

APPENDIX G  
**Culvert Sizing  
and  
CIP Site Maps**

APPENDIX G  
**Culvert Sizing**

Problem/CIP Identification		Existing Geometry Upstream of Culvert			Existing Geometry Downstream of Culvert						Existing Road Geometry		
Problem ID	CIP ID	Bankfull Width (ft)	Channel Depth (ft)	Channel Slope	Bottom Width (ft)	Top Width (ft)	Depth (ft)	Side Slopes (ft:1 ft V)	Down-stream Channel Slope	Manning's "n"	Height (ft)	Crest Length (ft)	Top Width (ft)
ASH-01	CIP19-ASH-C01	8.0	2.0	2.0%	8.0	20.0	2.0	3.0	2.0%	0.055	4	700	30
BRI-18	CIP11-BRI-C01	8.0	4.0	0.2%	8.0	18.0	5.0	1.0	0.5%	0.055	6	500	30
BRI-19	CIP11-BRI-C01	6.0	3.0	0.2%	6.0	24.0	3.0	3.0	0.2%	0.045	3	500	30
BRI-21	NA	8.0	2.0	0.2%	8.0	24.0	2.0	4.0	0.2%	0.085	6	500	30
HRN-09A	CIP11-HRN-C01	2.3	1.2	0.2%	10.0	30.0	1.0	10.0	0.2%	0.085	1.5	900	30
HRN-09B	CIP11-HRN-C01	2.1	1.0	0.2%	1.0	2.3	1.2	0.6	0.2%	0.035	1.5	100	30
HRN-09C	CIP11-HRN-C01	2.9	1.2	0.2%	1.0	2.3	1.2	0.6	0.2%	0.035	1.5	100	30
HRT-10	CIP11-HRT-C01	7.1	2.2	0.4%	6.0	18.0	3.0	2.0	2.0%	0.055	5	225	30
KRG-09	CIP11-KRG-C01	8.0	1.0	1.0%	4.0	36.0	8.0	2.0	1.0%	0.055	8	200	30
--	CIP11-KRG-C02	Data not available											
MUR-18	CIP11-MUR-C01	4.8	2.5	0.2%	10.0	30.0	1.0	10.0	0.4%	0.045	2	1300	30
MUR-26	NA	12.0	1.0	0.5%	10.0	34.0	3.0	4.0	0.5%	0.035	5	140	30
TWL-06	CIP11-TWL-C01	3.6	1.2	1.0%	2.0	5.4	2.2	0.8	1.0%	0.035	2.5	460	30
TWU-16	CIP11-TWU-C02	2.0	1.0	0.6%	2.0	6.0	1.0	2.0	0.6%	0.055	2	840	30
TWU-24	CIP11-TWU-C03	3.8	1.0	5.0%	3.0	6.0	1.0	1.5	5.0%	0.035	3	150	30
TWU-34	CIP11-TWU-C01	6.0	2.0	0.1%	6.0	14.0	2.0	2.0	0.1%	0.055	4	575	30

Problem/CIP Identification		Existing Culvert Geometry (Culvert 1)						Existing Culvert Geometry (Culvert 2)					
Problem ID	CIP ID	Number	Material	Diameter (in)	Manning's "n"	Length (ft)	Drop (ft)	Number	Material	Diameter (in)	Manning's "n"	Length (ft)	Drop (ft)
ASH-01	CIP19-ASH-C01	2	CMP	48	0.024	48	0.5	1	CMP	24	0.024	48	0.5
BRI-18	CIP11-BRI-C01	1	CMP	48	0.024	30	0						
BRI-19	CIP11-BRI-C01	2	CMP	24	0.012	30	0	2	CMP	18	0.024	30	0
BRI-21	NA	1	HDPE	48	0.024	30	0						
HRN-09A	CIP11-HRN-C01	1	Concrete	12	0.012	52	0						
HRN-09B	CIP11-HRN-C01	1	Concrete	12	0.012	46	0						
HRN-09C	CIP11-HRN-C01	1	Concrete	12	0.012	17	0						
HRT-10	CIP11-HRT-C01	1	Concrete	24	0.012	60	0.5						
KRG-09	CIP11-KRG-C01	1	CMP	48	0.024	30	0.5						
--	CIP11-KRG-C02	1	Concrete	12	0.024	27	1.0	2	Concrete	12	0.024	28	1
MUR-18	CIP11-MUR-C01	1	CMP	12	0.024	25	0						
MUR-26	NA	1	Concrete	36	0.012	41	0.2						
TWL-06	CIP11-TWL-C01	1	Concrete	18	0.012	43	0.5						
TWU-16	CIP11-TWU-C02	1	CMP	18	0.024	28	0.2						
TWU-24	CIP11-TWU-C03	1	Concrete	12	0.012	26	0.5						
TWU-34	CIP11-TWU-C01	2	Concrete	24	0.012	28	0	1	Concrete	24	0.012	28	0

<i>Problem/CIP Identification</i>		<i>Hydrologic Simulation (WWHM) Results</i>					
<b>Problem ID</b>	<b>CIP ID</b>	<b>2 Year (cfs)</b>	<b>5 Year (cfs)</b>	<b>10 Year (cfs)</b>	<b>25 Year (cfs)</b>	<b>50 Year (cfs)</b>	<b>100 Year (cfs)</b>
ASH-01	CIP19-ASH-C01	156	265	359	508	643	803
BRI-18	CIP11-BRI-C01	40	67	88	116	138	162
BRI-19	CIP11-BRI-C01	26	43	57	75	89	104
BRI-21	NA	23	38	50	65	78	92
HRN-09A	CIP11-HRN-C01	2	4	5	7	9	11
HRN-09B	CIP11-HRN-C01	1	2	2	3	4	5
HRN-09C	CIP11-HRN-C01	1	2	2	3	4	5
HRT-10	CIP11-HRT-C01	9	15	20	26	32	38
KRG-09	CIP11-KRG-C01	71	100	120	149	171	195
--	CIP11-KRG-C02	2	3	4	5.5	6.7	8.0
MUR-18	CIP11-MUR-C01	12	16	19	22	25	29
MUR-26	NA	27	41	51	67	80	94
TWL-06	CIP11-TWL-C01	9	14	19	25	31	37
TWU-16	CIP11-TWU-C02	4	6	8	11	13	15
TWU-24	CIP11-TWU-C03	3	5	7	9	11	14
TWU-34	CIP11-TWU-C01	24	34	42	52	60	69

Problem/CIP Identification		WDFW "Stream Simulation" Culvert Sizing Criteria			WDFW "No Slope" Culvert Sizing Criteria				
Problem ID	CIP ID	Maximum Culvert Slope	Culvert Bed Width	Minimum Countersink -- 30% Rise (ft)	Low to Moderate Natural Channel Gradient (<3%)?	Minimum Rise --- Slope * L < 0.2D	Design Width (ft)	Maximum Upstream Countersink -- 40% Rise (ft)	Minimum Downstream Countersink -- 20% Rise (ft)
ASH-01	CIP19-ASH-C01	2.50%	11.6	1.5	YES	4.8	8.00	2.0	1.0
BRI-18	CIP11-BRI-C01	0.25%	11.6	1.8	YES	1.2	8.00	2.4	1.2
BRI-19	CIP11-BRI-C01	0.25%	9.2	0.9	YES	0.24	6.00	1.2	0.6
BRI-21	NA	0.25%	11.6	0	YES	0.48	8.00	0.0	0.0
HRN-09A	CIP11-HRN-C01	0.25%	4.8	0.9	YES	0.12	2.33	1.2	0.6
HRN-09B	CIP11-HRN-C01	0.25%	4.5	0.6	YES	0.12	2.08	0.8	0.4
HRN-09C	CIP11-HRN-C01	0.25%	5.5	0.6	YES	0.12	2.92	0.8	0.4
HRT-10	CIP11-HRT-C01	0.50%	10.5	1.8	YES	2.4	7.08	2.4	1.2
KRG-09	CIP11-KRG-C01	1.25%	11.6	1.8	YES	2.4	8.00	2.4	1.2
--	CIP11-KRG-C02	Drainage on a steep slope (>20%), not considered a fish-bearing stream.							
MUR-18	CIP11-MUR-C01	0.25%	7.8	0.9	YES	0.24	4.83	1.2	0.6
MUR-26	NA	0.63%	16.4	0	YES	0.9	12.00	0.0	0.0
TWL-06	CIP11-TWL-C01	1.25%	6.3	1.2	YES	0.9	3.58	1.6	0.8
TWU-16	CIP11-TWU-C02	0.75%	4.4	0.9	YES	0.54	2.00	1.2	0.6
TWU-24	CIP11-TWU-C03	6.25%	6.5	1.5	NO	3	3.75	2.0	1.0
TWU-34	CIP11-TWU-C01	0.13%	9.2	1.5	YES	0.12	6.00	2.0	1.0

Problem/CIP Identification		Culvert Sizing Summary											
Problem ID	CIP ID	Culvert Fish Passage Design Basis	Culvert Type	Culvert Material	Culvert Span (ft)	Culvert Rise (ft)	Culvert Slope (ft/ft)	Cover with culvert top width (ft)	Upstream Counter-sink (ft)	Upstream Open Rise (ft)	Downstream Counter-sink (ft)	Downstream Open Rise (ft)	Culvert Flow, Headwater at Top of Culvert Inlet (cfs)
ASH-01	CIP19-ASH-C01	Stream Simulation	Box	Concrete	12.0	5.0	0.02	0.8	1.8	3.2	1.8	3.2	205
BRI-18	CIP11-BRI-C01	No Slope	Box	Concrete	9.0	6.0	0.00	2.0	2.0	4.0	1.9	4.2	186
BRI-19	CIP11-BRI-C01	No Slope	Box	Concrete	10.0	3.0	0.00	0.8	0.8	2.2	0.8	2.2	105
BRI-21	NA	Existing culvert adequately sized											
HRN-09A	CIP11-HRN-C01	Stream Simulation	Box	Concrete	11.0	3.0	0.00	0.8	2.3	0.7	2.2	0.8	12
HRN-09B	CIP11-HRN-C01	Stream Simulation	Box	Concrete	3.0	2.0	0.00	0.3	0.8	1.2	0.7	1.3	6
HRN-09C	CIP11-HRN-C01	Stream Simulation	Box	Concrete	3.0	2.0	0.00	0.3	0.8	1.2	0.8	1.2	6
HRT-10	CIP11-HRT-C01	Stream Simulation	Box	Concrete	11.0	6.0	0.01	1.8	2.8	3.2	1.9	4.1	130
KRG-09	CIP11-KRG-C01	No Slope	Box	Concrete	10.0	6.0	0.00	4.0	2.0	4.0	1.7	4.3	240
--	CIP11-KRG-C02	None	Pipe	CMP	2	--	0.03	1.0	--	--	--	--	8
MUR-18	CIP11-MUR-C01	Stream Simulation	Box	Concrete	10.0	3.0	0.00	0.8	1.8	1.2	1.7	1.3	29
MUR-26	NA	Existing culvert adequately sized											
TWL-06	CIP11-TWL-C01	Stream Simulation	Box	Concrete	7.0	4.0	0.00	0.7	2.2	1.8	1.7	2.3	43
TWU-16	CIP11-TWU-C02	Stream Simulation	Box	Concrete	5.0	3.0	0.00	0.4	1.4	1.6	1.2	1.8	25
TWU-24	CIP11-TWU-C03	Stream Simulation	Box	Concrete	6.0	5.0	0.00	0.7	2.7	2.3	1.4	3.6	62
TWU-34	CIP11-TWU-C01	No Slope	Box	Concrete	9.0	5.0	0.00	0.8	1.8	3.3	1.7	3.3	132









