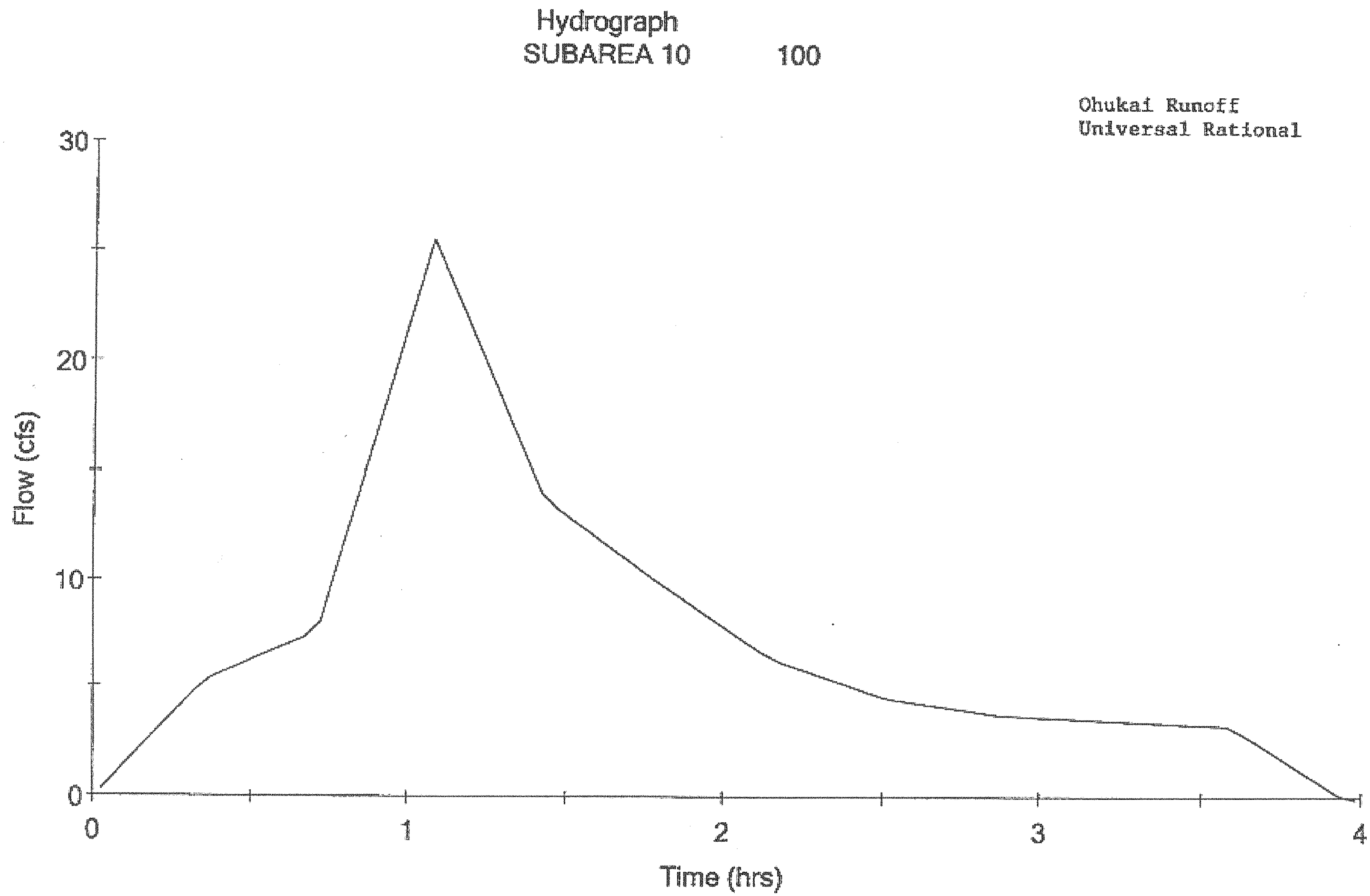
Default Network Design Storm File, ID IDF Storms

Return Event	Rainfall Type	IDF ID
100	I-D-F Curve	100yr-1hrKihei

MASTER NETWORK SUMMARY
Rational Method -- q/Qp

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

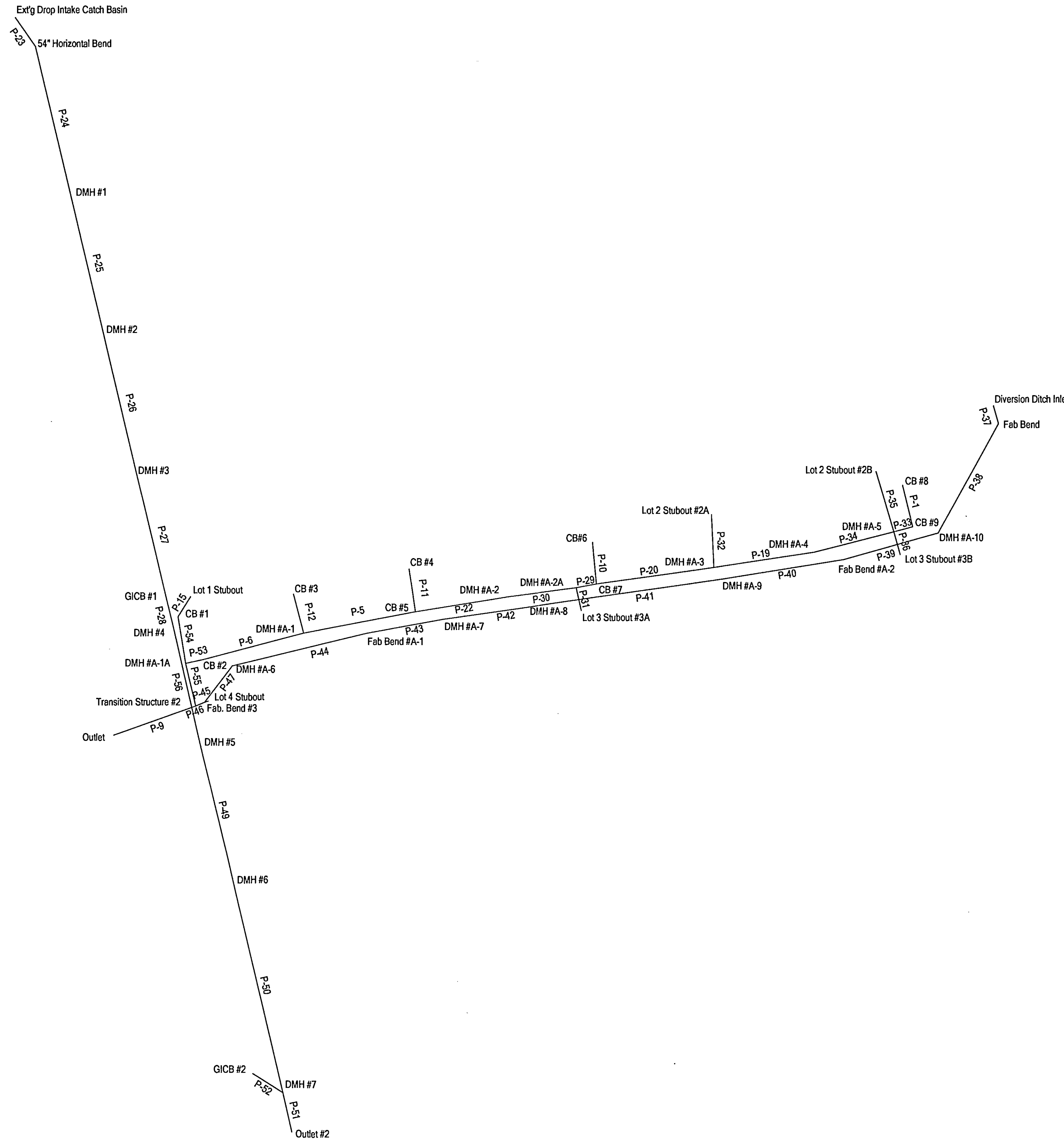
Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*OUT 10		JCT	100	2.492		1.1000	24.76		
POND 10	IN	POND	100	2.492		1.1000	24.76		
POND 10	OUT	POND	100	2.492		1.1000	24.76		
SUBAREA 10		AREA	100	2.492	L	1.0760	25.55		


Hydrograph
SUBAREA 10
100
Ohukai Runoff
Universal Rational
30
20
10
0
Flow (cfs)
0
1
2
3
4
Time (hrs)

<u>APPENDIX B</u>

HYDRAULIC (BACKWATER) CALCULATIONS

Scenario: Base



Title: Kaonoulu Market Place
v:\...\backwater\current compiled\backwater00.stm
10/25/08 12:54:18 PM

Project Engineer: Darren Okimoto
StormCAD v5.6 [05.06.007.00]

Calculation Results Summary

```
==================================================================
Scenario: Base


>>>> Info: Subsurface Network Rooted by: Outlet
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.


>>>> Info: Subsurface Network Rooted by: Outlet #2
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.
```

CALCULATION SUMMARY FOR SURFACE NETWORKS

Label	Inlet Type	Inlet	Total Intercepted Flow (cfs)	Total Bypassed Flow (cfs)	Captur Efficie (%)
Lot 4 Stubout	Generic Inlet	Generic Default 100%	0.00	0.00	1C
Diversion Ditch Inlet	Generic Inlet	Generic Default 100%	0.00	0.00	1C
Lot 3 Stubout #3B	Generic Inlet	Generic Default 100%	0.00	0.00	1C
Lot 2 Stubout #2B	Generic Inlet	Generic Default 100%	0.00	0.00	1C
Lot 2 Stubout #2A	Generic Inlet	Generic Default 100%	0.00	0.00	1C
Lot 3 Stubout #3A	Generic Inlet	Generic Default 100%	0.00	0.00	1C
CB #2	Generic Inlet	Generic Default 100%	0.00	0.00	1C
CB #5	Generic Inlet	Generic Default 100%	0.00	0.00	1C
CB #4	Generic Inlet	Generic Default 100%	0.00	0.00	1C
CB #3	Generic Inlet	Generic Default 100%	0.00	0.00	1C
CB #7	Generic Inlet	Generic Default 100%	0.00	0.00	1C
CB#6	Generic Inlet	Generic Default 100%	0.00	0.00	1C
CB #9	Generic Inlet	Generic Default 100%	0.00	0.00	1C
CB #8	Generic Inlet	Generic Default 100%	0.00	0.00	1C
CB #1	Generic Inlet	Generic Default 100%	0.00	0.00	1C
Lot 1 Stubout	Generic Inlet	Generic Default 100%	0.00	0.00	1C
GICB #2	Generic Inlet	Generic Default 100%	0.00	0.00	1C
GICB #1	Generic Inlet	Generic Default 100%	0.00	0.00	1C
Ext'g Drop Intake Catch Basin	Generic Inlet	Generic Default 100%	0.00	0.00	1C

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: Outlet

Label	Number of Sections	Section Size	Section Shape	Length (ft)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Upstream (ft)	Hydraulic Grade Downstream (ft)
P-9	1	102 inch	Circular	164.00	632.26	12.99	38.07	35.89
P-46	1	84 inch	Circular	33.93	543.79	14.13	41.41	40.71
P-55	1	36 inch	Circular	91.07	88.47	12.52	42.31	40.71
P-45	1	24 inch	Circular	8.07	20.79	6.62	43.96	43.89
P-47	1	84 inch	Circular	96.00	523.00	13.59	45.74	43.89
P-54	1	30 inch	Circular	97.82	33.07	6.74	45.38	44.74
P-53	1	36 inch	Circular	39.75	55.40	7.84	45.02	44.74
P-44	1	84 inch	Circular	288.65	523.00	19.25	53.04	47.75
P-15	1	24 inch	Circular	50.00	31.22	9.94	47.04	46.09
P-6	1	36 inch	Circular	215.02	52.80	7.47	47.32	45.97
P-43	1	84 inch	Circular	166.65	523.00	19.27	58.30	54.79
P-12	1	24 inch	Circular	84.75	2.03	0.65	48.19	48.19
P-5	1	30 inch	Circular	239.93	50.77	15.05	52.31	48.19
P-42	1	84 inch	Circular	348.44	523.00	22.57	74.71	60.40

Calculation Results Summary

P-11	1	24 inch	Circular	88.73	2.89	0.92	54.11	54.09
P-22	1	30 inch	Circular	196.52	45.38	20.80	65.43	54.09
P-41	1	84 inch	Circular	350.89	523.00	20.63	87.84	76.81
P-30	1	30 inch	Circular	145.00	45.38	17.08	71.18	66.55
P-40	1	84 inch	Circular	144.95	523.00	19.02	92.27	89.94
P-31	1	24 inch	Circular	50.37	18.22	10.52	71.50	71.18
P-29	1	30 inch	Circular	44.00	27.16	15.16	72.54	71.18
P-39	1	84 inch	Circular	201.53	523.00	19.04	98.45	94.02
P-10	1	24 inch	Circular	88.72	3.94	6.91	73.73	73.36
P-20	1	30 inch	Circular	246.17	19.36	13.72	82.19	73.36
P-38	1	96 inch	Circular	261.86	523.00	14.57	102.26	100.90
P-19	1	24 inch	Circular	212.31	6.42	11.30	93.45	82.82
P-32	1	24 inch	Circular	110.23	12.94	9.65	84.70	82.82
P-37	1	96 inch	Circular	38.00	523.00	14.56	104.42	104.19
P-34	1	24 inch	Circular	170.03	6.42	8.12	97.05	93.70
P-35	1	24 inch	Circular	132.25	2.50	6.06	99.35	97.39
P-33	1	24 inch	Circular	42.02	1.92	5.72	97.52	97.39
P-36	1	24 inch	Circular	48.32	2.00	5.68	97.61	97.39
P-1	1	24 inch	Circular	88.72	1.07	4.70	99.17	97.69

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
Outlet	632.26	45.00	29.58	29.58
Transition Structure #2	632.26	45.83	40.71	38.07
Fab. Bend #3	543.79	48.40	43.89	41.41
DMH #A-1A	88.47	49.13	44.74	42.31
Lot 4 Stubout	20.79	48.50	44.64	43.96
DMH #A-6	523.00	51.71	47.75	45.74
CB #1	33.07	48.87	46.09	45.38
CB #2	55.40	49.76	45.97	45.02
Fab Bend #A-1	523.00	59.30	54.79	53.04
Lot 1 Stubout	31.22	49.50	48.57	47.04
DMH #A-1	52.80	54.74	48.19	47.32
DMH #A-7	523.00	65.42	60.40	58.30
CB #3	2.03	54.26	48.20	48.19
CB #5	50.77	62.32	54.09	52.31
DMH #A-8	523.00	80.28	76.81	74.71
CB #4	2.89	62.32	54.12	54.11
DMH #A-2	45.38	70.88	66.55	65.43
DMH #A-9	523.00	94.70	89.94	87.84
DMH #A-2A	45.38	76.93	71.18	71.18
Fab Bend #A-2	523.00	100.30	94.02	92.27
Lot 3 Stubout #3A	18.22	77.10	72.27	71.50
CB #7	27.16	78.52	73.36	72.54
DMH #A-10	523.00	107.60	100.90	98.45
CB#6	3.94	78.52	73.98	73.73
DMH #A-3	19.36	88.05	82.82	82.19
Fab Bend	523.00	106.00	104.19	102.26
DMH #A-4	6.42	97.70	93.70	93.45
Lot 2 Stubout #2A	12.94	90.50	85.27	84.70
Diversion Ditch Inlet	523.00	107.00	106.22	104.42
DMH #A-5	6.42	103.75	97.39	97.05
Lot 2 Stubout #2B	2.50	104.40	99.55	99.35
CB #9	1.92	104.82	97.69	97.52
Lot 3 Stubout #3B	2.00	105.40	97.78	97.61
CB #8	1.07	104.82	99.29	99.17

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: Outlet #2

Calculation Results Summary

Label	Number of Sections	Section Size	Section Shape	Length (ft)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Upstream (ft)	Hydraulic Grade Downstream (ft)
P-51	1	54 inch	Circular	81.40	160.04	17.99	27.70	22.40
P-52	1	24 inch	Circular	74.00	6.85	2.18	29.80	29.73
P-50	1	60 inch	Circular	452.44	153.19	9.35	35.33	30.46
P-49	1	60 inch	Circular	350.00	153.19	11.85	41.16	36.69
P-56	1	60 inch	Circular	199.56	153.19	9.42	44.59	42.80
P-28	1	60 inch	Circular	58.16	153.19	21.30	45.42	45.53
P-27	1	60 inch	Circular	264.81	147.00	21.07	53.87	47.06
P-26	1	60 inch	Circular	300.00	147.00	21.08	63.53	55.05
P-25	1	60 inch	Circular	300.00	147.00	20.16	72.08	64.71
P-24	1	54 inch	Circular	321.00	147.00	13.22	76.33	73.18
P-23	1	54 inch	Circular	74.00	147.00	13.29	77.77	77.44

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
Outlet #2	160.04	27.32	19.82	19.82
DMH #7	160.04	32.00	29.73	27.70
GICB #2	6.85	31.30	29.87	29.80
DMH #6	153.19	37.90	36.69	35.33
DMH #5	153.19	46.25	42.80	41.16
DMH #4	153.19	49.91	45.53	44.59
GICB #1	153.19	51.00	47.06	45.42
DMH #3	147.00	59.60	55.05	53.87
DMH #2	147.00	68.10	64.71	63.53
DMH #1	147.00	76.60	73.26	72.08
54" Horizontal Bend	147.00	79.80	77.44	76.33
Ext'g Drop Intake Catch Basin	147.00	79.80	78.77	77.77

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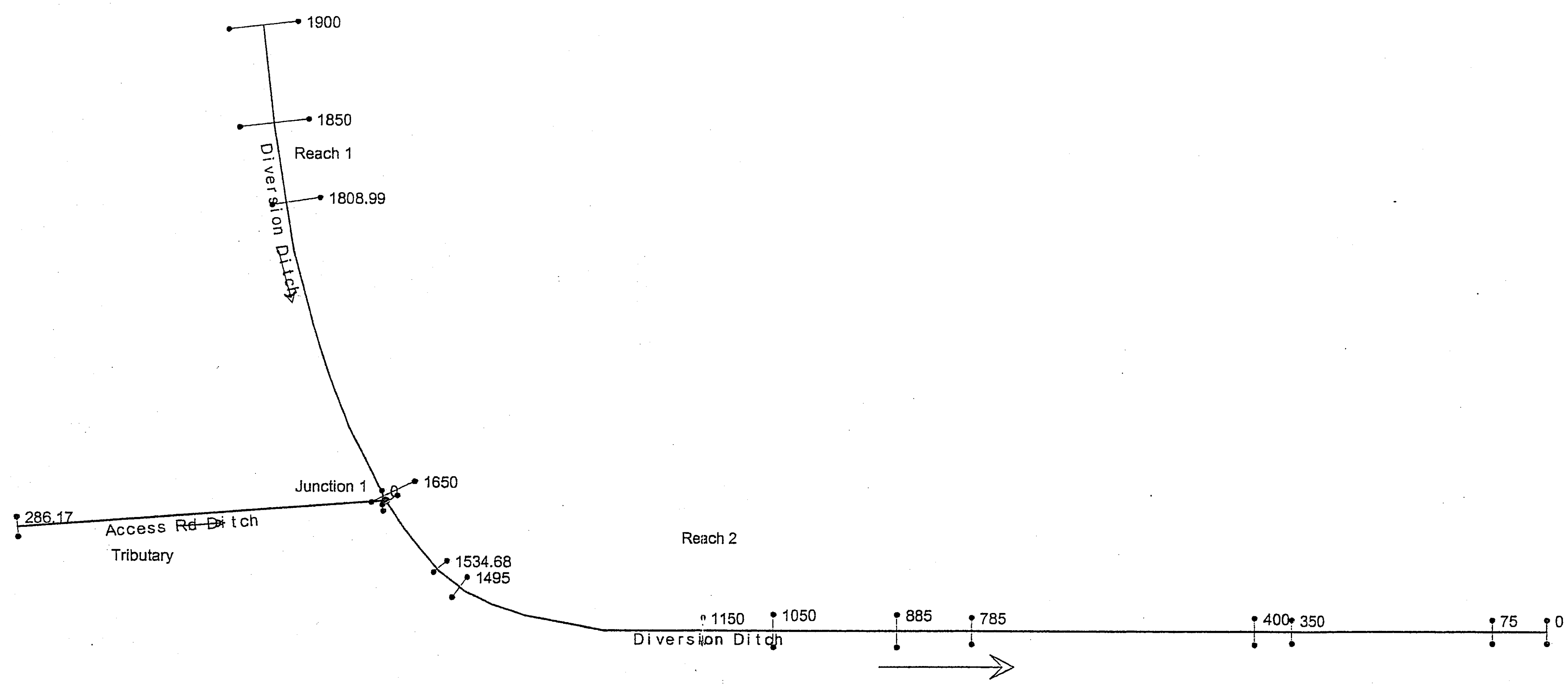
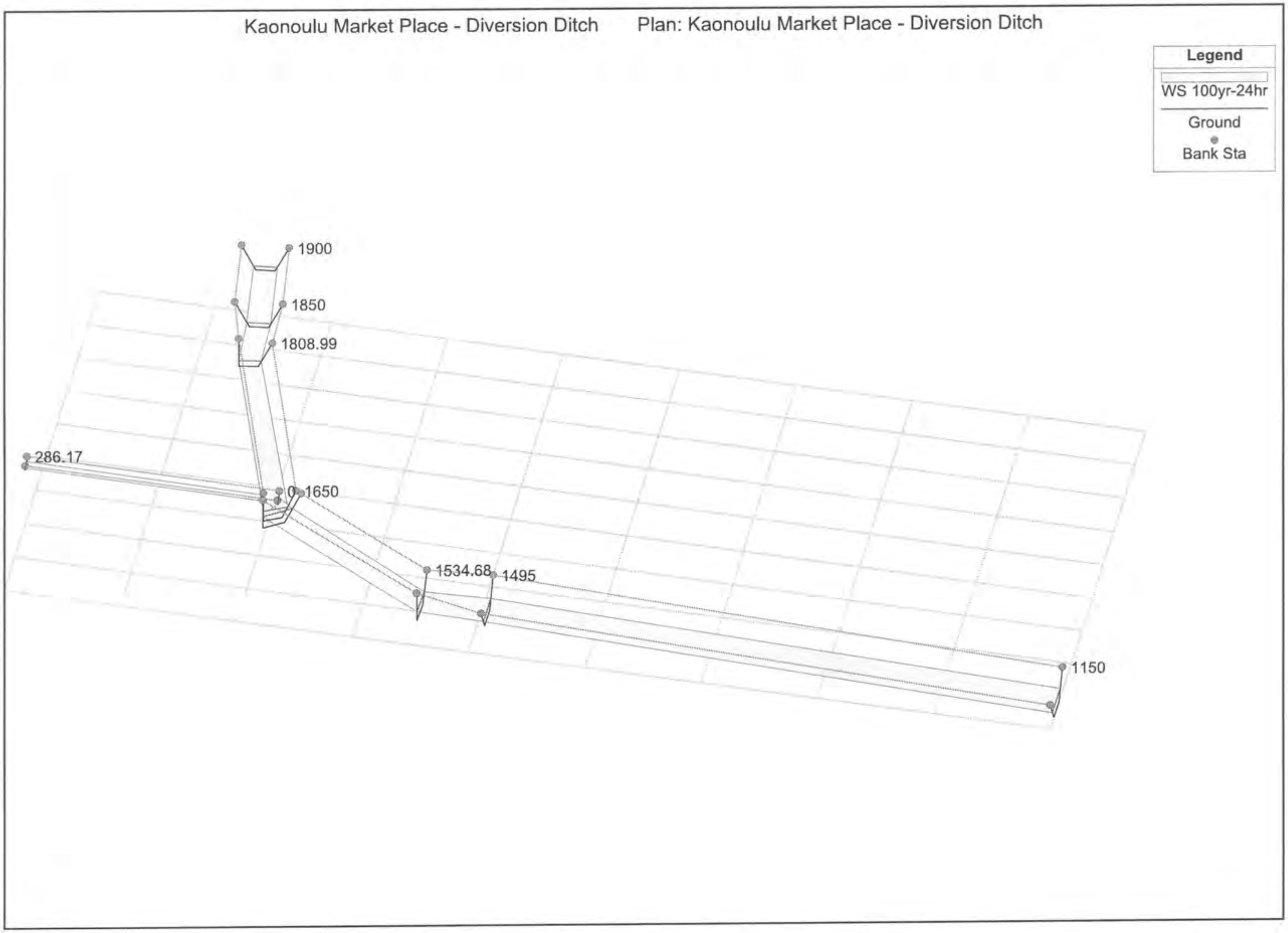
Completed: 10/26/2008 09:36:47 AM



KAONOULU MARKET PLACE – OFFSITE DIVERSION DITCH

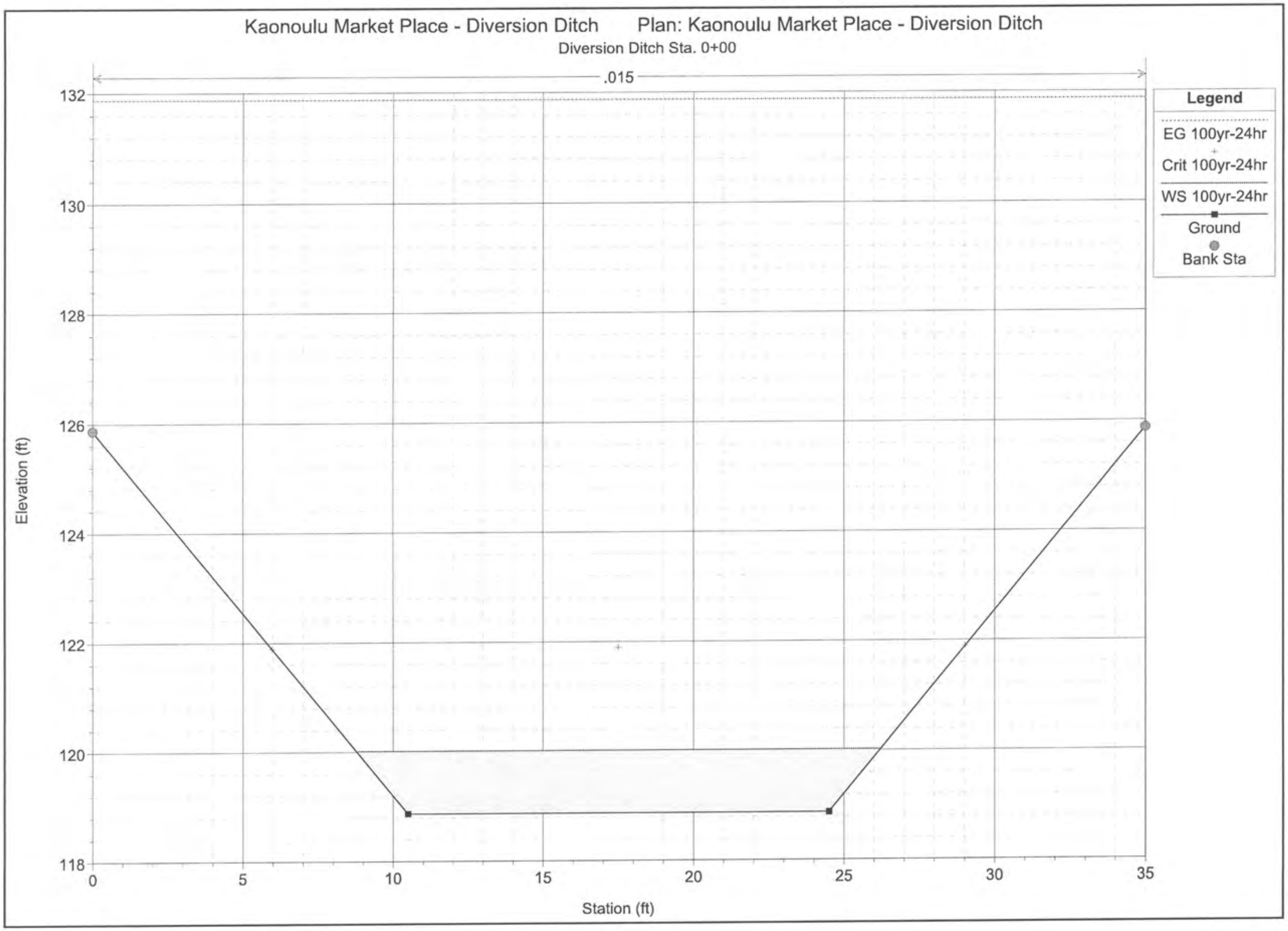

Kaonoulu Market Place - Diversion Ditch
Plan: Kaonoulu Market Place - Diversion Ditch
Legend
WS 100yr-24hr
Ground
Bank Sta
1900
1850
1808.99
286.17
0
1650
1534.68
1495
1150

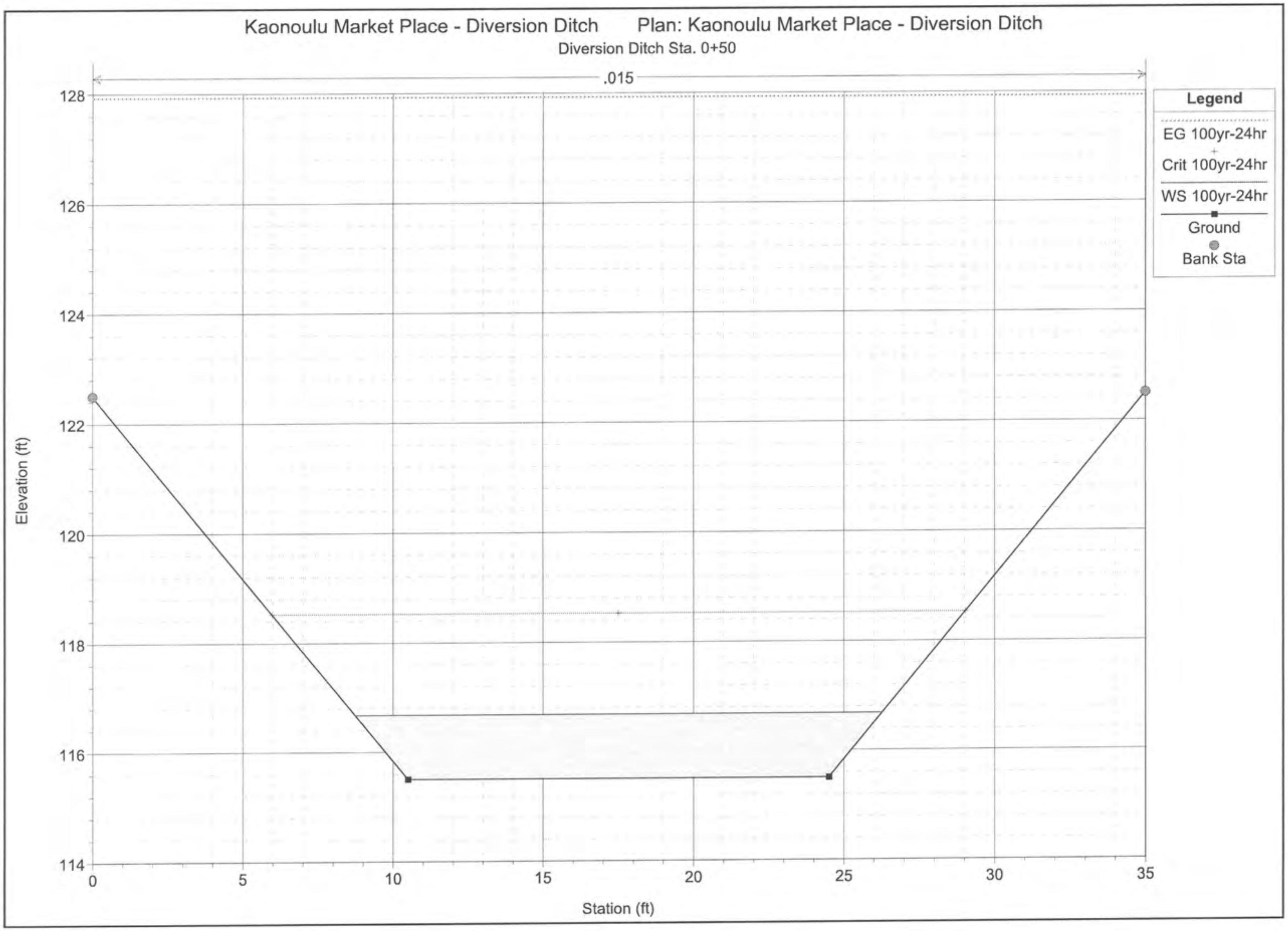
HEC-RAS Plan: DivDitch Profile: 100yr-24hr

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Diversion Ditch	Reach 1	1900	100yr-24hr	498.00	118.87	120.02	121.89	131.87	0.078414	27.63	18.03	17.44	4.79
Diversion Ditch	Reach 1	1850	100yr-24hr	498.00	115.50	116.67	118.52	127.92	0.072387	26.91	18.50	17.52	4.62
Diversion Ditch	Reach 1	1808.99	100yr-24hr	498.00	114.91	116.47	118.10	123.32	0.088910	21.00	23.71	16.34	3.07
Diversion Ditch	Reach 1	1650	100yr-24hr	498.00	112.62	115.38	115.81	117.34	0.013810	11.23	44.33	18.14	1.27
Diversion Ditch	Reach 2	1650	100yr-24hr	523.00	112.62	115.91	115.91	117.36	0.008528	9.65	54.17	18.93	1.01
Diversion Ditch	Reach 2	1534.68	100yr-24hr	523.00	110.97	113.66	114.26	115.94	0.016470	12.12	43.16	18.04	1.38
Diversion Ditch	Reach 2	1495	100yr-24hr	523.00	110.40	112.78	113.51	115.22	0.019615	12.54	41.71	21.13	1.57
Diversion Ditch	Reach 2	1150	100yr-24hr	523.00	105.44	108.20	108.55	109.89	0.011533	10.44	50.10	22.28	1.23
Access Rd Ditch	Tributary	286.17	100yr-24hr	25.00	121.50	122.43	122.23	122.59	0.009220	3.23	7.75	10.65	0.67
Access Rd Ditch	Tributary	0	100yr-24hr	25.00	117.63	118.36	118.36	118.66	0.022403	4.39	5.70	9.64	1.01

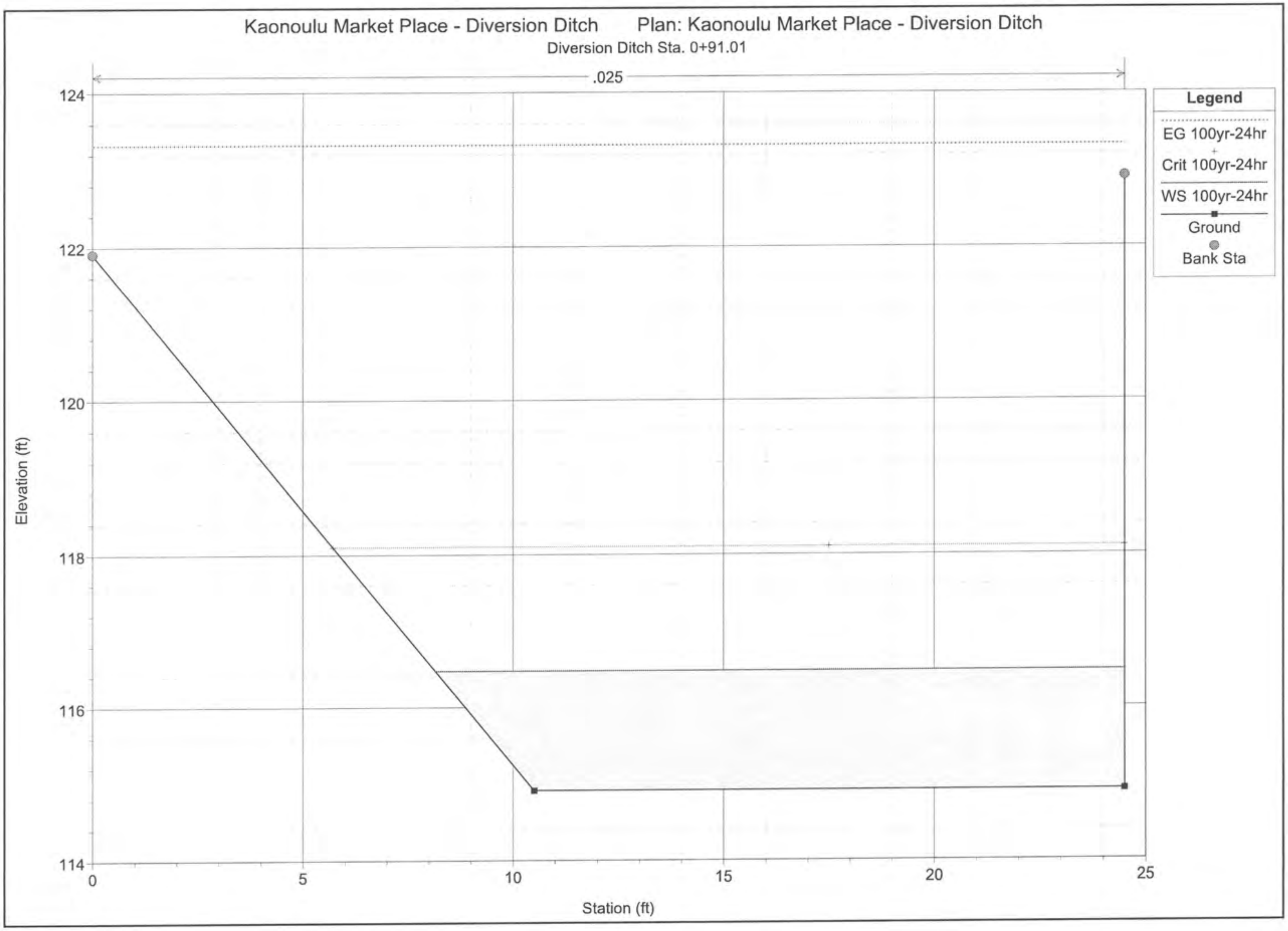
Kaonoulu Market Place UpStream Diversion Ditch to Transition Section Hydraulic Grade Line for 100-year 24-hr Storm

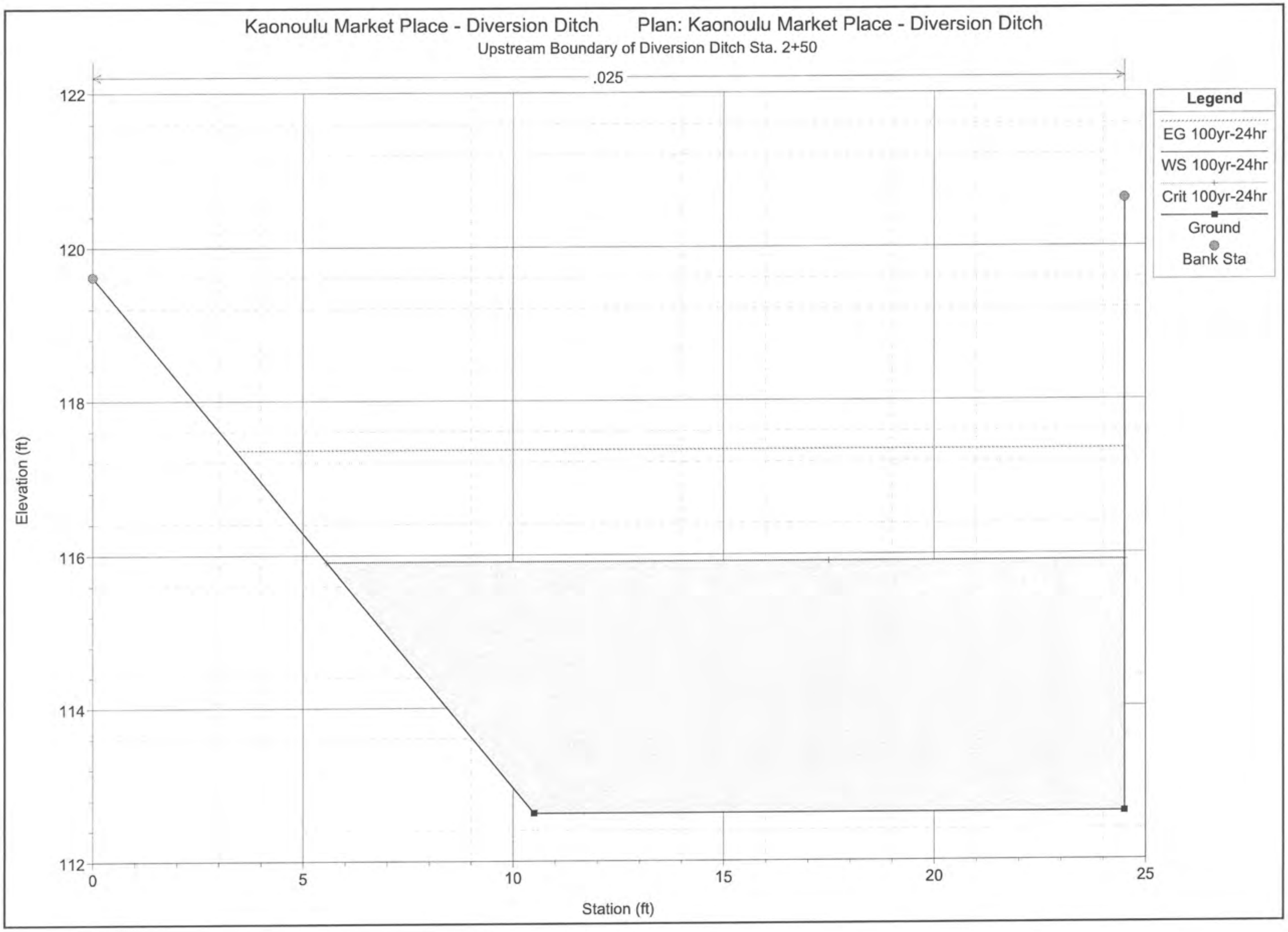
River	Sta	HEC-RAS Sta	Min Channel Elevation (ft)	W.S. Elevation (ft)	Top Width (ft)	Depth (ft)
Diversion Ditch	0+00	1900	118.87	120.02	17.44	1.15
	0+50	1850	115.50	116.67	17.52	1.17
	0+91.01	1808.99	114.91	116.47	16.34	1.56
	2+50	1650	112.62	115.91	18.93	3.29
	3+65.32	1534.68	110.97	113.66	18.04	2.69
	4+05	1495	110.40	112.78	21.13	2.38
	7+50	1150	105.44	108.20	22.28	2.76
Access Road Ditch	0+00	286.17	121.50	122.43	10.65	0.93
	2+86.17	0	117.63	118.36	9.64	0.73


Kaonoulu Market Place - Diversion Ditch Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Sta. 0+00
.015
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Bank Sta
Elevation (ft)
132
130
128
126
124
122
120
118
0
5
10
15
20
25
30
35
Station (ft)

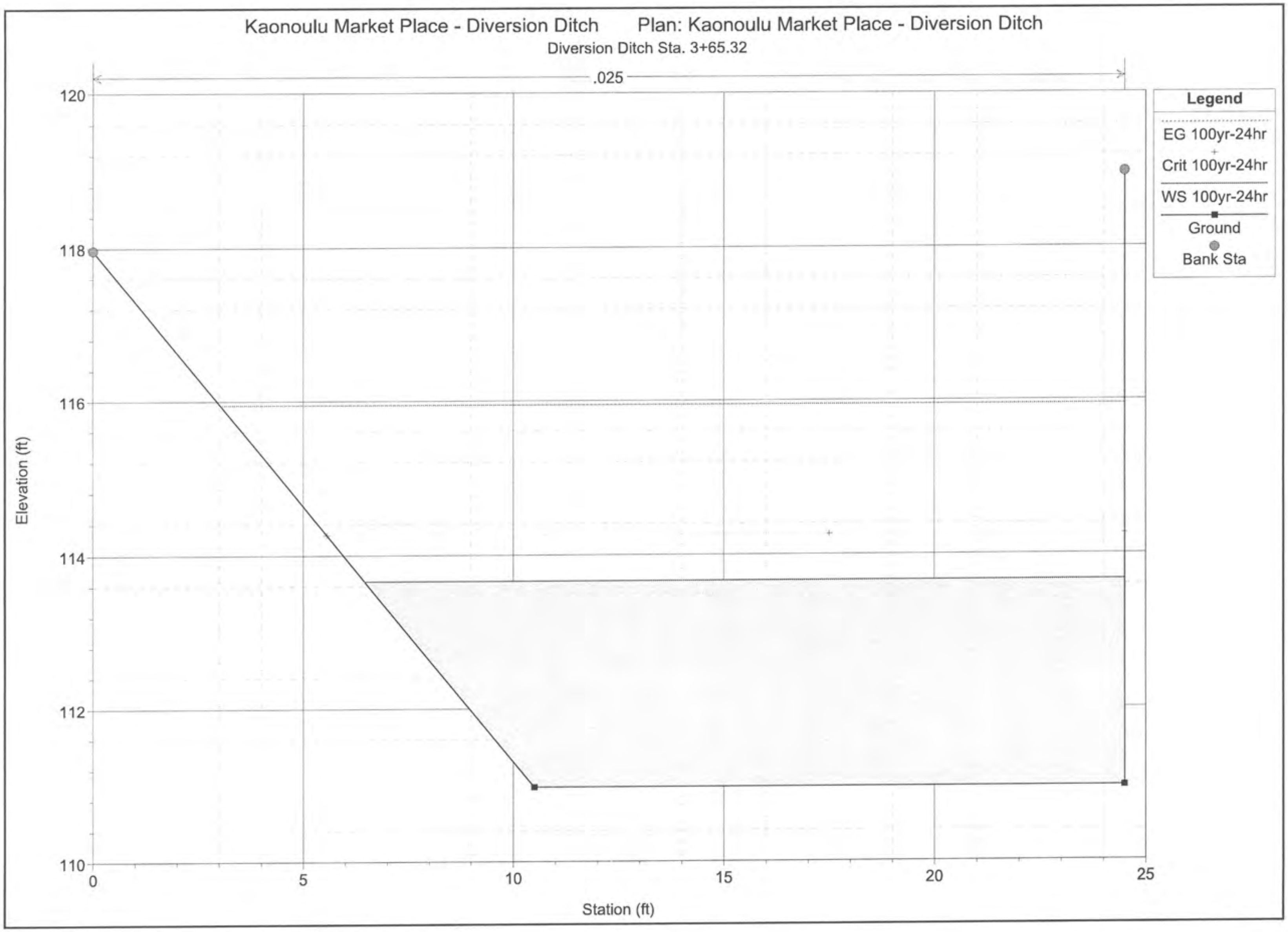


Kaonoulu Market Place - Diversion Ditch Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Sta. 0+50
.015
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Bank Sta
Elevation (ft)
128
126
124
122
120
118
116
114
0
5
10
15
20
25
30
35
Station (ft)

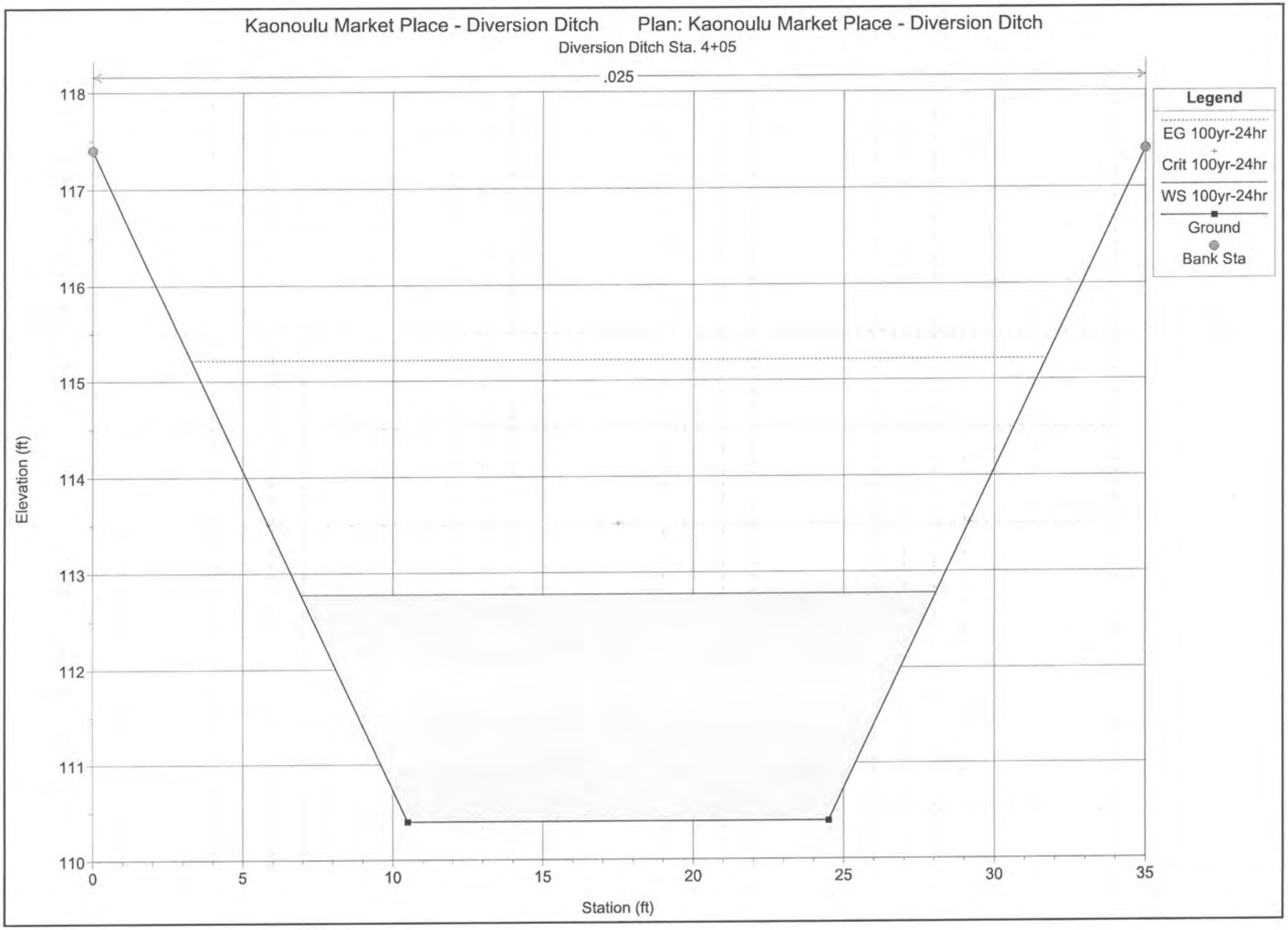

Kaonoulu Market Place - Diversion Ditch Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Sta. 0+91.01
.025
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Bank Sta
Elevation (ft)
124
122
120
118
116
114
0
5
10
15
20
25
Station (ft)



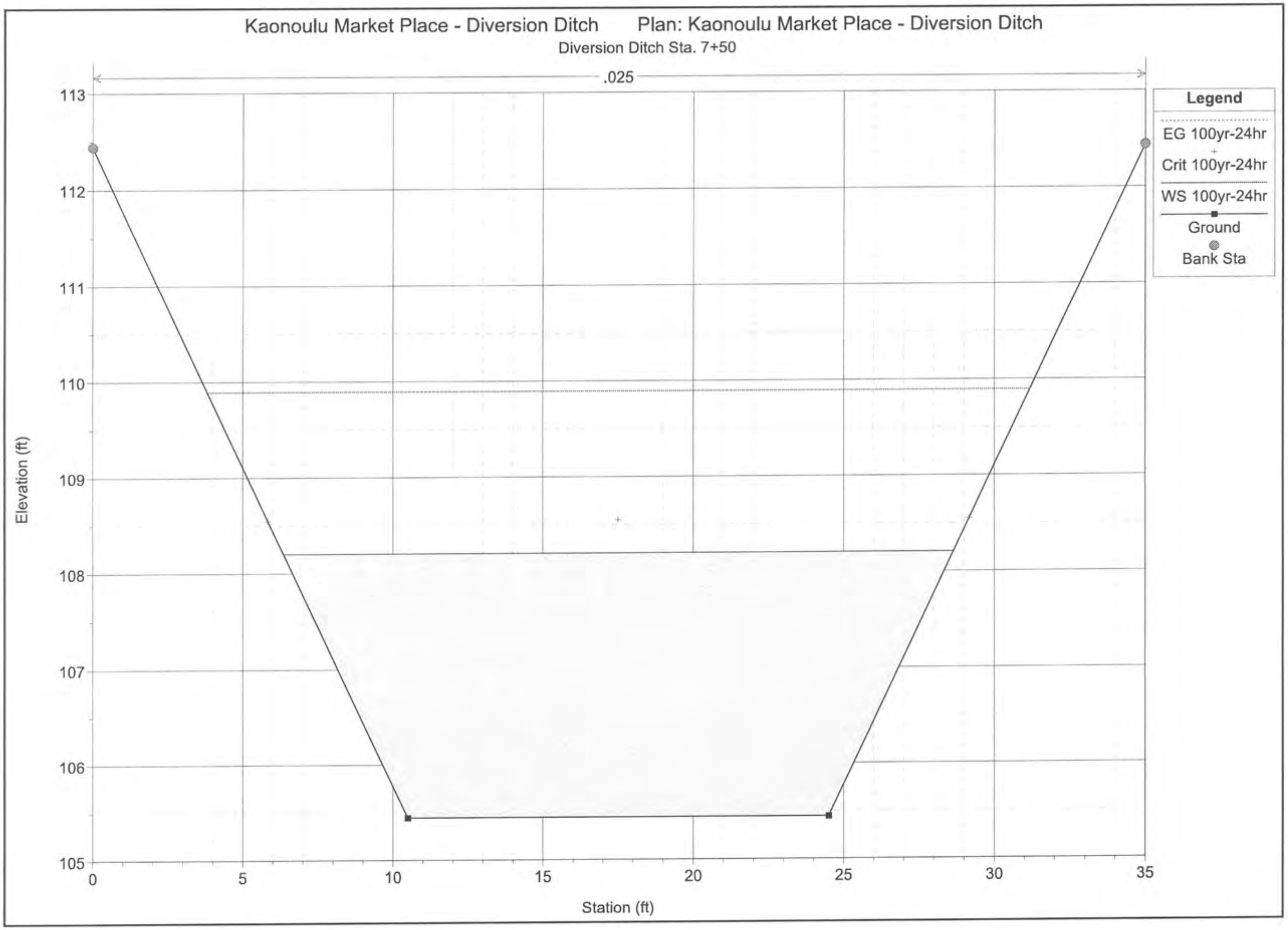
Kaonoulu Market Place - Diversion Ditch Plan: Kaonoulu Market Place - Diversion Ditch
Upstream Boundary of Diversion Ditch Sta. 2+50
.025
Legend
EG 100yr-24hr
WS 100yr-24hr
Crit 100yr-24hr
Ground
Bank Sta
Elevation (ft)
122
120
118
116
114
112
0
5
10
15
20
25
Station (ft)



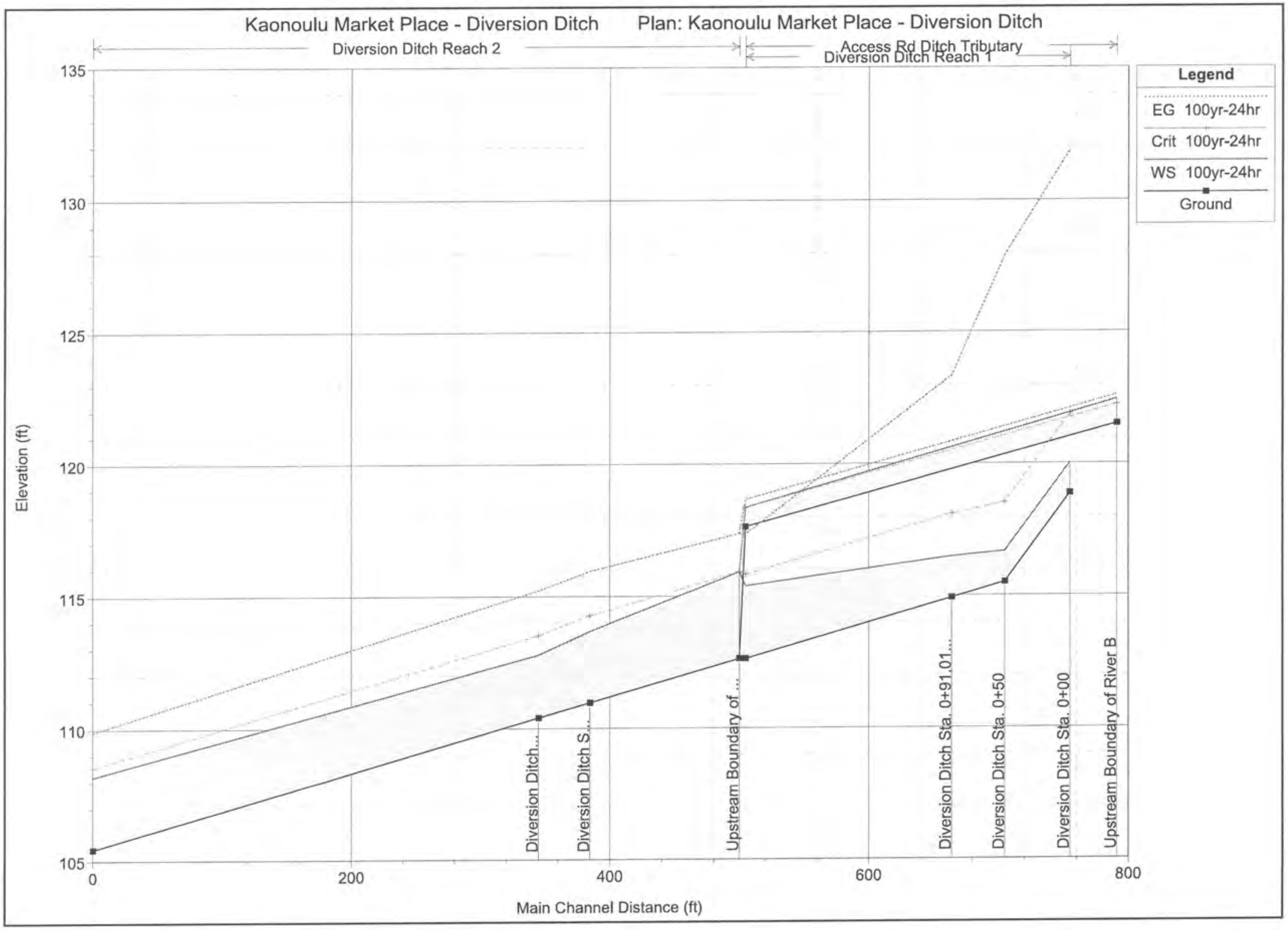
Kaonoulu Market Place - Diversion Ditch Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Sta. 3+65.32
.025
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Bank Sta
Elevation (ft)
120
118
116
114
112
110
0
5
10
15
20
25
Station (ft)



Kaonoulu Market Place - Diversion Ditch
Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Sta. 4+05
.025
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Bank Sta
Elevation (ft)
Station (ft)
118
117
116
115
114
113
112
111
110
0
5
10
15
20
25
30
35

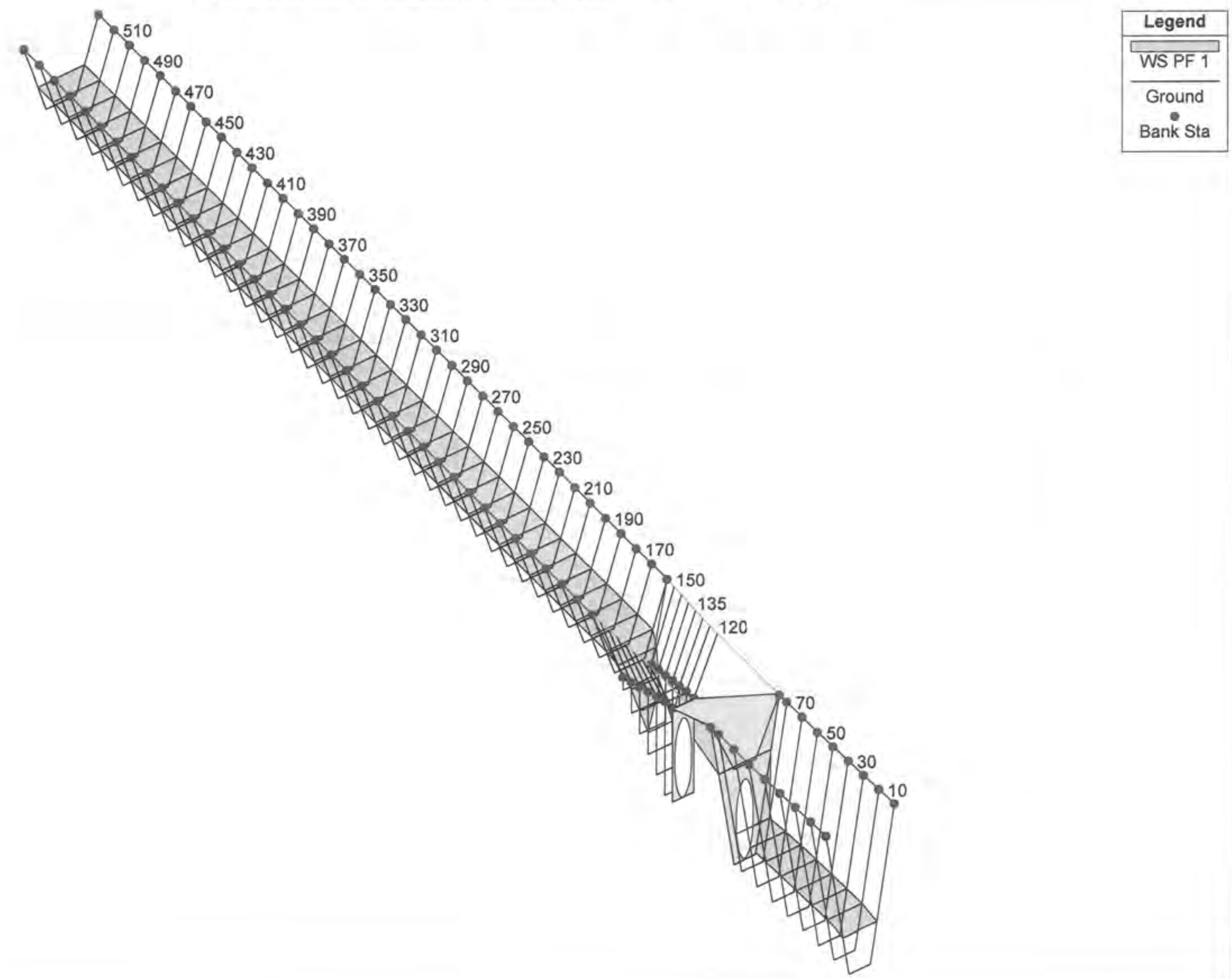


Kaonoulu Market Place - Diversion Ditch Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Sta. 7+50
.025
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Bank Sta
Elevation (ft)
113
112
111
110
109
108
107
106
105
Station (ft)
0
5
10
15
20
25
30
35



Kaonoulu Market Place - Diversion Ditch
Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Reach 2
Access Rd Ditch Tributary
Diversion Ditch Reach 1
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Elevation (ft)
135
130
125
120
115
110
105
0
200
400
600
800
Main Channel Distance (ft)
Diversion Ditch...
Diversion Ditch S...
Upstream Boundary of ...
Diversion Ditch Sta. 0+91.01...
Diversion Ditch Sta. 0+50
Diversion Ditch Sta. 0+00
Upstream Boundary of River B

KaonouluDiversionDitchIntercptorChannelT Plan: 1) Plan 01



HEC-RAS Plan: Plan 01 River: Diversion Ditch Reach: One Profile: PF 1

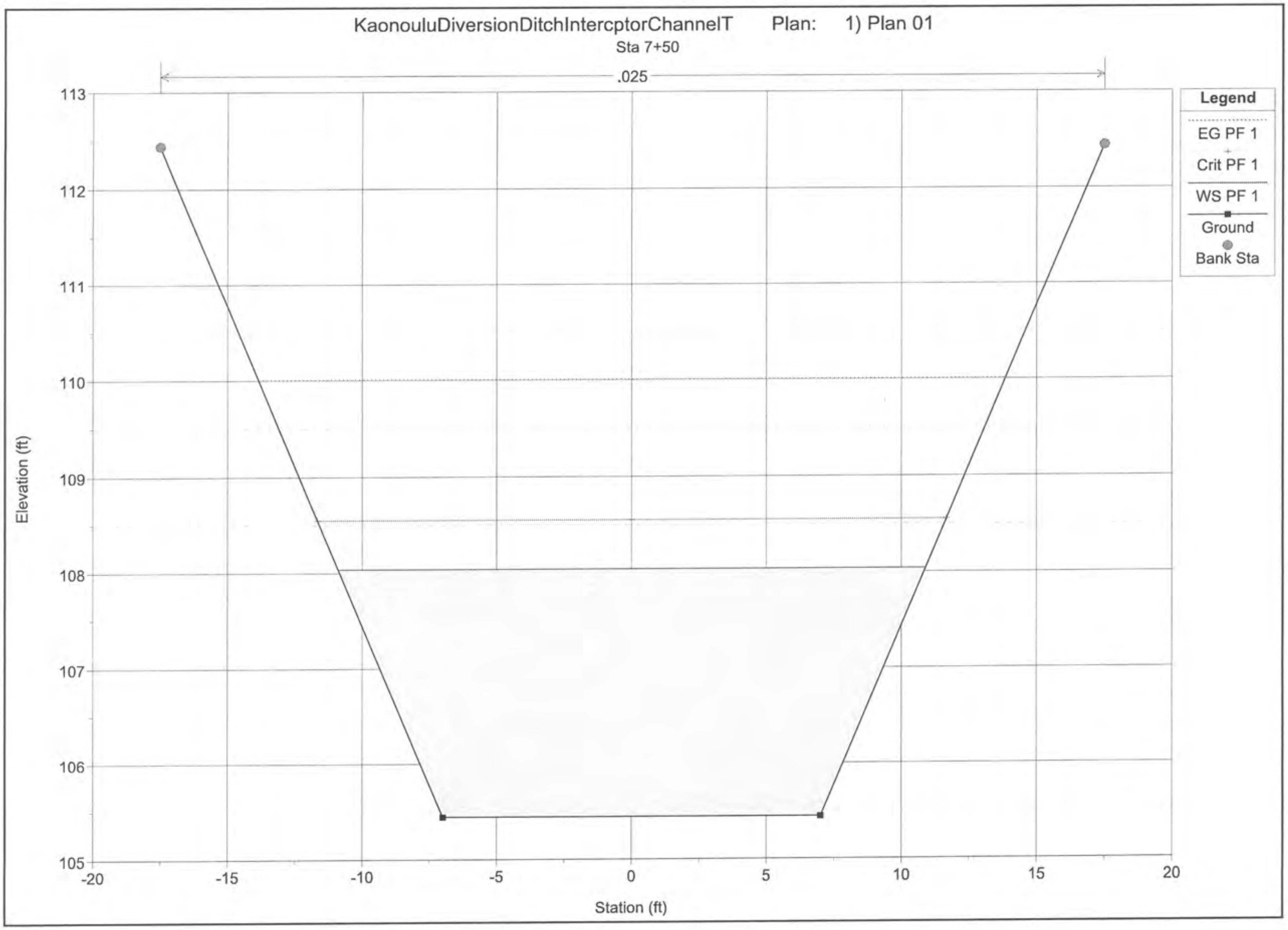
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
One	520	PF 1	523.00	110.76	113.35	113.87	115.33	0.014402	11.27	46.39	21.78	1.36
One	510	PF 1	523.00	110.62	113.24	113.73	115.17	0.013949	11.15	46.91	21.85	1.34
One	500	PF 1	523.00	110.47	113.07	113.58	115.03	0.014299	11.25	46.51	21.80	1.36
One	490	PF 1	523.00	110.33	112.93	113.44	114.89	0.014299	11.25	46.51	21.80	1.36
One	480	PF 1	523.00	110.19	112.79	113.30	114.75	0.014299	11.25	46.51	21.80	1.36
One	470	PF 1	523.00	110.04	112.65	113.15	114.60	0.014164	11.21	46.66	21.82	1.35
One	460	PF 1	523.00	109.90	112.51	113.01	114.46	0.014164	11.21	46.66	21.82	1.35
One	450	PF 1	523.00	109.75	112.35	112.86	114.31	0.014322	11.25	46.48	21.79	1.36
One	440	PF 1	523.00	109.61	112.21	112.72	114.17	0.014322	11.25	46.48	21.79	1.36
One	430	PF 1	523.00	109.47	112.07	112.58	114.03	0.014322	11.25	46.48	21.79	1.36
One	420	PF 1	523.00	109.32	111.92	112.43	113.88	0.014191	11.22	46.63	21.81	1.35
One	410	PF 1	523.00	109.18	111.78	112.29	113.74	0.014191	11.22	46.63	21.81	1.35
One	400	PF 1	523.00	109.04	111.64	112.15	113.60	0.014191	11.22	46.63	21.81	1.35
One	390	PF 1	523.00	108.89	111.49	112.00	113.45	0.014345	11.26	46.46	21.79	1.36
One	380	PF 1	523.00	108.75	111.35	111.86	113.31	0.014345	11.26	46.46	21.79	1.36
One	370	PF 1	523.00	108.60	111.20	111.71	113.16	0.014219	11.22	46.60	21.81	1.35
One	360	PF 1	523.00	108.46	111.06	111.57	113.02	0.014219	11.22	46.60	21.81	1.35
One	350	PF 1	523.00	108.32	110.92	111.43	112.88	0.014219	11.22	46.60	21.81	1.35
One	340	PF 1	523.00	108.17	110.77	111.28	112.74	0.014368	11.26	46.43	21.78	1.36
One	330	PF 1	523.00	108.03	110.63	111.14	112.60	0.014368	11.26	46.43	21.78	1.36
One	320	PF 1	523.00	107.89	110.49	111.00	112.46	0.014368	11.26	46.43	21.78	1.36
One	310	PF 1	523.00	107.74	110.34	110.85	112.30	0.014246	11.23	46.57	21.80	1.35
One	300	PF 1	523.00	107.60	110.20	110.71	112.16	0.014246	11.23	46.57	21.80	1.35
One	290	PF 1	523.00	107.45	110.04	110.56	112.02	0.014391	11.27	46.41	21.78	1.36
One	280	PF 1	523.00	107.31	109.90	110.42	111.88	0.014391	11.27	46.41	21.78	1.36
One	270	PF 1	523.00	107.17	109.76	110.28	111.74	0.014391	11.27	46.41	21.78	1.36
One	260	PF 1	523.00	107.02	109.62	110.13	111.58	0.014273	11.24	46.54	21.80	1.36
One	250	PF 1	523.00	106.88	109.48	109.99	111.44	0.014273	11.24	46.54	21.80	1.36
One	240	PF 1	523.00	106.74	109.34	109.85	111.30	0.014273	11.24	46.54	21.80	1.36
One	230	PF 1	523.00	106.59	109.18	109.70	111.16	0.014414	11.28	46.38	21.78	1.36
One	220	PF 1	523.00	106.45	109.04	109.56	111.02	0.014414	11.28	46.38	21.78	1.36
One	210	PF 1	523.00	106.30	108.90	109.41	110.86	0.014300	11.25	46.51	21.80	1.36
One	200	PF 1	523.00	106.16	108.76	109.27	110.72	0.014300	11.25	46.51	21.80	1.36
One	190	PF 1	523.00	106.02	108.62	109.13	110.58	0.014300	11.25	46.51	21.80	1.36
One	180	PF 1	523.00	105.87	108.48	108.98	110.43	0.014166	11.21	46.66	21.82	1.35
One	170	PF 1	523.00	105.73	108.34	108.84	110.29	0.014166	11.21	46.66	21.82	1.35
One	160	PF 1	523.00	105.59	108.20	108.70	110.15	0.014166	11.21	46.66	21.82	1.35
One	150	PF 1	523.00	105.44	108.04	108.55	110.00	0.014324	11.25	46.48	21.79	1.36

HEC-RAS Plan: Plan 01 River: Diversion Ditch Reach: One Profile: PF 1 (Continued)

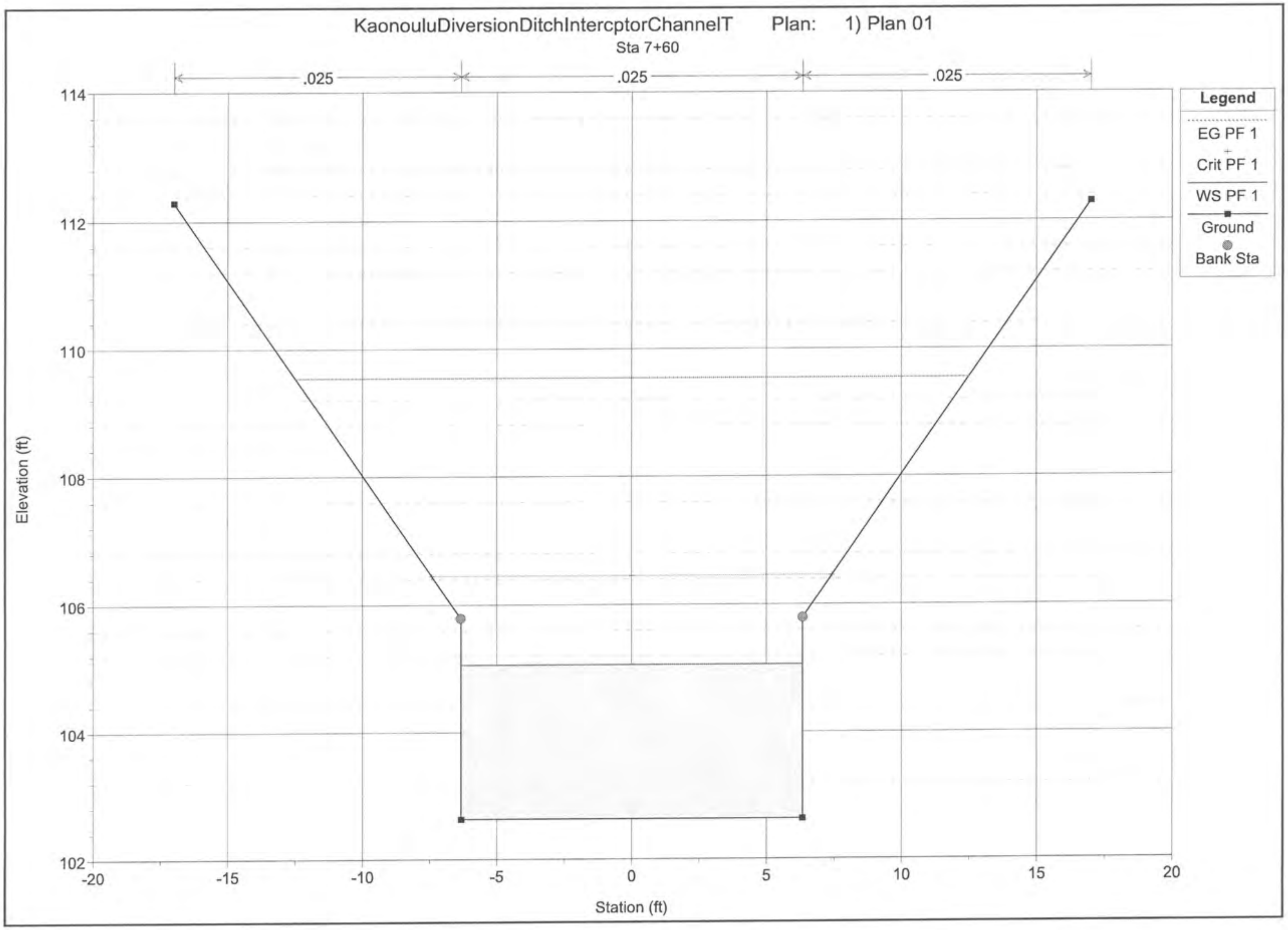
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
One	145	PF 1	523.00	104.33	107.13	107.95	109.85	0.016404	13.45	40.96	18.09	1.42
One	140	PF 1	523.00	102.63	105.06	106.45	109.54	0.038489	16.98	30.80	12.68	1.92
One	135	PF 1	523.00	101.22	103.49	105.10	109.19	0.053235	19.15	27.31	12.01	2.24
One	130	PF 1	523.00	99.81	102.02	103.85	108.78	0.066346	20.86	25.07	11.35	2.47
One	125	PF 1	523.00	98.41	106.31	102.62	106.91	0.002325	6.20	84.29	10.68	0.39
One	120	PF 1	523.00	97.00	106.38	101.38	106.86	0.001813	5.57	93.90	10.02	0.32
One	115		Culvert									
One	70	PF 1	523.00	96.28	100.34	100.23	101.87	0.007716	9.93	52.65	15.95	0.96
One	60	PF 1	523.00	96.13	100.38	100.08	101.75	0.006594	9.39	55.71	16.23	0.89
One	50	PF 1	523.00	95.99	100.40		101.65	0.005800	8.96	58.34	16.47	0.84
One	40	PF 1	523.00	95.94	100.33		101.59	0.005872	9.00	58.08	16.44	0.84
One	30	PF 1	523.00	95.89	100.27		101.54	0.005952	9.05	57.80	16.42	0.85
One	20	PF 1	523.00	95.84	100.20		101.48	0.006042	9.10	57.49	16.39	0.86
One	10	PF 1	523.00	95.79	100.12	99.74	101.42	0.006184	9.17	57.01	16.35	0.87
One	0	PF 1	523.00	95.74	99.69	99.69	101.33	0.008434	10.25	51.00	15.80	1.01

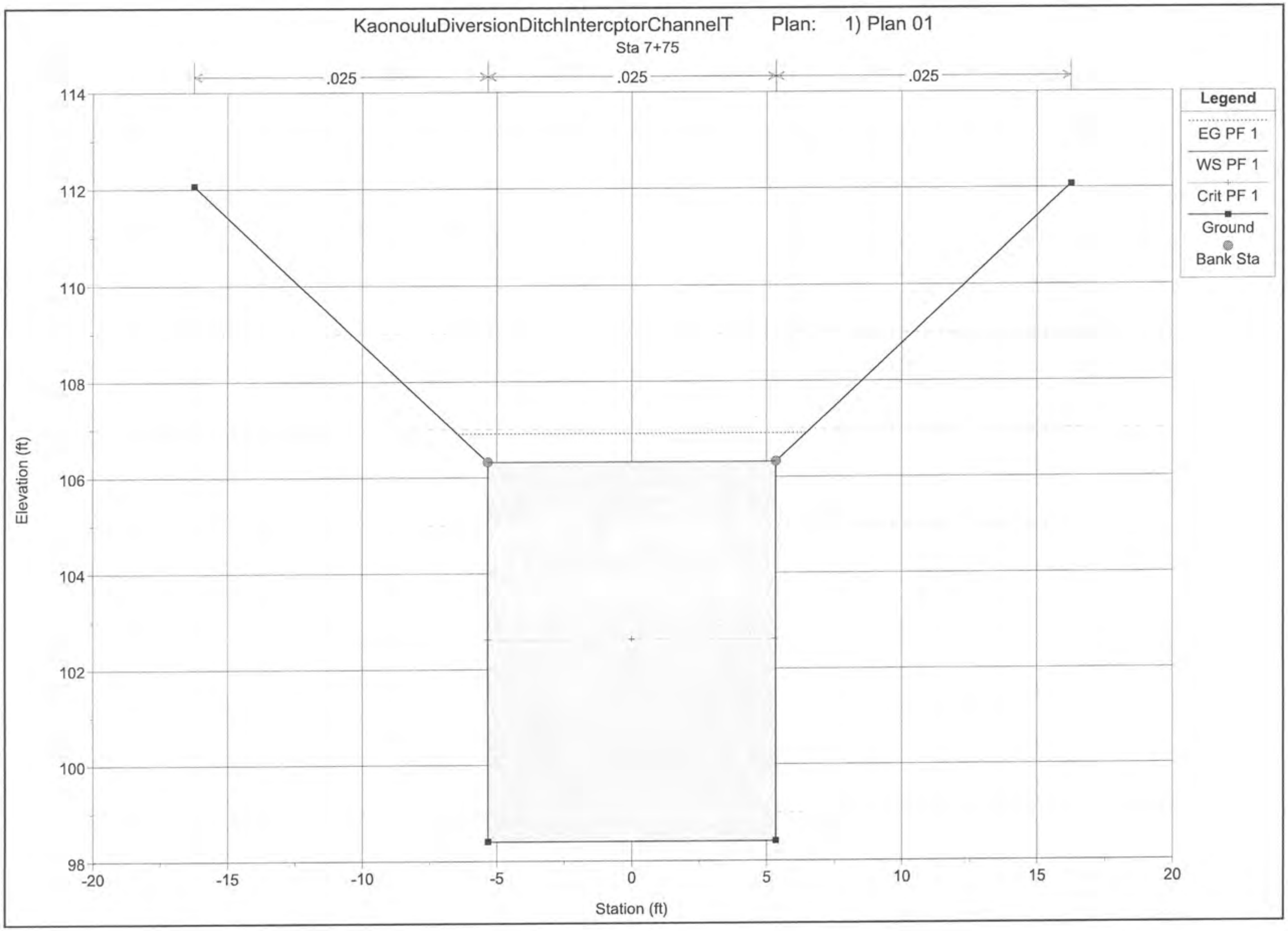
Kaonoulu Market Place Diversion Ditch-Interceptor Channel Hydraulic Grade Line for 100-year 24-hr Storm

Sta	HEC-RAS Sta	Min Channel Elevation (ft)	W.S. Elevation (ft)	Top Width (ft)	Depth (ft)
3+80	520	110.76	113.35	21.78	2.59
3+90	510	110.62	113.24	21.85	2.62
4+00	500	110.47	113.07	21.80	2.60
4+10	490	110.33	112.93	21.80	2.60
4+20	480	110.19	112.79	21.80	2.60
4+30	470	110.04	112.65	21.82	2.61
4+40	460	109.90	112.51	21.82	2.61
4+50	450	109.75	112.35	21.79	2.60
4+60	440	109.61	112.21	21.79	2.60
4+70	430	109.47	112.07	21.79	2.60
4+80	420	109.32	111.92	21.81	2.60
4+90	410	109.18	111.78	21.81	2.60
5+00	400	109.04	111.64	21.81	2.60
5+10	390	108.89	111.49	21.79	2.60
5+20	380	108.75	111.35	21.79	2.60
5+30	370	108.60	111.20	21.81	2.60
5+40	360	108.46	111.06	21.81	2.60
5+50	350	108.32	110.92	21.81	2.60
5+60	340	108.17	110.77	21.78	2.60
5+70	330	108.03	110.63	21.78	2.60
5+80	320	107.89	110.49	21.78	2.60
5+90	310	107.74	110.34	21.80	2.60
6+00	300	107.60	110.20	21.80	2.60
6+10	290	107.45	110.04	21.78	2.59
6+20	280	107.31	109.90	21.78	2.59
6+30	270	107.17	109.76	21.78	2.59
6+40	260	107.02	109.62	21.80	2.60
6+50	250	106.88	109.48	21.80	2.60
6+60	240	106.74	109.34	21.80	2.60
6+70	230	106.59	109.18	21.78	2.59
6+80	220	106.45	109.04	21.78	2.59
6+90	210	106.30	108.90	21.80	2.60
7+00	200	106.16	108.76	21.80	2.60
7+10	190	106.02	108.62	21.80	2.60
7+20	180	105.87	108.48	21.82	2.61
7+30	170	105.73	108.34	21.82	2.61
7+40	160	105.59	108.20	21.82	2.61
7+50	150	105.44	108.04	21.79	2.60
7+55	145	104.33	107.13	18.09	2.80
7+60	140	102.63	105.06	12.68	2.43
7+65	135	101.22	103.49	12.01	2.27
7+70	130	98.41	106.31	10.68	7.90
7+75	125	97.00	106.38	10.02	9.38
7+80	120	96-inch CAP Culvert			
7+85	115				
7+90	110				
7+95	105				
8+00	100				
8+10	90				
8+20	80				
8+30	70				
8+40	60				
8+50	50				
8+60	40				
8+70	30				
8+80	20				
8+90	10				
9+00	0				

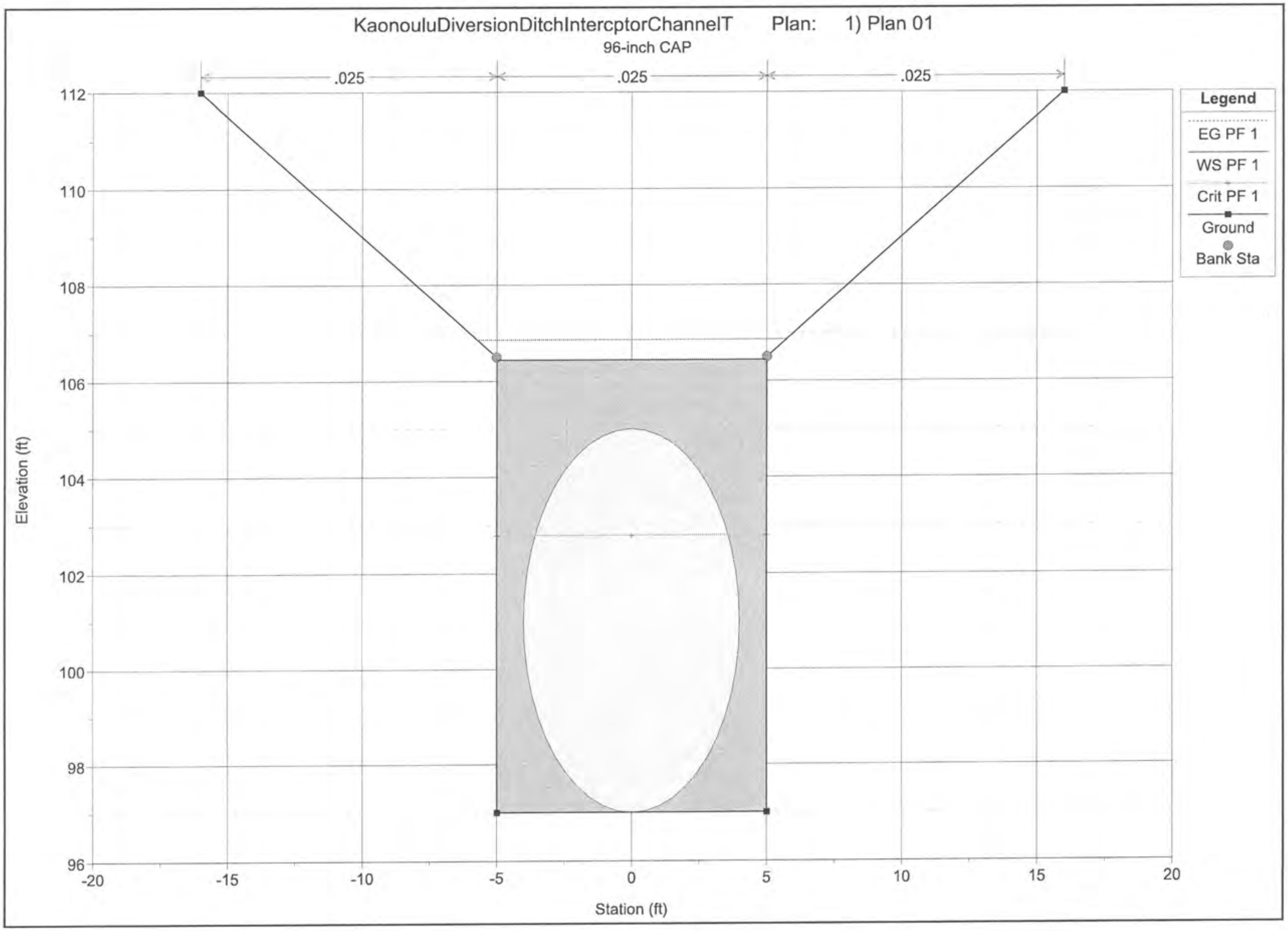


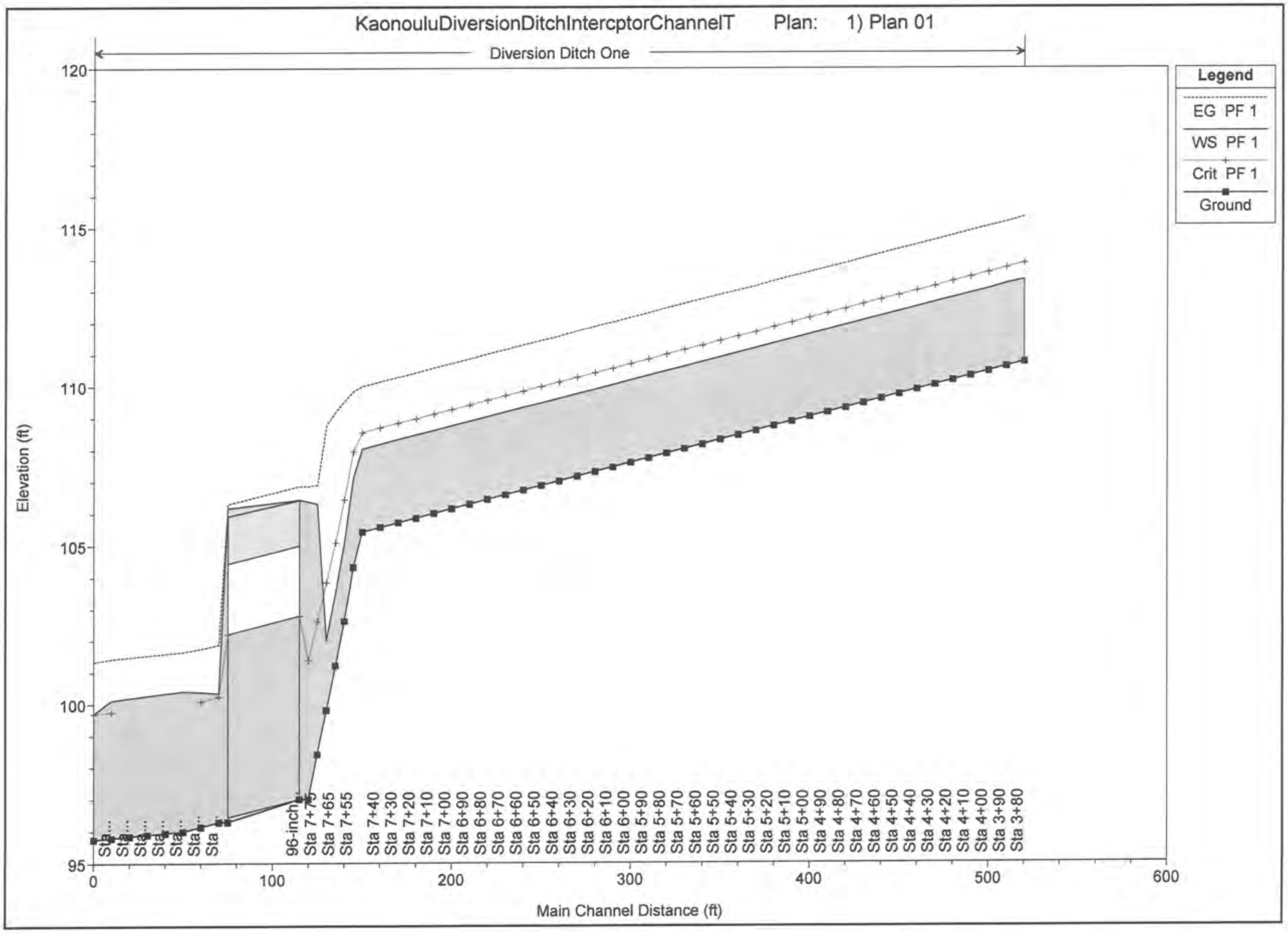
KaonouluDiversionDitchIntercptorChannelT Plan: 1) Plan 01
Sta 7+50
.025
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
113
112
111
110
109
108
107
106
105
-20
-15
-10
-5
0
5
10
15
20
Station (ft)


KaonouluDiversionDitchIntercptorChannelT Plan: 1) Plan 01
Sta 7+60
.025
.025
.025
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
114
112
110
108
106
104
102
-20
-15
-10
-5
0
5
10
15
20
Station (ft)



KaonouluDiversionDitchIntercptorChannelT Plan: 1) Plan 01
Sta 7+75
.025
.025
.025
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
114
112
110
108
106
104
102
100
98
-20
-15
-10
-5
0
5
10
15
20


KaonouluDiversionDitchIntercptorChannelT Plan: 1) Plan 01
96-inch CAP
.025
.025
.025
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
112
110
108
106
104
102
100
98
96
-20
-15
-10
-5
0
5
10
15
20
Station (ft)



KaonouluDiversionDitchIntercptorChannelT Plan: 1) Plan 01
Diversion Ditch One
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)
96-inch
Sta 7+75
Sta 7+65
Sta 7+55
Sta 7+40
Sta 7+30
Sta 7+20
Sta 7+10
Sta 7+00
Sta 6+90
Sta 6+80
Sta 6+70
Sta 6+60
Sta 6+50
Sta 6+40
Sta 6+30
Sta 6+20
Sta 6+10
Sta 6+00
Sta 5+90
Sta 5+80
Sta 5+70
Sta 5+60
Sta 5+50
Sta 5+40
Sta 5+30
Sta 5+20
Sta 5+10
Sta 5+00
Sta 4+90
Sta 4+80
Sta 4+70
Sta 4+60
Sta 4+50
Sta 4+40
Sta 4+30
Sta 4+20
Sta 4+10
Sta 4+00
Sta 3+90
Sta 3+80

APPENDIX C
Water Demand Calculations

APPENDIX C-1

Potable and Non-Potable Water Demand Calculation

PIILANI PROMENADE
Projected Daily Water Demand

POTABLE WATER	Base Unit			Consumption Rate[1]		Average Daily Demand			Max. Daily Demand
Multi-Family Residential	226 units	x	392 gals/unit [2]		==>	88,592 gpd	x 1.5	==>	132,888 gpd
Business Commercial	530,706 s.f.	x	140 gals/1000 s.f.		==>	74,299 gpd	x 1.5	==>	111,448 gpd
Light Industrial	57,588 s.f.	x	140 gals/1000 s.f.		==>	8,062 gpd	x 1.5	==>	12,093 gpd
Subtotal - Potable Water						170,953 gpd			256,430 gpd

NON-POTABLE WATER	Base Unit		Consumption Rate*		Average Daily Demand			Max. Daily Demand
Multi-Family Residential	226 units	x	168 gals/unit [3]	==>	37,968 gpd	x 1.5	==>	56,952 gpd
Park	2.3 Ac.	x	1,700 gals/Acre	==>	3,910 gpd	x 1.5	==>	5,865 gpd
Onsite Landscaping	21.0 Ac.	x	1,700 gals/Acre	==>	35,700 gpd	x 1.5	==>	53,550 gpd
Kaonoulu Street Landscaping	1.7 Ac.	x	1,700 gals/Acre	==>	2,890 gpd	x 1.5	==>	4,335 gpd
Subtotal - Non-Potable Water					80,468 gpd			120,702 gpd
COMBINED TOTAL					251,421 gpd			377,132 gpd

Notes:

[1] *Consumption rates taken from Water System Standards, Department of Water Supply County of Maui, State of Hawaii, 2002, Table 100-18, p. 111-3.*

[2] *Multi-Family domestic consumption estimated to be 70% of total consumption:*
MF domestic consumption = 560 gpd x 70% = 392 gpd

[3] *Multi-Family irrigation consumption estimated to be 30% of total consumption:*
MF irrigation consumption = 560 gpd x 30% = 168 gpd

APPENDIX C-2

Available Meter Capacity vs. Projected Demand

ADEQUACY OF DOMESTIC WATER METER CAPACITY AVAILABLE TO PIILANI PROMENADE

Compare available water meter capacity to projected capacity needed to complete build-out of Piilani Promenade.

Available Water Meter Capacity

Combined normal flow capacity of three 3-inch water meters already issued to Piilani Promenade by Maui County Dept. of Water Supply:

3 meters x 350 gpm/meter[1] = 1050 gpm

Needed Water Meter Capacity (Projected)

Needed Meter Capacity

= Average Daily Domestic Demand x Peaking Factor

= 171,000 gpd X 5.0

= 594 gpm

Since 1050 gpm < 594 gpm, available meter capacity should be adequate to meet projected need.

October 24, 2013

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[1]Safe Maximum Operating Capacity of 3-inch cold water meter per AWWA C701-88.

APPENDIX C-3

Fire Flow Demand Calculation

PRELIMINARY ISO FIRE FLOW DEMAND[1] CALCULATION
FOR PIILANI PROMENADE

Required Fire Flow, $F = 18\ C\ A^{0.5}$

Where: C = Construction Type Coefficient
A = Total Floor Area

C	=	0.8 (Non-combustible construction)
A	=	160,000 sq.ft.
F	=	$18(0.8)(160,000)^{0.5}$
	=	5760 gpm ==> 5750 gpm (Rounded to nearest 250 gpm)

CLOSEST BUILDINGS:

100 ft. to North
150+ ft. to South
150+ ft. to East
150+ ft. to West

ADJUSTMENTS FOR HAZARD AND EXPOSURE:

	5750 gpm	
-	0 gpm	(No adjustment for Occupancy)
+	575 gpm	(+10% Building Separation to North)
+	0 gpm	(+0% Building Separation to South)
+	0 gpm	(+0% Building Separation to East)
+	0 gpm	(+0% Building Separation to West)
	6325 gpm	

[1]Based on Insurance Services Office, "Guide for the Determination of Required Fire Flow", Second Edition, December 1974.

ADJUSTMENT FOR AUTOMATIC SPRINKLER PROTECTION:

```
     6325 gpm
-    4745 gpm (-75% Reduction for Automatic Fire Sprinklers)
+    1000 gpm (Estimated flow demand from fire sprinklers)
+     500 gpm (Additional hose streams)
     ________

     3080 gpm  ==>  3000 gpm (Rounded to nearest 250 gpm)
```

October 24, 2013

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APPENDIX D

Wastewater Calculations

PIILANI PROMENADE
Projected Daily Sewer Demand

RESIDENTIAL	Base Unit		Contribution Rate[1]			Average Daily Sewer Demand
Multi-Family Residential	226 units	x	255 gals/unit/day		==>	57,630 gpd

COMMERCIAL	Base Unit		No. Persons		Contribution Rate		Average Daily Sewer Demand
Business Commercial	530,706 s.f.	÷	200 s.f./person	x	20 gpcpd	==>	53,071 gpd
Light Industrial	57,588 s.f.	÷	500 s.f./person	x	25 gpcpd	==>	2,879 gpd
Subtotal							55,950 gpd
COMBINED TOTAL							113,580 gpd

Note:
[1] Contribution rates taken from County of Maui, Wastewater Reclamation Division, "Wastewater Flow Standards," February 2, 2000.