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March 4, 2004

To: Distribution List (see below)

RE: Horse Drive (& US 95) Interchange
Supplement to the Final Feasibility Study for
Offsite Drainage Report (2 of 3).
February 2004

Please find herewith for your review a copy of the above referenced report. You are invited to attend a review meeting scheduled for March 23, 2004 at 2:00pm in the City Engineer's Small Conference Room. If you can not attend please provide your written comments prior to that date.

Sincerely,

A handwritten signature in cursive script that reads "Daniel J. Keating".

Daniel J. Keating, PE
Engineering Project Manager

Distribution List: Gary Johnson, RTC-SNV
Jill Reilly, CCRFCD
Jeff Hale, NDOT
Chad Anson, Parsons
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A handwritten signature in cursive script that reads "Peter Jackson".

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Horse Drive Interchange

Supplement

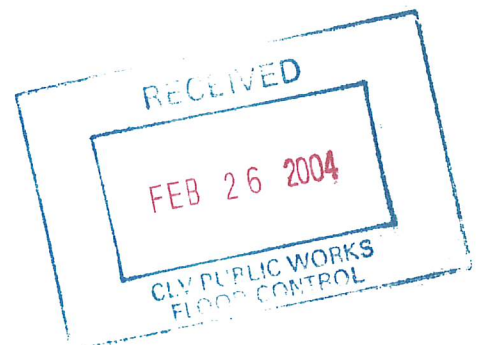
to the

Final Feasibility Study For Off-Site Drainage Report (VOLUME 2 OF 3)

February 2004

Prepared for:

CITY OF LAS VEGAS



Prepared by:

VTN Nevada

2727 South Rainbow Boulevard

Las Vegas, NV 89146

1.0 INTRODUCTION AND PURPOSE

1.1 Project Description

On December 18, 2002, VTN Nevada received a Notice to Proceed (NTP) from the City of Las Vegas for preliminary design services for the Horse Drive/US 95 Interchange. In October 2003, VTN submitted the Final Feasibility Study for Offsite Drainage Report to the City of Las Vegas (Volume 2 of 3). At the request of the City, the purpose of this Supplement report is to supplement and/or update the previous report to include a revised Future Condition analysis that incorporates a modified alignment for the proposed KCHU Facility, along the west side of the proposed Outer Beltway, as shown on the March 3, 2003 Northwest Consensus Map. This facility will direct overland flow away from the project area, therefore, greatly reducing the tributary area to the project in the Future Condition. The project site is located at the intersection of Horse Drive and US 95, approximately 1.5 miles south of the Kyle Canyon Road. Figure 1 (Vicinity Map) shows the general location of the project.

The majority of this report focuses discussion on the Future Offsite Drainage and the hydraulics of the approximately 1 mile MPU facility along US 95 (2002 MPU Facilities CN95 0199 to CN95 0295), as well as a review and update of the Interim (Design Condition) facility configuration as needed from future expectations. This report includes Future Condition offsite flows analysis, storm water collection points for the project Design Condition and Future Condition, and hydraulic performance of culverts in the Design and Future Conditions.

1.2 Previous Studies

Preparation of this Supplement included review of prior studies prepared for the project site. The *City of Las Vegas Northwest Neighborhood Flood Control Master Plan Phase 2* and *Clark County Regional Flood Control District 2002 MPU Base Models* were both used as a basis for the hydrologic analysis. The following table lists the reports that have been utilized in the process of preparing this report.

TABLE 1.1 - EXISTING STUDIES		
1	2002 CCRFCD Las Vegas Valley Flood Control Master Plan Update – By PBS&J, G.C. Wallace, and Louis Berger Group	9/2002
2	City of Las Vegas Northwest Neighborhood Flood Control Master Plan Phase 2 – By PBS&J	9/1999
3	Horse Drive Interchange Final Feasibility Study For Offsite Drainage Report (Volume 2 of 3) – By VTN Nevada	10/2003

2.0 EXISTING CONDITION HYDROLOGY

2.1 Summary

Two existing condition models were developed for VTN 2/5 diversion and VTN full diversion. These subbasins were modified to account for detailed topographic and observational data to further refine this analysis. In addition, detailed analysis of hydraulics and conveyance of flow along the west side of US 95 has also been performed. The specific means and methods used for delineating and verifying the existing condition offsite basins and analysis of hydraulic systems are discussed in the *Horse Drive Interchange Final Feasibility Study For Offsite Drainage Report*, October 2003, VTN Nevada.

The Existing Condition watershed is bounded by Kyle Canyon Road to the north, Grand Teton Drive to the south, and US 95 to the east. The watershed area slopes in an easterly direction towards US 95. In the existing condition, the tributary area consists of desert land and alluvial fans. Washes convey runoff from the project's watershed towards the west side of US 95. Here, a series of ditches, culverts and berms (weirs) work to convey portions of the runoff east, under the US 95 alignment, and portions south, paralleling the US 95 alignment. (Refer to Figure 4 from the October 2003 report, Existing Conditions-Culvert Location Map).

3.0 DESIGN CONDITION HYDROLOGY

3.1 Summary

The Design Condition refers to the interim development condition (VTN full diversion HEC-1 Model) between the completion of the Horse Drive Interchange and the MPU condition upstream. The Design Condition Hydrology, for the purpose of this supplement, has not changed from the previous Final Feasibility Study, October 2003. The culvert locations and hydraulic functions also remain the same, although the RCB size at Culvert 6 has been increased to accommodate the revised future flows. The 10'x4' RCB at the Culvert 6 location (see the Final Feasibility Study, October 2003) has been revised to a 12'x4' RCB. This, however, does not affect the Design Condition hydraulics at Culvert 6, due to the continued need for a restrictor plate to reduce the effective area of Culvert 6 down to a 6'x4' RCB, for Design Condition hydraulic purposes. Therefore the Design Condition HEC-1 model and culvert/weir analysis have not changed from the October 2003 report, and have not been included in this supplement.

The Design Condition features a portion of the proposed MPU Drainage Facility along US 95. The facility, located between the southbound lane of US 95 and the west frontage road, will convey a portion of the flows that reach the project area from approximately Culvert 5 to Culvert 11 at Grand Teton Drive. Care was taken to ensure that flowrates at all design points were not increased from the existing condition analysis. In most cases, the flowrates at the design points were reduced from existing condition (see Figures 4 & 6 from the October 2003 report to compare Existing and Design Conditions flows at each culvert). Although, the MPU facility will be sized for the VTN Future Condition (see Section 4.0), a portion of the Design Condition flows are diverted into the MPU facility to ensure existing flowrates to the east side of US 95 are not increased. Table 3.1 below summarizes and breaks down the Design Condition flows.

TABLE 3.1- VTN DESIGN CONDITION 100 YEAR HYDROLOGIC ANALYSIS

Design Point Location	Total Flow at Design Point (cfs)	Flow Diverted into MPU Facility (cfs)	Flow Conveyed South Along West Frontage Road to next Culvert (cfs)	Flow Conveyed Through West Frontage Road Culvert (cfs)	Flow Conveyed South Between West Frontage Road & US 95 (cfs)	Flow Conveyed to Eastside of US 95 (cfs)
MPU CN95 0275 Culvert 1	25	0	*	*	2	23
MPU CN95 0273 Culvert 2	1061	0	645	416	0	416
MPU CN95 0278 Culvert 3	15	0	0	15 ⁽¹⁾	*	*
MPU CN95 0269 Culvert 4	2541	0	1320	1221	297	925
MPU CN95 0267 Culvert 5 14'x4' RCB Lateral	1372	467	802	103	0	400
MPU CN95 0265 Culvert 6 6'x4' RCB Lateral	1734	226	710	798	0	798
Lateral 1 36" RCP	700	34	666	0	0	0
Lateral 2 36" RCP	666	32	634	0	0	0
MPU CN95 0261 Culvert 7	679	0	679	0	0	0
MPU CN95 0259 Culvert 8	880	0	697	183	0	183
MPU CN95 0256 Culvert 9	1868	0	1242	625	390	236
MPU CN95 0255 Culvert 10 29'x11' OPEN CHANNEL	1258	759	425	833	759	457
MPU CN95 0252 Culvert 11	531	0	0	531	645	1324

Notes:

* Flow is Not Applicable due to culvert location

⁽¹⁾ Flow from Culvert 3 is diverted to Culvert 1.

4.0 FUTURE CONDITION HYDROLOGY

4.1 Summary

Two future condition hydrology studies exist for reference; The Clark County Regional Flood Control District 2002 Master Plan Update (MPU), and the City of Las Vegas Northwest Neighborhood Study (future case). Two future conditions models were developed for comparison in the analysis of this study. The VTN Future Condition model modifies the VTN Design Condition model to determine future flowrates. The Revised 2002 MPU model was updated in order to better compare the future flowrates.

Both future conditions models (VTN Future Condition and Revised 2002 MPU) modify the location of the proposed KCHU facility to follow along the west side of the proposed Outer Beltway as shown on the Northwest Consensus Map. The Revised 2002 MPU model (see Figure 2, Revised 2002 MPU Offsite Subbasin Map) uses the MPU's WEST3.dat model as a basis and modifies the area to reflect the proposed location of the Outer Beltway. Although the areas do not completely match, this offers a better comparison at each design point. The VTN Future Condition model features 16 subbasins with a total area of 2.22 mi² and 10 design points along US 95 versus 6 subbasins with a total area of 2.18 mi² and only 3 design points in the Revised MPU model. The more design points were needed to properly design the hydraulics of the US 95 MPU facility (see Section 5.0) for future flowrates.

The VTN Future Condition model features adjusted Design Condition subbasin parameters to account for full development of the designated residential, open space (park area), or commercial zoned areas. Figure 3 Future Offsite Drainage Map shows the VTN Future Condition subbasin delineation with the approximate beltway location. Surface runoff from the west side of the outer beltway will be intercepted by the channel along the Outer Beltway and routed north along the beltway, out of the project area. This reduces the size of the effective watershed from 6.47 mi² in the Design Condition model to 2.22 mi² in the Future Condition model.

The future drainage conditions neighborhood study uses the same subbasin delineation and drainage parameters as the existing conditions neighborhood study. The flows are combined and routed differently due to the inclusion of proposed regional facilities. The neighborhood future study starts along US 95 just south of Kyle Canyon Road with a proposed 54" RCP. This pipe increases in size to a 66" RCP, a 90" RCP, and eventually to a 96" RCP near Horse Drive before transitioning to a 10' x 10' RCB near Rachel Street. The 2002 MPU also shows proposed regional facilities along US 95. It proposes local facilities south from near Kyle Canyon Road. At Brent Lane, the 2002 MPU proposes to begin a 96" RCP facility. This facility transitions to a 10' x 9' RCB up to Grand Teton

Drive, where it increases in size again to 2-10' x 7' RCBs. Although the 2002 MPU is a more recent study, the neighborhood study is slightly more detailed in this area with five subbasins bordering US 95 between Kyle Canyon Road and Grand Teton Road compared to three for the MPU study.

All future runoff reaching US 95 will be captured in the MPU facility, eliminating flows from crossing US 95. Runoff is routed south along the western frontage road until reaching the next MPU collection point. The Future Condition analysis proposes additional MPU collection points at the Culvert 8 and Culvert 10 locations, and the removal or plugging of existing Culverts 4 through 11. Culvert 1 and Culvert 3 are located outside of the future watershed and, therefore, were not included in the Future Condition model analysis. While the existing Culvert 2 was not modified from the existing condition for the Future model, the impacting flow is reduced from 1061cfs in the Design Condition model down to 43cfs in the Future Condition model. Using culvert locations as design points, Table 4.1 summarizes the total flows at the design points along US 95 in the NWNS, 2002 MPU, Revised 2002 MPU, and VTN Future Condition studies.

TABLE 4.1 - 100-YEAR FUTURE HYDROLOGY MODEL COMPARISON

Design Point Location	FLOW AT DESIGN POINTS ALONG US 95 FROM DESIGNATED MODEL (CFS)			
	NWNS FUT ⁽¹⁾	2002 MPU ⁽²⁾	Revised 2002 MPU ⁽³⁾	VTN Future Condition ⁽⁴⁾
MPU CN95 0275 Culvert 1	191	*	*	*
MPU CN95 0273 Culvert 2	232	*	*	43
MPU CN95 0278 Culvert 3	*	*	*	*
MPU CN95 0269 Culvert 4	308	400	415	325
MPU CN95 0267 Culvert 5	*	*	*	444
MPU CN95 0265 Culvert 6	763	*	*	902
MPU CN95 0261 Culvert 7	904	920	1066	968
MPU CN95 0259 Culvert 8	*	*	*	1176
MPU CN95 0256 Culvert 9	1719	*	*	2040
MPU CN95 0255 Culvert 10	*	2080	1916	1987
MPU CN95 0252 Culvert 11	2408	2437	2280	2194

NOTES:

* = HEC-1 model does not have a node at this location

⁽¹⁾ NWNS FUT = Ultimate Drainage Conditions Northwest Neighborhood Flood Control Master Plan, Sept 1999, Prepared for City of Las Vegas by PBS&J

⁽²⁾ 2002 MPU = Las Vegas Valley Flood Control Master Plan Update, 2002, Prepared for Clark County Regional Flood Control District by PBS&J

⁽³⁾ Revised 2002 MPU model = 02MPUREV.dat, included in Appendix A-4.2

⁽⁴⁾ VTN Future Condition Model = HORSEFUT.dat, included in Appendix A-5.4. Flow in this column includes flow in the MPU facility and the flow that is diverted south along the west frontage road.

5.0 MPU FACILITIES

5.1 Summary

The Horse Drive Interchange will cross the proposed 2002 CCRFCD MPU facilities CN95-0199/0259/0295 located along the Westside of US 95 (refer to the CCRFCD MPU Figure F-3, included in Appendix A2). MPU Figure F-3 indicates CN95 0295 and CN95 0259 (96-inch RCP) both have a flowrate of 923cfs, CN95 0199 (10'x9' RCBC) has a flowrate of 2081cfs and CN95 0167 (2-10'x7' RCBC) has a flowrate of 2421cfs. The portion of the MPU facility included in this project was designed to convey the future development flows presented in the VTN Future Condition model. Table 5.1 below, summarizes and breaks down future flows.

TABLE 5.1- VTN FUTURE CONDITION 100 YEAR HYDRAULIC ANALYSIS

Design Point Location	Flow at Design Point (cfs)	Flow Diverted South Along US 95 Frontage Road to next Collection Point (cfs)	Flow Diverted into MPU Facility (cfs)	Total Flow in MPU Facility (cfs)
MPU CN95 0275 Culvert 1 ⁽¹⁾	-	-	-	-
MPU CN95 0273 Culvert 2	43	1	42 ⁽²⁾	0
MPU CN95 0278 Culvert 3 ⁽¹⁾	-	-	-	-
MPU CN95 0269 Culvert 4	325	325	0	0
MPU CN95 0267 Culvert 5 14' x 4' RCB Lateral	444	0	444	444
MPU CN95 0265 Culvert 6 12' x 4' RCB Lateral	469	0	469	902
Lateral 1 36" RCP	71	66	5	904
Lateral 2 36" RCP	66	62	4	906
MPU CN95 0261 Culvert 7	62	62	0	906
MPU CN95 0259 Culvert 8 8' x 6' RCB Lateral	290	0	290	1176
MPU CN95 0256 Culvert 9	864	864	0	1176
MPU CN95 0255 Culvert 10 15' x 6' RCB Lateral	887	145	741	1842
MPU CN95 0252 Culvert 11	365	0	365	2194

Notes:

⁽¹⁾ Culverts 1 & 3 are located outside of the future watershed boundary.

⁽²⁾ Flow at this design point is conveyed through existing culverts to the east side of US95

5.2 Design Considerations

5.2.1 Utilities

There is an existing 36-inch water line within the proposed alignment of Tee Pee Lane, crossing US 95 at approximate Roadway station 56+75. At this stage, the depth to the top of pipe is shown as 2688.8±, as taken from the water line as-built drawings. As part of the Horse Interchange project, the existing 21-inch sanitary sewer line currently terminating within the Tee Pee Lane alignment at approximately station "TP" 1+87 will be extended to accommodate the development needs within the project area. A 12-inch sanitary sewer line will be constructed along the Horse Drive Alignment from the Frontage Road West 21-Inch sewer at "FRW" 98+41 / "HD" 120+43 aligned within the maintenance easement on the south side of Horse Drive. See Volume 1 of the October 2003 Report – Final Feasibility Study for a more detailed utility analysis.

5.2.2 Proposed Local Facilities

Based on the CLV neighborhood study, several collection points for future local facilities should be considered. The MPU facility will be designed with appropriate "stub-outs" and or confluence structures to allow connection with these local systems. Some of these confluence structures and "stub-outs" will be used to convey flows in the Design Condition for the interchange. A 14'x4' RCB lateral is provided at the Culvert 5 location (sta. 64+64.24). A 12'x4' RCB lateral is provided at the Culvert 6 location (sta. 56+92.53). Two 36" RCP "stub-outs" have been provided between Culvert 6 and 7 at approximate channel stations 51+43 and 55+15.

5.2.3 Inflow Structures

Based on the Future Condition hydrology model, additional confluence structures beyond the structures listed above will be required to collect future flows. This Future Study proposes an 8'x6' RCB lateral located near Culvert 8 to convey a maximum flow of 290cfs and a 16'x6' RCB lateral located near Culvert 10 to convey a maximum of 741cfs into the MPU facility along US 95. Figure 4, Future Conditions Inlet Locations Map, displays the Future Condition inlet locations along with the maximum future flows in the laterals and in the main channel.

5.3 Facility Layout

Appendix C includes a plan and profile for this regional facility. This facility has been designed to collect existing flows and perpetuate them along existing flow paths without increasing existing flowrates at project design points. The facility will also safely convey future flows to downstream facilities as intended in the 2002 MPU.

Confluence structures, located just down stream of Culverts 8 & 10, have been incorporated into the channel design in anticipation of future flow conditions. These confluence structures will not add any flow during the Design Condition, but are recommended for future planning. An 8'x6' RCB "stub-out" near Culvert 8, and a 16'x6' RCB "stub-out" near Culvert 10 are recommended to effectively convey future flows into the MPU facility, based on HY-8 Culvert Analysis. See Appendix B1 for Future Inlet Analysis calculations.

6.0 SUMMARY AND RECOMMENDATIONS

6.1 Summary

At the request of the City, the purpose of this Supplement report is to supplement and/or update the previous report, submitted to the City in October 2003, to include a Revised MPU (Future Condition) analysis that incorporates a modified alignment for the proposed KCHU Facility, along the west side of the proposed Outer Beltway, as shown on the March 3, 2003 Northwest Consensus Map. This facility will convey overland flow away from and around the project area, therefore, reducing the tributary area to the project from 6.47 mi² in the Design Condition model to 2.22 mi² in the Future Condition model. The MPU facility has been designed to convey the VTN Future Condition flowrates, and analyzed to ensure that it will safely convey the VTN Design Condition flowrates.

The project site is located at the intersection of Horse Drive and US 95, approximately 1.5 miles south of the Kyle Canyon Road. The approximately 1 mile long MPU Facility has been designed to collect flow in the Design Condition while perpetuating the existing flowrates across US 95. The Design Condition facility features two confluence structures and two inlet structures. In the Future Condition, the MPU Facility has been designed to collect all of the flow that reaches the US 95 west frontage road and convey it south in the facility, as intended in the 2002 MPU. The Future Condition facility features four confluence structures and two additional inlet structures.

7.0 REFERENCES

1. *Clark County Regional Flood Control District (CCRFCD), 1999 Hydraulic Criteria and Drainage Design Manual. Las Vegas, Nevada.*
2. *Urban Drainage Design Manual (HEC-22), FHWA, Nov 1996*
3. *Flood Hydrograph Package (HEC-1) User Manual, Sept 1990*
4. *Water Surface and Pressure Gradient Hydraulic Analysis System (WSPG) User Manual, Apr 1979*
5. *Uniform Standard Drawings For Public Works' Construction, Offsite Improvements, Clark County Area, Nevada, Dec 2001*
6. *Black Mountain & Mission Hills Detention Basin and Outfall Structure, VTN Nevada, July 1992*
7. *Drainage Study of Paradise Hills Development, Pentacore, 1995 – 2000*
8. *2002 CCRFCD Las Vegas Valley Flood Control Master Plan Update – by PBS&J, G.C. Wallace, and Louis Berger Group*
9. *Neenah Foundry Metal Castings, 11th Edition, 1989*
10. *Soil Conservation Service (SCS), 1985. Soil Survey of Las Vegas Valley Area, Nevada. United States Department of Agriculture*
11. *Mission Hills Western Interceptor Channel, VTN Nevada, May 1996*
12. *Soil Survey of Las Vegas Valley Area Nevada, US Department of Agriculture, July 1985*
13. *Hydraulic Design of Highway Culverts, Federal Highway Administration FHWA, September 1985*

APPENDIX A

FUTURE HYDROLOGY

100-YEAR FUTURE HYDROLOGY MODELS SUMMARY

Design Point Location	NWNS FUT ⁽¹⁾ (cfs)	2002 MPU ⁽²⁾		Revised 2002 MPU ⁽³⁾		VTN Future Condition ⁽⁴⁾	
		Area (mi ²)	Flow (cfs)	Area (mi ²)	Flow (cfs)	Area (mi ²)	Flow (cfs)
MPU CN95 0275 Culvert 1	191	*		*		*	
MPU CN95 0273 Culvert 2	232	*		*		0.03	43
MPU CN95 0278 Culvert 3	*	*		*		*	
MPU CN95 0269 Culvert 4	308	0.32	400	0.36	415	0.28	325
MPU CN95 0267 Culvert 5	*	*		*		0.39	444
MPU CN95 0265 Culvert 6	763	*		*		0.81	902
MPU CN95 0261 Culvert 7	904	0.80	920	1.00	1066	0.86	968
MPU CN95 0259 Culvert 8	*	*		*		1.10	1176
MPU CN95 0256 Culvert 9	1719	*		*		1.99	2040
MPU CN95 0255 Culvert 10	*	2.20	2080	1.84	1916	2.01	1987
MPU CN95 0252 Culvert 11	2408	3.03	2437	2.18	2280	2.22	2194

NOTES:

* = HEC-1 model does not have a node at this location

⁽¹⁾ NWNS FUT = Ultimate Drainage Conditions Northwest Neighborhood Flood Control Master Plan, Sept 1999, Prepared for City of Las Vegas by PBS&J

⁽²⁾ 2002 MPU = Las Vegas Valley Flood Control Master Plan Update, 2002, Prepared for Clark County Regional Flood Control District by PBS&J

⁽³⁾ Revised 2002 MPU model = 02MPUREV.dat, included in Appendix A-4.2

⁽⁴⁾ VTN Future Condition Model = HORSEFUT.dat, included in Appendix A-5.4. Flow in this column includes flow in the MPU facility and the flow that is diverted south along the west frontage road.

A-1

USDA SOIL SURVEY

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
140----- Casaga	0-1	Very gravelly sandy clay loam.	GC	A-2	0-5	30-55	25-50	15-30	10-20	25-35	10-15
	1-21	Clay loam-----	CL	A-6	0-5	90-100	85-100	80-95	65-75	35-40	15-20
	21-41	Very gravelly clay loam, gravelly clay loam.	GC	A-6, A-2	0	30-60	25-55	25-50	20-40	35-40	15-20
	41-60	Stratified very gravelly sandy loam to gravelly clay loam.	GM, GM-GC	A-1, A-2	0-5	40-60	35-55	25-35	10-20	15-25	NP-10
150----- Cave	0-6	Very stony sandy loam.	SM	A-1, A-2	10-25	70-85	55-75	40-55	20-30	15-20	NP-5
	6-60	Indurated-----	---	---	---	---	---	---	---	---	---
151----- Cave	0-5	Loamy fine sand	SM	A-2	0	95-100	95-100	80-90	15-20	---	NP
	5-11	Gravelly fine sandy loam.	SM	A-2	0	70-80	50-60	45-55	25-35	20-25	NP-5
	11-60	Indurated-----	---	---	---	---	---	---	---	---	---
152----- Cave	0-12	Gravelly fine sandy loam.	SM	A-2, A-4	0-5	70-90	60-75	45-65	25-40	20-25	NP-5
	12-36	Indurated-----	---	---	---	---	---	---	---	---	---
	36-60	Gravelly loamy sand, very gravelly sandy loam.	GM, SM	A-1, A-2	0-5	35-75	30-60	20-35	10-30	---	NP
	0-15	Gravelly fine sandy loam.	SM	A-2, A-4	0-5	70-90	60-75	45-65	25-40	20-25	NP-5
	15-60	Indurated-----	---	---	---	---	---	---	---	---	---
160----- Destazo	0-11	Cobbly fine sandy loam.	SM	A-2	25-35	85-95	80-90	55-70	25-35	20-30	NP-5
	11-40	Very gravelly sandy clay loam, very gravelly clay loam.	GM-GC, GC	A-1, A-2	5-10	35-55	30-50	15-30	10-25	25-40	5-15
	40-60	Gravelly sandy loam.	SM	A-1, A-2	0-5	60-70	55-65	45-55	20-30	25-30	NP-5
181*: Caliza-----	0-2	Extremely stony fine sandy loam.	GM	A-1	30-45	40-45	30-35	20-30	10-20	---	NP
	2-14	Very gravelly sandy loam.	GM	A-1	0-10	40-45	30-45	20-30	10-20	---	NP
	14-60	Stratified very gravelly loamy sand to extremely gravelly coarse sand.	GP-GM	A-1	0-10	35-45	25-40	10-20	5-10	---	NP
Pittman-----	0-2	Extremely stony fine sandy loam.	GM	A-1	30-45	30-60	25-55	20-45	15-25	15-25	NP-5
	2-23	Stratified gravelly loam to extremely gravelly coarse sand.	GM	A-1	10-30	40-60	35-55	20-35	15-25	15-20	NP-5
	23-32	Indurated-----	---	---	---	---	---	---	---	---	---
	32-50	Cemented-----	---	---	---	---	---	---	---	---	---
	50-60	Very gravelly sand, extremely gravelly sand.	GP	A-1	0	20-35	15-30	10-20	0-5	---	NP

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
90----- Dalian	0-4	Very gravelly fine sandy loam.	GM	A-1	0	30-55	25-50	20-40	10-25	---	NP
	4-61	Very gravelly sandy loam, extremely gravelly fine sandy loam.	GM, GP-GM GP	A-1	5-10	20-60	10-50	5-40	0-25	---	NP
191----- Dalian	0-5	Very cobbly fine sandy loam.	GM	A-1, A-2	35-50	55-65	50-60	40-55	20-30	---	NP
	5-60	Very gravelly sandy loam, extremely gravelly fine sandy loam.	GM, GP-GM	A-1	5-10	20-60	15-50	10-40	5-25	---	NP
92*: Dalian-----	0-5	Very gravelly fine sandy loam.	GM	A-1	0	30-55	25-50	20-40	10-25	---	NP
	5-60	Very gravelly sandy loam, extremely gravelly fine sandy loam.	GM,GP-GM	A-1	5-10	20-60	15-50	10-40	5-25	---	NP
McCullough-----	0-5	Very gravelly very fine sandy loam.	GM	A-1	5-10	35-45	30-40	25-40	15-25	20-25	NP-5
	5-30	Stratified loam to sandy loam.	SM	A-4, A-2	0	95-100	90-100	55-65	30-40	15-25	NP-5
	30-40	Stratified coarse sand to loamy fine sand.	SM	A-1, A-2	0	80-100	75-95	40-60	10-30	---	NP
	40-60	Extremely gravelly loamy sand.	GP-GM	A-1	5-10	20-30	15-25	10-15	5-10	---	NP
00----- Glencarb	0-6	Silt loam-----	ML, CL-ML	A-4	0	100	100	90-100	70-90	20-30	NP-10
	6-60	Stratified silty clay loam to very fine sandy loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	75-85	25-35	5-15
206----- Glencarb	0-8	Silt loam-----	ML, CL-ML	A-4	0	100	100	95-100	75-90	20-30	NP-10
	8-60	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	95-100	80-95	30-45	5-20
22----- Glencarb	0-6	Silty clay loam	CL	A-6	0	100	100	95-100	85-95	35-40	15-20
	6-60	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	95-100	80-95	30-45	5-20
36----- Glencarb	0-6	Very fine sandy loam.	ML, CL-ML	A-4	0	100	100	85-95	55-65	20-30	NP-10
	6-60	Stratified clay loam to very fine sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	95-100	75-85	20-30	5-15
37----- Glencarb	0-6	Very fine sandy loam.	ML, CL-ML	A-4	0	100	100	85-100	55-65	20-30	NP-10
	6-42	Stratified silty clay loam to silt loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	75-85	25-35	5-15
	42-60	Cemented-----	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches Pot	Percentage passing sieve number--				Liquid limit Pot	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
380----- Skyhaven	In										
	0-1	Very fine sandy loam.	SM, ML	A-4	0	80-100	75-100	70-95	40-70	15-25	NP-5
	1-8	Clay loam-----	CL	A-6	0	80-100	75-100	70-95	55-80	35-40	15-20
	8-37	Gravelly silty clay loam, gravelly loam, gravelly clay loam.	CL, GC	A-6	0-5	60-80	50-75	45-70	35-65	30-40	10-20
	37-60	Indurated-----	---	---	---	---	---	---	---	---	---
390----- Spring	0-11	Clay loam-----	CL	A-6, A-7	0	100	100	90-100	70-80	35-45	15-25
	11-43	Gypsiferous material.	---	---	---	---	---	---	---	---	---
	43-60	Clay loam, silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	75-90	35-45	15-25
00----- Tencee	0-5	Very gravelly fine sandy loam.	GM, GP-GM	A-1	0-15	35-55	25-50	20-40	5-20	20-30	NP-5
	5-15	Very gravelly sandy loam, very gravelly loam, very gravelly fine sandy loam.	GM, GP-GM	A-1, A-2	0-25	35-55	25-50	15-40	5-30	20-30	NP-5
	15	Indurated-----	---	---	---	---	---	---	---	---	---
415----- Izteco	0-2	Very gravelly sandy loam.	GM	A-1	0-30	45-60	30-50	20-35	10-20	15-20	NP-5
	2-30	Stratified very gravelly loam to extremely gravelly loamy coarse sand.	GP-GM, GM	A-1	0	30-40	15-35	10-25	5-15	15-20	NP-5
	30-60	Gypsiferous material.	---	---	---	---	---	---	---	---	---
417*: zteco-----	0-4	Very gravelly sandy loam.	GM	A-1	0-30	45-60	30-50	20-35	10-20	15-20	NP-5
	4-30	Stratified very gravelly loam to extremely gravelly loamy coarse sand.	GP-GM, GM	A-1	0	30-40	15-35	10-25	5-15	15-20	NP-5
	30-60	Gypsiferous material.	---	---	---	---	---	---	---	---	---
ock outcrop. 3*: Aztec-----	0-4	Gravelly fine sandy loam.	SM	A-1	0-10	75-85	60-75	45-60	15-25	15-20	NP-5
	4-30	Stratified very gravelly loam to extremely gravelly loamy coarse sand.	GP-GM, GM	A-1	0	30-40	15-35	10-25	5-15	15-20	NP-5
	30-60	Gypsiferous material.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare" and "occasional" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding		High water table		Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Months	Depth	Months	Depth	Thick-ness	Depth	Hard-ness	Uncoated steel	Concrete
				<u>Ft</u>		<u>In</u>		<u>In</u>			
105*: McCullough-----	B	Rare-----	---	>6.0	---	>60	---	---	---	High-----	High.
Jean-----	A	Rare-----	---	>6.0	---	>60	---	---	---	High-----	Low.
Bluepoint-----	A	None-----	---	>6.0	---	>60	---	---	---	High-----	Low.
107----- Arizo	A	Rare-----	---	>6.0	---	>60	---	---	---	High-----	Low.
112----- Arizo	A	Occasional	Mar-Sep	>6.0	---	>60	---	---	---	High-----	Low.
113----- Arizo	A	Rare-----	---	>6.0	---	>60	---	---	---	High-----	High.
117----- Arizo	A	None-----	---	>6.0	---	>60	---	---	---	High-----	Low.
120----- Bluepoint	A	Rare-----	---	4.0-6.0	Jun-Sep	>60	---	---	---	High-----	Moderate.
127, 128, 129----- Bluepoint	A	None-----	---	>6.0	---	>60	---	---	---	High-----	Low.
1----- Bracken-----	B	None-----	---	>6.0	---	40-60	Soft	---	---	High-----	High.
Destazo-----	B	None-----	---	>6.0	---	>60	---	---	---	High-----	High.
132----- Bracken	B	None-----	---	>6.0	---	40-60	Soft	---	---	High-----	High.
33*: Bracken-----	B	None-----	---	>6.0	---	40-60	Soft	---	---	High-----	High.
Rock outcrop.											
34----- Bracken	B	None-----	---	>6.0	---	40-60	Soft	---	---	High-----	High.
140----- Casaga	C	None-----	---	>6.0	---	>60	---	---	---	High-----	High.
50----- Cave	D	None-----	---	>6.0	---	>60	---	4-20	Thick	High-----	Low.
151----- Cave	D	None-----	---	>6.0	---	>60	---	10-20	Thick	High-----	Low.
152, 155----- Cave	D	None-----	---	>6.0	---	>60	---	4-20	Thick	High-----	Low.
50----- Destazo	B	None-----	---	>6.0	---	>60	---	---	---	High-----	High.
181*: Caliza-----	B	None-----	---	>6.0	---	>60	---	---	---	High-----	Low.
Wittman-----	C	None-----	---	>6.0	---	>60	---	20-30	Thick	High-----	Low.

1 footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding		High water table		Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Months	Depth Ft	Months	Depth In	Thick-ness	Depth In	Hard-ness	Uncoated steel	Concrete
182*: Caliza-----	B	None-----	---	>6.0	---	>60	---	---	---	High-----	Low.
Pittman-----	C	None-----	---	>6.0	---	>60	---	20-30	Thick	High-----	Low.
Arizo-----	A	Occasional	Mar-Sep	>6.0	---	>60	---	---	---	High-----	Low.
183----- Caliza	B	None-----	---	>6.0	---	>60	---	---	---	High-----	Low.
184----- Caliza	B	Rare-----	---	>6.0	---	>60	---	---	---	High-----	Low.
187----- Caliza	B	None-----	---	>6.0	---	>60	---	---	---	High-----	Low.
190----- Dalian	B	None-----	---	>6.0	---	>60	---	---	---	High-----	Low.
91----- Dalian	B	Rare-----	---	>6.0	---	>60	---	---	---	High-----	Low.
192*: Dalian-----	B	Rare-----	---	>6.0	---	>60	---	---	---	High-----	Low.
McCullough-----	B	Rare-----	---	>6.0	---	>60	---	---	---	High-----	Low.
200----- Glencarb	B	Rare-----	---	>6.0	---	>60	---	---	---	High-----	Moderate.
carb-----	C	Occasional	Jul-Sep	3.0-5.0	Jul-Jun	>60	---	---	---	High-----	High.
22----- Glencarb	C	Rare-----	---	3.0-5.0	Jul-Jun	>60	---	---	---	High-----	High.
236----- Glencarb	B	Rare-----	---	>6.0	---	>60	---	---	---	High-----	High.
37----- Glencarb	B	Rare-----	---	>6.0	---	>60	---	40-60	Thick	High-----	Low.
240----- Goodsprings	D	None-----	---	>6.0	---	>60	---	9-20	Thick	High-----	Low.
2, 255----- Grapevine	B	Rare-----	---	>6.0	---	>60	---	---	---	High-----	High.
60----- Jean	A	Rare-----	---	>6.0	---	>60	---	---	---	High-----	Low.
262*: Jean-----	A	Rare-----	---	>6.0	---	>60	---	---	---	High-----	Low.
ean-----	A	Occasional	Jun-Sep	>6.0	---	>60	---	---	---	High-----	Low.
Woodsprings-----	D	Rare-----	---	>6.0	---	>60	---	9-20	Thick	High-----	Low.
263*: Jean-----	A	Rare-----	---	>6.0	---	>60	---	---	---	High-----	Low.
Jean-----	A	Occasional	Jun-Sep	>6.0	---	>60	---	---	---	High-----	Low.
264----- Jean	A	Rare-----	---	>6.0	---	>60	---	---	---	High-----	Low.

: footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Well name and map symbol	Hydro-logic group	Flooding		High water table		Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Months	Depth Ft	Months	Depth In	Thick- ness	Depth In	Hard- ness	Uncoated steel	Concrete
270----- Land	B	Rare-----	---	3.5-6.0	Mar-Sep	>60	---	---	---	High-----	High.
278----- Land	D	Rare-----	---	1.5-3.0	Jan-Dec	>60	---	---	---	High-----	High.
282----- Land	C	Rare-----	---	3.0-3.5	Jan-Dec	>60	---	---	---	High-----	High.
300, 301----- Las Vegas	D	Rare-----	---	>6.0	---	>60	---	3-14	Thick	High-----	High.
302*: Las Vegas-----	D	Rare-----	---	>6.0	---	>60	---	3-14	Thick	High-----	High.
McCarran-----	B	Rare-----	---	>6.0	---	>60	---	---	---	High-----	High.
Grapevine-----	B	Rare-----	---	>6.0	---	>60	---	---	---	High-----	High.
305*: Las Vegas-----	D	Rare-----	---	>6.0	---	>60	---	3-14	Thick	High-----	High.
Destazo-----	B	Rare-----	---	>6.0	---	>60	---	---	---	High-----	High.
307*: Las Vegas-----	D	Rare-----	---	>6.0	---	>60	---	3-14	Thick	High-----	High.
Skyhaven-----	C	Rare-----	---	>6.0	---	>60	---	24-40	Thick	High-----	High.
325, 326----- McCarran	B	Rare-----	---	>6.0	---	>60	---	---	---	High-----	High.
----- Paradise	C	Rare-----	---	3.0-5.0	Dec-Mar	>60	---	---	---	High-----	Low.
360*: Rock outcrop.											
St. Thomas-----	D	None-----	---	>6.0	---	4-20	Hard	---	---	High-----	Low.
380----- Skyhaven	C	Rare-----	---	>6.0	---	>60	---	24-40	Thick	High-----	High.
390----- Spring	C	Rare-----	---	>6.0	---	>60	---	---	---	High-----	High.
400----- Tencee	D	None-----	---	>6.0	---	>60	---	7-20	Thick	High-----	Low.
415----- Aztec	B	None-----	---	>6.0	---	>60	---	---	---	High-----	High.
417*: Aztec-----	B	None-----	---	>6.0	---	>60	---	---	---	High-----	High.
Rock outcrop.											
418*: Aztec-----	B	None-----	---	>6.0	---	>60	---	---	---	High-----	High.
Nickel-----	B	None-----	---	>6.0	---	40-60	Hard	---	---	High-----	Low.
Knob Hill-----	B	None-----	---	>6.0	---	>60	---	---	---	High-----	Low.

See footnote at end of table.

A-2

PLANNING MAPS & STUDIES

HORSE DRI INTERCHAN

Supplement

To the

FINAL FEASIBI

STUDY FOR

OFFSITE

DRAINAG

REPORT

(2 of 3)

February 2004

Submitted To:

Subm



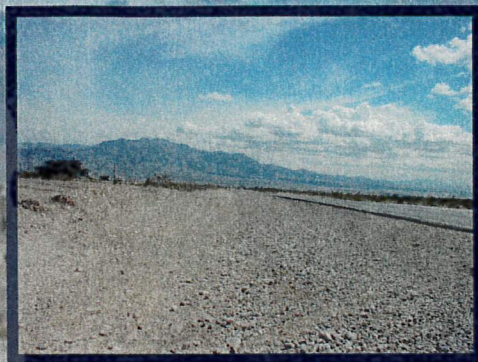
HORSE DRENCH INTERCHANGE Supplement To the FINAL FEASIBILITY STUDY FOR OFFSITE DRAINAGE REPORT

(2 of 3)

February 2004

Submitted To:

Submitted By:



HORSE DRIVE INTERCHANGE

Supplement

To the

FINAL FEASIBILITY STUDY FOR OFFSITE DRAINAGE REPORT

(2 of 3)

February 2004

Submitted To:

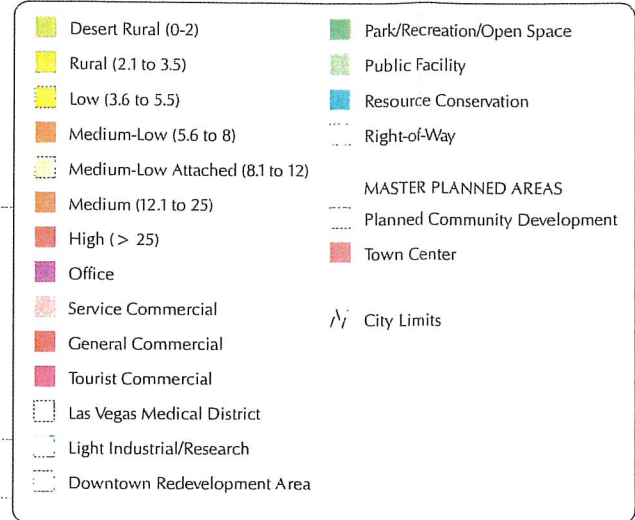


Submitted By:



City of Las Vegas

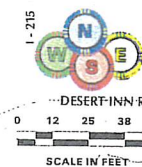
FUTURE LAND USE



NOTE: FUTURE LAND USE FROM
SOUTHWEST SECTOR PLAN 1996 RITZ MAP
& SEE SUMMERLIN AND SOUTHWEST
SPECIAL LAND USE PLAN (1997)

PHASE I: LAND USE PLAN (1997-1999)
(East of Beltway) by G.C. Wallace Inc.

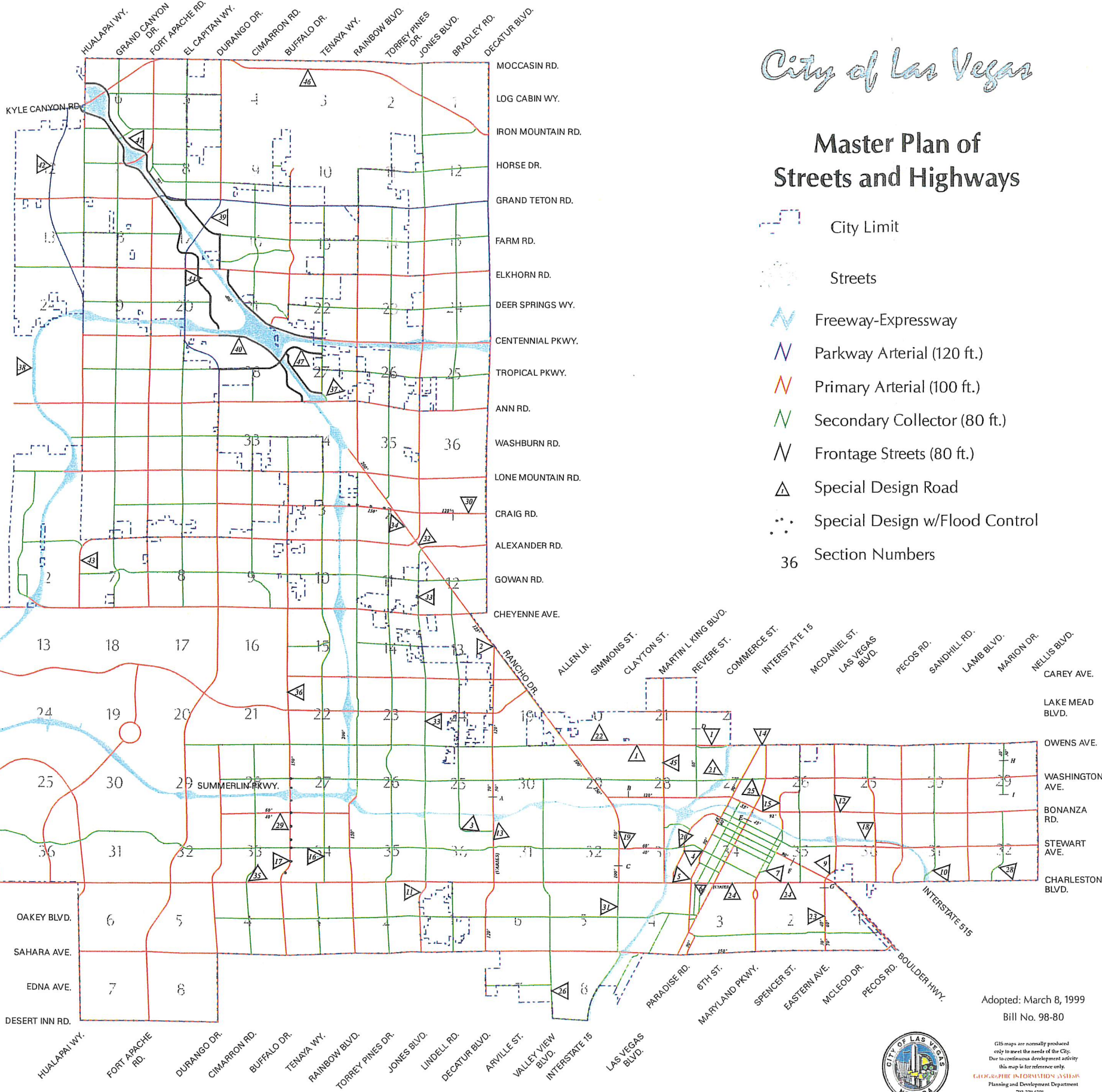
GENERAL DEVELOPMENT PLAN (January 21, 1997)
(West of Beltway) by PBR Consultants



Road Sections with Special Design

MAP NO.	PROJECT NAME	DESIGN NO.
1	Owens-Vegas Dr.	115-266
2	Decatur-Tonopah Hwy. Intersection	113-121
3	Michael Way to Alta	115-101
4	Gass-Alta Alignment	115-196
5	Second-Charleston Crossing	115-182
6	Fourth-Third St. at Colorado	115-185 & 115-185A
7	Twelfth-Thirteenth at Clark	115-138
8	Superceded by No. 15	115-304
9	Eastern-Twentyfifth Connector	115-181 & 115-143
10	Sandhill-Charleston Intersection	115-168
11	Jones-Charleston Intersection	115-175
12	Bonanza, east of Twentieth	115-123
13	Decatur, Alta to Bonanza	115-250
14	Owens, Main to Las Vegas Blvd.	107-V-532
15	Alignment, Twelfth & Thirteenth	115-304
16	Antelope Way	
17	Buffalo Dr.	115-281
18	Freeway-East Leg	115-323
19	Alta, Rancho to Tonopah	107-V-610
20	Alta, Highland to Railroad Property	
21	I-15, Bonanza to Owens I-0151 (7)43,	70091-1
22		
23	Eastern, St. Louis to Ballard	115-332
24	Charleston, Main to Twentyfifth	115-338
25	Washington, Main to Las Vegas Blvd.	107-V882
26	Valley View, Charleston to D.I. Rd.	115-345
27		
28	Marion, Charleston to Stewart	115-362
29	Westcliff, Rainbow to Buffalo	107-V957
30	Craig, Decatur to Jones	107-V959
31	Rancho, Sahara to Charleston	115-307
32	Alexander & Jones Intersection	115-356
33	Jones, Vegas to Rancho	115-364A
34	Craig, Torrey Pines to Rancho	115-368
35	Cimarron-Charleston Intersection	115-372A
36	Buffalo, Washington to Cheyenne	115-383

37
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City of Las Vegas

Master Plan of
Streets and Highways

- City Limit
- Streets
- Freeway-Expressway
- Parkway Arterial (120 ft.)
- Primary Arterial (100 ft.)
- Secondary Collector (80 ft.)
- Frontage Streets (80 ft.)
- Special Design Road
- Special Design w/Flood Control
- Section Numbers



R.O.W. Design Breakpoints

- A Bonanza Rd.
- B Tonopah Dr.
- C Palomino Ln.
- D Fredrick Ave.
- E Mesquite Ave.
- F 17th St.
- G Ballard Dr.
- H Monroe Ave.
- I Harris Ave.

Adopted: March 8, 1999
Bill No. 98-80



GIS maps are normally produced
only to meet the needs of the City.
Due to continuous development activity
this map is for reference only.
GEOGRAPHIC INFORMATION SYSTEMS
Planning and Development Department
702-325-4501
Plotted: March 19, 2003



LEGEND

- ### Typical Land Use

- 1 Undeveloped Land, Open Desert
- 2 Parks, Golf Courses
- 3 Rural
- 4 Low Density Residential
- 5 Medium Density Residential
- 6 High Density Residential
- 7 Public Facility, Multi Family
- 8 Commercial, Office, Retail, Casino
- 9 Light Industrial
- 10 Heavy Industrial
- 11 Schools
- 12 Lakes
- W N E

A horizontal number line is shown with tick marks at 0, 1,000, 2,000, 3,000, 4,000, and 5,000. The word "Feet" is written below the line. A dark shaded bar is drawn above the line, starting at 0 and ending at 5,000. There are four white rectangular segments within the shaded bar, each spanning 1,000 feet.

SCALE: 1 inch = 3000 feet

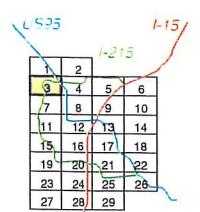
HYDROLOGIC SUBAREAS,
LAND USE & SOILS

FIGURE H-3

PBSJ &

G. C. WALLACE, INC.



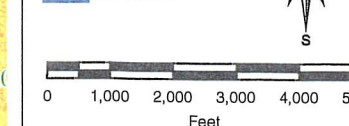
- Ultimate Development Boundary
- Watershed Boundary
- Subarea Boundary
- Flow Arrows

— Existing Facilities
— Proposed Facilities

- A Low Runoff Potential
- B Moderately Low Runoff Potential
- C Moderately High Runoff Potential
- D High Runoff Potential

1 Undeveloped Land, Open De
2 Parks, Golf Courses
3 Rural
4 Low Density Residential
5 Medium Density Residential
6 High Density Residential
7 Public Facility, Multi Family
8 Commercial, Office, Retail, C
9 Light Industrial
10 Heavy Industrial
11 Schools
12 Lakes

N
W



SCALE: 1 inch = 3000 feet

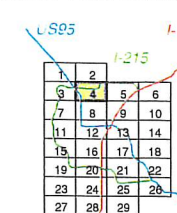
HYDROLOGIC SUBAREAS,
LAND USE & SOILS

FIGURE H-4

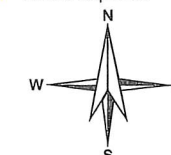




2002 LAS VEGAS VALLEY FLOOD CONTROL MASTER PLAN UPDATE

LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin
- Culvert
- Bridge
- Pipeline
- Lined Channel
- Unlined Channel
- Dike
- Natural Wash
- ID-Mile Separator



0 1,000 2,000 3,000 4,000 5,000
Feet

SCALE: 1 inch = 3000 feet

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30

FLOOD CONTROL FACILITIES
FIGURE F-3



G. C. WALLACE, INC.



ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
CN95		CENTENNIAL PKWY CHANNEL WEST / U.S 95 BRANCH						
0167	P1	2: 10' X 7' RCBC	1700	2421	3CNW72-C	CWEST3	3.03	1.50
0199	P1	10' X 9' RCBC	1703	2081	2CNW72-C	CWEST3	2.20	1.84
0259	P1	96" RCP	1688	923	CNW74-C	CWEST3	0.80	1.53
0295	P1	96" RCP	1658	923	CNW74-C	CWEST3	0.80	1.70
CNGT		CENTENNIAL PKWY CHANNEL WEST / GRAND TETON BRANCH						
0000	P1	66" RCP	3640	399	CNW71-C	CWEST3	0.84	3.09
0067	P1	66" RCP	2640	399	CNW71-C	CWEST3	0.84	3.41
0118	P1	60" RCP	2640	363	KYLEDET	KYLEDB	57.73	3.94
0168	P1	60" RCP	2700	363	KYLEDET	KYLEDB	57.73	4.09
0234	P1	78" RCP	3200	363	KYLEDET	KYLEDB	57.73	1.00
EKHU		ELKHORN AND HUALAPAI						
0000	P1	84" RCP	2640	757	CNW26-C	CWEST3	0.91	2.18
GOAN		GOWAN ANN ROAD DETENTION BASIN FACILITIES						
0000	P2	48" RCP	3200	168	CAM10DB	GW3SC	3.77	3.44
0059	P2	22,237 cfs PMF Spillway		22237	CAM10IN	GW3SC	3.77	
0060	P2	36" RCP Outlet	100	168	CAM10DB	GW3SC	3.77	
0061	P2	336 ac-ft Ann Road Detention Basin		3255	CAM10IN	GW3SC	3.77	
0065	P2	Soil Cement Chnl 8-45" W 3'D 4:1 SS	4500	878	CCAMDK3	GW3SC	0.65	2.56
GOBW		GOWAN BELTWAY WEST						
0220	P1	Conc Chnl 15"W 7.5'D 0:1 SS	1500	854	CEFPOA2	ALLGOW3	4.57	0.36
0248	P1	10' X 8' RCB	100	589	CCEFFOA1	ALLGOW3	4.26	0.38
0250	P1	Conc Chnl 10"W 7.5'D 0:1 SS	1400	555	CEFPOA1	GW3SC	0.49	0.38
0277	P1	Conc Chnl 10"W 4.5'D 0:1 SS	1400	305	CDMNA3	GW3SC	0.26	0.50
GONO		GOWAN NORTH SYSTEM						
0461	P1	10' X 9' RCB	1320	935	CTRHW-C	GW3SC	1.22	0.38
0486	P1	8' X 7' RCB	1320	730	CADHW-C	GW3SC	0.90	0.76
0511	P1	7' X 6' RCB	1320	541	CCPHW-C	GW3SC	0.60	1.14
KCHU		KYLE CANYON AND HUALAPAI						
0000	P1	10' X 10' RCB	1800	1203	CNW35-C	VSPRING3	1.26	0.40
0034	P1	90" RCP	1500	800	2CNW33-C	VSPRING3	0.82	2.12
0048	P1	78" RCP	1200	516	CNW33-C	VSPRING3	0.55	2.21
KCUN		KYLE CANYON AND UNKNOWN						
0000	P1	84" RCP	650	706	CNW1-C	VSPRING3	0.69	2.20
LVMD		LAS VEGAS WASH - MIDDLE						
3313	E	120,000 cfs PMF Spillway		120000	KYLEDB	KYLEDB	57.73	
3314	E	78" RCP Outlet	200	363	KYLEDET	KYLEDB	57.73	
3315	E	3,200 ac-ft Kyle Canyon Detention Basin		13554	KYLEDB	KYLEDB	57.73	
3316	E	Rip Rap Levee (South) 5'	3500	13554	KYLEDB	KYLEDB	57.73	3.00

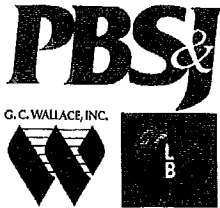
ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
LVMO		LAS VEGAS WASH - MOCCASIN						
0000	P1	Conc Chnl 30"W 12.5'D 0:1 SS	6800	12113	CNW130-C	VSPRING5	76.52	2.10
0127	P1	Conc Chnl 27"W 12.5'D 0:1 SS	7700	12092	3CNW64-C	VSPRING5	75.87	3.10
0276	P1	Bridge 30"W 10'D	400	11556	2C213B-5	VSPRING5	70.94	3.10
0280	P1	Conc Chnl 16"W 7'D 0:1 SS	3500	2479	CNW23-C	VSPRING3	5.71	2.86
0346	P1	Conc Chnl 16"W 7'D 0:1 SS	2600	2356	CNW17-C	VSPRING3	5.34	2.87
0396	P1	Conc Chnl 16"W 6.5'D 0:1 SS	2600	2226	2CNW11-C	VSPRING3	4.91	3.27
0445	P1	Conc Chnl 16"W 6.5'D 0:1 SS	2600	2025	2CNW5-C	VSPRING3	4.37	2.88
0494	P1	Conc Chnl 16"W 6'D 0:1 SS	2600	1778	RCFF1A-6	VSPRING3	3.70	2.88
MOKC		MOCCASIN AND KYLE CANYON						
0000	P1	12' X 10' RCB	6000	3891	2CNW64-C	VSPRING3	4.62	2.70
0120	P1	12' X 9' RCB	2100	3599	CNW50-C	VSPRING3	4.21	3.25
0159	P1	11' X 8' RCB	4000	2393	CNW21-C	VSPRING3	2.60	3.13
0222	P1	9' X 9' RCB	2600	2393	CNW21-C	VSPRING3	2.60	3.46
0325	P1	9' X 8' RCB	5700	2066	CNW7-C	VSPRING3	2.19	3.65
0380	P1	90" RCP	3000	1095	COFF5-1	VSPRING3	1.02	3.73
MORC		RANCHO/MOCCASIN						
0000	P0	Conc Chnl 34"W 13'D 0:1 SS	3700	11544	C213B-5	VSPRING5	65.23	1.00
0070	P0	Conc Chnl 34"W 14'D 0:1 SS	3700	11461	C213B-7	VSPRING5	63.96	0.80
MOSH		MOCCASIN AND SHEEP MOUNTAIN						
0000	P1	Conc Chnl 12"W 7.5'D 0:1 SS	2640	1777	COFF1A-6	VSPRING3	3.70	2.71
0053	P1	Conc Chnl 12"W 8'D 0:1 SS	2640	1596	COFF2B	VSPRING3	3.23	1.39
RCBC		RANCHO ROAD SYSTEM - BELTWAY CHANNEL						
0000	E	82 ac-ft Ft. Apache Detention Basin		1031	FADBIN	WEST3	1.23	0.00
0001	E	10,310 cfs PMF Spillway		10310	FADBIN	WEST3	1.23	0.00
0002	E	66" RCP Outlet with 42" Orifice	100	204	FADBIN	WEST3	1.23	0.00
0011	E	12' X 6' RCBC @ Fort Apache Detention Basin	134	1031	FADBIN	WEST3	1.23	1.87
0012	E	Conc Chnl 12"W 6'D 0:1 SS	1978	1031	FADBIN	WEST3	1.23	3.33
0047	E	12' X 6' RCBC @ Grand Canyon	70	875	CCDMNA1	WEST3	1.03	3.15
0051	E	Conc Chnl 12"W 6'D 0:1 SS	2690	875	CCDMNA1	WEST3	1.03	3.27
0096	E	10' X 6' RCBC @ Hualapai	190	636	CCDMNA22	WEST3	0.58	1.93
0100	E	Conc Chnl 12"W 5.5'D 0:1 SS	1968	636	CCDMNA22	WEST3	0.58	2.50
0153	E	Conc Chnl 10"W 5'D 0:1 SS	2222	636	CCDMNA22	WEST3	0.58	1.25
RCHB		RANCHO ROAD SYSTEM - BELTWAY						
0175	P2	Conc Chnl 16"W 6'D 0:1 SS	2700	1767	CNWBC3	WEST3	3.91	2.40
0227	P1	Conc Chnl 12"W 6.5'D 1.5:1 SS	4000	1767	CNWBC3	WEST3	3.91	1.00
0295	P1	8' X 6' RCB	5200	1212	CNW66-C	WEST3	1.86	3.30
0395	P1	78" RCP	1100	757	CNW26-C	WEST3	0.91	3.44

*The HEC-1 node shown identifies the controlling concentration point for the associated facility and is located upstream of this facility due to decreasing peak flow with increasing tributary area caused by storm distribution transitions, depth area reduction factors, or attenuation of flow from routing.
**As-built or design slopes were used when available. All other slopes are based on existing topography. The user should verify the facility slope listed prior to performing any facility specific analysis.

REGIONAL FLOOD CONTROL DISTRICT

2002 LAS VEGAS VALLEY
FLOOD CONTROL MASTER PLAN UPDATE
FACILITY INVENTORY
FIGURE F-3

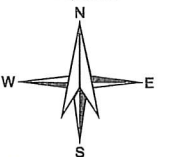
LEGEND	Street Name Designator	AA BB	Existing Facility	 E			
	Parent Stream Name	.....	Proposed or Modified Facility	 P	Bottom Width	 W	
	Stream Name	.....	Contingency Level	.....			
	ID / River Mile	00 00	Category B	 P0	Depth	 D	
	Distance above confluence	.....	Master Plan	 P1			
	With parent stream	.....	Preliminary Design	 P2	Side Slope, H:V	 SS	
	Miles in tenths	.....	Design	 P3			
						Construction Features	
						Cast in Place Concrete Pipe..... CIPCP	Reinforced Concrete Box..... RCB
						Corrugated Metal Arch Pipe Culvert..... CMAP	Reinforced Concrete Box Culvert..... RCBC
						Corrugated Metal Pipe Culvert..... CMP	Reinforced Concrete Pipe..... RCP
						High Density Polyethylene..... HDPE	Reinforced Concrete Pipe Culvert..... RPCP
						Helical Elliptical Reinforced Concrete Pipe..... HERCP	Storm Sewer Pipe..... SSP
						Reinforced Concrete Arch Pipe..... RCAC	



2002 LAS VEGAS VALLEY FLOOD CONTROL MASTER PLAN UPDATE

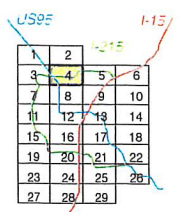
LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin
- Culvert
- Bridge
- Pipeline
- Lined Channel
- Unlined Channel
- Dike
- Natural Wash
- ID-Mile Separator



0 1,000 2,000 3,000 4,000 5,000
Feet

SCALE: 1 inch = 3000 feet



FLOOD CONTROL FACILITIES
FIGURE F-4

PBS&

G.C. WALLACE, INC.



ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%)**
CN95		CENTENNIAL PKWY CHANNEL WEST / U.S 95 BRANCH						
0000	P3	Conc Chnl 22'W 10'D 0:1 SS	3600	3533	CDBB3-C	CWEST3	4.68	0.84
0068	P1	3: 8' X 7' RCBC	1800	3192	CNW103-C	CWEST3	4.12	2.12
0102	P1	3: 8' X 6' RCBC	3400	2850	2CNW89-C	CWEST3	3.73	2.09
0167	P1	2: 10' X 7' RCBC	1700	2421	3CNW72-C	CWEST3	3.03	1.50
0199	P1	10' X 9' RCBC	1703	2081	2CNW72-C	CWEST3	2.20	1.84
0259	P1	96" RCP	1688	923	CNW74-C	CWEST3	0.80	1.53
CNEA		CENTENNIAL PKWY CHANNEL EAST						
0176	P3	Conc Chnl 15'W 6.5'D 0:1 SS	1500	948	CNN078-C	CWEST3	1.13	0.86
CNGT		CENTENNIAL PKWY CHANNEL WEST / GRAND TETON BRANCH						
0000	P1	66" RCP	3640	399	CNW71-C	CWEST3	0.84	3.09
CNWE		CENTENNIAL PKWY CHANNEL WEST						
0000	E	2: 27' X 10' RCBC @ Beltway	278	4834	CNW3D3-C	CWEST3	7.73	1.50
0005	P2	2: 27' X 10' RCB	764	4834	CNW3D3-C	CWEST3	7.73	1.10
0020	E	2: 27' X 10' RCB @ Decatur	308	4834	CNW3D3-C	CWEST3	7.73	2.60
0026	P2	2: 27' X 10' RCB	953	4834	CNW3D3-C	CWEST3	7.73	0.60
0045	P2	Conc Chnl 56'W 10'D 0:1 SS	1404	4834	CNW3D3-C	CWEST3	7.73	0.59
0070	E	27' X 10' RCBC @ Bradley	220	4834	CNW3D3-C	CWEST3	7.73	0.40
0071	P1	Add 27' X 10' RCBC @ Bradley	220	4834	CNW3D3-C	CWEST3	7.73	0.40
0075	P2	Conc Chnl 56'W 10'D 0:1 SS	1498	4735	2C3B4-C	CWEST3	7.47	0.40
0104	P2	56' X 10' RCBC	350	4735	2C3B4-C	CWEST3	7.47	0.40
0110	P2	Conc Chnl 56'W 10'D 0:1 SS	641	4735	2C3B4-C	CWEST3	7.47	0.40
0122	E	20' X 10' RCBC @ Jones	350	4735	2C3B4-C	CWEST3	7.47	0.40
0123	P2	36' X 10' RCBC @ Jones	350	4735	2C3B4-C	CWEST3	7.47	0.40
0129	P2	Conc Chnl 56'W 10'D 0:1 SS	763	4547	CNW3B3-C	CWEST3	6.71	0.40
0143	P2	56' X 10' RCBC	352	4547	CNW3B3-C	CWEST3	6.71	0.40
0150	P2	Conc Chnl 42'W 10'D 0:1 SS	1182	4547	CNW3B3-C	CWEST3	6.71	0.40
0173	P2	42' X 10' RCBC @ Torrey Pines	190	4547	CNW3B3-C	CWEST3	6.71	0.40
0176	P2	Conc Chnl 32'W 10'D 0:1 SS	2440	4547	CNW3B3-C	CWEST3	6.71	0.60
0222	P2	32' X 10' RCBC @ Rainbow	200	4520	CNW2D4-C	CWEST3	6.47	0.60
0226	P2	Conc Chnl 12'W 12'D 2:1 SS	1165	4390	CNW2D3-C	CWEST3	5.97	1.00
0248	P2	36' X 8' RCBC @ Rio	150	4390	CNW2D3-C	CWEST3	5.97	0.59
0251	P2	Conc Chnl 12'W 12'D 2:1 SS	1219	4390	CNW2D3-C	CWEST3	5.97	0.59
0274	E	32' X 10' RCBC @ Tenaya	140	4390	CNW2D3-C	CWEST3	5.97	0.45
0277	P2	Conc Chnl 13'W 10'D 2:1 SS	1430	3853	CNW2B2-C	CWEST3	5.16	0.45
0304	P2	32' X 10' RCB	6510	3853	CNW2B2-C	CWEST3	5.16	1.00
EKBU		ELKHORN SPRINGS AND BUFFALO						
0000	P1	84" RCP	800	444	NW134-C	CWEST3	0.54	1.00
EKDB		ELKHORN SPRINGS DETENTION BASIN						
0000	P3	Grass Chnl 15'W 5'D 4:1 SS	2640	269	CNW150-C	WEST3	1.16	0.57
0025	P1	54" RCP	1320	129	ELKBASIN	WEST3	0.91	1.50
0049	E	60" RCP	938	129	ELKBASIN	WEST3	0.91	0.13
0068	E	7,200 cfs PMF Spillway		7200	CNW133-C	WEST3	0.91	
0069	E	60" RCP Outlet	100	129	ELKBASIN	WEST3	0.91	
0070	E	48 ac-ft Elkhorn Springs Detention Basin		720	CNW133-C	WEST3	0.91	
EKEA		ELKHORN ROAD CHANNEL EAST						
0124	P2	Conc Chnl 40'W 7.5'D 0:1 SS	2440	2017	CELK06E	CWEST3	3.01	0.80
0171	P2	40' X 7.5' RCBC	190	1888	CELK06D	CWEST3	2.76	0.80
0174	P2	Conc Chnl 30'W 7.5'D 0:1 SS	2480	1888	CELK06D	CWEST3	2.76	0.50
0221	P2	30' X 7.5' RCBC	195	1727	CNN048-C	CWEST3	2.51	0.50
0225	P2	Conc Chnl 30'W 7.5'D 0:1 SS	2600	1727	CNN048-C	CWEST3	2.51	0.38
0274	P2	30' X 7.5' RCBC	305	1486	2C035-C	CWEST3	2.16	0.38
0280	P2	Conc Chnl 20'W 8.5'D 0:1 SS	3570	826	CNN035-C	CWEST3	1.04	0.25
0348	P2	16' X 9' RCBC	270	568	CNN020-C	CWEST3	0.65	0.30

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%)**
EKEA		ELKHORN ROAD CHANNEL EAST - continued						
0353	P2	Conc Chnl 16'W 7'D 0:1 SS	3160	378	NN021-C	CWEST3	0.41	0.30
0413	P2	10' X 5' RCBC	265	378	NN021-C	CWEST3	0.41	0.30
0417	P2	Conc Chnl 10'W 5'D 0:1 SS	1485	378	NN021-C	CWEST3	0.41	0.30
FMEA		FARM ROAD CHANNEL EAST						
0076	P0	Conc Chnl 12'W 5'D 2:1 SS	2640	805	CELK06B	CWEST3	1.11	0.80
0126	P0	Conc Chnl 12'W 4.5'D 2:1 SS	4000	645	CELK06A	CWEST3	0.86	0.60
GOEC		GOWAN NORTH - EL CAPITAN BRANCH						
0126	P1	10' X 7' RCB	1320	652	CTFR-C	GW3SC	0.96	0.38
0152	P1	7' X 6' RCB	1320	502	CARFP-C	GW3SC	0.70	0.77
0176	P1	78" RCP	1320	376	CCPFR-C	GW3SC	0.46	1.15
GTEA		GRAND TETON DRIVE CHANNEL EAST						
0000	P0	Conc Chnl 12'W 5.5'D 2:1 SS	7483	1307	CGT03E	CWEST3	2.89	1.03
0144	P0	12' X 7' RCBC	100	1141	CGT03D	CWEST3	2.55	1.50
0146	P0	Conc Chnl 12'W 5.5'D 2:1 SS	5300	1141	CGT03D	CWEST3	2.55	0.97
0246	P0	12' X 8' RCBC	100	1042	CGT03B	CWEST3	2.27	0.70
0248	P0	Conc Chnl 12'W 5.5'D 2:1 SS	5200	1042	CGT03B	CWEST3	2.27	0.74
LV03		CLAYTON STREET CHANNEL						
0031	E	Conc Chnl 8'W 8.1'D 1.5:1 SS	2600	948	CNN054-C	CWEST3	1.00	0.40
0081	E	2: 10' X 7' RCBC @ Tropical	100	731	CNN052-C	CWEST3	0.74	0.42
0082	E	Conc Chnl 7'W 7.1'D 1.5:1 SS	2600	731	CNN052-C	CWEST3	0.74	2.80
0131	P1	7' X 7' RCBC @ Centennial	100	731	CNN052-C	CWEST3	0.74	2.00
LVDE		LAS VEGAS WASH - DECATUR						
0000	P1	96" RCP	2640	509	CNW198-C	CWEST3	0.68	0.60
LVIM		LAS VEGAS WASH AND IRON MOUNTAIN						
0000	P1	90" RCP	1300	555	CNW206-C	CWEST3	1.16	1.10
LVMD		LAS VEGAS WASH - MIDDLE						
2197	E	Conc Chnl 50'W 10'D 0:1 SS	3629	5759	CNN030-C	CWEST5	19.66	1.04
2266	E	2: 24.5' X 10' RCBC @ Tropical	575	5698	CNN011-C	CWEST5	19.37	1.04
2276	E	Conc Chnl 50'W 10'D 0:1 SS	985	5698	CNN011-C	CWEST5	19.37	1.04
2294	E	2: 24.5' X 10' RCBC @ Ranchhouse	292	5698	CNN011-C	CWEST5	19.37	1.04
2300	E	Conc Chnl 50'W 10'D 0:1 SS	1100	5698	CNN011-C	CWEST5	19.37	1.48
2322	P2	2: 24.5' X 10' RCB	1200	3937	CNW3D4-C	WEST4	11.39	1.50
2324	P1	3: 12' X 10' RCB	5280	3937	CNW3D4-C	WEST4	11.39	0.36
2443	P1	3: 12' X 9 RCB	5280	3571	CNW188-C	WEST4	9.95	0.39
2490	P1	3: 12' X 9' RCB	5280	3528	CNW162-C*	WEST3	6.70	0.36
2525	P1	3: 12' X 9' RCB	1320	3528	CNW162-C*	WEST3	6.70	0.39
2550	P1	3: 12' X 9' RCB	1320	3528	CNW162-C*	WEST3	6.70	0.38
2574	P1	2: 12' X 10' RCB	1320	3528	CNW162-C*	WEST3	6.70	0.61
2599	P1	Conc Chnl 20'W 10.5'D 0:1 SS	1700	3528	CNW162-C	WEST3	6.70	0.70
2632	P1	11' X 9' RCBC	1400	1359	CNW139-C	WEST3	1.66	0.59
2661	P1	9' X 9' RCBC	2640	1359	CNW139-C	WEST3	1.66	1.00
2711	P1	9' X 7' RCBC	1320	1359	CNW139-C	WEST3	1.66	1.80
2737	P1	8' X 8' RCBC	1320	1359	CNW139-C	WEST3	1.66	1.81
2763	P1	78" RCP	2640	654	CNW109-C	WEST3	0.77	2.40
LVMJ		LAS VEGAS WASH - JONES						
0000	P1	7' X 6' RCB	2600	310	CNW178-C	CWEST3	0.50	0.40
LVMO		LAS VEGAS WASH - MOCCASIN						
0000	P1	Conc Chnl 30'W 12.5'D 0:1 SS	6800	12113	CNW130-C	VSPRING5	76.52	2.10
0127	P1	Conc Chnl 27'W 12.5'D 0:1 SS	7700	12092	3CNW64-C	VSPRING5	75.87	3.10
LVSM		LAS VEGAS WASH-SIMMONS						
0000	P1	8' X 8' RCB	4000	699	CNN044-C	CWEST3	0.82	0.63
0084	P1	6' X 5' RCB	2700	490	CNN040-C	CWEST3	0.51	2.22

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
LVUP		UPPER LAS VEGAS WASH						
0446	E	Floodway	24000	4259	ULWDB	SPRING5	199.03	1.04
0908	E	182,000 cfs PMF Spillway		182000	ULWIN	LOWER	200.44	
0909	E	3: 108" RCP Outlet	100	4259	ULWDB	SPRING5	199.03	
0910	E	1,760 ac-ft Upper Las Vegas Wash Detention Basin		15918	ULWIN	LOWER	200.44	
0911	P0	Upgrade to 2,190 ac-ft Upper Las Vegas Wash Detention Basin		15918	ULWIN	LOWER	200.44	
0976	E	Floodway	7000	13317	ULWIN	SPRING5	199.03	0.71
1076	E	Unlined Chnl 300'W 8.5'D 3:1 SS	9200	13317	ULWIN	SPRING5	199.03	0.80
1077	E	Soil Cement Levee 8.5' with 300'W Chnl	9200	13317	ULWIN	SPRING5	199.03	0.82
MOKC		MOCCASIN AND KYLE CANYON						
0000	P1	12' X 10' RCB	6000	3891	2CNW64-C	VSPRING3	4.62	2.70
MSBU		MOUTAIN SPA AND BUFFALO						
0000	P1	9' X 8' RCB	2640	897	CCNW128	CWEST3	1.52	0.60
MSIM		MOUNTAIN SPA AND IRON MOUNTAIN						
0000	P1	10' X 9' RCBC	700	1755	CNW147-C	CWEST3	2.87	1.14
0004	P1	90" RCP	5280	857	2C113-C	CWEST3	0.91	2.27
0106	P1	90" RCP	1320	857	2C113-C	CWEST3	0.91	2.30
MSLC		MOUNTAIN SPA AND LOG CABIN						
0000	P1	90" RCP	2640	622	CNW148-C	CWEST3	0.84	1.03
MSNV		MOUNTAIN SPA/VISTA RANCH						
0000	E	Grass Chnl 100'W 4.5'D 10:1 SS	6960	2555	CNW163-C	CWEST3	4.79	0.40
RCBC		RANCHO ROAD SYSTEM - BELTWAY CHANNEL						
0000	E	82 ac-ft Ft. Apache Detention Basin		1031	FADBIN	WEST3	1.23	
0001	E	10,310 cfs PMF Spillway		10310	FADBIN	WEST3	1.23	
0002	E	66" RCP Outlet with 42" Orifice	100	204	FADBIN	WEST3	1.23	
RCHB		RANCHO ROAD SYSTEM - BELTWAY CHANNEL						
0000	E	2: 12' X 8' RCB	1800	2543	CNW1C1-C	WEST3	4.81	0.50
0034	E	Conc Chnl 21'W 7.6'D 0:1 SS	1000	2282	CNWBE2-C	WEST3	4.50	0.80
0053	E	2: 12' X 8' RCBC	80	2282	CNWBE2-C	WEST3	4.50	1.38
0054	E	Conc Chnl 21'W 7.6'D 0:1 SS	600	2282	CNWBE2-C	WEST3	4.50	1.51
0065	E	2: 12' X 8' RCB	500	1985	CNWBC6-C	WEST3	4.16	0.30
0075	P2	2: 10' X 6' RCB	1400	1985	CNWBC6-C	WEST3	4.16	2.53
0101	P2	Conc Chnl 20'W 7.0'D 0:1 SS	1000	1985	CNWBC6-C	WEST3	4.16	0.94
0120	P2	2: 10' X 6' RCBC	100	1985	CNWBC6-C	WEST3	4.16	0.94
0122	P2	Conc Chnl 16'W 6'D 0:1 SS	2600	1985	CNWBC6-C	WEST3	4.16	2.27
0171	P2	16' X 7' RCBC	200	1767	CNWBC3	WEST3	3.91	1.75
0175	P2	Conc Chnl 16'W 6'D 0:1 SS	2700	1767	CNWBC3	WEST3	3.91	2.40
RCHO		RANCHO ROAD SYSTEM						
0028	E	54" RCP	1500	150	RCHDOB	WEST3	5.19	0.80
0056	P1	60" RCP	4000	227	NW1A-4-C	CWEST3	0.80	1.57
0059	P1	70,000 cfs PMF Spillway		70000	RCHOIN	WEST3	5.19	
0060	E	60" RCP Outlet	200	150	RCHODB	WEST3	5.19	
0061	E	125 ac-ft Rancho Road Detention Basin		2692	RCHOIN	WEST3	5.19	
0062	P1	Upgrade to 250 ac-ft Rancho Road Detention Basin		2692	RCHOIN	WEST3	5.19	
UPEA		UPPER LAS VEGAS WASH - EAST						
0000	E	Natural Wash 582'W	9600	4088	C116-9	VSHEEP5	14.84	1.00
UPEB		UPPER LAS VEGAS WASH - EAST BRANCH						
0000	P0	Rip Rap Chnl 140'W 5'D 3:1 SS	8500	4206	C102A	VSHEEP4	10.92	1.18
0001	P0	Rip Rap Levee 12'	8500	4206	C102A	VSHEEP4	10.92	1.18
0161	P0	Rip Rap Chnl 100'W 5'D 3:1 SS	10600	2790	102B	VSHEEP3	5.64	0.94
0162	P0	Rip Rap Levee 12'	10600	2790	102B	VSHEEP3	5.64	0.94
UPWE		UPPER LAS VEGAS WASH - WEST						
0000	E	Natural Wash 1001'W	24000	13460	C125A-15	VSHEEP5	190.36	1.30

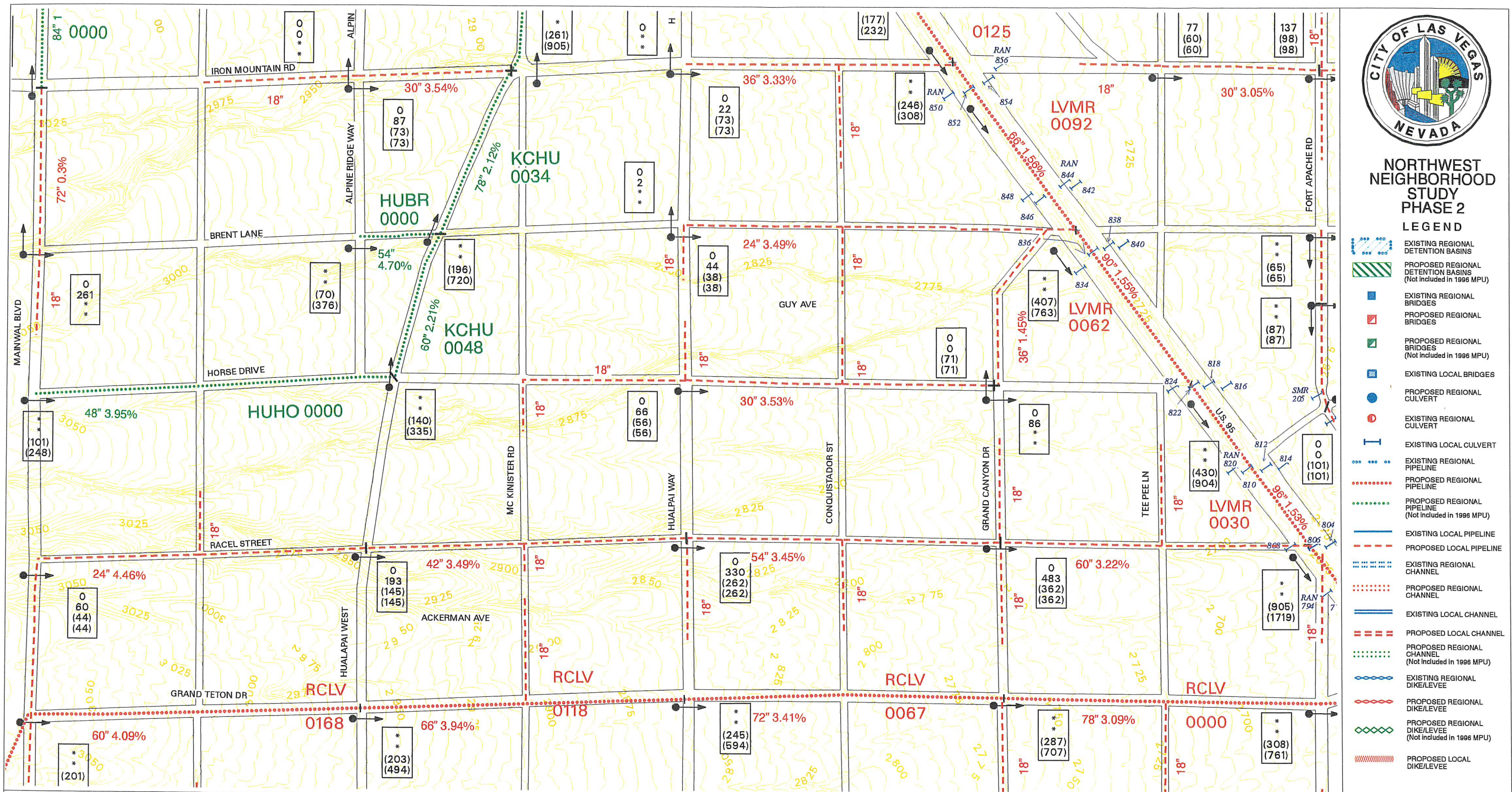
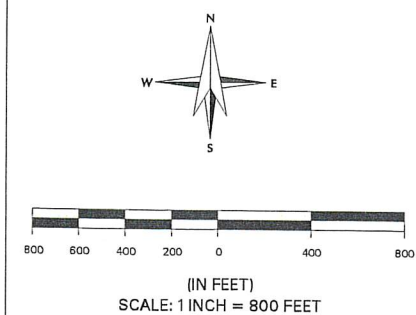


FIGURE F-7



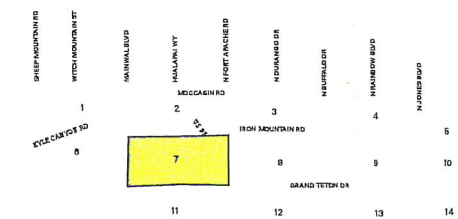
FLOW ARROW
 250 10-YEAR STREET FLOW
 500 100-YEAR STREET FLOW
 (300) 10-YEAR FACILITY FLOW
 (800) 100-YEAR FACILITY FLOW
 (FLOWS IN CFS)

NOTE:

Ultimate drainage conditions are based on future CN values with all flood control facilities in place. Regional facility identifiers were established based on the methodology used in the "1996 Clark County Regional Flood Control Master Plan Update for the Las Vegas Valley."

NOTE:

All regional facilities proposed in the "1996 Clark County Regional Flood Control Master Plan Update for the Las Vegas Valley" have been resized based on the flows developed in this study. In addition, many of these facilities have been changed from channels to reinforced concrete box culverts.

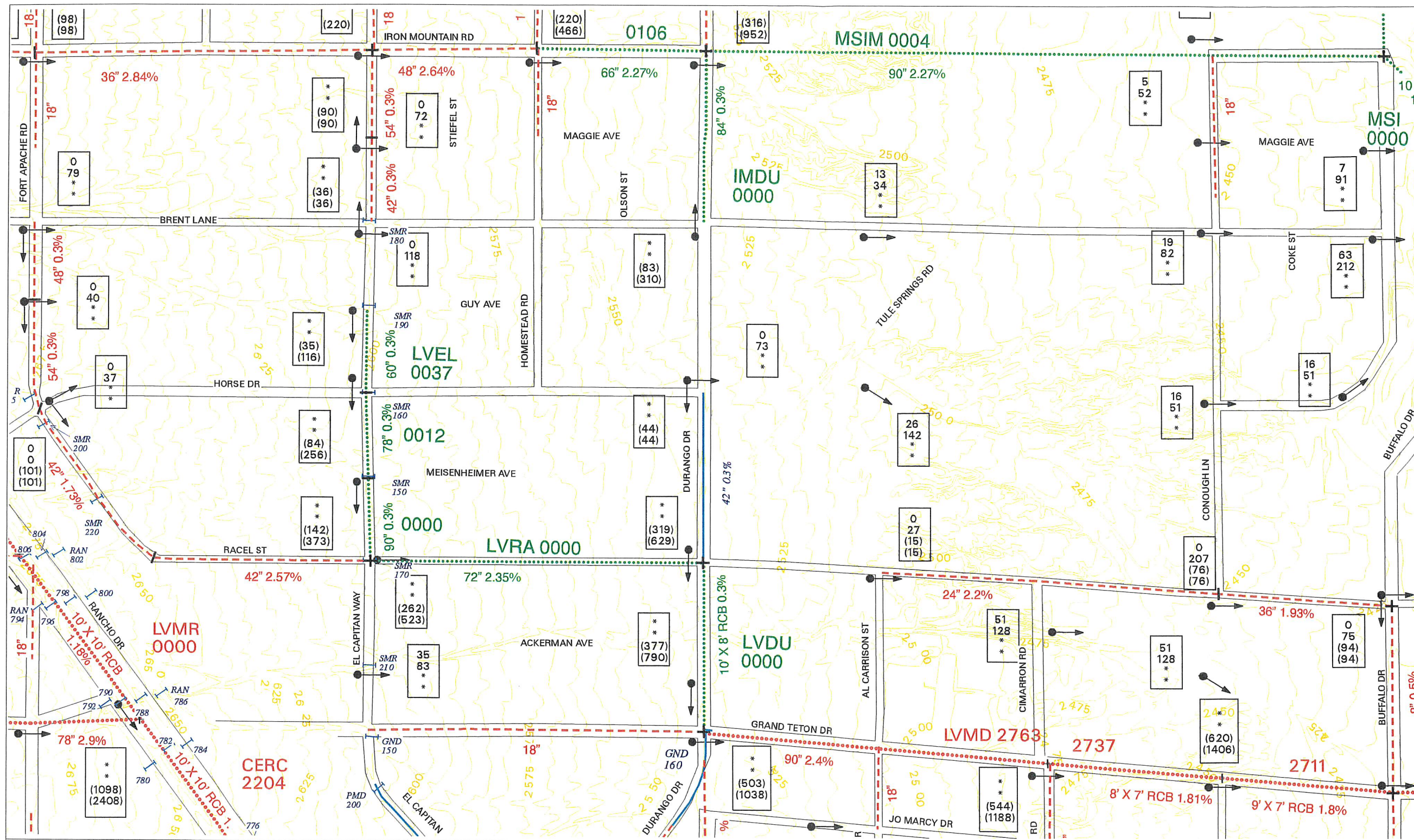


FUTURE DRAINAGE CONDITIONS

PBSJ

801 North Green Valley Parkway, Suite 100
Henderson, Nevada 89014-6138
Phone: 702/263-7275
Fax: 702/263-7200

ENGINEERING PLANNING GIS SURVEYING CONSTRUCTION SERVICES

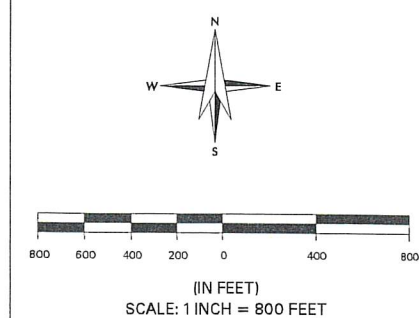


NORTHWEST NEIGHBORHOOD STUDY PHASE 2

LEGEND

- EXISTING REGIONAL DETENTION BASINS
- PROPOSED REGIONAL DETENTION BASINS (Not included in 1996 MPU)
- EXISTING REGIONAL BRIDGES
- PROPOSED REGIONAL BRIDGES
- PROPOSED REGIONAL BRIDGES (Not included in 1996 MPU)
- EXISTING LOCAL BRIDGES
- PROPOSED REGIONAL CULVERT
- EXISTING REGIONAL CULVERT
- EXISTING LOCAL CULVERT
- EXISTING REGIONAL PIPELINE
- PROPOSED REGIONAL PIPELINE
- PROPOSED REGIONAL PIPELINE (Not included in 1996 MPU)
- EXISTING LOCAL PIPELINE
- PROPOSED LOCAL PIPELINE
- EXISTING REGIONAL CHANNEL
- PROPOSED REGIONAL CHANNEL
- EXISTING LOCAL CHANNEL
- PROPOSED LOCAL CHANNEL
- PROPOSED REGIONAL CHANNEL (Not included in 1996 MPU)
- EXISTING REGIONAL DIKE/LEEVE
- PROPOSED REGIONAL DIKE/LEEVE
- PROPOSED REGIONAL DIKE/LEEVE (Not included in 1996 MPU)
- PROPOSED LOCAL DIKE/LEEVE

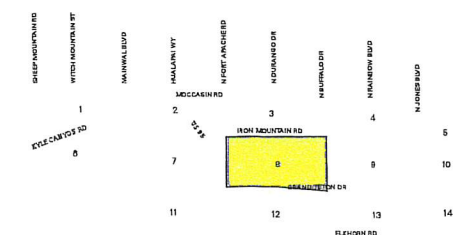
FIGURE F-8



FLOW ARROW
 250 10-YEAR STREET FLOW
 500 100-YEAR STREET FLOW
 (300) 10-YEAR FACILITY FLOW
 (800) 100-YEAR FACILITY FLOW
 (FLOWS IN CFS)

NOTE:
 Ultimate drainage conditions are based on future CN values with all flood control facilities in place.
 Regional facility identifiers were established based on the methodology used in the "1996 Clark County Regional Flood Control Master Plan Update for the Las Vegas Valley."

NOTE:
 All regional facilities proposed in the "1996 Clark County Regional Flood Control Master Plan Update for the Las Vegas Valley" have been resized based on the flows developed in this study. In addition, many of these facilities have been changed from channels to reinforced concrete box culverts.



FUTURE DRAINAGE CONDITIONS

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 ENGINEERING PLANNING GIS SURVEYING CONSTRUCTION SERVICES

A-3

CCRFCD REFERENCES

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

SIX HOUR DEPTH-AREA REDUCTION FACTORS

<u>Drainage Area (Square Miles)</u>	<u>Six-Hour Depth-Area Reduction Factor</u>
0.0	1.00
0.5	0.98
1.0	0.97
2.0	0.93
4.0	0.91
6.0	0.90
8.0	0.88
10.0	0.86
20.0	0.79
30.0	0.74
50.0	0.68
100.0	0.60
150.0	0.55
200.0	0.51
300.0	0.46
400.0	0.42
500.0	0.39

- NOTES: 1. A graphical representation of these factors is presented in Figure 514.
2. Consult with the local entity and/or the CCRFCD for guidance in using the Depth-Area Reduction Factors for drainage areas greater than 200 square miles.

<i>Revision</i>	<i>Date</i>

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

SIX-HOUR STORM DISTRIBUTIONS

Percent of Total Storm Depth				Percent of Total Storm Depth			
Storm Time (In Minutes)	SDN3	SDN4	SDN5	Storm Time (In Minutes)	SDN3	SDN4	SDN5
0	0.0	0.0	0.0	185	32.2	37.6	43.0
5	2.0	2.0	2.0	190	35.2	41.5	47.7
10	5.7	5.8	5.9	195	40.9	46.2	51.4
15	7.0	7.5	8.0	200	49.9	53.0	56.1
20	8.7	9.9	11.0	205	59.0	61.0	63.0
25	10.8	12.6	14.4	210	71.0	71.0	71.0
30	12.4	13.7	15.0	215	74.4	73.2	72.0
35	13.0	14.5	16.0	220	78.1	75.6	73.1
40	13.0	14.9	16.8	225	81.2	78.2	75.2
45	13.0	15.1	17.1	230	81.9	79.9	77.9
50	13.0	15.5	18.0	235	83.5	81.3	79.0
55	13.0	15.6	18.2	240	85.1	82.3	79.5
60	13.0	15.9	18.7	245	85.6	83.0	80.4
65	13.3	16.2	19.0	250	86.0	83.5	81.0
70	14.0	16.9	19.7	255	86.8	84.4	82.0
75	14.2	17.2	20.2	260	87.6	85.1	82.6
80	14.8	17.9	21.0	265	88.8	86.4	84.0
85	15.8	18.9	22.0	270	91.0	88.5	85.9
90	17.2	20.1	23.0	275	92.6	90.8	88.9
95	18.1	21.1	24.1	280	93.7	92.4	91.0
100	19.0	22.0	25.0	285	95.0	94.4	93.8
105	19.7	22.8	25.9	290	97.0	96.8	96.6
110	19.9	23.2	26.5	295	97.6	97.3	97.0
115	20.0	24.0	28.0	300	98.2	97.8	97.4
120	20.1	24.6	29.0	305	98.5	98.2	97.9
125	20.4	25.2	30.0	310	98.7	98.4	98.1
130	21.4	26.0	30.5	315	98.9	98.6	98.3
135	22.9	26.9	30.9	320	99.0	98.8	98.5
140	24.1	27.6	31.0	325	99.3	99.1	98.9
145	24.9	28.3	31.7	330	99.3	99.2	99.0
150	25.1	28.6	32.1	335	99.4	99.3	99.2
155	25.6	29.2	32.7	340	99.5	99.4	99.3
160	27.0	30.2	33.3	345	99.8	99.7	99.6
165	27.8	31.2	34.6	350	99.8	99.8	99.7
170	28.1	32.1	36.1	355	99.9	99.9	99.9
175	28.3	33.2	38.1	360	100.0	100.0	100.0
180	29.5	35.2	40.8				

- Notes: 1. For drainage areas less than 8 square miles in size, use SDN 3.
 2. For drainage areas greater than or equal to 8 square miles and less than 12 square miles in size, use SDN 4.
 3. For drainage areas greater than or equal to 12 square miles, use SDN 5.
 4. A graphical representation of these values is presented on Figure 515.

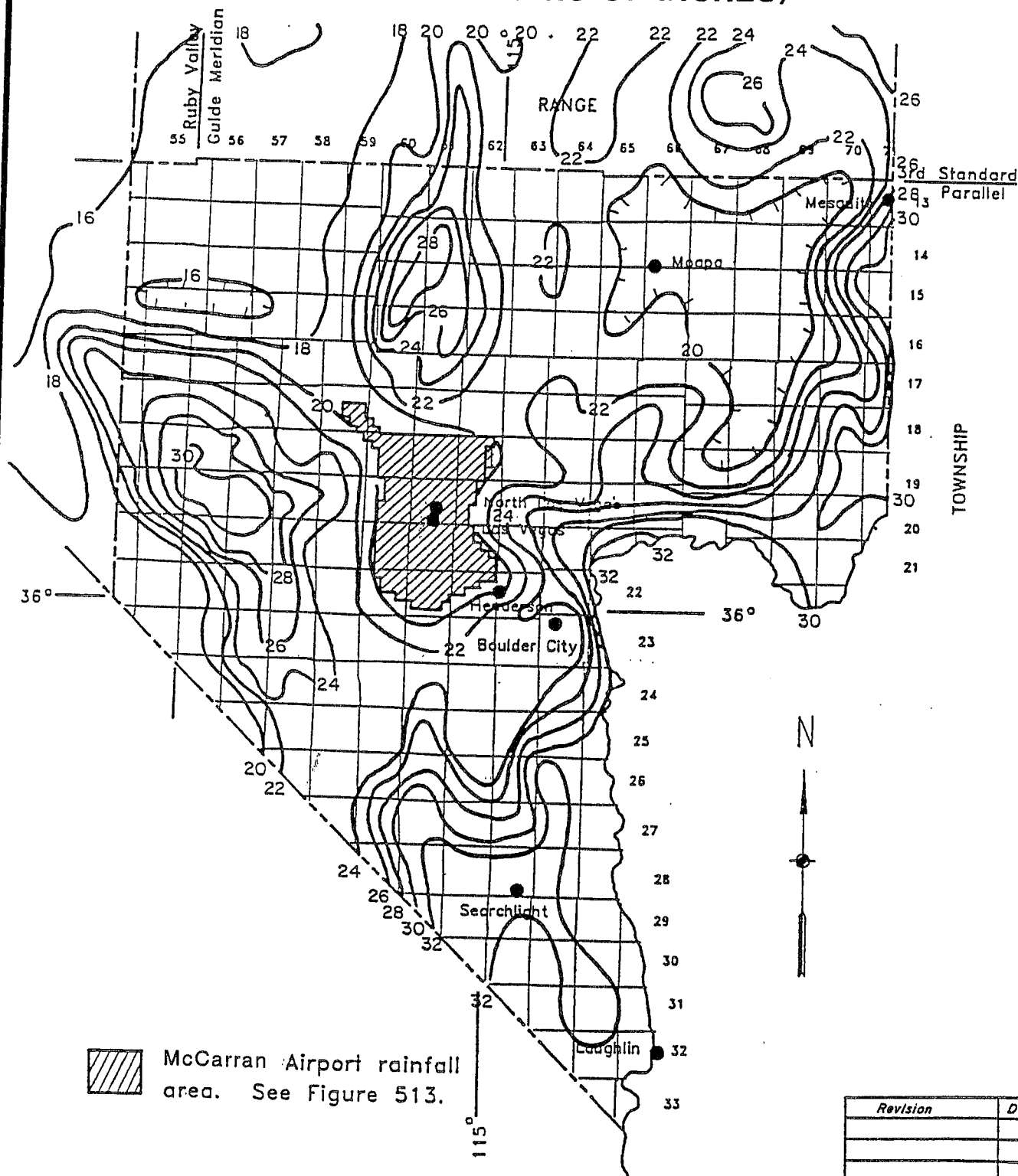
Revision	Date

REFERENCE:

TABLE 503

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RAINFALL DEPTH-DURATION-FREQUENCY 100-YEAR, 6-HOUR (DEPTHS IN TENTHS OF INCHES)



Revision	Date

WRC
ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 506

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS (URBAN AREAS¹)

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area ²	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.): ³					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved: curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved: open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ⁴ ...		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders).		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					

See Table 602A

Developing urban areas

Newly graded areas (pervious areas only, no vegetation) ⁵	77	86	91	94
--	----	----	----	----

- 1 Average runoff condition, and $I_p = 0.2S$.
- 2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system. Impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using Figure 603.
- 3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
- 4 Composite CN's for natural desert landscaping should be computed using Figure 603 based on the impervious area percentage (CN #98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
- 5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figure 603 based on the degree of development impervious area percentage) and the CN's for the newly graded pervious areas.

Revision	Date

**WRC
ENGINEERING**

REFERENCE:

SCS TR-55, USDA, June 1986.

**TABLE 602
1 of 4**

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS - RESIDENTIAL DISTRICTS

Average Lot Size or Usage ¹	Percent Impervious ²	Curve Number for Hydrologic Soil Groups			
		A	B	C	D
Apartments/Condos	72	81	88	91	93
Townhouses/6,000 sq ft lots or less	69	80	87	90	92
7,000 sq ft lots	63	76	84	89	91
8,000 sq ft lots	58	73	82	88	90
10,000 sq ft lots	38	61	75	83	87
14,000 sq ft lots	30	57	72	81	86
20,000 sq ft lots	25	54	70	80	85
40,000 sq ft lots	20	51	68	79	84
80,000 sq ft lots	12	46	65	77	82

1 Lot size should represent the size of the average lot and not the gross acreage divided by the number of lots.

2 Actual percent impervious value should be compared to selected land use type.

3 In cases where average residential lots are smaller than 6,000 sq ft, commercial/business/industrial land use should be used.

Revision	Date

REFERENCE:

TABLE 602A

A-4.0

REVISED 2002 MPU MODEL

A-4.1

STANDARD FORM 4

HORSE DR. / U.S. 95 INTERCHANGE

REVISED 2002 MPU SUBBASINS: STANDARD FORM 4

SUB-BASIN DATA				INITIAL/OVERLAND TIME			TRAVEL TIME				CONC.	t _c CHECK (URBANIZED BASINS)		FINAL CONC.	LAG TIME
DESIG.	AREA mi ²	CN	K ⁽¹⁾	LENGTH L _i (ft)	SLOPE S _i (%)	t _i ⁽²⁾ (min.)	LENGTH L _i (ft)	SLOPE S _i (%)	VELOCITY V(fps) ⁽³⁾	t _i ⁽⁴⁾ (min.)	t _c ⁽⁵⁾ (min.)	TOTAL LENGTH	t _c ⁽⁶⁾ (min.)	t _c (min.)	t _{LAG} ⁽⁷⁾ (hours)
NW45R	0.378	89.1	0.786	200	3.463	5.3	6,700	3.463	5.69	19.6	24.9	6,900	48.3	24.9	0.249
NW62R	0.360	89.4	0.791	200	3.418	5.2	7,050	3.418	5.66	20.8	26.0	7,250	50.3	26.0	0.260
NW71R	0.340	87.1	0.760	200	3.483	5.7	8,900	3.483	5.71	26.0	31.7	9,100	60.6	31.7	0.317
NW72R	0.455	91.2	0.814	200	2.938	5.1	8,000	2.938	5.24	25.4	30.5	8,200	55.6	30.5	0.305
NW74R	0.644	90.3	0.801	200	3.478	5.0	10,150	3.478	5.71	29.6	34.7	10,350	67.5	34.7	0.347

NOTE:

$$(1) \quad K = 0.0132 C_n - 0.39$$

$$(2) \quad t_i = \frac{1.8(1.1 - K)L_i^{1/2}}{S_i^{1/3}}$$

$$(3) \quad V = CS^{1/2}$$

Where $C = 30.6$ for curb height street flow

(See CCRFCD manual pp 606)

$$(4) \quad t = \frac{L}{60V}$$

$$(5) \quad t_c = t_i + t_t$$

$$(6) \quad t_c = \frac{L}{180} + 10$$

$$(7) \quad t_{LAG} = 0.6t_c$$

A-4.2

HEC-1 RESULTS

02MPUREV.dat

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* SEPTEMBER 1990
* VERSION 4.0
*
* RUN DATE 02/20/2004 TIME 10:42:22
*
*****

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

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      X   X XXXXXXX XXXXX      X
      X   X X      X      X    XX
      X   X X      X      X    X
      XXXXXX XXXX  X      XXXXX X
      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

```

*** FREE ***
*DIAGRAM
1 ID HORSE DRIVE INTERCHANGE AND US 95
2 ID DATE: 02/19/2004
3 ID HEC1 FILE: 02MPUREV.DAT
4 ID ***** FUTURE DESIGN CONDITION MODEL *****
5 ID ASSUMES ALL FLOW FROM WEST OF FUTURE OUTER BELTWAY IS DIVERTED
6 ID NORTHWARD AROUND THIS AREA OF INTEREST
7 ID ASSUMES ULTIMATE DEVELOPEMENT
8 ID
9 ID BASE MODEL -
10 ID CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT 2002 MASTER PLAN UPDATE
11 ID WEST TRIBUTARY
12 ID
13 ID 100-YEAR, 6-HOUR STORM, SDN3
14 ID
15 IT 5 0 0 300
16 IO 5 0 0
17 IN 5 0 0
18 JR PREC 1.0 0.986 0.977 0.973 0.970 0.937 0.928
*
19 KK NW28-C
20 BA 0.495
21 PB 3.04
22 PC 0.000 0.020 0.057 0.070 0.087 0.108 0.124 0.130 0.130 0.130
23 PC 0.130 0.130 0.130 0.133 0.140 0.142 0.148 0.158 0.172 0.181
24 PC 0.190 0.197 0.199 0.200 0.201 0.204 0.214 0.229 0.241 0.249
25 PC 0.251 0.256 0.270 0.278 0.281 0.283 0.295 0.322 0.352 0.409
26 PC 0.499 0.590 0.710 0.744 0.781 0.812 0.819 0.835 0.851 0.856
27 PC 0.860 0.868 0.876 0.888 0.910 0.926 0.937 0.950 0.970 0.976
28 PC 0.982 0.985 0.987 0.989 0.990 0.993 0.993 0.994 0.995 0.998
29 PC 0.998 0.999 1.000
30 LS 0 85.7
31 UD 0.197
*
32 KK DNW28-C
33 KM 81 CFS FROM DNW78-C TO KYLE CANYON
34 KM OUTFALL IN PROPOSED LOCAL FACILITY
35 DT DNW28-C
36 DI 0 82 100 500 1000 5000
37 DQ 0 81 81 81 81 81
*
38 KK NW62R
39 BA 0.360
40 PB 2.79
41 LS 0 89.4
42 UD 0.260
*
43 KK RNW62R
44 KM ROUTE NW62R TO CNW74R
45 KM FACILITY = LOCAL CENTENNIAL PARKWAY CHANNEL WEST/U.S. 95 FACILITY
46 KM FACILITY ID-MILE = LOCAL
47 KM LINING = RCP
48 RD 1650 0.0151 0.015 0 CIRC 8 0
*
49 KK 2RNW62R
50 KM ROUTE NW62R TO CNW74R
51 KM FACILITY = CENTENNIAL PARKWAY CHANNEL WEST/U.S. 95 FACILITY
52 KM FACILITY ID-MILE = CN95 0295
53 KM LINING = RCB
54 RD 1658 0.0170 0.015 0 TRAP 12 0
*
55 KK NW74R
56 BA 0.644

```


57	PB	2.84						
58	LS	0	90.3					
59	UD	0.347						
	*							
60	KK	CNW74R						
61	KM	COMBINE CNW74R AND 2RNW62R						
62	HC	2						
	*							
63	KK	RCNW74R						
64	KM	ROUTE CNW74R TO CNW72R						
65	KM	FACILITY = CENTENNIAL PARKWAY CHANNEL WEST/U.S. 95 FACILITY						
66	KM	FACILITY ID-MILE = CN95 0199,0259						
67	KM	LINING = RCB						
68	RD	3100 0.0184 0.015	0	TRAP	14	0		
	*							
69	KK	NW45R						
70	BA	0.378						
71	PB	2.93						
72	LS	0	89.1					
73	UD	0.249						
	*							
74	KK	RNW45R						
75	KM	ROUTE NW45R TO CNW72R						
76	KM	RACEL						
77	RD	6150 0.0317 0.016	0	TRAP	0	50		
	*							
78	KK	NW72R						
79	BA	0.455						
80	PB	2.81						
81	LS	0	91.2					
82	UD	0.305						
	*							
83	KK	CNW72R						
84	KM	COMBINE NW72R AND RCNW45R						
85	KM	RACEL @ RANCHO						
86	HC	2						
	*							
87	KK	2CNW72R						
88	KM	COMBINE CNW72R AND RCNW74R						
89	KM	RANCHO ROAD SYSTEM @ RACEL						
90	HC	2						
	*							
91	KK	DNW28R						
92	KM	RETRIEVE FLOW FROM NW28-C						
93	DR	DNW28-C						
	*							
94	KK	RDNDW28-C						
95	KM	ROUTE DNW28-C TO CNW71R						
96	KM	FACILITY = CENTENNIAL PARKWAY CHANNEL WEST/GRAND TETON BRANCH						
97	KM	FACILITY ID-MILE = CNGT 0000,0067,0118						
98	KM	LINING = RCP						
99	RD	8090 0.0341 0.015	0	CIRC	6	0		
	*							
100	KK	NW71R						
101	BA	0.340						
102	PB	2.87						
103	LS	0	87.1					
104	UD	0.317						
	*							
105	KK	CNW71R						
106	KM	COMBINE NW71R AND RDNW71R						
107	KM	WEST TRIBUTARY FLOW @ RANCHO ROAD SYSTEM						
108	HC	2						
	*							
109	KK	RCNW71R						
110	KM	ROUTE CNW71R TO 3CNW72R						
111	KM	FACILITY = CENTENNIAL PARKWAY CHANNEL WEST/GRAND TETON BRANCH						
112	KM	FACILITY ID-MILE = CNGT 0000						
113	KM	LINING = RCP						
114	RD	830 0.0309 0.015	0	CIRC	6	0		
	*							
115	KK	3CNW72R						
116	KM	COMBINE 2CNW72R AND CNW71R						
117	KM	RANCHO ROAD SYSTEM FLOW @ GRAND TETON						
118	HC	2						
	*							
119	KK	RCNW72R						
120	KM	ROUTE 3CNW72R TO CNW89-C						
121	KM	FACILITY = CENTENNIAL PARKWAY CHANNEL WEST/U.S. 95 FACILITY						
122	KM	FACILITY ID-MILE = CN95 0102,0167						
123	KM	LINING = RCB						
124	RD	3200 0.015 0.015	0	TRAP	20	0		
	*							
125	ZZ							

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE	(V) ROUTING	(--->) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	(<---) RETURN OF DIVERTED OR PUMPED FLOW
19	NW28-C	
35		-----> DNW28-C
32	DNW28-C	
38	NW62R	
43	RNW62R	
49	2RNW62R	
55		NW74R
60	CNW74R	
63	RCNW74R	
69		NW45R
74		RNW45R
78		NW72R
83		CNW72R
87	2CNW72R	
93		<----- DNW28-C
91	DNW28R	
94	RDW28-C	
100		NW71R
105		CNW71R
109	RCNW71R	
115	3CNW72R	
119	RCNW72R	

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION


```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* SEPTEMBER 1990
* VERSION 4.0
*
* RUN DATE 02/20/2004 TIME 10:42:22
*
*****

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

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HORSE DRIVE INTERCHANGE AND US 95
DATE: 02/19/2004
HEC1 FILE: 02MPUREV.DAT
***** FUTURE DESIGN CONDITION MODEL *****
ASSUMES ALL FLOW FROM WEST OF FUTURE OUTER BELTWAY IS DIVERTED
NORTHWARD AROUND THIS AREA OF INTEREST
ASSUMES ULTIMATE DEVELOPEMENT

```

```

BASE MODEL -
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT 2002 MASTER PLAN UPDATE
WEST TRIBUTARY

```

100-YEAR, 6-HOUR STORM, SDN3

```

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

IT          HYDROGRAPH TIME DATA
            NMIN       5  MINUTES IN COMPUTATION INTERVAL
            IDATE      1  0  STARTING DATE
            ITIME      0000 STARTING TIME
            NQ         300 NUMBER OF HYDROGRAPH ORDINATES
            NDDATE     2  0  ENDING DATE
            NDTIME     0055 ENDING TIME
            ICENT      19  CENTURY MARK

            COMPUTATION INTERVAL .08 HOURS
            TOTAL TIME BASE 24.92 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

JP          MULTI-PLAN OPTION
            NPLAN      1  NUMBER OF PLANS

JR          MULTI-RATIO OPTION
            RATIOS OF PRECIPITATION
            1.00      .99      .98      .97      .97      .94      .93

```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
 TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO PRECIPITATION						
				RATIO 1 1.00	RATIO 2 .99	RATIO 3 .98	RATIO 4 .97	RATIO 5 .97	RATIO 6 .94	RATIO 7 .93
HYDROGRAPH AT +	NW28-C	.50	1 FLOW TIME	624. 3.58	611. 3.58	602. 3.58	598. 3.58	596. 3.58	565. 3.58	556. 3.58
DIVERSION TO +	DNW28-C	.50	1 FLOW TIME	81. 3.25	81. 3.25	81. 3.25	81. 3.25	81. 3.25	81. 3.25	81. 3.25
HYDROGRAPH AT +	DNW28-C	.50	1 FLOW TIME	543. 3.58	530. 3.58	521. 3.58	517. 3.58	515. 3.58	484. 3.58	475. 3.58
HYDROGRAPH AT +	NW62R	.36	1 FLOW TIME	423. 3.67	415. 3.67	410. 3.67	407. 3.67	406. 3.67	386. 3.67	381. 3.67
ROUTED TO +	RNW62R	.36	1 FLOW TIME	413. 3.67	405. 3.67	400. 3.67	397. 3.67	395. 3.67	377. 3.67	371. 3.67
ROUTED TO +	2RNW62R	.36	1 FLOW TIME	410. 3.75	402. 3.75	397. 3.75	394. 3.75	392. 3.75	374. 3.75	369. 3.75
HYDROGRAPH AT +	NW74R	.64	1 FLOW TIME	701. 3.75	688. 3.75	680. 3.75	676. 3.75	673. 3.75	642. 3.75	634. 3.75
2 COMBINED AT +	CNW74R	1.00	1 FLOW TIME	1112. 3.75	1090. 3.75	1077. 3.75	1070. 3.75	1066. 3.75	1017. 3.75	1003. 3.75
ROUTED TO +	RCNW74R	1.00	1 FLOW TIME	1096. 3.75	1074. 3.75	1061. 3.75	1054. 3.75	1049. 3.75	1001. 3.75	988. 3.75
HYDROGRAPH AT +	NW45R	.38	1 FLOW TIME	479. 3.67	470. 3.67	464. 3.67	461. 3.67	459. 3.67	438. 3.67	432. 3.67
ROUTED TO +	RNW45R	.38	1 FLOW TIME	477. 3.83	468. 3.83	463. 3.83	460. 3.83	458. 3.83	438. 3.83	432. 3.83
HYDROGRAPH AT +	NW72R	.46	1 FLOW TIME	535. 3.75	526. 3.75	520. 3.75	517. 3.75	515. 3.75	492. 3.75	486. 3.75
2 COMBINED AT +	CNW72R	.83	1 FLOW TIME	1001. 3.75	982. 3.75	970. 3.75	964. 3.75	960. 3.75	915. 3.75	903. 3.75
2 COMBINED AT +	2CNW72R	1.84	1 FLOW TIME	2097. 3.75	2056. 3.75	2031. 3.75	2018. 3.75	2009. 3.75	1916. 3.75	1891. 3.75
HYDROGRAPH AT +	DNW28R	.00	1 FLOW TIME	81. 3.25	81. 3.25	81. 3.25	81. 3.25	81. 3.25	81. 3.25	81. 3.25
ROUTED TO +	RDNW28-C	.00	1 FLOW TIME	83. 3.42	83. 3.42	82. 3.42	82. 3.42	82. 3.42	82. 3.42	85. 3.42
HYDROGRAPH AT +	NW71R	.34	1 FLOW TIME	346. 3.75	339. 3.75	335. 3.75	333. 3.75	331. 3.75	315. 3.75	310. 3.75
2 COMBINED AT +	CNW71R	.34	1 FLOW TIME	428. 3.75	421. 3.75	416. 3.75	414. 3.75	412. 3.75	396. 3.75	391. 3.75
ROUTED TO +	RCNW71R	.34	1 FLOW TIME	426. 3.75	419. 3.75	414. 3.75	412. 3.75	411. 3.75	394. 3.75	389. 3.75
2 COMBINED AT +	3CNW72R	2.18	1 FLOW TIME	2523. 3.75	2475. 3.75	2445. 3.75	2430. 3.75	2420. 3.75	2310. 3.75	2280. 3.75
ROUTED TO +	RCNW72R	2.18	1 FLOW TIME	2474. 3.75	2430. 3.75	2397. 3.75	2384. 3.75	2371. 3.75	2265. 3.83	2234. 3.83

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

A-5.0

VTN FUTURE CONDITION MODEL

A-5.1

CURVE NUMBER CALCULATIONS

HORSE DR. / U.S. 95 INTERCHANGE

ULTIMATE FUTURE CONDITIONS: CN CALCULATION

SUBBASIN	SOIL GROUP	TOTAL BASIN AREA (ac.)	High Density Residential (7,000 sq ft Lots)		Commercial and Business		Open Space Condition		Fair	WEIGHTED AVE. CN
			SOIL GROUP B % of Total Area	SOIL GROUP D % of Total Area	SOIL GROUP B % of Total Area	SOIL GROUP D % of Total Area	SOIL GROUP B % of Total Area	SOIL GROUP D % of Total Area		
OFF14A	B & D	45.31	23.00	77.00						89.4
OFF15	B & D	151.69	15.00	85.00						90.0
OFF16	D	136.74		100.00						91.0
OFF17	D	134.72		55.00				45.00		87.9
OFF18	D	144.90		85.00				15.00		90.0
OFF19	D	124.40		80.00				20.00		89.6
OFF20A	B & D	119.96	10.00	78.00				12.00		89.5
OFF20B	D	67.26		70.00				30.00		88.9
OFF21A	D	12.62		100.00						91.0
OFF21B	D	17.05				100.00				95.0
OFF22	B & D	136.83	40.00	5.00	49.00	6.00				88.9
OFF23	D	15.62				100.00				95.0
OFF24A	D	19.76		90.00				10.00		90.3
OFF24B	D	33.77		60.00				40.00		88.2
OFF26	B	16.80			100.00					92.0
OFF28	B & D	193.36	66.00	34.00						86.4

CN # Breakdown According to Table 602 CCRFCD:

Cover and Hydrologic Condition	HYDROLOGIC SOIL GROUP	
	B	D
High Density Residential (7,000 sq ft Lots)	84	91
Commercial and Business	92	95
Open Space, Fair Condition (50% < grass cover < 75%)	69	84

A-5.2

SUBBASIN SLOPES

HORSE DR. / U.S. 95 INTERCHANGE

ULTIMATE FUTURE CONDITIONS: SLOPE CALCULATION

SUBBASIN	TRAVEL			
	ELEVATION 1	ELEVATION 2	DISTANCE	SLOPE (%)
OFF14A	2875.18	2780.00	2943.81	3.23
OFF15	3075.05	2756.10	8539.38	3.74
OFF16	3074.05	2754.79	8617.06	3.71
OFF17	2992.48	2705.00	8436.34	3.41
OFF18	3059.13	2760.00	7964.13	3.76
OFF19	3037.80	2740.00	8450.85	3.52
OFF20A	3001.46	2769.62	6650.13	3.49
OFF20B	2924.00	2754.51	5112.45	3.32
OFF21A	2820.00	2759.00	1598.42	3.82
OFF21B	2720.30	2680.00	1290.36	3.12
OFF22	2849.24	2655.00	6087.98	3.19
OFF23	2715.00	2673.32	1562.61	2.67
OFF24A	2875.00	2790.12	2737.30	3.10
OFF24B	2804.50	2715.00	2677.36	3.34
OFF26	2854.58	2790.00	2027.16	3.19
OFF28	3092.23	2770.00	8722.19	3.69

A-5.3

STANDARD FORM 4

HORSE DR. / U.S. 95 INTERCHANGE

ULTIMATE FUTURE CONDITIONS: STANDARD FORM 4

SUB-BASIN DATA				INITIAL/OVERLAND TIME			TRAVEL TIME				CONC.	t _c CHECK		FINAL	LAG
DESIG.	AREA	CN	K ⁽¹⁾	t _i			t _t				TIME	(URBANIZED BASINS)		CONC.	TIME
	mi ²			LENGTH	SLOPE	t _i ⁽²⁾	LENGTH	SLOPE	VELOCITY	t _t ⁽⁴⁾	t _c ⁽⁶⁾	TOTAL	t _c ⁽⁶⁾	t _c	t _{LAG} ⁽⁷⁾
				L(ft)	S _t (%)	(min.)	L(ft)	S _t (%)	V(fps) ⁽³⁾	(min.)	(min.)	LENGTH	(min.)	(min.)	(hours)
OFF14A	0.0708	89.4	0.790	200	3.233	5.3	2,744	3.233	5.50	8.3	13.6	2,944	26.4	13.6	0.136
OFF15	0.2370	90.0	0.797	200	3.735	5.0	8,339	3.735	5.91	23.5	28.5	8,539	57.4	28.5	0.285
OFF16	0.2137	91.0	0.811	200	3.705	4.8	8,417	3.705	5.89	23.8	28.6	8,617	57.9	28.6	0.286
OFF17	0.2105	87.9	0.770	300	3.408	6.8	8,136	3.408	5.65	24.0	30.9	8,436	56.9	30.9	0.309
OFF18	0.2264	90.0	0.797	300	3.756	6.1	7,664	3.756	5.93	21.5	27.6	7,964	54.2	27.6	0.276
OFF19	0.1944	89.6	0.793	300	3.524	6.3	8,151	3.524	5.74	23.6	29.9	8,451	56.9	29.9	0.299
OFF20A	0.1874	89.5	0.791	300	3.486	6.4	6,350	3.486	5.71	18.5	24.9	6,650	46.9	24.9	0.249
OFF20B	0.1051	88.9	0.783	300	3.315	6.6	4,812	3.315	5.57	14.4	21.0	5,112	38.4	21.0	0.210
OFF21A	0.0197	91.0	0.811	200	3.816	4.7	1,398	3.816	5.98	3.9	8.6	1,598	18.9	8.6	0.086
OFF21B	0.0266	95.0	0.864	200	3.123	4.1	1,090	3.123	5.41	3.4	7.5	1,290	17.2	7.5	0.075
OFF22	0.2138	88.9	0.784	200	3.191	5.5	5,888	3.191	5.47	18.0	23.4	6,088	43.8	23.4	0.234
OFF23	0.0244	95.0	0.864	200	2.667	4.3	1,363	2.667	5.00	4.5	8.9	1,563	18.7	8.9	0.089
OFF24A	0.0309	90.3	0.802	300	3.101	6.4	2,437	3.101	5.39	7.5	13.9	2,737	25.2	13.9	0.139
OFF24B	0.0528	88.2	0.774	300	3.343	6.8	2,377	3.343	5.59	7.1	13.9	2,677	24.9	13.9	0.139
OFF26	0.0263	92.0	0.824	100	3.186	3.4	1,927	3.186	5.46	5.9	9.3	2,027	21.3	9.3	0.093
OFF28	0.3021	86.4	0.750	200	3.694	5.8	8,522	3.694	5.88	24.1	29.9	8,722	58.5	29.9	0.299

NOTE:

$$(1) \quad K = 0.0132 C_n - 0.39$$

$$(2) \quad t_i = \frac{1.8(1.1 - K)L_i^{1/2}}{S_i^{1/3}}$$

$$(3) \quad V = CS^{1/2}$$

Where $C = 30.6$ for curb height street flow
(See CCRFCD manual pp 606)

$$(4) \quad t = \frac{L}{60V}$$

$$(5) \quad t_c = t_i + t_t$$

$$(6) \quad t_c = \frac{L}{180} + 10$$

$$(7) \quad t_{LAG} = 0.6t_c$$

A-5.4

HEC-1 RESULTS

HORSEFUT.dat


```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* SEPTEMBER 1990
* VERSION 4.0
*
* RUN DATE 02/13/2004 TIME 15:26:46
*
*****

```

```

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

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X X XXXXXXX XXXX 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 XXXXXXX XXXX XXX

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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

*DIAGRAM

*** FREE ***

```

1 ID HORSE DRIVE INTERCHANGE AND US 95
2 ID DATE: 01/20/2004
3 ID HEC1 FILE: HORSEFUT.DAT
4 ID ***** FUTURE DESIGN CONDITION MODEL *****
5 ID ASSUMES ALL FLOW FROM WEST OF FUTURE OUTER BELTWAY IS DIVERTED
6 ID NORTHWARD AROUND THIS AREA OF INTEREST
7 ID ASSUMES ULTIMATE DEVELOPEMENT
8 ID
9 ID MODEL BASED ON HEC1 FILE: HORSE9.DAT (DESIGN MODEL) FROM THE OCTOBER
10 ID 2003 DRAINAGE REPORT
11 ID MODEL BASED ON HEC1 FILE: EXN37F.DAT (100 YEAR WITHOUT FLOWSPLIT) FROM
12 ID THE JUNE 2003 DRAFT ONSITE DRAINAGE REPORT
13 ID JR CARD RATIOS REPRESENT DEPTH-AREA REDUCTION FACTORS (DARF'S)
14 ID
15 ID
16 ID 100-YEAR, 6-HOUR STORM, SDN3
17 ID DARF RATIOS
18 ID AREAS OF 0, 4-0.28, 5-0.39, 6-0.81, 7-0.83, 8-1.10, 9-1.99, 10-2.01, 11-2.22
19 ID
20 IT 5 0 0 300
21 IO 5 0 0
22 IN 5 0 0
23 JR PREC 1 0.989 0.984 0.974 0.973 0.966 0.930 0.930 0.928
*
24 KK FUT26
25 BA 0.0263
26 PB 2.784
27 PC 0.000 0.020 0.057 0.070 0.087 0.108 0.124 0.130 0.130 0.130
28 PC 0.130 0.130 0.130 0.133 0.140 0.142 0.148 0.158 0.172 0.181
29 PC 0.190 0.197 0.199 0.200 0.201 0.204 0.214 0.229 0.241 0.249
30 PC 0.251 0.256 0.270 0.278 0.281 0.283 0.295 0.322 0.352 0.409
31 PC 0.499 0.590 0.710 0.744 0.781 0.812 0.819 0.835 0.851 0.856
32 PC 0.860 0.868 0.876 0.888 0.910 0.926 0.937 0.950 0.970 0.976
33 PC 0.982 0.985 0.987 0.989 0.990 0.993 0.993 0.994 0.995 0.998
34 PC 0.998 0.999 1.000
35 LS 0 92
36 UD 0.093
*
37 KKRCFUT26
38 KM ROUTE TO CULVERT 2
39 RK 12530 0.0337 0.02 0 TRAP 135 13
*
40 KK DCFUT26
41 KM FLOW SPLIT AT CULVERT
42 KM DIVERSION TO THE OTHER SIDE OF US 95
43 DT DIVCUL2
44 DI 0 153 711 1164 1610 2094 2626 3117
45 DQ 0 150 300 450 600 750 900 1050
*
46 KK FUT14A
47 BA .0708
48 PB 2.880
49 LS 0 89.4
50 UD 0.136
*
51 KK CFUT14A
52 KM COMBINE BASIN FUT14A AND BY PASS FR CULVERT 2
53 HC 2
*

```

54 KKRCFUT14A
55 KM ROUTE TO THE NEXT CULVERT AT BASIN FUT20A
56 RK 8379 0.0322 0.02 0 TRAP 0 5
*

57 KK FUT20A
58 BA 0.1874
59 PB 2.775
60 LS 0 89.5
61 UD 0.249
*

62 KK CFUT20A
63 KM COMBINE BASIN FUT20A AND FUT14A
64 HC 2
*

65 KKRCFUT20A
66 KM ROUTE TO THE NEXT CULVERT AT BASIN FUT20B
67 RK 1000 0.0189 0.02 0 TRAP 0 15
*

68 KK FUT20B
69 BA 0.1051
70 PB 2.826
71 LS 0 88.9
72 UD 0.210
*

73 KK CFUT20B
74 KM COMBINE BASIN FUT20B WITH RDCFUT20A AND BYPASS
75 KM FROM CULVERT AT BASIN FUT20A
76 HC 2
*

77 KKDCFUT20B
78 KM FLOW SPLIT AT CULVERT
79 KM DIVERSION TO THE OTHER SIDE OF US 95
80 KM ALL IS DIVERTED IN FUTURE CONDITIONS
81 DT DIVCUL5
82 DI 0 2000.0
83 DQ 0 1999.9
*

84 KKRCFUT20B
85 KM ROUTE TO THE NEXT CULVERT AT BASIN FUT19
86 RK 714 0.0210 0.02 0 TRAP 0 15
*

87 KK FUT19
88 BA 0.1944
89 PB 2.803
90 LS 0 89.6
91 UD 0.299
*

92 KK FUT18
93 BA 0.2264
94 PB 2.876
95 LS 0 90
96 UD 0.276
*

97 KK RCFUT18
98 KM ROUTE CFUT18 TO BASIN FUT19
99 RK 1000 0.0346 0.02 0 TRAP 0 4
*

100 KKRCFUT18
101 KM COMBINE RCFUT18 WITH CFUT19 AND BYPASS
102 KM FROM CULVERT AT BASIN FUT20B
103 HC 3
*

104 KKDCRCFUT18
105 KM FLOW SPLIT AT CULVERT
106 KM DIVERSION TO THE OTHER SIDE OF US 95
107 KM ALL IS DIVERTED IN FUTURE CONDITIONS
108 DT DIVCUL6
109 DI 0 2000.0
110 DQ 0 1999.9
*

111 KKRCRCFUT18
112 KM ROUTE TO THE NEXT CULVERT AT BASIN FUT24B
113 RK 1055 0.0190 0.02 0 TRAP 30 35
*

114 KK FUT24B
115 BA 0.0528
116 PB 2.773
117 LS 0 88.2
118 UD 0.139
*

119 KK CFUT24B
120 KM COMBINE BASIN FUT24B AND BYPASS
121 KM FROM LAT2
122 HC 2


```

*
123 KK DLAT1
124 KM FLOW SPLIT AT LAT1
125 KM DIVERSION INTO CHANNEL BETWEEN FRONTAGE AND US95 SOUTH
126 DT DIVLAT1
127 DI 0 56 209 356 579 728 1351
128 DQ 0 4 11 18 28 35 67
*

129 KK DLAT2
130 KM FLOW SPLIT AT LAT2
131 KM DIVERSION INTO CHANNEL BETWEEN FRONTAGE AND US95 SOUTH
132 DT DIVLAT2
133 DI 0 56 209 356 579 728 1351
134 DQ 0 4 11 18 28 35 67
*

135 KK RDCFUT24B
136 KM ROUTE TO THE NEXT CULVERT AT BASIN FUT17
137 RK 800 0.0199 0.02 0 TRAP 0 23
*

138 KK FUT24A
139 BA 0.0309
140 PB 2.820
141 LS 0 90.3
142 UD 0.139
*

143 KK RFUT24A
144 KM ROUTE BASIN FUT24A TO BASIN FUT17
145 RK 2178 0.0299 0.02 0 TRAP 25 14
*

146 KK FUT17
147 BA 0.2105
148 PB 2.773
149 LS 0 87.9
150 UD 0.309
*

151 KK CFUT17
152 KM COMBINE BASIN FUT17 AND RFUT24A WITH BYPASS FROM
153 KM CULVERT AT BASIN FUT24B
154 HC 3
*

155 KK DCFUT17
156 KM FLOW SPLIT AT CULVERT
157 KM DIVERSION TO THE OTHER SIDE OF US 95
158 KM ALL IS DIVERTED IN FUTURE CONDITIONS
159 DT DIVCUL8
160 DI 0 2000.0
161 DQ 0 1999.9
*

162 KK RDCFUT17
163 KM ROUTE TO THE NEXT CULVERT AT BASIN FUT21B
164 RK 1055 0.0228 0.02 0 TRAP 0 23
*

165 KK ON1
166 KM START CENTENNIAL POINT HEC-1
167 BA 0.0042
168 PB 2.86
169 LS 0 91.2
170 UD 0.085
*

171 KK ON4A
172 BA 0.0045
173 LS 0 91.2
174 UD 0.077
*

175 KK C1
176 KM COMBINE ON1 AND ON2
177 HC 2
*

178 KK D1
179 KM DIVERT FLOW INTO BASIN ON6
180 DT DIV1
181 DI 0 16
182 DQ 0 13
*

183 KK ON5
184 BA 0.0052
185 LS 0 91.2
186 UD 0.080
*

187 KK C2
188 KM COMBINE C1 AND BASIN ON5
189 HC 2
*

190 KK D1A

```

191	KM	DIVERT FLOW FOR LATER USE IN HEC1 RUN	
192	DT	DIV1A	
193	DI	0	50
194	DQ	0	50
	*		
195	KK	ON4B	
196	BA	0.0031	
197	LS	0	91.2
198	UD	0.085	
	*		
199	KK	RET1	
200	KM	RETRIEVE FLOW FROM D1	
201	DR	DIV1	
	*		
202	KK	ON6	
203	BA	0.0039	
204	LS	0	91.2
205	UD	0.074	
	*		
206	KK	C3	
207	KM	COMBINE RET1 AND BASIN ON6	
208	HC	2	
	*		
209	KK	D1B	
210	KM	DIVERT FLOW FOR LATER USE IN HEC1 RUN	
211	DT	DIV1B	
212	DI	0	50
213	DQ	0	50
	*		
214	KK	ON2	
215	BA	0.0050	
216	LS	0	91.2
217	UD	0.080	
	*		
218	KK	ON3	
219	BA	0.0063	
220	LS	0	91.5
221	UD	0.079	
	*		
222	KK	ON9	
223	BA	0.0045	
224	LS	0	91.4
225	UD	0.096	
	*		
226	KK	C4	
227	KM	COMBINE BASINS ON2, ON3 AND ON9	
228	HC	3	
	*		
229	KK	D2	
230	KM	DIVERT FLOW INTO BASIN ON8	
231	DT	DIV2	
232	DI	0	29
233	DQ	0	24
	*		
234	KK	ON10	
235	BA	0.0025	
236	LS	0	91.5
237	UD	0.071	
	*		
238	KK	C5	
239	KM	COMBINE C4 AND BASIN ON10	
240	HC	2	
	*		
241	KK	D3	
242	KM	DIVERT FLOWS INTO BASIN ON7	
243	DT	DIV3	
244	DI	0	10
245	DQ	0	8
	*		
246	KK	ON11	
247	BA	0.0025	
248	LS	0	91.5
249	UD	0.067	
	*		
250	KK	C6	
251	KM	COMBINE C5 AND BASIN ON11	
252	HC	2	
	*		
253	KK	D1C	
254	KM	DIVERT FLOW FOR LATER USE IN HEC1 RUN	
255	DT	DIV1C	
256	DI	0	50
257	DQ	0	50
	*		

258	KK	CD1C					
259	KM	COMBINE D1A ON4B D1B AND D1C					
260	KM	PICK UP AT FUT23					
261	HC	4					
	*						
262	KK	RCD1C					
263	KM	ROUTE CD1C TO BASIN FUT23					
264	RK	2640 0.0346 0.02 0 TRAP 100 2					
	*						
265	KK	DRCD1C					
266	KM	DIVERT FLOW TO BASIN FUT23					
267	DTDIVFUT23						
268	DI	0 50 100					
269	DQ	0 50 100					
	*						
270	KK	ON8					
271	BA	0.0042					
272	LS	0 83.5					
273	UD	0.074					
	*						
274	KK	RET2					
275	KM	RETREIVE FLOW D2					
276	DR	DIV2					
	*						
277	KK	C7					
278	KM	COMBINE ON8 AND RET2					
279	HC	2					
	*						
280	KK	RET3					
281	KM	RETREIVE FLOW D3					
282	DR	DIV3					
	*						
283	KK	ON7					
284	BA	0.0073					
285	LS	0 91.3					
286	UD	0.077					
	*						
287	KK	C8					
288	KM	COMBINE BASIN C7, RET3, AND BASIN ON7					
289	HC	3					
	*						
290	KK	RET1A					
291	KM	RETREIVE FLOW FROM D1A IN TEE PEE					
292	DR	DIV1A					
	*						
293	KK	RET1B					
294	KM	RETREIVE FLOW FROM D1B IN TEE PEE					
295	DR	DIV1B					
	*						
296	KK	RET1C					
297	KM	RETREIVE FLOW FROM D1C IN TEE PEE					
298	DR	DIV1C					
	*						
299	KK	C9					
300	KM	COMBINE BASIN C8, RET1A, RET1B, RET1C IN TEE PEE					
301	HC	4					
	*						
302	KK	ON2D					
303	KM	START GRAND CANYON APARTMENT HEC-1					
304	KM	RUNOFF FROM BASIN ON2D					
305	BA	0.0105					
306	PB	2.900					
307	LS	0 95					
308	UD	0.094					
	*						
309	KK	ON5D					
310	KM	RUNOFF FROM BASIN ON5D					
311	BA	0.0038					
312	LS	0 95					
313	UD	0.067					
	*						
314	KK	CP1					
315	KM	COMBINATION OF BASINS ON2D AND ON5D					
316	HC	2					
	*						
317	KK	ON3D					
318	KM	RUNOFF FROM BASIN ON3D					
319	BA	0.0036					
320	LS	0 95					
321	UD	0.084					
	*						
322	KK	CP2					

323	KM	COMBINATION OF BASINS CP1 (ON2D, ON5D) AND ON3D						
324	HC	2						
	*							
325	KK	ON1D						
326	KM	RUNOFF FROM BASIN ON1D						
327	BA	0.0075						
328	LS	0	95					
329	UD	0.079						
	*							
330	KK	ON4D						
331	KM	RUNOFF FROM BASIN ON4D						
332	BA	0.0041						
333	LS	0	95					
334	UD	0.096						
	*							
335	KK	CP3						
336	KM	COMBINATION OF BASINS ON1D AND ON4D						
337	HC	2						
	*							
338	KK	CP4						
339	KM	COMBINATIONS OF CP2 (ON2D, ON5D, ON3D) AND CP3 (ON1D, ON4D)						
340	HC	2						
	*							
341	KK	FUT28						
342	BA	0.3021						
343	PB	2.98						
344	LS	0	86.4					
345	UD	0.299						
	*							
346	KK	RFUT28						
347	KM	ROUTE BASIN FUT28 TO BASIN FUT15						
348	RK	600	0.0479	0.02	0	TRAP	10	3
	*							
349	KK	FUT15						
350	BA	0.2370						
351	PB	2.863						
352	LS	0	90					
353	UD	0.285						
	*							
354	KK	CFUT15						
355	KM	COMBINE BASIN FUT15 WITH RFUT28						
356	HC	2						
	*							
357	KK	RFUT15						
358	KM	ROUTE CFUT15 TO BASIN FUT16						
359	RK	800	0.0479	0.02	0	TRAP	10	3
	*							
360	KK	FUT16						
361	BA	0.2137						
362	PB	2.818						
363	LS	0	91					
364	UD	0.286						
	*							
365	KK	FUT21A						
366	BA	0.0197						
367	PB	2.818						
368	LS	0	91					
369	UD	0.086						
	*							
370	KK	CFUT21A						
371	KM	COMBINE BASIN FUT21A WITH FUT16 AND BASIN RFUT15						
372	HC	3						
	*							
373	KK	KKRCFUT21A						
374	KM	ROUTE CFUT21A TO BASIN FUT21B						
375	KM	ROUTE IN RCB CHANNEL BETWEEN GRAND CANYON APT AND DEVELOPMENT						
376	RK	1250	0.0347	0.016	0	TRAP	8	0
	*							
377	KK	CCP4						
378	KM	COMBINE CP4 C9 CD1C AND RCFUT21A						
379	KM	CD1C IS DIVERSION OF FLOW ON TEE PEE FR CENTENNIAL POINT						
380	KM	CP4 AND C9 ARE ENDING OF THE APARTMENT COMPLEX AND DEVELOPMENT						
381	HC	4						
	*							
382	KK	RCCP4						
383	KM	ROUTE CCP4 TO BASIN FUT21B						
384	RK	1100	0.0215	0.02	0	TRAP	0	10
	*							
385	KK	FUT21B						
386	BA	0.0266						
387	PB	2.775						
388	LS	0	95					
389	UD	0.075						
	*							


```

390 KK CFUT21B
391 KM COMBINE BASIN FUT21B WITH RCCCP4 AND BYPASS
392 KM FROM CULVERT AT BASIN FUT17
393 HC 3
*
* KK DCFUT21B
* KM FLOW SPLIT AT CULVERT
* KM DIVERSION TO THE OTHER SIDE OF US 95
* DT DIVCUL9
* DI 0 219 931 1179 1419 1679 1878 2068 2243 2451
* DQ 0 180 270 360 450 540 630 720 800 900
*

394 KKRDCFUT21B
395 KM ROUTE TO THE NEXT CULVERT AT BASIN FUT23
396 RK 430 0.0233 0.02 0 TRAP 0 10
*

397 KKRETFUT23
398 KM RETREIVE FLOW FROM DIVFUT23
399 DRDIVFUT23
*

400 KK FUT23
401 BA 0.0244
402 PB 2.787
403 LS 0 95
404 UD 0.089
*

405 KK CFUT23
406 KM COMBINE BASIN FUT23 WITH RDCFUT21B
407 HC 3
*

408 KK DCFUT23
409 KM FLOW SPLIT AT CULVERT
410 KM DIVERSION TO THE OTHER SIDE OF US 95
411 DTDIVCUL10
412 DI 0 300.0 600.0 748 1080 1398 1614
413 DQ 0 299.9 599.9 700 799 859 891
*

414 KKRDCFUT23
415 KM ROUTE TO THE NEXT CULVERT AT BASIN FUT22
416 RK 905 0.0177 0.02 0 TRAP 0 30
*

417 KK FUT22
418 BA 0.2138
419 PB 2.820
420 LS 0 88.9
421 UD 0.234
*

422 KK CFUT22
423 KM COMBINE BASIN FUT22 WITH RDCFUT23
424 HC 2
*

425 KK DCFUT22
426 KM FLOW SPLIT AT CULVERT
427 KM DIVERSION TO THE OTHER SIDE OF US 95
428 DTDIVCUL11
429 DI 0 100.0 700.0 900.0 1056
430 DQ 0 99.9 699.9 899.9 1000
*

431 KK RET5
432 KM RETREIVE FLOW FROM DIVCUL5
433 DR DIVCUL5
*

434 KK RRET5
435 KM ROUTE RET5 TO CRET6
436 KM FACILITY = CENTENNIAL PARKWAY CHANNEL WEST/U.S. 95 FACILITY
437 KM FACILITY ID-MILE = CN95 0295
438 KM LINING = 4'X12' RCB
439 RK 700 0.0170 0.013 0 TRAP 12 0
*

440 KK RET6
441 KM RETREIVE FLOW FROM DIVCUL6
442 DR DIVCUL6
*

443 KK CRET6
444 KM COMBINE RET6 AND RCRET5
445 HC 2
*

446 KK RTLAT1
447 KM RETREIVE FLOW FROM DIVLAT1
448 DR DIVLAT1
*

449 KK CRTLAT1
450 KM COMBINE RTLAT1 AND DRET6
451 HC 2

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```

*
452 KKRCRTLAT1
453 KM ROUTE CRTLAT1 TO CRTLAT2
454 KM FACILITY = CENTENNIAL PARKWAY CHANNEL WEST/U.S. 95 FACILITY
455 KM FACILITY ID-MILE = CN95 0295
456 KM LINING = 4'X14' RCB
457 RK 370 0.0150 0.013 0 TRAP 14 0
*
458 KK RTLAT2
459 KM RETREIVE FLOW FROM DIVLAT2
460 DR DIVLAT2
*
461 KK CRTLAT2
462 KM COMBINE RTLAT2 AND CRTLAT1
463 HC 2
*
464 KKRCRTLAT2
465 KM ROUTE CRTLAT2 TO CRET9
466 KM FACILITY = CENTENNIAL PARKWAY CHANNEL WEST/U.S. 95 FACILITY
467 KM FACILITY ID-MILE = CN95 0259
468 KM LINING = 4'X14' RCB
469 RK 1600 0.0150 0.013 0 TRAP 14 0
*
470 KK RET8
471 KM RETREIVE FLOW FROM DIVCUL8
472 DR DIVCUL8
*
473 KK CRET8
474 KM COMBINE RET8 AND CRTLAT2
475 HC 2
*
476 KK RCRET8
477 KM ROUTE CRET8 TO CRET10
478 KM FACILITY = CENTENNIAL PARKWAY CHANNEL WEST/U.S. 95 FACILITY
479 KM FACILITY ID-MILE = CN95 0259
480 KM LINING = 4'X14' RCB
481 RK 1700 0.0140 0.013 0 TRAP 14 0
*
482 KK RET10
483 KM RETREIVE FLOW FROM DIVCUL10
484 DRDIVCUL10
*
485 KK CRRET10
486 KM COMBINE RET10 AND RCRET9
487 HC 2
*
488 KK RCRET10
489 KM ROUTE CRET10 TO CRET11
490 KM FACILITY = CENTENNIAL PARKWAY CHANNEL WEST/U.S. 95 FACILITY
491 KM FACILITY ID-MILE = CN95 0199
492 KM LINING = 11'X16' RECT
493 RK 850 0.0084 0.013 0 TRAP 16 0
*
494 KK RET11
495 KM RETREIVE FLOW FROM DIVCUL11
496 DRDIVCUL11
*
497 KK CRET11
498 KM COMBINE RET11 AND RCRET10
499 HC 2
*
500 KK RCRET11
501 KM ROUTE CRET11 TO
502 KM FACILITY = CENTENNIAL PARKWAY CHANNEL WEST/U.S. 95 FACILITY
503 KM FACILITY ID-MILE = CN95 0167
504 KM LINING = 2:10' X 9' RCBC
505 RK 1700 0.0150 0.013 0 TRAP 20 0
*
*
506 ZZ

```



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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* SEPTEMBER 1990
* VERSION 4.0
*
* RUN DATE 02/13/2004 TIME 15:26:46
*
*****

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

```

HORSE DRIVE INTERCHANGE AND US 95

DATE: 01/20/2004

HEC1 FILE: HORSEFUT.DAT

***** . FUTURE DESIGN CONDITION MODEL *****

ASSUMES ALL FLOW FROM WEST OF FUTURE OUTER BELTWAY IS DIVERTED

NORTHWARD AROUND THIS AREA OF INTEREST

ASSUMES ULTIMATE DEVELOPEMENT

MODEL BASED ON HEC1 FILE: HORSE9.DAT (DESIGN MODEL) FROM THE OCTOBER
2003 DRAINAGE REPORT

MODEL BASED ON HEC1 FILE: EXN37F.DAT (100 YEAR WITHOUT FLOWSPLIT) FROM
THE JUNE 2003 DRAFT ONSITE DRAINAGE REPORT

JR CARD RATIOS REPRESENT DEPTH-AREA REDUCTION FACTORS (DARF'S)

100-YEAR, 6-HOUR STORM, SDN3

DARF RATIOS

AREAS OF 0, 4-0.28, 5-0.39, 6-0.81, 7-0.83, 8-1.10, 9-1.99, 10-2.01, 11-2.22

21 IO

OUTPUT CONTROL VARIABLES

IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

IT

HYDROGRAPH TIME DATA

NMIN 5 MINUTES IN COMPUTATION INTERVAL
IDATE 1 0 STARTING DATE
ITIME 0000 STARTING TIME
NQ 300 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 2 0 ENDING DATE
NDTIME 0055 ENDING TIME
ICENT 19 CENTURY MARK

COMPUTATION INTERVAL .08 HOURS

TOTAL TIME BASE 24.92 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

JP

MULTI-PLAN OPTION

NPLAN 1 NUMBER OF PLANS

JR

MULTI-RATIO OPTION

RATIOS OF PRECIPITATION

1.00 .99 .98 .97 .97 .97 .93 .93 .93

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT
 LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
 NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW

```

24      FUT26
      V
      V
37      RCCFUT26
      .
      .
43      .-----> DIVCUL2
40      DCFUT26
      .
      .
46      .      FUT14A
      .
      .
51      CFUT14A.....
      V
      V
54      RCFUT14A
      .
      .
57      .      FUT20A
      .
      .
62      CFUT20A.....
      V
      V
65      RDCFUT20
      .
      .
68      .      FUT20B
      .
      .
73      CFUT20B.....
      .
      .
81      .-----> DIVCUL5
77      DCFUT20B
      V
      V
84      RDCFUT20
      .
      .
87      .      FUT19
      .
      .
92      .      .      FUT18
      .      .      V
      .      .      V
97      .      .      RCFUT18
      .      .      .
      .      .      .
100     CRCFUT18.....
      .
      .
108     .-----> DIVCUL6
104     DCRCFUT1
      V
      V
111     RDCRCFUT
      .
      .
114     .      FUT24B
      .
      .
119     CFUT24B.....
      .
      .
126     .-----> DIVLAT1
123     DLAT1
      .
      .
132     .-----> DIVLAT2
129     DLAT2
      V
      V
135     RDCFUT24
      .
      .
138     .      FUT24A
      .      V
      .      V
143     .      RFUT24A
      .      .
      .      .
146     .      .      FUT17
      .      .      .
      .      .      .
151     CFUT17.....
      .
      .
159     .-----> DIVCUL8
155     DCFUT17
      V
      V
  
```



```

162 RDCFUT17
165 .
171 . ON1
175 . ON4A
180 . C1.....
178 . D1-----> DIV1
183 . ON5
187 . C2.....
192 . D1A-----> DIV1A
190 .
195 . ON4B
201 . RET1.<----- DIV1
199 .
202 . ON6
206 . C3.....
211 . D1B-----> DIV1B
209 .
214 . ON2
218 . ON3
222 . ON9
226 . C4.....
231 . D2-----> DIV2
229 .
234 . ON10
238 . C5.....
243 . D3-----> DIV3
241 .
246 . ON11
250 . C6.....
255 . D1C-----> DIV1C
253 .
258 . CD1C.....
262 . V
RCD1C
267 . D1C-----> DIVFUT23
265 . DRCD1C
270 . ON8
276 . RET2.<----- DIV2
274 .
277 . C7.....
282 . <----- DIV3

```

280	.	.	.	RET3	.
283	.	.	.	ON7	.
287	.	.	C8	.....	.
292	.	.	.	.	.
290	.	.	RET1A	.	< DIV1A
295	.	.	.	.	.
293	.	.	RET1B	.	< DIV1B
298	.	.	.	.	.
296	.	.	.	RET1C	< DIV1C
299	.	.	C9	.....	.
302	.	.	.	ON2D	.
309	.	.	.	ON5D	.
314	.	.	CP1	.....	.
317	.	.	.	ON3D	.
322	.	.	CP2	.....	.
325	.	.	.	ON1D	.
330	.	.	.	ON4D	.
335	.	.	CP3	.....	.
338	.	.	CP4	.....	.
341	.	.	.	FUT28	.
346	.	.	.	V	.
	.	.	.	V	.
	.	.	.	RFUT28	.
349	.	.	.	.	FUT15
354	.	.	.	CFUT15	.....
	.	.	.	V	.
357	.	.	.	V	.
	.	.	.	RFUT15	.
360	.	.	.	.	FUT16
365	.	.	.	.	FUT21A
370	.	.	.	CFUT21A	.....
	.	.	.	V	.
373	.	.	.	V	.
	.	.	.	RCFUT21A	.
377	.	.	CCP4	.....	.
	.	.	.	V	.
382	.	.	.	V	.
	.	.	.	RCCP4	.
385	.	.	.	FUT21B	.
390	.	.	CFUT21B	.....	.
	.	.	.	V	.
	.	.	.	V	.
394	.	.	.	RDCFUT21	.
399	.	.	.	< DIVFUT23	.
397	.	.	RETFUT23	.	.
400	.	.	.	FUT23	.

```

405 CFUT23.....
.
.
411 .----->DIVCUL10
408 DCFUT23
.
V
V
414 RDCFUT23
.
.
417 . FUT22
.
.
422 CFUT22.....
.
.
428 .----->DIVCUL11
425 DCFUT22
.
.
433 .<----- DIVCUL5
431 . RET5
.
V
V
434 . RRET5
.
.
442 .<----- DIVCUL6
440 . RET6
.
.
443 . CRET6.....
.
.
448 .<----- DIVLAT1
446 . RTLAT1
.
.
449 . CRTLAT1.....
.
V
V
452 . RCRTLAT1
.
.
460 .<----- DIVLAT2
458 . RTLAT2
.
.
461 . CRTLAT2.....
.
V
V
464 . RCRTLAT2
.
.
472 .<----- DIVCUL8
470 . RET8
.
.
473 . CRET8.....
.
V
V
476 . RCRET8
.
.
484 .<-----DIVCUL10
482 . RET10
.
.
485 . CRRET10.....
.
V
V
488 . RCRET10
.
.
496 .<-----DIVCUL11
494 . RET11
.
.
497 . CRET11.....
.
V
V
500 . RCRET11

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION


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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* SEPTEMBER 1990
* VERSION 4.0
*
* RUN DATE 02/13/2004 TIME 15:26:46
*
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* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****

```

HORSE DRIVE INTERCHANGE AND US 95
DATE: 01/20/2004
HEC1 FILE: HORSEFUT.DAT

***** . FUTURE DESIGN CONDITION MODEL *****
ASSUMES ALL FLOW FROM WEST OF FUTURE OUTER BELTWAY IS DIVERTED
NORTHWARD AROUND THIS AREA OF INTEREST
ASSUMES ULTIMATE DEVELOPEMENT

MODEL BASED ON HEC1 FILE: HORSE9.DAT (DESIGN MODEL) FROM THE OCTOBER
2003 DRAINAGE REPORT
MODEL BASED ON HEC1 FILE: EXN37F.DAT (100 YEAR WITHOUT FLOWSPLIT) FROM
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JR CARD RATIOS REPRESENT DEPTH-AREA REDUCTION FACTORS (DARF'S)

100-YEAR, 6-HOUR STORM, SDN3
DARF RATIOS
AREAS OF 0, 4-0.28, 5-0.39, 6-0.81, 7-0.83, 8-1.10, 9-1.99, 10-2.01, 11-2.22

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

IT HYDROGRAPH TIME DATA
NMIN 5 MINUTES IN COMPUTATION INTERVAL
IDATE 1 0 STARTING DATE
ITIME 0000 STARTING TIME
NQ 300 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 2 0 ENDING DATE
NDTIME 0055 ENDING TIME
ICENT 19 CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 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

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.00 .99 .98 .97 .97 .97 .93 .93 .93

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
 TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION								
					RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
					1.00	.99	.98	.97	.97	.97	.93	.93	.93
HYDROGRAPH AT													
+	FUT26	.03	1	FLOW	46.	45.	45.	45.	45.	44.	42.	42.	42.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
ROUTED TO													
+	RCCFUT26	.03	1	FLOW	43.	40.	41.	41.	41.	42.	41.	41.	39.
				TIME	4.08	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17
DIVERSION TO													
+	DIVCUL2	.03	1	FLOW	42.	39.	40.	41.	40.	41.	40.	40.	38.
				TIME	4.08	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT													
+	DCFUT26	.03	1	FLOW	1.	1.	1.	1.	1.	1.	1.	1.	1.
				TIME	4.08	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT													
+	FUT14A	.07	1	FLOW	109.	107.	107.	105.	105.	104.	99.	99.	99.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CFUT14A	.10	1	FLOW	109.	107.	107.	105.	105.	104.	99.	99.	99.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO													
+	RCFUT14A	.10	1	FLOW	106.	104.	104.	102.	101.	100.	95.	95.	94.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	FUT20A	.19	1	FLOW	224.	220.	219.	216.	215.	213.	202.	202.	202.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT													
+	CFUT20A	.28	1	FLOW	330.	325.	322.	318.	317.	314.	297.	297.	296.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO													
+	RDCFUT20	.28	1	FLOW	323.	318.	315.	311.	310.	307.	291.	291.	290.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	FUT20B	.11	1	FLOW	132.	130.	129.	127.	127.	126.	119.	119.	119.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT													
+	CFUT20B	.39	1	FLOW	454.	447.	444.	438.	437.	432.	410.	410.	408.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
DIVERSION TO													
+	DIVCUL5	.39	1	FLOW	454.	447.	444.	438.	437.	432.	410.	410.	408.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	DCFUT20B	.39	1	FLOW	0.	0.	0.	0.	0.	0.	0.	0.	0.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO													
+	RDCFUT20	.39	1	FLOW	0.	0.	0.	0.	0.	0.	0.	0.	0.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT													
+	FUT19	.19	1	FLOW	216.	213.	212.	209.	208.	206.	196.	196.	195.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT													
+	FUT18	.23	1	FLOW	275.	271.	269.	265.	265.	262.	249.	249.	248.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO													
+	RCFUT18	.23	1	FLOW	271.	267.	265.	261.	261.	258.	245.	245.	244.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT													
+	CRCFUT18	.81	1	FLOW	486.	479.	476.	469.	469.	464.	441.	441.	440.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
DIVERSION TO													
+	DIVCUL6	.81	1	FLOW	486.	479.	476.	469.	469.	464.	441.	441.	440.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT													
+	DCRCFUT1	.81	1	FLOW	0.	0.	0.	0.	0.	0.	0.	0.	0.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO													
+	RDCRCFUT	.81	1	FLOW	0.	0.	0.	0.	0.	0.	0.	0.	0.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00

Culvert 4

Culvert 5

Culvert 6

HYDROGRAPH AT +	FUT24B	.05	1	FLOW TIME	74. 3.58	72. 3.58	72. 3.58	71. 3.58	71. 3.58	70. 3.58	66. 3.58	66. 3.58	66. 3.58
2 COMBINED AT +	CFUT24B	.86	1	FLOW TIME	74. 3.58	72. 3.58	72. 3.58	71. 3.58	71. 3.58	70. 3.58	66. 3.58	66. 3.58	66. 3.58
DIVERSION TO +	DIVLAT1	.86	1	FLOW TIME	5. 3.58	5. 3.58	5. 3.58	5. 3.58	5. 3.58	5. 3.58	4. 3.58	4. 3.58	4. 3.58
HYDROGRAPH AT +	DLAT1	.86	1	FLOW TIME	69. 3.58	68. 3.58	67. 3.58	66. 3.58	66. 3.58	65. 3.58	62. 3.58	62. 3.58	62. 3.58
DIVERSION TO +	DIVLAT2	.86	1	FLOW TIME	5. 3.58	5. 3.58	5. 3.58	4. 3.58	4. 3.58	4. 3.58	4. 3.58	4. 3.58	4. 3.58
HYDROGRAPH AT +	DLAT2	.86	1	FLOW TIME	64. 3.58	63. 3.58	63. 3.58	62. 3.58	62. 3.58	61. 3.58	58. 3.58	58. 3.58	57. 3.58
ROUTED TO +	RDCFUT24	.86	1	FLOW TIME	63. 3.58	61. 3.58	61. 3.58	60. 3.58	60. 3.58	59. 3.58	56. 3.58	56. 3.58	56. 3.58
HYDROGRAPH AT +	FUT24A	.03	1	FLOW TIME	48. 3.58	47. 3.58	47. 3.58	46. 3.58	46. 3.58	45. 3.58	43. 3.58	43. 3.58	43. 3.58
ROUTED TO +	RFUT24A	.03	1	FLOW TIME	45. 3.58	44. 3.58	44. 3.58	43. 3.58	43. 3.58	43. 3.58	41. 3.58	41. 3.58	41. 3.58
HYDROGRAPH AT +	FUT17	.21	1	FLOW TIME	213. 3.75	210. 3.75	208. 3.75	205. 3.75	205. 3.75	203. 3.75	192. 3.75	192. 3.75	191. 3.75
3 COMBINED AT +	CFUT17	1.10	1	FLOW TIME	304. 3.67	300. 3.67	298. 3.67	293. 3.67	293. 3.67	290. 3.67	274. 3.67	274. 3.67	273. 3.67
DIVERSION TO +	DIVCUL8	1.10	1	FLOW TIME	304. 3.67	300. 3.67	298. 3.67	293. 3.67	293. 3.67	290. 3.67	274. 3.67	274. 3.67	273. 3.67
HYDROGRAPH AT +	DCFUT17	1.10	1	FLOW TIME	0. 3.67	0. 3.67	0. 3.67	0. 3.67	0. 3.67	0. 3.67	0. 3.67	0. 3.67	0. 3.67
ROUTED TO +	RDCFUT17	1.10	1	FLOW TIME	0. 3.92	0. 3.92	0. 3.92	0. 3.92	0. 3.92	0. 3.92	0. 3.92	0. 3.92	0. 3.92
HYDROGRAPH AT +	ON1	.00	1	FLOW TIME	8. 3.50	8. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50
HYDROGRAPH AT +	ON4A	.00	1	FLOW TIME	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50
2 COMBINED AT +	C1	.01	1	FLOW TIME	16. 3.50	16. 3.50	16. 3.50	16. 3.50	15. 3.50	15. 3.50	15. 3.50	15. 3.50	15. 3.50
DIVERSION TO +	DIV1	.01	1	FLOW TIME	13. 3.50	13. 3.50	13. 3.50	13. 3.50	13. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50
HYDROGRAPH AT +	D1	.01	1	FLOW TIME	3. 3.50	3. 3.50	3. 3.50	3. 3.50	3. 3.50	3. 3.50	3. 3.50	3. 3.50	3. 3.50
HYDROGRAPH AT +	ON5	.01	1	FLOW TIME	10. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50
2 COMBINED AT +	C2	.01	1	FLOW TIME	13. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50	11. 3.50
DIVERSION TO +	DIV1A	.01	1	FLOW TIME	13. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50	11. 3.50
HYDROGRAPH AT +	D1A	.01	1	FLOW TIME	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08
HYDROGRAPH AT +	ON4B	.00	1	FLOW TIME	6. 3.50	6. 3.50	6. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50
HYDROGRAPH AT +	RET1	.00	1	FLOW TIME	13. 3.50	13. 3.50	13. 3.50	13. 3.50	13. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50

Laterals 1 & 2

Culvert 8

HYDROGRAPH AT +	ON6	.00	1	FLOW TIME	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50
2 COMBINED AT +	C3	.00	1	FLOW TIME	20. 3.50	20. 3.50	20. 3.50	20. 3.50	20. 3.50	20. 3.50	19. 3.50	19. 3.50	19. 3.50
DIVERSION TO +	DIV1B	.00	1	FLOW TIME	20. 3.50	20. 3.50	20. 3.50	20. 3.50	20. 3.50	20. 3.50	19. 3.50	19. 3.50	19. 3.50
HYDROGRAPH AT +	D1B	.00	1	FLOW TIME	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08
HYDROGRAPH AT +	ON2	.00	1	FLOW TIME	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50	8. 3.50	8. 3.50	8. 3.50
HYDROGRAPH AT +	ON3	.01	1	FLOW TIME	12. 3.50	12. 3.50	12. 3.50	11. 3.50	11. 3.50	11. 3.50	11. 3.50	11. 3.50	11. 3.50
HYDROGRAPH AT +	ON9	.00	1	FLOW TIME	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	7. 3.50	7. 3.50	7. 3.50
3 COMBINED AT +	C4	.02	1	FLOW TIME	29. 3.50	29. 3.50	28. 3.50	28. 3.50	28. 3.50	28. 3.50	26. 3.50	26. 3.50	26. 3.50
DIVERSION TO +	DIV2	.02	1	FLOW TIME	24. 3.50	24. 3.50	23. 3.50	23. 3.50	23. 3.50	23. 3.50	22. 3.50	22. 3.50	22. 3.50
HYDROGRAPH AT +	D2	.02	1	FLOW TIME	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50
HYDROGRAPH AT +	ON10	.00	1	FLOW TIME	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	4. 3.50	4. 3.50	4. 3.50
2 COMBINED AT +	C5	.02	1	FLOW TIME	10. 3.50	10. 3.50	10. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50
DIVERSION TO +	DIV3	.02	1	FLOW TIME	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	7. 3.50	7. 3.50	7. 3.50
HYDROGRAPH AT +	D3	.02	1	FLOW TIME	2. 3.50	2. 3.50	2. 3.50	2. 3.50	2. 3.50	2. 3.50	2. 3.50	2. 3.50	2. 3.50
HYDROGRAPH AT +	ON11	.00	1	FLOW TIME	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	4. 3.50	4. 3.50	4. 3.50
2 COMBINED AT +	C6	.02	1	FLOW TIME	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	6. 3.50	6. 3.50	6. 3.50
DIVERSION TO +	DIV1C	.02	1	FLOW TIME	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	6. 3.50	6. 3.50	6. 3.50
HYDROGRAPH AT +	D1C	.02	1	FLOW TIME	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08
4 COMBINED AT +	CD1C	.04	1	FLOW TIME	6. 3.50	6. 3.50	6. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50
ROUTED TO +	RCD1C	.04	1	FLOW TIME	5. 3.67	5. 3.75	5. 3.75	5. 3.67	5. 3.67	5. 3.67	5. 3.75	5. 3.75	5. 3.75
DIVERSION TO +	DIVFUT23	.04	1	FLOW TIME	5. 3.67	5. 3.75	5. 3.75	5. 3.67	5. 3.67	5. 3.67	5. 3.75	5. 3.75	5. 3.75
HYDROGRAPH AT +	DRCD1C	.04	1	FLOW TIME	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08	0. .08
HYDROGRAPH AT +	ON8	.00	1	FLOW TIME	6. 3.50	6. 3.50	6. 3.50	6. 3.50	6. 3.50	6. 3.50	5. 3.50	5. 3.50	5. 3.50
HYDROGRAPH AT +	RET2	.00	1	FLOW TIME	24. 3.50	24. 3.50	23. 3.50	23. 3.50	23. 3.50	23. 3.50	22. 3.50	22. 3.50	22. 3.50
2 COMBINED AT +	C7	.00	1	FLOW TIME	30. 3.50	29. 3.50	29. 3.50	29. 3.50	29. 3.50	29. 3.50	27. 3.50	27. 3.50	27. 3.50

HYDROGRAPH AT +	RET3	.00	1	FLOW TIME	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	7. 3.50	7. 3.50	7. 3.50
HYDROGRAPH AT +	ON7	.01	1	FLOW TIME	14. 3.50	14. 3.50	13. 3.50	13. 3.50	13. 3.50	13. 3.50	12. 3.50	12. 3.50	12. 3.50
3 COMBINED AT +	C8	.01	1	FLOW TIME	51. 3.50	51. 3.50	50. 3.50	50. 3.50	50. 3.50	49. 3.50	47. 3.50	47. 3.50	47. 3.50
HYDROGRAPH AT +	RET1A	.00	1	FLOW TIME	13. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50	12. 3.50	11. 3.50
HYDROGRAPH AT +	RET1B	.00	1	FLOW TIME	20. 3.50	20. 3.50	20. 3.50	20. 3.50	20. 3.50	20. 3.50	19. 3.50	19. 3.50	19. 3.50
HYDROGRAPH AT +	RET1C	.00	1	FLOW TIME	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	6. 3.50	6. 3.50	6. 3.50
4 COMBINED AT +	C9	.01	1	FLOW TIME	91. 3.50	90. 3.50	89. 3.50	88. 3.50	88. 3.50	87. 3.50	83. 3.50	83. 3.50	83. 3.50
HYDROGRAPH AT +	ON2D	.01	1	FLOW TIME	21. 3.50	21. 3.50	21. 3.50	20. 3.50	20. 3.50	20. 3.50	19. 3.50	19. 3.50	19. 3.50
HYDROGRAPH AT +	ON5D	.00	1	FLOW TIME	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50
2 COMBINED AT +	CP1	.01	1	FLOW TIME	29. 3.50	29. 3.50	29. 3.50	28. 3.50	28. 3.50	28. 3.50	27. 3.50	27. 3.50	27. 3.50
HYDROGRAPH AT +	ON3D	.00	1	FLOW TIME	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50
2 COMBINED AT +	CP2	.02	1	FLOW TIME	37. 3.50	36. 3.50	36. 3.50	36. 3.50	36. 3.50	35. 3.50	34. 3.50	34. 3.50	34. 3.50
HYDROGRAPH AT +	ON1D	.01	1	FLOW TIME	16. 3.50	16. 3.50	15. 3.50	15. 3.50	15. 3.50	15. 3.50	15. 3.50	15. 3.50	14. 3.50
HYDROGRAPH AT +	ON4D	.00	1	FLOW TIME	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	8. 3.50	7. 3.50
2 COMBINED AT +	CP3	.01	1	FLOW TIME	24. 3.50	24. 3.50	23. 3.50	23. 3.50	23. 3.50	23. 3.50	22. 3.50	22. 3.50	22. 3.50
2 COMBINED AT +	CP4	.03	1	FLOW TIME	61. 3.50	60. 3.50	60. 3.50	59. 3.50	59. 3.50	58. 3.50	56. 3.50	56. 3.50	56. 3.50
HYDROGRAPH AT +	FUT28	.30	1	FLOW TIME	324. 3.75	318. 3.75	316. 3.75	311. 3.75	311. 3.75	307. 3.75	290. 3.75	290. 3.75	289. 3.75
ROUTED TO +	RFUT28	.30	1	FLOW TIME	323. 3.75	318. 3.75	315. 3.75	311. 3.75	310. 3.75	307. 3.75	290. 3.75	290. 3.75	289. 3.75
HYDROGRAPH AT +	FUT15	.24	1	FLOW TIME	280. 3.67	276. 3.67	274. 3.67	270. 3.67	270. 3.67	267. 3.67	253. 3.67	253. 3.67	253. 3.67
2 COMBINED AT +	CFUT15	.54	1	FLOW TIME	602. 3.75	592. 3.75	588. 3.75	580. 3.75	579. 3.75	573. 3.75	543. 3.75	543. 3.75	541. 3.75
ROUTED TO +	RFUT15	.54	1	FLOW TIME	601. 3.75	592. 3.75	587. 3.75	579. 3.75	578. 3.75	572. 3.75	542. 3.75	542. 3.75	540. 3.75
HYDROGRAPH AT +	FUT16	.21	1	FLOW TIME	256. 3.67	252. 3.67	251. 3.67	247. 3.67	247. 3.67	245. 3.67	233. 3.67	233. 3.67	232. 3.67
HYDROGRAPH AT +	FUT21A	.02	1	FLOW TIME	35. 3.50	34. 3.50	34. 3.50	34. 3.50	34. 3.50	33. 3.50	32. 3.50	32. 3.50	32. 3.50
3 COMBINED AT +	CFUT21A	.77	1	FLOW TIME	871. 3.75	858. 3.75	852. 3.75	840. 3.75	839. 3.75	830. 3.75	787. 3.75	787. 3.75	785. 3.75
ROUTED TO +	RCFUT21A	.77	1	FLOW TIME	870. 3.75	857. 3.75	851. 3.75	839. 3.75	838. 3.75	830. 3.75	787. 3.75	787. 3.75	785. 3.75

4 COMBINED AT	CCP4	.86	1	FLOW TIME	935. 3.67	921. 3.67	914. 3.67	902. 3.67	900. 3.67	891. 3.67	845. 3.75	845. 3.75	842. 3.75
ROUTED TO	RCCP4	.86	1	FLOW TIME	933. 3.75	920. 3.75	913. 3.75	901. 3.75	899. 3.75	890. 3.75	845. 3.75	845. 3.75	842. 3.75
HYDROGRAPH AT	FUT21B	.03	1	FLOW TIME	54. 3.50	53. 3.50	53. 3.50	52. 3.50	52. 3.50	52. 3.50	50. 3.50	50. 3.50	50. 3.50
3 COMBINED AT	CFUT21B	1.99	1	FLOW TIME	954. 3.75	940. 3.75	933. 3.75	921. 3.75	919. 3.75	910. 3.75	864. 3.75	864. 3.75	861. 3.75
ROUTED TO	RDCFUT21	1.99	1	FLOW TIME	954. 3.75	940. 3.75	933. 3.75	920. 3.75	919. 3.75	910. 3.75	863. 3.75	863. 3.75	861. 3.75
HYDROGRAPH AT	RETUT23	.00	1	FLOW TIME	5. 3.67	5. 3.75	5. 3.75	5. 3.67	5. 3.67	5. 3.67	5. 3.75	5. 3.75	5. 3.75
HYDROGRAPH AT	FUT23	.02	1	FLOW TIME	47. 3.50	47. 3.50	47. 3.50	46. 3.50	46. 3.50	46. 3.50	44. 3.50	44. 3.50	44. 3.50
3 COMBINED AT	CFUT23	2.01	1	FLOW TIME	979. 3.75	965. 3.75	958. 3.75	945. 3.75	943. 3.75	934. 3.75	887. 3.75	887. 3.75	884. 3.75
DIVERSION TO	DIVCUL10	2.01	1	FLOW TIME	769. 3.75	765. 3.75	763. 3.75	759. 3.75	758. 3.75	756. 3.75	741. 3.75	741. 3.75	741. 3.75
HYDROGRAPH AT	DCFUT23	2.01	1	FLOW TIME	210. 3.75	200. 3.75	195. 3.75	186. 3.75	185. 3.75	179. 3.75	145. 3.75	145. 3.75	144. 3.75
ROUTED TO	RDCFUT23	2.01	1	FLOW TIME	210. 3.75	200. 3.75	195. 3.75	186. 3.75	185. 3.75	178. 3.75	145. 3.75	145. 3.75	143. 3.75
HYDROGRAPH AT	FUT22	.21	1	FLOW TIME	261. 3.67	257. 3.67	255. 3.67	251. 3.67	251. 3.67	248. 3.67	236. 3.67	236. 3.67	235. 3.67
2 COMBINED AT	CFUT22	2.22	1	FLOW TIME	459. 3.67	445. 3.67	438. 3.67	425. 3.67	424. 3.67	415. 3.67	367. 3.67	367. 3.67	365. 3.67
DIVERSION TO	DIVCUL11	2.22	1	FLOW TIME	459. 3.67	444. 3.67	438. 3.67	425. 3.67	424. 3.67	415. 3.67	367. 3.67	367. 3.67	365. 3.67
HYDROGRAPH AT	DCFUT22	2.22	1	FLOW TIME	0. 3.42	0. 3.42	0. 3.42	0. 3.42	0. 3.42	0. 3.42	0. 3.42	0. 3.42	0. 3.42
HYDROGRAPH AT	RET5	.00	1	FLOW TIME	454. 3.67	447. 3.67	444. 3.67	438. 3.67	437. 3.67	432. 3.67	410. 3.67	410. 3.67	408. 3.67
ROUTED TO	RRET5	.00	1	FLOW TIME	452. 3.67	445. 3.67	442. 3.67	436. 3.67	435. 3.67	430. 3.67	408. 3.67	408. 3.67	406. 3.67
HYDROGRAPH AT	RET6	.00	1	FLOW TIME	486. 3.75	479. 3.75	476. 3.75	469. 3.75	469. 3.75	464. 3.75	441. 3.75	441. 3.75	440. 3.75
2 COMBINED AT	CRET6	.00	1	FLOW TIME	935. 3.67	921. 3.67	914. 3.67	902. 3.67	900. 3.67	891. 3.67	844. 3.67	844. 3.67	842. 3.67
HYDROGRAPH AT	RTLAT1	.00	1	FLOW TIME	5. 3.58	5. 3.58	5. 3.58	5. 3.58	5. 3.58	5. 3.58	4. 3.58	4. 3.58	4. 3.58
2 COMBINED AT	CRTLAT1	.00	1	FLOW TIME	939. 3.67	925. 3.67	919. 3.67	906. 3.67	904. 3.67	895. 3.67	848. 3.67	848. 3.67	846. 3.67
ROUTED TO	RCRTLAT1	.00	1	FLOW TIME	937. 3.67	923. 3.67	916. 3.67	903. 3.67	902. 3.67	893. 3.67	845. 3.67	845. 3.67	843. 3.67
HYDROGRAPH AT	RTLAT2	.00	1	FLOW TIME	5. 3.58	5. 3.58	5. 3.58	4. 3.58	4. 3.58	4. 3.58	4. 3.58	4. 3.58	4. 3.58
2 COMBINED AT	CRTLAT2	.00	1	FLOW TIME	941. 3.67	927. 3.67	920. 3.67	907. 3.67	906. 3.67	896. 3.67	849. 3.67	849. 3.67	847. 3.67
ROUTED TO	RCRTLAT2	.00	1	FLOW TIME	931. 3.67	917. 3.67	910. 3.67	898. 3.67	896. 3.67	887. 3.67	840. 3.67	840. 3.67	837. 3.67

Culvert 9

Culvert 10

Culvert 11

Culvert 5

Culvert 6

Laterals 1 & 2

HYDROGRAPH AT	RET8	.00	1	FLOW TIME	304. 3.67	300. 3.67	298. 3.67	293. 3.67	293. 3.67	Culvert 8	290. 3.67	274. 3.67	274. 3.67	273. 3.67
2 COMBINED AT	CRET8	.00	1	FLOW TIME	1236. 3.67	1217. 3.67	1208. 3.67	1191. 3.67	1189. 3.67		1176. 3.67	1114. 3.67	1114. 3.67	1110. 3.67
ROUTED TO	RCRET8	.00	1	FLOW TIME	1224. 3.67	1204. 3.67	1195. 3.67	1179. 3.67	1176. 3.67		1164. 3.67	1102. 3.67	1102. 3.67	1098. 3.67
HYDROGRAPH AT	RET10	.00	1	FLOW TIME	769. 3.75	765. 3.75	763. 3.75	759. 3.75	758. 3.75		756. 3.75	741. 3.75	Culvert 10	741. 3.75
2 COMBINED AT	CRRET10	.00	1	FLOW TIME	1992. 3.67	1968. 3.67	1957. 3.67	1937. 3.67	1934. 3.67		1919. 3.67	1842. 3.67		1838. 3.67
ROUTED TO	RCRET10	.00	1	FLOW TIME	1985. 3.67	1961. 3.75	1950. 3.75	1930. 3.75	1928. 3.75		1913. 3.75	1840. 3.75	1840. 3.75	1835. 3.75
HYDROGRAPH AT	RET11	.00	1	FLOW TIME	459. 3.67	444. 3.67	438. 3.67	425. 3.67	424. 3.67		415. 3.67	367. 3.67	Culvert 11	365. 3.67
2 COMBINED AT	CRET11	.00	1	FLOW TIME	2444. 3.67	2405. 3.67	2387. 3.67	2355. 3.67	2351. 3.67		2326. 3.67	2201. 3.67		2194. 3.67
ROUTED TO	RCRET11	.00	1	FLOW TIME	2432. 3.75	2395. 3.75	2379. 3.75	2346. 3.75	2343. 3.75		2320. 3.75	2200. 3.75	2200. 3.75	2193. 3.75

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

APPENDIX B

HYDRAULIC CALCULATIONS

B-1

FUTURE INLET ANALYSIS

INLET 5 @ CULVERT 5

CURRENT DATE: 01-22-2004
CURRENT TIME: 09:54:50

FILE DATE: 01-22-2004
FILE NAME: HORSE-5F

[illegible]

SITE DATA			CULVERT SHAPE, MATERIAL, INLET					
U	INLET	OUTLET	CULVERT	BARRELS	SPAN	RISE	MANNING	INLET
V	ELEV.	ELEV.	LENGTH	SHAPE	SPAN	RISE	MANNING	INLET
NO.	(ft)	(ft)	(ft)	MATERIAL	(ft)	(ft)	n	TYPE
1	2744.25	2731.55	142.57	1 RCB	14.00	4.00	.015	CONVENTIONAL
2								
3								
4								
5								
6								

ÀÁÂÃÄÅÆÇÈÉÊËÌÍÎÏÐÑÒÓÔÕÖ×ØÙÚÛÜÝÞßàáâãäåæçèéêëìíîïðñòóôõö÷øùúûüýþÿ

SUMMARY OF CULVERT FLOWS (cfs) FILE: HORSE-5F DATE: 01-22-2004

[illegible][illegible]

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: HORSE-5F DATE: 01-22-2004

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
0.00	0.000	100.00	0.00	0.00
2746.67	0.000	150.00	0.00	0.00
2747.21	0.000	200.00	0.00	0.00
2747.71	0.000	250.00	0.00	0.00
2748.19	0.000	300.00	0.00	0.00
2748.69	0.000	350.00	0.00	0.00
2749.22	0.000	400.00	0.00	0.00
2749.71	0.000	444.00	0.00	0.00
2750.40	0.000	500.00	0.00	0.00
2751.07	0.000	550.00	0.00	0.00
2751.81	0.000	600.00	0.00	0.00

<1> TOLERANCE (ft) = 0.010
 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 01-22-2004

FILE DATE: 01-22-2004

CURRENT TIME: 09:54:50

FILE NAME: HORSE-5F

PERFORMANCE CURVE FOR CULVERT 1 - 1(14.00 (ft) BY 4.00 (ft)) RCB

DIS- HEAD- INLET OUTLET
 CHARGE WATER CONTROL CONTROL FLOW NORMAL CRIT. OUTLET TW OUTLET TW
 FLOW ELEV. DEPTH DEPTH TYPE DEPTH DEPTH DEPTH DEPTH DEPTH VEL. VEL.
 (cfs) (ft) (ft) (ft) <F4> (ft) (ft) (ft) (ft) (ft) (fps) (fps)

DIS-CHARGE FLOW (cfs)	HEAD-ELEV. (ft)	INLET-DEPTH (ft)	OUTLET-DEPTH (ft)	INLET-CONTROL TYPE	OUTLET-CONTROL DEPTH (ft)	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
100.00	2746.08	1.83	-10.02	1-S2n	0.43	1.17	0.37	0.48	19.39	7.31	
150.00	2746.67	2.42	-9.71	1-S2n	0.54	1.53	0.57	0.62	18.93	8.57	
200.00	2747.21	2.96	-9.37	1-S2n	0.65	1.85	0.68	0.74	20.87	9.58	
250.00	2747.71	3.46	-9.00	1-S2n	0.76	2.15	0.80	0.85	22.32	10.45	
300.00	2748.19	3.94	-8.59	1-S2n	0.86	2.43	0.91	0.95	23.54	11.21	
350.00	2748.69	4.44	-8.13	1-S2n	0.94	2.69	1.02	1.04	24.43	11.89	
400.00	2749.22	4.97	-7.63	1-S2n	1.02	2.94	1.12	1.13	25.42	12.51	
444.00	2749.71	5.46	-7.15	1-S2n	1.10	3.16	1.22	1.21	26.08	13.02	
500.00	2750.40	6.15	-6.50	1-S2n	1.19	3.42	1.34	1.30	26.73	13.62	
550.00	2751.07	6.82	-5.86	1-S2n	1.26	3.64	1.44	1.38	27.28	14.12	
600.00	2751.81	7.56	-5.18	1-S2n	1.33	3.86	1.55	1.46	27.69	14.59	

El. inlet face invert 2744.25 ft El. outlet invert 2731.55 ft

El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT *****

INLET STATION	0.00 ft
INLET ELEVATION	2744.25 ft
OUTLET STATION	142.00 ft
OUTLET ELEVATION	2731.55 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0894
CULVERT LENGTH ALONG SLOPE	142.57 ft

***** CULVERT DATA SUMMARY *****

BARREL SHAPE	BOX
BARREL SPAN	14.00 ft
BARREL RISE	4.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.015
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (90-45 DEG.)
INLET DEPRESSION	NONE

[illegible]

INLET 6 @ CULVERT 6

CURRENT DATE: 02-04-2004
CURRENT TIME: 16:52:21

FILE DATE: 02-04-2004
FILE NAME: HORSE-6F

[illegible]

SUMMARY OF CULVERT FLOWS (cfs) FILE: HORSE-6F DATE: 02-04-2004

[illegible]

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: HORSE-6F DATE: 02-04-2004

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
0.00	0.000	200.00	0.00	0.00
2736.52	0.000	230.00	0.00	0.00
2736.86	0.000	260.00	0.00	0.00
2737.21	0.000	290.00	0.00	0.00
2737.56	0.000	320.00	0.00	0.00
2737.94	0.000	350.00	0.00	0.00
2738.34	0.000	380.00	0.00	0.00
2738.76	0.000	410.00	0.00	0.00
2739.20	0.000	440.00	0.00	0.00
2739.67	0.000	469.00	0.00	0.00
2740.19	0.000	500.00	0.00	0.00

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000
 ~~~~~



| DIS-<br>CHARGE<br>FLOW<br>(cfs) | HEAD-<br>WATER<br>ELEV.<br>(ft) | INLET<br>CONTROL<br>DEPTH<br>(ft) | OUTLET<br>CONTROL<br>DEPTH<br>(ft) | FLOW<br>NORMAL<br>TYPE<br><F4> | CRIT.<br>OUTLET<br>DEPTH<br>(ft) | OUTLET<br>DEPTH<br>(ft) | TW<br>OUTLET<br>DEPTH<br>(ft) | OUTLET<br>VEL.<br>(fps) | TW<br>VEL.<br>(fps) |
|---------------------------------|---------------------------------|-----------------------------------|------------------------------------|--------------------------------|----------------------------------|-------------------------|-------------------------------|-------------------------|---------------------|
|---------------------------------|---------------------------------|-----------------------------------|------------------------------------|--------------------------------|----------------------------------|-------------------------|-------------------------------|-------------------------|---------------------|

|        |         |      |      |       |      |      |      |      |       |      |
|--------|---------|------|------|-------|------|------|------|------|-------|------|
| 200.00 | 2736.17 | 3.17 | 3.17 | 1-S1f | 0.61 | 2.06 | 2.20 | 4.00 | 7.58  | 0.00 |
| 230.00 | 2736.52 | 3.52 | 3.52 | 1-S1f | 0.67 | 2.26 | 2.40 | 4.00 | 7.99  | 0.00 |
| 260.00 | 2736.86 | 3.86 | 3.86 | 1-S1f | 0.74 | 2.45 | 2.60 | 4.00 | 8.33  | 0.00 |
| 290.00 | 2737.21 | 4.21 | 4.21 | 1-S1f | 0.80 | 2.63 | 2.80 | 4.00 | 8.63  | 0.00 |
| 320.00 | 2737.57 | 4.57 | 4.57 | 1-S1f | 0.84 | 2.81 | 3.00 | 4.00 | 8.89  | 0.00 |
| 350.00 | 2737.94 | 4.94 | 4.94 | 1-S1f | 0.89 | 2.98 | 3.10 | 4.00 | 9.41  | 0.00 |
| 380.00 | 2738.34 | 5.34 | 5.34 | 1-S1f | 0.94 | 3.15 | 3.30 | 4.00 | 9.60  | 0.00 |
| 410.00 | 2738.76 | 5.76 | 5.76 | 1-S1f | 0.98 | 3.32 | 3.50 | 4.00 | 9.76  | 0.00 |
| 440.00 | 2739.20 | 6.20 | 6.20 | 1-S1f | 1.03 | 3.48 | 3.60 | 4.00 | 10.19 | 0.00 |
| 469.00 | 2739.66 | 6.66 | 6.66 | 1-S1f | 1.07 | 3.63 | 3.80 | 4.00 | 10.29 | 0.00 |
| 500.00 | 2740.19 | 7.19 | 7.19 | 1-S1f | 1.12 | 3.79 | 3.90 | 4.00 | 10.68 | 0.00 |

[illegible]

|                            |         |    |
|----------------------------|---------|----|
| INLET STATION              | 0.00    | ft |
| INLET ELEVATION            | 2733.00 | ft |
| OUTLET STATION             | 83.73   | ft |
| OUTLET ELEVATION           | 2720.55 | ft |
| NUMBER OF BARRELS          | 1       |    |
| SLOPE (V/H)                | 0.1487  |    |
| CULVERT LENGTH ALONG SLOPE | 84.65   | ft |

|                     |                          |
|---------------------|--------------------------|
| BARREL SHAPE        | BOX                      |
| BARREL SPAN         | 12.00 ft                 |
| BARREL RISE         | 4.00 ft                  |
| BARREL MATERIAL     | CONCRETE                 |
| BARREL MANNING'S n  | 0.015                    |
| INLET TYPE          | CONVENTIONAL             |
| INLET EDGE AND WALL | SQUARE EDGE (90-45 DEG.) |
| INLET DEPRESSION    | NONE                     |

[illegible]

FILE DATE: 02-04-2004  
FILE NAME: HORSE-6F

[illegible]

CONSTANT WATER SURFACE ELEVATION  
2724.55

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#####
##### ROADWAY OVERTOPPING DATA #####
#####

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|                                    |        |          |
|------------------------------------|--------|----------|
| ROADWAY SURFACE                    |        | PAVED    |
| EMBANKMENT TOP WIDTH               |        | 28.00 ft |
| ***** USER DEFINED ROADWAY PROFILE |        |          |
| CROSS-SECTION                      | X      | Y        |
| COORD. NO.                         | ft     | ft       |
| 1                                  | 0.00   | 2741.08  |
| 2                                  | 0.00   | 2743.00  |
| 3                                  | 82.00  | 2742.00  |
| 4                                  | 153.00 | 2741.10  |

[illegible]

**INLET 8 @ CULVERT 8**



SUMMARY OF CULVERT FLOWS (cfs)                      FILE: HORSE-8F                      DATE: 02-09-2004

[illegible]

SUMMARY OF ITERATIVE SOLUTION ERRORS      FILE: HORSE-8F      DATE: 02-09-2004

[illegible][illegible]

CURRENT DATE: 02-09-2004

FILE DATE: 02-09-2004

CURRENT TIME: 12:38:21

FILE NAME: HORSE-8F

PERFORMANCE CURVE FOR CULVERT 1 - 1( 8.00 (ft) BY 6.00 (ft)) RCB

DIS- HEAD- INLET OUTLET  
 CHARGE WATER CONTROL CONTROL FLOW NORMAL CRIT. OUTLET TW OUTLET TW  
 FLOW ELEV. DEPTH DEPTH TYPE DEPTH DEPTH DEPTH DEPTH DEPTH VEL. VEL.  
 (cfs) (ft) (ft) (ft) <F4> (ft) (ft) (ft) (ft) (ft) (fps) (fps)

| DIS-CHARGE FLOW (cfs) | HEAD- WATER ELEV. (ft) | INLET CONTROL DEPTH (ft) | OUTLET CONTROL DEPTH (ft) | FLOW TYPE | NORMAL DEPTH (ft) | CRIT. DEPTH (ft) | OUTLET DEPTH (ft) | TW DEPTH (ft) | OUTLET VEL. (fps) | TW VEL. (fps) |
|-----------------------|------------------------|--------------------------|---------------------------|-----------|-------------------|------------------|-------------------|---------------|-------------------|---------------|
| 100.00                | 2695.53                | 2.73                     | 2.73                      | 1-S1f     | 0.69              | 1.70             | 1.80              | 6.00          | 6.94              | 0.00          |
| 130.00                | 2696.06                | 3.26                     | 3.26                      | 1-S1f     | 0.81              | 2.02             | 2.20              | 6.00          | 7.39              | 0.00          |
| 160.00                | 2696.55                | 3.75                     | 3.75                      | 1-S1f     | 0.93              | 2.32             | 2.50              | 6.00          | 8.00              | 0.00          |
| 190.00                | 2697.02                | 4.22                     | 4.22                      | 1-S1f     | 1.05              | 2.60             | 2.80              | 6.00          | 8.48              | 0.00          |
| 220.00                | 2697.46                | 4.66                     | 4.66                      | 1-S1f     | 1.17              | 2.87             | 3.00              | 6.00          | 9.17              | 0.00          |
| 250.00                | 2697.89                | 5.09                     | 5.09                      | 1-S1f     | 1.27              | 3.13             | 3.30              | 6.00          | 9.47              | 0.00          |
| 280.00                | 2698.31                | 5.51                     | 5.51                      | 1-S1f     | 1.37              | 3.37             | 3.50              | 6.00          | 10.00             | 0.00          |
| 290.00                | 2698.45                | 5.65                     | 5.65                      | 1-S1f     | 1.40              | 3.45             | 3.60              | 6.00          | 10.07             | 0.00          |
| 340.00                | 2699.15                | 6.35                     | 6.35                      | 1-S1f     | 1.56              | 3.84             | 4.00              | 6.00          | 10.62             | 0.00          |
| 370.00                | 2699.58                | 6.78                     | 6.78                      | 1-S1f     | 1.66              | 4.06             | 4.20              | 6.00          | 11.01             | 0.00          |
| 400.00                | 2700.03                | 7.23                     | 7.23                      | 1-S1f     | 1.75              | 4.28             | 4.40              | 6.00          | 11.36             | 0.00          |

El. inlet face invert 2692.80 ft El. outlet invert 2677.08 ft

El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

\*\*\*\*\*

\*\*\*\*\* SITE DATA \*\*\*\*\* CULVERT INVERT \*\*\*\*\*

INLET STATION 0.00 ft  
 INLET ELEVATION 2692.80 ft  
 OUTLET STATION 250.00 ft  
 OUTLET ELEVATION 2677.08 ft  
 NUMBER OF BARRELS 1  
 SLOPE (V/H) 0.0629  
 CULVERT LENGTH ALONG SLOPE 250.49 ft

\*\*\*\*\* CULVERT DATA SUMMARY \*\*\*\*\*

BARREL SHAPE BOX  
 BARREL SPAN 8.00 ft  
 BARREL RISE 6.00 ft  
 BARREL MATERIAL CONCRETE  
 BARREL MANNING'S n 0.015  
 INLET TYPE CONVENTIONAL  
 INLET EDGE AND WALL SQUARE EDGE (90-45 DEG.)  
 INLET DEPRESSION NONE

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FILE DATE: 02-09-2004  
FILE NAME: HORSE-8F

[illegible]

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#####
##### ROADWAY OVERTOPPING DATA #####
#####

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ROADWAY SURFACE                                PAVED
EMBANKMENT TOP WIDTH                          28.00 ft
***** USER DEFINED ROADWAY PROFILE
CROSS-SECTION          X          Y
COORD. NO.             ft          ft
      1                0.00      2717.00
      2               122.00      2713.50
      3               225.00      2716.00
*****

```



**INLET 10 @ CULVERT 10**

CURRENT DATE: 02-04-2004  
CURRENT TIME: 17:17:56

FILE DATE: 02-04-2004  
FILE NAME: HORSE10F

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#####
##### FHWA CULVERT ANALYSIS #####
##### HY-8, VERSION 6.0 #####
#####
#####;
 3 C 3 SITE DATA 3 CULVERT SHAPE, MATERIAL, INLET 3
 3 U #####'
 3 L 3 INLET OUTLET CULVERT 3 BARRELS 3
 3 V 3 ELEV. ELEV. LENGTH 3 SHAPE SPAN RISE MANNING INLET 3
 3 NO. 3 (ft) (ft) (ft) 3 MATERIAL (ft) (ft) n TYPE 3
 3 1 3 2666.40 2654.19 146.61 3 1 RCB 15.00 6.00 .015 CONVENTIONAL 3
 3 2 3 3
 3 3 3 3
 3 4 3 3
 3 5 3 3
 3 6 3 3
#####

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SUMMARY OF CULVERT FLOWS (cfs)                      FILE: HORSE10F                      DATE: 02-04-2004

[illegible]

SUMMARY OF ITERATIVE SOLUTION ERRORS    FILE: HORSE10F    DATE: 02-04-2004

| HEAD      | HEAD       | TOTAL      | FLOW        | % FLOW |
|-----------|------------|------------|-------------|--------|
| ELEV (ft) | ERROR (ft) | FLOW (cfs) | ERROR (cfs) | ERROR  |
| 0.00      | 0.000      | 500.00     | 0.00        | 0.00   |
| 2672.03   | 0.000      | 550.00     | 0.00        | 0.00   |
| 2672.41   | 0.000      | 600.00     | 0.00        | 0.00   |
| 2672.78   | 0.000      | 650.00     | 0.00        | 0.00   |
| 2673.17   | 0.000      | 700.00     | 0.00        | 0.00   |
| 2673.32   | 0.000      | 719.00     | 0.00        | 0.00   |
| 2673.98   | 0.000      | 800.00     | 0.00        | 0.00   |
| 2674.40   | 0.000      | 850.00     | 0.00        | 0.00   |
| 2674.85   | 0.000      | 900.00     | 0.00        | 0.00   |
| 2675.31   | 0.000      | 950.00     | 0.00        | 0.00   |
| 2675.80   | 0.000      | 1000.00    | 0.00        | 0.00   |

[illegible]

CURRENT DATE: 02-04-2004

FILE DATE: 02-04-2004

CURRENT TIME: 17:17:56

FILE NAME: HORSE10F

PERFORMANCE CURVE FOR CULVERT 1 - 1( 15.00 (ft) BY 6.00 (ft)) RCB

DIS- HEAD- INLET OUTLET  
 CHARGE WATER CONTROL CONTROL FLOW NORMAL CRIT. OUTLET TW OUTLET TW  
 FLOW ELEV. DEPTH DEPTH TYPE DEPTH DEPTH DEPTH DEPTH DEPTH VEL. VEL.  
 (cfs) (ft) (ft) (ft) <F4> (ft) (ft) (ft) (ft) (ft) (fps) (fps)

| DIS-CHARGE FLOW (cfs) | HEAD- ELEV. (ft) | INLET DEPTH (ft) | OUTLET DEPTH (ft) | CONTROL TYPE | CONTROL DEPTH (ft) | NORMAL DEPTH (ft) | CRIT. DEPTH (ft) | OUTLET DEPTH (ft) | TW DEPTH (ft) | OUTLET VEL. (fps) | TW VEL. (fps) |
|-----------------------|------------------|------------------|-------------------|--------------|--------------------|-------------------|------------------|-------------------|---------------|-------------------|---------------|
| 500.00                | 2671.66          | 5.26             | 5.26              | 1-S1f        | 1.15               | 3.26              | 3.40             | 6.00              | 9.80          | 0.00              | 0.00          |
| 550.00                | 2672.03          | 5.63             | 5.63              | 1-S1f        | 1.23               | 3.48              | 3.60             | 6.00              | 10.19         | 0.00              | 0.00          |
| 600.00                | 2672.41          | 6.01             | 6.01              | 1-S1f        | 1.29               | 3.68              | 3.80             | 6.00              | 10.53         | 0.00              | 0.00          |
| 650.00                | 2672.78          | 6.38             | 6.38              | 1-S1f        | 1.36               | 3.89              | 4.00             | 6.00              | 10.83         | 0.00              | 0.00          |
| 700.00                | 2673.17          | 6.77             | 6.77              | 1-S1f        | 1.42               | 4.08              | 4.20             | 6.00              | 11.11         | 0.00              | 0.00          |
| 719.00                | 2673.32          | 6.92             | 6.92              | 1-S1f        | 1.45               | 4.16              | 4.30             | 6.00              | 11.15         | 0.00              | 0.00          |
| 800.00                | 2673.98          | 7.58             | 7.58              | 1-S1f        | 1.55               | 4.46              | 4.60             | 6.00              | 11.59         | 0.00              | 0.00          |
| 850.00                | 2674.40          | 8.00             | 8.00              | 1-S1f        | 1.61               | 4.65              | 4.80             | 6.00              | 11.81         | 0.00              | 0.00          |
| 900.00                | 2674.85          | 8.45             | 8.45              | 1-S1f        | 1.68               | 4.83              | 5.00             | 6.00              | 12.00         | 0.00              | 0.00          |
| 950.00                | 2675.31          | 8.91             | 8.91              | 1-S1f        | 1.74               | 5.00              | 5.20             | 6.00              | 12.18         | 0.00              | 0.00          |
| 1000.00               | 2675.80          | 9.40             | 9.40              | 1-S1f        | 1.81               | 5.18              | 5.30             | 6.00              | 12.58         | 0.00              | 0.00          |

El. inlet face invert 2666.40 ft El. outlet invert 2654.19 ft

El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

\*\*\*\*\* SITE DATA \*\*\*\*\* CULVERT INVERT \*\*\*\*\*

INLET STATION 0.00 ft  
 INLET ELEVATION 2666.40 ft  
 OUTLET STATION 146.10 ft  
 OUTLET ELEVATION 2654.19 ft  
 NUMBER OF BARRELS 1  
 SLOPE (V/H) 0.0836  
 CULVERT LENGTH ALONG SLOPE 146.61 ft

\*\*\*\*\* CULVERT DATA SUMMARY \*\*\*\*\*

BARREL SHAPE BOX  
 BARREL SPAN 15.00 ft  
 BARREL RISE 6.00 ft  
 BARREL MATERIAL CONCRETE  
 BARREL MANNING'S n 0.015  
 INLET TYPE CONVENTIONAL  
 INLET EDGE AND WALL SQUARE EDGE (90-45 DEG.)  
 INLET DEPRESSION NONE

\*\*\*\*\*



CONSTANT WATER SURFACE ELEVATION  
2660.19

|                      |          |
|----------------------|----------|
| ROADWAY SURFACE      | PAVED    |
| EMBANKMENT TOP WIDTH | 28.00 ft |

| CROSS-SECTION<br>COORD. NO. | X<br>ft | Y<br>ft |
|-----------------------------|---------|---------|
| 1                           | 0.00    | 2675.00 |
| 2                           | 75.00   | 2674.00 |
| 3                           | 121.00  | 2673.40 |

[illegible]

**B-2**

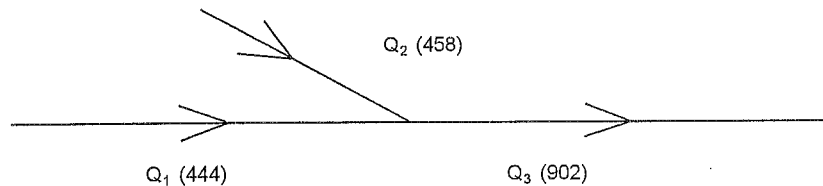
**FUTURE CONFLUENCE ANALYSIS**

**CONFLUENCE @ CULVERT 6**



W.O.#: 6093  
 Calculated by: J.L.W.  
 Checked by:  
 Date:

UPSTREAM STATION "56+92.53"  
 CONFLUENCE MOMENTUM ANALYSIS  
 (FUTURE FLOW COMBINATION 1)



GIVEN DATA

| DISCHARGES           |     | CHANNEL WIDTHS      |       | FLOW DEPTHS         |       | FROUDE NO.     |      | ANGLE & LENGTH |        |
|----------------------|-----|---------------------|-------|---------------------|-------|----------------|------|----------------|--------|
| Q <sub>1</sub> (cfs) | 444 | b <sub>1</sub> (ft) | 12.00 | y <sub>1</sub> (ft) | 2.573 | F <sub>1</sub> | 1.58 | θ (deg)        | 0      |
| Q <sub>2</sub> (cfs) | 458 | b <sub>2</sub> (ft) | 12.00 | y <sub>2</sub> (ft) | 1.325 | F <sub>2</sub> | 4.41 | cos θ          | 1.0000 |
| Q <sub>3</sub> (cfs) | 902 | b <sub>3</sub> (ft) | 25.25 | y <sub>3</sub> (ft) | 1.510 | F <sub>3</sub> | 3.39 | L (ft)         | 60.00  |

MOMENTUM EQUATION\*

$$\frac{Q_1^2}{gA_1} + \frac{Q_2^2}{gA_2} \cos \theta + \frac{b_1 y_1^2}{2} + \frac{(b_3 - b_1)}{2} y_1^2 = \frac{Q_3^2}{gA_3} + \frac{b_3 y_3^2}{2}$$

$$y_{c3} = \sqrt[3]{\frac{Q_3^2}{b_3^2 g}} = 3.41$$

$$0.85 y_{c3} = 2.90$$

MOMENTUM UPSTREAM\* (ft<sup>3</sup>)

MOMENTUM DOWNSTREAM\* (ft<sup>3</sup>)

$$\frac{Q_1^2}{gA_1} = \frac{Q_1^2}{32.2(b_1 y_1)} = 198.3$$

$$y_3 = 1.510 \text{ ft}$$

$$\frac{Q_2^2}{gA_2} \cos \theta = \frac{Q_2^2}{32.2(b_2 y_2)} \cos \theta = 409.7$$

$$\frac{Q_3^2}{gA_3} = \frac{Q_3^2}{32.2(b_3 y_3)} = 662.8$$

$$\frac{b_1 y_1^2}{2} = 39.7$$

$$\frac{b_3 y_3^2}{2} = 28.8$$

$$\frac{(b_3 - b_1)}{2} y_1^2 = 43.9$$

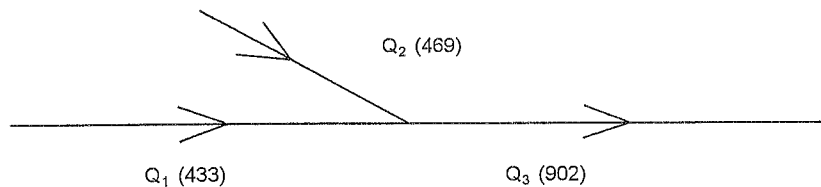
$$\sum M_{1-2} = 691.6$$

$$\sum M_{1-2} = 691.6$$

\* THE TERM  $r$  (SPECIFIC WEIGHT OF WATER) HAS BEEN OMITTED FROM ALL TERMS OF THIS EQUATION AND THE FOLLOWING COMPUTATIONS.

W.O.# 6093  
 Calculated by: J.L.W.  
 Checked by:  
 Date:

UPSTREAM STATION "56+92.53"  
 CONFLUENCE MOMENTUM ANALYSIS  
 (FUTURE FLOW COMBINATION 2)



GIVEN DATA

| DISCHARGES               | CHANNEL WIDTHS            | FLOW DEPTHS               | FROUDE NO.          | ANGLE & LENGTH |
|--------------------------|---------------------------|---------------------------|---------------------|----------------|
| Q <sub>1</sub> (cfs) 433 | b <sub>1</sub> (ft) 12.00 | y <sub>1</sub> (ft) 2.530 | F <sub>1</sub> 1.58 | θ (deg) 0      |
| Q <sub>2</sub> (cfs) 469 | b <sub>2</sub> (ft) 12.00 | y <sub>2</sub> (ft) 1.352 | F <sub>2</sub> 4.38 | cos θ 1.0000   |
| Q <sub>3</sub> (cfs) 902 | b <sub>3</sub> (ft) 25.25 | y <sub>3</sub> (ft) 1.505 | F <sub>3</sub> 3.41 | L (ft) 60.00   |

MOMENTUM EQUATION\*

$$\frac{Q_1^2}{gA_1} + \frac{Q_2^2}{gA_2} \cos \theta + \frac{b_1 y_1^2}{2} + \frac{(b_3 - b_1)}{2} y_1^2 = \frac{Q_3^2}{gA_3} + \frac{b_3 y_3^2}{2}$$

$$y_{c3} = \sqrt[3]{\frac{Q_3^2}{b_3^2 g}} = 3.41$$

$$0.85y_{c3} = 2.90$$

MOMENTUM UPSTREAM\* (ft<sup>3</sup>)

MOMENTUM DOWNSTREAM\* (ft<sup>3</sup>)

$$\frac{Q_1^2}{gA_1} = \frac{Q_1^2}{32.2(b_1 y_1)} = 191.8$$

$$y_3 = 1.505 \text{ ft}$$

$$\frac{Q_2^2}{gA_2} \cos \theta = \frac{Q_2^2}{32.2(b_2 y_2)} \cos \theta = 421.0$$

$$\frac{Q_3^2}{gA_3} = \frac{Q_3^2}{32.2(b_3 y_3)} = 665.0$$

$$\frac{b_1 y_1^2}{2} = 38.4$$

$$\frac{b_3 y_3^2}{2} = 28.6$$

$$\frac{(b_3 - b_1)}{2} y_1^2 = 42.4$$

$$\sum M_{1-2} = 693.6$$

$$\sum M_{1-2} = 693.6$$

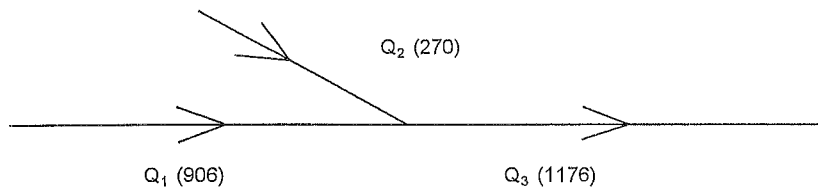
\* THE TERM  $r$  (SPECIFIC WEIGHT OF WATER) HAS BEEN OMITTED FROM ALL TERMS OF THIS EQUATION AND THE FOLLOWING COMPUTATIONS.

**CONFLUENCE @ CULVERT 8**



W.O.#: 6093  
 Calculated by: J.L.W.  
 Checked by:  
 Date:

UPSTREAM STATION "34+74.12"  
 CONFLUENCE MOMENTUM ANALYSIS  
 (FUTURE FLOW COMBINATION 1)



GIVEN DATA

| DISCHARGES                 | CHANNEL WIDTHS            | FLOW DEPTHS               | FROUDE NO.          | ANGLE & LENGTH |
|----------------------------|---------------------------|---------------------------|---------------------|----------------|
| Q <sub>1</sub> (cfs) 906   | b <sub>1</sub> (ft) 13.00 | y <sub>1</sub> (ft) 2.522 | F <sub>1</sub> 3.07 | θ (deg) 0      |
| Q <sub>2</sub> (cfs) 270   | b <sub>2</sub> (ft) 8.00  | y <sub>2</sub> (ft) 1.388 | F <sub>2</sub> 3.64 | cos θ 1.0000   |
| Q <sub>3</sub> (cfs) 1,176 | b <sub>3</sub> (ft) 23.00 | y <sub>3</sub> (ft) 1.838 | F <sub>3</sub> 3.61 | L (ft) 60.00   |

MOMENTUM EQUATION\*

$$\frac{Q_1^2}{gA_1} + \frac{Q_2^2}{gA_2} \cos \theta + \frac{b_1 y_1^2}{2} + \frac{(b_3 - b_1)}{2} y_1^2 = \frac{Q_3^2}{gA_3} + \frac{b_3 y_3^2}{2}$$

$$y_{c3} = \sqrt[3]{\frac{Q_3^2}{b_3^2 g}} = 4.33$$

$$0.85 y_{c3} = 3.68$$

MOMENTUM UPSTREAM\* (ft<sup>3</sup>)

MOMENTUM DOWNSTREAM\* (ft<sup>3</sup>)

$$\frac{Q_1^2}{gA_1} = \frac{Q_1^2}{32.2(b_1 y_1)} = 777.5$$

$$y_3 = 1.838 \text{ ft}$$

$$\frac{Q_2^2}{gA_2} \cos \theta = \frac{Q_2^2}{32.2(b_2 y_2)} \cos \theta = 203.9$$

$$\frac{Q_3^2}{gA_3} = \frac{Q_3^2}{32.2(b_3 y_3)} = 1015.7$$

$$\frac{b_1 y_1^2}{2} = 41.3$$

$$\frac{b_3 y_3^2}{2} = 38.9$$

$$\frac{(b_3 - b_1)}{2} y_1^2 = 31.8$$

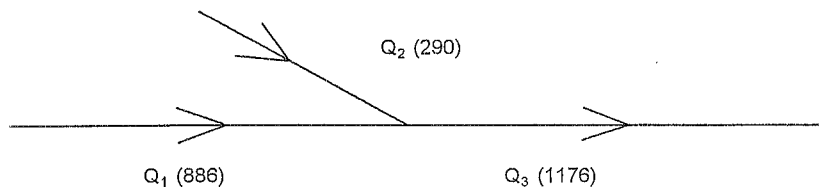
$$\sum M_{1-2} = 1054.6$$

$$\sum M_{1-2} = 1054.6$$

\* THE TERM  $\gamma$  (SPECIFIC WEIGHT OF WATER) HAS BEEN OMITTED FROM ALL TERMS OF THIS EQUATION AND THE FOLLOWING COMPUTATIONS.

W.O.#: 6093  
 Calculated by: J.L.W.  
 Checked by:  
 Date:

UPSTREAM STATION "34+74.12"  
 CONFLUENCE MOMENTUM ANALYSIS  
 (FUTURE FLOW COMBINATION 2)



GIVEN DATA

| DISCHARGES           |       | CHANNEL WIDTHS      |       | FLOW DEPTHS         |       | FROUDE NO.     |      | ANGLE & LENGTH |        |
|----------------------|-------|---------------------|-------|---------------------|-------|----------------|------|----------------|--------|
| Q <sub>1</sub> (cfs) | 886   | b <sub>1</sub> (ft) | 13.00 | y <sub>1</sub> (ft) | 2.482 | F <sub>1</sub> | 3.07 | θ (deg)        | 0      |
| Q <sub>2</sub> (cfs) | 290   | b <sub>2</sub> (ft) | 8.00  | y <sub>2</sub> (ft) | 1.462 | F <sub>2</sub> | 3.61 | cos θ          | 1.0000 |
| Q <sub>3</sub> (cfs) | 1,176 | b <sub>3</sub> (ft) | 23.00 | y <sub>3</sub> (ft) | 1.848 | F <sub>3</sub> | 3.59 | L (ft)         | 60.00  |

MOMENTUM EQUATION\*

$$\frac{Q_1^2}{gA_1} + \frac{Q_2^2}{gA_2} \cos \theta + \frac{b_1 y_1^2}{2} + \frac{(b_3 - b_1)}{2} y_1^2 = \frac{Q_3^2}{gA_3} + \frac{b_3 y_3^2}{2}$$

$$y_{c3} = \sqrt[3]{\frac{Q_3^2}{b_3^2 g}} = 4.33$$

$$0.85 y_{c3} = 3.68$$

MOMENTUM UPSTREAM\* (ft<sup>3</sup>)

MOMENTUM DOWNSTREAM\* (ft<sup>3</sup>)

$$\frac{Q_1^2}{gA_1} = \frac{Q_1^2}{32.2(b_1 y_1)} = 755.6$$

$$y_3 = 1.848 \text{ ft}$$

$$\frac{Q_2^2}{gA_2} \cos \theta = \frac{Q_2^2}{32.2(b_2 y_2)} \cos \theta = 223.3$$

$$\frac{Q_3^2}{gA_3} = \frac{Q_3^2}{32.2(b_3 y_3)} = 1010.4$$

$$\frac{b_1 y_1^2}{2} = 40.0$$

$$\frac{b_3 y_3^2}{2} = 39.3$$

$$\frac{(b_3 - b_1)}{2} y_1^2 = 30.8$$

$$\sum M_{1-2} = 1049.7$$

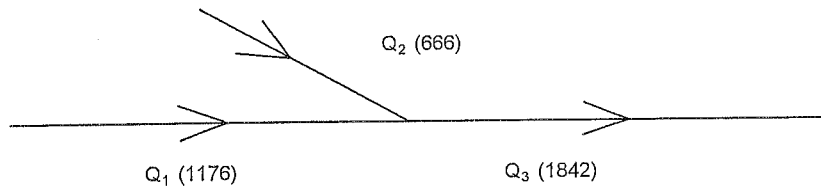
$$\sum M_{1-2} = 1049.7$$

\* THE TERM  $\gamma$  (SPECIFIC WEIGHT OF WATER) HAS BEEN OMITTED FROM ALL TERMS OF THIS EQUATION AND THE FOLLOWING COMPUTATIONS.

**CONFLUENCE @ CULVERT 10**

W.O.#: 6093  
 Calculated by: J.L.W.  
 Checked by:  
 Date:

UPSTREAM STATION "20+35.60"  
 CONFLUENCE MOMENTUM ANALYSIS  
 (FUTURE FLOW COMBINATION 1)



GIVEN DATA

| DISCHARGES           |       | CHANNEL WIDTHS      |       | FLOW DEPTHS         |       | FROUDE NO.     |      | ANGLE & LENGTH |        |
|----------------------|-------|---------------------|-------|---------------------|-------|----------------|------|----------------|--------|
| Q <sub>1</sub> (cfs) | 1,176 | b <sub>1</sub> (ft) | 12.00 | y <sub>1</sub> (ft) | 5.326 | F <sub>1</sub> | 1.41 | θ (deg)        | 0      |
| Q <sub>2</sub> (cfs) | 666   | b <sub>2</sub> (ft) | 16.00 | y <sub>2</sub> (ft) | 1.525 | F <sub>2</sub> | 3.90 | COS θ          | 1.0000 |
| Q <sub>3</sub> (cfs) | 1,842 | b <sub>3</sub> (ft) | 30.00 | y <sub>3</sub> (ft) | 2.211 | F <sub>3</sub> | 3.29 | L (ft)         | 100.00 |

MOMENTUM EQUATION\*

$$\frac{Q_1^2}{gA_1} + \frac{Q_2^2}{gA_2} \cos \theta + \frac{b_1 y_1^2}{2} + \frac{(b_3 - b_1)}{2} y_1^2 = \frac{Q_3^2}{gA_3} + \frac{b_3 y_3^2}{2}$$

$$y_{c3} = \sqrt[3]{\frac{Q_3^2}{b_3^2 g}} = 4.89$$

$$0.85y_{c3} = 4.16$$

MOMENTUM UPSTREAM\* (ft<sup>3</sup>)

MOMENTUM DOWNSTREAM\* (ft<sup>3</sup>)

$$\frac{Q_1^2}{gA_1} = \frac{Q_1^2}{32.2(b_1 y_1)} = 672.0$$

$$y_3 = 2.211 \text{ ft}$$

$$\frac{Q_2^2}{gA_2} \cos \theta = \frac{Q_2^2}{32.2(b_2 y_2)} \cos \theta = 564.6$$

$$\frac{Q_3^2}{gA_3} = \frac{Q_3^2}{32.2(b_3 y_3)} = 1588.8$$

$$\frac{b_1 y_1^2}{2} = 170.2$$

$$\frac{b_3 y_3^2}{2} = 73.3$$

$$\frac{(b_3 - b_1)}{2} y_1^2 = 255.3$$

$$\sum M_{1-2} = 1662.1$$

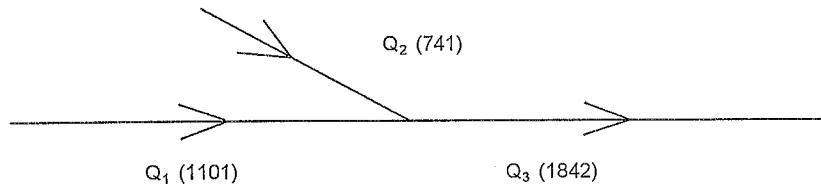
$$\sum M_{1-2} = 1662.1$$

\* THE TERM  $\gamma$  (SPECIFIC WEIGHT OF WATER) HAS BEEN OMITTED FROM ALL TERMS OF THIS EQUATION AND THE FOLLOWING COMPUTATIONS.



W.O.#: 6093  
 Calculated by: J.L.W.  
 Checked by:  
 Date:

UPSTREAM STATION "20+35.60"  
 CONFLUENCE MOMENTUM ANALYSIS  
 (FUTURE FLOW COMBINATION 2)



GIVEN DATA

| DISCHARGES           |       | CHANNEL WIDTHS      |       | FLOW DEPTHS         |       | FROUDE NO.     |      | ANGLE & LENGTH |        |
|----------------------|-------|---------------------|-------|---------------------|-------|----------------|------|----------------|--------|
| Q <sub>1</sub> (cfs) | 1,101 | b <sub>1</sub> (ft) | 12.00 | y <sub>1</sub> (ft) | 5.095 | F <sub>1</sub> | 1.41 | θ (deg)        | 0      |
| Q <sub>2</sub> (cfs) | 741   | b <sub>2</sub> (ft) | 16.00 | y <sub>2</sub> (ft) | 1.659 | F <sub>2</sub> | 3.82 | cos θ          | 1.0000 |
| Q <sub>3</sub> (cfs) | 1,842 | b <sub>3</sub> (ft) | 30.00 | y <sub>3</sub> (ft) | 2.233 | F <sub>3</sub> | 3.24 | L (ft)         | 100.00 |

MOMENTUM EQUATION\*

$$\frac{Q_1^2}{gA_1} + \frac{Q_2^2}{gA_2} \cos \theta + \frac{b_1 y_1^2}{2} + \frac{(b_3 - b_1)}{2} y_1^2 = \frac{Q_3^2}{gA_3} + \frac{b_3 y_3^2}{2}$$

$$y_{c3} = \sqrt[3]{\frac{Q_3^2}{b_3^2 g}} = 4.89$$

$$0.85y_{c3} = 4.16$$

MOMENTUM UPSTREAM\* (ft<sup>3</sup>)

MOMENTUM DOWNSTREAM\* (ft<sup>3</sup>)

$$\frac{Q_1^2}{gA_1} = \frac{Q_1^2}{32.2(b_1 y_1)} = 615.7$$

$$y_3 = 2.233 \text{ ft}$$

$$\frac{Q_2^2}{gA_2} \cos \theta = \frac{Q_2^2}{32.2(b_2 y_2)} \cos \theta = 642.4$$

$$\frac{Q_3^2}{gA_3} = \frac{Q_3^2}{32.2(b_3 y_3)} = 1572.7$$

$$\frac{b_1 y_1^2}{2} = 155.8$$

$$\frac{b_3 y_3^2}{2} = 74.8$$

$$\frac{(b_3 - b_1)}{2} y_1^2 = 233.6$$

$$\sum M_{1-2} = 1647.5$$

$$\sum M_{1-2} = 1647.5$$

\* THE TERM  $\gamma$  (SPECIFIC WEIGHT OF WATER) HAS BEEN OMITTED FROM ALL TERMS OF THIS EQUATION AND THE FOLLOWING COMPUTATIONS.

**B-3**

**FUTURE HYDRAULIC SUMMARY**

HYDRAULICS SUMMARY - MAINLINE  
FUTURE CONDITION FLOWS  
(n=0.015)

Values in English Units

| CHANNEL<br>STATION | REMARKS                               | DESIGN<br>FLOW<br>Q | DEPTH<br>OF FLOW<br>y | INVERT<br>ELEV | VELOCITY<br>V | H.G.L.  | E.G.L.  | CHANNEL<br>TYPE | BASE<br>WIDTH | SIDE<br>SLOPE | FLOW<br>AREA | W.S.<br>WIDTH | FROUDE<br>NUMBER | CURVE<br>RADIUS<br>R | SUPER<br>ELEV | ROLL<br>WAVE <sup>(2)</sup> | CCRFGD<br>MIN FB <sup>(3)</sup> | MIN<br>WALL HT | DESIGN<br>WALL HT | ACTUAL<br>FB | FB<br>CHECK |
|--------------------|---------------------------------------|---------------------|-----------------------|----------------|---------------|---------|---------|-----------------|---------------|---------------|--------------|---------------|------------------|----------------------|---------------|-----------------------------|---------------------------------|----------------|-------------------|--------------|-------------|
| 66+06.24           | begin 4'x14' RCB                      | 444                 | 3.150                 | 2744.25        | 10.07         | 2747.40 | 2748.97 | RCB             | 14            | 0             | 44.10        | 14.00         | 1.00             |                      |               |                             | 2.07                            | 5.22           | 4.00              | 0.85         | RCB, Ok     |
| 64+64.24           | end 4'x14' RCB                        | 444                 | 1.217                 | 2731.55        | 26.06         | 2732.77 | 2743.31 | RCB             | 14            | 0             | 17.04        | 14.00         | 4.16             |                      |               |                             | 1.70                            | 2.91           | 4.00              | 2.78         | RCB, Ok     |
| 64+64.24           | begin 6'x28.25' RCB, begin confluence | 444                 | 0.595                 | 2731.55        | 26.43         | 2732.15 | 2742.99 | RCB             | 28.25         | 0             | 16.81        | 28.25         | 6.04             |                      |               |                             | 1.56                            | 2.15           | 6.00              | 5.41         | RCB, Ok     |
| 63+94.24           | end 6'x28.25' RCB                     | 444                 | 0.814                 | 2730.15        | 19.31         | 2730.96 | 2736.75 | RCB             | 28.25         | 0             | 23.00        | 28.25         | 3.77             |                      |               |                             | 1.45                            | 2.26           | 6.00              | 5.19         | RCB, Ok     |
| 63+94.24           | begin transition                      | 444                 | 0.814                 | 2730.15        | 19.31         | 2730.96 | 2736.75 | RCB             | 28.25         | 0             | 23.00        | 28.25         | 3.77             |                      |               |                             | 1.45                            | 2.26           | 6.00              | 5.19         | RCB, Ok     |
| 62+54.24           | end transition, end confluence        | 444                 | 2.541                 | 2725.95        | 14.56         | 2728.49 | 2731.78 | RCB             | 12            | 0             | 30.49        | 12.00         | 1.61             |                      |               |                             | 1.50                            | 4.04           | 6.00              | 3.46         | RCB, Ok     |
| 62+54.24           | begin 6'x12' RCB                      | 444                 | 2.541                 | 2725.95        | 14.56         | 2728.49 | 2731.78 | RCB             | 12            | 0             | 30.49        | 12.00         | 1.61             |                      |               |                             | 1.50                            | 4.04           | 6.00              | 3.46         | RCB, Ok     |
| 61+71.83           |                                       | 444                 | 2.557                 | 2725.16        | 14.47         | 2727.72 | 2730.97 | RCB             | 12            | 0             | 30.68        | 12.00         | 1.59             |                      |               |                             | 1.49                            | 4.05           | 6.00              | 3.44         | RCB, Ok     |
| 61+71.83           | PT, R=1000'                           | 444                 | 2.557                 | 2725.16        | 14.47         | 2727.72 | 2730.97 | RCB             | 12            | 0             | 30.68        | 12.00         | 1.59             | 1000                 | 0.078         |                             | 1.49                            | 4.13           | 6.00              | 3.36         | RCB, Ok     |
| 59+57.24           | PC, R=1000                            | 444                 | 2.572                 | 2723.10        | 14.38         | 2725.67 | 2728.88 | RCB             | 12            | 0             | 30.86        | 12.00         | 1.58             | 1000                 | 0.077         |                             | 1.49                            | 4.14           | 6.00              | 3.35         | RCB, Ok     |
| 59+57.24           | PT, R=1000'                           | 444                 | 2.572                 | 2723.10        | 14.38         | 2725.67 | 2728.88 | RCB             | 12            | 0             | 30.86        | 12.00         | 1.58             | 1000                 | 0.077         |                             | 1.49                            | 4.14           | 6.00              | 3.35         | RCB, Ok     |
| 57+42.64           | PC, R=1000                            | 444                 | 2.571                 | 2721.03        | 14.39         | 2723.60 | 2726.82 | RCB             | 12            | 0             | 30.85        | 12.00         | 1.58             | 1000                 | 0.077         |                             | 1.49                            | 4.14           | 6.00              | 3.35         | RCB, Ok     |
| 57+42.64           |                                       | 444                 | 2.571                 | 2721.03        | 14.39         | 2723.60 | 2726.82 | RCB             | 12            | 0             | 30.85        | 12.00         | 1.58             |                      |               |                             | 1.49                            | 4.06           | 6.00              | 3.43         | RCB, Ok     |
| 56+92.53           | end 6'x12' RCB                        | 444                 | 2.573                 | 2720.55        | 14.38         | 2723.12 | 2726.33 | RCB             | 12            | 0             | 30.88        | 12.00         | 1.58             |                      |               |                             | 1.49                            | 4.07           | 6.00              | 3.43         | RCB, Ok     |
| 56+92.53           | begin 8'x25.25' RCB, begin confluence | 902                 | 2.431                 | 2720.55        | 14.69         | 2722.98 | 2726.33 | RCB             | 25.25         | 0             | 61.38        | 25.25         | 1.66             |                      |               |                             | 1.49                            | 3.92           | 8.00              | 5.57         | RCB, Ok     |
| 56+32.53           | end 8'x25.25' RCB                     | 902                 | 2.399                 | 2719.97        | 14.89         | 2722.37 | 2725.81 | RCB             | 25.25         | 0             | 60.57        | 25.25         | 1.69             |                      |               |                             | 1.50                            | 3.90           | 8.00              | 5.60         | RCB, Ok     |
| 56+32.53           | begin transition                      | 902                 | 2.399                 | 2719.97        | 14.89         | 2722.37 | 2725.81 | RCB             | 25.25         | 0             | 60.57        | 25.25         | 1.69             |                      |               |                             | 1.50                            | 3.90           | 8.00              | 5.60         | RCB, Ok     |
| 55+37.53           | end transition, end confluence        | 902                 | 4.116                 | 2717.10        | 15.65         | 2721.21 | 2725.02 | RCB             | 14            | 0             | 57.62        | 14.00         | 1.36             |                      |               |                             | 1.63                            | 5.74           | 8.00              | 3.88         | RCB, Ok     |
| 55+37.53           | begin 8'x14' RCB                      | 902                 | 4.116                 | 2717.10        | 15.65         | 2721.21 | 2725.02 | RCB             | 14            | 0             | 57.62        | 14.00         | 1.36             |                      |               |                             | 1.63                            | 5.74           | 8.00              | 3.88         | RCB, Ok     |
| 55+15.00           |                                       | 902                 | 3.949                 | 2716.77        | 16.32         | 2720.72 | 2724.85 | RCB             | 14            | 0             | 55.29        | 14.00         | 1.45             |                      |               |                             | 1.64                            | 5.59           | 8.00              | 4.05         | RCB, Ok     |
| 55+15.00           | 36" RCP lateral entrance              | 904                 | 3.981                 | 2716.77        | 16.22         | 2720.75 | 2724.84 | RCB             | 14            | 0             | 55.73        | 14.00         | 1.43             |                      |               |                             | 1.64                            | 5.62           | 8.00              | 4.02         | RCB, Ok     |
| 51+43.31           |                                       | 904                 | 3.293                 | 2711.38        | 19.61         | 2714.67 | 2720.64 | RCB             | 14            | 0             | 46.10        | 14.00         | 1.90             |                      |               |                             | 1.73                            | 5.02           | 8.00              | 4.71         | RCB, Ok     |
| 51+43.31           | 36" RCP lateral entrance              | 906                 | 3.306                 | 2711.38        | 19.57         | 2714.69 | 2720.63 | RCB             | 14            | 0             | 46.28        | 14.00         | 1.90             |                      |               |                             | 1.73                            | 5.03           | 8.00              | 4.69         | RCB, Ok     |
| 40+21.75           |                                       | 906                 | 3.208                 | 2695.12        | 20.17         | 2698.33 | 2704.64 | RCB             | 14            | 0             | 44.91        | 14.00         | 1.98             |                      |               |                             | 1.74                            | 4.95           | 8.00              | 4.79         | RCB, Ok     |
| 40+21.75           | PT, R=1000'                           | 906                 | 3.208                 | 2695.12        | 20.17         | 2698.33 | 2704.64 | RCB             | 14            | 0             | 44.91        | 14.00         | 1.98             | 1000                 | 0.177         |                             | 1.74                            | 5.13           | 8.00              | 4.62         | RCB, Ok     |
| 37+65.39           |                                       | 906                 | 3.207                 | 2691.40        | 20.18         | 2694.61 | 2700.93 | RCB             | 14            | 0             | 44.90        | 14.00         | 1.99             | 1000                 | 0.177         |                             | 1.74                            | 5.13           | 8.00              | 4.62         | RCB, Ok     |
| 37+65.39           |                                       | 906                 | 3.207                 | 2691.40        | 20.18         | 2694.61 | 2700.93 | RCB             | 14            | 0             | 44.90        | 14.00         | 1.99             | 1000                 | 0.177         |                             | 1.74                            | 5.13           | 8.00              | 4.62         | RCB, Ok     |
| 37+47.93           | end 8'x14' RCB; PC, R=1000            | 906                 | 2.962                 | 2690.27        | 21.85         | 2693.23 | 2700.64 | RCB             | 14            | 0             | 41.47        | 14.00         | 2.24             | 1000                 | 0.208         |                             | 1.78                            | 4.95           | 8.00              | 4.83         | RCB, Ok     |
| 37+47.93           | begin transition                      | 906                 | 2.962                 | 2690.27        | 21.85         | 2693.23 | 2700.64 | RCB             | 14            | 0             | 41.47        | 14.00         | 2.24             |                      |               |                             | 1.78                            | 4.75           | 8.00              | 5.04         | RCB, Ok     |
| 37+39.93           | end transition                        | 906                 | 3.155                 | 2689.75        | 22.09         | 2692.90 | 2700.48 | RCB             | 13            | 0             | 41.02        | 13.00         | 2.19             |                      |               |                             | 1.81                            | 4.96           | 8.00              | 4.85         | RCB, Ok     |

| CHANNEL<br>STATION | REMARKS                            | DESIGN<br>FLOW<br>Q | DEPTH<br>OF FLOW<br>y | INVERT<br>ELEV | VELOCITY<br>V | H.G.L.  | E.G.L.  | CHANNEL<br>TYPE | BASE<br>WIDTH | SIDE<br>SLOPE | FLOW<br>AREA | W.S.<br>WIDTH | FROUDE<br>NUMBER | CURVE<br>RADIUS<br>R | SUPER<br>ELEV | ROLL<br>WAVE <sup>(2)</sup> | CCRFCD<br>MIN FB <sup>(3)</sup> | MIN<br>WALL HT | DESIGN<br>WALL HT | ACTUAL<br>FB | FB<br>CHECK |
|--------------------|------------------------------------|---------------------|-----------------------|----------------|---------------|---------|---------|-----------------|---------------|---------------|--------------|---------------|------------------|----------------------|---------------|-----------------------------|---------------------------------|----------------|-------------------|--------------|-------------|
| 37+39.93           | begin 8'x13' RCB; PT, R=1000       | 906                 | 3.155                 | 2689.75        | 22.09         | 2692.90 | 2700.48 | RCB             | 13            | 0             | 41.02        | 13.00         | 2.19             | 1000                 | 0.197         |                             | 1.81                            | 5.16           | 8.00              | 4.65         | RCB, Ok     |
| 36+12.53           |                                    | 906                 | 2.425                 | 2681.46        | 28.74         | 2683.89 | 2696.71 | RCB             | 13            | 0             | 31.53        | 13.00         | 3.25             | 1000                 | 0.333         |                             | 1.97                            | 4.72           | 8.00              | 5.24         | RCB, Ok     |
| 36+12.53           |                                    | 906                 | 2.425                 | 2681.46        | 28.74         | 2683.89 | 2696.71 | RCB             | 13            | 0             | 31.53        | 13.00         | 3.25             | 1000                 | 0.333         |                             | 1.97                            | 4.72           | 8.00              | 5.24         | RCB, Ok     |
| 34+74.12           | end 8'x13' RCB; PC, R=1000         | 906                 | 2.522                 | 2677.17        | 27.64         | 2679.69 | 2691.55 | RCB             | 13            | 0             | 32.79        | 13.00         | 3.07             | 1000                 | 0.308         |                             | 1.94                            | 4.77           | 8.00              | 5.17         | RCB, Ok     |
| 34+74.12           | begin 8'x23' RCB, begin confluence | 1,176               | 2.026                 | 2677.17        | 25.24         | 2679.20 | 2689.09 | RCB             | 23            | 0             | 46.60        | 23.00         | 3.12             |                      |               |                             | 1.80                            | 3.82           | 8.00              | 5.97         | RCB, Ok     |
| 34+14.12           | end 8'x23' RCB                     | 1,176               | 2.167                 | 2676.57        | 23.60         | 2678.74 | 2687.39 | RCB             | 23            | 0             | 49.84        | 23.00         | 2.83             |                      |               |                             | 1.76                            | 3.93           | 8.00              | 5.83         | RCB, Ok     |
| 34+14.12           | begin transition                   | 1,176               | 2.167                 | 2676.57        | 23.60         | 2678.74 | 2687.39 | RCB             | 23            | 0             | 49.84        | 23.00         | 2.83             |                      |               |                             | 1.76                            | 3.93           | 8.00              | 5.83         | RCB, Ok     |
| 33+14.12           | end transition, end confluence     | 1,176               | 4.037                 | 2671.94        | 24.28         | 2675.98 | 2685.13 | RCB             | 12            | 0             | 48.44        | 12.00         | 2.13             |                      |               |                             | 1.97                            | 6.00           | 8.00              | 3.96         | RCB, Ok     |
| 33+14.12           | begin 8'x12' RCB                   | 1,176               | 4.037                 | 2671.94        | 24.28         | 2675.98 | 2685.13 | RCB             | 12            | 0             | 48.44        | 12.00         | 2.13             |                      |               |                             | 1.97                            | 6.00           | 8.00              | 3.96         | RCB, Ok     |
| 26+70.00           |                                    | 1,176               | 3.930                 | 2659.06        | 24.94         | 2662.99 | 2672.65 | RCB             | 12            | 0             | 47.16        | 12.00         | 2.22             |                      |               |                             | 1.98                            | 5.91           | 8.00              | 4.07         | RCB, Ok     |
| 26+70.00           |                                    | 1,176               | 3.930                 | 2659.06        | 24.94         | 2662.99 | 2672.65 | RCB             | 12            | 0             | 47.16        | 12.00         | 2.22             |                      |               |                             | 1.98                            | 5.91           | 8.00              | 4.07         | RCB, Ok     |
| 20+35.60           | end 8'x12' RCB                     | 1,176               | 5.326                 | 2654.19        | 18.40         | 2659.52 | 2664.77 | RCB             | 12            | 0             | 63.91        | 12.00         | 1.41             |                      |               |                             | 1.80                            | 7.13           | 8.00              | 2.67         | RCB, Ok     |
| 20+35.60           | begin 8'x30' RCB, begin confluence | 1,842               | 3.693                 | 2654.19        | 17.50         | 2657.88 | 2662.64 | RCB             | 30            | 0             | 110.79       | 30.00         | 1.60             |                      |               |                             | 1.68                            | 5.37           | 8.00              | 4.31         | RCB, Ok     |
| 19+65.60           | end 8'x30' RCB                     | 1,842               | 3.869                 | 2653.81        | 16.71         | 2657.67 | 2662.01 | RCB             | 30            | 0             | 116.07       | 30.00         | 1.50             |                      |               |                             | 1.66                            | 5.52           | 8.00              | 4.13         | RCB, Ok     |
| 19+65.60           | begin transition                   | 1,842               | 3.869                 | 2653.81        | 16.71         | 2657.67 | 2662.01 | RCB             | 30            | 0             | 116.07       | 30.00         | 1.50             |                      |               |                             | 1.66                            | 5.52           | 8.00              | 4.13         | RCB, Ok     |
| 18+75.60           | end transition, end confluence     | 1,842               | 5.143                 | 2651.16        | 17.91         | 2656.31 | 2661.29 | RCB             | 20            | 0             | 102.86       | 20.00         | 1.39             |                      |               |                             | 1.77                            | 6.92           | 8.00              | 2.86         | RCB, Ok     |
| 18+75.60           | begin 8'x20' RCB                   | 1,842               | 5.143                 | 2651.16        | 17.91         | 2656.31 | 2661.29 | RCB             | 20            | 0             | 102.86       | 20.00         | 1.39             |                      |               |                             | 1.77                            | 6.92           | 8.00              | 2.86         | RCB, Ok     |
| 12+29.75           | end 8'x20' RCB                     | 1,842               | 5.414                 | 2647.61        | 17.01         | 2653.02 | 2657.52 | RCB             | 20            | 0             | 108.28       | 20.00         | 1.29             |                      |               |                             | 1.75                            | 7.16           | 8.00              | 2.59         | RCB, Ok     |

Note:

(1) Depth with air entrainment,  $y^*/y = 0.906(e)^{0.0615}$  ( $Fr \geq 1.60$ ;  $y^* = y$ ,  $Fr < 1.60$ ). See *WASURO User's Manual (Draft)*, US Army Corps of Engineers Los Angeles District, July 1985.

(2) To be calculated in the future.

(3) For supercritical flow,  $F_B = 1+0.025V(Y^{1/3})$ ; for subcritical flow,  $FB = 0.5+V^2/2g$ . See *Hydrologic Criteria and Drainage Design Manual*, CCRFCD, 1999.



**B-4**

**FUTURE MAINLINE WSPG OUTPUT**

*HF41.dat*

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -

HORSE DRIVE INTERCHANGE ROADWAY DESIGN

HEADING LINE NO 2 IS -

CHANNEL WITH ULTIMATE FLOW, BEGINNING Q = 444 CFS

HEADING LINE NO 3 IS -

WSPG FILE: HF41.DAT, BY: J.L.W., VTN, 2/18/04

DATE: 2/18/2004  
TIME: 14:45

F0515P

## WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING

PAGE 1

[illegible]

## WATER SURFACE PROFILE - ELEMENT CARD LISTING

| ELEMENT NO                                                                                                                                                                                                         | DESCRIPTION        | STATION | INVERT  | SECT | W S ELEV | RADIUS | ANGLE | ANG PT | MAN H |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------|---------|------|----------|--------|-------|--------|-------|
| 1                                                                                                                                                                                                                  | IS A SYSTEM OUTLET | 1229.75 | 2647.61 | 15   | 0.00     |        |       |        |       |
| 2                                                                                                                                                                                                                  | IS A REACH         | 1875.60 | 2651.16 | 15   | 0.015    | 0.00   | 0.00  | 0.00   | 0     |
| 3                                                                                                                                                                                                                  | IS A TRANSITION    | 1965.60 | 2653.81 | 1    | 0.015    |        |       |        |       |
| 4                                                                                                                                                                                                                  | IS A REACH         | 2035.60 | 2654.19 | 1    | 0.015    | 0.00   | 0.00  | 0.00   | 0     |
| 5                                                                                                                                                                                                                  | IS A JUNCTION      | 2035.60 | 2654.19 | 19   | 0.015    | 0.00   | 0.10  | 0.00   |       |
| THE ABOVE ELEMENT CONTAINED AN INVERT ELEV WHICH WAS NOT GREATER THAN THE PREVIOUS INVERT ELEV -WARNING<br>THE ABOVE ELEMENT CONTAINED AN INVERT ELEV WHICH WAS NOT GREATER THAN THE PREVIOUS INVERT ELEV -WARNING |                    |         |         |      |          |        |       |        |       |
| 6                                                                                                                                                                                                                  | IS A REACH         | 2670.00 | 2659.06 | 19   | 0.015    | 0.00   | 0.00  | 0.00   | 0     |
| 7                                                                                                                                                                                                                  | IS A REACH         | 3314.12 | 2671.94 | 19   | 0.015    | 0.00   | 0.00  | 0.00   | 0     |
| 8                                                                                                                                                                                                                  | IS A TRANSITION    | 3414.12 | 2676.57 | 18   | 0.015    |        |       |        |       |
| 9                                                                                                                                                                                                                  | IS A REACH         | 3474.12 | 2677.17 | 18   | 0.015    | 0.00   | 0.00  | 0.00   | 0     |
| 10                                                                                                                                                                                                                 | IS A JUNCTION      | 3474.12 | 2677.17 | 2    | 0.015    | 0.00   | 0.10  | 0.00   |       |
| THE ABOVE ELEMENT CONTAINED AN INVERT ELEV WHICH WAS NOT GREATER THAN THE PREVIOUS INVERT ELEV -WARNING<br>THE ABOVE ELEMENT CONTAINED AN INVERT ELEV WHICH WAS NOT GREATER THAN THE PREVIOUS INVERT ELEV -WARNING |                    |         |         |      |          |        |       |        |       |



## WATER SURFACE PROFILE - ELEMENT CARD LISTING

| ELEMENT NO                                                                                                                                                                                                         | IS A            | REACH | STATION | INVERT  | SECT | N     | RADIUS  | ANGLE | ANG PT  | MAN H |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------|---------|---------|------|-------|---------|-------|---------|-------|
| 11                                                                                                                                                                                                                 | IS A REACH      |       | 3612.53 | 2681.46 | 2    | 0.015 | 1000.00 | 4.00  | 0.00    | 0     |
| 12                                                                                                                                                                                                                 | IS A REACH      |       | 3739.93 | 2689.75 | 2    | 0.015 | 1000.00 | 4.00  | 0.00    | 0     |
| 13                                                                                                                                                                                                                 | IS A TRANSITION |       | 3747.93 | 2690.27 | 3    | 0.015 |         |       |         |       |
| 14                                                                                                                                                                                                                 | IS A REACH      |       | 3765.39 | 2691.40 | 3    | 0.015 | 1000.00 | 4.00  | 0.00    | 0     |
| 15                                                                                                                                                                                                                 | IS A REACH      |       | 4021.75 | 2695.12 | 3    | 0.015 | 1000.00 | 4.00  | 0.00    | 0     |
| 16                                                                                                                                                                                                                 | IS A REACH      |       | 5143.31 | 2711.38 | 3    | 0.015 | 0.00    | 0.00  | 0.00    | 0     |
| 17                                                                                                                                                                                                                 | IS A JUNCTION   |       | 5143.31 | 2711.38 | 3    | 0.015 | 2.0     | 0.0   | 2714.55 | 0.00  |
| THE ABOVE ELEMENT CONTAINED AN INVERT ELEV WHICH WAS NOT GREATER THAN THE PREVIOUS INVERT ELEV -WARNING<br>THE ABOVE ELEMENT CONTAINED AN INVERT ELEV WHICH WAS NOT GREATER THAN THE PREVIOUS INVERT ELEV -WARNING |                 |       |         |         |      |       |         |       |         |       |
| 18                                                                                                                                                                                                                 | IS A REACH      |       | 5515.00 | 2716.77 | 3    | 0.015 | 0.00    | 0.00  | 0.00    | 0     |
| 19                                                                                                                                                                                                                 | IS A JUNCTION   |       | 5515.00 | 2716.77 | 3    | 0.015 | 2.0     | 0.0   | 2720.12 | 0.00  |
| THE ABOVE ELEMENT CONTAINED AN INVERT ELEV WHICH WAS NOT GREATER THAN THE PREVIOUS INVERT ELEV -WARNING<br>THE ABOVE ELEMENT CONTAINED AN INVERT ELEV WHICH WAS NOT GREATER THAN THE PREVIOUS INVERT ELEV -WARNING |                 |       |         |         |      |       |         |       |         |       |
| 20                                                                                                                                                                                                                 | IS A REACH      |       | 5537.53 | 2717.10 | 3    | 0.015 | 0.00    | 0.00  | 0.00    | 0     |
| 21                                                                                                                                                                                                                 | IS A TRANSITION |       | 5632.53 | 2719.97 | 9    | 0.015 |         |       |         |       |

## WATER SURFACE PROFILE - ELEMENT CARD LISTING

| ELEMENT NO                                                                                              | IS A                  | REACH | STATION | INVERT  | SECT | N     | RADIUS | ANGLE | ANG PT | MAN H |         |      |      |      |  |
|---------------------------------------------------------------------------------------------------------|-----------------------|-------|---------|---------|------|-------|--------|-------|--------|-------|---------|------|------|------|--|
| ELEMENT NO 22                                                                                           | IS A REACH            |       | 5692.53 | 2720.55 | 9    | 0.015 | 0.00   | 0.00  | 0.00   | 0     |         |      |      |      |  |
| ELEMENT NO 23                                                                                           | IS A JUNCTION         |       | 5692.53 | 2720.55 | 4    | 8     | 0      | 0.015 | 458.0  | 0.0   | 2720.55 | 0.00 | 0.10 | 0.00 |  |
| THE ABOVE ELEMENT CONTAINED AN INVERT ELEV WHICH WAS NOT GREATER THAN THE PREVIOUS INVERT ELEV -WARNING |                       |       |         |         |      |       |        |       |        |       |         |      |      |      |  |
| THE ABOVE ELEMENT CONTAINED AN INVERT ELEV WHICH WAS NOT GREATER THAN THE PREVIOUS INVERT ELEV -WARNING |                       |       |         |         |      |       |        |       |        |       |         |      |      |      |  |
| ELEMENT NO 24                                                                                           | IS A REACH            |       | 5742.64 | 2721.03 | 4    |       |        |       |        |       |         |      |      |      |  |
| ELEMENT NO 25                                                                                           | IS A REACH            |       | 5957.24 | 2723.10 | 4    |       |        |       |        |       |         |      |      |      |  |
| ELEMENT NO 26                                                                                           | IS A REACH            |       | 6171.83 | 2725.16 | 4    |       |        |       |        |       |         |      |      |      |  |
| ELEMENT NO 27                                                                                           | IS A REACH            |       | 6254.24 | 2725.95 | 4    |       |        |       |        |       |         |      |      |      |  |
| ELEMENT NO 28                                                                                           | IS A TRANSITION       |       | 6394.24 | 2730.15 | 10   |       |        |       |        |       |         |      |      |      |  |
| ELEMENT NO 29                                                                                           | IS A REACH            |       | 6464.24 | 2731.55 | 10   |       |        |       |        |       |         |      |      |      |  |
| ELEMENT NO 30                                                                                           | IS A WALL EXIT        |       | 6464.24 | 2731.55 | 7    |       |        |       |        |       |         |      |      |      |  |
| ELEMENT NO 31                                                                                           | IS A REACH            |       | 6606.24 | 2744.25 | 7    |       |        |       |        |       |         |      |      |      |  |
| ELEMENT NO 32                                                                                           | IS A SYSTEM HEADWORKS |       | 6606.24 | 2744.25 | 7    |       |        |       |        |       |         |      |      |      |  |

NO EDIT ERRORS ENCOUNTERED-COMPUTATION IS NOW BEGINNING

\*\* WARNING NO. 2 \*\* - WATER SURFACE ELEVATION GIVEN IS LESS THAN OR EQUALS INVERT ELEVATION IN HDWKDS, W.S.ELEV = INV + DC

## WATER SURFACE PROFILE LISTING

HORSE DRIVE INTERCHANGE ROADWAY DESIGN  
 CHANNEL WITH ULTIMATE FLOW, BEGINNING Q = 444 CFS  
 WSPG FILE: HF41.DAT, BY: J.L.W., VTN, 2/18/04

| STATION   | INVERT<br>ELEV | DEPTH<br>OF FLOW | W.S.<br>ELEV | Q      | VEL    | VEL<br>HEAD | ENERGY<br>GRD. EL. | SUPER<br>ELEV | CRITICAL<br>DEPTH | HGT/<br>DIA | BASE/<br>ID NO. | ZL   | NO<br>PIER | AVBPR |
|-----------|----------------|------------------|--------------|--------|--------|-------------|--------------------|---------------|-------------------|-------------|-----------------|------|------------|-------|
| L/ELEM    | SO             |                  |              |        | SF AVE |             | HF                 | NORM DEPTH    |                   | ZR          |                 |      |            |       |
| *****     |                |                  |              |        |        |             |                    |               |                   |             |                 |      |            |       |
| 1229.75   | 2647.61        | 5.414            | 2653.024     | 1842.0 | 17.01  | 4.494       | 2657.518           | 0.00          | 6.412             | 8.00        | 20.00           | 0.00 | 0          | 0.00  |
| 238.86    | 0.00550        |                  |              |        |        | .005553     | 1.33               |               | 5.423             |             |                 | 0.00 |            |       |
| 1468.61   | 2648.92        | 5.393            | 2654.316     | 1842.0 | 17.08  | 4.528       | 2658.844           | 0.00          | 6.412             | 8.00        | 20.00           | 0.00 | 0          | 0.00  |
| 406.99    | 0.00550        |                  |              |        |        | .005992     | 2.44               |               | 5.423             |             |                 | 0.00 |            |       |
| 1875.60   | 2651.16        | 5.143            | 2656.303     | 1842.0 | 17.91  | 4.981       | 2661.284           | 0.00          | 6.412             | 8.00        | 20.00           | 0.00 | 0          | 0.00  |
| TRANS STR | 0.02944        |                  |              |        |        | .007376     | 0.66               |               |                   |             |                 | 0.00 |            |       |
| 1965.60   | 2653.81        | 3.869            | 2657.679     | 1842.0 | 16.71  | 4.334       | 2662.013           | 0.00          | 5.064             | 8.00        | 30.00           | 0.00 | 1          | 1.50  |
| 70.00     | 0.00543        |                  |              |        |        | .008944     | 0.63               |               | 4.502             |             |                 | 0.00 |            |       |
| 2035.60   | 2654.19        | 3.693            | 2657.883     | 1842.0 | 17.50  | 4.756       | 2662.639           | 0.00          | 5.064             | 8.00        | 30.00           | 0.00 | 1          | 1.50  |
| JUNCT STR | 0.00000        |                  |              |        |        | .009095     | 0.00               |               |                   |             |                 | 0.00 |            |       |
| 2035.60   | 2654.19        | 5.326            | 2659.516     | 1176.0 | 18.40  | 5.257       | 2664.773           | 0.00          | 6.683             | 8.00        | 12.00           | 0.00 | 0          | 0.00  |
| 82.12     | 0.00768        |                  |              |        |        | .008869     | 0.73               |               | 5.567             |             |                 | 0.00 |            |       |
| 2117.72   | 2654.82        | 5.231            | 2660.051     | 1176.0 | 18.74  | 5.450       | 2665.501           | 0.00          | 6.683             | 8.00        | 12.00           | 0.00 | 0          | 0.00  |
| 148.00    | 0.00768        |                  |              |        |        | .009715     | 1.44               |               | 5.567             |             |                 | 0.00 |            |       |
| 2265.72   | 2655.96        | 4.987            | 2660.943     | 1176.0 | 19.65  | 5.995       | 2666.938           | 0.00          | 6.683             | 8.00        | 12.00           | 0.00 | 0          | 0.00  |
| 108.49    | 0.00768        |                  |              |        |        | .011064     | 1.20               |               | 5.567             |             |                 | 0.00 |            |       |
| 2374.21   | 2656.79        | 4.755            | 2661.544     | 1176.0 | 20.61  | 6.595       | 2668.139           | 0.00          | 6.683             | 8.00        | 12.00           | 0.00 | 0          | 0.00  |
| 88.83     | 0.00768        |                  |              |        |        | .012609     | 1.12               |               | 5.567             |             |                 | 0.00 |            |       |
| 2463.04   | 2657.47        | 4.534            | 2662.005     | 1176.0 | 21.61  | 7.254       | 2669.259           | 0.00          | 6.683             | 8.00        | 12.00           | 0.00 | 0          | 0.00  |
| 76.73     | 0.00768        |                  |              |        |        | .014382     | 1.10               |               | 5.567             |             |                 | 0.00 |            |       |
| 2539.77   | 2658.06        | 4.323            | 2662.383     | 1176.0 | 22.67  | 7.980       | 2670.363           | 0.00          | 6.683             | 8.00        | 12.00           | 0.00 | 0          | 0.00  |
| 68.29     | 0.00768        |                  |              |        |        | .016416     | 1.12               |               | 5.567             |             |                 | 0.00 |            |       |

WATER SURFACE PROFILE LISTING  
HORSE DRIVE INTERCHANGE ROADWAY DESIGN  
CHANNEL WITH ULTIMATE FLOW, BEGINNING Q = 444 CFS  
WSPG FILE: HF41.DAT, BY: J.L.W., VTN, 2/18/04

| STATION   | INVERT<br>ELEV | DEPTH<br>OF FLOW | W.S.<br>ELEV | Q      | VEL   | VEL<br>HEAD | ENERGY<br>GRD.EL. | SUPER<br>ELEV | CRITICAL<br>DEPTH | HGT/<br>DIA | BASE/<br>ID NO. | ZL    | NO<br>PIER | AVBPR |
|-----------|----------------|------------------|--------------|--------|-------|-------------|-------------------|---------------|-------------------|-------------|-----------------|-------|------------|-------|
| L/ELEM    | SO             |                  |              |        |       | SF AVE      | HF                |               | NORM DEPTH        |             |                 | ZR    |            |       |
| *****     | *****          | *****            | *****        | *****  | ***** | *****       | *****             | *****         | *****             | *****       | *****           | ***** | *****      | ***** |
| 2608.06   | 2658.58        | 4.122            | 2662.706     | 1176.0 | 23.78 | 8.778       | 2671.484          | 0.00          | 6.683             | 8.00        | 12.00           | 0.00  | 0          | 0.00  |
| 61.94     | 0.00768        |                  |              |        |       | .018752     | 1.16              |               | 5.567             |             |                 | 0.00  |            |       |
| 2670.00   | 2659.06        | 3.930            | 2662.990     | 1176.0 | 24.94 | 9.656       | 2672.646          | 0.00          | 6.683             | 8.00        | 12.00           | 0.00  | 0          | 0.00  |
| 92.31     | 0.02000        |                  |              |        |       | .020000     | 1.85              |               | 3.930             |             |                 | 0.00  |            |       |
| 2762.31   | 2660.91        | 3.930            | 2664.836     | 1176.0 | 24.94 | 9.656       | 2674.492          | 0.00          | 6.683             | 8.00        | 12.00           | 0.00  | 0          | 0.00  |
| 551.81    | 0.02000        |                  |              |        |       | .019275     | 10.64             |               | 3.930             |             |                 | 0.00  |            |       |
| 3314.12   | 2671.94        | 4.037            | 2675.977     | 1176.0 | 24.28 | 9.151       | 2685.128          | 0.00          | 6.683             | 8.00        | 12.00           | 0.00  | 0          | 0.00  |
| TRANS STR | 0.04630        |                  |              |        |       | .022011     | 2.20              |               |                   |             |                 | 0.00  |            |       |
| 3414.12   | 2676.57        | 2.167            | 2678.737     | 1176.0 | 23.60 | 8.646       | 2687.383          | 0.00          | 4.331             | 8.00        | 23.00           | 0.00  | 0          | 0.00  |
| 18.44     | 0.01000        |                  |              |        |       | .026274     | 0.48              |               | 2.932             |             |                 | 0.00  |            |       |
| 3432.56   | 2676.75        | 2.125            | 2678.879     | 1176.0 | 24.06 | 8.991       | 2687.870          | 0.00          | 4.331             | 8.00        | 23.00           | 0.00  | 0          | 0.00  |
| 41.56     | 0.01000        |                  |              |        |       | .029254     | 1.22              |               | 2.932             |             |                 | 0.00  |            |       |
| 3474.12   | 2677.17        | 2.026            | 2679.196     | 1176.0 | 25.24 | 9.890       | 2689.086          | 0.00          | 4.331             | 8.00        | 23.00           | 0.00  | 0          | 0.00  |
| JUNCT STR | 0.00000        |                  |              |        |       | .033266     | 0.00              |               |                   |             |                 | 0.00  |            |       |
| 3474.12   | 2677.17        | 2.522            | 2679.692     | 906.0  | 27.64 | 11.860      | 2691.552          | 0.00          | 5.325             | 8.00        | 13.00           | 0.00  | 0          | 0.00  |
| 138.41    | 0.03100        |                  |              |        |       | .037260     | 5.16              |               | 2.630             |             |                 | 0.00  |            |       |
| 3612.53   | 2681.46        | 2.425            | 2683.885     | 906.0  | 28.74 | 12.824      | 2696.709          | 0.00          | 5.325             | 8.00        | 13.00           | 0.00  | 0          | 0.00  |
| 20.87     | 0.06507        |                  |              |        |       | .038010     | 0.79              |               | 2.051             |             |                 | 0.00  |            |       |
| 3633.40   | 2682.82        | 2.486            | 2685.304     | 906.0  | 28.03 | 12.199      | 2697.503          | 0.00          | 5.325             | 8.00        | 13.00           | 0.00  | 0          | 0.00  |
| 31.99     | 0.06507        |                  |              |        |       | .034194     | 1.09              |               | 2.051             |             |                 | 0.00  |            |       |
| 3665.39   | 2684.90        | 2.608            | 2687.507     | 906.0  | 26.72 | 11.090      | 2698.597          | 0.00          | 5.325             | 8.00        | 13.00           | 0.00  | 0          | 0.00  |
| 24.90     | 0.06507        |                  |              |        |       | .029706     | 0.74              |               | 2.051             |             |                 | 0.00  |            |       |



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## WATER SURFACE PROFILE LISTING

HORSE DRIVE INTERCHANGE ROADWAY DESIGN  
 CHANNEL WITH ULTIMATE FLOW, BEGINNING Q = 444 CFS  
 WSPG FILE: HF41.DAT, BY: J.L.W., VTN, 2/18/04

| STATION   | INVERT<br>ELEV | DEPTH<br>OF FLOW | W.S.<br>ELEV | Q     | VEL   | VEL<br>HEAD | ENERGY<br>GRD.EL. | SUPER<br>ELEV | CRITICAL<br>DEPTH | HGT/<br>DIA | BASE/<br>ID NO. | ZL   | NO<br>PIER | AVBPR |
|-----------|----------------|------------------|--------------|-------|-------|-------------|-------------------|---------------|-------------------|-------------|-----------------|------|------------|-------|
| L/ELEM    | SO             |                  |              |       |       | SF AVE      | HF                |               | NORM DEPTH        |             |                 | ZR   |            |       |
| 3690.29   | 2686.52        | 2.735            | 2689.255     | 906.0 | 25.48 | 10.082      | 2699.337          | 0.00          | 5.325             | 8.00        | 13.00           | 0.00 | 0          | 0.00  |
| 19.96     | 0.06507        |                  |              |       |       | .025824     | 0.52              |               | 2.051             |             |                 | 0.00 |            |       |
| 3710.25   | 2687.82        | 2.869            | 2690.687     | 906.0 | 24.29 | 9.165       | 2699.852          | 0.00          | 5.325             | 8.00        | 13.00           | 0.00 | 0          | 0.00  |
| 16.27     | 0.06507        |                  |              |       |       | .022463     | 0.37              |               | 2.051             |             |                 | 0.00 |            |       |
| 3726.52   | 2688.88        | 3.009            | 2691.886     | 906.0 | 23.16 | 8.332       | 2700.218          | 0.00          | 5.325             | 8.00        | 13.00           | 0.00 | 0          | 0.00  |
| 13.41     | 0.06507        |                  |              |       |       | .019553     | 0.26              |               | 2.051             |             |                 | 0.00 |            |       |
| 3739.93   | 2689.75        | 3.155            | 2692.905     | 906.0 | 22.09 | 7.575       | 2700.480          | 0.00          | 5.325             | 8.00        | 13.00           | 0.00 | 0          | 0.00  |
| TRANS STR | 0.06500        |                  |              |       |       | .018250     | 0.15              |               |                   |             |                 | 0.00 |            |       |
| 3747.93   | 2690.27        | 2.962            | 2693.232     | 906.0 | 21.85 | 7.411       | 2700.643          | 0.00          | 5.068             | 8.00        | 14.00           | 0.00 | 0          | 0.00  |
| 7.63      | 0.06472        |                  |              |       |       | .017486     | 0.13              |               | 1.942             |             |                 | 0.00 |            |       |
| 3755.56   | 2690.76        | 3.058            | 2693.822     | 906.0 | 21.16 | 6.955       | 2700.777          | 0.00          | 5.068             | 8.00        | 14.00           | 0.00 | 0          | 0.00  |
| 9.83      | 0.06472        |                  |              |       |       | .015589     | 0.15              |               | 1.942             |             |                 | 0.00 |            |       |
| 3765.39   | 2691.40        | 3.207            | 2694.607     | 906.0 | 20.18 | 6.323       | 2700.930          | 0.00          | 5.068             | 8.00        | 14.00           | 0.00 | 0          | 0.00  |
| 1.69      | 0.01451        |                  |              |       |       | .014506     | 0.02              |               | 3.207             |             |                 | 0.00 |            |       |
| 3767.08   | 2691.43        | 3.207            | 2694.632     | 906.0 | 20.18 | 6.323       | 2700.955          | 0.00          | 5.068             | 8.00        | 14.00           | 0.00 | 0          | 0.00  |
| 254.67    | 0.01451        |                  |              |       |       | .014500     | 3.69              |               | 3.207             |             |                 | 0.00 |            |       |
| 4021.75   | 2695.12        | 3.208            | 2698.328     | 906.0 | 20.17 | 6.319       | 2704.647          | 0.00          | 5.068             | 8.00        | 14.00           | 0.00 | 0          | 0.00  |
| 679.11    | 0.01450        |                  |              |       |       | .014493     | 9.84              |               | 3.208             |             |                 | 0.00 |            |       |
| 4700.86   | 2704.97        | 3.208            | 2708.173     | 906.0 | 20.17 | 6.319       | 2714.492          | 0.00          | 5.068             | 8.00        | 14.00           | 0.00 | 0          | 0.00  |
| 442.45    | 0.01450        |                  |              |       |       | .013884     | 6.14              |               | 3.208             |             |                 | 0.00 |            |       |
| 5143.31   | 2711.38        | 3.306            | 2714.686     | 906.0 | 19.57 | 5.949       | 2720.635          | 0.00          | 5.068             | 8.00        | 14.00           | 0.00 | 0          | 0.00  |
| JUNCT STR | 0.00000        |                  |              |       |       | .013321     | 0.00              |               |                   |             |                 | 0.00 |            |       |

WATER SURFACE PROFILE LISTING  
HORSE DRIVE INTERCHANGE ROADWAY DESIGN  
CHANNEL WITH ULTIMATE FLOW, BEGINNING Q = 444 CFS  
WSPG FILE: HF41.DAT, BY: J.L.W., VTN, 2/18/04

| STATION   | INVERT<br>ELEV | DEPTH<br>OF FLOW | W.S.<br>ELEV | Q     | VEL   | VEL<br>HEAD | ENERGY<br>GRD.EL. | SUPER<br>ELEV | CRITICAL<br>DEPTH | HGT/<br>DIA | BASE/<br>ID NO. | ZL   | NO | AVBPR |
|-----------|----------------|------------------|--------------|-------|-------|-------------|-------------------|---------------|-------------------|-------------|-----------------|------|----|-------|
| L/ELEM    | SO             |                  |              |       |       | SF AVE      | HF                |               |                   | NORM DEPTH  |                 | ZR   |    |       |
| *****     |                |                  |              |       |       |             |                   |               |                   |             |                 |      |    |       |
| 5143.31   | 2711.38        | 3.293            | 2714.673     | 904.0 | 19.61 | 5.969       | 2720.642          | 0.00          | 5.060             | 8.00        | 14.00           | 0.00 | 0  | 0.00  |
| 189.72    | 0.01450        |                  |              |       |       | .012521     | 2.38              |               |                   | 3.202       |                 | 0.00 |    |       |
| 5333.03   | 2714.13        | 3.451            | 2717.582     | 904.0 | 18.71 | 5.437       | 2723.019          | 0.00          | 5.060             | 8.00        | 14.00           | 0.00 | 0  | 0.00  |
| 91.12     | 0.01450        |                  |              |       |       | .010925     | 1.00              |               |                   | 3.202       |                 | 0.00 |    |       |
| 5424.15   | 2715.45        | 3.619            | 2719.072     | 904.0 | 17.84 | 4.943       | 2724.015          | 0.00          | 5.060             | 8.00        | 14.00           | 0.00 | 0  | 0.00  |
| 54.80     | 0.01450        |                  |              |       |       | .009524     | 0.52              |               |                   | 3.202       |                 | 0.00 |    |       |
| 5478.95   | 2716.25        | 3.796            | 2720.043     | 904.0 | 17.01 | 4.494       | 2724.537          | 0.00          | 5.060             | 8.00        | 14.00           | 0.00 | 0  | 0.00  |
| 36.05     | 0.01450        |                  |              |       |       | .008309     | 0.30              |               |                   | 3.202       |                 | 0.00 |    |       |
| 5515.00   | 2716.77        | 3.981            | 2720.751     | 904.0 | 16.22 | 4.085       | 2724.836          | 0.00          | 5.060             | 8.00        | 14.00           | 0.00 | 0  | 0.00  |
| JUNCT STR | 0.00000        |                  |              |       |       | .007817     | 0.00              |               |                   |             |                 | 0.00 |    |       |
| 5515.00   | 2716.77        | 3.949            | 2720.719     | 902.0 | 16.32 | 4.133       | 2724.852          | 0.00          | 5.053             | 8.00        | 14.00           | 0.00 | 0  | 0.00  |
| 22.53     | 0.01465        |                  |              |       |       | .007450     | 0.17              |               |                   | 3.187       |                 | 0.00 |    |       |
| 5537.53   | 2717.10        | 4.116            | 2721.216     | 902.0 | 15.65 | 3.804       | 2725.020          | 0.00          | 5.053             | 8.00        | 14.00           | 0.00 | 0  | 0.00  |
| TRANS STR | 0.03021        |                  |              |       |       | .007941     | 0.75              |               |                   |             |                 | 0.00 |    |       |
| 5632.53   | 2719.97        | 2.399            | 2722.369     | 902.0 | 14.89 | 3.443       | 2725.812          | 0.00          | 3.410             | 8.00        | 25.25           | 0.00 | 0  | 0.00  |
| 60.00     | 0.00967        |                  |              |       |       | .008691     | 0.52              |               |                   | 2.334       |                 | 0.00 |    |       |
| 5692.53   | 2720.55        | 2.431            | 2722.981     | 902.0 | 14.69 | 3.353       | 2726.334          | 0.00          | 3.410             | 8.00        | 25.25           | 0.00 | 0  | 0.00  |
| JUNCT STR | 0.00000        |                  |              |       |       | .009065     | 0.00              |               |                   |             |                 | 0.00 |    |       |
| 5692.53   | 2720.55        | 2.573            | 2723.123     | 444.0 | 14.38 | 3.211       | 2726.334          | 0.00          | 3.491             | 6.00        | 12.00           | 0.00 | 0  | 0.00  |
| 50.11     | 0.00958        |                  |              |       |       | .009631     | 0.48              |               |                   | 2.576       |                 | 0.00 |    |       |
| 5742.64   | 2721.03        | 2.571            | 2723.601     | 444.0 | 14.39 | 3.217       | 2726.818          | 0.00          | 3.491             | 6.00        | 12.00           | 0.00 | 0  | 0.00  |
| 214.60    | 0.00965        |                  |              |       |       | .009632     | 2.07              |               |                   | 2.570       |                 | 0.00 |    |       |

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## WATER SURFACE PROFILE LISTING

HORSE DRIVE INTERCHANGE ROADWAY DESIGN  
 CHANNEL WITH ULTIMATE FLOW, BEGINNING Q = 444 CFS  
 WSPG FILE: HF41.DAT, BY: J.L.W., VTN, 2/18/04

| STATION   | INVERT<br>ELEV | DEPTH<br>OF FLOW | W.S.<br>ELEV | Q     | VEL   | VEL<br>HEAD | ENERGY<br>GRD.EL. | SUPER<br>ELEV | CRITICAL<br>DEPTH | HGT/<br>DIA | BASE/<br>ID NO. | ZL   | NO<br>PIER | AVBPR |
|-----------|----------------|------------------|--------------|-------|-------|-------------|-------------------|---------------|-------------------|-------------|-----------------|------|------------|-------|
| L/ELEM    | SO             |                  |              |       |       | SF AVE      | HF                |               |                   | NORM DEPTH  |                 | ZR   |            |       |
| 5957.24   | 2723.10        | 2.572            | 2725.672     | 444.0 | 14.38 | 3.212       | 2728.884          | 0.00          | 3.491             | 6.00        | 12.00           | 0.00 | 0          | 0.00  |
| 214.59    | 0.00960        |                  |              |       |       | .009709     | 2.08              |               |                   | 2.575       |                 | 0.00 |            |       |
| 6171.83   | 2725.16        | 2.557            | 2727.717     | 444.0 | 14.47 | 3.251       | 2730.968          | 0.00          | 3.491             | 6.00        | 12.00           | 0.00 | 0          | 0.00  |
| 82.41     | 0.00959        |                  |              |       |       | .009886     | 0.81              |               |                   | 2.576       |                 | 0.00 |            |       |
| 6254.24   | 2725.95        | 2.541            | 2728.491     | 444.0 | 14.56 | 3.292       | 2731.783          | 0.00          | 3.491             | 6.00        | 12.00           | 0.00 | 0          | 0.00  |
|           |                |                  |              |       |       | .031927     | 4.47              |               |                   |             |                 | 0.00 |            |       |
| TRANS STR | 0.03000        |                  |              |       |       |             |                   |               |                   |             |                 |      |            |       |
| 6394.24   | 2730.15        | 0.814            | 2730.964     | 444.0 | 19.31 | 5.790       | 2736.754          | 0.00          | 1.973             | 6.00        | 28.25           | 0.00 | 0          | 0.00  |
| 8.51      | 0.02000        |                  |              |       |       | .056459     | 0.48              |               |                   | 1.104       |                 | 0.00 |            |       |
| 6402.75   | 2730.32        | 0.791            | 2731.111     | 444.0 | 19.86 | 6.124       | 2737.235          | 0.00          | 1.973             | 6.00        | 28.25           | 0.00 | 0          | 0.00  |
| 13.08     | 0.02000        |                  |              |       |       | .064007     | 0.84              |               |                   | 1.104       |                 | 0.00 |            |       |
| 6415.83   | 2730.58        | 0.755            | 2731.337     | 444.0 | 20.83 | 6.737       | 2738.074          | 0.00          | 1.973             | 6.00        | 28.25           | 0.00 | 0          | 0.00  |
| 11.65     | 0.02000        |                  |              |       |       | .074786     | 0.87              |               |                   | 1.104       |                 | 0.00 |            |       |
| 6427.48   | 2730.82        | 0.719            | 2731.534     | 444.0 | 21.85 | 7.411       | 2738.945          | 0.00          | 1.973             | 6.00        | 28.25           | 0.00 | 0          | 0.00  |
| 10.50     | 0.02000        |                  |              |       |       | .087392     | 0.92              |               |                   | 1.104       |                 | 0.00 |            |       |
| 6437.98   | 2731.03        | 0.686            | 2731.711     | 444.0 | 22.91 | 8.151       | 2739.862          | 0.00          | 1.973             | 6.00        | 28.25           | 0.00 | 0          | 0.00  |
| 9.54      | 0.02000        |                  |              |       |       | .102137     | 0.97              |               |                   | 1.104       |                 | 0.00 |            |       |
| 6447.52   | 2731.22        | 0.654            | 2731.870     | 444.0 | 24.03 | 8.966       | 2740.836          | 0.00          | 1.973             | 6.00        | 28.25           | 0.00 | 0          | 0.00  |
| 8.71      | 0.02000        |                  |              |       |       | .119385     | 1.04              |               |                   | 1.104       |                 | 0.00 |            |       |
| 6456.23   | 2731.39        | 0.624            | 2732.014     | 444.0 | 25.20 | 9.863       | 2741.877          | 0.00          | 1.973             | 6.00        | 28.25           | 0.00 | 0          | 0.00  |
| 8.01      | 0.02000        |                  |              |       |       | .139564     | 1.12              |               |                   | 1.104       |                 | 0.00 |            |       |
| 6464.24   | 2731.55        | 0.595            | 2732.145     | 444.0 | 26.43 | 10.850      | 2742.995          | 0.00          | 1.973             | 6.00        | 28.25           | 0.00 | 0          | 0.00  |
|           |                |                  |              |       |       |             |                   |               |                   |             |                 | 0.00 |            |       |

WALL EXIT

WATER SURFACE PROFILE LISTING  
HORSE DRIVE INTERCHANGE ROADWAY DESIGN  
CHANNEL WITH ULTIMATE FLOW, BEGINNING Q = 444 CFS  
WSPG FILE: HF41.DAT, BY: J.L.W., VTN, 2/18/04

| STATION | INVERT<br>ELEV | DEPTH<br>OF FLOW | W.S.<br>ELEV | Q     | VEL   | VEL<br>HEAD | ENERGY<br>GRD.EL. | SUPER<br>ELEV | CRITICAL<br>DEPTH | HGT/<br>DIA | BASE/<br>ID NO. | ZL   | NO<br>PIER | AVBPR |
|---------|----------------|------------------|--------------|-------|-------|-------------|-------------------|---------------|-------------------|-------------|-----------------|------|------------|-------|
| L/ELEM  | SO             |                  |              |       |       | SF AVE      | HF                |               | NORM DEPTH        |             |                 | ZR   |            |       |
| 6464.24 | 2731.55        | 1.217            | 2732.767     | 444.0 | 26.06 | 10.542      | 2743.309          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00 | 0          | 0.00  |
| 30.75   | 0.08944        |                  |              |       |       | .061577     | 1.89              |               | 1.104             |             |                 | 0.00 |            |       |
| 6494.99 | 2734.30        | 1.273            | 2735.573     | 444.0 | 24.91 | 9.632       | 2745.205          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00 | 0          | 0.00  |
| 22.50   | 0.08944        |                  |              |       |       | .053272     | 1.20              |               | 1.104             |             |                 | 0.00 |            |       |
| 6517.49 | 2736.31        | 1.335            | 2737.647     | 444.0 | 23.75 | 8.757       | 2746.404          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00 | 0          | 0.00  |
| 16.79   | 0.08944        |                  |              |       |       | .045912     | 0.77              |               | 1.104             |             |                 | 0.00 |            |       |
| 6534.28 | 2737.81        | 1.401            | 2739.215     | 444.0 | 22.64 | 7.961       | 2747.176          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00 | 0          | 0.00  |
| 13.15   | 0.08944        |                  |              |       |       | .039585     | 0.52              |               | 1.104             |             |                 | 0.00 |            |       |
| 6547.43 | 2738.99        | 1.469            | 2740.459     | 444.0 | 21.59 | 7.237       | 2747.696          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00 | 0          | 0.00  |
| 10.60   | 0.08944        |                  |              |       |       | .034145     | 0.36              |               | 1.104             |             |                 | 0.00 |            |       |
| 6558.03 | 2739.94        | 1.541            | 2741.479     | 444.0 | 20.58 | 6.579       | 2748.058          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00 | 0          | 0.00  |
| 8.72    | 0.08944        |                  |              |       |       | .029465     | 0.26              |               | 1.104             |             |                 | 0.00 |            |       |
| 6566.75 | 2740.72        | 1.616            | 2742.334     | 444.0 | 19.63 | 5.981       | 2748.315          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00 | 0          | 0.00  |
| 7.26    | 0.08944        |                  |              |       |       | .025438     | 0.18              |               | 1.104             |             |                 | 0.00 |            |       |
| 6574.01 | 2741.37        | 1.695            | 2743.063     | 444.0 | 18.71 | 5.437       | 2748.500          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00 | 0          | 0.00  |
| 6.10    | 0.08944        |                  |              |       |       | .021972     | 0.13              |               | 1.104             |             |                 | 0.00 |            |       |
| 6580.11 | 2741.91        | 1.778            | 2743.691     | 444.0 | 17.84 | 4.943       | 2748.634          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00 | 0          | 0.00  |
| 5.15    | 0.08944        |                  |              |       |       | .018988     | 0.10              |               | 1.104             |             |                 | 0.00 |            |       |
| 6585.26 | 2742.37        | 1.864            | 2744.237     | 444.0 | 17.01 | 4.494       | 2748.731          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00 | 0          | 0.00  |
| 4.35    | 0.08944        |                  |              |       |       | .016416     | 0.07              |               | 1.104             |             |                 | 0.00 |            |       |
| 6589.61 | 2742.76        | 1.955            | 2744.717     | 444.0 | 16.22 | 4.085       | 2748.802          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00 | 0          | 0.00  |
| 3.66    | 0.08944        |                  |              |       |       | .014200     | 0.05              |               | 1.104             |             |                 | 0.00 |            |       |



## WATER SURFACE PROFILE LISTING

HORSE DRIVE INTERCHANGE ROADWAY DESIGN  
 CHANNEL WITH ULTIMATE FLOW, BEGINNING Q = 444 CFS  
 WSPG FILE: HF41.DAT, BY: J.L.W., VTN, 2/18/04

| STATION | INVERT<br>ELEV | DEPTH<br>OF FLOW | W.S.<br>ELEV | Q     | VEL   | VEL<br>HEAD | ENERGY<br>GRD.EL. | SUPER<br>ELEV | CRITICAL<br>DEPTH | HGT/<br>DIA | BASE/<br>ID NO. | ZL<br>PIER | NO | AVBPR |
|---------|----------------|------------------|--------------|-------|-------|-------------|-------------------|---------------|-------------------|-------------|-----------------|------------|----|-------|
| L/ELEM  | SO             |                  |              |       |       | SF AVE      | HF                |               |                   | NORM DEPTH  |                 | ZR         |    |       |
| 6593.27 | 2743.09        | 2.051            | 2745.141     | 444.0 | 15.46 | 3.714       | 2748.855          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00       | 0  | 0.00  |
| 3.08    | 0.08944        |                  |              |       |       | .012290     | 0.04              |               |                   | 1.104       |                 | 0.00       |    |       |
| 6596.35 | 2743.37        | 2.151            | 2745.517     | 444.0 | 14.75 | 3.376       | 2748.893          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00       | 0  | 0.00  |
| 2.57    | 0.08944        |                  |              |       |       | .010643     | 0.03              |               |                   | 1.104       |                 | 0.00       |    |       |
| 6598.92 | 2743.59        | 2.256            | 2745.851     | 444.0 | 14.06 | 3.069       | 2748.920          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00       | 0  | 0.00  |
| 2.10    | 0.08944        |                  |              |       |       | .009222     | 0.02              |               |                   | 1.104       |                 | 0.00       |    |       |
| 6601.02 | 2743.78        | 2.366            | 2746.149     | 444.0 | 13.40 | 2.790       | 2748.939          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00       | 0  | 0.00  |
| 1.70    | 0.08944        |                  |              |       |       | .007994     | 0.01              |               |                   | 1.104       |                 | 0.00       |    |       |
| 6602.72 | 2743.93        | 2.481            | 2746.416     | 444.0 | 12.78 | 2.537       | 2748.953          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00       | 0  | 0.00  |
| 1.33    | 0.08944        |                  |              |       |       | .006934     | 0.01              |               |                   | 1.104       |                 | 0.00       |    |       |
| 6604.05 | 2744.05        | 2.602            | 2746.656     | 444.0 | 12.19 | 2.306       | 2748.962          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00       | 0  | 0.00  |
| 0.99    | 0.08944        |                  |              |       |       | .006018     | 0.01              |               |                   | 1.104       |                 | 0.00       |    |       |
| 6605.04 | 2744.14        | 2.730            | 2746.872     | 444.0 | 11.62 | 2.096       | 2748.968          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00       | 0  | 0.00  |
| 0.68    | 0.08944        |                  |              |       |       | .005227     | 0.00              |               |                   | 1.104       |                 | 0.00       |    |       |
| 6605.72 | 2744.20        | 2.863            | 2747.066     | 444.0 | 11.08 | 1.906       | 2748.972          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00       | 0  | 0.00  |
| 0.39    | 0.08944        |                  |              |       |       | .004542     | 0.00              |               |                   | 1.104       |                 | 0.00       |    |       |
| 6606.11 | 2744.24        | 3.002            | 2747.241     | 444.0 | 10.56 | 1.733       | 2748.974          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00       | 0  | 0.00  |
| 0.13    | 0.08944        |                  |              |       |       | .003947     | 0.00              |               |                   | 1.104       |                 | 0.00       |    |       |
| 6606.24 | 2744.25        | 3.150            | 2747.400     | 444.0 | 10.07 | 1.574       | 2748.974          | 0.00          | 3.150             | 4.00        | 14.00           | 0.00       | 0  | 0.00  |

HORSE DRIVE INTERCHANGE ROADWAY DESIGN  
CHANNEL WITH ULTIMATE FLOW, BEGINNING Q = 444 CFS  
WSPG FILE: HF41.DAT, BY: J.L.W., VTN, 2/18/04

| TIME    | STATION | TYPE |
|---------|---------|------|
| 1229.75 | I WCH E | R    |
| 1265.36 |         |      |
| 1300.96 |         |      |
| 1336.57 |         |      |
| 1372.17 |         |      |
| 1407.78 |         |      |
| 1443.39 |         |      |
| 1478.99 | I WCH E | R    |
| 1514.60 |         |      |
| 1550.20 |         |      |
| 1585.81 |         |      |
| 1621.41 |         |      |
| 1657.02 |         |      |
| 1692.63 |         |      |
| 1728.23 |         |      |
| 1763.84 |         |      |
| 1799.44 |         |      |
| 1835.05 |         |      |
| 1870.66 |         |      |
| 1906.26 | I WCH E | TX   |
| 1941.87 |         |      |
| 1977.47 | I W C X | R    |
| 2013.08 |         |      |
| 2048.69 | I WC X  | JX   |
| 2084.29 | I WCH E | R    |
| 2119.90 | I WCH E | R    |
| 2155.50 |         |      |
| 2191.11 |         |      |
| 2226.72 |         |      |
| 2262.32 |         |      |
| 2297.93 | I WCH E | R    |
| 2333.53 |         |      |
| 2369.14 |         |      |
| 2404.74 | I WCH E | R    |
| 2440.35 |         |      |
| 2475.96 | I WCH E | R    |
| 2511.56 |         |      |
| 2547.17 | I WCH E | R    |
| 2582.77 |         |      |
| 2618.38 | I WCH E | R    |
| 2653.99 |         |      |
| 2689.59 | I WCH E | R    |
| 2725.20 |         |      |
| 2760.80 |         |      |
| 2796.41 | I WCH E | R    |
| 2832.02 |         |      |
| 2867.62 |         |      |
| 2903.23 |         |      |
| 2938.83 |         |      |
| 2974.44 |         |      |
| 3010.04 |         |      |
| 3045.65 |         |      |
| 3081.26 |         |      |
| 3116.86 |         |      |
| 3152.47 |         |      |
| 3188.07 |         |      |
| 3223.68 |         |      |
| 3259.29 |         |      |
| 3294.89 |         |      |
| 3330.50 | I WCH E | TX   |
| 3366.10 |         |      |
| 3401.71 |         |      |
| 3437.32 | IWC H E | R    |
| 3472.92 | IWC H E | R    |
| 3508.53 | IWC H E | JX   |
| 3544.13 | IWC H E | R    |
| 3579.74 |         |      |
| 3615.34 | IWC H E | R    |
| 3650.95 | IWC H E | R    |
| 3686.56 | IWC H E | R    |
| 3722.16 | IWC H E | R    |
| 3757.77 | IWC H E | R    |
| 3793.37 | IWC H E | R    |
| 3828.98 | IWC H E | TX   |
| 3864.59 | IWC H E | R    |
| 3900.19 | IWC H E | R    |
| 3935.80 | IWC H E | R    |
| 3971.40 | IWC H E | R    |
| 4007.01 |         |      |
| 4042.62 | I WCH E | R    |
| 4078.22 |         |      |
| 4113.83 |         |      |
| 4149.43 |         |      |
| 4185.04 |         |      |
| 4220.65 |         |      |
| 4256.25 |         |      |
| 4291.86 |         |      |
| 4327.46 |         |      |
| 4363.07 |         |      |
| 4398.67 |         |      |
| 4434.28 |         |      |
| 4469.89 |         |      |
| 4505.49 |         |      |
| 4541.10 |         |      |



**B-5**

**DESIGN HYDRAULIC SUMMARY**



HYDRAULICS SUMMARY - MAINLINE  
DESIGN CONDITION FLOWS  
(n=0.015)

Values in English Units

| CHANNEL<br>STATION | REMARKS                               | DESIGN<br>FLOW<br>Q | DEPTH<br>OF FLOW<br>y | INVERT<br>ELEV | VELOCITY<br>V | H.G.L.  | E.G.L.  | CHANNEL<br>TYPE | BASE<br>WIDTH | SIDE<br>SLOPE | FLOW<br>AREA | W.S.<br>WIDTH | FROUDE<br>NUMBER | CURVE<br>RADIUS<br>R | SUPER<br>ELEV | ROLL<br>WAVE <sup>(2)</sup> | CCRFGD<br>MIN FB <sup>(3)</sup> | MIN<br>WALL HT | DESIGN<br>WALL HT | ACTUAL<br>FB | FB<br>CHECK |
|--------------------|---------------------------------------|---------------------|-----------------------|----------------|---------------|---------|---------|-----------------|---------------|---------------|--------------|---------------|------------------|----------------------|---------------|-----------------------------|---------------------------------|----------------|-------------------|--------------|-------------|
| 66+06.24           | begin 4'x14' RCB                      | 467                 | 3.258                 | 2744.25        | 10.24         | 2747.51 | 2749.14 | RCB             | 14            | 0             | 45.61        | 14.00         | 1.00             |                      |               |                             | 2.13                            | 5.39           | 4.00              | 0.74         | RCB, Ok     |
| 64+64.24           | end 4'x14' RCB                        | 467                 | 1.265                 | 2731.55        | 26.36         | 2732.82 | 2743.60 | RCB             | 14            | 0             | 17.71        | 14.00         | 4.13             |                      |               |                             | 1.71                            | 2.98           | 4.00              | 2.74         | RCB, Ok     |
| 64+64.24           | begin 6'x28.25' RCB, begin confluence | 467                 | 0.619                 | 2731.55        | 26.72         | 2732.17 | 2743.26 | RCB             | 28.25         | 0             | 17.49        | 28.25         | 5.98             |                      |               |                             | 1.57                            | 2.19           | 6.00              | 5.38         | RCB, Ok     |
| 63+94.24           | end 6'x28.25' RCB                     | 467                 | 0.836                 | 2730.15        | 19.77         | 2730.99 | 2737.06 | RCB             | 28.25         | 0             | 23.62        | 28.25         | 3.81             |                      |               |                             | 1.47                            | 2.30           | 6.00              | 5.16         | RCB, Ok     |
| 63+94.24           | begin transition                      | 467                 | 0.836                 | 2730.15        | 19.77         | 2730.99 | 2737.06 | RCB             | 28.25         | 0             | 23.62        | 28.25         | 3.81             |                      |               |                             | 1.47                            | 2.30           | 6.00              | 5.16         | RCB, Ok     |
| 62+54.24           | end transition, end confluence        | 467                 | 2.619                 | 2725.95        | 14.86         | 2728.57 | 2732.00 | RCB             | 12            | 0             | 31.43        | 12.00         | 1.62             |                      |               |                             | 1.51                            | 4.13           | 6.00              | 3.38         | RCB, Ok     |
| 62+54.24           | begin 6'x12' RCB                      | 467                 | 2.619                 | 2725.95        | 14.86         | 2728.57 | 2732.00 | RCB             | 12            | 0             | 31.43        | 12.00         | 1.62             |                      |               |                             | 1.51                            | 4.13           | 6.00              | 3.38         | RCB, Ok     |
| 61+71.83           |                                       | 467                 | 2.640                 | 2725.16        | 14.74         | 2727.80 | 2731.17 | RCB             | 12            | 0             | 31.68        | 12.00         | 1.60             |                      |               |                             | 1.51                            | 4.15           | 6.00              | 3.36         | RCB, Ok     |
| 61+71.83           | PT, R=1000'                           | 467                 | 2.640                 | 2725.16        | 14.74         | 2727.80 | 2731.17 | RCB             | 12            | 0             | 31.68        | 12.00         | 1.60             | 1000                 | 0.081         |                             | 1.51                            | 4.23           | 6.00              | 3.28         | RCB, Ok     |
| 59+57.24           | PC, R=1000                            | 467                 | 2.661                 | 2723.10        | 14.62         | 2725.76 | 2729.08 | RCB             | 12            | 0             | 31.93        | 12.00         | 1.58             | 1000                 | 0.080         |                             | 1.51                            | 4.25           | 6.00              | 3.26         | RCB, Ok     |
| 59+57.24           | PT, R=1000'                           | 467                 | 2.661                 | 2723.10        | 14.62         | 2725.76 | 2729.08 | RCB             | 12            | 0             | 31.93        | 12.00         | 1.58             | 1000                 | 0.080         |                             | 1.51                            | 4.25           | 6.00              | 3.26         | RCB, Ok     |
| 57+42.64           | PC, R=1000                            | 467                 | 2.661                 | 2721.03        | 14.62         | 2723.69 | 2727.01 | RCB             | 12            | 0             | 31.93        | 12.00         | 1.58             | 1000                 | 0.080         |                             | 1.51                            | 4.25           | 6.00              | 3.26         | RCB, Ok     |
| 57+42.64           |                                       | 467                 | 2.661                 | 2721.03        | 14.62         | 2723.69 | 2727.01 | RCB             | 12            | 0             | 31.93        | 12.00         | 1.58             |                      |               |                             | 1.51                            | 4.17           | 6.00              | 3.34         | RCB, Ok     |
| 56+92.53           | end 6'x12' RCB                        | 467                 | 2.663                 | 2720.55        | 14.61         | 2723.21 | 2726.53 | RCB             | 12            | 0             | 31.96        | 12.00         | 1.58             |                      |               |                             | 1.51                            | 4.17           | 6.00              | 3.34         | RCB, Ok     |
| 56+92.53           | begin 8'x25.25' RCB, begin confluence | 680                 | 1.948                 | 2720.55        | 13.82         | 2722.50 | 2725.46 | RCB             | 25.25         | 0             | 49.19        | 25.25         | 1.74             |                      |               |                             | 1.43                            | 3.38           | 8.00              | 6.05         | RCB, Ok     |
| 56+32.53           | end 8'x25.25' RCB                     | 680                 | 1.949                 | 2719.97        | 13.82         | 2721.92 | 2724.89 | RCB             | 25.25         | 0             | 49.21        | 25.25         | 1.74             |                      |               |                             | 1.43                            | 3.38           | 8.00              | 6.05         | RCB, Ok     |
| 56+32.53           | begin transition                      | 680                 | 1.949                 | 2719.97        | 13.82         | 2721.92 | 2724.89 | RCB             | 25.25         | 0             | 49.21        | 25.25         | 1.74             |                      |               |                             | 1.43                            | 3.38           | 8.00              | 6.05         | RCB, Ok     |
| 55+37.53           | end transition, end confluence        | 680                 | 3.150                 | 2717.10        | 15.42         | 2720.25 | 2723.94 | RCB             | 14            | 0             | 44.10        | 14.00         | 1.53             |                      |               |                             | 1.57                            | 4.72           | 8.00              | 4.85         | RCB, Ok     |
| 55+37.53           | begin 8'x14' RCB                      | 680                 | 3.150                 | 2717.10        | 15.42         | 2720.25 | 2723.94 | RCB             | 14            | 0             | 44.10        | 14.00         | 1.53             |                      |               |                             | 1.57                            | 4.72           | 8.00              | 4.85         | RCB, Ok     |
| 55+15.00           |                                       | 680                 | 3.062                 | 2716.77        | 15.86         | 2719.83 | 2723.74 | RCB             | 14            | 0             | 42.87        | 14.00         | 1.60             |                      |               |                             | 1.58                            | 4.64           | 8.00              | 4.94         | RCB, Ok     |
| 55+15.00           | 36" RCP lateral entrance              | 712                 | 3.638                 | 2716.77        | 13.98         | 2720.41 | 2723.44 | RCB             | 14            | 0             | 50.93        | 14.00         | 1.29             |                      |               |                             | 1.54                            | 5.18           | 8.00              | 4.36         | RCB, Ok     |
| 51+43.31           |                                       | 712                 | 2.790                 | 2711.38        | 18.23         | 2714.17 | 2719.33 | RCB             | 14            | 0             | 39.06        | 14.00         | 1.92             |                      |               |                             | 1.64                            | 4.43           | 8.00              | 5.21         | RCB, Ok     |
| 51+43.31           | 36" RCP lateral entrance              | 742                 | 3.145                 | 2711.38        | 16.85         | 2714.52 | 2718.93 | RCB             | 14            | 0             | 44.03        | 14.00         | 1.67             |                      |               |                             | 1.62                            | 4.76           | 8.00              | 4.86         | RCB, Ok     |
| 40+21.75           |                                       | 742                 | 2.799                 | 2695.12        | 18.94         | 2697.92 | 2703.49 | RCB             | 14            | 0             | 39.19        | 14.00         | 2.00             |                      |               |                             | 1.67                            | 4.47           | 8.00              | 5.20         | RCB, Ok     |
| 40+21.75           | PT, R=1000'                           | 742                 | 2.799                 | 2695.12        | 18.94         | 2697.92 | 2703.49 | RCB             | 14            | 0             | 39.19        | 14.00         | 2.00             | 1000                 | 0.156         |                             | 1.67                            | 4.62           | 8.00              | 5.05         | RCB, Ok     |
| 37+65.39           |                                       | 742                 | 2.799                 | 2691.40        | 18.94         | 2694.20 | 2699.77 | RCB             | 14            | 0             | 39.19        | 14.00         | 2.00             | 1000                 | 0.156         |                             | 1.67                            | 4.62           | 8.00              | 5.05         | RCB, Ok     |
| 37+65.39           |                                       | 742                 | 2.799                 | 2691.40        | 18.94         | 2694.20 | 2699.77 | RCB             | 14            | 0             | 39.19        | 14.00         | 2.00             | 1000                 | 0.156         |                             | 1.67                            | 4.62           | 8.00              | 5.05         | RCB, Ok     |
| 37+47.93           | end 8'x14' RCB; PC, R=1000            | 742                 | 2.562                 | 2690.27        | 20.68         | 2692.83 | 2699.47 | RCB             | 14            | 0             | 35.87        | 14.00         | 2.28             | 1000                 | 0.186         |                             | 1.71                            | 4.46           | 8.00              | 5.25         | RCB, Ok     |
| 37+47.93           | begin transition                      | 742                 | 2.562                 | 2690.27        | 20.68         | 2692.83 | 2699.47 | RCB             | 14            | 0             | 35.87        | 14.00         | 2.28             |                      |               |                             | 1.71                            | 4.27           | 8.00              | 5.44         | RCB, Ok     |
| 37+39.93           | end transition                        | 742                 | 2.720                 | 2689.75        | 20.98         | 2692.47 | 2699.30 | RCB             | 13            | 0             | 35.36        | 13.00         | 2.24             |                      |               |                             | 1.73                            | 4.45           | 8.00              | 5.28         | RCB, Ok     |

| CHANNEL<br>STATION | REMARKS                              | DESIGN<br>FLOW<br>Q | DEPTH<br>OF FLOW<br>y | INVERT<br>ELEV | VELOCITY<br>V | H.G.L.  | E.G.L.  | CHANNEL<br>TYPE | BASE<br>WIDTH | SIDE<br>SLOPE | FLOW<br>AREA | W.S.<br>WIDTH | FROUDE<br>NUMBER | CURVE<br>RADIUS<br>R | SUPER<br>ELEV | ROLL<br>WAVE <sup>(2)</sup> | CCRFCD<br>MIN FB <sup>(3)</sup> | MIN<br>WALL HT | DESIGN<br>WALL HT | ACTUAL<br>FB | FB<br>CHECK |
|--------------------|--------------------------------------|---------------------|-----------------------|----------------|---------------|---------|---------|-----------------|---------------|---------------|--------------|---------------|------------------|----------------------|---------------|-----------------------------|---------------------------------|----------------|-------------------|--------------|-------------|
| 37+39.93           | begin 8'x13' RCB; PT, R=1000         | 742                 | 2.720                 | 2689.75        | 20.98         | 2692.47 | 2699.30 | RCB             | 13            | 0             | 35.36        | 13.00         | 2.24             | 1000                 | 0.178         |                             | 1.73                            | 4.63           | 8.00              | 5.10         | RCB, Ok     |
| 36+12.53           |                                      | 742                 | 2.074                 | 2681.46        | 27.51         | 2683.53 | 2695.29 | RCB             | 13            | 0             | 26.96        | 13.00         | 3.37             | 1000                 | 0.306         |                             | 1.88                            | 4.26           | 8.00              | 5.62         | RCB, Ok     |
| 36+12.53           |                                      | 742                 | 2.074                 | 2681.46        | 27.51         | 2683.53 | 2695.29 | RCB             | 13            | 0             | 26.96        | 13.00         | 3.37             | 1000                 | 0.306         |                             | 1.88                            | 4.26           | 8.00              | 5.62         | RCB, Ok     |
| 34+74.12           | end 8'x13' RCB; PC, R=1000           | 742                 | 2.189                 | 2677.17        | 26.07         | 2679.36 | 2689.91 | RCB             | 13            | 0             | 28.46        | 13.00         | 3.11             | 1000                 | 0.274         |                             | 1.85                            | 4.31           | 8.00              | 5.54         | RCB, Ok     |
| 34+74.12           | begin 8'x23' RCB, begin confluence   | 742                 | 1.210                 | 2677.17        | 26.66         | 2678.38 | 2689.42 | RCB             | 23            | 0             | 27.83        | 23.00         | 4.27             |                      |               |                             | 1.71                            | 2.92           | 8.00              | 6.79         | RCB, Ok     |
| 34+14.12           | end 8'x23' RCB                       | 742                 | 1.391                 | 2676.57        | 23.20         | 2677.96 | 2686.32 | RCB             | 23            | 0             | 31.99        | 23.00         | 3.47             |                      |               |                             | 1.65                            | 3.04           | 8.00              | 6.61         | RCB, Ok     |
| 34+14.12           | begin transition                     | 742                 | 1.391                 | 2676.57        | 23.20         | 2677.96 | 2686.32 | RCB             | 23            | 0             | 31.99        | 23.00         | 3.47             |                      |               |                             | 1.65                            | 3.04           | 8.00              | 6.61         | RCB, Ok     |
| 33+14.12           | end transition, end confluence       | 742                 | 2.654                 | 2671.94        | 23.30         | 2674.59 | 2683.02 | RCB             | 12            | 0             | 31.85        | 12.00         | 2.52             |                      |               |                             | 1.81                            | 4.46           | 8.00              | 5.35         | RCB, Ok     |
| 33+14.12           | begin 8'x12' RCB                     | 742                 | 2.654                 | 2671.94        | 23.30         | 2674.59 | 2683.02 | RCB             | 12            | 0             | 31.85        | 12.00         | 2.52             |                      |               |                             | 1.81                            | 4.46           | 8.00              | 5.35         | RCB, Ok     |
| 26+70.00           |                                      | 742                 | 2.847                 | 2659.06        | 21.72         | 2661.91 | 2669.23 | RCB             | 12            | 0             | 34.16        | 12.00         | 2.27             |                      |               |                             | 1.77                            | 4.62           | 8.00              | 5.15         | RCB, Ok     |
| 26+70.00           |                                      | 742                 | 2.847                 | 2659.06        | 21.72         | 2661.91 | 2669.23 | RCB             | 12            | 0             | 34.16        | 12.00         | 2.27             |                      |               |                             | 1.77                            | 4.62           | 8.00              | 5.15         | RCB, Ok     |
| 20+35.60           | end 8'x12' RCB                       | 742                 | 3.914                 | 2654.19        | 15.80         | 2658.10 | 2661.98 | RCB             | 12            | 0             | 46.97        | 12.00         | 1.41             |                      |               |                             | 1.62                            | 5.54           | 8.00              | 4.09         | RCB, Ok     |
| 20+35.60           | begin 11'x30' RECT, begin confluence | 1,454               | 3.134                 | 2654.19        | 15.46         | 2657.32 | 2661.04 | RECT            | 30            | 0             | 94.02        | 30.00         | 1.54             |                      |               |                             | 1.57                            | 4.70           | 11.00             | 7.87         | OK          |
| 19+65.60           | end 11'x30' RECT                     | 1,454               | 3.199                 | 2653.81        | 15.15         | 2657.00 | 2660.57 | RECT            | 30            | 0             | 95.97        | 30.00         | 1.49             |                      |               |                             | 1.56                            | 4.76           | 11.00             | 7.80         | OK          |
| 19+65.60           | begin transition                     | 1,454               | 3.199                 | 2653.81        | 15.15         | 2657.00 | 2660.57 | RECT            | 30            | 0             | 95.97        | 30.00         | 1.49             |                      |               |                             | 1.56                            | 4.76           | 11.00             | 7.80         | OK          |
| 18+75.60           | end transition, end confluence       | 1,454               | 4.304                 | 2651.16        | 16.89         | 2655.47 | 2659.90 | RECT            | 20            | 0             | 86.08        | 20.00         | 1.43             |                      |               |                             | 1.69                            | 5.99           | 11.00             | 6.70         | OK          |
| 18+75.60           | begin 11'x20' RECT                   | 1,454               | 4.304                 | 2651.16        | 16.89         | 2655.47 | 2659.90 | RECT            | 20            | 0             | 86.08        | 20.00         | 1.43             |                      |               |                             | 1.69                            | 5.99           | 11.00             | 6.70         | OK          |
| 12+29.75           | end 11'x20' RECT                     | 1,454               | 4.603                 | 2647.61        | 15.79         | 2652.21 | 2656.08 | RECT            | 20            | 0             | 92.06        | 20.00         | 1.30             |                      |               |                             | 1.66                            | 6.26           | 11.00             | 6.40         | OK          |

Note:

(1) Depth with air entrainment,  $y^*/y = 0.906(e)^{0.0015}$  ( $Fr \geq 1.60$ ;  $y^* = y$ ,  $Fr < 1.60$ ). See *WASURO User's Manual (Draft)*, US Army Corps of Engineers Los Angeles District, July 1985.

(2) To be calculated in the future.

(3) For supercritical flow,  $F_B = 1 + 0.025V(Y^{1/3})$ ; for subcritical flow,  $F_B = 0.5 + V^2/2g$ . See *Hydrologic Criteria and Drainage Design Manual*, CCRFCD, 1999.



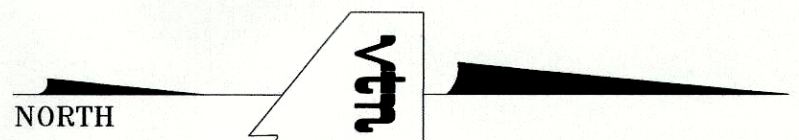
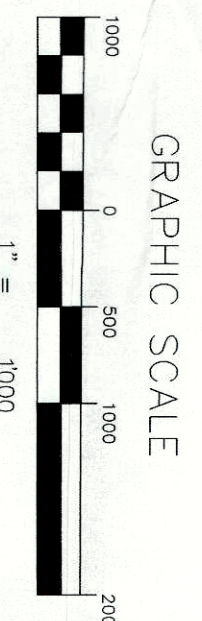
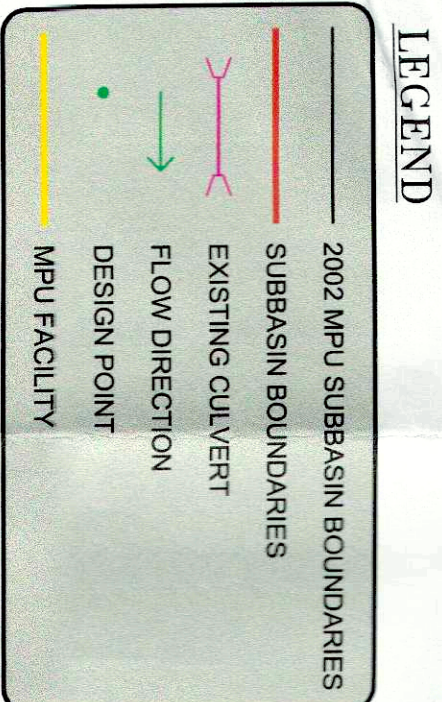
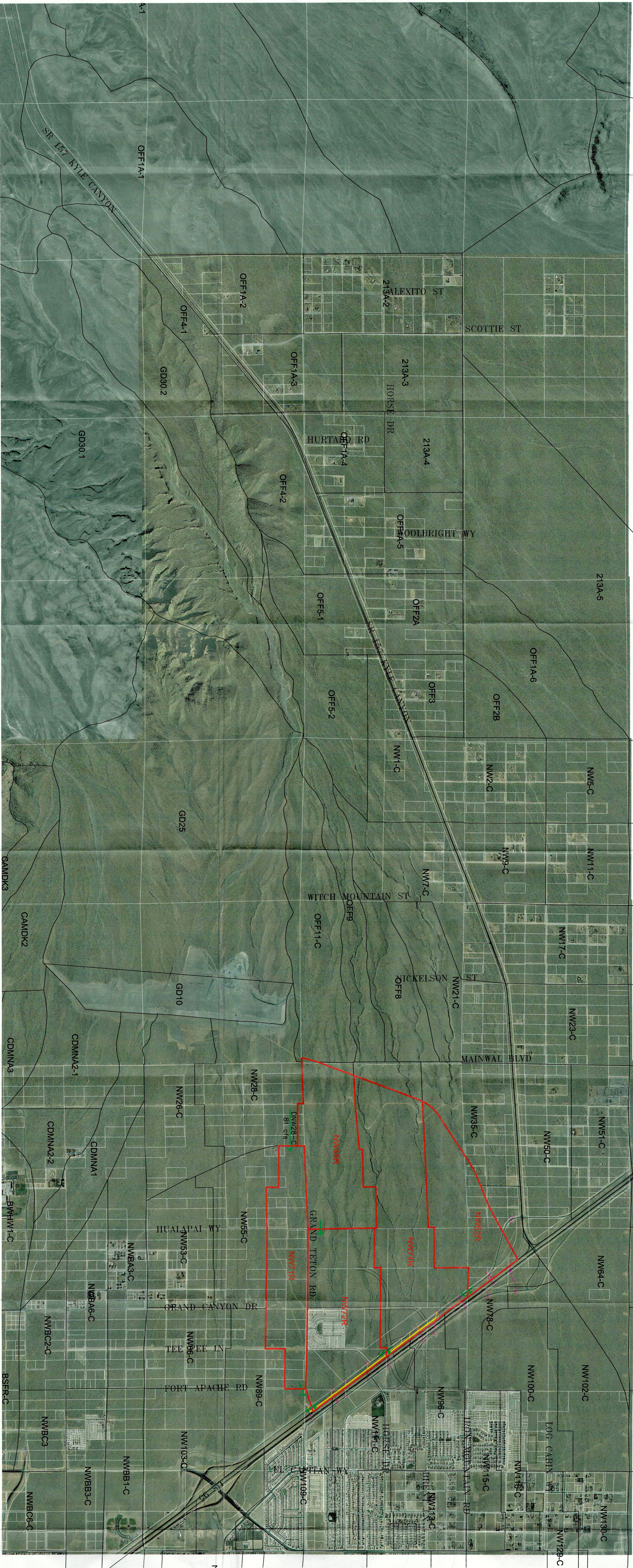


FIGURE 2.0  
REVISED 2002 MPU OFFSITE DRAINAGE MAP

HORSE DRIVE / US 95 INTERCHANGE  
FINAL FEASIBILITY STUDY - SUPPLEMENT

DEPARTMENT OF PUBLIC WORKS  
CITY OF LAS VEGAS

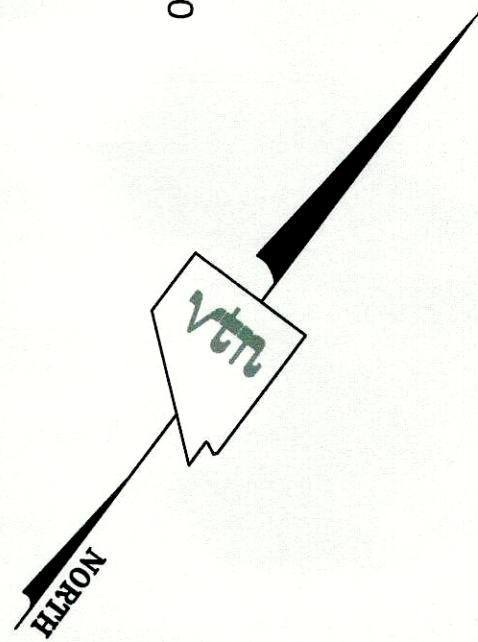
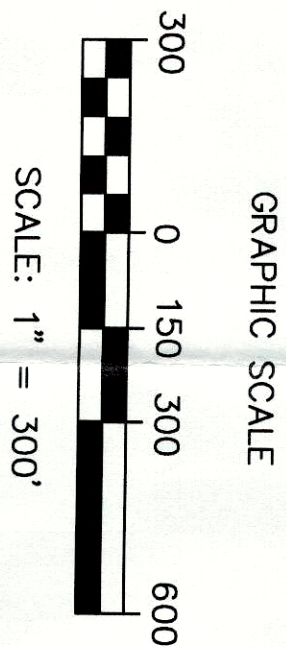
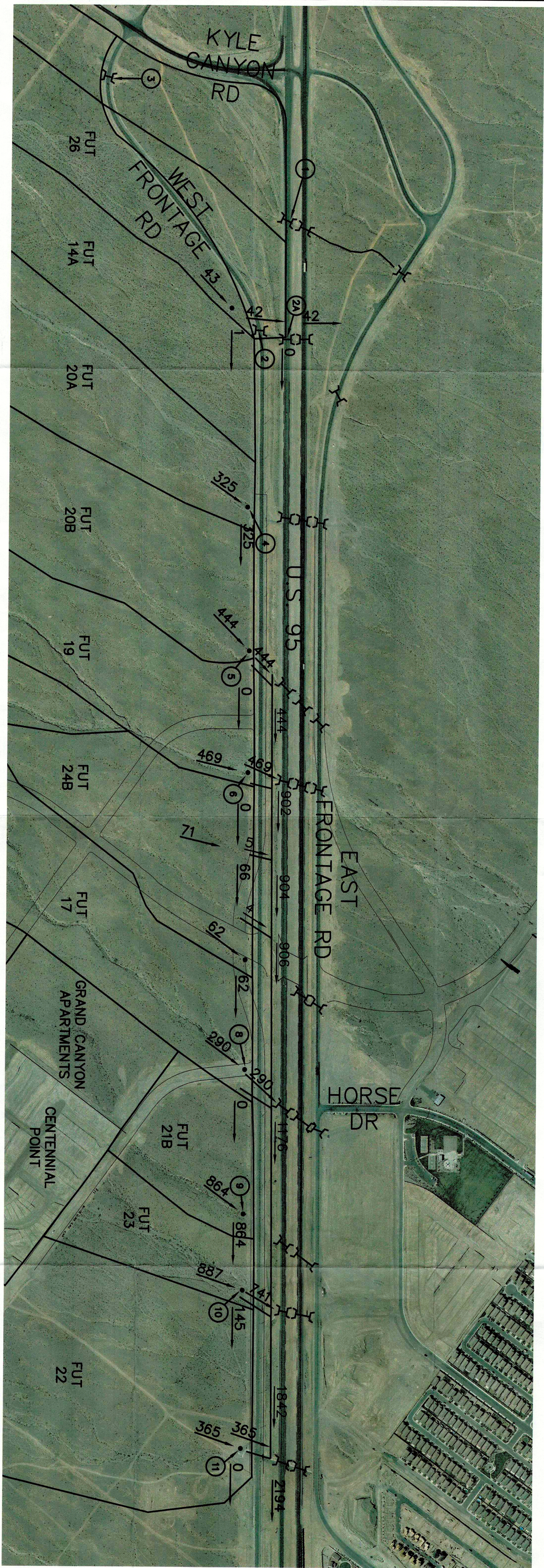


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| REV | DATE | BY | REVISION |
|-----|------|----|----------|
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|     |      |    |          |

|               |
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| NO. 0093      |
| BY TMM        |
| DATE 02/19/04 |
| SCALE         |
| SHEET         |
| FIG 2.0       |
| SHEETS        |





## LEGEND

- FUT 17** DENOTES FUTURE OFF-SITE BASIN NAME
-  DENOTES CULVERT I.D. (VTN)
- DENOTES FLOW IN CULVERT
- DENOTES FLOW THAT WEIRS OVER SIDE DIKE & CONTINUES TO NEXT CULVERT
- DENOTES FLOW UP-STREAM OF CULVERT
- 1320 DENOTES FLOW IN MPU FACILITY

|     |      |    |          |
|-----|------|----|----------|
| △   |      |    |          |
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### FUTURE CONDITIONS INLET LOCATION MAP

PROJECT **HORSE DRIVE INTERCHANGE**  
**FINAL FEASIBILITY STUDY - SUPPLEMENT**

SEAL

WO. NO. 6093

DESIGNED BY **JW**

DRAWN BY **TMM**

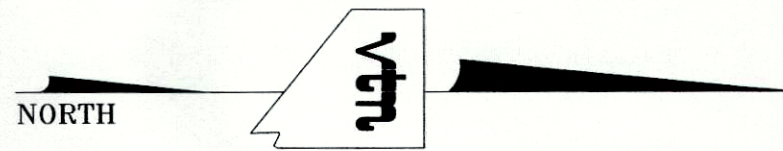
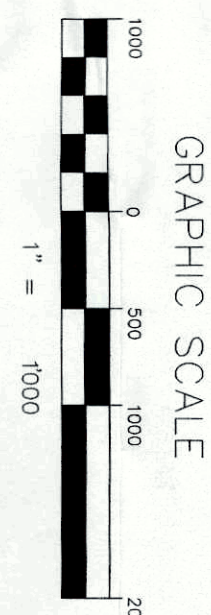
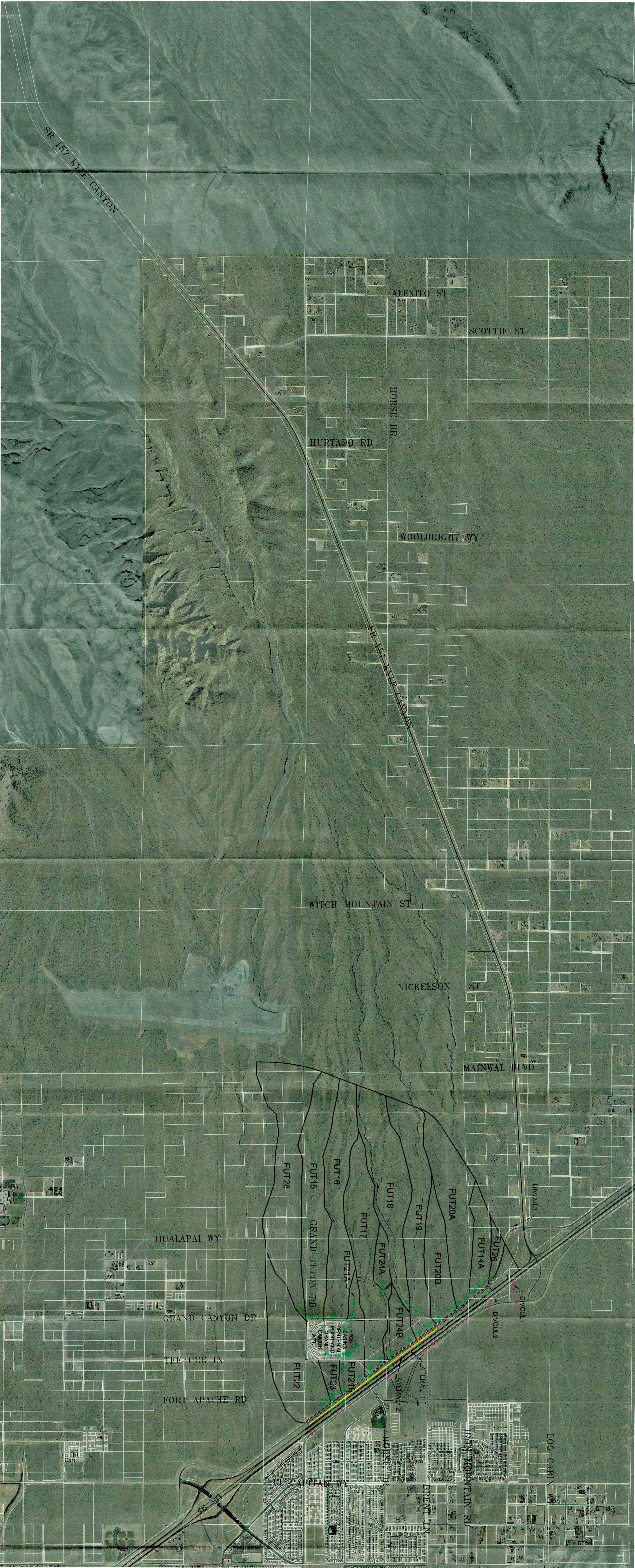
DATE 02/19/04

HORIZ. 1" = 300'  
SCALE  
VERT.

|         |       |
|---------|-------|
| DRAWING | SHEET |
|---------|-------|

FIG 4  
OF  
SHEETS





| REV | DATE | BY | REVISION |
|-----|------|----|----------|
|     |      |    |          |
|     |      |    |          |
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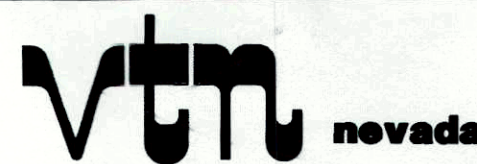
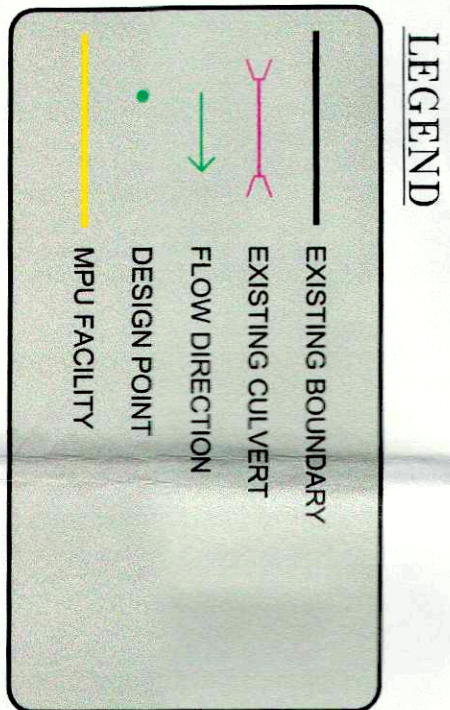


FIGURE 3.0  
FUTURE CONDITION OFFSITE DRAINAGE MAP

HORSE DRIVE / US 95 INTERCHANGE  
FINAL FEASIBILITY STUDY - SUPPLEMENT

TITLE  
PROJECT

SCALE



| HORSE DRIVE INTERCHANGE - FUTURE CONDITION 100-YEAR FLOWS |                            |                                                   |                          |                           |
|-----------------------------------------------------------|----------------------------|---------------------------------------------------|--------------------------|---------------------------|
| DESIGN POINT LOCATION                                     | FLOW AT DESIGN POINT (CFS) | FLOW FROM INTERCHANGE FROM FUTURE CONDITION (CFS) | DIVERSION INTO WPI (CFS) | TOTAL FLOW FROM WPI (CFS) |
| CW00000726                                                | 43                         | 1                                                 | 42.01                    | 0                         |
| CW00000723                                                |                            |                                                   |                          |                           |
| CW00000726                                                |                            |                                                   |                          |                           |
| CW00000731                                                | 325                        | 325                                               | 0                        | 0                         |
| CW00000719                                                |                            |                                                   |                          |                           |
| CW00000727                                                | 444                        | 0                                                 | 444                      | 444                       |
| CW00000728                                                |                            |                                                   |                          |                           |
| CW00000726                                                | 469                        | 0                                                 | 469                      | 902                       |
| CW00000726                                                |                            |                                                   |                          |                           |
| CW00000726                                                | 71                         | 66                                                | 0                        | 504                       |
| CW00000726                                                | 66                         | 62                                                | 4                        | 508                       |
| CW00000726                                                | 82                         | 62                                                | 0                        | 908                       |
| CW00000726                                                |                            |                                                   |                          |                           |
| CW00000726                                                | 290                        | 0                                                 | 290                      | 1178                      |
| CW00000726                                                |                            |                                                   |                          |                           |
| CW00000726                                                | 864                        | 864                                               | 0                        | 1178                      |
| CW00000726                                                |                            |                                                   |                          |                           |
| CW00000726                                                | 887                        | 146                                               | 741                      | 1842                      |
| CW00000726                                                |                            |                                                   |                          |                           |
| CW00000726                                                | 368                        | 0                                                 | 368                      | 2184                      |

(1) Diversion points 1 & 3 are located outside of the future watershed boundary.  
(2) Flow within design point is conveyed through existing culverts to the east side of US 95.



SHEET NO. 1

