PRELIMINARY DRAINAGE REPORT

Asteria Highlands

Plan # _____
Case # 12-PP-2017
Q-S # _____
[X] Accepted
[ ] Corrections
M. Rahman 12/28/17
Reviewed By Date

Prepared for:

Hines
2375 E. Camelback Rd, Suite 150
Phoenix, AZ 85016

Prepared by:

Kimley-Horn and Associates
291102002
December 2017

Kimley»Horn

12-PP-2017
12/18/17

PRELIMINARY DRAINAGE REPORT

ASTERIA HIGHLANDS

DECEMBER 2017

Expires 06/30/19

Prepared By:

Kimley»Horn

Contents

Figures

Appendices

INTRODUCTION

SITE LOCATION

This Preliminary Drainage report has been prepared for the proposed Asteria Highlands development (Development). The Development is bound to the east by 128th Street, to the west by a proposed development (Sereno Canyon), and to the north and south by an undeveloped residential property. The Story Rock development is on the east side of 128th Street. The Development is located within Section 11 of Township 4 North, Range 5 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. Refer to **Figure 1A** and **Figure 1B** for the Location Map and Aerial Photo Map, respectively.

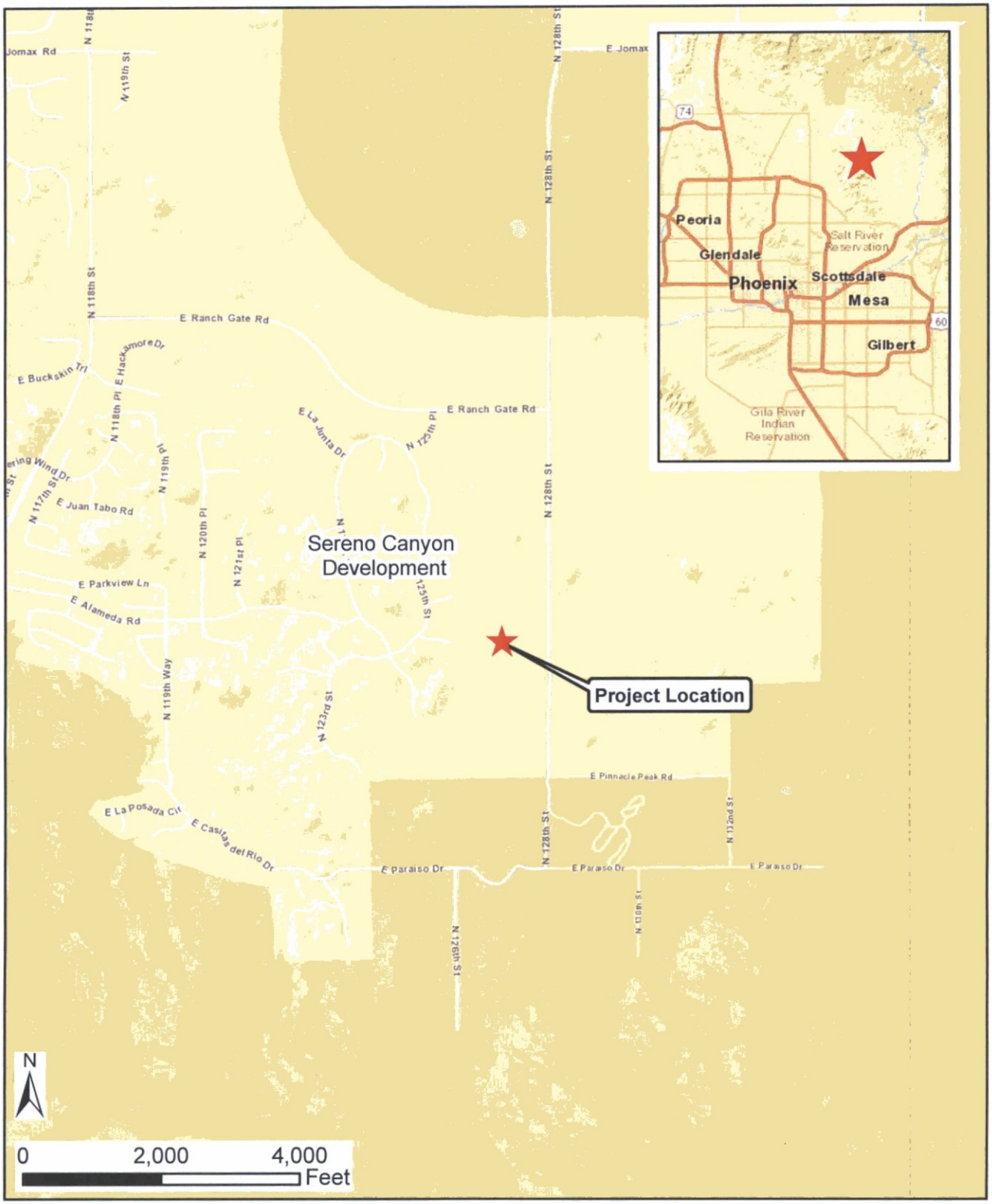
PROJECT SIZE AND TYPE

The Development is a proposed 40-acre custom-lot residential subdivision. The proposed development consists of 31 residential units. The majority of the Development is zoned R1-35 ESL. Lots one (1) through four (4) are zoned R1-70. The proposed site is located within the City of Scottsdale (City) and falls under the City's Environmentally Sensitive Lands Ordinance (ESLO).

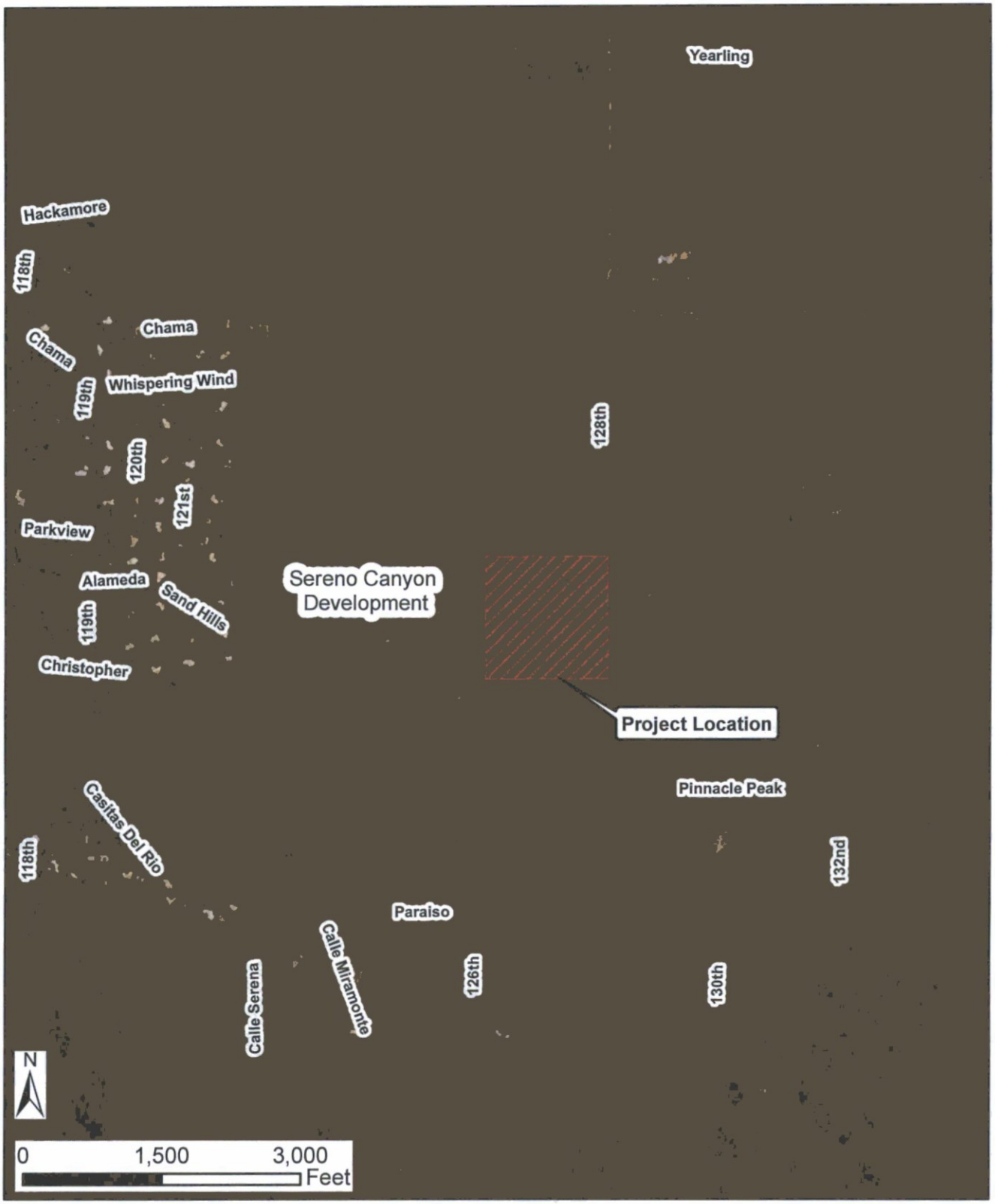
PURPOSE AND OBJECTIVES

This report establishes drainage parameters and criteria for the Development. This report establishes a general hydrologic and hydraulic plan for the development of the site.

- Demonstrate compliance with the City's Design Standards & Polices Manual (DSPM)
- Quantify offsite runoff from being conveyed through the existing property
- Establish drainage parameters and criteria for design.
- Provide a hydraulic analysis for the Development.



Kimley»Horn Expect More. Experience Better.	Asteria Highlands	Scottsdale, AZ
	Figure 1A. Location Map	



Kimley»Horn Expect More. Experience Better.	Asteria Highlands	Scottsdale, AZ
	Figure 1B. Aerial Photo Map	

DESCRIPTION OF EXISTING DRAINAGE CONDITIONS AND CHARACTERISTICS

EXISTING ONSITE CONDITIONS

The Development consists of undeveloped natural desert. The Development slopes from southwest to northeast with an average slope of 3.9%. Three significant washes cross the site. Significant washes are defined as having a 100-year peak discharge of 50 cubic feet per second (cfs) or more. All three significant washes flow from southwest to northeast, discharging onto 128th Street. Refer to **Figure 2** for the Existing Conditions Map.

EXISTING OFFSITE DRAINAGE CONDITIONS

Offsite runoff originates southwest of the development from large, undeveloped sub-basins. The offsite basins are part of the McDowell Sonoran Preserve. Offsite runoff is conveyed through the site by three (3) significant washes. Refer to **Figure 2.**

There are no washes with 100-year peak discharges of 750 cfs or greater, which indicates that no Vista Corridors exist within the project area. Existing conditions hydrologic results can be found in **Appendix A.**

CONTEXT RELATIVE TO ADJACENT PROJECTS AND IMPROVEMENTS

Runoff discharges east to 128th Street and north to the adjacent undeveloped parcel. Runoff crossing 128th Street will be conveyed through the Story Rock development. The Story Rock development is currently under final design. The Story Rock development will be constructing a portion of the 128th Street improvements including several culvert crossings. The culvert crossings will be conveying runoff from the Development and are included in the hydraulic analysis completed for this report.

FLOOD HAZARD ZONES ON PROPERTY, FIRM MAPS

The development is located within one flood zone as shown on Flood Insurance Rate Map (FIRM) panel number 04013C1335M dated November 4, 2015. Panel 04013C1335M is not printed, because no special flood hazard areas exist in its area. The Development is in a Zone D flood zone. Zone D flood zones are classified as "Areas in which flood hazards are undetermined, but possible."

PROPOSED DRAINAGE PLAN

PROPOSED ONSITE DRAINAGE PLAN

The Development consists of 31 single-family units. Runoff will be conveyed in the streets to the northeast corner of the site. Runoff will be collected in a storm drain system and discharged to detention basins.

The detention basin at the northeast corner of the site, SON05, will be used to collect onsite runoff from a storm drain system. This basin will have an 18-inch bleed off pipe with a 12-inch orifice plate to discharge runoff to a northern exit point. The detention basin will overtop during the 100-year storm event. The overflow will be conveyed towards the existing conditions discharge point from the site.

Onsite runoff in the southern portion of the Development will be collected in detention basin SON18 that will have two 18-inch outlet pipes. The runoff reaching this detention basin is being routed to two separate exit points on the site to maintain pre-development conditions. In the existing condition, two subbasins with separate exit points make up the proposed subbasin ON18. Both outlet pipes will have 12-inch orifice plates. One will discharge to CP15 and the other to CP20.

The post development peak discharges exiting the site are equal to or less than pre-development peak discharges, except for one location: CP10 in the 2-year and 10-year storm events. The post-development discharge exceeds the pre-development discharges by one (1) cfs in both cases, but meets the 100-year pre-development discharge. Four (4) culverts will convey runoff across 128th Street to the Story Rock development. The roadway and culvert are being designed with the Story Rock development.

Lots located adjacent to the significant wash will have finished floor elevations a minimum of one foot above the 100-year base flood elevation (BFE). Refer to Figure 4 for the Proposed Conditions Drainage Map.

PROPOSED ONSITE HYDROLOGY

Onsite runoff maintains post-development peak discharges at or below pre-development conditions at exit points for the Development, except for CP10 in the 2-year and 10-year storm events. A normal depth calculation was done for the pre- and post-project conditions for the wash downstream of the exit point to determine the impacts. The results show that the rise in WSEL for CP10 is 0.01 feet in both the 2-year and 10-year storm events. The velocity increases for CP10 are 0.07 fps and 0.03 fps respectively. See **Appendix D** for normal depth calculations. These changes in WSEL and velocity are negligible, and downstream drainage structures are designed for the 10-year storm event.

Onsite runoff is routed to detention basins to attenuate runoff. A summary of the pre- and post-development peak discharges is provided in **Table 1**. Refer to **Appendix A** and **Appendix B** for the detailed hydrologic model results.

Table 1. Peak Discharge Summary

HEC-1 Combination Point (Pre/Post)	Pre Q_2 [cfs]	Post Q_2 [cfs]	Pre Q_{10} [cfs]	Post Q_{10} [cfs]	Pre Q_{100} [cfs]	Post Q_{100} [cfs]
ON07/ON07	2	1	5	3	9	6
CP05/SON05	5	2	14	5	31	19
CP10/CP10	14	15	40	41	99	98
ON12/ON12	1	1	3	3	7	6
ON15/CP15	3	3	9	8	20	15
CP20/CP20	20	19	56	55	138	134
CP25/CP25	9	9	25	24	62	60

PROPOSED ONSITE HYDRAULICS

Onsite runoff will be conveyed in the local streets to two storm drain systems. One is located at the northeast corner of the site. The other is located at the southeast corner. Per the DSPM, all interior streets will be designed to convey the peak discharge from the 10-year storm event at or below the top of curb elevation. Additionally, the streets will convey the 100-year runoff within the proposed right-of-way tracts and maintain a maximum flow depth of eight (8) inches above the gutter flow line. Detailed street capacity analysis will be completed as part of the final design. Storm drain systems will convey runoff from the streets to the two retention basins. Storm drain analysis will be completed with final design.

The significant wash in the southeast corner of the site in subbasin ON25 (refer to **Figure 2**) will be unaffected by the improvements. The wash running through subbasin ON10 (refer to **Figure 2**) will be routed through a 2-24" culvert under the proposed roadway (refer to **Figure 4**), with no overtopping in the 10-year storm and less than three (3) inches of overtopping in the 100-year event. Runoff through the significant wash in subbasin ON20 (refer to **Figure 2**) will be conveyed under the proposed driveway with an eight-foot (8') span bridge (refer to **Figure 4**). The driveway will have a dry crossing in the 100-year event. The culverts conveying runoff across 128th Street were confirmed in the Story Rock design to convey both the 10- and 100-year events without overtopping the road.

Lateral erosion setbacks were determined for the significant washes. The minimum setbacks of 20 feet for straight channel reaches and 50 feet for channels with obvious curvature required per the Arizona Department of Water Resources State Standard for Watercourse System Sediment Balance (SS5-96) were used. To mitigate lateral erosion setbacks and scour, gabion basket walls will be placed between the wash and the proposed lots. The gabion basket walls or other form of erosion protection will be designed during the final design. Erosion setbacks are depicted in **Figure 4**.

The two impacted significant washes were analyzed to determine the BFE of the washes. The pad elevations for each lot will be set eight inches above the adjacent BFE, ensuring the lowest finished floor will be at least one foot above the BFE per the DSPM. Inundation limits are depicted in **Figure 4**.

Pre-development versus post-development BFE's were analyzed; refer to **Table 2** for a summary. Where the significant wash in subbasin ON10 (refer to **Figure 3**) exits the Development, the post-development BFE is lower than the pre-development. The significant wash in subbasin ON20 (refer to Figure 3) has a BFE increase of less than 0.1 feet. The increase in BFE can be attributed to instability in the hydraulic model. Such instability is common with natural washes. The minor increase in BFE will not impact downstream structures. Refer to **Appendix D** for detailed results.

Table 2. Wash BFE Summary

XS	Wash	Pre Q_{100} [cfs]	Post Q_{100} [cfs]	Pre BFE [ft]	Post BFE [ft]	Pre Velocity [fps]	Post Velocity [fps]
2	ON10	99	98	2693.05	2691.93	4.3	4.8
11	ON20	138	134	2711.03	2711.08	5.4	5.8

DATA ANALYSIS METHODS

HYDROLOGY

The U.S. Army Corps of Engineers HEC-1 hydrologic computer program was used to determine the 2-year, 10-year, and 100-year peak discharges for offsite and onsite subbasins. The hydrologic model prepared for this report uses rainfall depths from National Oceanic and Atmospheric Administration Atlas 14 (NOAA 14). The watershed is within NOAA 14 Map Index 64, Cell Numbers 460, 461, 500, 501, 540, and 541. The six-hour storm duration was used for this project due to the size of the contributing watershed. Refer to **Appendix A.** The Drainage Design Management System for Windows (DDMSW) program was used to develop the hydrologic parameters for the onsite drainage areas and offsite drainage areas east of the Development. The site is located southwest of the Story Rock Phase 2 development project. Their offsite subbasin delineations were used as a basis and divided into onsite and offsite subbasins for this project. Due to the re-divided subbasins and new routes for this project, the peak offsite discharges from Story Rock Phase 2 do not match the corresponding discharges leaving our project site. No hydrologic parameters, such as land use or soil, were modified.

The default NMIN value was changed in DDMSW from 5 to 3 based on the FCDMC Drainage Design Manual – Hydrology manual. The lower value was used for the shorter time of concentrations. The "Non-default value or value out of range" note in the proposed conditions parameters in **Appendix B** is because of the varying subbasin sizes and flowpaths. The selected NMIN parameter will not meet the time of concentration requirements specified in the FCDMC Drainage Design Manual – Hydrology due to the varying subbasin sizes. The HEC-1 models were run with varying NMIN parameters to confirm that the hydrograph shape and peaks were valid. Green and Ampt rainfall loss parameters were estimated using DDMSW, DS&PM and FCDMC Drainage Design Manual – Hydrology, see **Table 3.** No changes were made to the default hydrologic parameters. The Clark unit hydrograph was used. Offsite subbasins were delineated using the City Quarter Section Topography. Existing land use types for the HEC-1 models were based on aerial photography. The existing land use is undeveloped desert. The post-development condition land use is being re-zoned to R1-35 and R1-70. A sensitivity analysis was completed with the Story Rock project to confirm the RTIMP values for the developed condition. The analysis for zone R1-35 is included in **Appendix A.** Land use maps for the existing and proposed development conditions are provided in **Appendix A** and **Appendix B. Table 3** is a summary of the land use parameters used in the hydrologic model.

Table 3. Green & Ampt Parameters

FCDMC Land Use Code	Land Use Category	COS Land Use	IA [in]	R_{timp} [%]	Cover [%]	D_{theta} [cfs]	Kb [cfs]
120	Estate Residential	R1-70	0.30	5	30	Normal	Min
130	Large Lot Residential	R1-35	0.30	15	50	Normal	Min
2002	Pavement/Rooftops	Paved Streets	0.05	95	0	Dry	Min
Desert	Desert Landscaping	Undisturbed Desert	0.35	0	25	Dry	Low

One soil type was identified for the onsite and offsite subbasins using the web soil survey from the National Resource Conservation Service (NRCS). Maps showing the soil type is shown in **Appendix A** and **Appendix B.** A list of the soils found in the watershed is shown below:

- Gran-Wickenburg complex, 1 to 10 percent slopes (64561)

Normal depth method was used for routes through existing channels. Eight point cross sections are provided.

HYDRAULICS

The two (2) impacted onsite significant washes were modeled using HEC-RAS version 5.0. Cross sections were cut using project topography. Manning's n values for the channel and overbanks (0.035 and 0.05, respectively) were selected to match the HEC-1 hydrologic model for the Story Rock development. Runoff in the washes was updated to reflect the results of the post-development condition. The HEC-RAS model was also used to size the onsite culvert and bridge. For the culverts, an entrance loss coefficient of 0.5 for concrete pipes with square cut ends was used. An exit loss coefficient of 1.0 was used for a sudden expansion of flow. For the remaining cross sections, contraction and expansion coefficients of 0.1 and 0.3 were used, respectively. Ineffective flow areas were set in cross-sections where either smaller washes joined the significant wash or where a culvert or bridge constricts flow. Refer to **Figure 4** for cross-section locations and ineffective flow areas. Refer to **Appendix D** for the HEC-RAS model results.

Lateral erosion setbacks were determined based on the Arizona Department of Water Resources (ADWR) State Standard 5-96 (SS5-96) Level I Analysis. The calculated setbacks were less than the minimum requirement, therefore the minimum setbacks were used. Refer to **Figure 4** for the Proposed Conditions Drainage Map.

STORMWATER STORAGE METHOD

The existing property is a part of the ESLO. Based on new City ordinances, a waiver will need to be obtained for any volume less than the 100-year, 2-hour volume. However, there is no waiver fee associated with the volumes that do not result in an increase in downstream runoff. See **Appendix C** for a copy of the waiver.

Detention basins are being used to meet pre- vs. post- conditions. The detention basins are also used to treat the first flush.

CONCLUSIONS

- Hydrologic models were prepared for the onsite and offsite areas for the pre- and post-development conditions. The Development will not increase post-development peak discharges exiting the site from the pre-development conditions, except for negligible increases at one (1) discharge point in the 2-year and 10-year storm events. Detention basins with orifice plates are used to attenuate onsite runoff. The detention basins will treat the first flush.

- Three significant washes cross the Development. One will be unaffected by the improvements. The other two will be routed through a culvert and a bridge under the proposed roadway. The improved washes will exit the Development at their existing locations. Lateral erosion calculations were performed to determine where erosion protection will be needed. Gabion walls will be designed to protect lots from lateral erosion and scour.

- Culverts crossing 128th Street were designed with the Story Rock development. They will convey the 100-year storm event without overtopping 128th Street.

- Finished floor elevations will be set at a minimum of one foot above the adjacent wash BFE.

REFERENCES

Arizona Department of Water Resources, *State Standard for Watercourse System Sediment Balance*, September 1996.

City of Scottsdale, *Design Standards and Policies Manual*, January 2010.

Flood Control District of Maricopa County, *Pinnacle Peak West Area Drainage Master Plan*, 2013.

Federal Emergency Management Agency, Flood Insurance Rate Map Panel No04013C1335M, dated November 2015.

Flood Control District of Maricopa County, *Drainage Design Manual – Hydrology*, updated August 15, 2013.

City of Scottsdale Topography Quarter Section Maps.

Appendix A Existing Conditions Hydrology

- *NOAA 14 Rainfall*
- *Existing Conditions Soils*
- *Existing Conditions Land Use*
- *Subbasin Parameters*
- *Time of Concentration Map*
- *Routing Reaches*
- *HEC-1 Results*

Appendix A Existing Conditions Hydrology

- *NOAA 14 Rainfall*

ID	Method	Duration	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
DEFAULT	NOAA14	5 MIN	0.315	0.424	0.505	0.611	0.690	0.769
	NOAA14	10 MIN	0.480	0.645	0.769	0.930	1.050	1.170
	NOAA14	15 MIN	0.595	0.800	0.953	1.153	1.302	1.451
	NOAA14	30 MIN	0.801	1.077	1.283	1.553	1.753	1.954
	NOAA14	1 HOUR	0.991	1.333	1.588	1.922	2.170	2.418
	NOAA14	2 HOUR	1.126	1.492	1.770	2.142	2.421	2.707
	NOAA14	3 HOUR	1.194	1.555	1.841	2.236	2.548	2.867
	NOAA14	6 HOUR	1.422	1.804	2.110	2.525	2.847	3.180
	NOAA14	12 HOUR	1.707	2.146	2.493	2.964	3.326	3.698
	NOAA14	24 HOUR	2.118	2.755	3.269	3.996	4.581	5.199

Map Index 64, Cell Number 460, 461, 500, 501, 540, and 541

Appendix A Existing Conditions Hydrology

- *Existing Conditions Soils*

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)	Comments
Major Basin ID: 01									
OFF05	645	61	64561	0.005	100.00	0.150	-	100	
OFF10	645	61	64561	0.028	100.00	0.150	-	100	
OFF11	645	61	64561	0.004	100.00	0.150	-	100	
OFF20	645	61	64561	0.077	100.00	0.150	-	100	
OFF25	645	61	64561	0.034	100.00	0.150	-	100	
ON05	645	61	64561	0.010	100.00	0.150	-	100	
ON07	645	61	64561	0.003	100.00	0.150	-	100	
ON10	645	61	64561	0.027	100.00	0.150	-	100	
ON12	645	61	64561	0.003	100.00	0.150	-	100	
ON15	645	61	64561	0.010	100.00	0.150	-	100	
ON20	645	61	64561	0.007	100.00	0.150	-	100	
ON25	645	61	64561	0.002	100.00	0.150	-	100	

Appendix A Existing Conditions Hydrology

- *Existing Conditions Land Use*

Flood Control District of Maricopa County
Drainage Design Management System
LAND USE
Project Reference: ASTERIA EX

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	DTHETA	Kb	Description
Major Basin ID: 01									
OFF05	DESERT	0.0052	100.0	0.35	0	25.0	DRY	0.073	Desert
		0.0052	**100.0**						
OFF10	DESERT	0.0284	100.0	0.35	0	25.0	DRY	0.063	Desert
		0.0284	**100.0**						
OFF11	DESERT	0.0038	100.0	0.35	0	25.0	DRY	0.074	Desert
		0.0038	**100.0**						
OFF20	DESERT	0.0774	100.0	0.35	0	25.0	DRY	0.057	Desert
		0.0774	**100.0**						
OFF25	DESERT	0.0338	100.0	0.35	0	25.0	DRY	0.062	Desert
		0.0338	**100.0**						
ON05	DESERT	0.0102	100.0	0.35	0	25.0	DRY	0.069	Desert
		0.0102	**100.0**						
ON07	DESERT	0.0030	100.0	0.35	0	25.0	DRY	0.076	Desert
		0.0030	**100.0**						
ON10	DESERT	0.0271	100.0	0.35	0	25.0	DRY	0.063	Desert
		0.0271	**100.0**						
ON12	DESERT	0.0033	100.0	0.35	0	25.0	DRY	0.076	Desert
		0.0033	**100.0**						
ON15	DESERT	0.0097	100.0	0.35	0	25.0	DRY	0.069	Desert
		0.0097	**100.0**						
ON20	DESERT	0.0072	100.0	0.35	0	25.0	DRY	0.071	Desert

* Non default value

Flood Control District of Maricopa County
Drainage Design Management System
LAND USE
Project Reference: ASTERIA EX

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	DTHETA	Kb	Description
Major Basin ID: 01									
		0.0072	**100.0**						
ON25	DESERT	0.0017	100.0	0.35	0	25.0	DRY	0.079	Desert
		0.0017	**100.0**						

* Non default value

Appendix A Existing Conditions Hydrology

- *Subbasin Parameters*

Flood Control District of Maricopa County
Drainage Design Management System
SUB BASINS
Project Reference: ASTERIA EX

Area ID	Sub Basin Parameters						Rainfall Losses						Return Period Parameters					
	Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
Major Basin ID: 01																		
OFF05	0.005	0.08	346.2	277.0	NATURAL	0.073	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.182	0.170	0.151*	0.133*	0.122*	0.113 *
												Vel (f/s)	0.64	0.69	0.78	0.88	0.96	1.04
												R (Hrs)	0.152	0.140	0.123	0.107	0.097	0.090
OFF11	0.004	0.07	876.7	313.0	Natural	0.074	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.165*	0.154*	0.137*	0.120*	0.111*	0.103 *
												Vel (f/s)	0.62	0.67	0.75	0.86	0.92	1.00
												R (Hrs)	0.139	0.128	0.113	0.098	0.089	0.082
OFF10	0.028	0.40	225.6	222.8	NATURAL	0.063	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.403	0.376	0.335	0.294	0.270	0.251
												Vel (f/s)	1.46	1.56	1.75	2.00	2.17	2.34
												R (Hrs)	0.498	0.460	0.405	0.351	0.319	0.295
ON07	0.003	0.06	309.1	266.5	Natural	0.076	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.163*	0.152*	0.135*	0.119*	0.109*	0.102 *
												Vel (f/s)	0.54	0.58	0.65	0.74	0.81	0.86
												R (Hrs)	0.143	0.132	0.116	0.100	0.091	0.084
OFF20	0.077	0.72	295.8	261.9	NATURAL	0.057	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.489	0.455	0.406	0.356	0.327	0.305
												Vel (f/s)	2.16	2.32	2.60	2.97	3.23	3.46
												R (Hrs)	0.554	0.512	0.451	0.390	0.355	0.328
ON12	0.003	0.11	321.1	270.2	Natural	0.076	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.220	0.205	0.182	0.160*	0.147*	0.137 *
												Vel (f/s)	0.73	0.79	0.89	1.01	1.10	1.18
												R (Hrs)	0.322	0.298	0.262	0.227	0.207	0.191
OFF25	0.034	0.50	504.0	303.0	NATURAL	0.062	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.407	0.379	0.338	0.296	0.272	0.253
												Vel (f/s)	1.80	1.93	2.17	2.48	2.70	2.90
												R (Hrs)	0.538	0.497	0.438	0.379	0.345	0.318
ON05	0.010	0.24	172.3	172.3	NATURAL	0.069	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.355	0.330	0.295	0.259	0.238	0.221
												Vel (f/s)	0.99	1.07	1.19	1.36	1.48	1.59
												R (Hrs)	0.516	0.477	0.420	0.363	0.331	0.305
ON10	0.027	0.41	204.4	204.2	NATURAL	0.063	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.420	0.391	0.348	0.306	0.281	0.262
												Vel (f/s)	1.43	1.54	1.73	1.97	2.14	2.30
												R (Hrs)	0.542	0.501	0.441	0.382	0.347	0.321

* Non default value or value out of range

Flood Control District of Maricopa County
Drainage Design Management System
SUB BASINS
Project Reference: ASTERIA EX

Area ID	Sub Basin Parameters						Rainfall Losses						Return Period Parameters					
	Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
Major Basin ID: 01																		
ON15	0.010	0.22	242.0	234.7	NATURAL	0.069	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.309	0.287	0.256	0.225	0.207	0.192
												Vel (f/s)	1.04	1.12	1.26	1.43	1.56	1.68
												R (Hrs)	0.412	0.381	0.336	0.290	0.264	0.244
ON20	0.007	0.24	233.1	228.5	NATURAL	0.071	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.330	0.307	0.274	0.240	0.221	0.206
												Vel (f/s)	1.07	1.15	1.28	1.47	1.59	1.71
												R (Hrs)	0.583	0.539	0.475	0.411	0.374	0.345
ON25	0.002	0.07	328.6	272.4	NATURAL	0.079	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.178	0.166*	0.148*	0.130*	0.119*	0.111 *
												Vel (f/s)	0.58	0.62	0.69	0.79	0.86	0.92
												R (Hrs)	0.225	0.208	0.183	0.158	0.144	0.133

* Non default value or value out of range

Appendix A Existing Conditions Hydrology

- *Time of Concentration Map*

Appendix A Existing Conditions Hydrology

- *Routing Reaches*

Flood Control District of Maricopa County
Drainage Design Management System
HEC-1 ROUTING DATA
Project Reference: ASTERIA EX

Route ID	LOB N	Chan N	ROB N	Length (ft)	Slope (ft/ft)	Max Elev (ft)		1.	2.	3.	4.	5.	6.	7.	8.
NORMAL DEPTH															
Major Basin 01															
RON05	0.035	0.035	0.035	1,253.80	0.0327	-	X:	9.60	73.10	89.30	91.70	92.70	98.60	120.20	226.30
							Y:	2,741.00	2,731.94	2,731.00	2,730.00	2,730.00	2,733.00	2,736.00	2,753.00
RON10A	0.035	0.035	0.035	1,763.40	0.0366	-	X:	3.20	62.30	106.10	114.70	118.30	140.60	211.30	287.50
							Y:	2,752.00	2,740.99	2,738.24	2,736.07	2,737.30	2,740.34	2,743.12	2,754.09
RON10B	0.035	0.035	0.035	1,763.40	0.0366	-	X:	3.20	62.30	106.10	114.70	118.30	140.60	211.30	287.50
							Y:	2,752.00	2,740.99	2,738.24	2,736.07	2,737.30	2,740.34	2,743.12	2,754.09
RON20	0.035	0.035	0.035	767.00	0.0339	-	X:	50.60	70.30	78.60	88.30	94.50	100.00	113.70	161.00
							Y:	2,741.42	2,740.89	2,740.01	2,738.78	2,738.91	2,740.99	2,743.04	2,748.80
RON25	0.035	0.035	0.035	219.00	0.0411	-	X:	-	33.10	62.10	77.00	81.70	84.60	140.40	158.60
							Y:	2,739.49	2,736.34	2,734.18	2,733.23	2,733.44	2,733.82	2,737.85	2,739.50

Appendix A Existing Conditions Hydrology

- *HEC-1 Results*

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE   31MAY17  TIME  18:27:00   *
*                                       *
*****************************************
```

Existing 2-year

```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*         (916) 756-1104                *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
    1         ID        Flood Control District of Maricopa County
    2         ID        ASTERIA EX - ASTERIA EX
    3         ID        2 YEAR
    4         ID        6 Hour  Storm
    5         ID        Unit Hydrograph: Clark
    6         ID        Storm: Multiple
    7         ID        05/04/2017
              *DIAGRAM
    8         IT       3  1JAN99       0    2000
    9         IO       5
   10         IN      15
              *
   11         JD   1.422  0.0001
   12         PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
   13         PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
   14         PC   0.962   0.972   0.983   0.991   1.000
   15         JD   1.413  0.5000
   16         PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
   17         PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
   18         PC   0.962   0.972   0.983   0.991   1.000
              *
   19         KK    ON07   BASIN
   20         BA   0.003
   21         LG    0.35    0.40    6.00    0.18       0
   22         UC   0.163   0.143
   23         UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   24         UA     100
              *
   25         KK   OFF05   BASIN
   26         BA   0.005
   27         LG    0.35    0.40    6.00    0.18       0
   28         UC   0.182   0.152
   29         UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   30         UA     100
              *
   31         KK   RON05   ROUTE
   32         RS       1    FLOW
   33         RC   0.035   0.035   0.035    1254  0.0327    0.00
   34         RX    9.60   73.10   89.30   91.70   92.70   98.60  120.20  226.30
   35         RY  2741.0 2731.94 2731.00 2730.00 2730.00 2733.00 2736.00 2753.00
              *
   36         KK    ON05   BASIN
   37         BA   0.010
   38         LG    0.35    0.40    6.00    0.18       0
   39         UC   0.355   0.516
   40         UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   41         UA     100
              *
```

1 HEC-1 INPUT PAGE 2

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
```

```
   42          KK    CP05 COMBINE
   43          HC       2
               *

   44          KK   OFF10   BASIN
   45          BA   0.028
   46          LG    0.35    0.40    6.00    0.18       0
   47          UC   0.403   0.498
   48          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   49          UA     100
               *

   50          KK  RON10A   ROUTE
   51          RS       1    FLOW
   52          RC   0.035   0.035   0.035    1763  0.0366    0.00
   53          RX    3.20   62.30  106.10  114.70  118.30  140.60  211.30  287.50
   54          RY  2752.0 2740.99 2738.24 2736.07 2737.30 2740.34 2743.12 2754.09
               *

   55          KK   OFF11   BASIN
   56          BA  0.0038
   57          LG    0.35    0.40    6.00    0.18       0
   58          UC   0.165   0.139
   59          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   60          UA     100
               *

   61          KK  RON10B   ROUTE
   62          RS       1    FLOW
   63          RC   0.035   0.035   0.035    1763  0.0366    0.00
   64          RX    3.20   62.30  106.10  114.70  118.30  140.60  211.30  287.50
   65          RY  2752.0 2740.99 2738.24 2736.07 2737.30 2740.34 2743.12 2754.09
               *

   66          KK    ON10   BASIN
   67          BA   0.027
   68          LG    0.35    0.40    6.00    0.18       0
   69          UC   0.420   0.542
   70          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   71          UA     100
               *

   72          KK    CP10 COMBINE
   73          HC       3
               *

   74          KK   OFF20   BASIN
   75          BA   0.077
   76          LG    0.35    0.40    6.00    0.18       0
   77          UC   0.489   0.554
   78          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   79          UA     100
               *
1                                        HEC-1 INPUT                                        PAGE  3

  LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

   80          KK   RON20   ROUTE
   81          RS       1    FLOW
   82          RC   0.035   0.035   0.035     767  0.0339    0.00
   83          RX   50.60   70.30   78.60   88.30   94.50  100.00  113.70  161.00
   84          RY  2741.4 2740.89 2740.01 2738.78 2738.91 2740.99 2743.04 2748.80
               *

   85          KK    ON20   BASIN
   86          BA   0.007
   87          LG    0.35    0.40    6.00    0.18       0
   88          UC   0.330   0.583
   89          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   90          UA     100
               *

   91          KK    CP20 COMBINE
   92          HC       2
               *

   93          KK   OFF25   BASIN
   94          BA   0.034
   95          LG    0.35    0.40    6.00    0.18       0
   96          UC   0.407   0.538
   97          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   98          UA     100
               *

   99          KK   RON25   ROUTE
  100          RS       1    FLOW
  101          RC   0.035   0.035   0.035     219  0.0411    0.00
  102          RX    0.00   33.10   62.10   77.00   81.70   84.60  140.40  158.60
  103          RY  2739.5 2736.34 2734.18 2733.23 2733.44 2733.82 2737.85 2739.50
               *
```

```
          104          KK    ON25   BASIN
          105          BA   0.002
          106          LG    0.35    0.40    6.00    0.18       0
          107          UC   0.178   0.225
          108          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          109          UA     100
                       *

          110          KK    CP25 COMBINE
          111          HC       2
                       *

          112          KK    ON12   BASIN
          113          BA   0.003
          114          LG    0.35    0.40    6.00    0.18       0
          115          UC   0.220   0.322
          116          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          117          UA     100
                       *
1                                                HEC-1 INPUT                                          PAGE  4

        LINE           ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          118          KK    ON15   BASIN
          119          BA   0.010
          120          LG    0.35    0.40    6.00    0.18       0
          121          UC   0.309   0.412
          122          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          123          UA     100
                       *
          124          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE       (V) ROUTING          (---->) DIVERSION OR PUMP FLOW

   NO.       (.) CONNECTOR        (<----) RETURN OF DIVERTED OR PUMPED FLOW

    19         ON07
                 .
                 .
    25           .       OFF05
                 .           V
                 .           V
    31           .       RON05
                 .         .
                 .         .
    36           .           .       ON05
                 .           .         .
                 .           .         .
    42           .         CP05.........
                 .           .
                 .           .
    44           .           .     OFF10
                 .           .       V
                 .           .       V
    50           .           .     RON10A
                 .           .         .
                 .           .         .
    55           .           .         .     OFF11
                 .           .         .       V
                 .           .         .       V
    61           .           .         .     RON10B
                 .           .         .         .
                 .           .         .         .
    66           .           .         .         .       ON10
                 .           .         .         .         .
                 .           .         .         .         .
    72           .           .       CP10.......................
                 .           .         .
                 .           .         .
    74           .           .         .     OFF20
                 .           .         .       V
                 .           .         .       V
    80           .           .         .     RON20
                 .           .         .         .
                 .           .         .         .
    85           .           .         .         .       ON20
                 .           .         .         .         .
                 .           .         .         .         .
    91           .           .         .       CP20.........
                 .           .         .         .
                 .           .         .         .
    93           .           .         .         .     OFF25
                 .           .         .         .       V
                 .           .         .         .       V
    99           .           .         .         .     RON25
                 .           .         .         .         .
                 .           .         .         .         .
   104           .           .         .         .         .       ON25
                 .           .         .         .         .         .
```

```
  110          .          .          .          .       CP25.....
               .          .          .          .          .
               .          .          .          .          .
  112          .          .          .          .          .       ON12
               .          .          .          .          .          .
               .          .          .          .          .          .
  118          .          .          .          .          .          .       ON15

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                    *****************************************
*                                       *                    *                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
*              JUN  1998                *                    *    HYDROLOGIC ENGINEERING CENTER      *
*            VERSION 4.1                *                    *         609 SECOND STREET             *
*                                       *                    *       DAVIS, CALIFORNIA 95616         *
*  RUN DATE   31MAY17  TIME  18:27:00   *                    *          (916) 756-1104               *
*                                       *                    *                                       *
*****************************************                    *****************************************
```

Flood Control District of Maricopa County
ASTERIA EX - ASTERIA EX
2 YEAR
6 Hour Storm
Unit Hydrograph: Clark
Storm: Multiple
05/04/2017

```
  9 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN          3  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1JAN99  STARTING DATE
                     ITIME        0000  STARTING TIME
                        NQ        2000  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      5JAN99  ENDING DATE
                    NDTIME        0357  ENDING TIME
                     ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL      .05 HOURS
                      TOTAL TIME BASE   99.95 HOURS

        ENGLISH UNITS
             DRAINAGE AREA         SQUARE MILES
             PRECIPITATION DEPTH   INCHES
             LENGTH, ELEVATION     FEET
             FLOW                  CUBIC FEET PER SECOND
             STORAGE VOLUME        ACRE-FEET
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT

  11 JD       INDEX STORM NO. 1
                    STRM       1.42  PRECIPITATION DEPTH
                    TRDA        .00  TRANSPOSITION DRAINAGE AREA

  12 PI         PRECIPITATION PATTERN
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .02   .02   .02   .02
                .03   .03   .03   .03   .03   .09   .09   .09   .09   .09
                .02   .02   .02   .02   .02   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

  15 JD       INDEX STORM NO. 2
                    STRM       1.41  PRECIPITATION DEPTH
                    TRDA        .50  TRANSPOSITION DRAINAGE AREA

  16 PI         PRECIPITATION PATTERN
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .02   .02   .02   .02   .02
                .03   .03   .03   .03   .03   .09   .09   .09   .09   .09
                .02   .02   .02   .02   .02   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
```

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	ON07	2.	4.10	0.	0.	0.	.00		
+	HYDROGRAPH AT	OFF05	3.	4.10	0.	0.	0.	.00		
+	ROUTED TO	RON05	3.	4.15	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON05	3.	4.25	0.	0.	0.	.01		
+	2 COMBINED AT	CP05	5.	4.20	0.	0.	0.	.01		
+	HYDROGRAPH AT	OFF10	8.	4.30	1.	0.	0.	.03		
+	ROUTED TO	RON10A	7.	4.40	1.	0.	0.	.03		
+	HYDROGRAPH AT	OFF11	2.	4.10	0.	0.	0.	.00		
+	ROUTED TO	RON10B	2.	4.15	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON10	7.	4.30	1.	0.	0.	.03		
+	3 COMBINED AT	CP10	14.	4.35	2.	0.	0.	.06		
+	HYDROGRAPH AT	OFF20	19.	4.35	2.	1.	0.	.08		
+	ROUTED TO	RON20	18.	4.40	2.	1.	0.	.08		
+	HYDROGRAPH AT	ON20	2.	4.25	0.	0.	0.	.01		
+	2 COMBINED AT	CP20	20.	4.40	3.	1.	0.	.08		
+	HYDROGRAPH AT	OFF25	9.	4.30	1.	0.	0.	.03		
+	ROUTED TO	RON25	9.	4.30	1.	0.	0.	.03		
+	HYDROGRAPH AT	ON25	1.	4.10	0.	0.	0.	.00		
+	2 COMBINED AT	CP25	9.	4.30	1.	0.	0.	.04		
+	HYDROGRAPH AT	ON12	1.	4.15	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON15	3.	4.20	0.	0.	0.	.01		

*** NORMAL END OF HEC-1 ***

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE   31MAY17  TIME  18:29:31   *
*                                       *
*****************************************
```

Existing 10-year

```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*         (916) 756-1104                *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

   1          ID        Flood Control District of Maricopa County
   2          ID        ASTERIA EX - ASTERIA EX
   3          ID        10 YEAR
   4          ID        6 Hour  Storm
   5          ID        Unit Hydrograph: Clark
   6          ID        Storm: Multiple
   7          ID        05/04/2017
              *DIAGRAM
   8          IT       3  1JAN99       0    2000
   9          IO       5
  10          IN      15
              *
  11          JD   2.110  0.0001
  12          PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  13          PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  14          PC   0.962   0.972   0.983   0.991   1.000
  15          JD   2.097  0.5000
  16          PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  17          PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  18          PC   0.962   0.972   0.983   0.991   1.000
              *

  19          KK    ON07   BASIN
  20          BA   0.003
  21          LG    0.35    0.40    6.00    0.18       0
  22          UC   0.135   0.116
  23          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
  24          UA     100
              *

  25          KK   OFF05   BASIN
  26          BA   0.005
  27          LG    0.35    0.40    6.00    0.18       0
  28          UC   0.151   0.123
  29          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
  30          UA     100
              *

  31          KK   RON05   ROUTE
  32          RS       1    FLOW
  33          RC   0.035   0.035   0.035    1254  0.0327    0.00
  34          RX    9.60   73.10   89.30   91.70   92.70   98.60  120.20  226.30
  35          RY  2741.0 2731.94 2731.00 2730.00 2730.00 2733.00 2736.00 2753.00
              *

  36          KK    ON05   BASIN
  37          BA   0.010
  38          LG    0.35    0.40    6.00    0.18       0
  39          UC   0.295   0.420
  40          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
  41          UA     100
              *
```

1 HEC-1 INPUT PAGE 2

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
```

```
          KK    CP05 COMBINE
          HC       2
          *

          KK   OFF10   BASIN
          BA   0.028
          LG    0.35    0.40    6.00    0.18       0
          UC   0.335   0.405
          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          UA     100
          *

          KK  RON10A   ROUTE
          RS       1    FLOW
          RC   0.035   0.035   0.035    1763  0.0366    0.00
          RX    3.20   62.30  106.10  114.70  118.30  140.60  211.30  287.50
          RY  2752.0 2740.99 2738.24 2736.07 2737.30 2740.34 2743.12 2754.09
          *

          KK   OFF11   BASIN
          BA  0.0038
          LG    0.35    0.40    6.00    0.18       0
          UC   0.137   0.113
          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          UA     100
          *

          KK  RON10B   ROUTE
          RS       1    FLOW
          RC   0.035   0.035   0.035    1763  0.0366    0.00
          RX    3.20   62.30  106.10  114.70  118.30  140.60  211.30  287.50
          RY  2752.0 2740.99 2738.24 2736.07 2737.30 2740.34 2743.12 2754.09
          *

          KK    ON10   BASIN
          BA   0.027
          LG    0.35    0.40    6.00    0.18       0
          UC   0.348   0.441
          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          UA     100
          *

          KK    CP10 COMBINE
          HC       3
          *

          KK   OFF20   BASIN
          BA   0.077
          LG    0.35    0.40    6.00    0.18       0
          UC   0.406   0.451
          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          UA     100
          *

1                                        HEC-1 INPUT                                    PAGE  3

     LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          KK   RON20   ROUTE
          RS       1    FLOW
          RC   0.035   0.035   0.035     767  0.0339    0.00
          RX   50.60   70.30   78.60   88.30   94.50  100.00  113.70  161.00
          RY  2741.4 2740.89 2740.01 2738.78 2738.91 2740.99 2743.04 2748.80
          *

          KK    ON20   BASIN
          BA   0.007
          LG    0.35    0.40    6.00    0.18       0
          UC   0.274   0.475
          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          UA     100
          *

          KK    CP20 COMBINE
          HC       2
          *

          KK   OFF25   BASIN
          BA   0.034
          LG    0.35    0.40    6.00    0.18       0
          UC   0.338   0.438
          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          UA     100
          *

          KK   RON25   ROUTE
          RS       1    FLOW
          RC   0.035   0.035   0.035     219  0.0411    0.00
          RX    0.00   33.10   62.10   77.00   81.70   84.60  140.40  158.60
          RY  2739.5 2736.34 2734.18 2733.23 2733.44 2733.82 2737.85 2739.50
          *
```

```
          104          KK    ON25   BASIN
          105          BA   0.002
          106          LG    0.35    0.40    6.00    0.18       0
          107          UC   0.148   0.183
          108          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          109          UA     100
                       *

          110          KK    CP25 COMBINE
          111          HC       2
                       *

          112          KK    ON12   BASIN
          113          BA   0.003
          114          LG    0.35    0.40    6.00    0.18       0
          115          UC   0.182   0.262
          116          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          117          UA     100
                       *
1                                              HEC-1 INPUT                                          PAGE  4

         LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          118          KK    ON15   BASIN
          119          BA   0.010
          120          LG    0.35    0.40    6.00    0.18       0
          121          UC   0.256   0.336
          122          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          123          UA     100
                       *
          124          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (---->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    19        ON07
                .
                .
    25          .       OFF05
                .          V
                .          V
    31          .       RON05
                .          .
                .          .
    36          .          .        ON05
                .          .          .
                .          .          .
    42          .       CP05.............
                .          .
                .          .
    44          .          .       OFF10
                .          .          V
                .          .          V
    50          .          .      RON10A
                .          .          .
                .          .          .
    55          .          .          .       OFF11
                .          .          .          V
                .          .          .          V
    61          .          .          .      RON10B
                .          .          .          .
                .          .          .          .
    66          .          .          .          .        ON10
                .          .          .          .          .
                .          .          .          .          .
    72          .          .       CP10.........................
                .          .          .
                .          .          .
    74          .          .          .       OFF20
                .          .          .          V
                .          .          .          V
    80          .          .          .      RON20
                .          .          .          .
                .          .          .          .
    85          .          .          .          .        ON20
                .          .          .          .          .
                .          .          .          .          .
    91          .          .          .       CP20.............
                .          .          .          .
                .          .          .          .
    93          .          .          .          .       OFF25
                .          .          .          .          V
                .          .          .          .          V
    99          .          .          .          .       RON25
                .          .          .          .          .
                .          .          .          .          .
   104          .          .          .          .          .        ON25
                .          .          .          .          .          .
```

```
  110          .          .          .          .       CP25.....
               .          .          .          .          .
  112          .          .          .          .          .       ON12
               .          .          .          .          .          .
               .          .          .          .          .          .
  118          .          .          .          .          .          .       ON15

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                    *****************************************
*                                       *                    *                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
*             JUN  1998                 *                    *    HYDROLOGIC ENGINEERING CENTER      *
*          VERSION 4.1                  *                    *         609 SECOND STREET             *
*                                       *                    *       DAVIS, CALIFORNIA 95616         *
*  RUN DATE   31MAY17  TIME  18:29:31   *                    *          (916) 756-1104               *
*                                       *                    *                                       *
*****************************************                    *****************************************

                          Flood Control District of Maricopa County
                          ASTERIA EX - ASTERIA EX
                          10 YEAR
                          6 Hour  Storm
                          Unit Hydrograph: Clark
                          Storm: Multiple
                          05/04/2017

  9 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          5  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN          3  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1JAN99  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ        2000  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     5JAN99  ENDING DATE
                      NDTIME        0357  ENDING TIME
                      ICENT          19  CENTURY MARK

                    COMPUTATION INTERVAL      .05 HOURS
                        TOTAL TIME BASE    99.95 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT

 11 JD          INDEX STORM NO. 1
                      STRM        2.11  PRECIPITATION DEPTH
                      TRDA         .00  TRANSPOSITION DRAINAGE AREA

 12 PI           PRECIPITATION PATTERN
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .02   .02   .02   .02   .02
                  .03   .03   .03   .03   .03   .09   .09   .09   .09   .09
                  .02   .02   .02   .02   .02   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

 15 JD          INDEX STORM NO. 2
                      STRM        2.10  PRECIPITATION DEPTH
                      TRDA         .50  TRANSPOSITION DRAINAGE AREA

 16 PI           PRECIPITATION PATTERN
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .02   .02   .02   .02   .02
                  .03   .03   .03   .03   .03   .09   .09   .09   .09   .09
                  .02   .02   .02   .02   .02   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                  .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
```

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	ON07	5.	4.05	0.	0.	0.	.00		
+	HYDROGRAPH AT	OFF05	8.	4.05	0.	0.	0.	.00		
+	ROUTED TO	RON05	7.	4.10	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON05	8.	4.20	1.	0.	0.	.01		
+	2 COMBINED AT	CP05	14.	4.15	1.	0.	0.	.01		
+	HYDROGRAPH AT	OFF10	21.	4.20	2.	1.	0.	.03		
+	ROUTED TO	RON10A	19.	4.30	2.	1.	0.	.03		
+	HYDROGRAPH AT	OFF11	6.	4.05	0.	0.	0.	.00		
+	ROUTED TO	RON10B	5.	4.10	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON10	19.	4.25	2.	1.	0.	.03		
+	3 COMBINED AT	CP10	40.	4.25	5.	1.	0.	.06		
+	HYDROGRAPH AT	OFF20	52.	4.30	6.	1.	0.	.08		
+	ROUTED TO	RON20	52.	4.30	6.	1.	0.	.08		
+	HYDROGRAPH AT	ON20	5.	4.20	1.	0.	0.	.01		
+	2 COMBINED AT	CP20	56.	4.30	7.	2.	1.	.08		
+	HYDROGRAPH AT	OFF25	24.	4.25	3.	1.	0.	.03		
+	ROUTED TO	RON25	24.	4.25	3.	1.	0.	.03		
+	HYDROGRAPH AT	ON25	3.	4.05	0.	0.	0.	.00		
+	2 COMBINED AT	CP25	25.	4.25	3.	1.	0.	.04		
+	HYDROGRAPH AT	ON12	3.	4.10	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON15	9.	4.15	1.	0.	0.	.01		

*** NORMAL END OF HEC-1 ***

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN   1998                *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE   31MAY17  TIME  18:29:39   *
*                                       *
*****************************************
```

Existing 100-year

```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*          (916) 756-1104               *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
    1         ID        Flood Control District of Maricopa County
    2         ID        ASTERIA EX - ASTERIA EX
    3         ID        100 YEAR
    4         ID        6 Hour  Storm
    5         ID        Unit Hydrograph: Clark
    6         ID        Storm: Multiple
    7         ID        05/04/2017
              *DIAGRAM
    8         IT       3  1JAN99       0    2000
    9         IO       5
   10         IN      15
              *
   11         JD   3.180  0.0001
   12         PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
   13         PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
   14         PC   0.962   0.972   0.983   0.991   1.000
   15         JD   3.161  0.5000
   16         PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
   17         PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
   18         PC   0.962   0.972   0.983   0.991   1.000
              *
   19         KK    ON07   BASIN
   20         BA   0.003
   21         LG    0.35    0.40    6.00    0.18       0
   22         UC   0.102   0.084
   23         UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   24         UA     100
              *
   25         KK   OFF05   BASIN
   26         BA   0.005
   27         LG    0.35    0.40    6.00    0.18       0
   28         UC   0.113   0.090
   29         UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   30         UA     100
              *
   31         KK   RON05   ROUTE
   32         RS       1    FLOW
   33         RC   0.035   0.035   0.035    1254  0.0327    0.00
   34         RX    9.60   73.10   89.30   91.70   92.70   98.60  120.20  226.30
   35         RY  2741.0 2731.94 2731.00 2730.00 2730.00 2733.00 2736.00 2753.00
              *
   36         KK    ON05   BASIN
   37         BA   0.010
   38         LG    0.35    0.40    6.00    0.18       0
   39         UC   0.221   0.305
   40         UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   41         UA     100
              *
```

1 HEC-1 INPUT PAGE 2

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
```

```
 42          KK    CP05 COMBINE
 43          HC       2
             *

 44          KK   OFF10   BASIN
 45          BA   0.028
 46          LG    0.35    0.40    6.00    0.18       0
 47          UC   0.251   0.295
 48          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 49          UA     100
             *

 50          KK  RON10A   ROUTE
 51          RS       1    FLOW
 52          RC   0.035   0.035   0.035    1763  0.0366    0.00
 53          RX    3.20   62.30  106.10  114.70  118.30  140.60  211.30  287.50
 54          RY  2752.0 2740.99 2738.24 2736.07 2737.30 2740.34 2743.12 2754.09
             *

 55          KK   OFF11   BASIN
 56          BA  0.0038
 57          LG    0.35    0.40    6.00    0.18       0
 58          UC   0.103   0.082
 59          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 60          UA     100
             *

 61          KK  RON10B   ROUTE
 62          RS       1    FLOW
 63          RC   0.035   0.035   0.035    1763  0.0366    0.00
 64          RX    3.20   62.30  106.10  114.70  118.30  140.60  211.30  287.50
 65          RY  2752.0 2740.99 2738.24 2736.07 2737.30 2740.34 2743.12 2754.09
             *

 66          KK    ON10   BASIN
 67          BA   0.027
 68          LG    0.35    0.40    6.00    0.18       0
 69          UC   0.262   0.321
 70          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 71          UA     100
             *

 72          KK    CP10 COMBINE
 73          HC       3
             *

 74          KK   OFF20   BASIN
 75          BA   0.077
 76          LG    0.35    0.40    6.00    0.18       0
 77          UC   0.305   0.328
 78          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 79          UA     100
             *
1                                        HEC-1 INPUT                                        PAGE  3

LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 80          KK   RON20   ROUTE
 81          RS       1    FLOW
 82          RC   0.035   0.035   0.035     767  0.0339    0.00
 83          RX   50.60   70.30   78.60   88.30   94.50  100.00  113.70  161.00
 84          RY  2741.4 2740.89 2740.01 2738.78 2738.91 2740.99 2743.04 2748.80
             *

 85          KK    ON20   BASIN
 86          BA   0.007
 87          LG    0.35    0.40    6.00    0.18       0
 88          UC   0.206   0.345
 89          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 90          UA     100
             *

 91          KK    CP20 COMBINE
 92          HC       2
             *

 93          KK   OFF25   BASIN
 94          BA   0.034
 95          LG    0.35    0.40    6.00    0.18       0
 96          UC   0.253   0.318
 97          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 98          UA     100
             *

 99          KK   RON25   ROUTE
100          RS       1    FLOW
101          RC   0.035   0.035   0.035     219  0.0411    0.00
102          RX    0.00   33.10   62.10   77.00   81.70   84.60  140.40  158.60
103          RY  2739.5 2736.34 2734.18 2733.23 2733.44 2733.82 2737.85 2739.50
             *
```

```
          104          KK   ON25   BASIN
          105          BA  0.002
          106          LG   0.35    0.40    6.00    0.18       0
          107          UC  0.111   0.133
          108          UA      0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          109          UA    100
                       *

          110          KK   CP25 COMBINE
          111          HC      2
                       *

          112          KK   ON12   BASIN
          113          BA  0.003
          114          LG   0.35    0.40    6.00    0.18       0
          115          UC  0.137   0.191
          116          UA      0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          117          UA    100
                       *
1                                          HEC-1 INPUT                                          PAGE  4

         LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          118          KK   ON15   BASIN
          119          BA  0.010
          120          LG   0.35    0.40    6.00    0.18       0
          121          UC  0.192   0.244
          122          UA      0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          123          UA    100
                       *
          124          ZZ
1
              SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (---->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<----) RETURN OF DIVERTED OR PUMPED FLOW

    19        ON07
                .
                .
    25          .       OFF05
                .           V
                .           V
    31          .       RON05
                .         .
                .         .
    36          .         .         ON05
                .         .           .
                .         .           .
    42          .       CP05.............
                .         .
                .         .
    44          .         .       OFF10
                .         .         V
                .         .         V
    50          .         .       RON10A
                .         .           .
                .         .           .
    55          .         .           .       OFF11
                .         .           .         V
                .         .           .         V
    61          .         .           .       RON10B
                .         .           .           .
                .         .           .           .
    66          .         .           .           .         ON10
                .         .           .           .           .
                .         .           .           .           .
    72          .         .           .         CP10.........................
                .         .           .
                .         .           .
    74          .         .           .       OFF20
                .         .           .         V
                .         .           .         V
    80          .         .           .       RON20
                .         .           .           .
                .         .           .           .
    85          .         .           .           .         ON20
                .         .           .           .           .
                .         .           .           .           .
    91          .         .           .         CP20.............
                .         .           .           .
                .         .           .           .
    93          .         .           .           .       OFF25
                .         .           .           .         V
                .         .           .           .         V
    99          .         .           .           .       RON25
                .         .           .           .           .
                .         .           .           .           .
   104          .         .           .           .           .         ON25
                .         .           .           .           .           .
```

```
  110          .         .         .         .       CP25.....
               .         .         .         .         .
               .         .         .         .         .
  112          .         .         .         .         .       ON12
               .         .         .         .         .         .
               .         .         .         .         .         .
  118          .         .         .         .         .         .       ON15

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                    ***************************************
*                                       *                    *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS     *
*             JUN   1998                *                    *    HYDROLOGIC ENGINEERING CENTER    *
*          VERSION 4.1                  *                    *         609 SECOND STREET           *
*                                       *                    *       DAVIS, CALIFORNIA 95616       *
*  RUN DATE   31MAY17  TIME  18:29:39   *                    *         (916) 756-1104              *
*                                       *                    *                                     *
*****************************************                    ***************************************
```

Flood Control District of Maricopa County
ASTERIA EX - ASTERIA EX
100 YEAR
6 Hour Storm
Unit Hydrograph: Clark
Storm: Multiple
05/04/2017

```
  9 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                     NMIN           3  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1JAN99  STARTING DATE
                     ITIME        0000  STARTING TIME
                       NQ         2000  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      5JAN99  ENDING DATE
                    NDTIME        0357  ENDING TIME
                    ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL      .05 HOURS
                      TOTAL TIME BASE    99.95 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT

  11 JD       INDEX STORM NO. 1
                    STRM        3.18  PRECIPITATION DEPTH
                    TRDA         .00  TRANSPOSITION DRAINAGE AREA

  12 PI         PRECIPITATION PATTERN
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .02       .02       .02       .02       .02
                  .03       .03       .03       .03       .03       .09       .09       .09       .09       .09
                  .02       .02       .02       .02       .02       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00

  15 JD       INDEX STORM NO. 2
                    STRM        3.16  PRECIPITATION DEPTH
                    TRDA         .50  TRANSPOSITION DRAINAGE AREA

  16 PI         PRECIPITATION PATTERN
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .02       .02       .02       .02       .02
                  .03       .03       .03       .03       .03       .09       .09       .09       .09       .09
                  .02       .02       .02       .02       .02       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
```

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	ON07	9.	4.05	1.	0.	0.	.00		
+	HYDROGRAPH AT	OFF05	15.	4.05	1.	0.	0.	.00		
+	ROUTED TO	RON05	13.	4.05	1.	0.	0.	.00		
+	HYDROGRAPH AT	ON05	18.	4.15	2.	0.	0.	.01		
+	2 COMBINED AT	CP05	31.	4.10	3.	1.	0.	.01		
+	HYDROGRAPH AT	OFF10	51.	4.15	5.	1.	0.	.03		
+	ROUTED TO	RON10A	47.	4.20	5.	1.	0.	.03		
+	HYDROGRAPH AT	OFF11	11.	4.05	1.	0.	0.	.00		
+	ROUTED TO	RON10B	10.	4.10	1.	0.	0.	.00		
+	HYDROGRAPH AT	ON10	46.	4.15	5.	1.	0.	.03		
+	3 COMBINED AT	CP10	99.	4.20	10.	2.	1.	.06		
+	HYDROGRAPH AT	OFF20	129.	4.20	13.	3.	1.	.08		
+	ROUTED TO	RON20	127.	4.20	13.	3.	1.	.08		
+	HYDROGRAPH AT	ON20	12.	4.15	1.	0.	0.	.01		
+	2 COMBINED AT	CP20	138.	4.20	14.	4.	1.	.08		
+	HYDROGRAPH AT	OFF25	59.	4.15	6.	1.	0.	.03		
+	ROUTED TO	RON25	58.	4.15	6.	1.	0.	.03		
+	HYDROGRAPH AT	ON25	5.	4.05	0.	0.	0.	.00		
+	2 COMBINED AT	CP25	62.	4.15	6.	2.	1.	.04		
+	HYDROGRAPH AT	ON12	7.	4.05	1.	0.	0.	.00		
+	HYDROGRAPH AT	ON15	20.	4.10	2.	0.	0.	.01		

*** NORMAL END OF HEC-1 ***

Appendix B Proposed Conditions Hydrology

- *NOAA 14 Rainfall*
- *Proposed Conditions Soils*
- *Proposed Conditions Land Use*
- *Subbasin Parameters*
- *Time of Concentration Map*
- *Routing Reaches*
- *Proposed Storage*
- *Proposed Diversions*
- *HEC-1 Results*

Appendix B Proposed Conditions Hydrology

- *NOAA 14 Rainfall*

ID	Method	Duration	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
DEFAULT	NOAA14	5 MIN	0.315	0.424	0.505	0.611	0.690	0.769
	NOAA14	10 MIN	0.480	0.645	0.769	0.930	1.050	1.170
	NOAA14	15 MIN	0.595	0.800	0.953	1.153	1.302	1.451
	NOAA14	30 MIN	0.801	1.077	1.283	1.553	1.753	1.954
	NOAA14	1 HOUR	0.991	1.333	1.588	1.922	2.170	2.418
	NOAA14	2 HOUR	1.126	1.492	1.770	2.142	2.421	2.707
	NOAA14	3 HOUR	1.194	1.555	1.841	2.236	2.548	2.867
	NOAA14	6 HOUR	1.422	1.804	2.110	2.525	2.847	3.180
	NOAA14	12 HOUR	1.707	2.146	2.493	2.964	3.326	3.698
	NOAA14	24 HOUR	2.118	2.755	3.269	3.996	4.581	5.199

Map Index 64, Cell Number 460, 461, 500, 501, 540, and 541

Appendix B Proposed Conditions Hydrology

- *Proposed Conditions Soils*

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)	Comments
Major Basin ID: 01									
OFF05	645	61	64561	0.005	100.00	0.150	-	100	
OFF10	645	61	64561	0.028	100.00	0.150	-	100	
OFF11	645	61	64561	0.004	100.00	0.150	-	100	
OFF20	645	61	64561	0.077	100.00	0.150	-	100	
OFF25	645	61	64561	0.034	100.00	0.150	-	100	
ON05	645	61	64561	0.017	100.00	0.150	-	100	
ON07	645	61	64561	0.002	100.00	0.150	-	100	
ON08	645	61	64561	0.001	100.00	0.150	-	100	
ON09	645	61	64561	0.001	100.00	0.150	-	100	
ON10	645	61	64561	0.007	100.00	0.150	-	100	
ON11	645	61	64561	0.001	100.00	0.150	-	100	
ON12	645	61	64561	0.002	100.00	0.150	-	100	
ON13	645	61	64561	0.006	100.00	0.150	-	100	
ON15	645	61	64561	0.005	100.00	0.150	-	100	
ON18	645	61	64561	0.013	100.00	0.150	-	100	
ON20	645	61	64561	0.003	100.00	0.150	-	100	
ON22	645	61	64561	0.003	100.00	0.150	-	100	
ON25	645	61	64561	0.001	100.00	0.150	-	100	

Appendix B Proposed Conditions Hydrology

- *Proposed Conditions Land Use*

Flood Control District of Maricopa County
Drainage Design Management System
LAND USE
Project Reference: ASTERIA PROP

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	DTHETA	Kb	Description
Major Basin ID: 01									
OFF05	DESERT	0.0052	100.0	0.35	0	25.0	DRY	0.073	Desert
		0.0052	**100.0**						
OFF10	DESERT	0.0284	100.0	0.35	0	25.0	DRY	0.063	Desert
		0.0284	**100.0**						
OFF11	DESERT	0.0038	100.0	0.35	0	25.0	DRY	0.074	Desert
		0.0038	**100.0**						
OFF20	DESERT	0.0774	100.0	0.35	0	25.0	DRY	0.057	Desert
		0.0774	**100.0**						
OFF25	DESERT	0.0338	100.0	0.35	0	25.0	DRY	0.062	Desert
		0.0338	**100.0**						
ON05	120	0.0035	21.2	0.30	5	30.0	NORMAL	0.034	Estate Residential (1/5 du per acre to 1 du per acre)
	130	0.0078	47.3	0.30	15	50.0	NORMAL	0.034	Large Lot Residential - Single Family (1 du per acre to 2 du
	2002	0.0013	7.9	0.05	95	0.0	DRY	0.034	Pavement and Rooftops
	DESERT	0.0039	23.6	0.35	0	25.0	DRY	0.066	Desert
		0.0165	**100.0**						
ON07	120	0.0004	25.0	0.30	5	30.0	NORMAL	0.039	Estate Residential (1/5 du per acre to 1 du per acre)
	DESERT	0.0012	75.0	0.35	0	25.0	DRY	0.079	Desert
		0.0016	**100.0**						
ON08	DESERT	0.0014	100.0	0.35	0	25.0	DRY	0.083	Desert
		0.0014	**100.0**						
ON09	DESERT	0.0013	100.0	0.35	0	25.0	DRY	0.083	Desert

* Non default value

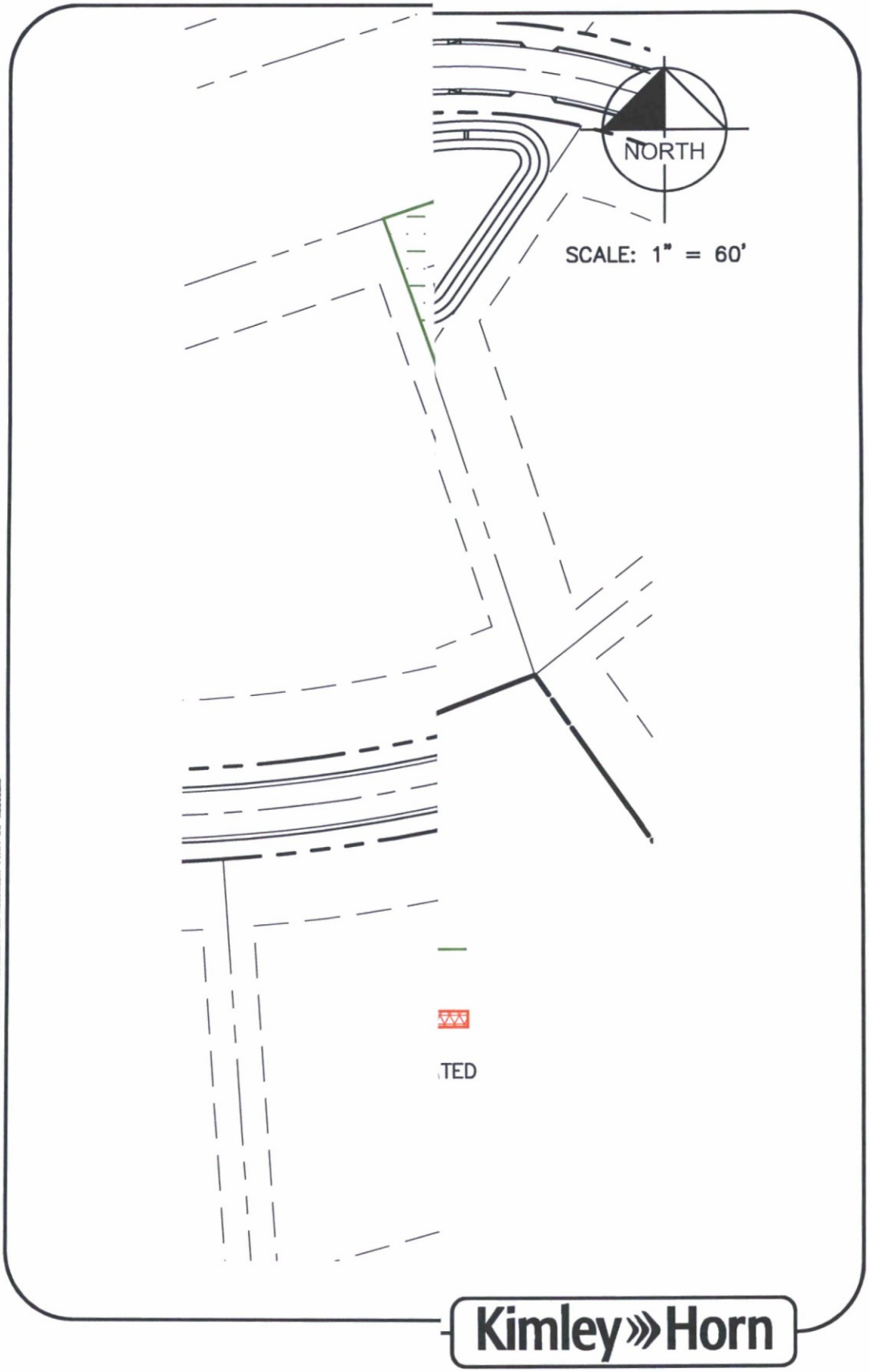
Flood Control District of Maricopa County
Drainage Design Management System
LAND USE
Project Reference: ASTERIA PROP

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	DTHETA	Kb	Description
Major Basin ID: 01									
		0.0013	**100.0**						
ON10	2002	0.0001	1.4	0.05	95	0.0	DRY	0.036	Pavement and Rooftops
	DESERT	0.0071	98.6	0.35	0	25.0	DRY	0.071	Desert
		0.0072	**100.0**						
ON11	DESERT	0.0013	100.0	0.35	0	25.0	DRY	0.083	Desert
		0.0013	**100.0**						
ON12	130	0.0008	34.8	0.30	15	50.0	NORMAL	0.039	Large Lot Residential - Single Family (1 du per acre to 2 du
	2002	0.0002	8.7	0.05	95	0.0	DRY	0.039	Pavement and Rooftops
	DESERT	0.0013	56.5	0.35	0	25.0	DRY	0.079	Desert
		0.0023	**100.0**						
ON13	130	0.0052	82.5	0.30	15	50.0	NORMAL	0.036	Large Lot Residential - Single Family (1 du per acre to 2 du
	2002	0.0007	11.1	0.05	95	0.0	DRY	0.036	Pavement and Rooftops
	DESERT	0.0004	6.3	0.35	0	25.0	DRY	0.072	Desert
		0.0063	**99.9**						
ON15	130	0.0009	19.1	0.30	15	50.0	NORMAL	0.037	Large Lot Residential - Single Family (1 du per acre to 2 du
	2002	0.0008	17.0	0.05	95	0.0	DRY	0.037	Pavement and Rooftops
	DESERT	0.0030	63.8	0.35	0	25.0	DRY	0.073	Desert
		0.0047	**99.9**						
ON18	130	0.0118	91.5	0.30	15	50.0	NORMAL	0.034	Large Lot Residential - Single Family (1 du per acre to 2 du
	2002	0.0008	6.2	0.05	95	0.0	DRY	0.034	Pavement and Rooftops

* Non default value

Flood Control District of Maricopa County
Drainage Design Management System
LAND USE
Project Reference: ASTERIA PROP

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetation Cover (%)	DTHETA	Kb	Description
Major Basin ID: 01									
ON18	DESERT	0.0003	2.3	0.35	0	25.0	DRY	0.067	Desert
		0.0129	**100.0**						
ON20	130	0.0010	38.5	0.30	15	50.0	NORMAL	0.038	Large Lot Residential - Single Family (1 du per acre to 2 du
	2002	0.0004	15.4	0.05	95	0.0	DRY	0.038	Pavement and Rooftops
	DESERT	0.0012	46.2	0.35	0	25.0	DRY	0.076	Desert
		0.0026	**100.1**						
ON22	DESERT	0.0030	100.0	0.35	0	25.0	DRY	0.076	Desert
		0.0030	**100.0**						
ON25	2002	0.0003	20.0	0.05	95	0.0	DRY	0.041	Pavement and Rooftops
	DESERT	0.0012	80.0	0.35	0	25.0	DRY	0.083	Desert
		0.0015	**100.0**						



Kimley»Horn

Area ID	Sub Basin Parameters						Rainfall Losses						Return Period Parameters					
	Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
Major Basin ID: 01																		
ON07	0.002	0.05	320.8	270.1	Urban	0.069	0.34	0.36	6.00	0.177	1	**Tc (Hrs)**	0.137*	0.129*	0.115*	0.101*	0.093*	0.087 *
												Vel (f/s)	0.54	0.57	0.64	0.73	0.79	0.84
												R (Hrs)	0.129	0.119	0.106	0.091	0.083	0.077
ON08	0.001	0.07	235.3	230.1	Urban	0.083	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.193	0.180	0.160*	0.141*	0.129*	0.120 *
												Vel (f/s)	0.53	0.57	0.64	0.73	0.80	0.86
												R (Hrs)	0.364	0.336	0.296	0.256	0.233	0.215
ON10	0.007	0.26	220.1	218.3	Urban	0.071	0.35	0.40	6.00	0.174	1	**Tc (Hrs)**	0.345	0.322	0.288	0.253	0.232	0.216
												Vel (f/s)	1.11	1.18	1.32	1.51	1.64	1.77
												R (Hrs)	0.654	0.606	0.534	0.463	0.422	0.390
ON12	0.002	0.07	342.5	276.1	Urban	0.061	0.31	0.35	6.00	0.186	13	**Tc (Hrs)**	0.142*	0.134*	0.121*	0.108*	0.100*	0.094 *
												Vel (f/s)	0.72	0.77	0.85	0.95	1.03	1.09
												R (Hrs)	0.174	0.164	0.146	0.129	0.118	0.110
ON15	0.005	0.11	265.5	248.6	Urban	0.060	0.29	0.37	6.00	0.176	19	**Tc (Hrs)**	0.176	0.167	0.152*	0.136*	0.127*	0.119 *
												Vel (f/s)	0.92	0.97	1.06	1.19	1.27	1.36
												R (Hrs)	0.189	0.178	0.160	0.142	0.131	0.122
ON18	0.013	0.19	127.0	127.0	Urban	0.035	0.29	0.26	6.00	0.210	20	**Tc (Hrs)**	0.213	0.202	0.184	0.164*	0.153*	0.145 *
												Vel (f/s)	1.31	1.38	1.51	1.70	1.82	1.92
												R (Hrs)	0.209	0.197	0.178	0.157	0.145	0.136
ON20	0.003	0.08	329.1	272.5	Urban	0.056	0.28	0.34	6.00	0.185	20	**Tc (Hrs)**	0.140*	0.133*	0.121*	0.108*	0.101*	0.095 *
												Vel (f/s)	0.84	0.88	0.97	1.09	1.16	1.24
												R (Hrs)	0.152	0.143	0.129	0.114	0.105	0.099
ON22	0.003	0.26	180.4	180.4	Urban	0.076	0.35	0.40	6.00	0.176		**Tc (Hrs)**	0.383	0.356	0.318	0.279	0.256	0.239
												Vel (f/s)	1.00	1.07	1.20	1.37	1.49	1.60
												R (Hrs)	1.189	1.099	0.968	0.837	0.762	0.704
ON25	0.001	0.07	328.6	272.4	Urban	0.074	0.29	0.40	6.00	0.167	19	**Tc (Hrs)**	0.153*	0.145*	0.132*	0.118*	0.110*	0.103 *
												Vel (f/s)	0.67	0.71	0.78	0.87	0.93	1.00
												R (Hrs)	0.281	0.265	0.238	0.210	0.194	0.182

Flood Control District of Maricopa County
Drainage Design Management System
SUB BASINS
Project Reference: ASTERIA PROP

Area ID	Sub Basin Parameters						Rainfall Losses					Return Period Parameters					
	Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr

* Non default value or value out of range

Appendix B Proposed Conditions Hydrology

- *Time of Concentration Map*

Appendix B Proposed Conditions Hydrology

- *Routing Reaches*

Flood Control District of Maricopa County
Drainage Design Management System
HEC-1 ROUTING DATA
Project Reference: ASTERIA PROP

2/13/2017

Route ID	LOB N	Chan N	ROB N	Length (ft)	Slope (ft/ft)	Max Elev (ft)		1.	2.	3.	4.	5.	6.	7.	8.
NORMAL DEPTH															
Major Basin 01															
RON08	0.035	0.035	0.035	284.80	0.0562	-	X:	10.90	45.60	57.90	60.00	62.80	80.90	106.80	119.50
							Y:	2,749.71	2,745.71	2,744.30	2,743.47	2,744.86	2,747.52	2,749.05	2,750.64
RON09	0.035	0.035	0.035	361.10	0.0111	-	X:	-	30.80	47.40	61.80	64.90	69.00	81.20	88.10
							Y:	2,753.60	2,749.73	2,748.26	2,746.45	2,747.49	2,749.35	2,752.43	2,753.75
RON10A	0.035	0.035	0.035	1,364.30	0.0374	-	X:	23.50	54.60	78.90	83.60	87.30	92.40	111.30	161.10
							Y:	2,742.00	2,733.67	2,731.88	2,730.29	2,732.80	2,733.37	2,735.66	2,741.50
RON10B	0.035	0.035	0.035	1,599.00	0.0375	-	X:	23.50	54.60	78.90	83.60	87.30	92.40	111.30	161.10
							Y:	2,742.00	2,733.67	2,731.88	2,730.29	2,732.80	2,733.37	2,735.66	2,741.50
RON10C	0.035	0.035	0.035	1,353.80	0.0332	-	X:	12.60	28.00	47.90	52.40	55.50	67.80	76.30	97.20
							Y:	2,720.98	2,718.87	2,717.34	2,716.24	2,717.19	2,718.00	2,718.06	2,719.79
RON10D	0.035	0.035	0.035	533.00	0.0488	-	X:	27.90	27.90	44.00	63.60	66.50	74.50	94.90	125.60
							Y:	2,715.00	2,711.32	2,707.83	2,707.15	2,708.37	2,708.33	2,709.32	2,717.00
RON11	0.035	0.035	0.035	328.70	0.0243	-	X:	35.90	50.00	57.80	62.40	64.10	65.90	69.50	74.20
							Y:	2,761.42	2,759.24	2,758.33	2,757.03	2,757.56	2,758.16	2,758.70	2,759.53
RON15	0.035	0.035	0.035	482.60	0.0518	-	X:	-	34.00	36.80	42.90	43.00	45.70	50.00	83.90
							Y:	2,722.15	2,717.32	2,717.22	2,715.48	2,715.48	2,716.96	2,719.25	2,728.77
RON20	0.035	0.035	0.035	226.00	0.0354	-	X:	-	67.00	78.70	95.90	103.60	109.20	130.20	221.40
							Y:	2,739.00	2,729.44	2,728.38	2,725.60	2,725.84	2,727.71	2,727.42	2,738.58
RON22A	0.035	0.035	0.035	380.80	0.0315	-	X:	-	60.50	72.00	88.30	94.50	100.00	113.70	161.00
							Y:	2,741.78	2,740.72	2,740.72	2,738.78	2,738.91	2,740.99	2,743.04	2,748.80
RON25	0.035	0.035	0.035	219.00	0.0411	-	X:	-	33.10	62.10	77.00	81.70	84.60	140.40	158.60
							Y:	2,739.49	2,736.34	2,734.18	2,733.23	2,733.44	2,733.82	2,737.85	2,739.50

Route ID	LOB N	Chan N	ROB N	Length (ft)	Slope (ft/ft)	Max Elev (ft)	1.	2.	3.	4.	5.	6.	7.	8.

Appendix B Proposed Conditions Hydrology

- *Proposed Storage*

Flood Control District of Maricopa County
Drainage Design Management System
HEC-1 STORAGE FACILITIES

12/15/2017

Storage Basin ID:	**SON05**										
Spillway Characteristics (SS)			1	2	3	4	5	6	7	8	9	10
Spillway Crest Elevation:	-NA-	**Volume (ac-ft)**		0.1	0.2	0.3	0.4	0.6	0.8	0.8	0.9	1.0
Spillway Length:	-NA-	**Discharge (cfs)**	0	0	1	3	4	5	5	9	16	24
Discharge Coefficient:	-NA-	**Elevation (ft)**	2,710.0	2,710.5	2,711.0	2,711.5	2,712.0	2,712.5	2,713.0	2,713.3	2,713.5	2,713.8
Weir Coefficient:	-NA-											
Low-Level Outlet (SL)			11	12	13	14.	15	16	17	18	19	20
Centerline Elevation:	-NA-	**Volume (ac-ft)**	1.1	-	-	-	-	-	-	-	-	-
Cross-Section Area:	-NA-	**Discharge (cfs)**	34	0	0	0	0	0	0	0	0	0
Discharge Coefficient:	-NA-	**Elevation (ft)**	2,714.0	-	-	-	-	-	-	-	-	-
Orifice Equation Exponent:	-NA-											
Top of Dam Overflow (ST)			2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr				
Elevation Top of Dam:	-NA-	**Peak Volume (ac-ft)**	0.00	0.00	0.00	0.00	0.00	0.00				
Length of Dam:	-NA-	**Peak Stage (ft)**	0.00	0.00	0.00	0.00	0.00	0.00				
Discharge Coefficient:	-NA-	**Peak Discharge (cfs)**	0	0	0	0	0	0				
Weir Coefficient:	-NA-											

Storage Basin ID:	**SON18**										
Spillway Characteristics (SS)			1	2	3	4	5	6	7	8	9	10
Spillway Crest Elevation:	-NA-	**Volume (ac-ft)**		0.1	0.2	0.4	0.6	0.7	0.9	1.1	1.3	1.6
Spillway Length:	-NA-	**Discharge (cfs)**	0	0	1	3	4	5	5	6	7	7
Discharge Coefficient:	-NA-	**Elevation (ft)**	2,732.6	2,733.0	2,733.5	2,734.0	2,734.5	2,735.0	2,735.5	2,736.0	2,736.5	2,737.0
Weir Coefficient:	-NA-											
Low-Level Outlet (SL)			11	12	13	14.	15	16	17	18	19	20
Centerline Elevation:	-NA-	**Volume (ac-ft)**	1.7	1.8	1.9	2.1	-	-	-	-	-	-
Cross-Section Area:	-NA-	**Discharge (cfs)**	21	46	78	116	0	0	0	0	0	0
Discharge Coefficient:	-NA-	**Elevation (ft)**	2,737.3	2,737.5	2,737.8	2,738.0	-	-	-	-	-	-
Orifice Equation Exponent:	-NA-											
Top of Dam Overflow (ST)			2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr				
Elevation Top of Dam:	-NA-	**Peak Volume (ac-ft)**	0.00	0.00	0.00	0.00	0.00	0.00				
Length of Dam:	-NA-	**Peak Stage (ft)**	0.00	0.00	0.00	0.00	0.00	0.00				
Discharge Coefficient:	-NA-	**Peak Discharge (cfs)**	0	0	0	0	0	0				
Weir Coefficient:	-NA-											

Kimley»Horn

Project ***Asteria Highlands***
Subject **Detention Basin Calculations**
Designed by **DWT** Date 5/31/2017 Project No. 291102002
Checked by Date

Objective: to determine the storage-flow relationship for small detention basins

SON05 ***Drains in 2.76 hours***

Outlet Diameter	1.00 ft	Outlet X-Sect Area	0.785 ft^2
Outlet Elevation	2710.5 ft	No. of Outlet Barrels	1
Weir Length	10 ft	Outlet Pipe Slope	0.005 ft/ft
Weir Elevation	2713 ft	Weir Coefficient	2.7

Elevation [ft]	Surface Storage Area [ft^2]	Surface Storage Area [acre]	Average Area [acre]	Δ Elev [ft]	Δ Vol [ac-ft]	Σ Vol [ac-ft]	Δ Time to Drain [hr]	Q_{pipe} [cfs]	Q_{weir} [cfs]	Total Q_{out} [cfs]
2710	7,548	0.17				0		0.00	0.00	0
			0.19	0.5	0.09		0.00			
2710.5	8,590	0.20				0.09		0.00	0.00	0
			0.21	0.5	0.10		2.01			
2711	9,635	0.22				0.20		1.26	0.00	1
			0.23	0.5	0.12		0.75			
2711.5	10,794	0.25				0.31		2.52	0.00	3
			0.26	0.5	0.13		0.50			
2712	11,936	0.27				0.44		3.78	0.00	4
			0.29	0.5	0.14		0.41			
2712.5	13,115	0.30				0.59		4.63	0.00	5
			0.32	0.5	0.16		0.38			
2713	14,426	0.33				0.75		5.35	0.00	5
			0.34	0.3	0.08		0.14			
2713.25	15,047	0.35				0.83		5.67	3.38	9
			0.35	0.3	0.09		0.09			
2713.5	15,675	0.36				0.92		5.98	9.55	16
			0.37	0.3	0.09		0.06			
2713.75	16,312	0.37				1.01		6.27	17.54	24
			0.38	0.3	0.10		0.04			
2714	16,957	0.39				1.11		6.55	27.00	34

Notes:
Q_{pipe} goes from Mannings Eqn to Orifice Eqn when water surface exceeds 1.2*(Outlet Diameter)
per Linsley et al. *Water Resources Engineering* 4th Edition, pg 652.

Kimley»Horn

Project ***Asteria Highlands***
Subject **Detention Basin Calculations**
Designed by **DWT** Date 5/31/2017 Project No. 291102002
Checked by Date

Objective: to determine the storage-flow relationship for small detention basins

SON18 ***Drains in 3.64 hours***

Outlet Diameter	1.00 ft	Outlet X-Sect Area	0.785 ft^2
Outlet Elevation	2733 ft	No. of Outlet Barrels	1
Weir Length	40 ft	Outlet Pipe Slope	0.005 ft/ft
Weir Elevation	2737 ft	Weir Coefficient	2.7

Elevation [ft]	Surface Storage Area [ft^2]	Surface Storage Area [acre]	Average Area [acre]	Δ Elev [ft]	Δ Vol [ac-ft]	Σ Vol [ac-ft]	Δ Time to Drain [hr]	Q_{pipe} [cfs]	Q_{weir} [cfs]	Total Q_{out} [cfs]
2732.6	10,878	0.25				0		0.00	0.00	0
			0.26	0.4	0.10		0.00			
2733	11,627	0.27				0.10		0.00	0.00	0
			0.28	0.5	0.14		2.67			
2733.5	12,622	0.29				0.24		1.26	0.00	1
			0.30	0.5	0.15		0.97			
2734	13,648	0.31				0.39		2.52	0.00	3
			0.33	0.5	0.16		0.62			
2734.5	14,694	0.34				0.56		3.78	0.00	4
			0.35	0.5	0.17		0.50			
2735	15,763	0.36				0.73		4.63	0.00	5
			0.37	0.5	0.19		0.45			
2735.5	16,862	0.39				0.92		5.35	0.00	5
			0.40	0.5	0.20		0.43			
2736	17,966	0.41				1.12		5.98	0.00	6
			0.43	0.5	0.21		0.41			
2736.5	19,116	0.44				1.33		6.55	0.00	7
			0.45	0.5	0.23		0.40			
2737	20,262	0.47				1.56		7.07	0.00	7
			0.47	0.3	0.12		0.10			
2737.25	20,860	0.48				1.67		7.32	13.50	21
			0.49	0.3	0.12		0.04			
2737.5	21,466	0.49				1.80		7.56	38.18	46
			0.50	0.3	0.12		0.02			
2737.75	22,078	0.51				1.92		7.80	70.15	78
			0.51	0.3	0.13		0.02			
2738	22,697	0.52				2.05		8.02	108.00	116

Notes:
Q_{pipe} goes from Mannings Eqn to Orifice Eqn when water surface exceeds 1.2*(Outlet Diameter)
per Linsley et al. *Water Resources Engineering* 4th Edition, pg 652.

Appendix B Proposed Conditions Hydrology

- *Proposed Diversions*

Flood Control District of Maricopa County
Drainage Design Management System
HEC-1 DIVERSIONS
Project Reference: ASTERIA PROP

Diversion ID/ DT Card ID	Maximum Volume (ac-ft)	Maximum Diversion (cfs)		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
DON18	0.30	100.0	**Inflow (cfs)**		1	3	4	5	6	7	21	46	78
			Diversion (cfs)		1	2	2	3	3	4	11	23	39

Appendix B Proposed Conditions Hydrology

- *HEC-1 Results*

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   05DEC17  TIME  20:16:59   *
*                                       *
*****************************************
```

Proposed 2-year

```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*          (916) 756-1104               *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

   1      ID        Flood Control District of Maricopa County
   2      ID        ASTERIA PROP - ASTERIA PROP
   3      ID        2 YEAR
   4      ID        6 Hour  Storm
   5      ID        Unit Hydrograph: Clark
   6      ID        Storm: Multiple
   7      ID        06/01/2017
          *DIAGRAM
   8      IT       3  1JAN99       0     400
   9      IO       5
  10      IN      15
          *
  11      JD   1.422  0.0001
  12      PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  13      PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  14      PC   0.962   0.972   0.983   0.991   1.000
  15      JD   1.413  0.5000
  16      PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  17      PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  18      PC   0.962   0.972   0.983   0.991   1.000
          *

  19      KK    ON07   BASIN
  20      BA   0.002
  21      LG    0.34    0.36    6.00    0.18       1
  22      UC   0.137   0.129
  23      UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  24      UA     100
          *

  25      KK    ON05   BASIN
  26      BA   0.017
  27      LG    0.29    0.30    6.00    0.19      16
  28      UC   0.276   0.354
  29      UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  30      UA     100
          *

  31      KK  SON05  STORAGE
  32      KO       3       3
  33      RS       1    STOR
  34      SV     0.0    0.20    0.31    0.44    0.59    0.75    0.83    0.92    1.01    1.11
  35      SE  2710.0 2711.00 2711.50 2712.00 2712.50 2713.00 2713.25 2713.50 2713.75 2714.00
  36      SQ     0.0     1.0     3.0     4.0     5.0     5.0     9.0    16.0    24.0    34.0
          *

  37      KK   OFF05   BASIN
  38      BA   0.005
  39      LG    0.35    0.40    6.00    0.18       0
  40      UC   0.182   0.152
  41      UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  42      UA     100
          *
```

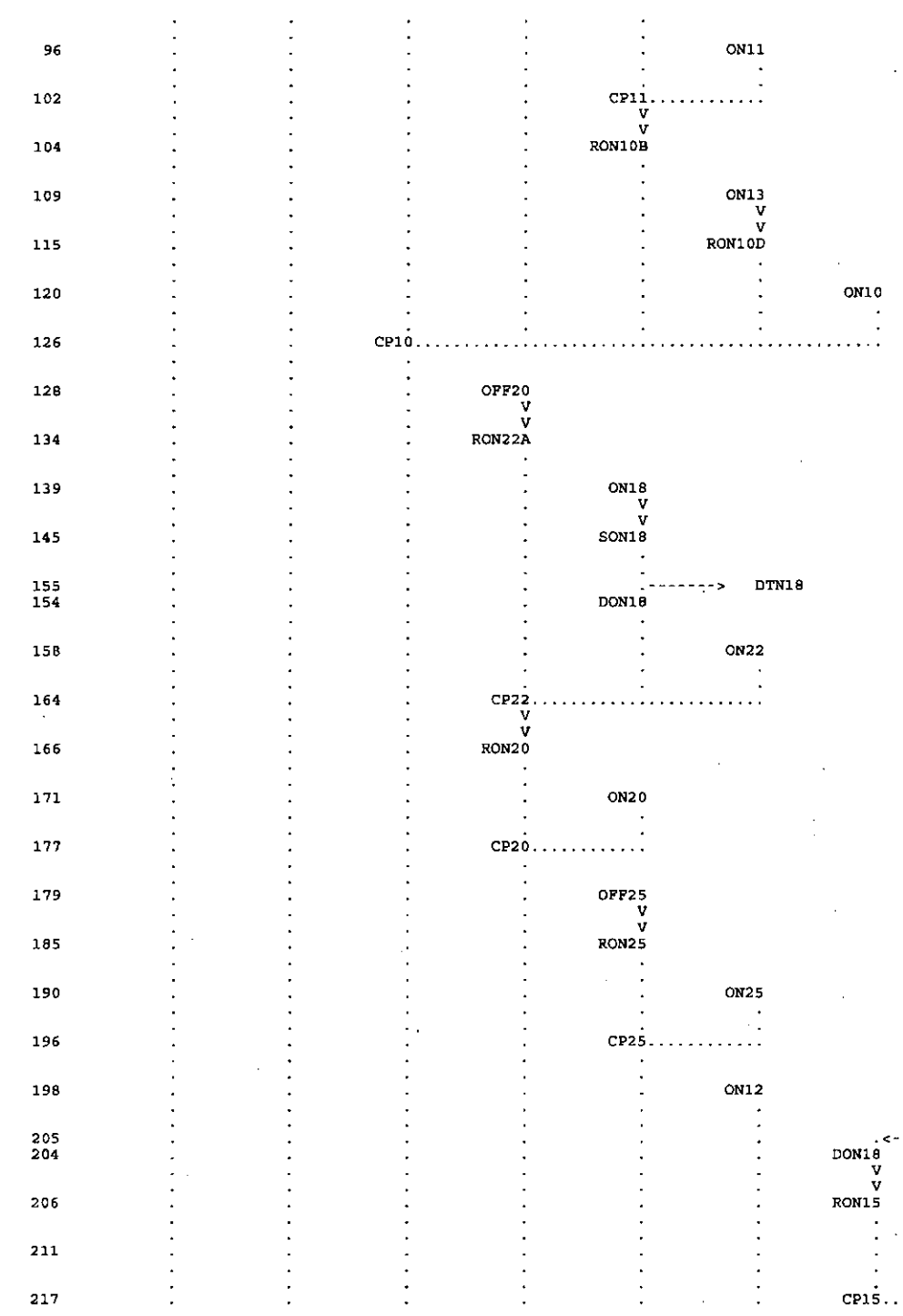
1 HEC-1 INPUT PAGE 2

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  43      KK   RON08   ROUTE
  44      RS       1    FLOW
  45      RC   0.035   0.035   0.035     285  0.0562    0.00
  46      RX   10.90   45.60   57.90   60.00   62.80   80.90  106.80  119.50
  47      RY  2749.7 2745.71 2744.30 2743.47 2744.86 2747.52 2749.05 2750.64
          *
```

```
   48          KK    ON08   BASIN
   49          BA   0.001
   50          LG    0.35    0.40    6.00    0.18       0
   51          UC   0.193   0.364
   52          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
   53          UA     100
               *

   54          KK    CP08 COMBINE
   55          HC       2
               *

   56          KK  RON10C   ROUTE
   57          RS       1    FLOW
   58          RC   0.035   0.035   0.035    1354  0.0332    0.00
   59          RX   12.60   28.00   47.90   52.40   55.50   67.80   76.30   97.20
   60          RY  2721.0 2718.87 2717.34 2716.24 2717.19 2718.00 2718.06 2719.79
               *

   61          KK   OFF10   BASIN
   62          BA   0.028
   63          LG    0.35    0.40    6.00    0.18       0
   64          UC   0.403   0.498
   65          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
   66          UA     100
               *

   67          KK   RON09   ROUTE
   68          RS       1    FLOW
   69          RC   0.035   0.035   0.035     361  0.0111    0.00
   70          RX    0.00   30.80   47.40   61.80   64.90   69.00   81.20   88.10
   71          RY  2753.6 2749.73 2748.26 2746.45 2747.49 2749.35 2752.43 2753.75
               *

   72          KK    ON09   BASIN
   73          BA   0.001
   74          LG    0.35    0.40    6.00    0.18       0
   75          UC   0.195   0.409
   76          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
   77          UA     100
               *
1                                        HEC-1 INPUT                                        PAGE  3

  LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

   78          KK    CP09 COMBINE
   79          HC       2
               *

   80          KK  RON10A   ROUTE
   81          RS       1    FLOW
   82          RC   0.035   0.035   0.035    1364  0.0374    0.00
   83          RX   23.50   54.60   78.90   83.60   87.30   92.40  111.30  161.10
   84          RY  2742.0 2733.67 2731.88 2730.29 2732.80 2733.37 2735.66 2741.50
               *

   85          KK   OFF11   BASIN
   86          BA  0.0038
   87          LG    0.35    0.40    6.00    0.18       0
   88          UC   0.165   0.139
   89          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
   90          UA     100
               *

   91          KK   RON11   ROUTE
   92          RS       1    FLOW
   93          RC   0.035   0.035   0.035     329  0.0243    0.00
   94          RX   35.90   50.00   57.80   62.40   64.10   65.90   69.50   74.20
   95          RY  2761.4 2759.24 2758.33 2757.03 2757.56 2758.16 2758.70 2759.53
               *

   96          KK    ON11   BASIN
   97          BA   0.001
   98          LG    0.35    0.40    6.00    0.18       0
   99          UC   0.212   0.493
  100          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  101          UA     100
               *

  102          KK    CP11 COMBINE
  103          HC       2
               *

  104          KK  RON10B   ROUTE
  105          RS       1    FLOW
  106          RC   0.035   0.035   0.035    1599  0.0375    0.00
  107          RX   23.50   54.60   78.90   83.60   87.30   92.40  111.30  161.10
  108          RY  2742.0 2733.67 2731.88 2730.29 2732.80 2733.37 2735.66 2741.50
               *

  109          KK    ON13   BASIN
  110          BA   0.006
  111          LG    0.28    0.28    6.00    0.20      23
  112          UC   0.167   0.171
  113          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  114          UA     100
               *
1                                        HEC-1 INPUT                                        PAGE  4

  LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
```

```
 115          KK  RON10D   ROUTE
 116          RS       1    FLOW
 117          RC   0.035   0.035   0.035     533  0.0488    0.00
 118          RX   27.90   27.90   44.00   63.60   66.50   74.50   94.90  125.60
 119          RY 2715.0 2711.32 2707.83 2707.15 2708.37 2708.33 2709.32 2717.00
              *

 120          KK   ON10   BASIN
 121          BA  0.007
 122          LG   0.35    0.40    6.00    0.17       1
 123          UC  0.345   0.654
 124          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 125          UA    100
              *

 126          KK   CP10 COMBINE
 127          HC      5
              *

 128          KK   OFF20   BASIN
 129          BA  0.077
 130          LG   0.35    0.40    6.00    0.18       0
 131          UC  0.489   0.554
 132          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 133          UA    100
              *

 134          KK  RON22A   ROUTE
 135          RS       1    FLOW
 136          RC   0.035   0.035   0.035     381  0.0315    0.00
 137          RX    0.00   60.50   72.00   88.30   94.50  100.00  113.70  161.00
 138          RY 2741.8 2740.72 2740.72 2738.78 2738.91 2740.99 2743.04 2748.80
              *

 139          KK   ON18   BASIN
 140          BA  0.013
 141          LG   0.29    0.26    6.00    0.21      20
 142          UC  0.213   0.209
 143          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 144          UA    100
              *

 145          KK   SON18 STORAGE
 146          KO      3       3
 147          RS      1    STOR
 148          SV           0.10    0.24    0.39    0.56    0.73    0.92    1.12    1.33    1.56
 149          SV   1.67    1.80    1.92    2.05
 150          SE 2732.6 2733.00 2733.50 2734.00 2734.50 2735.00 2735.50 2736.00 2736.50 2737.00
 151          SE 2737.3 2737.50 2737.75 2738.00
 152          SQ    0.0     0.0     1.0     3.0     4.0     5.0     5.0     6.0     7.0     7.0
 153          SQ   21.0    46.0    78.0   116.0
              *
1                                        HEC-1 INPUT                                    PAGE  5

LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 154          KK   DON18  DIVERT
 155          DT   DTN18    0.30   100.0
 156          DI     0.0     1.0     3.0     4.0     5.0     6.0     7.0    21.0    46.0    78.0
 157          DQ     0.0     0.5     1.5     2.0     2.5     3.0     3.5    10.5    23.0    39.0
              *

 158          KK   ON22   BASIN
 159          BA  0.003
 160          LG   0.35    0.40    6.00    0.18       0
 161          UC  0.383   1.189
 162          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 163          UA    100
              *

 164          KK   CP22 COMBINE
 165          HC      3
              *

 166          KK   RON20   ROUTE
 167          RS       1    FLOW
 168          RC   0.035   0.035   0.035     226  0.0354    0.00
 169          RX    0.00   67.00   78.70   95.90  103.60  109.20  130.20  221.40
 170          RY 2739.0 2729.44 2728.38 2725.60 2725.84 2727.71 2727.42 2738.58
              *

 171          KK   ON20   BASIN
 172          BA  0.003
 173          LG   0.28    0.34    6.00    0.19      20
 174          UC  0.140   0.152
 175          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 176          UA    100
              *

 177          KK   CP20 COMBINE
 178          HC      2
              *

 179          KK   OFF25   BASIN
 180          BA  0.034
 181          LG   0.35    0.40    6.00    0.18       0
 182          UC  0.407   0.538
 183          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 184          UA    100
              *

 185          KK   RON25   ROUTE
```

```
          186          RS       1    FLOW
          187          RC   0.035   0.035   0.035     219  0.0411    0.00
          188          RX    0.00   33.10   62.10   77.00   81.70   84.60  140.40  158.60
          189          RY  2739.5 2736.34 2734.18 2733.23 2733.44 2733.82 2737.85 2739.50
                       *
1                                                HEC-1 INPUT                                                PAGE  6

        LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          190          KK    ON25   BASIN
          191          BA   0.001
          192          LG    0.29    0.40    6.00    0.17      19
          193          UC   0.153   0.281
          194          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          195          UA     100
                       *

          196          KK    CP25 COMBINE
          197          HC       2
                       *

          198          KK    ON12   BASIN
          199          BA   0.002
          200          LG    0.31    0.35    6.00    0.19      13
          201          UC   0.142   0.174
          202          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          203          UA     100
                       *

          204          KK   DON18RETRIEVE
          205          DR   DTN18
                       *

          206          KK   RON15   ROUTE
          207          RS       1    FLOW
          208          RC   0.035   0.035   0.035     483  0.0518    0.00
          209          RX    0.00   34.00   36.80   42.90   43.00   45.70   50.00   83.90
          210          RY  2722.2 2717.32 2717.22 2715.48 2715.48 2716.96 2719.25 2728.77
                       *

          211          KK    ON15   BASIN
          212          BA  0.0047
          213          LG    0.29    0.37    6.00    0.18      19
          214          UC   0.176   0.189
          215          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          216          UA     100
                       *

          217          KK    CP15 COMBINE
          218          HC       2
                       *
          219          ZZ
1
                    SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (---->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<----) RETURN OF DIVERTED OR PUMPED FLOW

    19        ON07
                .
                .                                    \
    25          .        ON05
                .           V
                .           V
    31          .      SON05
                .          .
                .          .
    37          .          .       OFF05
                .          .          V
                .          .          V
    43          .          .       RON08
                .          .          .
                .          .          .
    48          .          .          .        ON08
                .          .          .          .
                .          .          .          .
    54          .          .        CP08.........
                .          .          V
                .          .          V
    56          .          .      RON10C
                .          .          .
                .          .          .
    61          .          .          .       OFF10
                .          .          .          V
                .          .          .          V
    67          .          .          .       RON09
                .          .          .          .
                .          .          .          .
    72          .          .          .          .        ON09
                .          .          .          .          .
                .          .          .          .          .
    78          .          .          .        CP09.........
                .          .          .          V
                .          .          .          V
    80          .          .          .      RON10A
                .          .          .          .
                .          .          .          .
    85          .          .          .          .       OFF11
                .          .          .          .          V
                .          .          .          .          V
    91          .          .          .          .       RON11
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   05DEC17  TIME  20:16:59   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

Flood Control District of Maricopa County
ASTERIA PROP - ASTERIA PROP
2 YEAR
6 Hour Storm
Unit Hydrograph: Clark
Storm: Multiple
06/01/2017

```
 9 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                   NMIN           3  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1JAN99  STARTING DATE
                   ITIME        0000  STARTING TIME
                      NQ         400  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1JAN99  ENDING DATE
                  NDTIME        1957  ENDING TIME
                  ICENT           19  CENTURY MARK

                COMPUTATION INTERVAL      .05 HOURS
                    TOTAL TIME BASE    19.95 HOURS

       ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT

11 JD         INDEX STORM NO. 1
                    STRM        1.42  PRECIPITATION DEPTH
                    TRDA         .00  TRANSPOSITION DRAINAGE AREA

12 PI           PRECIPITATION PATTERN
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .02       .02       .02       .02       .02
                  .03       .03       .03       .03       .03       .09       .09       .09       .09       .09
                  .02       .02       .02       .02       .02       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00

15 JD         INDEX STORM NO. 2
                    STRM        1.41  PRECIPITATION DEPTH
                    TRDA         .50  TRANSPOSITION DRAINAGE AREA

16 PI           PRECIPITATION PATTERN
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .02       .02       .02       .02       .02
                  .03       .03       .03       .03       .03       .09       .09       .09       .09       .09
                  .02       .02       .02       .02       .02       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                  .00       .00       .00       .00       .00       .00       .00       .00       .00       .00

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
31 KK       *    SON05   *      STORAGE
            *            *
            **************

32 KO         OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          3  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

           HYDROGRAPH ROUTING DATA

33 RS         STORAGE ROUTING
                   NSTPS           1  NUMBER OF SUBREACHES
                    ITYP        STOR  TYPE OF INITIAL CONDITION
                  RSVRIC         .00  INITIAL CONDITION
                       X         .00 WORKING R AND D COEFFICIENT

34 SV           STORAGE          .0       .2       .3       .4       .6       .8       .8       .9      1.0      1.1

35 SE         ELEVATION     2710.00  2711.00  2711.50  2712.00  2712.50  2713.00  2713.25  2713.50  2713.75  2714.00

36 SQ         DISCHARGE          0.       1.       3.       4.       5.       5.       9.      16.      24.      34.

                                                    ***

    ***             ***              ***              ***              ***

                     HYDROGRAPH AT STATION   SON05
                    TRANSPOSITION AREA       .0 SQ MI
```

```
  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     19.95-HR
+   (CFS)       (HR)
                      (CFS)
+       3.      4.60                1.           0.           0.           0.
                    (INCHES)       .485         .541         .541         .541
                     (AC-FT)        0.           0.           0.           0.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                    6-HR        24-HR        72-HR     19.95-HR
+  (AC-FT)      (HR)
        0.      4.60                0.           0.           0.           0.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                    6-HR        24-HR        72-HR     19.95-HR
+   (FEET)      (HR)
   2711.43      4.60             2710.69      2710.24      2710.24      2710.24

                      CUMULATIVE AREA =     .02 SQ MI


      ***           ***           ***           ***           ***

                      HYDROGRAPH AT STATION   SON05
                     TRANSPOSITION AREA       .5 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     19.95-HR
+   (CFS)       (HR)
                      (CFS)
+       3.      4.60                1.           0.           0.           0.
                    (INCHES)       .479         .535         .535         .535
                     (AC-FT)        0.           0.           0.           0.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                    6-HR        24-HR        72-HR     19.95-HR
+  (AC-FT)      (HR)
        0.      4.60                0.           0.           0.           0.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                    6-HR        24-HR        72-HR     19.95-HR
+   (FEET)      (HR)
   2711.42      4.60             2710.69      2710.24      2710.24      2710.24

                      CUMULATIVE AREA =     .02 SQ MI

      ***           ***           ***           ***           ***


                      INTERPOLATED HYDROGRAPH AT   SON05

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     19.95-HR
+   (CFS)       (HR)
                      (CFS)
+       3.      4.60                1.           0.           0.           0.
                    (INCHES)       .481         .537         .537         .537
                     (AC-FT)        0.           0.           0.           0.

                      CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

           **************
           *            *
 145 KK    *     SON18  *      STORAGE
           *            *
           **************

 146 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          3  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

              HYDROGRAPH ROUTING DATA

 147 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP       STOR  TYPE OF INITIAL CONDITION
                     RSVRIC        .00  INITIAL CONDITION
                          X        .00 WORKING R AND D COEFFICIENT

 148 SV            STORAGE         .0         .1         .2         .4         .6         .7         .9        1.1        1.3        1.6
                                  1.7        1.8        1.9        2.0

 150 SE            ELEVATION   2732.60    2733.00    2733.50    2734.00    2734.50    2735.00    2735.50    2736.00    2736.50    2737.00
                               2737.30    2737.50    2737.75    2738.00

 152 SQ            DISCHARGE         0.         0.         1.         3.         4.         5.         5.         6.         7.         7.
                                  21.        46.        78.       116.
                                                                    ***

      ***           ***           ***           ***           ***

                      HYDROGRAPH AT STATION    SON18
                     TRANSPOSITION AREA        .0 SQ MI
```

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	19.95-HR
+ (CFS)	(HR)					
		(CFS)				
+ 2.	4.50		1.	0.	0.	0.
		(INCHES)	.427	.442	.442	.442
		(AC-FT)	0.	0.	0.	0.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	19.95-HR
+ (AC-FT)	(HR)				
0.	4.45	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	19.95-HR
+ (FEET)	(HR)				
2733.72	4.50	2733.27	2733.02	2733.02	2733.02

CUMULATIVE AREA = .01 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION SON18
TRANSPOSITION AREA .5 SQ MI

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	19.95-HR
+ (CFS)	(HR)					
		(CFS)				
+ 2.	4.50		1.	0.	0.	0.
		(INCHES)	.421	.435	.435	.435
		(AC-FT)	0.	0.	0.	0.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	19.95-HR
+ (AC-FT)	(HR)				
0.	4.45	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	19.95-HR
+ (FEET)	(HR)				
2733.72	4.50	2733.27	2733.01	2733.01	2733.01

CUMULATIVE AREA = .01 SQ MI

*** *** *** *** ***

INTERPOLATED HYDROGRAPH AT SON18

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	19.95-HR
+ (CFS)	(HR)					
		(CFS)				
+ 2.	4.50		1.	0.	0.	0.
		(INCHES)	.424	.438	.438	.438
		(AC-FT)	0.	0.	0.	0.

CUMULATIVE AREA = .01 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	ON07	1.	4.05	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON05	9.	4.10	1.	0.	0.	.02		
+	ROUTED TO	SON05	3.	4.60	1.	0.	0.	.02		
+	HYDROGRAPH AT	OFF05	3.	4.05	0.	0.	0.	.00		
+	ROUTED TO	RON08	3.	4.10	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON08	0.	4.10	0.	0.	0.	.00		
+	2 COMBINED AT	CP08	3.	4.10	0.	0.	0.	.01		
+	ROUTED TO	RON10C	3.	4.15	0.	0.	0.	.01		
+	HYDROGRAPH AT	OFF10	7.	4.20	1.	0.	0.	.03		
+	ROUTED TO	RON09	7.	4.25	1.	0.	0.	.03		
+	HYDROGRAPH AT	ON09	0.	4.10	0.	0.	0.	.00		

+	2 COMBINED AT	CP09	7.	4.25	1.	0.	0.	.03
+	ROUTED TO	RON10A	7.	4.30	1.	0.	0.	.03
+	HYDROGRAPH AT	OFF11	2.	4.05	0.	0.	0.	.00
+	ROUTED TO	RON11	2.	4.10	0.	0.	0.	.00
+	HYDROGRAPH AT	ON11	0.	4.10	0.	0.	0.	.00
+	2 COMBINED AT	CP11	3.	4.10	0.	0.	0.	.00
+	ROUTED TO	RON10B	2.	4.20	0.	0.	0.	.00
+	HYDROGRAPH AT	ON13	5.	4.05	0.	0.	0.	.01
+	ROUTED TO	RON10D	5.	4.10	0.	0.	0.	.01
+	HYDROGRAPH AT	ON10	2.	4.20	0.	0.	0.	.01
+	5 COMBINED AT	CP10	15.	4.20	2.	1.	1.	.05
+	HYDROGRAPH AT	OFF20	17.	4.25	2.	1.	1.	.08
+	ROUTED TO	RON22A	17.	4.25	2.	1.	1.	.08
+	HYDROGRAPH AT	ON18	9.	4.05	1.	0.	0.	.01
+	ROUTED TO	SON18	2.	4.50	1.	0.	0.	.01
+	DIVERSION TO	DTN18	1.	4.50	0.	0.	0.	.01
+	HYDROGRAPH AT	DON18	1.	4.50	0.	0.	0.	.01
+	HYDROGRAPH AT	ON22	0.	4.25	0.	0.	0.	.00
+	3 COMBINED AT	CP22	18.	4.25	3.	1.	1.	.09
+	ROUTED TO	RON20	18.	4.30	3.	1.	1.	.09
+	HYDROGRAPH AT	ON20	2.	4.05	0.	0.	0.	.00
+	2 COMBINED AT	CP20	19.	4.25	3.	1.	1.	.10
+	HYDROGRAPH AT	OFF25	8.	4.20	1.	0.	0.	.03
+	ROUTED TO	RON25	8.	4.20	1.	0.	0.	.03
+	HYDROGRAPH AT	ON25	1.	4.05	0.	0.	0.	.00
+	2 COMBINED AT	CP25	9.	4.20	1.	0.	0.	.04
+	HYDROGRAPH AT	ON12	1.	4.05	0.	0.	0.	.00
+	HYDROGRAPH AT	DON18	1.	4.50	0.	0.	0.	.01
+	ROUTED TO	RON15	1.	4.50	0.	0.	0.	.01
+	HYDROGRAPH AT	ON15	3.	4.05	0.	0.	0.	.00
+	2 COMBINED AT	CP15	4.	4.05	1.	0.	0.	.00

*** NORMAL END OF HEC-1 ***

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE   05DEC17  TIME  20:17:07   *
*                                       *
*****************************************
```

Proposed 10-year

```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*          (916) 756-1104               *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE  ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
   1  ID        Flood Control District of Maricopa County
   2  ID        ASTERIA PROP - ASTERIA PROP
   3  ID        10 YEAR
   4  ID        6 Hour  Storm
   5  ID        Unit Hydrograph: Clark
   6  ID        Storm: Multiple
   7  ID        06/01/2017
      *DIAGRAM
   8  IT      3  1JAN99       0     400
   9  IO      5
  10  IN     15
      *
  11  JD  2.110  0.0001
  12  PC  0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  13  PC  0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  14  PC  0.962   0.972   0.983   0.991   1.000
  15  JD  2.097  0.5000
  16  PC  0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  17  PC  0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  18  PC  0.962   0.972   0.983   0.991   1.000
      *
  19  KK   ON07   BASIN
  20  BA  0.002
  21  LG   0.34    0.36    6.00    0.18       1
  22  UC  0.115   0.106
  23  UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  24  UA    100
      *
  25  KK   ON05   BASIN
  26  BA  0.017
  27  LG   0.29    0.30    6.00    0.19      16
  28  UC  0.237   0.299
  29  UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  30  UA    100
      *
  31  KK  SON05  STORAGE
  32  KO      3       3
  33  RS      1    STOR
  34  SV    0.0    0.20    0.31    0.44    0.59    0.75    0.83    0.92    1.01    1.11
  35  SE 2710.0 2711.00 2711.50 2712.00 2712.50 2713.00 2713.25 2713.50 2713.75 2714.00
  36  SQ    0.0     1.0     3.0     4.0     5.0     5.0     9.0    16.0    24.0    34.0
      *
  37  KK   OFF05   BASIN
  38  BA  0.005
  39  LG   0.35    0.40    6.00    0.18       0
  40  UC  0.151   0.123
  41  UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  42  UA    100
      *
```

1 HEC-1 INPUT PAGE 2

```
LINE  ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
  43  KK   RON08   ROUTE
  44  RS      1    FLOW
  45  RC  0.035   0.035   0.035     285  0.0562    0.00
  46  RX  10.90   45.60   57.90   60.00   62.80   80.90  106.80  119.50
  47  RY 2749.7 2745.71 2744.30 2743.47 2744.86 2747.52 2749.05 2750.64
      *
```

```
  48          KK    ON08   BASIN
  49          BA   0.001
  50          LG    0.35    0.40    6.00    0.18       0
  51          UC   0.160   0.296
  52          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  53          UA     100
              *

  54          KK    CP08 COMBINE
  55          HC       2
              *

  56          KK  RON10C   ROUTE
  57          RS       1    FLOW
  58          RC   0.035   0.035   0.035    1354  0.0332    0.00
  59          RX   12.60   28.00   47.90   52.40   55.50   67.80   76.30   97.20
  60          RY  2721.0 2718.87 2717.34 2716.24 2717.19 2718.00 2718.06 2719.79
              *

  61          KK   OFF10   BASIN
  62          BA   0.028
  63          LG    0.35    0.40    6.00    0.18       0
  64          UC   0.335   0.405
  65          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  66          UA     100
              *

  67          KK   RON09   ROUTE
  68          RS       1    FLOW
  69          RC   0.035   0.035   0.035     361  0.0111    0.00
  70          RX    0.00   30.80   47.40   61.80   64.90   69.00   81.20   88.10
  71          RY  2753.6 2749.73 2748.26 2746.45 2747.49 2749.35 2752.43 2753.75
              *

  72          KK    ON09   BASIN
  73          BA   0.001
  74          LG    0.35    0.40    6.00    0.18       0
  75          UC   0.162   0.333
  76          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  77          UA     100
              *
```



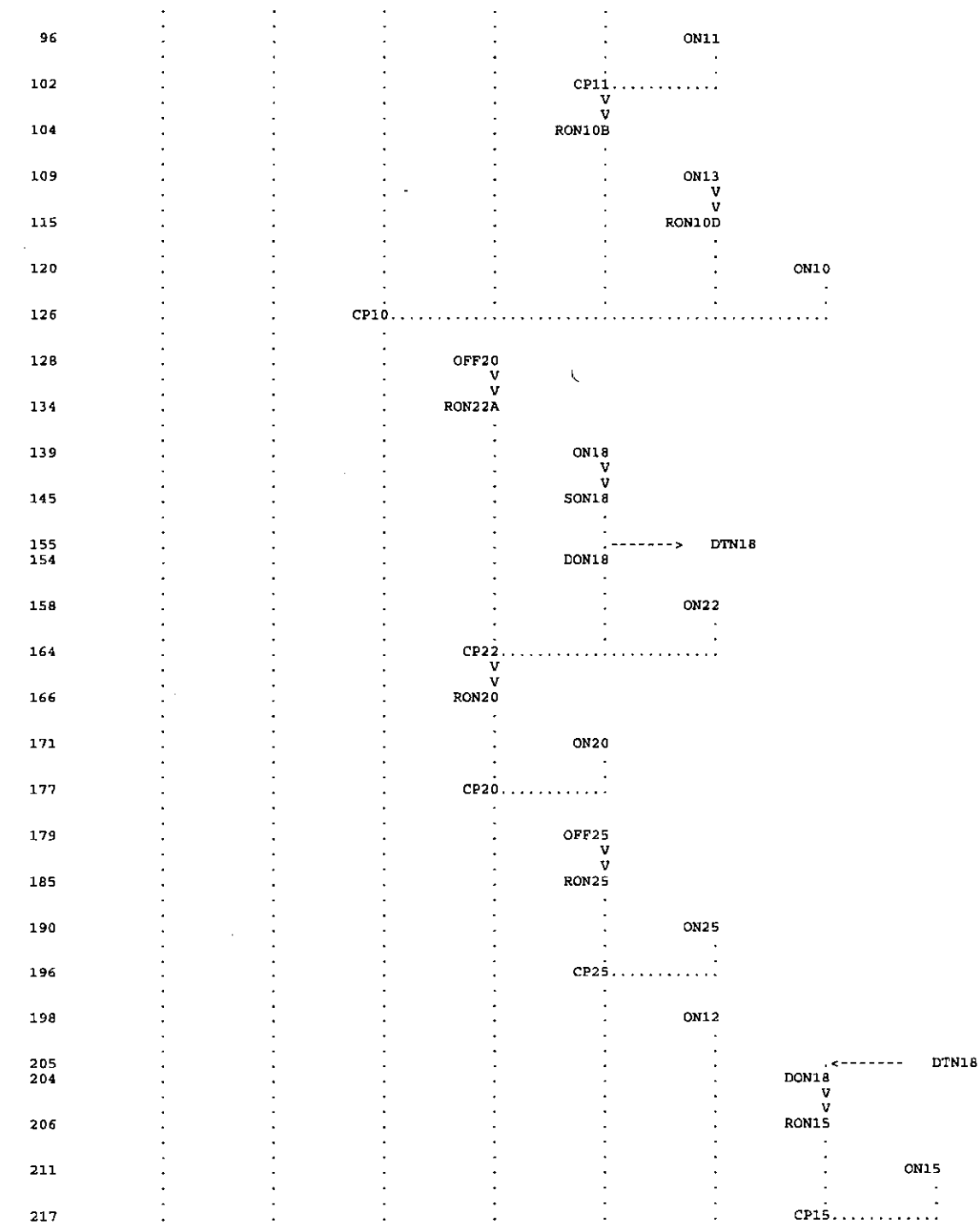
```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  78          KK    CP09 COMBINE
  79          HC       2
              *

  80          KK  RON10A   ROUTE
  81          RS       1    FLOW
  82          RC   0.035   0.035   0.035    1364  0.0374    0.00
  83          RX   23.50   54.60   78.90   83.60   87.30   92.40  111.30  161.10
  84          RY  2742.0 2733.67 2731.88 2730.29 2732.80 2733.37 2735.66 2741.50
              *

  85          KK   OFF11   BASIN
  86          BA  0.0038
  87          LG    0.35    0.40    6.00    0.18       0
  88          UC   0.137   0.113
  89          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  90          UA     100
              *

  91          KK   RON11   ROUTE
  92          RS       1    FLOW
  93          RC   0.035   0.035   0.035     329  0.0243    0.00
  94          RX   35.90   50.00   57.80   62.40   64.10   65.90   69.50   74.20
  95          RY  2761.4 2759.24 2758.33 2757.03 2757.56 2758.16 2758.70 2759.53
              *

  96          KK    ON11   BASIN
  97          BA   0.001
  98          LG    0.35    0.40    6.00    0.18       0
  99          UC   0.176   0.401
 100          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 101          UA     100
              *

 102          KK    CP11 COMBINE
 103          HC       2
              *

 104          KK  RON10B   ROUTE
 105          RS       1    FLOW
 106          RC   0.035   0.035   0.035    1599  0.0375    0.00
 107          RX   23.50   54.60   78.90   83.60   87.30   92.40  111.30  161.10
 108          RY  2742.0 2733.67 2731.88 2730.29 2732.80 2733.37 2735.66 2741.50
              *

 109          KK    ON13   BASIN
 110          BA   0.006
 111          LG    0.28    0.28    6.00    0.20      23
 112          UC   0.145   0.146
 113          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 114          UA     100
              *
```



```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
```

```
115          KK  RON10D   ROUTE
116          RS       1    FLOW
117          RC   0.035   0.035   0.035     533  0.0488    0.00
118          RX   27.90   27.90   44.00   63.60   66.50   74.50   94.90  125.60
119          RY  2715.0 2711.32 2707.83 2707.15 2708.37 2708.33 2709.32 2717.00
             *

120          KK    ON10   BASIN
121          BA   0.007
122          LG    0.35    0.40    6.00    0.17       1
123          UC   0.288   0.534
124          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
125          UA     100
             *

126          KK    CP10 COMBINE
127          HC       5
             *

128          KK   OFF20   BASIN
129          BA   0.077
130          LG    0.35    0.40    6.00    0.18       0
131          UC   0.406   0.451
132          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
133          UA     100
             *

134          KK  RON22A   ROUTE
135          RS       1    FLOW
136          RC   0.035   0.035   0.035     381  0.0315    0.00
137          RX    0.00   60.50   72.00   88.30   94.50  100.00  113.70  161.00
138          RY  2741.8 2740.72 2740.72 2738.78 2738.91 2740.99 2743.04 2748.80
             *

139          KK    ON18   BASIN
140          BA   0.013
141          LG    0.29    0.26    6.00    0.21      20
142          UC   0.184   0.178
143          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
144          UA     100
             *

145          KK   SON18 STORAGE
146          KO       3       3
147          RS       1    STOR
148          SV            0.10    0.24    0.39    0.56    0.73    0.92    1.12    1.33    1.56
149          SV    1.67    1.80    1.92    2.05
150          SE  2732.6 2733.00 2733.50 2734.00 2734.50 2735.00 2735.50 2736.00 2736.50 2737.00
151          SE  2737.3 2737.50 2737.75 2738.00
152          SQ     0.0     0.0     1.0     3.0     4.0     5.0     5.0     6.0     7.0     7.0
153          SQ    21.0    46.0    78.0   116.0
             *
1                                        HEC-1 INPUT                                        PAGE  5
        LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

154          KK   DON18  DIVERT
155          DT   DTN18    0.30   100.0
156          DI     0.0     1.0     3.0     4.0     5.0     6.0     7.0    21.0    46.0    78.0
157          DQ     0.0     0.5     1.5     2.0     2.5     3.0     3.5    10.5    23.0    39.0
             *

158          KK    ON22   BASIN
159          BA   0.003
160          LG    0.35    0.40    6.00    0.18       0
161          UC   0.318   0.968
162          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
163          UA     100
             *

164          KK    CP22 COMBINE
165          HC       3
             *

166          KK   RON20   ROUTE
167          RS       1    FLOW
168          RC   0.035   0.035   0.035     226  0.0354    0.00
169          RX    0.00   67.00   78.70   95.90  103.60  109.20  130.20  221.40
170          RY  2739.0 2729.44 2728.38 2725.60 2725.84 2727.71 2727.42 2738.58
             *

171          KK    ON20   BASIN
172          BA   0.003
173          LG    0.28    0.34    6.00    0.19      20
174          UC   0.121   0.129
175          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
176          UA     100
             *

177          KK    CP20 COMBINE
178          HC       2
             *

179          KK   OFF25   BASIN
180          BA   0.034
181          LG    0.35    0.40    6.00    0.18       0
182          UC   0.338   0.438
183          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
184          UA     100
             *

185          KK   RON25   ROUTE
```

```
          186          RS       1    FLOW
          187          RC   0.035   0.035   0.035     219  0.0411    0.00
          188          RX    0.00   33.10   62.10   77.00   81.70   84.60  140.40  158.60
          189          RY  2739.5 2736.34 2734.18 2733.23 2733.44 2733.82 2737.85 2739.50
                       *
1                                          HEC-1 INPUT                                    PAGE  6

        LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          190          KK    ON25   BASIN
          191          BA   0.001
          192          LG    0.29    0.40    6.00    0.17      19
          193          UC   0.132   0.238
          194          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          195          UA     100
                       *

          196          KK    CP25 COMBINE
          197          HC       2
                       *

          198          KK    ON12   BASIN
          199          BA   0.002
          200          LG    0.31    0.35    6.00    0.19      13
          201          UC   0.121   0.146
          202          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          203          UA     100
                       *

          204          KK   DON18RETRIEVE
          205          DR   DTN18
                       *

          206          KK   RON15   ROUTE
          207          RS       1    FLOW
          208          RC   0.035   0.035   0.035     483  0.0518    0.00
          209          RX    0.00   34.00   36.80   42.90   43.00   45.70   50.00   83.90
          210          RY  2722.2 2717.32 2717.22 2715.48 2715.48 2716.96 2719.25 2728.77
                       *

          211          KK    ON15   BASIN
          212          BA  0.0047
          213          LG    0.29    0.37    6.00    0.18      19
          214          UC   0.152   0.160
          215          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          216          UA     100
                       *

          217          KK    CP15 COMBINE
          218          HC       2
                       *
          219          ZZ
1
              SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    19        ON07
                .
                .
    25          .        ON05
                .          V
                .          V
    31          .      SON05
                .          .
                .          .
    37          .          .       OFF05
                .          .         V
                .          .         V
    43          .          .       RON08
                .          .          .
                .          .          .
    48          .          .          .        ON08
                .          .          .          .
                .          .          .          .
    54          .          .        CP08.........
                .          .         V
                .          .         V
    56          .          .       RON10C
                .          .          .
                .          .          .
    61          .          .          .       OFF10
                .          .          .         V
                .          .          .         V
    67          .          .          .       RON09
                .          .          .          .
                .          .          .          .
    72          .          .          .          .        ON09
                .          .          .          .          .
                .          .          .          .          .
    78          .          .          .        CP09.........
                .          .          .         V
                .          .          .         V
    80          .          .          .       RON10A
                .          .          .          .
                .          .          .          .
    85          .          .          .          .       OFF11
                .          .          .          .         V
                .          .          .          .         V
    91          .          .          .          .       RON11
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   05DEC17  TIME  20:17:07   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

Flood Control District of Maricopa County
ASTERIA PROP - ASTERIA PROP
10 YEAR
6 Hour Storm
Unit Hydrograph: Clark
Storm: Multiple
06/01/2017

```
 9 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT           HYDROGRAPH TIME DATA
                     NMIN          3  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1JAN99  STARTING DATE
                    ITIME        0000  STARTING TIME
                       NQ         400  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      1JAN99  ENDING DATE
                   NDTIME        1957  ENDING TIME
                    ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL      .05 HOURS
                     TOTAL TIME BASE    19.95 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT

11 JD          INDEX STORM NO. 1
                    STRM        2.11  PRECIPITATION DEPTH
                    TRDA         .00  TRANSPOSITION DRAINAGE AREA

12 PI            PRECIPITATION PATTERN
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .02   .02   .02   .02   .02
                   .03   .03   .03   .03   .03   .09   .09   .09   .09   .09
                   .02   .02   .02   .02   .02   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

15 JD          INDEX STORM NO. 2
                    STRM        2.10  PRECIPITATION DEPTH
                    TRDA         .50  TRANSPOSITION DRAINAGE AREA

16 PI            PRECIPITATION PATTERN
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .02   .02   .02   .02   .02
                   .03   .03   .03   .03   .03   .09   .09   .09   .09   .09
                   .02   .02   .02   .02   .02   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
31 KK       *    SON05   *      STORAGE
            *            *
            **************

32 KO          OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          3  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

             HYDROGRAPH ROUTING DATA

33 RS          STORAGE ROUTING
                    NSTPS          1  NUMBER OF SUBREACHES
                     ITYP       STOR  TYPE OF INITIAL CONDITION
                   RSVRIC        .00  INITIAL CONDITION
                        X        .00 WORKING R AND D COEFFICIENT

34 SV            STORAGE         .0    .2    .3    .4    .6    .8    .8    .9   1.0   1.1

35 SE          ELEVATION    2710.00 2711.00 2711.50 2712.00 2712.50 2713.00 2713.25 2713.50 2713.75 2714.00

36 SQ          DISCHARGE         0.    1.    3.    4.    5.    5.    9.   16.   24.   34.

                                                    ***

    ***           ***           ***           ***           ***

                   HYDROGRAPH AT STATION   SON05
                  TRANSPOSITION AREA       .0 SQ MI
```

+	2 COMBINED AT	CP09	21.	4.15	2.	1.	1.	.03
+	ROUTED TO	RON10A	20.	4.25	2.	1.	1.	.03
+	HYDROGRAPH AT	OFF11	6.	4.00	0.	0.	0.	.00
+	ROUTED TO	RON11	6.	4.05	0.	0.	0.	.00
+	HYDROGRAPH AT	ON11	1.	4.10	0.	0.	0.	.00
+	2 COMBINED AT	CP11	7.	4.05	0.	0.	0.	.00
+	ROUTED TO	RON10B	6.	4.10	0.	0.	0.	.00
+	HYDROGRAPH AT	ON13	10.	4.05	1.	0.	0.	.01
+	ROUTED TO	RON10D	9.	4.05	1.	0.	0.	.01
+	HYDROGRAPH AT	ON10	4.	4.15	1.	0.	0.	.01
+	5 COMBINED AT	CP10	41.	4.15	4.	1.	1.	.05
+	HYDROGRAPH AT	OFF20	50.	4.20	6.	2.	2.	.08
+	ROUTED TO	RON22A	50.	4.20	6.	2.	2.	.08
+	HYDROGRAPH AT	ON18	19.	4.05	1.	0.	0.	.01
+	ROUTED TO	SON18	4.	4.40	1.	0.	0.	.01
+	DIVERSION TO	DTN18	2.	4.40	1.	0.	0.	.01
+	HYDROGRAPH AT	DON18	2.	4.40	1.	0.	0.	.01
+	HYDROGRAPH AT	ON22	1.	4.20	0.	0.	0.	.00
+	3 COMBINED AT	CP22	53.	4.20	7.	2.	2.	.09
+	ROUTED TO	RON20	53.	4.20	7.	2.	2.	.09
+	HYDROGRAPH AT	ON20	5.	4.00	0.	0.	0.	.00
+	2 COMBINED AT	CP20	55.	4.20	7.	2.	2.	.10
+	HYDROGRAPH AT	OFF25	24.	4.15	3.	1.	1.	.03
+	ROUTED TO	RON25	23.	4.15	3.	1.	1.	.03
+	HYDROGRAPH AT	ON25	1.	4.05	0.	0.	0.	.00
+	2 COMBINED AT	CP25	24.	4.15	3.	1.	1.	.04
+	HYDROGRAPH AT	ON12	3.	4.00	0.	0.	0.	.00
+	HYDROGRAPH AT	DON18	2.	4.40	1.	0.	0.	.01
+	ROUTED TO	RON15	2.	4.45	1.	0.	0.	.01
+	HYDROGRAPH AT	ON15	7.	4.05	1.	0.	0.	.00
+	2 COMBINED AT	CP15	8.	4.05	1.	0.	0.	.00

*** NORMAL END OF HEC-1 ***

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   05DEC17  TIME  20:17:16   *
*                                       *
*****************************************
```

Proposed 100-year

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

   1          ID        Flood Control District of Maricopa County
   2          ID        ASTERIA PROP - ASTERIA PROP
   3          ID        100 YEAR
   4          ID        6 Hour  Storm
   5          ID        Unit Hydrograph: Clark
   6          ID        Storm: Multiple
   7          ID        06/01/2017
              *DIAGRAM
   8          IT      3  1JAN99       0     400
   9          IO      5
  10          IN     15
              *
  11          JD  3.180  0.0001
  12          PC  0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  13          PC  0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  14          PC  0.962   0.972   0.983   0.991   1.000
  15          JD  3.161  0.5000
  16          PC  0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  17          PC  0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  18          PC  0.962   0.972   0.983   0.991   1.000
              *

  19          KK   ON07   BASIN
  20          BA  0.002
  21          LG   0.34    0.36    6.00    0.18       1
  22          UC  0.087   0.077
  23          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  24          UA    100
              *

  25          KK   ON05   BASIN
  26          BA  0.017
  27          LG   0.29    0.30    6.00    0.19      16
  28          UC  0.185   0.227
  29          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  30          UA    100
              *

  31          KK  SON05  STORAGE
  32          KO      3       3
  33          RS      1    STOR
  34          SV    0.0     0.2    0.31    0.44    0.59    0.75    0.83    0.92    1.01    1.11
  35          SE 2710.0 2711.00 2711.50 2712.00 2712.50 2713.00 2713.25 2713.50 2713.75 2714.00
  36          SQ    0.0     1.0     3.0     4.0     5.0     5.0     9.0    16.0    24.0    34.0
              *

  37          KK   OFF05  BASIN
  38          BA  0.005
  39          LG   0.35    0.40    6.00    0.18       0
  40          UC  0.113   0.090
  41          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  42          UA    100
              *
```

1 HEC-1 INPUT PAGE 2

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  43          KK   RON08   ROUTE
  44          RS      1    FLOW
  45          RC  0.035   0.035   0.035     285  0.0562    0.00
  46          RX  10.90   45.60   57.90   60.00   62.80   80.90  106.80  119.50
  47          RY 2749.7 2745.71 2744.30 2743.47 2744.86 2747.52 2749.05 2750.64
              *
```

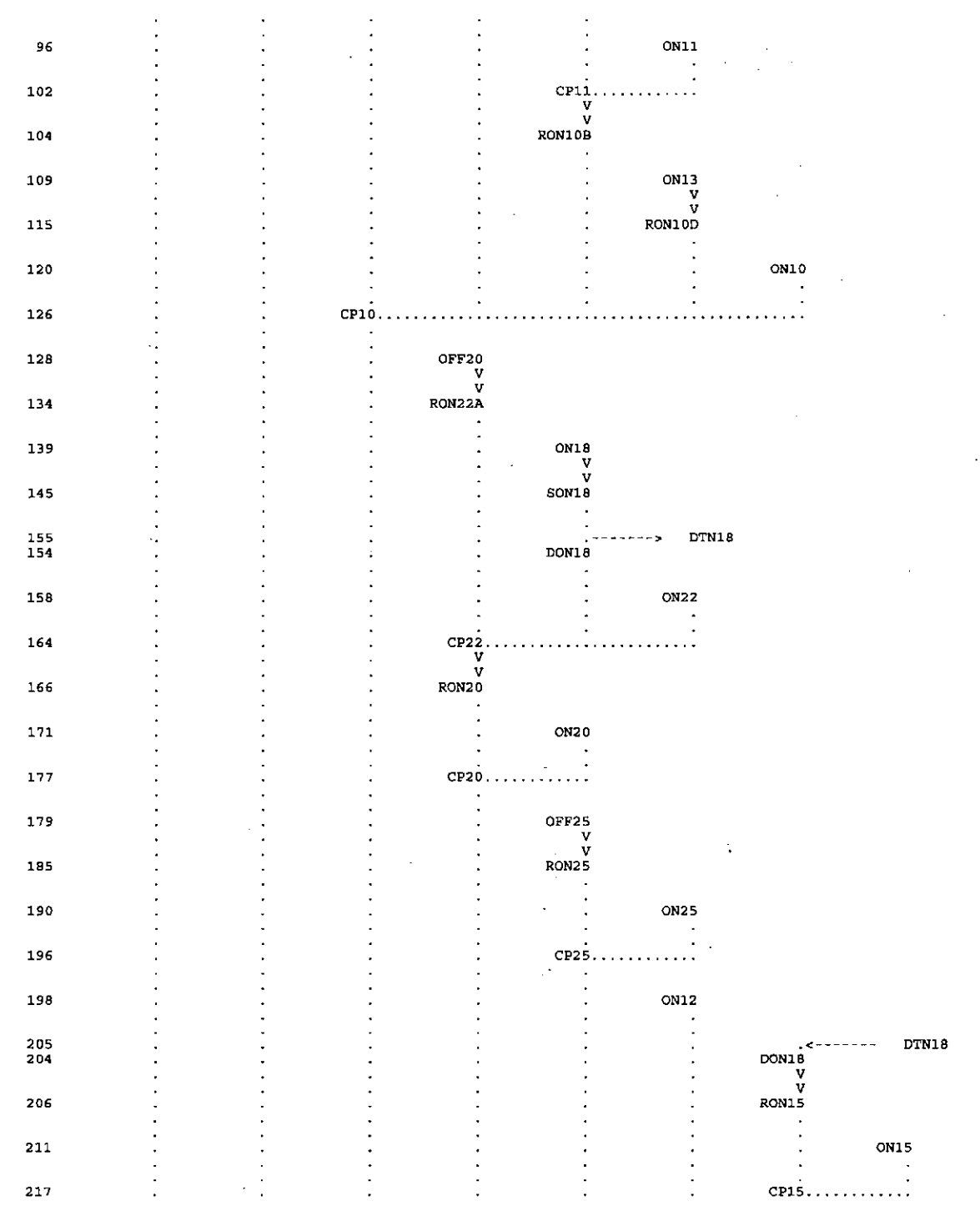
```
   48          KK    ON08   BASIN
   49          BA   0.001
   50          LG    0.35    0.40    6.00    0.18       0
   51          UC   0.120   0.215
   52          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
   53          UA     100
               *

   54          KK    CP08 COMBINE
   55          HC       2
               *

   56          KK  RON10C   ROUTE
   57          RS       1    FLOW
   58          RC   0.035   0.035   0.035    1354  0.0332    0.00
   59          RX   12.60   28.00   47.90   52.40   55.50   67.80   76.30   97.20
   60          RY  2721.0 2718.87 2717.34 2716.24 2717.19 2718.00 2718.06 2719.79
               *

   61          KK   OFF10   BASIN
   62          BA   0.028
   63          LG    0.35    0.40    6.00    0.18       0
   64          UC   0.251   0.295
   65          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
   66          UA     100
               *

   67          KK   RON09   ROUTE
   68          RS       1    FLOW
   69          RC   0.035   0.035   0.035     361  0.0111    0.00
   70          RX    0.00   30.80   47.40   61.80   64.90   69.00   81.20   88.10
   71          RY  2753.6 2749.73 2748.26 2746.45 2747.49 2749.35 2752.43 2753.75
               *

   72          KK    ON09   BASIN
   73          BA   0.001
   74          LG    0.35    0.40    6.00    0.18       0
   75          UC   0.121   0.242
   76          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
   77          UA     100
               *
1                                        HEC-1 INPUT                                        PAGE  3

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   78          KK    CP09 COMBINE
   79          HC       2
               *

   80          KK  RON10A   ROUTE
   81          RS       1    FLOW
   82          RC   0.035   0.035   0.035    1364  0.0374    0.00
   83          RX   23.50   54.60   78.90   83.60   87.30   92.40  111.30  161.10
   84          RY  2742.0 2733.67 2731.88 2730.29 2732.80 2733.37 2735.66 2741.50
               *

   85          KK   OFF11   BASIN
   86          BA  0.0038
   87          LG    0.35    0.40    6.00    0.18       0
   88          UC   0.103   0.082
   89          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
   90          UA     100
               *

   91          KK   RON11   ROUTE
   92          RS       1    FLOW
   93          RC   0.035   0.035   0.035     329  0.0243    0.00
   94          RX   35.90   50.00   57.80   62.40   64.10   65.90   69.50   74.20
   95          RY  2761.4 2759.24 2758.33 2757.03 2757.56 2758.16 2758.70 2759.53
               *

   96          KK    ON11   BASIN
   97          BA   0.001
   98          LG    0.35    0.40    6.00    0.18       0
   99          UC   0.132   0.292
  100          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  101          UA     100
               *

  102          KK    CP11 COMBINE
  103          HC       2
               *

  104          KK  RON10B   ROUTE
  105          RS       1    FLOW
  106          RC   0.035   0.035   0.035    1599  0.0375    0.00
  107          RX   23.50   54.60   78.90   83.60   87.30   92.40  111.30  161.10
  108          RY  2742.0 2733.67 2731.88 2730.29 2732.80 2733.37 2735.66 2741.50
               *

  109          KK    ON13   BASIN
  110          BA   0.006
  111          LG    0.28    0.28    6.00    0.20      23
  112          UC   0.114   0.113
  113          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  114          UA     100
               *
1                                        HEC-1 INPUT                                        PAGE  4

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
115          KK  RON10D   ROUTE
116          RS      1    FLOW
117          RC  0.035   0.035   0.035     533  0.0488    0.00
118          RX  27.90   27.90   44.00   63.60   66.50   74.50   94.90  125.60
119          RY 2715.0 2711.32 2707.83 2707.15 2708.37 2708.33 2709.32 2717.00
             *

120          KK   ON10   BASIN
121          BA  0.007
122          LG   0.35    0.40    6.00    0.17       1
123          UC  0.216   0.390
124          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
125          UA    100
             *

126          KK   CP10 COMBINE
127          HC      5
             *

128          KK   OFF20   BASIN
129          BA  0.077
130          LG   0.35    0.40    6.00    0.18       0
131          UC  0.305   0.328
132          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
133          UA    100
             *

134          KK  RON22A   ROUTE
135          RS      1    FLOW
136          RC  0.035   0.035   0.035     381  0.0315    0.00
137          RX   0.00   60.50   72.00   88.30   94.50  100.00  113.70  161.00
138          RY 2741.8 2740.72 2740.72 2738.78 2738.91 2740.99 2743.04 2748.80
             *

139          KK   ON18   BASIN
140          BA  0.013
141          LG   0.29    0.26    6.00    0.21      20
142          UC  0.145   0.136
143          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
144          UA    100
             *

145          KK  SON18 STORAGE
146          KO      3       3
147          RS      1    STOR
148          SV          0.10    0.24    0.39    0.56    0.73    0.92    1.12    1.33    1.56
149          SV   1.67    1.80    1.92    2.05
150          SE 2732.6 2733.00 2733.50 2734.00 2734.50 2735.00 2735.50 2736.00 2736.50 2737.00
151          SE 2737.3 2737.50 2737.75 2738.00
152          SQ    0.0     0.0     1.0     3.0     4.0     5.0     5.0     6.0     7.0     7.0
153          SQ   21.0    46.0    78.0   116.0
             *
```



```
LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

154          KK   DON18  DIVERT
155          DT   DTN18    0.30   100.0
156          DI     0.0     1.0     3.0     4.0     5.0     6.0     7.0    21.0    46.0    78.0
157          DQ     0.0     0.5     1.5     2.0     2.5     3.0     3.5    10.5    23.0    39.0
             *

158          KK   ON22   BASIN
159          BA  0.003
160          LG   0.35    0.40    6.00    0.18       0
161          UC  0.239   0.704
162          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
163          UA    100
             *

164          KK   CP22 COMBINE
165          HC      3
             *

166          KK  RON20   ROUTE
167          RS      1    FLOW
168          RC  0.035   0.035   0.035     226  0.0354    0.00
169          RX   0.00   67.00   78.70   95.90  103.60  109.20  130.20  221.40
170          RY 2739.0 2729.44 2728.38 2725.60 2725.84 2727.71 2727.42 2738.58
             *

171          KK   ON20   BASIN
172          BA  0.003
173          LG   0.28    0.34    6.00    0.19      20
174          UC  0.095   0.099
175          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
176          UA    100
             *

177          KK   CP20 COMBINE
178          HC      2
             *

179          KK   OFF25   BASIN
180          BA  0.034
181          LG   0.35    0.40    6.00    0.18       0
182          UC  0.253   0.318
183          UA      0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
184          UA    100
             *

185          KK  RON25   ROUTE
```

```
          186          RS       1    FLOW
          187          RC   0.035   0.035   0.035     219  0.0411    0.00
          188          RX    0.00   33.10   62.10   77.00   81.70   84.60  140.40  158.60
          189          RY  2739.5 2736.34 2734.18 2733.23 2733.44 2733.82 2737.85 2739.50
                       *
1                                          HEC-1 INPUT                                    PAGE  6

        LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          190          KK    ON25   BASIN
          191          BA   0.001
          192          LG    0.29    0.40    6.00    0.17      19
          193          UC   0.103   0.182
          194          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          195          UA     100
                       *

          196          KK    CP25 COMBINE
          197          HC       2
                       *

          198          KK    ON12   BASIN
          199          BA   0.002
          200          LG    0.31    0.35    6.00    0.19      13
          201          UC   0.094   0.110
          202          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          203          UA     100
                       *

          204          KK   DON18RETRIEVE
          205          DR   DTN18
                       *

          206          KK   RON15   ROUTE
          207          RS       1    FLOW
          208          RC   0.035   0.035   0.035     483  0.0518    0.00
          209          RX    0.00   34.00   36.80   42.90   43.00   45.70   50.00   83.90
          210          RY  2722.2 2717.32 2717.22 2715.48 2715.48 2716.96 2719.25 2728.77
                       *

          211          KK    ON15   BASIN
          212          BA  0.0047
          213          LG    0.29    0.37    6.00    0.18      19
          214          UC   0.119   0.122
          215          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          216          UA     100
                       *

          217          KK    CP15 COMBINE
          218          HC       2
                       *
          219          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING           (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR         (<---) RETURN OF DIVERTED OR PUMPED FLOW

    19        ON07
                .
                .
    25          .         ON05
                .            V
                .            V
    31          .       SON05
                .          .
                .          .
    37          .          .       OFF05
                .          .          V
                .          .          V
    43          .          .       RON08
                .          .          .
                .          .          .
    48          .          .          .        ON08
                .          .          .          .
                .          .          .          .
    54          .          .        CP08.........
                .          .          V
                .          .          V
    56          .          .       RON10C
                .          .          .
                .          .          .
    61          .          .          .       OFF10
                .          .          .          V
                .          .          .          V
    67          .          .          .       RON09
                .          .          .          .
                .          .          .          .
    72          .          .          .          .        ON09
                .          .          .          .          .
                .          .          .          .          .
    78          .          .          .        CP09.........
                .          .          .          V
                .          .          .          V
    80          .          .          .       RON10A
                .          .          .          .
                .          .          .          .
    85          .          .          .          .       OFF11
                .          .          .          .          V
                .          .          .          .          V
    91          .          .          .          .       RON11
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE   05DEC17  TIME  20:17:16   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*          (916) 756-1104               *
*                                       *
*****************************************
```

Flood Control District of Maricopa County
ASTERIA PROP - ASTERIA PROP
100 YEAR
6 Hour Storm
Unit Hydrograph: Clark
Storm: Multiple
06/01/2017

```
 9 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                    NMIN           3  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1JAN99  STARTING DATE
                   ITIME        0000  STARTING TIME
                      NQ         400  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1JAN99  ENDING DATE
                  NDTIME        1957  ENDING TIME
                   ICENT          19  CENTURY MARK

                COMPUTATION INTERVAL      .05 HOURS
                    TOTAL TIME BASE   19.95 HOURS

       ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT

11 JD         INDEX STORM NO. 1
                    STRM        3.18  PRECIPITATION DEPTH
                    TRDA         .00  TRANSPOSITION DRAINAGE AREA

12 PI           PRECIPITATION PATTERN
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .02   .02   .02   .02   .02
                .03   .03   .03   .03   .03   .09   .09   .09   .09   .09
                .02   .02   .02   .02   .02   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

15 JD         INDEX STORM NO. 2
                    STRM        3.16  PRECIPITATION DEPTH
                    TRDA         .50  TRANSPOSITION DRAINAGE AREA

16 PI           PRECIPITATION PATTERN
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .02   .02   .02   .02   .02
                .03   .03   .03   .03   .03   .09   .09   .09   .09   .09
                .02   .02   .02   .02   .02   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
                .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
31 KK     *    SON05   *      STORAGE
          *            *
          **************

32 KO         OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          3  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

           HYDROGRAPH ROUTING DATA

33 RS         STORAGE ROUTING
                    NSTPS          1  NUMBER OF SUBREACHES
                     ITYP       STOR  TYPE OF INITIAL CONDITION
                   RSVRIC         .00  INITIAL CONDITION
                        X         .00 WORKING R AND D COEFFICIENT

34 SV           STORAGE          .0       .2       .3       .4       .6       .8       .8       .9      1.0      1.1

35 SE         ELEVATION     2710.00  2711.00  2711.50  2712.00  2712.50  2713.00  2713.25  2713.50  2713.75  2714.00

36 SQ         DISCHARGE          0.       1.       3.       4.       5.       5.       9.      16.      24.      34.

                                                    ***

    ***             ***             ***             ***             ***

                  HYDROGRAPH AT STATION   SON05
                 TRANSPOSITION AREA       .0 SQ MI
```

```
  PEAK FLOW     TIME                             MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR      19.95-HR
+    (CFS)      (HR)
                            (CFS)
+       20.     4.30                      3.           1.          1.           1.
                          (INCHES)     1.804        1.907       1.907        1.907
                           (AC-FT)        2.           2.          2.           2.

 PEAK STORAGE   TIME                           MAXIMUM AVERAGE STORAGE
                                        6-HR        24-HR       72-HR      19.95-HR
+  (AC-FT)      (HR)
        1.      4.30                      0.           0.          0.           0.

  PEAK STAGE    TIME                            MAXIMUM AVERAGE STAGE
                                        6-HR        24-HR       72-HR      19.95-HR
+   (FEET)      (HR)
   2713.61      4.30                 2711.48      2710.50     2710.50      2710.50

                           CUMULATIVE AREA =      .02 SQ MI

       ***              ***         ***           ***           ***

                            HYDROGRAPH AT STATION    SON05
                          TRANSPOSITION AREA        .5 SQ MI

  PEAK FLOW     TIME                             MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR      19.95-HR
+    (CFS)      (HR)
                            (CFS)
+       19.     4.30                      3.           1.          1.           1.
                          (INCHES)     1.788        1.891       1.891        1.891
                           (AC-FT)        2.           2.          2.           2.

 PEAK STORAGE   TIME                           MAXIMUM AVERAGE STORAGE
                                        6-HR        24-HR       72-HR      19.95-HR
+  (AC-FT)      (HR)
        1.      4.30                      0.           0.          0.           0.

  PEAK STAGE    TIME                            MAXIMUM AVERAGE STAGE
                                        6-HR        24-HR       72-HR      19.95-HR
+   (FEET)      (HR)
   2713.61      4.30                 2711.47      2710.50     2710.50      2710.50

                           CUMULATIVE AREA =      .02 SQ MI

       ***              ***         ***           ***           ***


                           INTERPOLATED HYDROGRAPH AT    SON05

  PEAK FLOW     TIME                             MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR      19.95-HR
+    (CFS)      (HR)
                            (CFS)
+       19.     4.30                      3.           1.          1.           1.
                          (INCHES)     1.795        1.897       1.897        1.897
                           (AC-FT)        2.           2.          2.           2.

                           CUMULATIVE AREA =      .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 145 KK       *   SON18    *      STORAGE
              *            *
              **************

 146 KO           OUTPUT CONTROL VARIABLES
                        IPRNT          3  PRINT CONTROL
                        IPLOT          3  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE

                HYDROGRAPH ROUTING DATA

 147 RS           STORAGE ROUTING
                        NSTPS          1  NUMBER OF SUBREACHES
                        ITYP        STOR  TYPE OF INITIAL CONDITION
                       RSVRIC        .00  INITIAL CONDITION
                            X        .00  WORKING R AND D COEFFICIENT

 148 SV            STORAGE          .0         .1         .2         .4         .6         .7         .9        1.1        1.3        1.6
                                   1.7        1.8        1.9        2.0

 150 SE           ELEVATION    2732.60    2733.00    2733.50    2734.00    2734.50    2735.00    2735.50    2736.00    2736.50    2737.00
                               2737.30    2737.50    2737.75    2738.00

 152 SQ           DISCHARGE         0.         0.         1.         3.         4.         5.         5.         6.         7.         7.
                                   21.        46.        78.       116.
                                                                 ***

      ***              ***         ***           ***           ***

                            HYDROGRAPH AT STATION    SON18
                          TRANSPOSITION AREA        .0 SQ MI
```

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	19.95-HR
+ (CFS)	(HR)					
		(CFS)				
+ 6.	4.40		2.	1.	1.	1.
		(INCHES)	1.770	1.824	1.824	1.824
		(AC-FT)	1.	1.	1.	1.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	19.95-HR
+ (AC-FT)	(HR)					
1.	4.40		0.	0.	0.	0.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
			6-HR	24-HR	72-HR	19.95-HR
+ (FEET)	(HR)					
2735.84	4.40		2734.07	2733.28	2733.28	2733.28

CUMULATIVE AREA = .01 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION SON18
TRANSPOSITION AREA .5 SQ MI

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	19.95-HR
+ (CFS)	(HR)					
		(CFS)				
+ 6.	4.40		2.	1.	1.	1.
		(INCHES)	1.755	1.809	1.809	1.809
		(AC-FT)	1.	1.	1.	1.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	19.95-HR
+ (AC-FT)	(HR)					
1.	4.40		0.	0.	0.	0.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
			6-HR	24-HR	72-HR	19.95-HR
+ (FEET)	(HR)					
2735.82	4.40		2734.06	2733.28	2733.28	2733.28

CUMULATIVE AREA = .01 SQ MI

*** *** *** *** ***

INTERPOLATED HYDROGRAPH AT SON18

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	19.95-HR
+ (CFS)	(HR)					
		(CFS)				
+ 6.	4.40		2.	1.	1.	1.
		(INCHES)	1.762	1.815	1.815	1.815
		(AC-FT)	1.	1.	1.	1.

CUMULATIVE AREA = .01 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	ON07	6.	4.00	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON05	38.	4.05	3.	1.	1.	.02		
+	ROUTED TO	SON05	19.	4.30	3.	1.	1.	.02		
+	HYDROGRAPH AT	OFF05	15.	4.00	1.	0.	0.	.00		
+	ROUTED TO	RON08	15.	4.00	1.	0.	0.	.00		
+	HYDROGRAPH AT	ON08	2.	4.05	0.	0.	0.	.00		
+	2 COMBINED AT	CP08	17.	4.00	1.	0.	0.	.01		
+	ROUTED TO	RON10C	15.	4.05	1.	0.	0.	.01		
+	HYDROGRAPH AT	OFF10	50.	4.10	5.	1.	1.	.03		
+	ROUTED TO	RON09	49.	4.10	5.	1.	1.	.03		
+	HYDROGRAPH AT	ON09	2.	4.05	0.	0.	0.	.00		

+	2 COMBINED AT	CP09	51.	4.10	5.	1.	1.	.03
+	ROUTED TO	RON10A	49.	4.15	5.	1.	1.	.03
+	HYDROGRAPH AT	OFF11	12.	4.00	1.	0.	0.	.00
+	ROUTED TO	RON11	11.	4.00	1.	0.	0.	.00
+	HYDROGRAPH AT	ON11	2.	4.05	0.	0.	0.	.00
+	2 COMBINED AT	CP11	13.	4.00	1.	0.	0.	.00
+	ROUTED TO	RON10B	12.	4.05	1.	0.	0.	.00
+	HYDROGRAPH AT	ON13	18.	4.00	1.	0.	0.	.01
+	ROUTED TO	RON10D	17.	4.05	1.	0.	0.	.01
+	HYDROGRAPH AT	ON10	11.	4.10	1.	0.	0.	.01
+	5 COMBINED AT	CP10	98.	4.10	9.	3.	3.	.05
+	HYDROGRAPH AT	OFF20	125.	4.10	13.	4.	4.	.08
+	ROUTED TO	RON22A	124.	4.15	13.	4.	4.	.08
+	HYDROGRAPH AT	ON18	35.	4.00	3.	1.	1.	.01
+	ROUTED TO	SON18	6.	4.40	2.	1.	1.	.01
+	DIVERSION TO	DTN18	3.	4.40	1.	0.	0.	.01
+	HYDROGRAPH AT	DON18	5.	5.35	2.	1.	1.	.01
+	HYDROGRAPH AT	ON22	3.	4.10	1.	0.	0.	.00
+	3 COMBINED AT	CP22	130.	4.15	15.	5.	5.	.09
+	ROUTED TO	RON20	131.	4.15	15.	5.	5.	.09
+	HYDROGRAPH AT	ON20	9.	4.00	1.	0.	0.	.00
+	2 COMBINED AT	CP20	134.	4.15	16.	5.	5.	.10
+	HYDROGRAPH AT	OFF25	58.	4.10	6.	2.	2.	.03
+	ROUTED TO	RON25	58.	4.10	6.	2.	2.	.03
+	HYDROGRAPH AT	ON25	3.	4.00	0.	0.	0.	.00
+	2 COMBINED AT	CP25	60.	4.10	6.	2.	2.	.04
+	HYDROGRAPH AT	ON12	6.	4.00	0.	0.	0.	.00
+	HYDROGRAPH AT	DON18	3.	4.40	1.	0.	0.	.01
+	ROUTED TO	RON15	3.	4.40	1.	0.	0.	.01
+	HYDROGRAPH AT	ON15	13.	4.00	1.	0.	0.	.00
+	2 COMBINED AT	CP15	15.	4.00	2.	0.	0.	.00

*** NORMAL END OF HEC-1 ***

Appendix C Stormwater Waiver

Request for Stormwater Storage Waiver

City of Scottsdale Case Numbers:

___ - PA - ____ ____ - ZN - ____ ____ - UP - ____ ____ - DR - ___ ____ - PP - ____ PC#_____

*The applicant/developer must complete and submit this form to the city for processing and obtain approval of waiver request **before submitting improvement plans**.* Denial of the waiver may require the developer to submit a revised site plan to the Development Review Board.

Date 2/17/2017 **Project Name** Asteria Highlands

Project Location East of 128th Street, North of Pinnacle Peak Road alighment.

Applicant Contact Zach Schmidt, P.E., CFM **Company Name** Kimley-Horn

Phone 602-906-1116 Fax _____ E-mail zach.schmidt@kimley-horn.com

Address 7740 N. 16th Street, Suite 300, Phoenix, AZ 85020

Waiver Criteria

A project must meet at least one of three criteria listed below for the city to consider waiving some or all required stormwater storage. **However, regardless of the criteria, a waiver will only be granted if the applicant can demonstrate that the effect of a waiver will not increase the potential for flooding on any property.** Check the applicable box and provide a signed engineering report and supporting engineering analysis that demonstrate the project meets the criteria and that the effect of a waiver will not increase the potential for flooding on any property.

If the runoff for the project has been included in a storage facility at another location, the applicant must demonstrate that the stormwater storage facility was specifically designed to accommodate runoff from the subject property and that the runoff will be conveyed to this location through an adequately designed conveyance facility.

☐ 1. The development is adjacent to a conveyance facility that an engineering analysis shows is designed and constructed to handle the additional runoff from the site as a result of development.

☐ 2. The development is on a parcel less than one-half acre in size.

☑ 3. Stormwater storage requirements conflict with requirements of the Environmentally Sensitive Lands Ordinance (ESLO).

For a full storage waiver, a conflict with ESLO is limited to:

- Property located in the hillside landform as defined in the city Zoning Ordinance
- Property in the upper desert landform that has a land slope steeper than 5% as defined in the city Zoning Ordinance
- Property within the ESL zoning overlay district where the only viable location for a stormwater storage basin requires blasting

This full waiver only applies to those portions of property meeting one of these three requirements.

Partial waivers are available for projects or portions of properties within the Environmentally Sensitive Lands Zoning Overlay District, not meeting any of the three full waiver criteria above, if post-development peak discharge rates do not exceed pre-development conditions, based on the 10- and 100-year storm events.

By signing below, I certify that the stated project meets the waiver criteria selected above as demonstrated by the attached documentation.

Zachary Schmidt
Engineer

12/15/2017
Date

Planning, Neighborhood & Transportation Division

7447 E Indian School Road, Suite 105, Scottsdale, AZ 85251 • Phone: 480-312-2500 • Fax: 480-312-7781

Request for Stormwater Storage Waiver

City of Scottsdale Case Numbers:

___ - PA - ___ ___ - ZN - ___ ___ - UP - ___ ___ - DR - ___ 6 - PP - 2016 PC# ___

CITY STAFF TO COMPLETE THIS PAGE

Project Name _____

Check Appropriate Boxes:

☐ Meets waiver criteria (specify): ☐ 1 ☐ 2 ☐ 3

☐ Recommend approve waiver.

☐ Recommend deny waiver:
- ☐ None of waiver criteria met.
- ☐ Downstream conditions prohibit waiver of any storage.
- ☐ Other:

Explain: _____

_____

☐ Return waiver request:
- ☐ Insufficient data provided.
- ☐ Other: _____

Explain: _____

_____

Recommended Conditions of Waiver:
- ☐ All storage requirements waived.
- ☐ Post-development peak discharge rates do not exceed pre-development conditions.
- ☐ Other:

Explain: _____

_____

☐ **Waiver approved per above conditions.**

☐ **Waiver denied.**

_____ _____

Floodplain Administrator or Designee Date

Planning, Neighborhood & Transportation Division

7447 E Indian School Road, Suite 105, Scottsdale, AZ 85251 • Phone: 480-312-2500 • Fax: 480-312-7781

Request for Stormwater Storage Waiver

City of Scottsdale Case Numbers:

___ - PA - ___ ___ - ZN - ___ ___ - UP - ___ ___ - DR - ___ 6 - PP - 2016 PC# ___

In-Lieu Fee and In-Kind Contributions

In-lieu fees are only applicable to projects where post-development peak discharge rates exceed pre-development levels, based on the 10- and 100-year storm events. If the city grants a waiver, the developer is required to calculate and contribute an in-lieu fee based on what it would cost the city to provide a storage basin, sized as described below, including costs such as land acquisition, construction, landscaping, design, construction management, and maintenance over a 75-year design life. The fee for this cost is $1.87 per cubic foot of stormwater storage for a virtual storage basin designed to mitigate the increase in runoff associated with the 100-year/2-hour storm event. The applicant may submit site-specific in-lieu fee calculations subject to the Floodplain Administrator's approval.

The Floodplain Administrator considers in-kind contributions on a case-by-case basis. An in-kind contribution can serve as part of or instead of the calculated in-lieu fee. In-kind contributions must be stormwater related and must constitute a public benefit. In-lieu fees and in-kind contributions are subject to the approval of the Floodplain Administrator or designee.

Project Name _____

The waived stormwater storage volume is calculated using a simplified approach as follows:

$V = \Delta CRA$; where

V = stormwater storage volume required, in cubic feet,
ΔC = increase in weighted average runoff coefficient over disturbed area ($C_{post} - C_{pre}$),
R = 100-year/2-hour precipitation depth, in feet (DSPM, Appendix 4-1D, page 11), and
A = area of disturbed ground, in square feet

Furthermore,

$V_w = V - V_p$; where
V_w = volume waived,
V = volume required, and
V_p = volume provided

R = _____
ΔC= _____
A = _____
V = _____
V_p= _____
V_w= _____

☐ An in-lieu fee will be paid, based on the following calculations and supporting documentation:
In-lieu fee ($) = V_w (cu. ft.) x $1.87 per cubic foot = _____

☐ An in-kind contribution will be made, as follows:

_____
_____
_____

☐ No in-lieu fee is required. Reason:

_____
_____

Approved by:

_____ _____
Floodplain Administrator or Designee Date

Planning, Neighborhood & Transportation Division
7447 E Indian School Road, Suite 105, Scottsdale, AZ 85251 • Phone: 480-312-2500 • Fax: 480-312-7781

Appendix D Hydraulic Analysis

- *CP10 Normal Depth Analysis*
- *HEC-RAS Results*

Appendix D Hydraulic Analysis

- *CP10 Normal Depth Analysis*

Worksheet for Pre CP10 2-year Downstream XS

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02850	ft/ft
Discharge	14.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2705.53
0+10	2704.39
0+58	2695.63
0+67	2695.47
0+73	2695.71
0+79	2696.28
0+99	2696.89
1+62	2701.34
1+86	2703.56

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2705.53)	(1+86, 2703.56)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.39	ft
Elevation Range	2695.47 to 2705.53 ft	
Flow Area	4.79	ft²
Wetted Perimeter	18.39	ft

Worksheet for Pre CP10 2-year Downstream XS

Results

Hydraulic Radius	0.26	ft
Top Width	18.36	ft
Normal Depth	0.39	ft
Critical Depth	0.39	ft
Critical Slope	0.02795	ft/ft
Velocity	2.92	ft/s
Velocity Head	0.13	ft
Specific Energy	0.52	ft
Froude Number	1.01	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.39	ft
Critical Depth	0.39	ft
Channel Slope	0.02850	ft/ft
Critical Slope	0.02795	ft/ft

Cross Section for Pre CP10 2-year Downstream XS

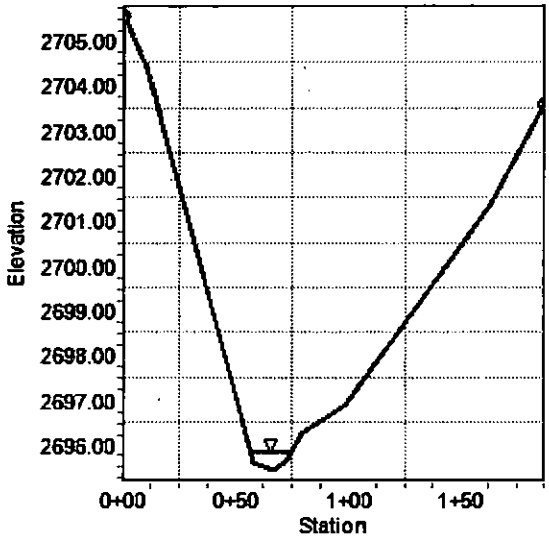
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02850	ft/ft
Normal Depth	0.39	ft
Discharge	14.00	ft³/s

Cross Section Image



Worksheet for Post CP10 2-year Downstream XS

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02850	ft/ft
Discharge	15.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2705.53
0+10	2704.39
0+58	2695.63
0+67	2695.47
0+73	2695.71
0+79	2696.28
0+99	2696.89
1+62	2701.34
1+86	2703.56

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2705.53)	(1+86, 2703.56)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.40	ft
Elevation Range	2695.47 to 2705.53 ft	
Flow Area	5.01	ft²
Wetted Perimeter	18.59	ft

Worksheet for Post CP10 2-year Downstream XS

Results

Hydraulic Radius		0.27	ft
Top Width		18.55	ft
Normal Depth		0.40	ft
Critical Depth		0.40	ft
Critical Slope		0.02761	ft/ft
Velocity		2.99	ft/s
Velocity Head		0.14	ft
Specific Energy		0.54	ft
Froude Number		1.01	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.40	ft
Critical Depth	0.40	ft
Channel Slope	0.02850	ft/ft
Critical Slope	0.02761	ft/ft

Cross Section for Post CP10 2-year Downstream XS

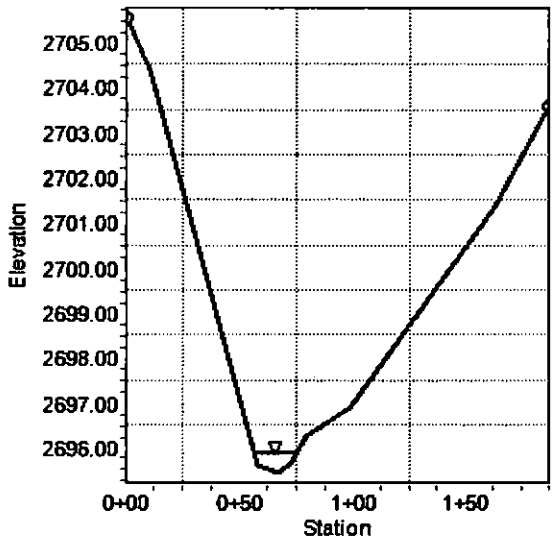
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02850	ft/ft
Normal Depth	0.40	ft
Discharge	15.00	ft³/s

Cross Section Image



Worksheet for Pre CP10 10-year Downstream XS

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02850	ft/ft
Discharge	40.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2705.53
0+10	2704.39
0+58	2695.63
0+67	2695.47
0+73	2695.71
0+79	2696.28
0+99	2696.89
1+62	2701.34
1+86	2703.56

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2705.53)	(1+86, 2703.56)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.63	ft
Elevation Range	2695.47 to 2705.53 ft	
Flow Area	9.72	ft²
Wetted Perimeter	22.32	ft

Worksheet for Pre CP10 10-year Downstream XS

Results

Hydraulic Radius		0.44	ft
Top Width		22.25	ft
Normal Depth		0.63	ft
Critical Depth		0.66	ft
Critical Slope		0.02325	ft/ft
Velocity		4.12	ft/s
Velocity Head		0.26	ft
Specific Energy		0.89	ft
Froude Number		1.10	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.63	ft
Critical Depth	0.66	ft
Channel Slope	0.02850	ft/ft
Critical Slope	0.02325	ft/ft

Cross Section for Pre CP10 10-year Downstream XS

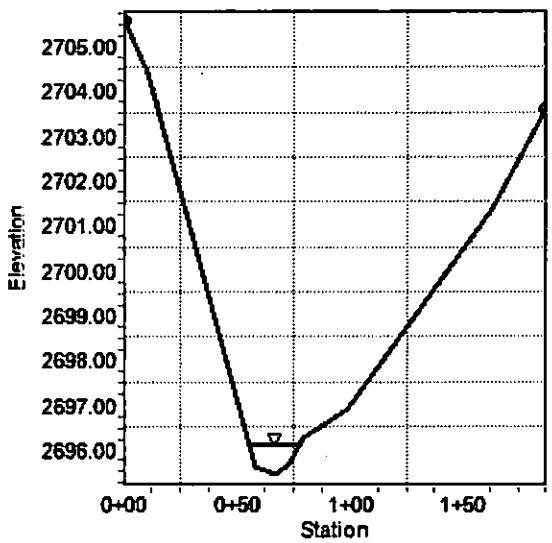
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02850	ft/ft
Normal Depth	0.63	ft
Discharge	40.00	ft³/s

Cross Section Image



Worksheet for Post CP10 10-year Downstream XS

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02850	ft/ft
Discharge	41.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2705.53
0+10	2704.39
0+58	2695.63
0+67	2695.47
0+73	2695.71
0+79	2696.28
0+99	2696.89
1+62	2701.34
1+86	2703.56

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2705.53)	(1+86, 2703.56)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.64	ft
Elevation Range	2695.47 to 2705.53 ft	
Flow Area	9.88	ft²
Wetted Perimeter	22.44	ft

Worksheet for Post CP10 10-year Downstream XS

Results

Hydraulic Radius		0.44	ft
Top Width		22.37	ft
Normal Depth		0.64	ft
Critical Depth		0.67	ft
Critical Slope		0.02316	ft/ft
Velocity		4.15	ft/s
Velocity Head		0.27	ft
Specific Energy		0.90	ft
Froude Number		1.10	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.64	ft
Critical Depth	0.67	ft
Channel Slope	0.02850	ft/ft
Critical Slope	0.02316	ft/ft

Cross Section for Post CP10 10-year Downstream XS

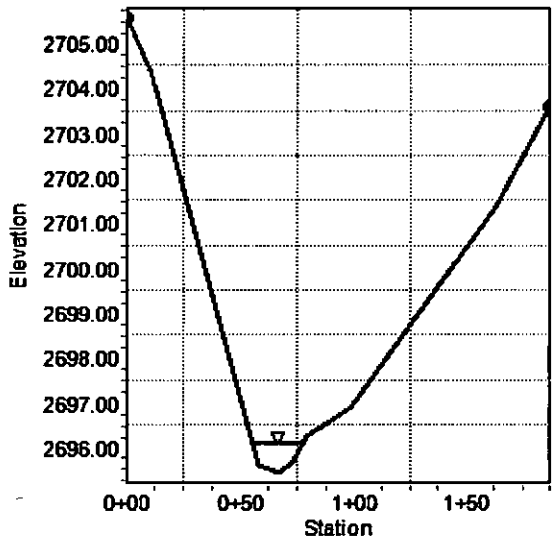
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02850	ft/ft
Normal Depth	0.64	ft
Discharge	41.00	ft³/s

Cross Section Image



Appendix D Hydraulic Analysis

- *HEC-RAS Results*

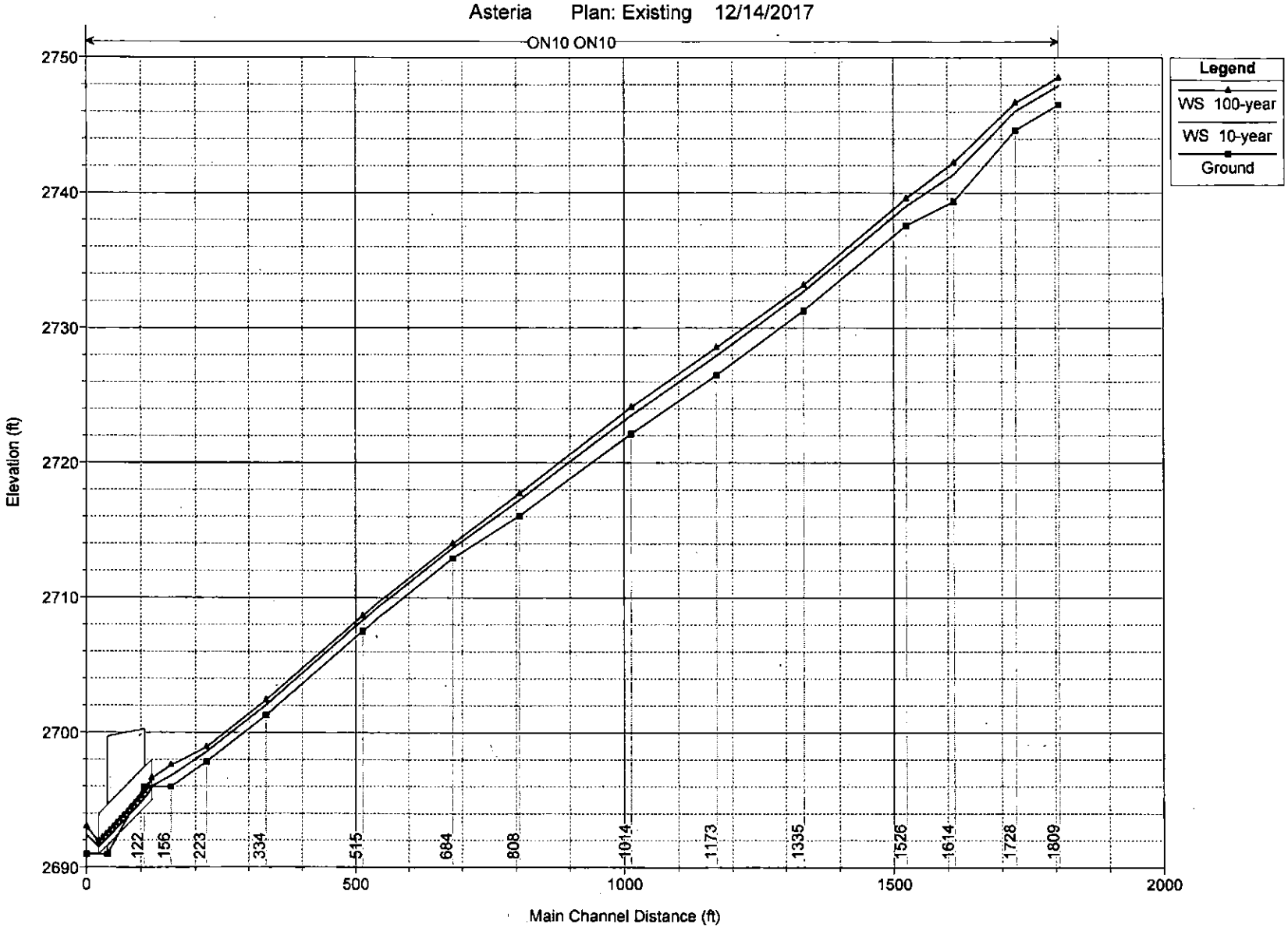
Existing Conditions Model

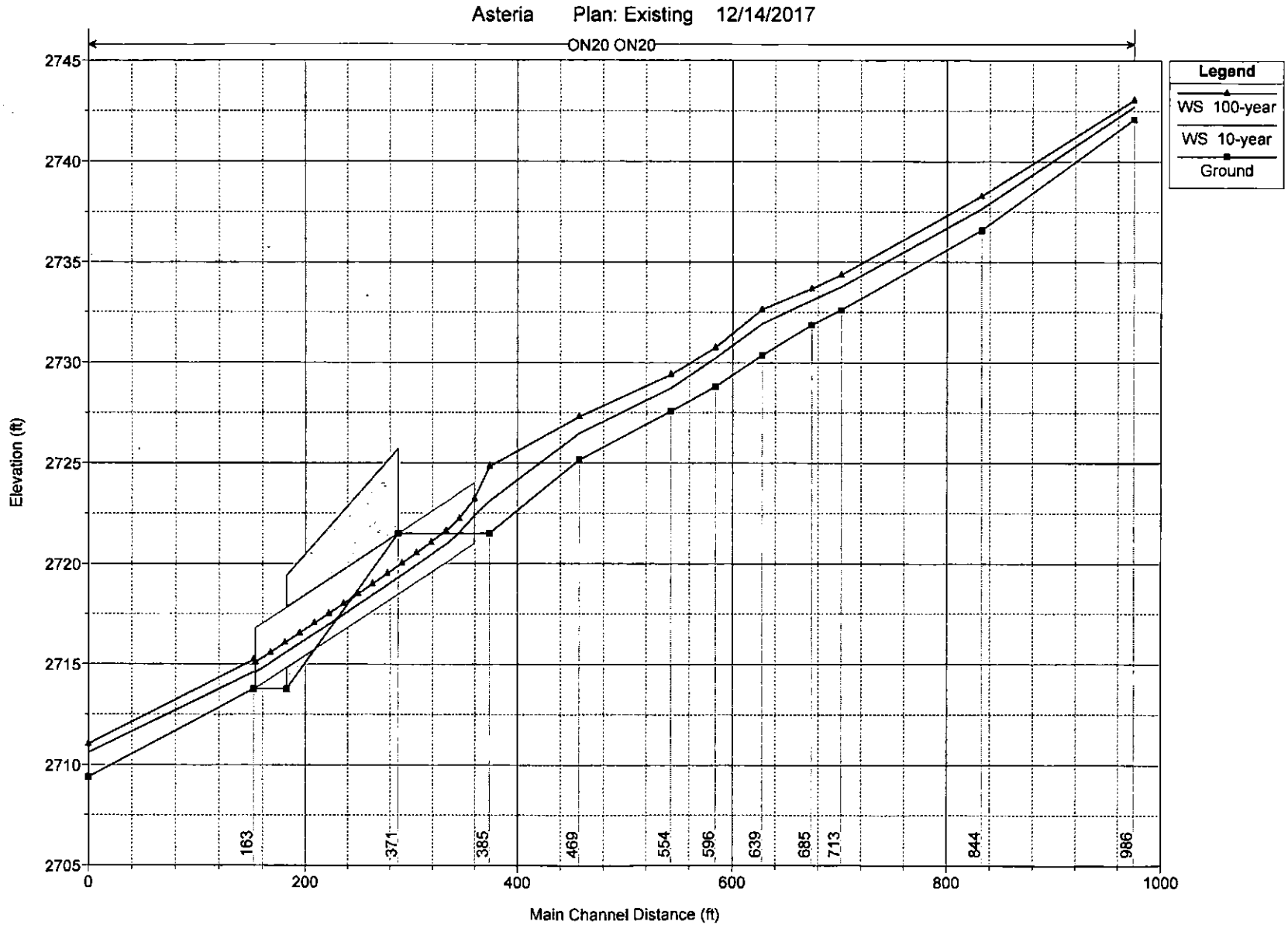
HEC-RAS Plan: EX

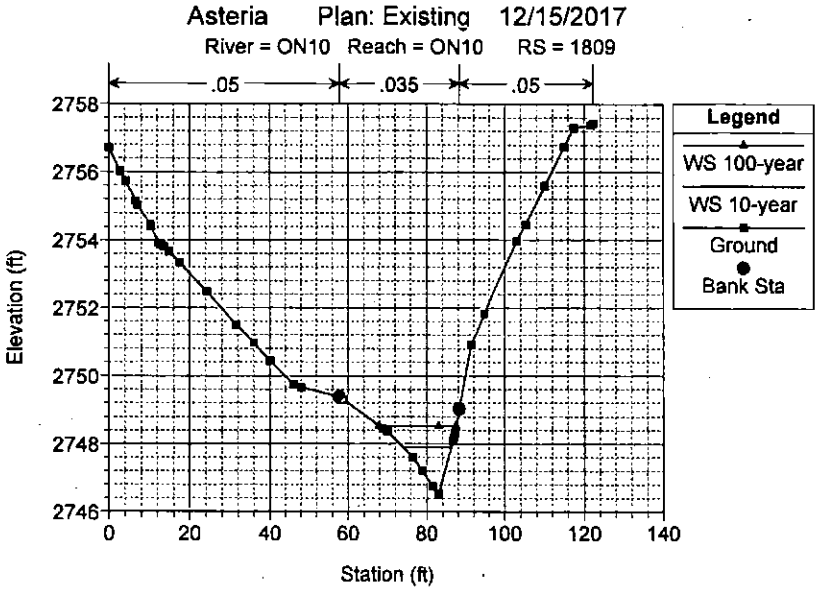
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
ON20	ON20	986	10-year	56.00	2742.07	2742.71	2742.71	2742.89	0.021631	3.54	17.05	53.10	0.95
ON20	ON20	986	100-year	138.00	2742.07	2743.03	2743.03	2743.29	0.015771	4.39	39.40	81.17	0.90
ON20	ON20	844	10-year	56.00	2736.57	2737.64	2737.64	2738.01	0.020927	4.88	11.48	15.84	1.01
ON20	ON20	844	100-year	138.00	2736.57	2738.27	2738.27	2738.80	0.018428	5.83	23.68	22.66	1.00
ON20	ON20	713	10-year	56.00	2732.61	2733.77	2733.77	2734.12	0.020772	4.76	11.77	16.96	1.01
ON20	ON20	713	100-year	138.00	2732.61	2734.37	2734.37	2734.91	0.018032	5.90	23.41	22.83	1.01
ON20	ON20	685	10-year	56.00	2731.86	2733.09	2733.09	2733.41	0.017755	4.59	12.86	23.85	0.94
ON20	ON20	685	100-year	138.00	2731.86	2733.67	2733.67	2734.08	0.011832	5.52	32.40	44.48	0.85
ON20	ON20	639	10-year	56.00	2730.35	2731.92	2731.92	2732.31	0.019801	5.05	11.30	16.83	0.99
ON20	ON20	639	100-year	138.00	2730.35	2732.63	2732.63	2733.08	0.011498	5.72	31.07	39.99	0.83
ON20	ON20	596	10-year	56.00	2728.80	2730.21	2730.21	2730.52	0.023852	4.45	12.59	21.58	1.03
ON20	ON20	596	100-year	138.00	2728.80	2730.73	2730.73	2731.17	0.021359	5.33	25.90	30.97	1.03
ON20	ON20	554	10-year	56.00	2727.58	2728.73	2728.73	2729.11	0.021039	4.95	11.32	15.31	1.01
ON20	ON20	554	100-year	138.00	2727.58	2729.40	2729.40	2729.95	0.018133	5.98	23.09	20.95	1.00
ON20	ON20	469	10-year	56.00	2725.16	2726.47	2726.47	2726.91	0.018991	5.31	10.54	21.14	0.99
ON20	ON20	469	100-year	138.00	2725.16	2727.30	2727.30	2727.49	0.008841	3.54	40.30	53.53	0.67
ON20	ON20	385	10-year	56.00	2721.51	2723.11	2722.71	2723.24	0.005768	2.91	19.26	23.38	0.55
ON20	ON20	385	100-year	138.00	2721.51	2724.82	2723.30	2724.90	0.000861	2.20	63.65	39.11	0.25
ON20	ON20	371		Culvert									
ON20	ON20	163	10-year	56.00	2713.77	2714.61	2714.61	2714.97	0.022482	4.85	11.54	15.97	1.01
ON20	ON20	163	100-year	138.00	2713.77	2715.21	2715.21	2715.87	0.019603	6.50	21.23	16.00	0.99
ON20	ON20	11	10-year	56.00	2709.40	2710.61	2710.61	2710.86	0.016286	4.25	16.39	49.55	0.90
ON20	ON20	11	100-year	138.00	2709.40	2711.03	2711.03	2711.38	0.013986	5.40	36.09	69.75	0.90
ON10	ON10	1809	10-year	40.00	2746.51	2747.92	2747.92	2748.27	0.021896	4.73	8.46	12.58	1.02
ON10	ON10	1809	100-year	99.00	2746.51	2748.53	2748.53	2749.00	0.019424	5.49	18.02	19.57	1.01
ON10	ON10	1728	10-year	40.00	2744.63	2746.05	2746.05	2746.40	0.021584	4.76	8.40	12.23	1.01
ON10	ON10	1728	100-year	99.00	2744.63	2746.65	2746.65	2747.13	0.019120	5.56	17.82	18.89	1.01

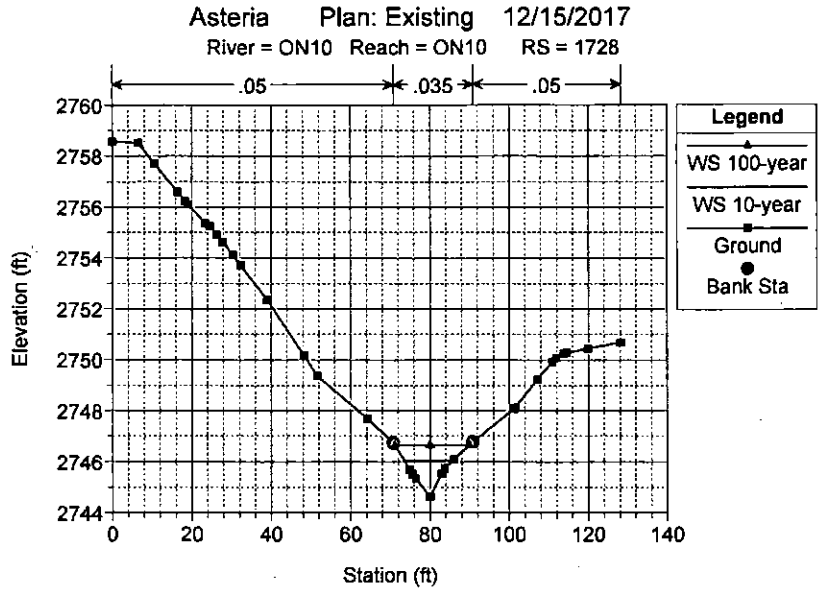
HEC-RAS Plan: EX (Continued)

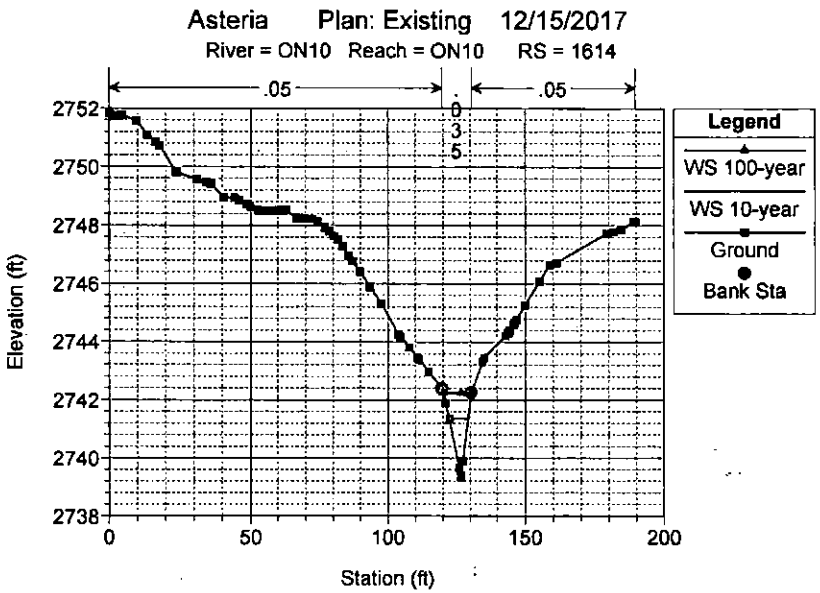
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
ON10	ON10	1614	10-year	40.00	2739.36	2741.37	2741.37	2741.88	0.022485	5.76	6.94	6.93	1.01
ON10	ON10	1614	100-year	99.00	2739.36	2742.24	2742.24	2742.97	0.019884	6.84	14.47	10.25	1.01
ON10	ON10	1526	10-year	40.00	2737.56	2739.01	2739.01	2739.32	0.022877	4.50	8.89	14.56	1.02
ON10	ON10	1526	100-year	99.00	2737.56	2739.57	2739.57	2739.98	0.019287	5.17	19.21	23.58	0.99
ON10	ON10	1335	10-year	40.00	2731.26	2732.68	2732.68	2732.97	0.023386	4.29	9.32	16.68	1.01
ON10	ON10	1335	100-year	99.00	2731.26	2733.15	2733.15	2733.63	0.018810	5.57	18.09	21.23	0.99
ON10	ON10	1173	10-year	40.00	2726.51	2727.95	2727.95	2728.29	0.021654	4.67	8.56	14.26	1.00
ON10	ON10	1173	100-year	99.00	2726.51	2728.55	2728.55	2729.04	0.018670	5.65	17.53	24.39	0.99
ON10	ON10	1014	10-year	40.00	2722.13	2723.50	2723.50	2723.81	0.020471	4.65	9.43	16.27	0.99
ON10	ON10	1014	100-year	99.00	2722.13	2724.11	2724.11	2724.44	0.010863	5.15	28.07	46.31	0.80
ON10	ON10	808	10-year	40.00	2716.06	2717.23	2717.23	2717.50	0.022602	4.17	9.71	20.49	1.01
ON10	ON10	808	100-year	99.00	2716.06	2717.70	2717.70	2718.09	0.014895	5.15	21.91	31.59	0.91
ON10	ON10	684	10-year	40.00	2712.89	2713.65	2713.65	2713.85	0.026110	3.55	11.31	30.97	1.02
ON10	ON10	684	100-year	99.00	2712.89	2713.97	2713.97	2714.29	0.021003	4.56	22.21	37.02	1.00
ON10	ON10	515	10-year	40.00	2707.50	2708.30	2708.30	2708.53	0.023235	3.86	10.55	26.84	1.00
ON10	ON10	515	100-year	99.00	2707.50	2708.65	2708.65	2708.99	0.019944	4.72	21.64	40.44	1.03
ON10	ON10	334	10-year	40.00	2701.29	2702.04	2702.04	2702.26	0.025324	3.73	10.73	25.80	1.02
ON10	ON10	334	100-year	99.00	2701.29	2702.40	2702.40	2702.77	0.021147	4.87	20.33	28.48	1.02
ON10	ON10	223	10-year	40.00	2697.84	2698.59	2698.59	2698.79	0.026412	3.56	11.23	30.09	1.03
ON10	ON10	223	100-year	99.00	2697.84	2698.92	2698.92	2699.24	0.021622	4.56	21.69	34.45	1.01
ON10	ON10	156	10-year	40.00	2695.99	2696.79	2696.79	2696.99	0.018093	3.69	12.04	39.12	0.90
ON10	ON10	156	100-year	99.00	2695.99	2697.57	2697.04	2697.63	0.002250	2.21	54.75	62.33	0.36
ON10	ON10	122		Culvert									
ON10	ON10	2	10-year	40.00	2691.00	2692.40	2692.18	2692.56	0.008015	3.43	12.84	88.31	0.65
ON10	ON10	2	100-year	99.00	2691.00	2693.05	2692.71	2693.32	0.008005	4.34	24.36	99.49	0.68

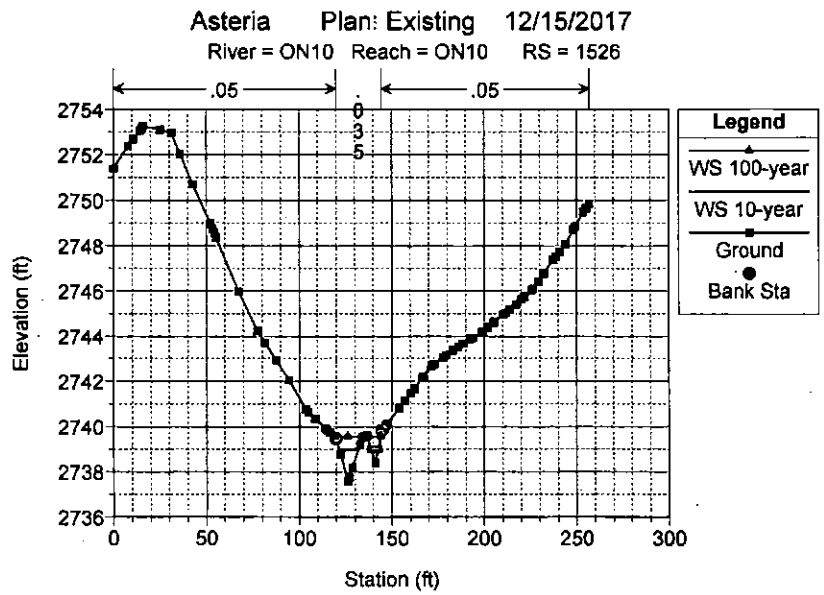

Asteria Plan: Existing 12/14/2017
ON10 ON10
Legend
WS 100-year
WS 10-year
Ground
Elevation (ft)
2750
2740
2730
2720
2710
2700
2690
0
500
1000
1500
2000
Main Channel Distance (ft)
122
156
223
334
515
684
808
1014
1173
1335
1526
1614
1728
1809

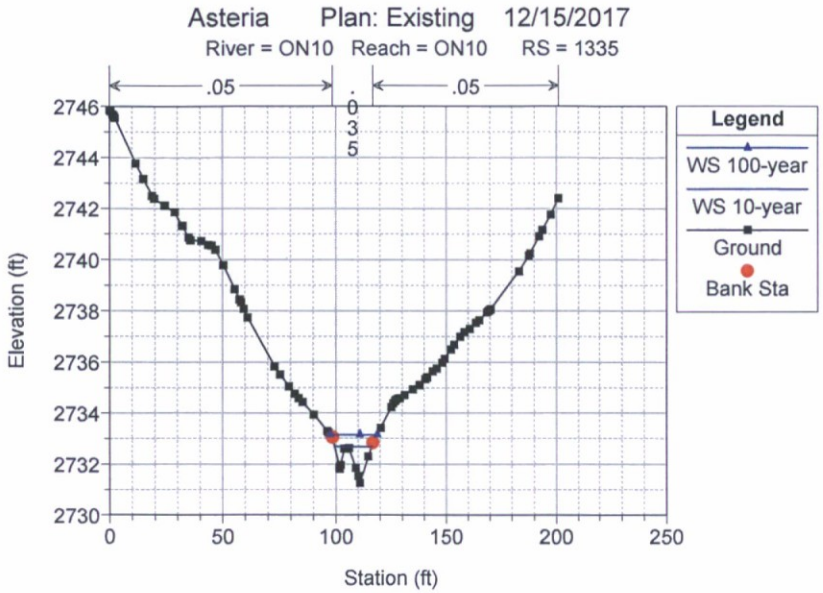

Asteria Plan: Existing 12/14/2017
ON20 ON20
Legend
WS 100-year
WS 10-year
Ground
Elevation (ft)
2745
2740
2735
2730
2725
2720
2715
2710
2705
0
200
400
600
800
1000
Main Channel Distance (ft)
163
371
385
469
554
596
639
685
713
844
986

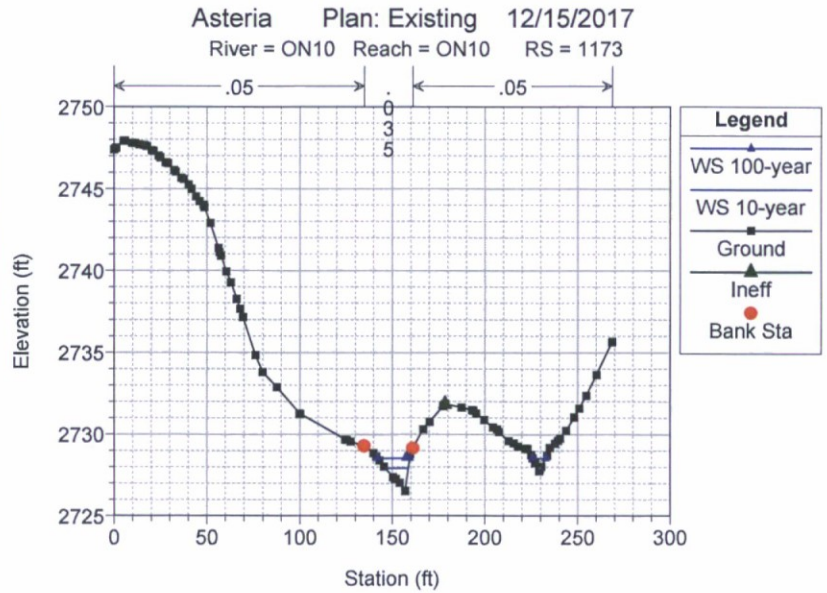

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 1809
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

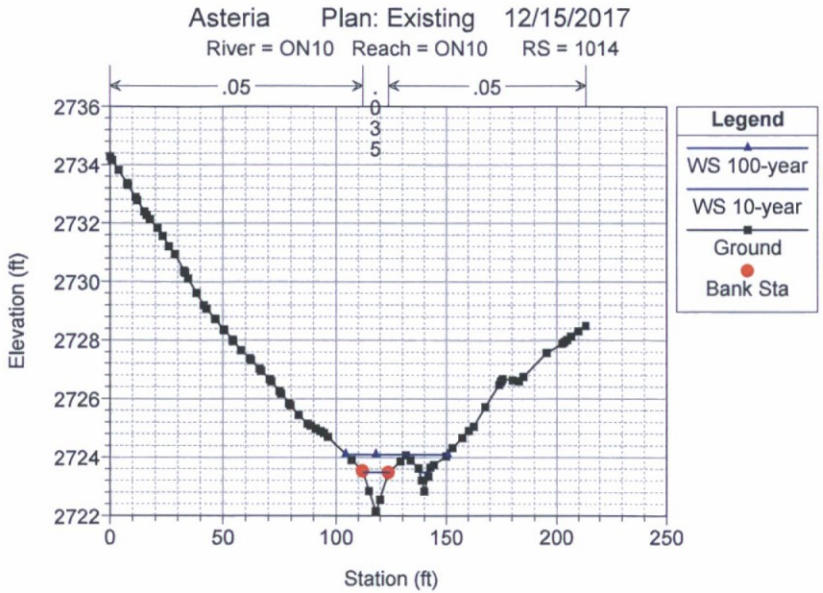

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 1728
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

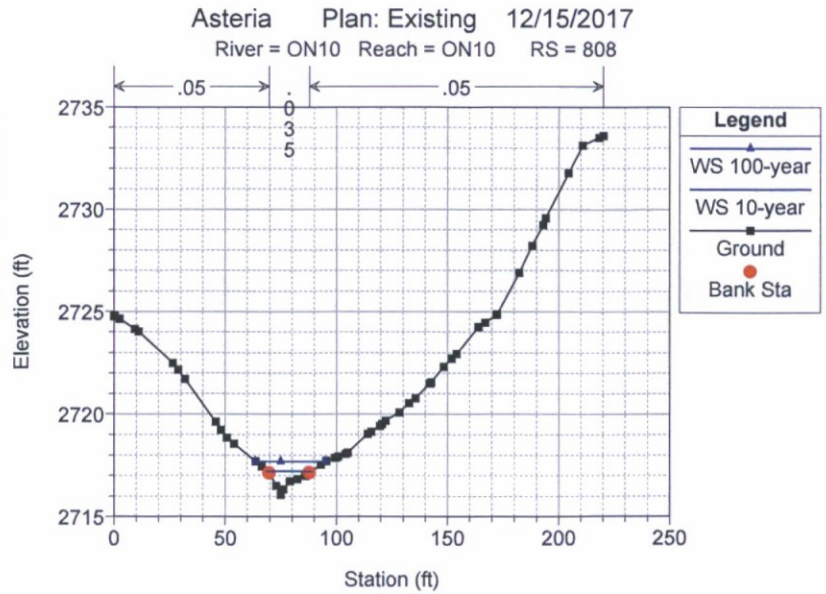

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 1614
.05
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

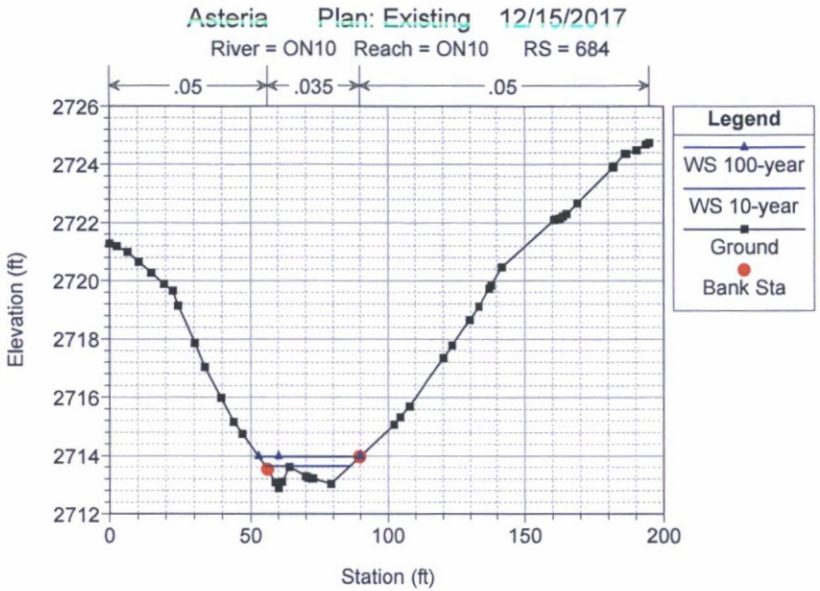

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 1526
.05
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

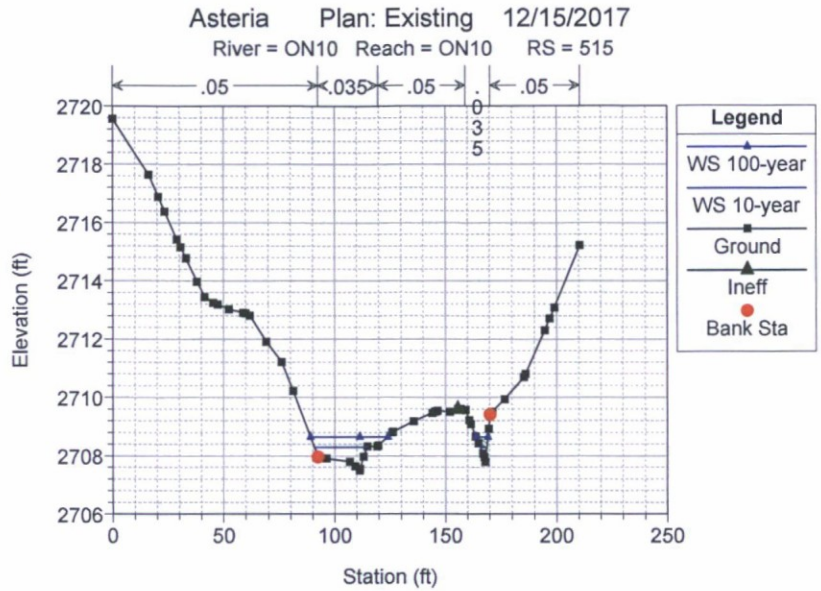

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 1335
.05
.035
.05
Legend
WS 100-year
WS 10-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2746
2744
2742
2740
2738
2736
2734
2732
2730
0
50
100
150
200
250

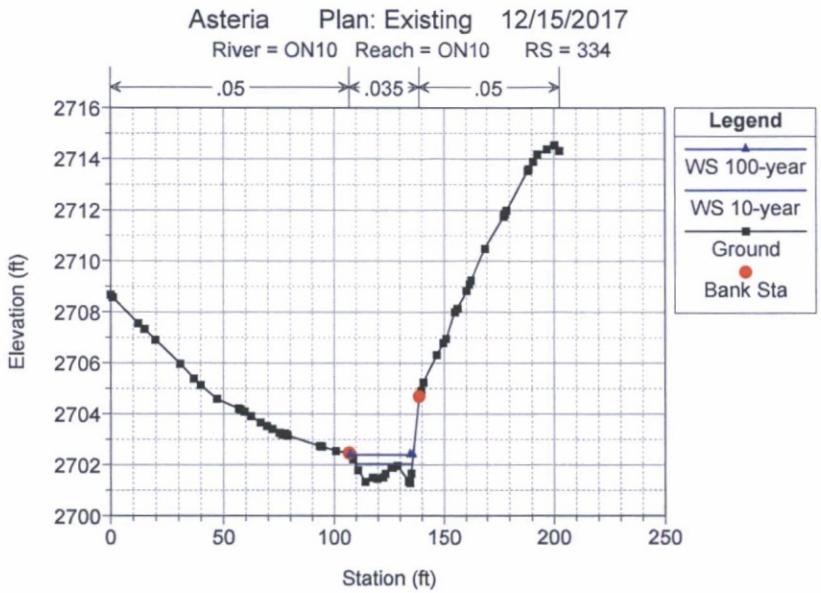

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 1173
.05
.035
.05
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
2750
2745
2740
2735
2730
2725
0
50
100
150
200
250
300

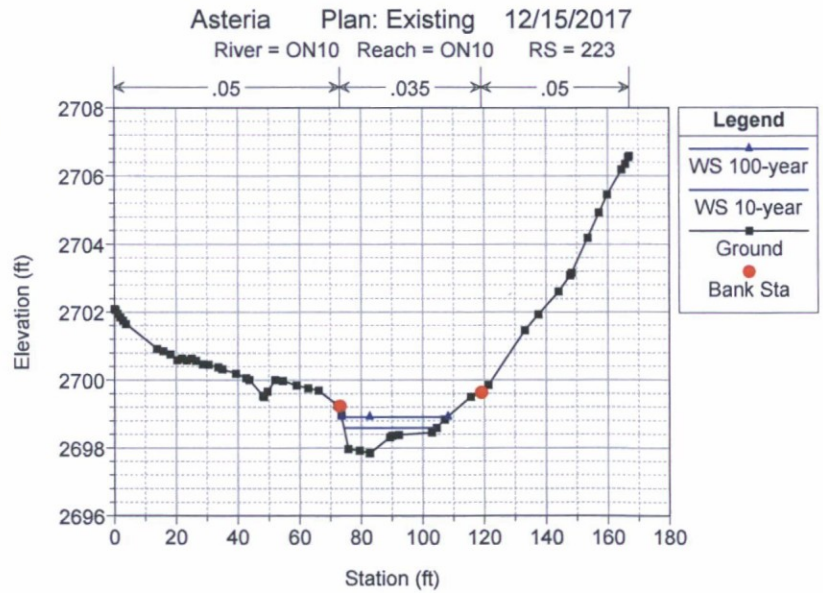

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 1014
.05
.035
.05
Legend
WS 100-year
WS 10-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2736
2734
2732
2730
2728
2726
2724
2722
0
50
100
150
200
250

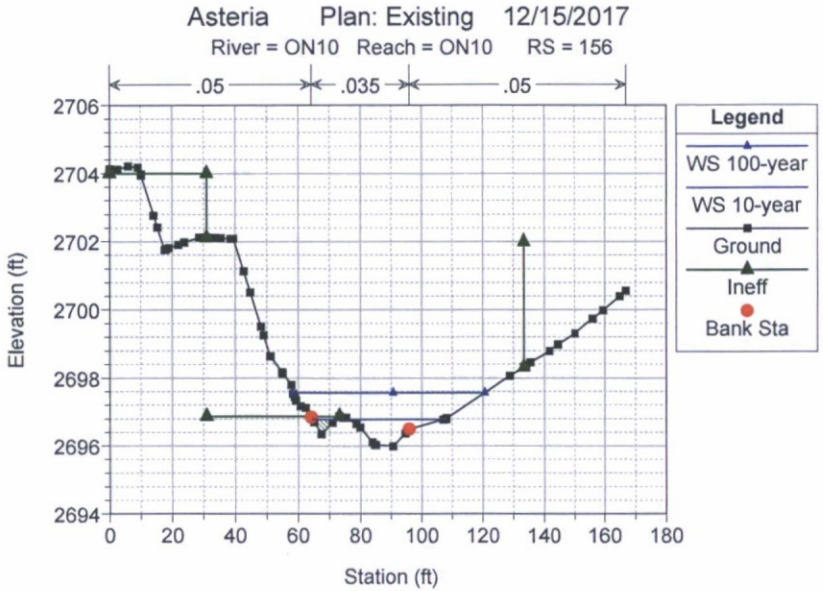

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 808
.05
.035
.05
Legend
WS 100-year
WS 10-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2735
2730
2725
2720
2715
0
50
100
150
200
250

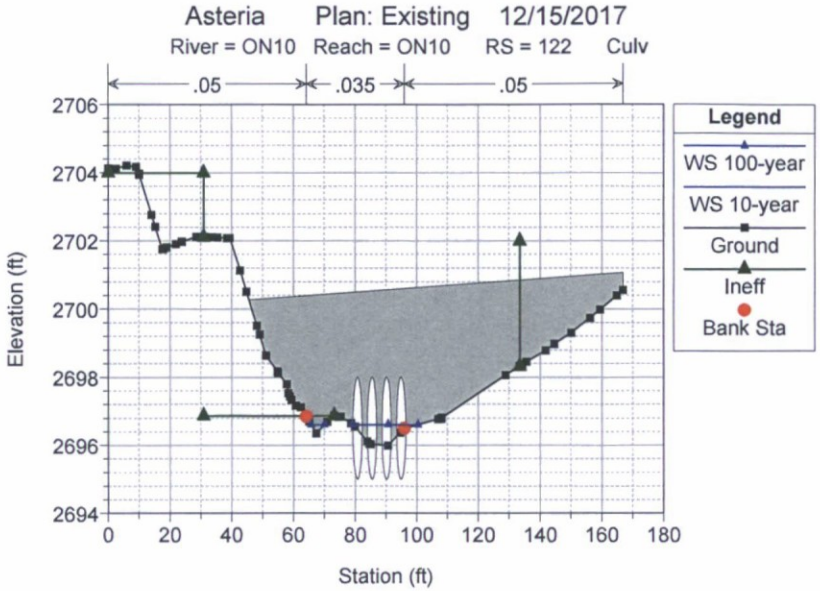

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 684
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

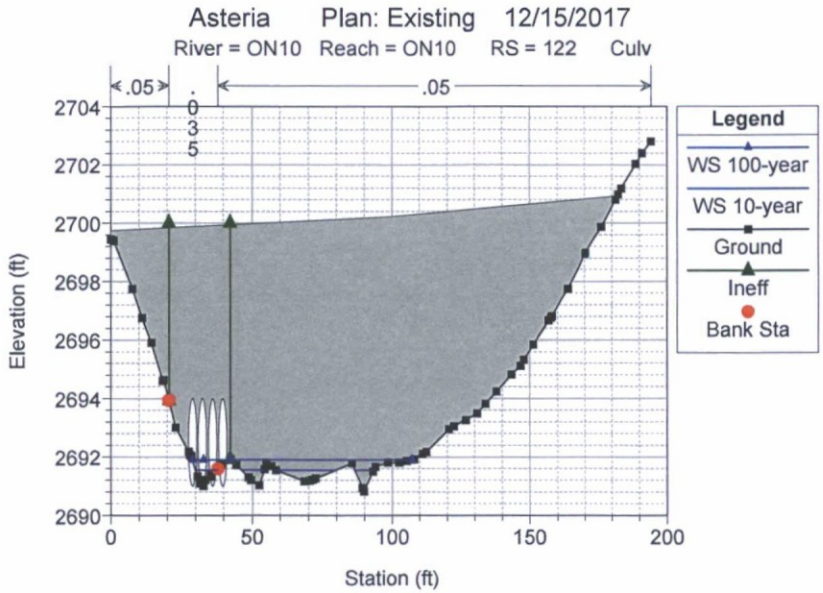

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 515
.05
.035
.05
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

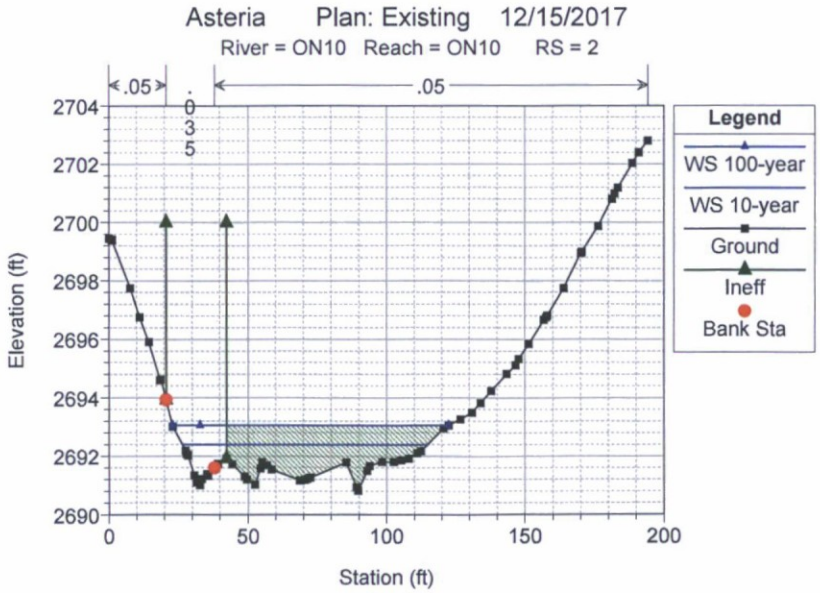

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 334
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

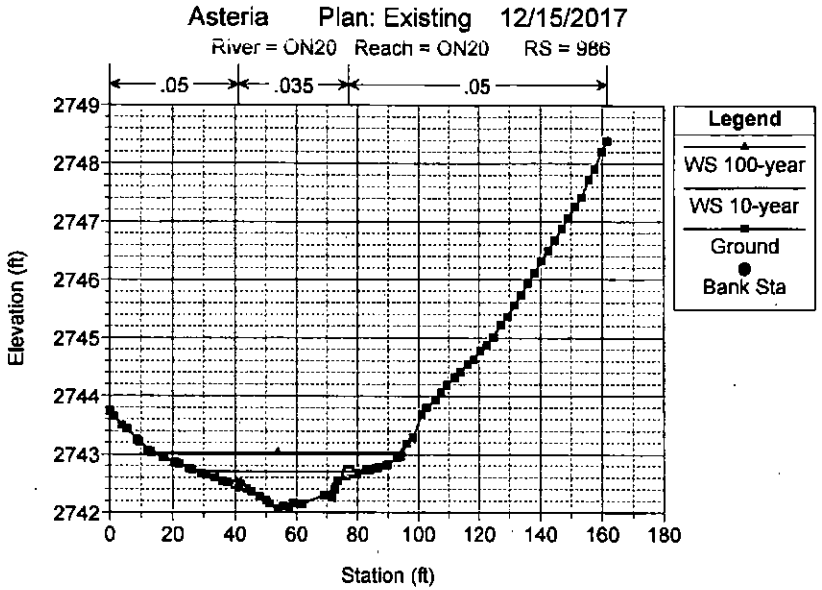

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 223
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

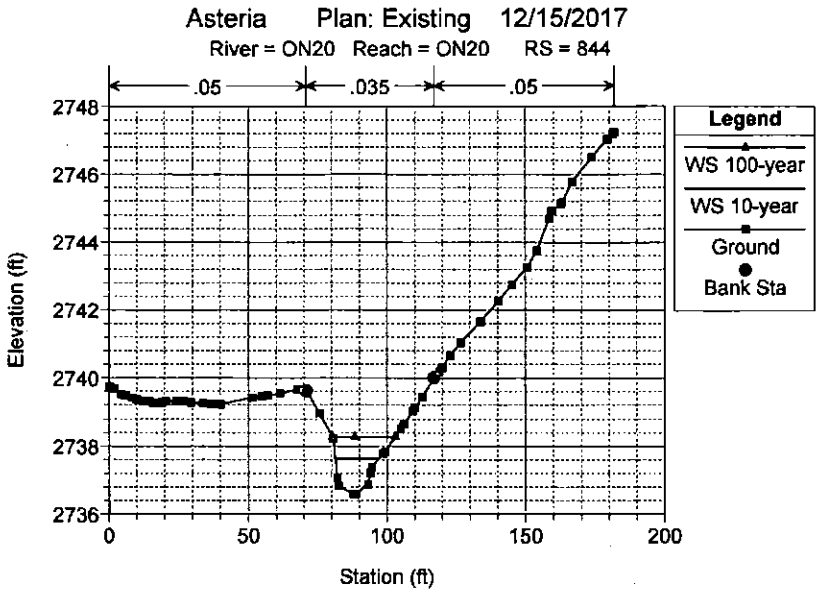

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 156
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

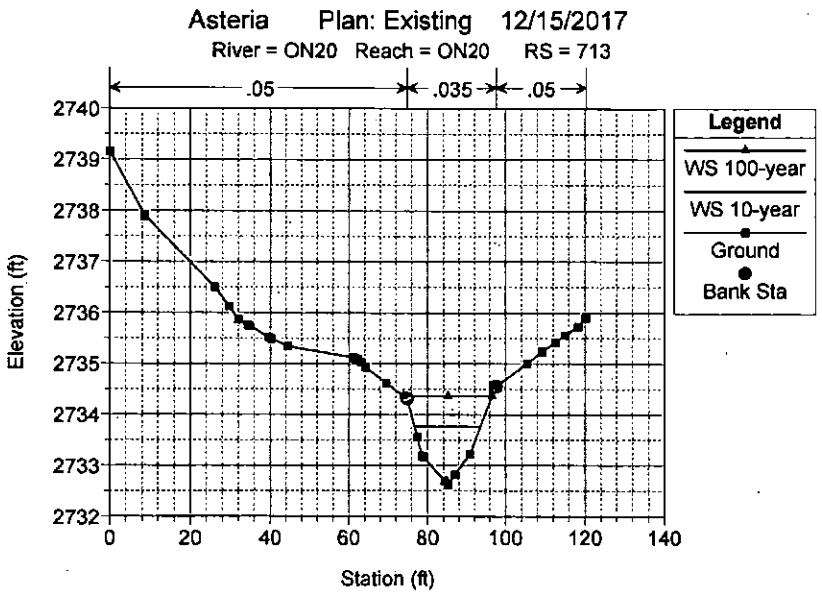

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 122 Culv
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

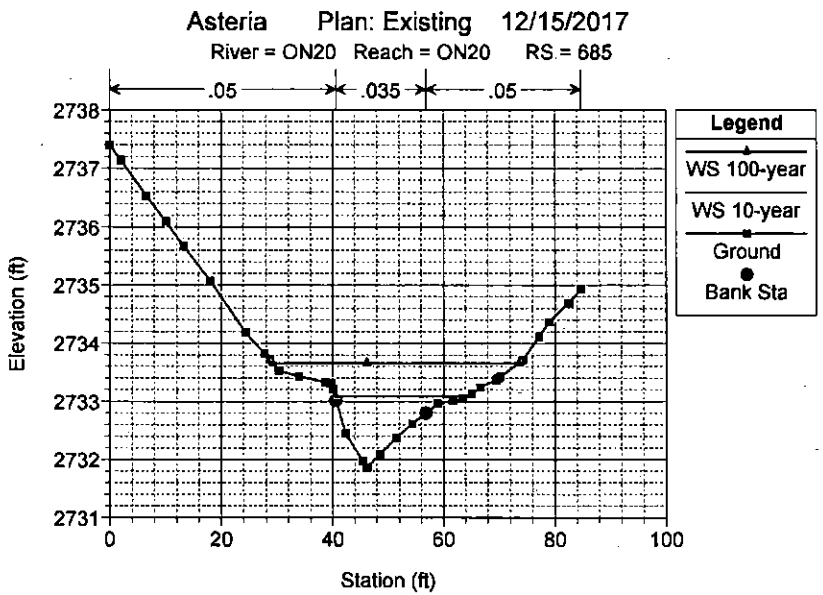

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 122 Culv
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

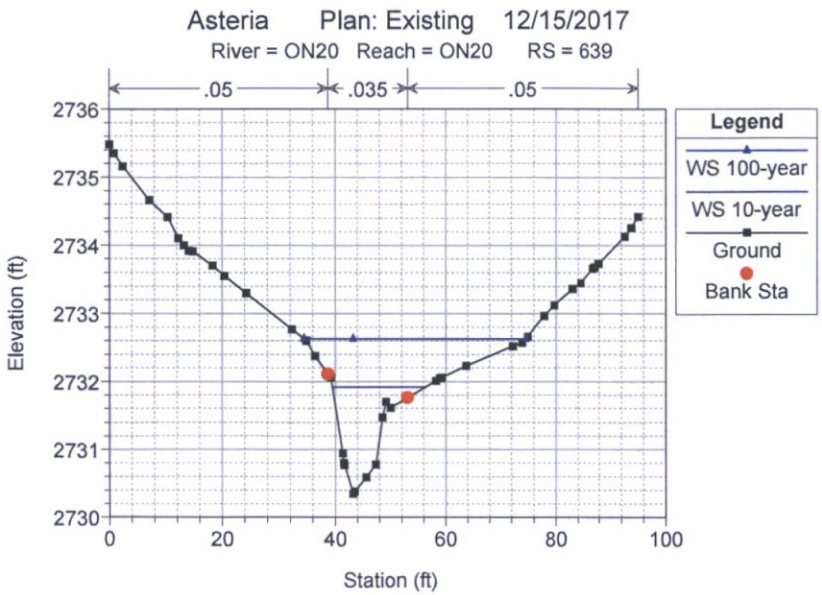

Asteria Plan: Existing 12/15/2017
River = ON10 Reach = ON10 RS = 2
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

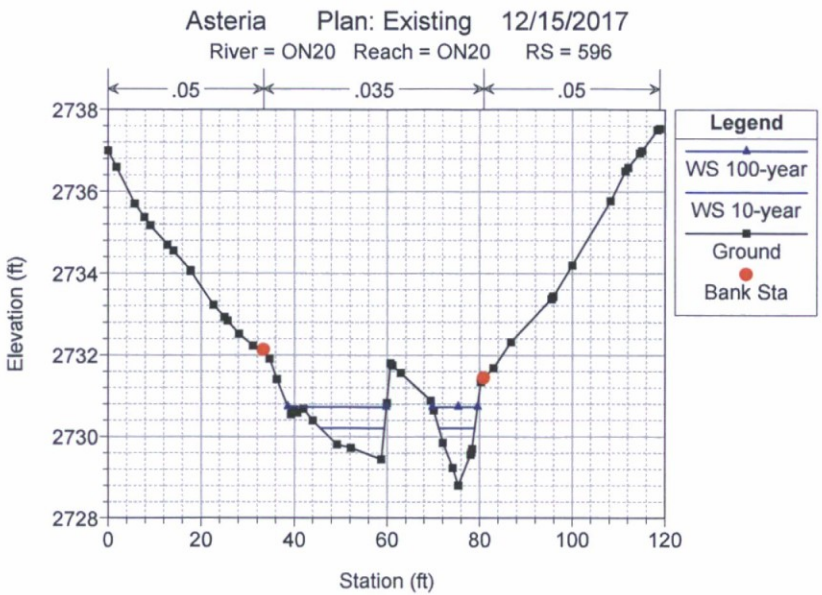

Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 986
.05
.035
.05
Legend
WS 100-year
WS 10-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2749
2748
2747
2746
2745
2744
2743
2742
0
20
40
60
80
100
120
140
160
180

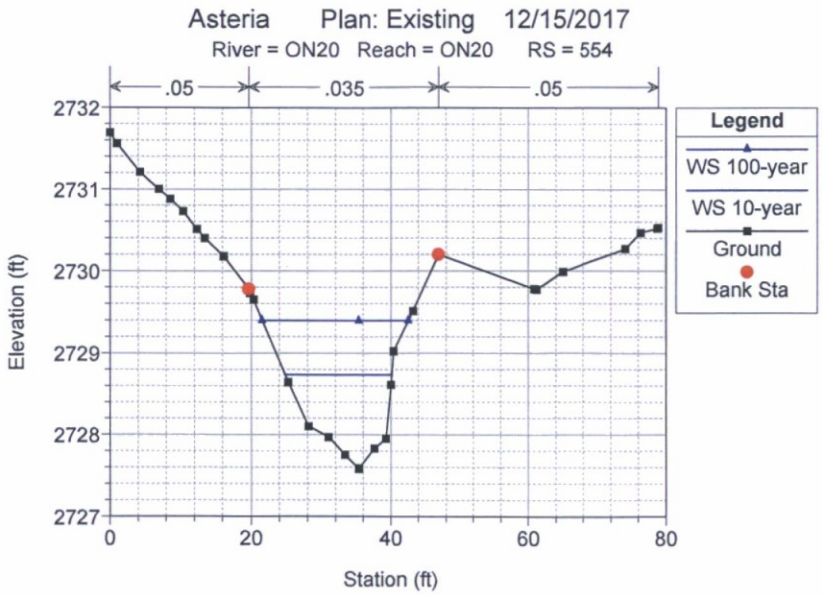

Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 844
.05
.035
.05
Legend
WS 100-year
WS 10-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2748
2746
2744
2742
2740
2738
2736
0
50
100
150
200

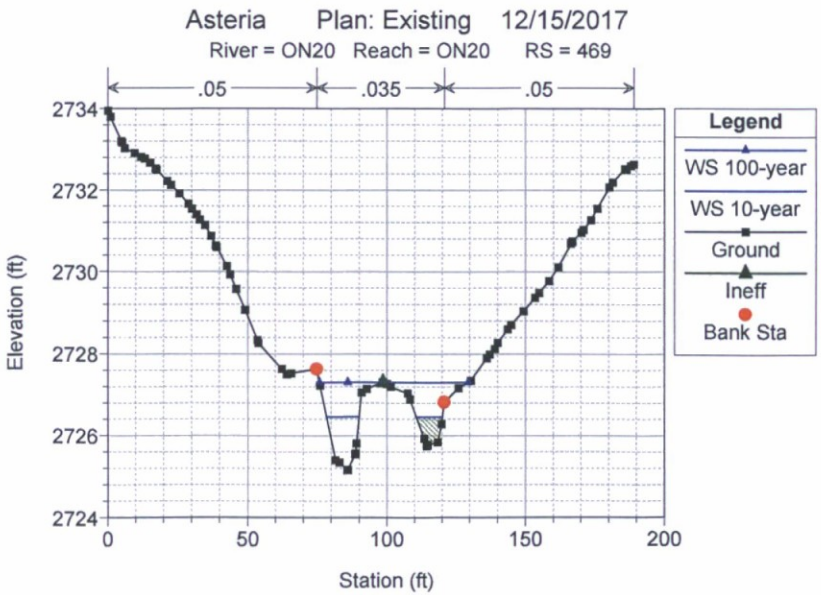

Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 713
.05
.035
.05
Legend
WS 100-year
WS 10-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2740
2739
2738
2737
2736
2735
2734
2733
2732
0
20
40
60
80
100
120
140

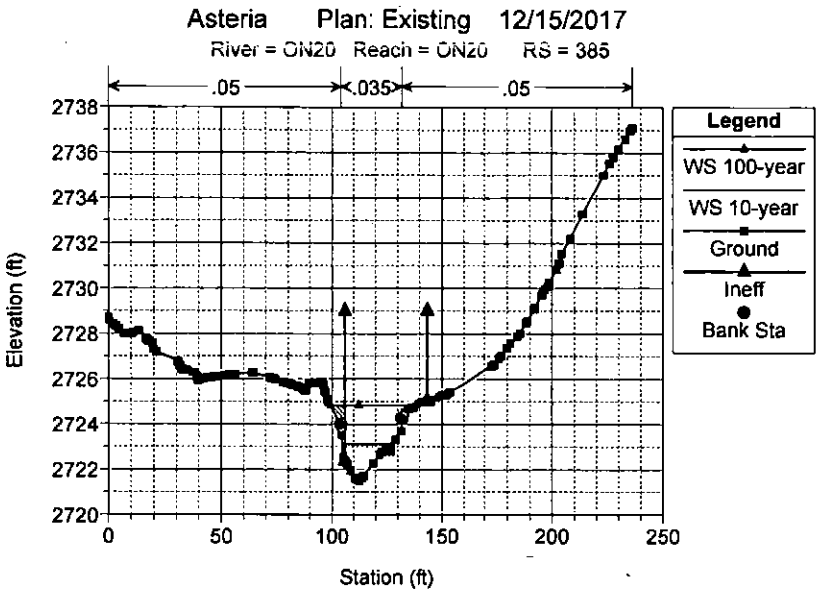

Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 685
.05
.035
.05
Legend
WS 100-year
WS 10-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2738
2737
2736
2735
2734
2733
2732
2731
0
20
40
60
80
100

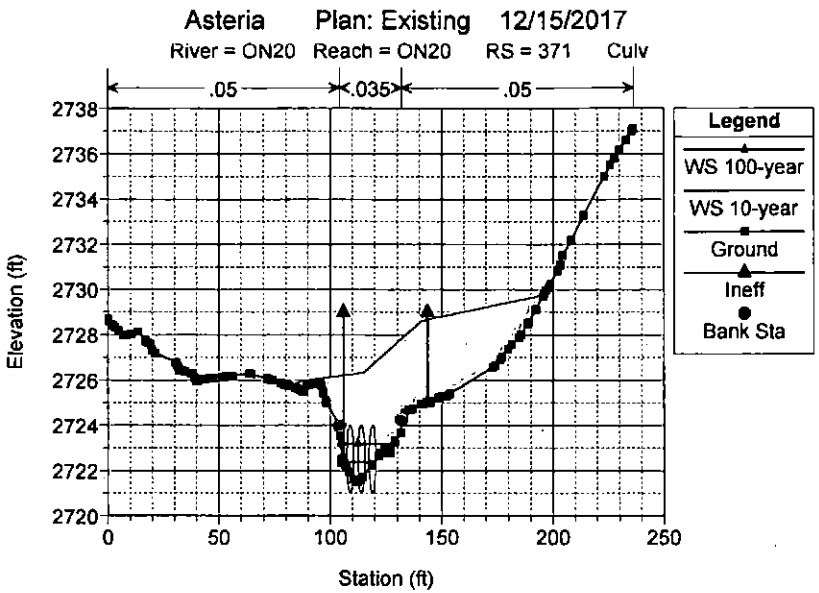

Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 639
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

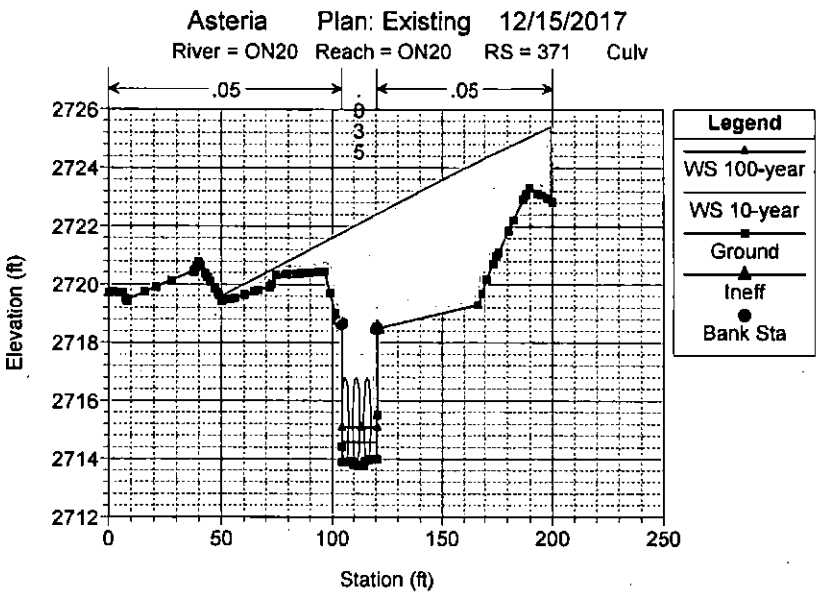

Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 596
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

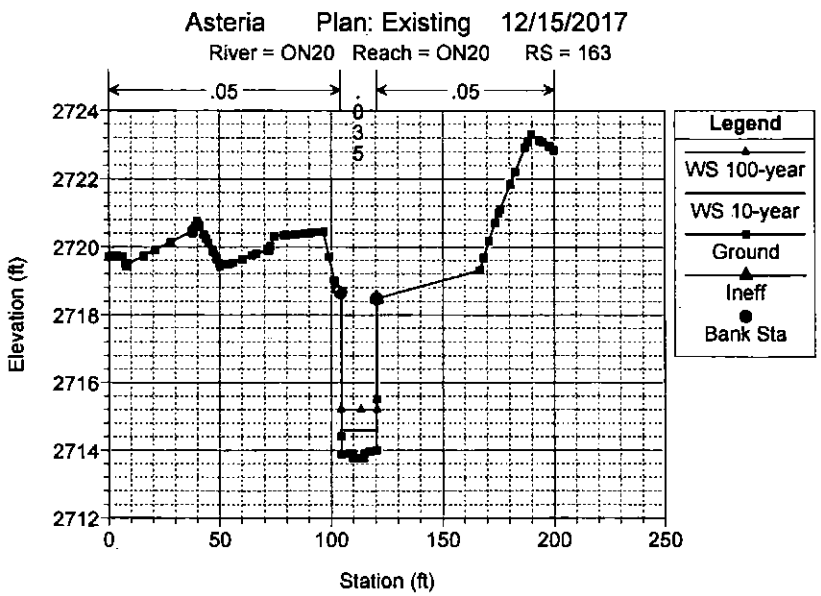

Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 554
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

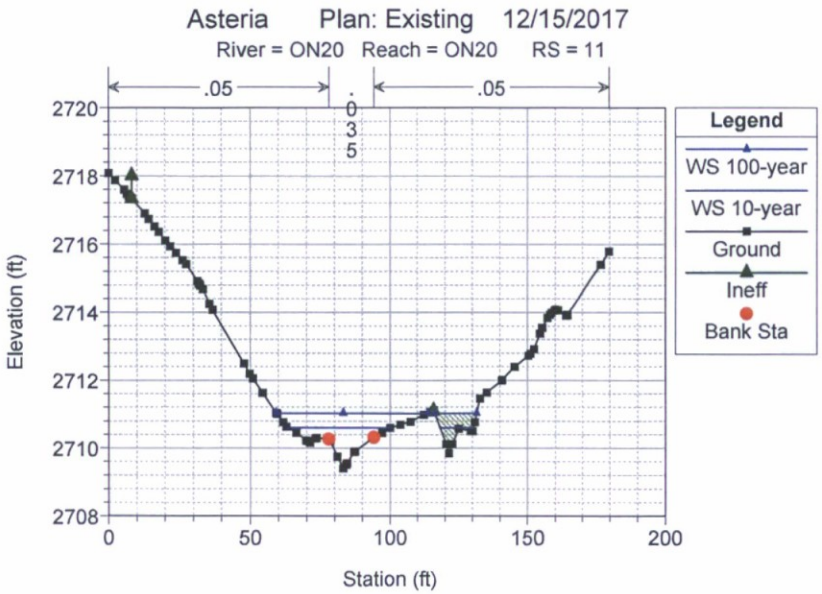

Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 469
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta


Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 385
.05
.035
.05
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
2738
2736
2734
2732
2730
2728
2726
2724
2722
2720
0
50
100
150
200
250


Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 371 Culv
.05
.035
.05
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
2738
2736
2734
2732
2730
2728
2726
2724
2722
2720
0
50
100
150
200
250


Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 371 Culv
.05
.035
.05
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
2726
2724
2722
2720
2718
2716
2714
2712
0
50
100
150
200
250


Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 163
.05
.035
.05
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
2724
2722
2720
2718
2716
2714
2712
0
50
100
150
200
250


Asteria Plan: Existing 12/15/2017
River = ON20 Reach = ON20 RS = 11
.05
.
0
3
5
.05
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta
Elevation (ft)
2720
2718
2716
2714
2712
2710
2708
0
50
100
150
200
Station (ft)

Proposed Conditions Model

HEC-RAS Plan: PR

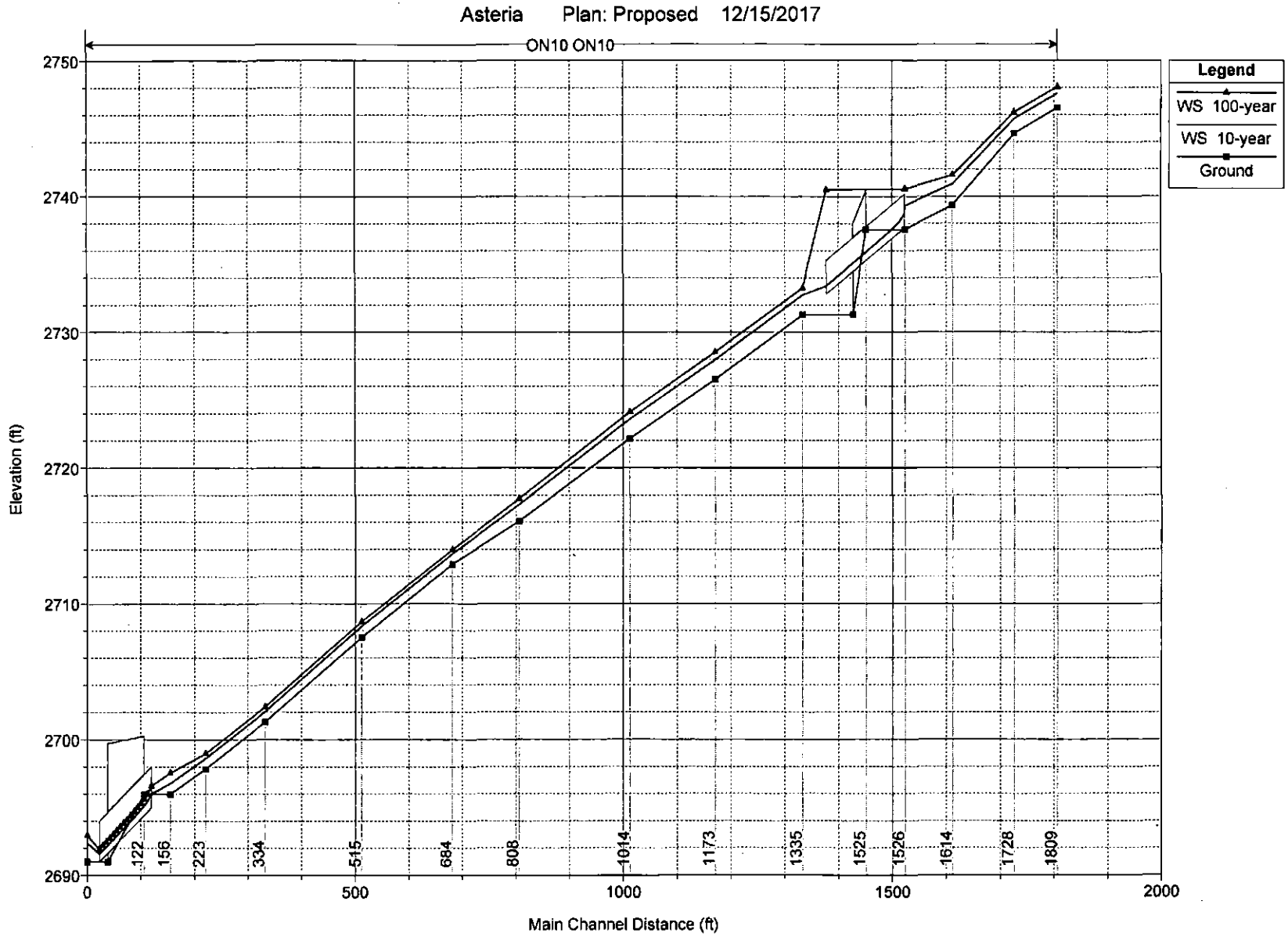
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
ON20	ON20	986	10-year	53.00	2742.07	2742.69	2742.69	2742.92	0.022820	4.12	16.28	50.78	1.01
ON20	ON20	986	100-year	130.00	2742.07	2743.05	2743.05	2743.30	0.014619	4.71	41.48	82.22	0.89
ON20	ON20	844	10-year	53.00	2736.57	2737.62	2737.62	2737.97	0.020312	4.75	11.15	15.65	0.99
ON20	ON20	844	100-year	130.00	2736.57	2738.23	2738.23	2738.79	0.015515	6.05	22.69	21.99	0.95
ON20	ON20	713	10-year	53.00	2732.61	2733.76	2733.76	2734.14	0.017747	5.08	11.52	16.84	0.97
ON20	ON20	713	100-year	130.00	2732.61	2734.33	2734.33	2735.00	0.016604	6.93	22.64	22.23	1.02
ON20	ON20	685	10-year	53.00	2731.86	2733.06	2733.06	2733.38	0.018063	4.52	12.25	23.25	0.94
ON20	ON20	685	100-year	130.00	2731.86	2733.63	2733.63	2734.03	0.011685	5.39	31.15	45.88	0.84
ON20	ON20	639	10-year	55.00	2730.35	2731.92	2731.92	2732.30	0.019251	4.97	11.27	16.79	0.97
ON20	ON20	639	100-year	134.00	2730.35	2732.61	2732.61	2733.05	0.011386	5.65	30.40	39.55	0.83
ON20	ON20	596	10-year	55.00	2728.80	2731.70	2730.23	2731.71	0.000255	0.98	62.27	46.79	0.13
ON20	ON20	596	100-year	134.00	2728.80	2732.29	2730.74	2732.32	0.000542	1.71	92.45	56.33	0.19
ON20	ON20	591		Bridge									
ON20	ON20	554	10-year	55.00	2727.58	2728.75	2728.75	2729.18	0.019473	5.38	10.38	15.45	1.00
ON20	ON20	554	100-year	134.00	2727.58	2729.50	2729.50	2730.18	0.014485	6.66	20.18	24.26	1.01
ON20	ON20	469	10-year	55.00	2725.16	2726.46	2726.46	2726.89	0.019069	5.29	10.39	20.99	0.99
ON20	ON20	469	100-year	134.00	2725.16	2727.22	2727.22	2727.88	0.016174	6.50	20.95	47.26	0.97
ON20	ON20	385	10-year	55.00	2721.51	2723.07	2722.70	2723.21	0.005444	3.03	18.52	23.23	0.55
ON20	ON20	385	100-year	134.00	2721.51	2724.74	2723.29	2724.82	0.000862	2.36	61.00	36.06	0.26
ON20	ON20	371		Culvert									
ON20	ON20	163	10-year	55.00	2713.77	2714.61	2714.61	2714.96	0.021103	4.87	11.58	15.97	1.00
ON20	ON20	163	100-year	134.00	2713.77	2715.18	2715.18	2715.84	0.019293	6.65	20.77	16.00	1.02
ON20	ON20	11	10-year	55.00	2709.40	2710.66	2710.66	2710.91	0.013519	4.62	18.17	52.15	0.85
ON20	ON20	11	100-year	134.00	2709.40	2711.08	2711.08	2711.41	0.012882	5.83	38.92	72.06	0.89
ON10	ON10	1809	10-year	21.00	2746.51	2747.59	2747.59	2747.88	0.024235	4.31	4.87	9.09	1.03
ON10	ON10	1809	100-year	51.00	2746.51	2748.07	2748.07	2748.45	0.019810	5.00	10.44	14.14	0.99

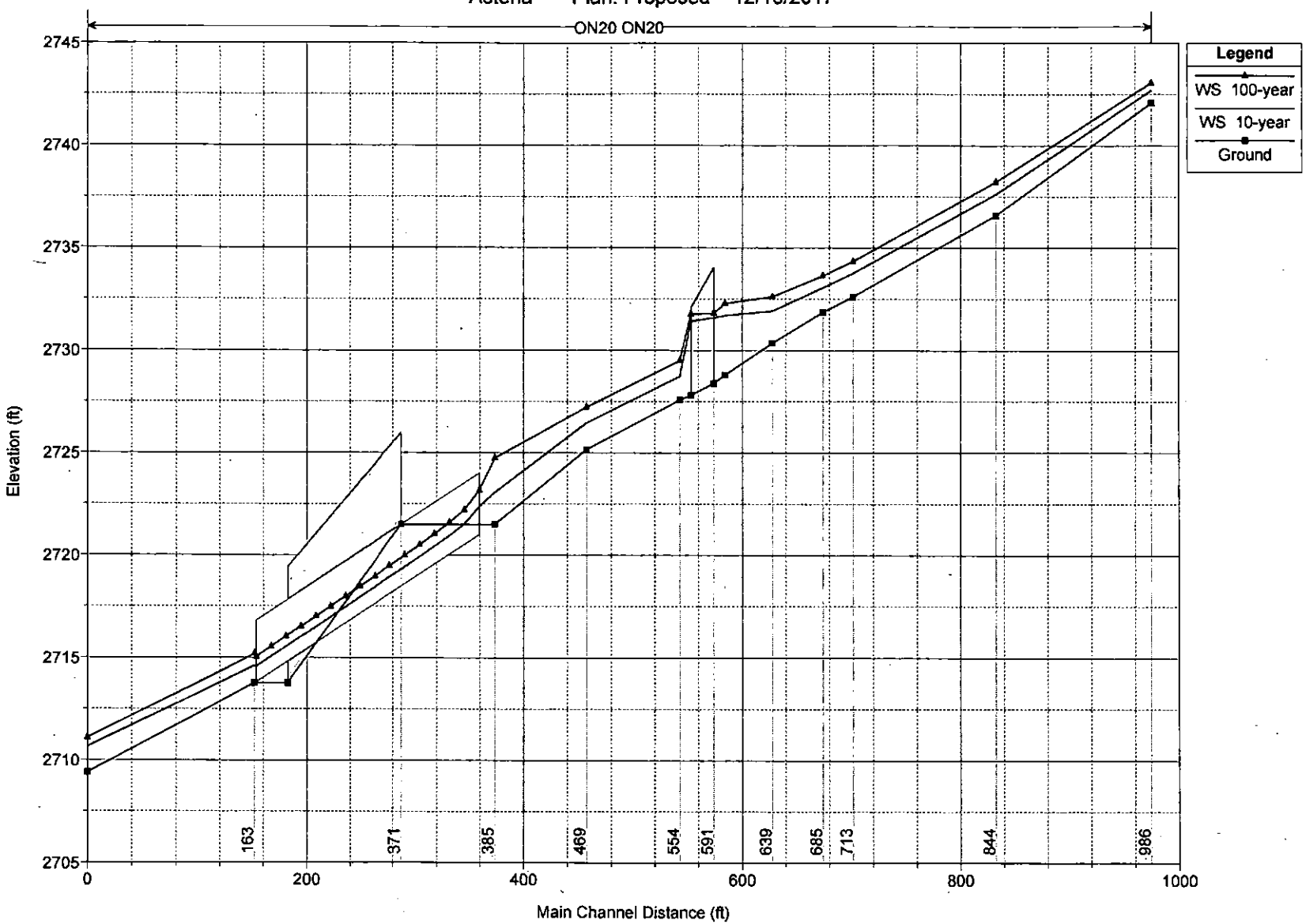
HEC-RAS Plan: PR (Continued)

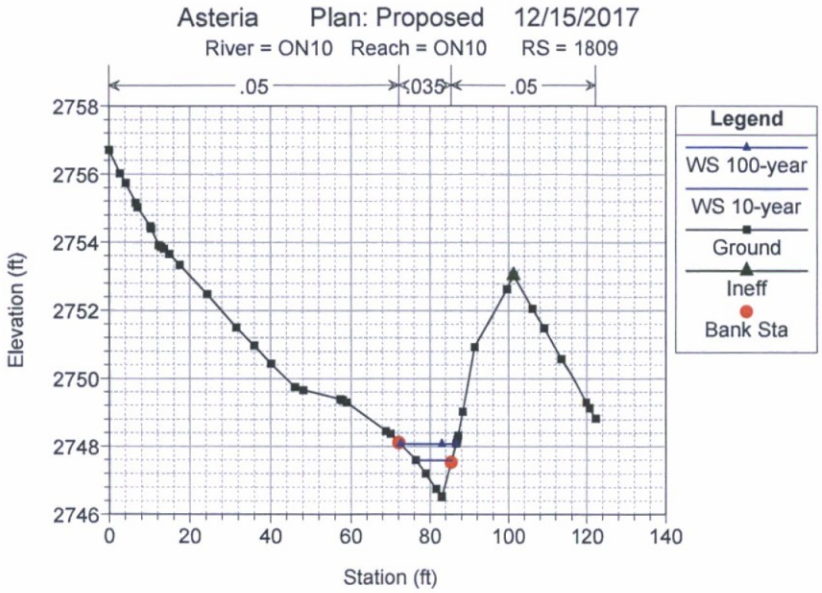
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
ON10	ON10	1728	10-year	21.00	2744.63	2745.72	2745.72	2746.00	0.022414	4.24	4.95	8.81	1.00
ON10	ON10	1728	100-year	51.00	2744.63	2746.19	2746.19	2746.58	0.018827	5.00	10.32	13.84	0.97
ON10	ON10	1614	10-year	21.00	2739.36	2740.92	2740.92	2741.31	0.024170	5.04	4.17	5.37	1.01
ON10	ON10	1614	100-year	51.00	2739.36	2741.58	2741.58	2742.14	0.021687	6.02	8.47	7.72	1.01
ON10	ON10	1526	10-year	21.00	2737.56	2739.32	2738.72	2739.36	0.001850	1.67	14.10	18.61	0.31
ON10	ON10	1526	100-year	51.00	2737.56	2740.52	2739.16	2740.54	0.000391	1.24	55.16	46.23	0.16
ON10	ON10	1525		Culvert									
ON10	ON10	1335	10-year	41.00	2731.26	2732.75	2732.75	2733.06	0.015663	4.73	10.44	17.12	0.89
ON10	ON10	1335	100-year	98.00	2731.26	2733.26	2733.26	2733.77	0.015213	6.35	20.43	22.88	0.95
ON10	ON10	1173	10-year	41.00	2726.51	2727.96	2727.96	2728.30	0.021596	4.70	8.73	12.75	1.00
ON10	ON10	1173	100-year	98.00	2726.51	2728.53	2728.53	2729.03	0.018534	5.69	17.23	21.03	0.99
ON10	ON10	1014	10-year	41.00	2722.13	2723.57	2723.57	2723.90	0.020692	4.61	8.92	19.50	0.99
ON10	ON10	1014	100-year	98.00	2722.13	2724.08	2724.08	2724.36	0.010464	4.79	30.11	51.45	0.78
ON10	ON10	808	10-year	41.00	2716.06	2717.31	2717.31	2717.57	0.016528	4.56	11.29	22.20	0.98
ON10	ON10	808	100-year	98.00	2716.06	2717.72	2717.72	2718.10	0.017029	5.64	22.44	32.00	1.03
ON10	ON10	684	10-year	41.00	2712.89	2713.67	2713.67	2713.86	0.024722	3.50	11.70	31.22	1.01
ON10	ON10	684	100-year	98.00	2712.89	2713.98	2713.98	2714.28	0.020541	4.41	22.23	37.05	1.00
ON10	ON10	515	10-year	41.00	2707.50	2708.33	2708.33	2708.54	0.024355	3.67	11.38	28.78	1.01
ON10	ON10	515	100-year	98.00	2707.50	2708.66	2708.66	2709.00	0.019107	4.79	21.79	35.03	0.98
ON10	ON10	334	10-year	41.00	2701.29	2702.06	2702.06	2702.27	0.024020	3.70	11.08	25.90	1.00
ON10	ON10	334	100-year	98.00	2701.29	2702.40	2702.40	2702.76	0.020991	4.84	20.24	28.45	1.01
ON10	ON10	223	10-year	41.00	2697.84	2698.62	2698.62	2698.84	0.018746	3.85	12.18	30.50	0.92
ON10	ON10	223	100-year	98.00	2697.84	2698.98	2698.98	2699.31	0.016871	4.98	23.75	35.33	0.94
ON10	ON10	156	10-year	41.00	2695.99	2696.77	2696.77	2696.98	0.021303	3.69	11.56	37.78	0.96
ON10	ON10	156	100-year	98.00	2695.99	2697.54	2697.07	2697.61	0.002476	2.36	53.44	61.94	0.38
ON10	ON10	122		Culvert									

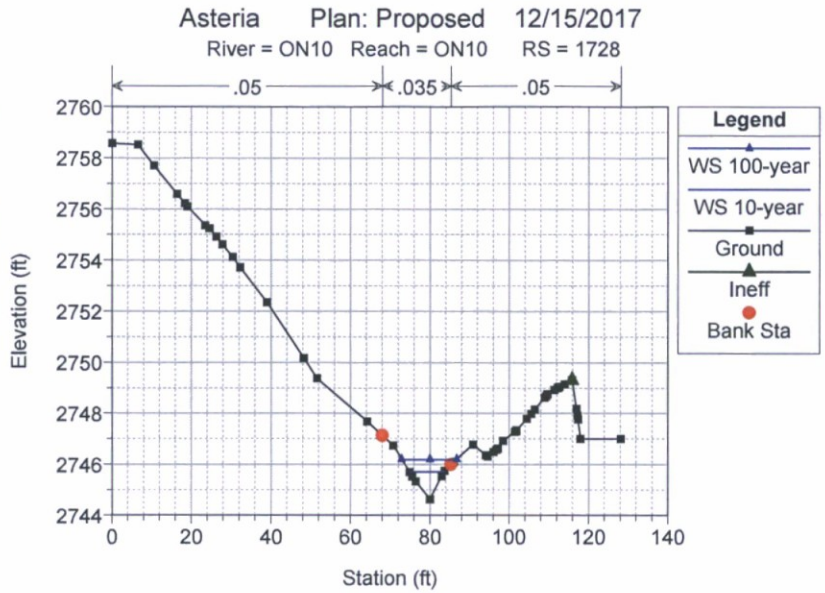
HEC-RAS Plan: PR (Continued)

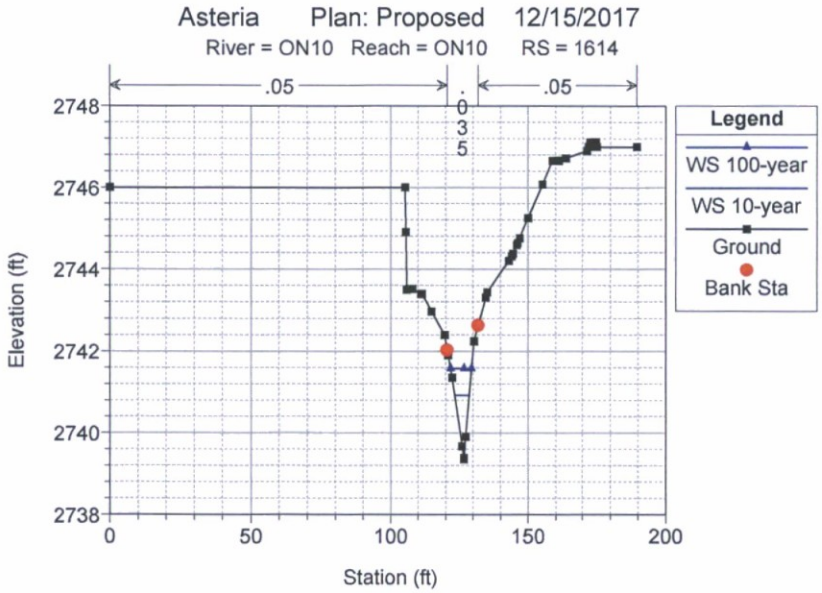
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
ON10	ON10	2	10-year	41.00	2691.00	2692.36	2692.14	2692.54	0.008003	3.40	12.31	87.77	0.65
ON10	ON10	2	100-year	98.00	2691.00	2692.93	2692.67	2693.27	0.007999	4.76	22.12	96.96	0.70

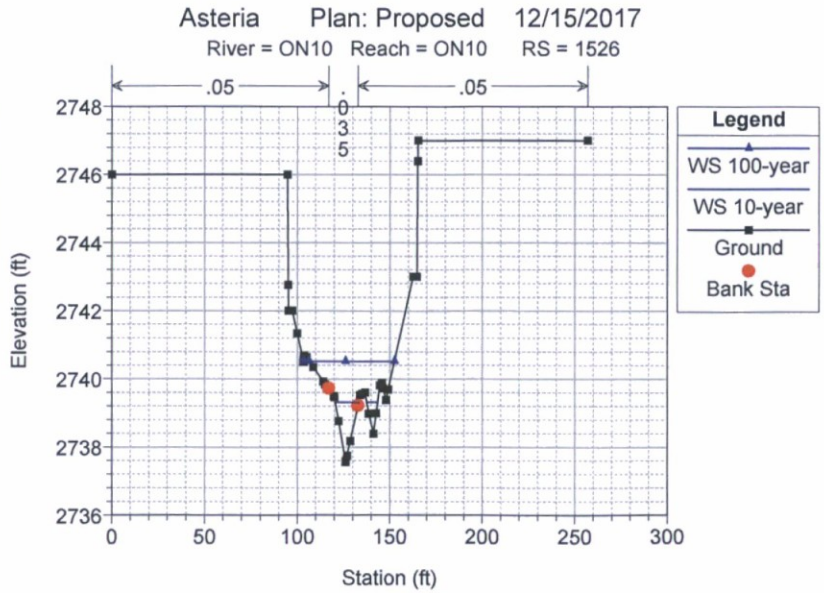

Asteria Plan: Proposed 12/15/2017
ON10 ON10
Legend
WS 100-year
WS 10-year
Ground
Elevation (ft)
2750
2740
2730
2720
2710
2700
2690
0
500
1000
1500
2000
Main Channel Distance (ft)
122
156
223
334
515
684
808
1014
1173
1335
1525
1526
1614
1728
1809

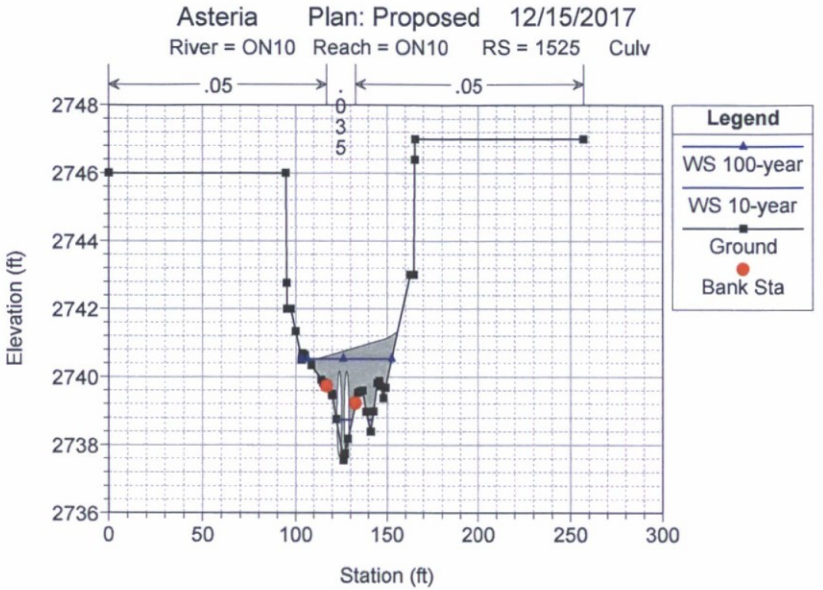

Asteria Plan: Proposed 12/15/2017
ON20 ON20
Legend
WS 100-year
WS 10-year
Ground
Elevation (ft)
2745
2740
2735
2730
2725
2720
2715
2710
2705
0
200
400
600
800
1000
Main Channel Distance (ft)
163
371
385
469
554
591
639
685
713
844
986

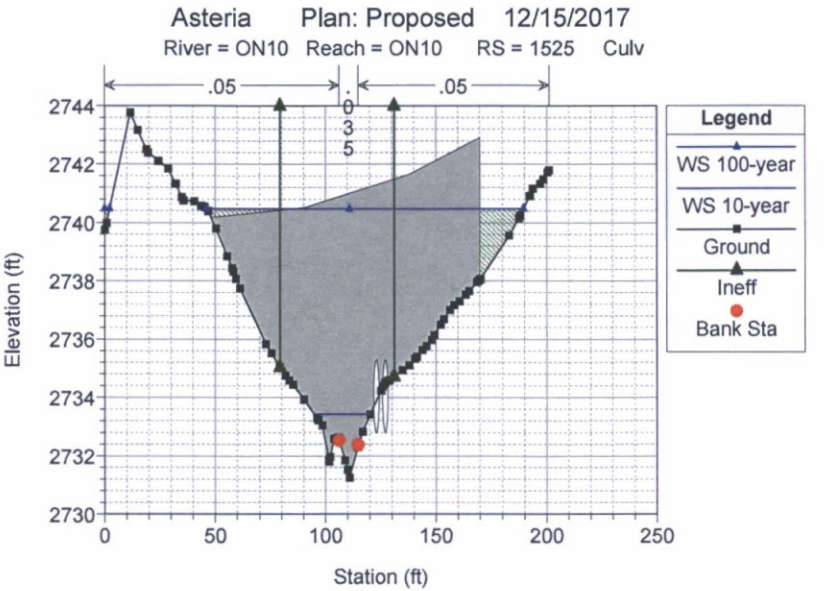

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 1809
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

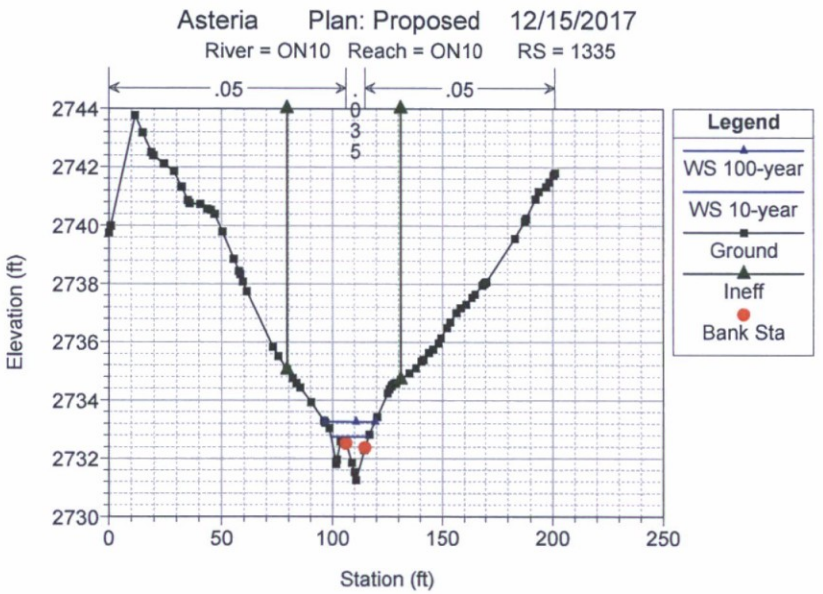

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 1728
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

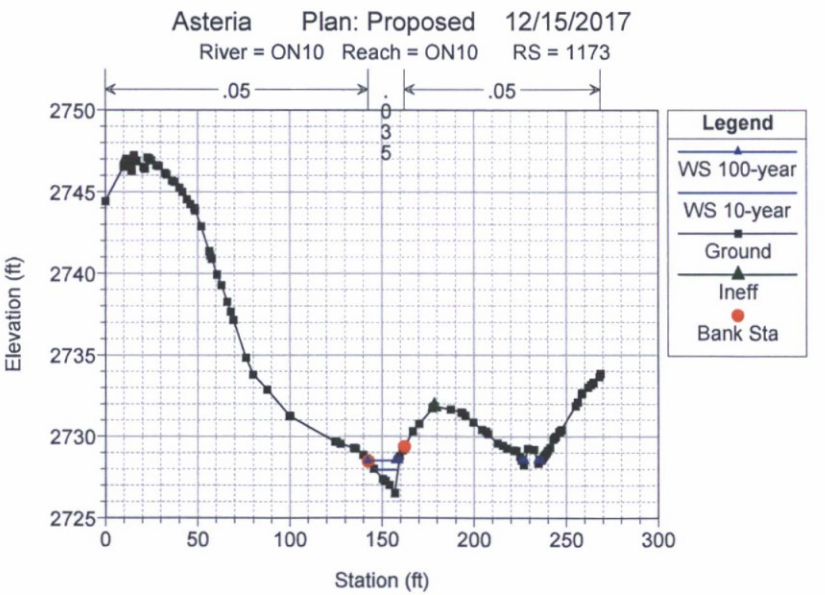

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 1614
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

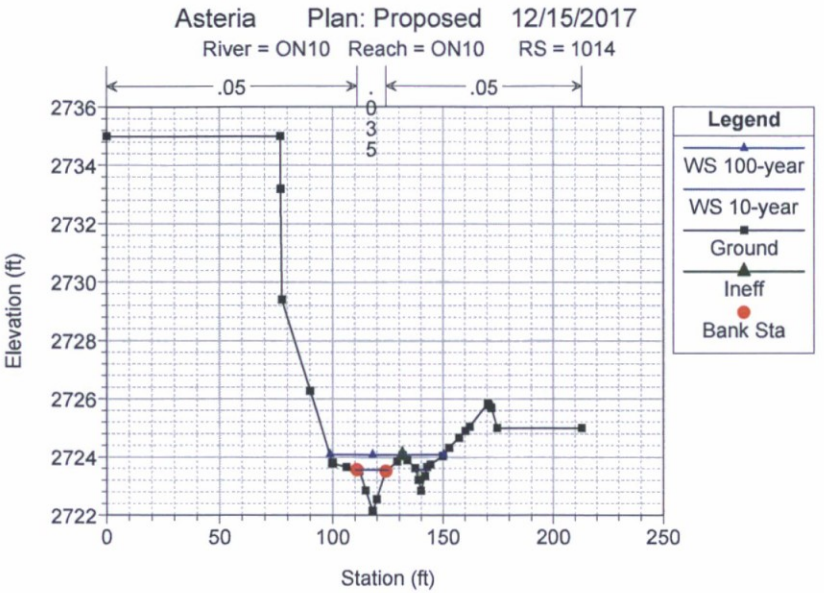

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 1526
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

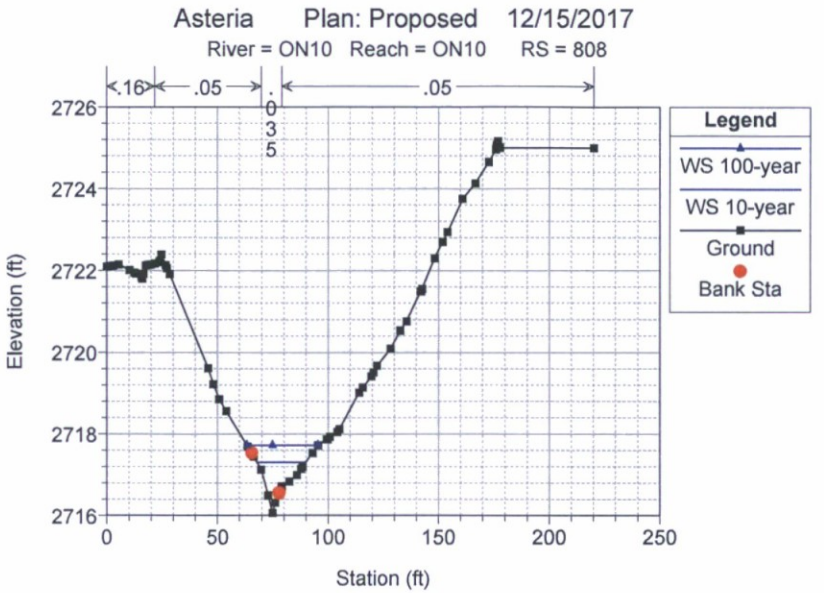

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 1525 Culv
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

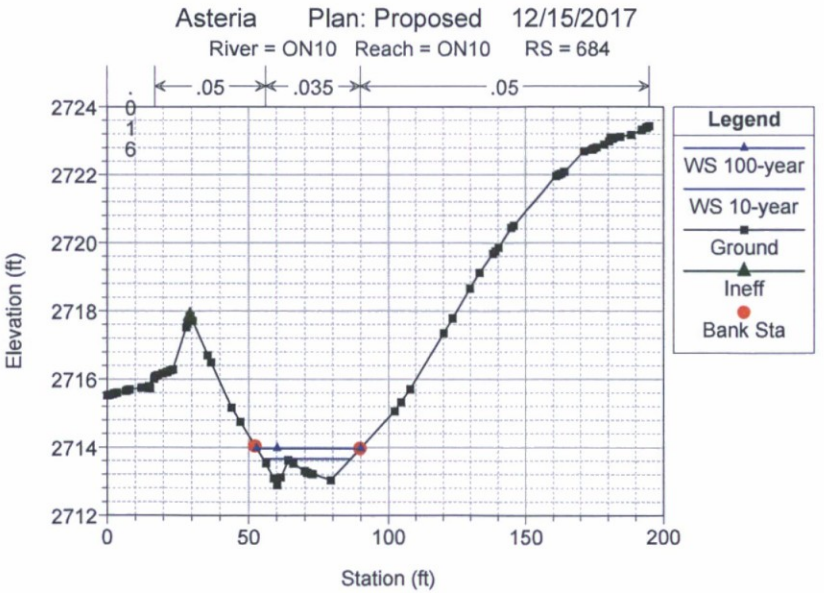

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 1525 Culv
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

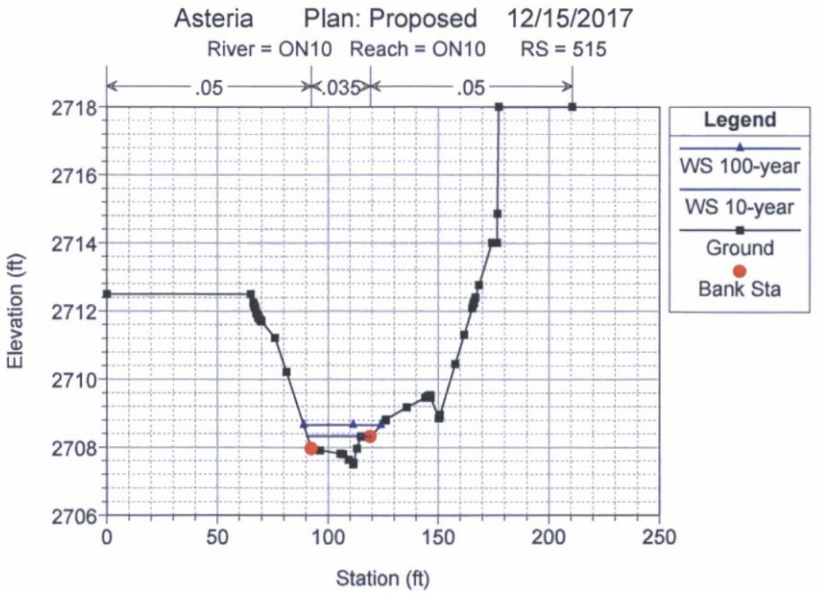

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 1335
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

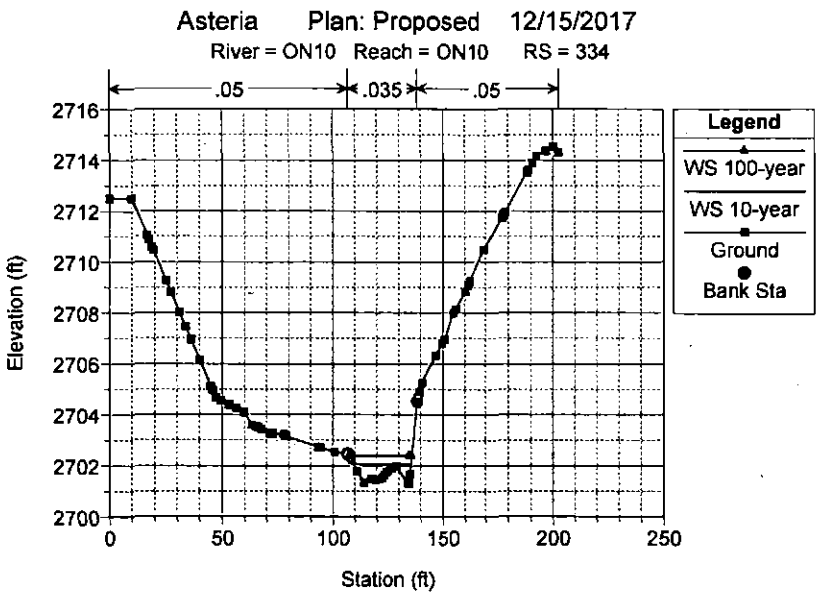

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 1173
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

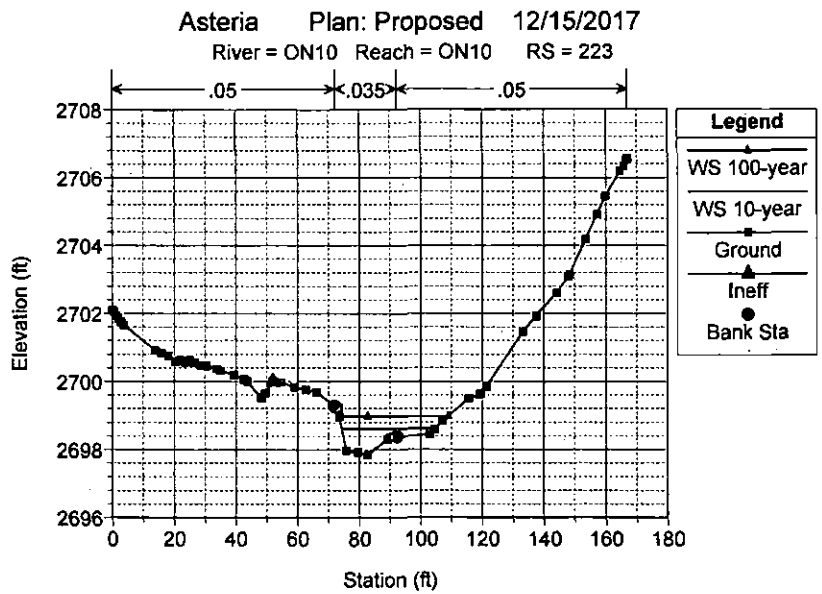

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 1014
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

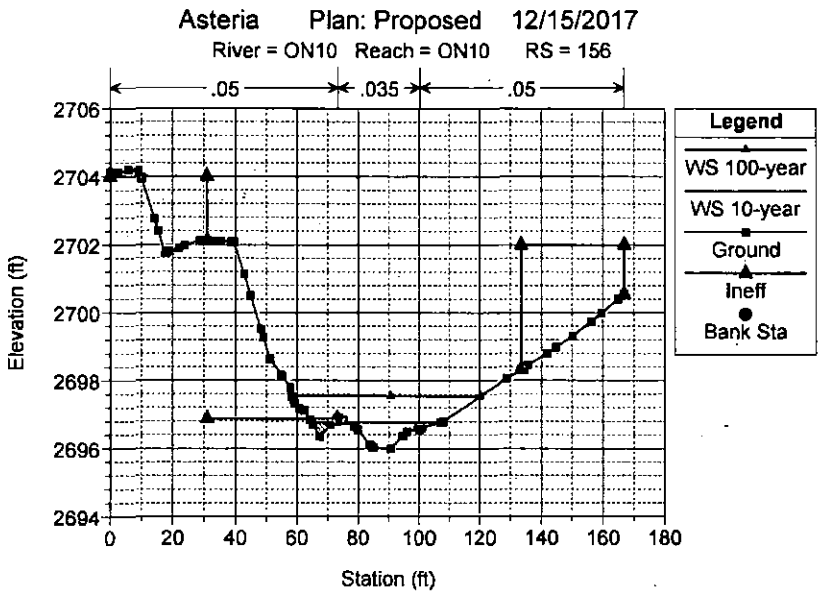

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 808
.16
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

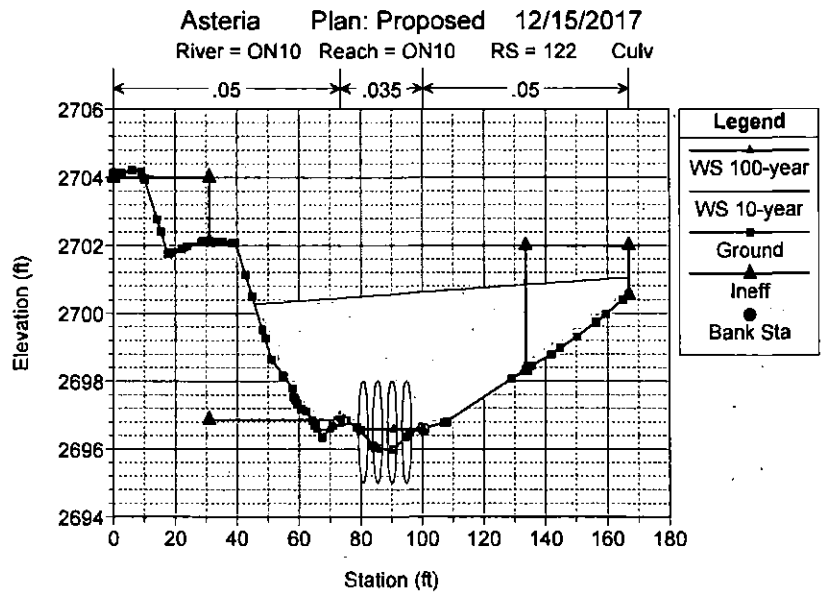

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 684
.05
.035
.05
.016
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

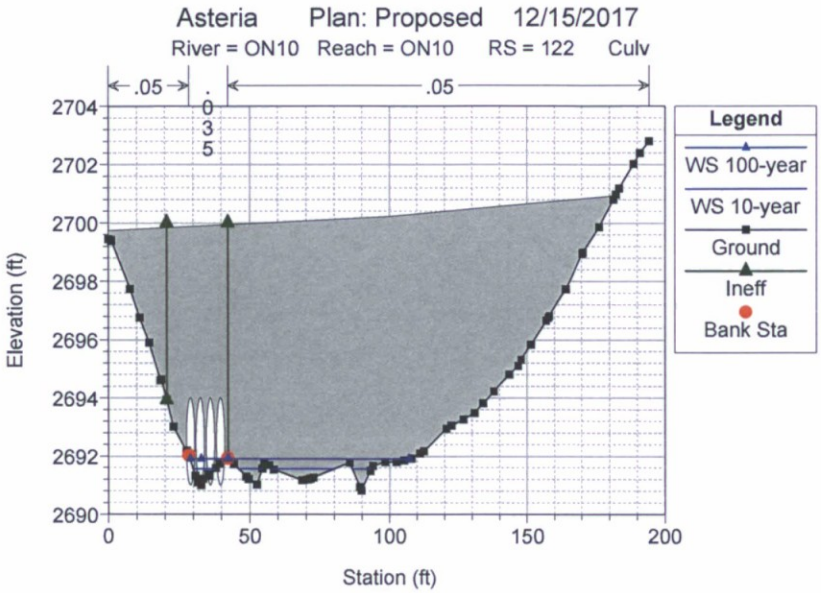

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 515
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

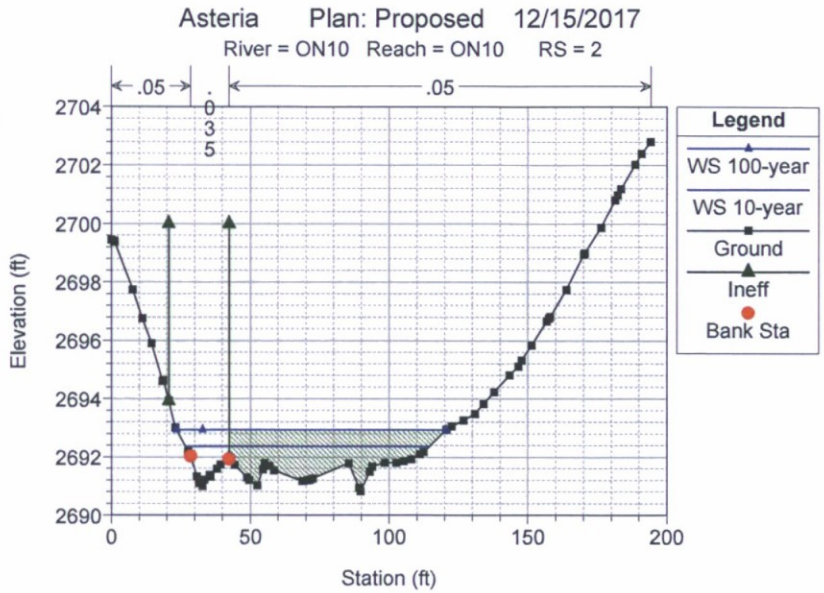

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 334
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

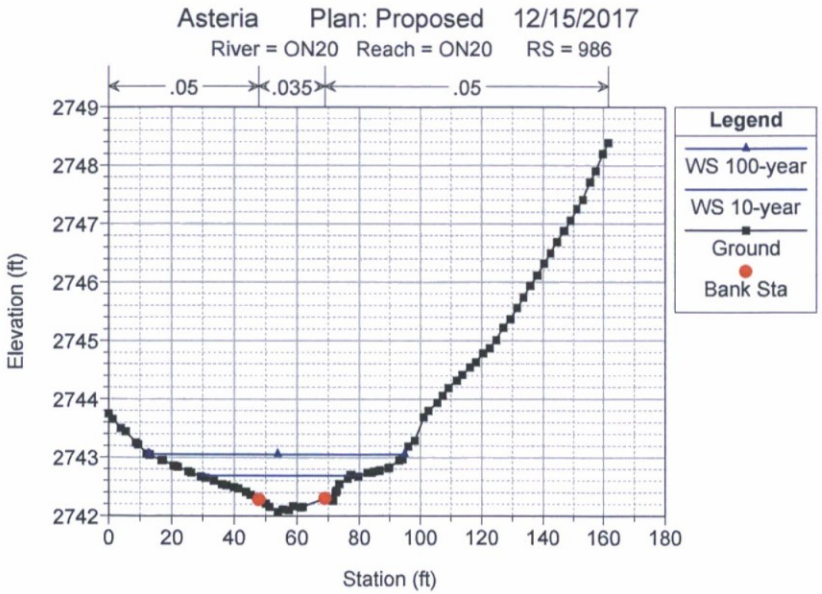

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 223
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

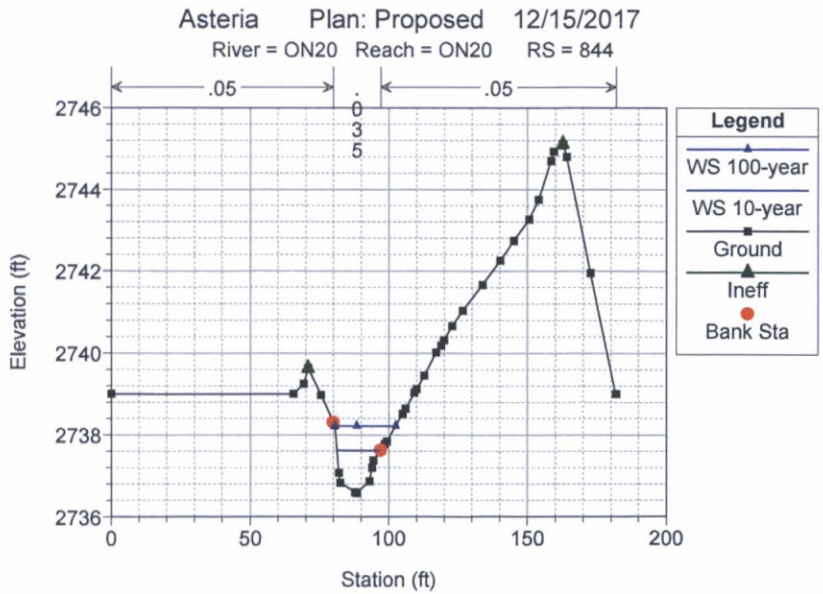

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 156
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

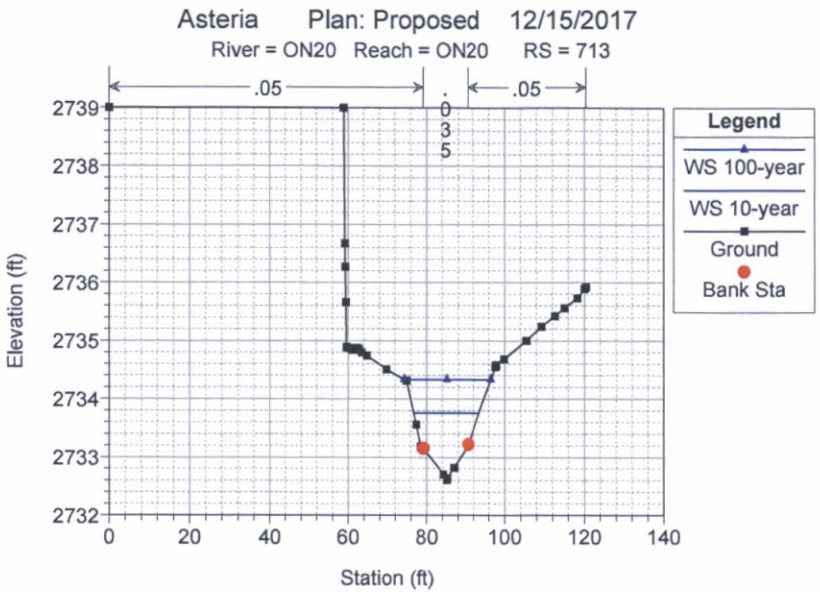

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 122 Culv
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

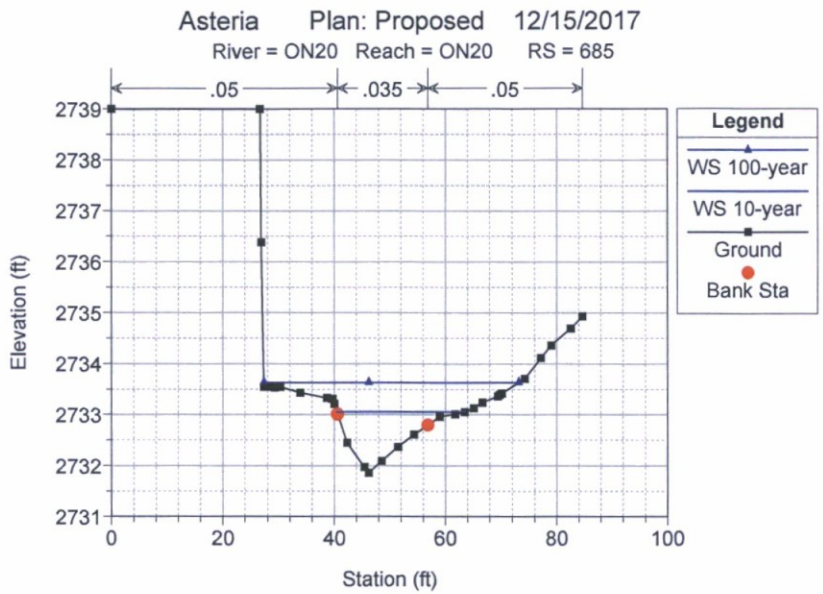

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 122 Culv
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

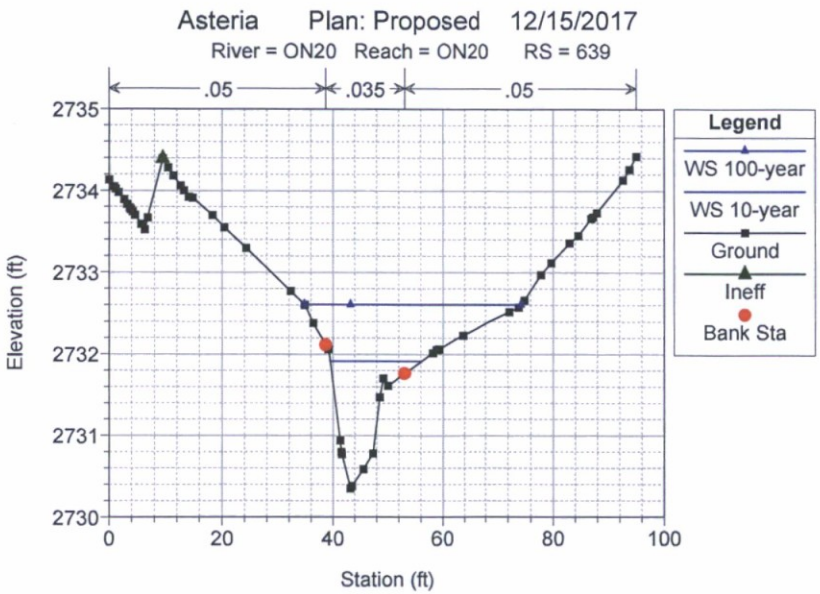

Asteria Plan: Proposed 12/15/2017
River = ON10 Reach = ON10 RS = 2
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

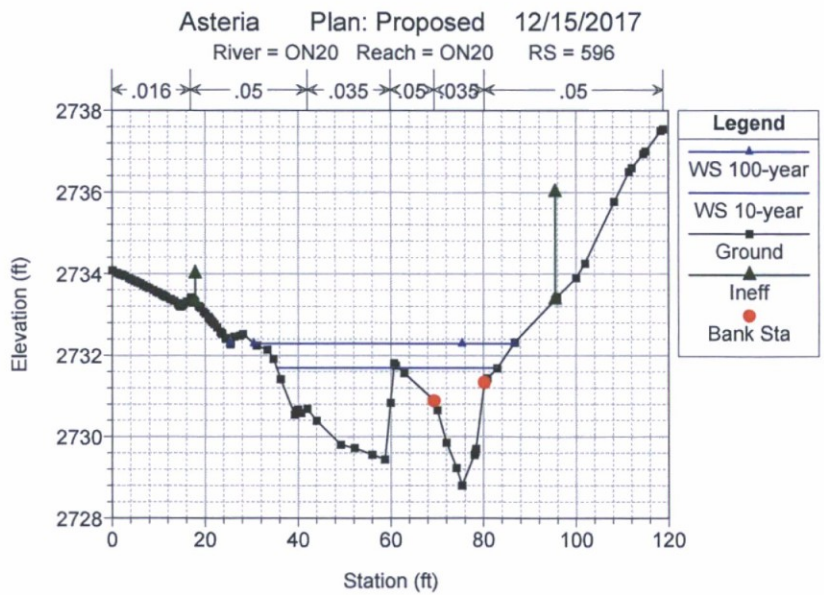

Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 986
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

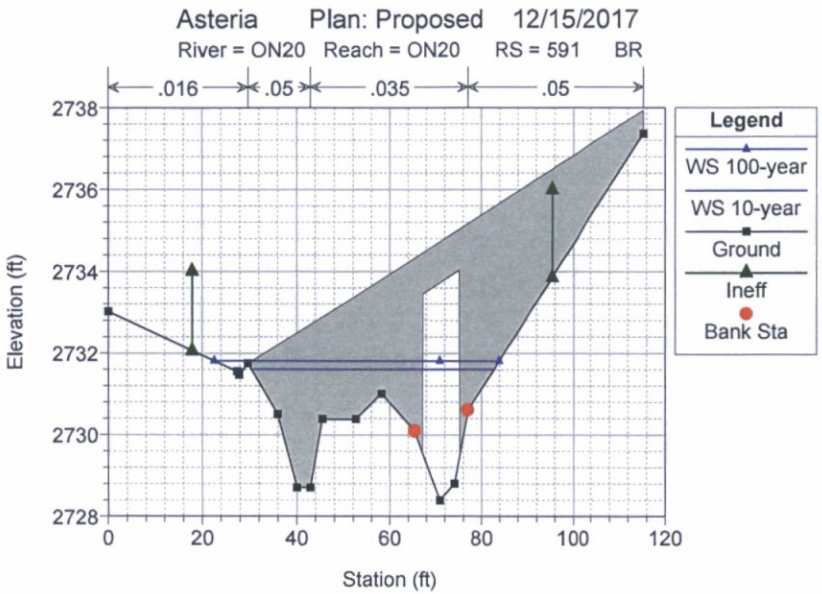

Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 844
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

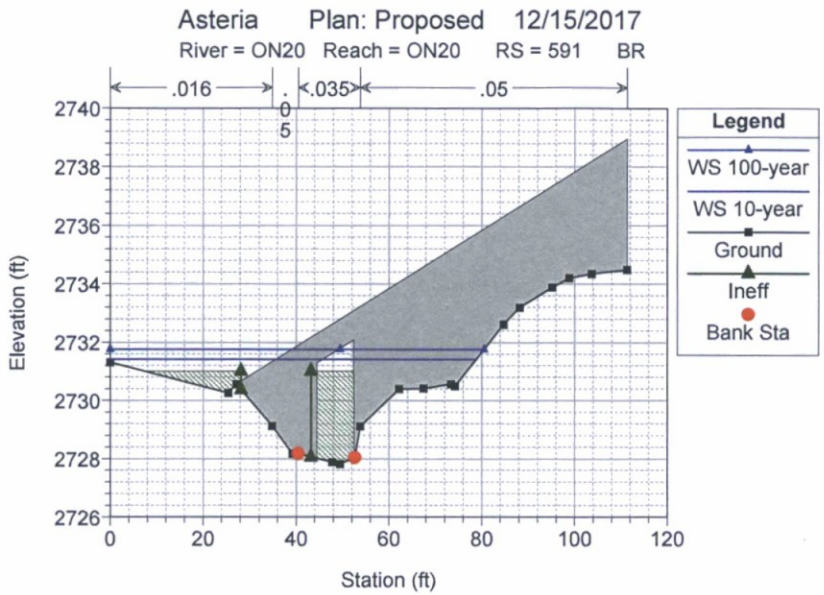

Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 713
.05
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

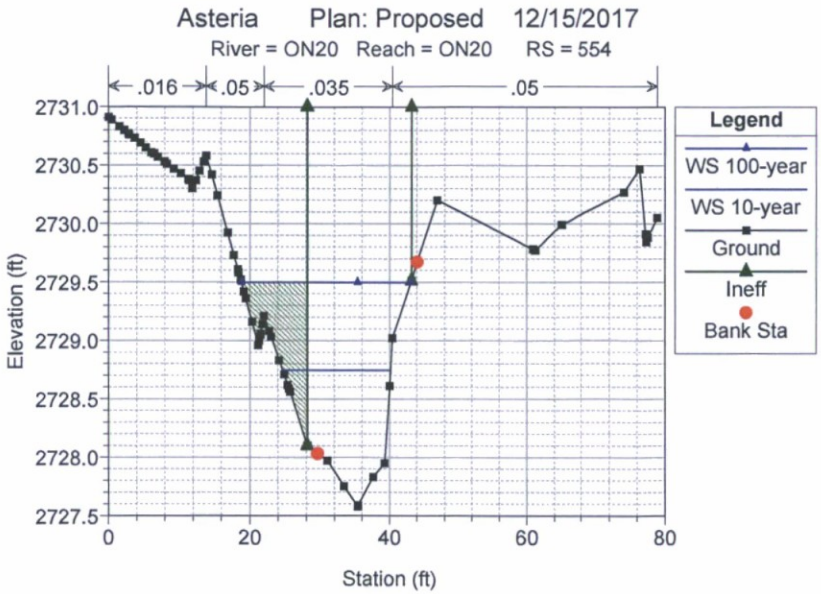

Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 685
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Bank Sta

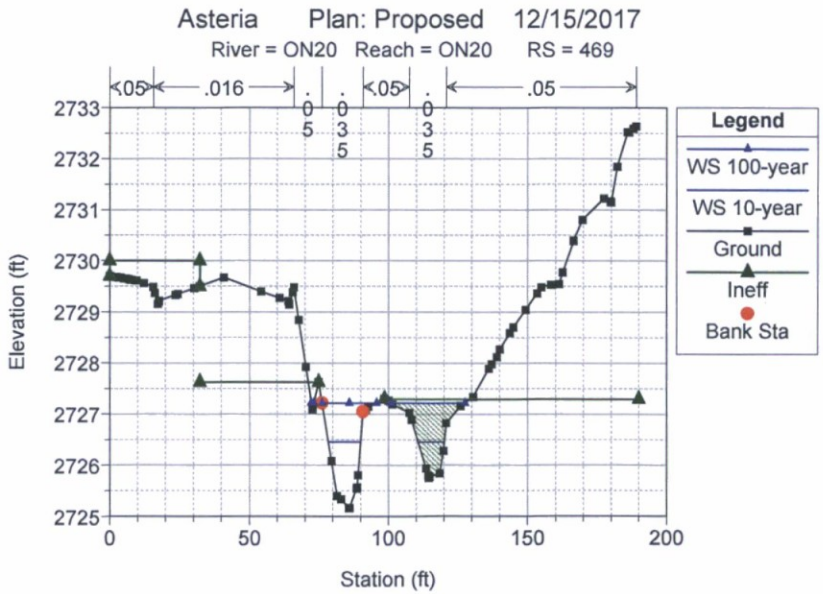

Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 639
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

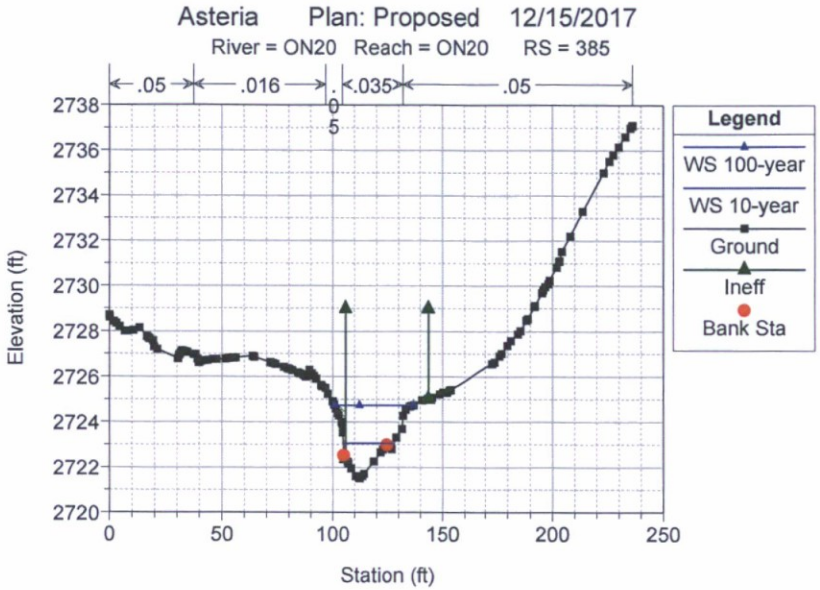

Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 596
.016
.05
.035
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

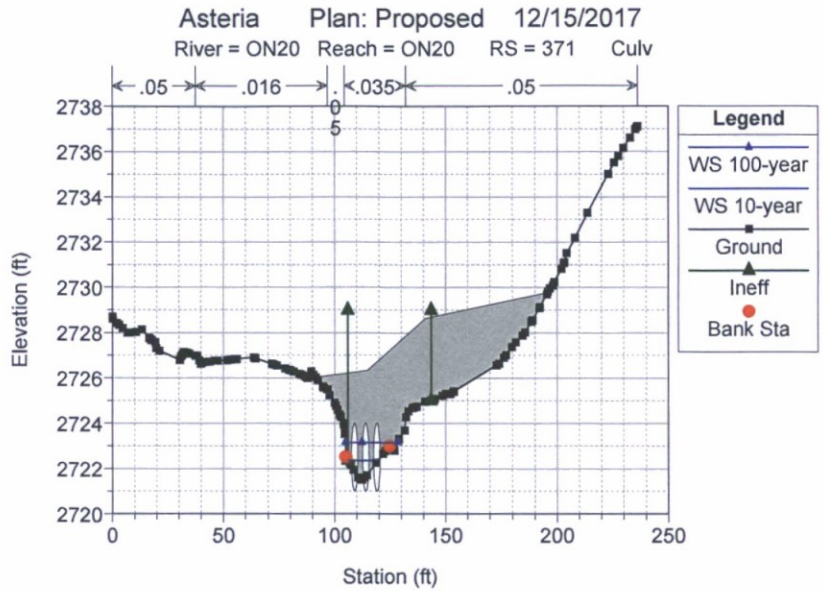

Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 591 BR
.016 .05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

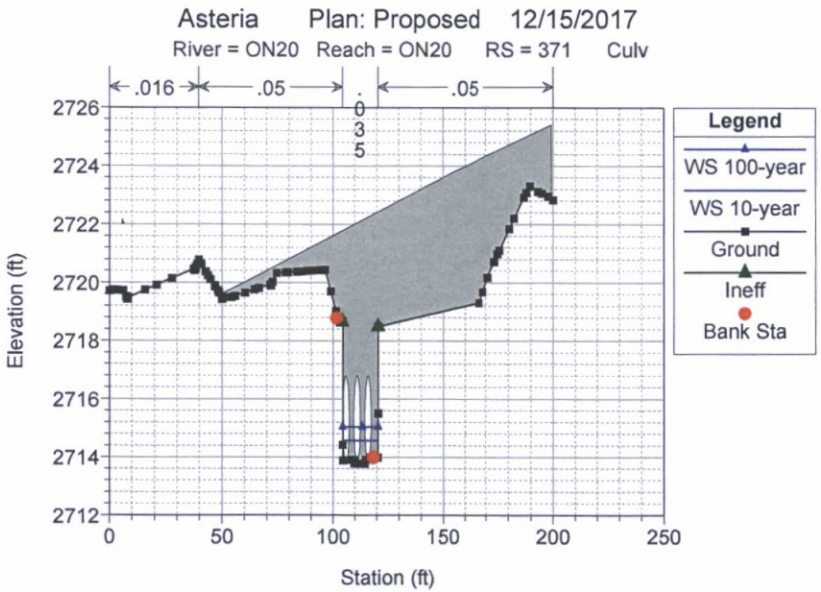

Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 591 BR
.016 .05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

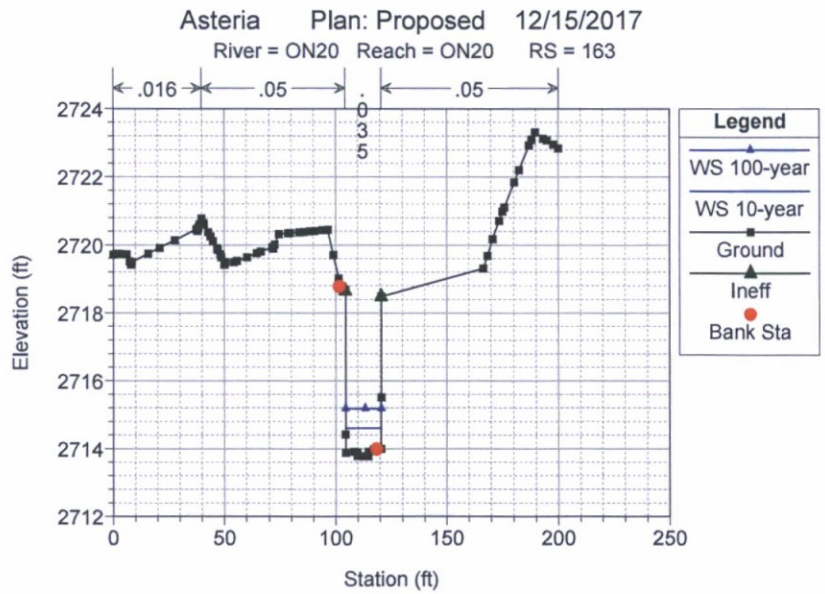

Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 554
.016 .05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta

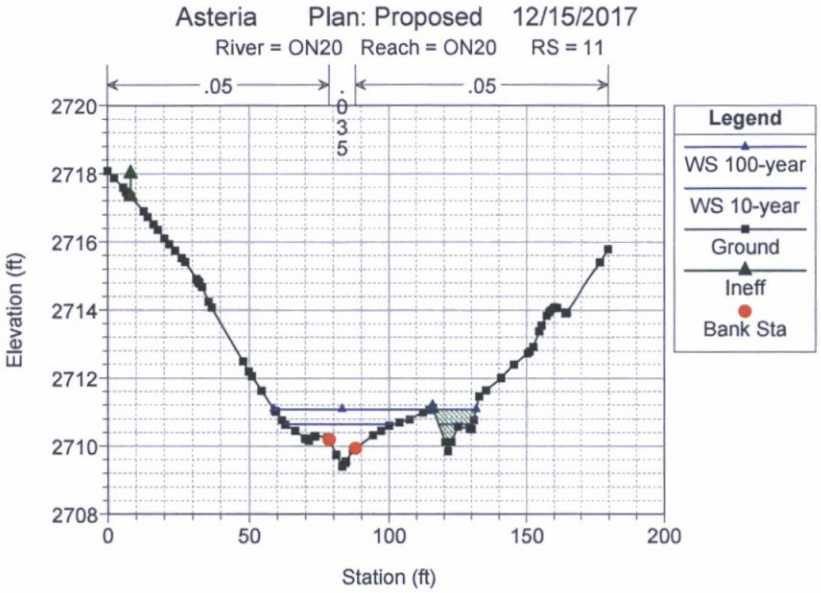

Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 469
.05 .016 .05 .05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta


Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 385
.05 .016 .035 .05
0.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta


Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 371 Culv
.05 .016 .035 .05
0.05
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta


Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 371 Culv
.016 .05 .05
0.35
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta


Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 163
.016 .05 .05
0.35
Elevation (ft)
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta


Asteria Plan: Proposed 12/15/2017
River = ON20 Reach = ON20 RS = 11
.05
.035
.05
2720
2718
2716
2714
2712
2710
2708
Elevation (ft)
0
50
100
150
200
Station (ft)
Legend
WS 100-year
WS 10-year
Ground
Ineff
Bank Sta