RECLAMATION

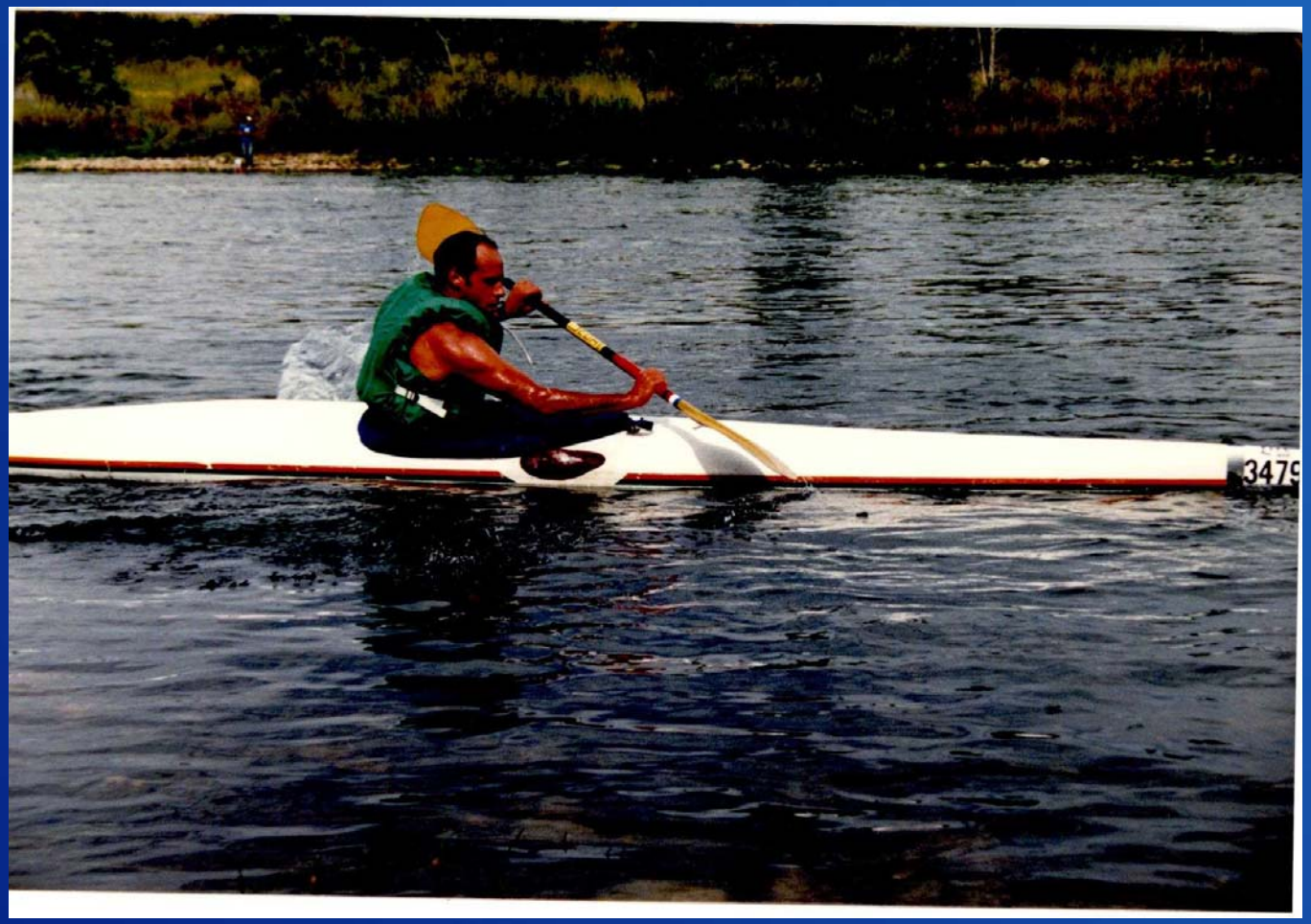
Managing Water in the West

Moss Effects on River Stage

(2009)

U.S. Department of the Interior
Bureau of Reclamation

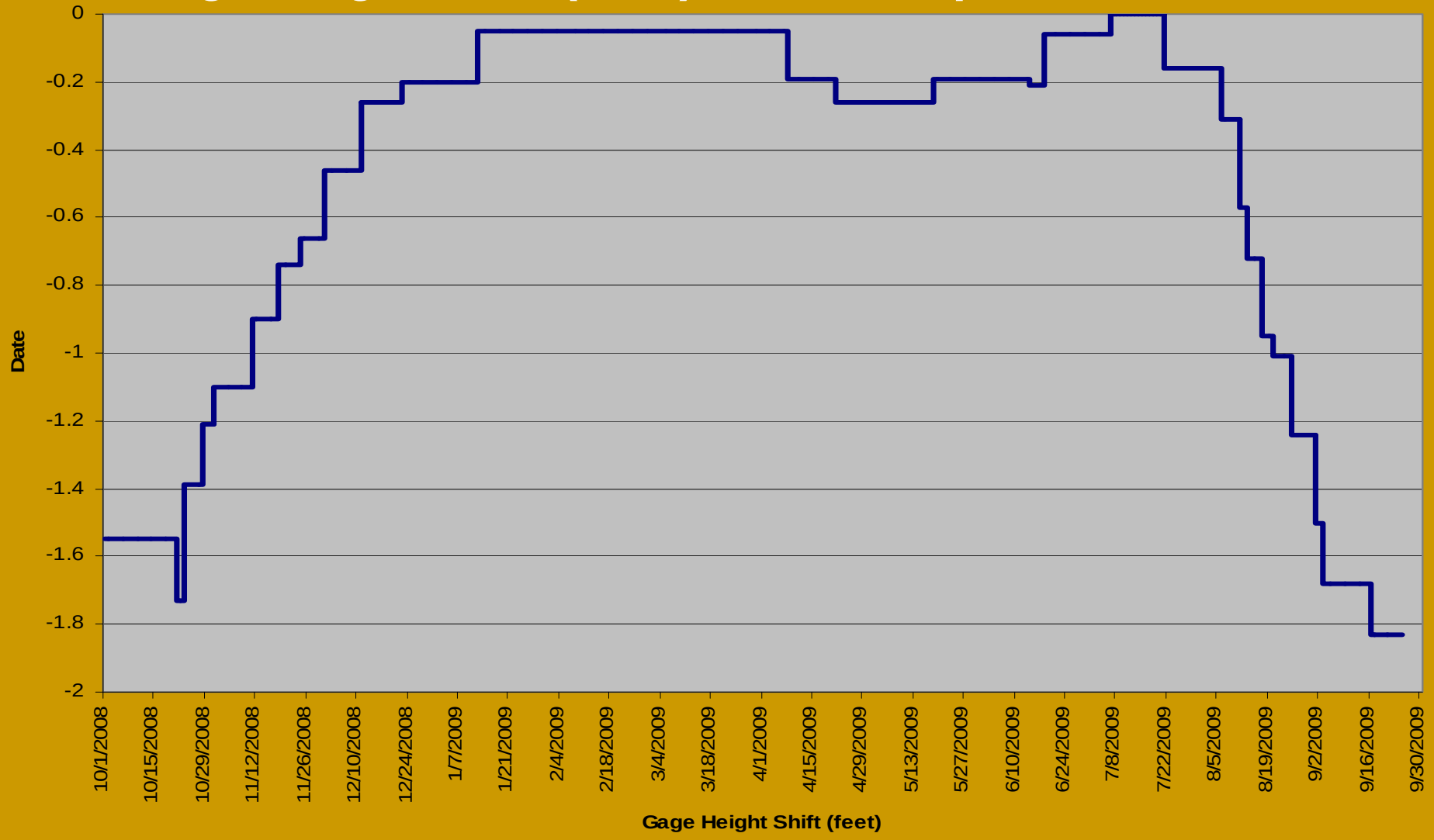
Lenny’s Fist Experience with the BHR



RECLAMATION

Bighorn River near St. Xavier MT

Gage Height Shift (Feet) Oct. 08-Sept. 09



Bighorn River System near St. Xavier MT
Gage Height Shift 1999 to 2010 (in feet)

Year	Nov. Flow (CFS)	Shift Oct/Nov Max	Shift Jan/Feb Min	Shift Mar/Apr Min	Riv. Drop (Oct/Nov) to (Jan/Feb)	Riv. Drop (Oct/Nov) to (Mar/Apr)
2009	2500	1.55	0.05	0.05	**1.5**	**1.5**
2008	1,900	1.06	0.14	0.05	0.92	1.01
2007	1,500	1.2	0.15	0.08	1.05	1.12
2006	2,500	1.46	0.12	0.12	1.34	1.34
2005	1,500	1.15	0.2	0.11	0.95	1.04
2004	1,500	1.08	0.27	0.13	0.81	0.95
2003	1,300	1.04	0.28	0.17	0.76	0.87
2002	1,500	1.12	0.4	0.15	0.72	0.97
2001	2,000	0.99	0.06	0.04	0.93	0.95
2000	2,750	1.16	0.06	0.06	1.1	1.1
1999	3,500	0.96	0.14	0.14	0.82	0.82
Projections for 2010						
2010	2500	183	0.17	0.10	**1.66**	**1.73**

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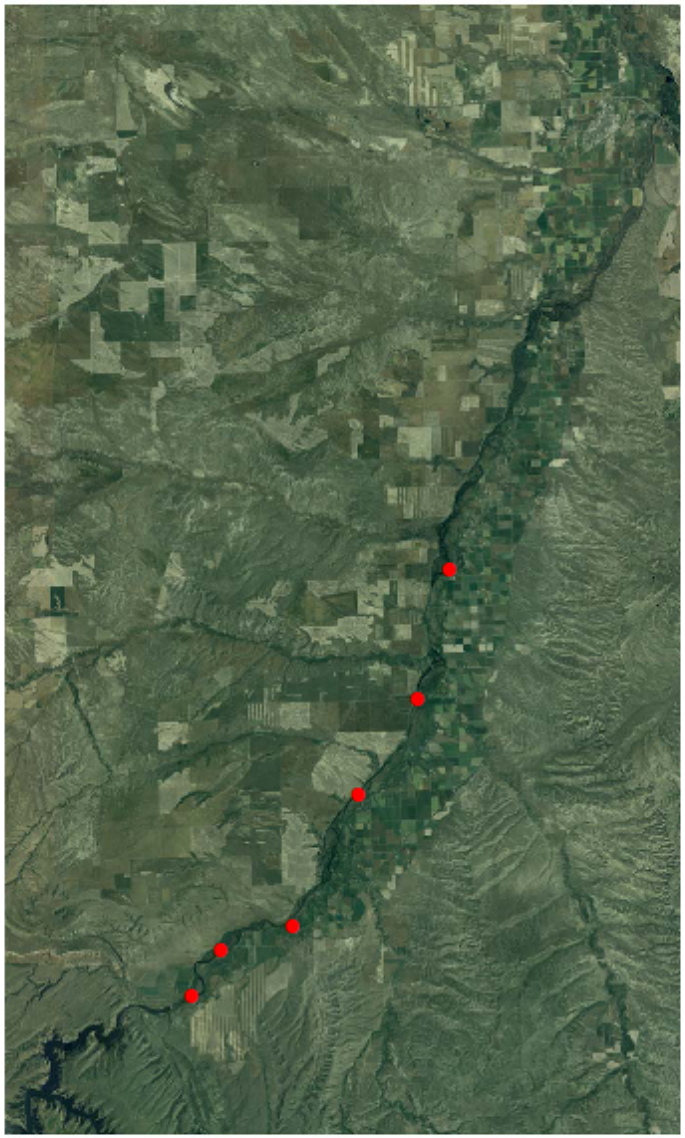
Bighorn Stage Measurement Sites



0 2 4 8 12 Miles

Date	River Flow (cfs)	St Xavier Gage Shift (ft)	Approximate River Mile 1	3	6	11	15	20
August 6, 2009	3348	-0.16	2.32	2.29	1.53	1.30	1.70	1.29
September 16, 2009	3106	-1.68	3.68	2.80	1.82	1.50	1.70	1.39
September 24, 2009	2970	-1.83	3.64	2.80	1.80	1.55	1.75	1.38
Difference	378	-1.67	1.32	0.51	0.27	0.25	0.05	0.09

Option One to Reduce Impact of Stage Shift

2009	Constant Flow CFS	Modified Flow CFS	Estimated Shift	Gage Ht.	Drop (ft.) Increment	Total Drop (ft.)
Oct	2700	2,400	1.83	61.75		
Nov	2700	2,500	1.5	61.5	0.25	0.25
Dec	2700	2,600	0.8	60.88	0.62	0.87
Jan	2700	2,800	0.25	60.49	0.39	1.26
Feb	2700	2,850	0.15	60.43	0.06	1.32
Mar	2700	2,875	0.12	60.42	0.01	1.33
Apr	2700	2,875	0.1	60.4	0.02	1.35
Avg.	2,700	2,700		Total Shift		1.35
				Shift Reduced		.38

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Date	River Flow (cfs)	St Xavier Gage Shift (ft)	Approximate River Mile 1	3	6	11	15	20
August 6, 2009	3348	-0.16	2.32	2.29	1.53	1.30	1.70	1.29
September 16, 2009	3106	-1.68	3.68	2.80	1.82	1.50	1.70	1.39
September 24, 2009	2970	-1.83	3.64	2.80	1.80	1.55	1.75	1.38
Difference	378	-1.67	1.32	0.51	0.27	0.25	0.05	0.09

Option 2 to Reduce Impact of Stage Shift

2009	Constant Flow CFS	Modified Flow CFS	Estimated Shift	Gage Ht.	Drop (ft.) Increment	Total Drop (ft.)
Oct	2700	2,250	1.83	61.63		
Nov	2700	2,350	1.5	61.38	0.25	0.25
Dec	2700	2,700	0.8	60.96	0.42	0.67
Jan	2700	2,900	0.25	60.57	0.39	1.06
Feb	2700	2,900	0.15	60.47	0.1	1.16
Mar	2700	2,900	0.12	60.44	0.03	1.19
Apr	2700	2,900	0.1	60.42	0.02	1.21
Avg.	2,700	2,700		Total		1.21
				Shift Reduced		0.52

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Date	River Flow (cfs)	St Xavier Gage Shift (ft)	Approximate River Mile 1	3	6	11	15	20
August 6, 2009	3348	-0.16	2.32	2.29	1.53	1.30	1.70	1.29
September 16, 2009	3106	-1.68	3.68	2.80	1.82	1.50	1.70	1.39
September 24, 2009	2970	-1.83	3.64	2.80	1.80	1.55	1.75	1.38
Difference	378	-1.67	1.32	0.51	0.27	0.25	0.05	0.09

Questions?

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Option to Reduce Impact of Stage Shift

2009	Flow CFS	Shift	Gage Ht.	Drop (ft.)	Total
Oct	2,000	1.55	61.13	Increment	Drop (ft.)
Nov	2,100	1.45	61.13	0	0
Dec	2,400	0.8	60.72	0.41	0.41
Jan	2,800	0.25	60.49	0.23	0.64
Feb	2,900	0.18	60.5	-0.01	0.63
Mar	2,800	0.18	60.42	0.08	0.71
Avg.	**2,500**		Total	**0.71**	

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Date	River Flow (cfs)	St Xavier Gage Shift (ft)	Approximate River Mile 1	3	6	11	15	20
August 6, 2009	3348	-0.16	2.32	2.29	1.53	1.30	1.70	1.29
September 16, 2009	3106	-1.68	3.68	2.80	1.82	1.50	1.70	1.39
September 24, 2009	2970	-1.83	3.64	2.80	1.80	1.55	1.75	1.38
Difference	378	-1.67	1.32	0.51	0.27	0.25	0.05	0.09

Rating Curve	GH	Flow						
	60.37	2970						
	Difference	62.04	61.69	60.88	60.64	60.62	60.42	60.46

Option to Protect Rearing Habitat and Reduce Impact of Shift

2009	Constant Flow CFS	Modified Flow CFS	Estimated Shift	Gage Ht.	Drop (ft.) Increment	Total Drop (ft.)
Oct	2500	1,900	1.55	61.04		
Nov	2500	2,000	1.45	61.03	0.01	0.01
Dec	2500	2,300	0.8	60.64	0.39	0.4
Jan	2500	2,400	0.25	60.17	0.47	0.87
Feb	2500	2,500	0.18	60.18	-0.01	0.86
Mar	2500	2,500	0.18	60.18	0	0.86
Apr	1900	2,400	0.11	60.03	0.15	1.01
May	1900	2,400	0.11	60.03	0	1.01
June	1900	2,300	0.11	59.95	0.08	1.09
Avg.	**2,300**	**2,300**		**Total**	**1.09**	

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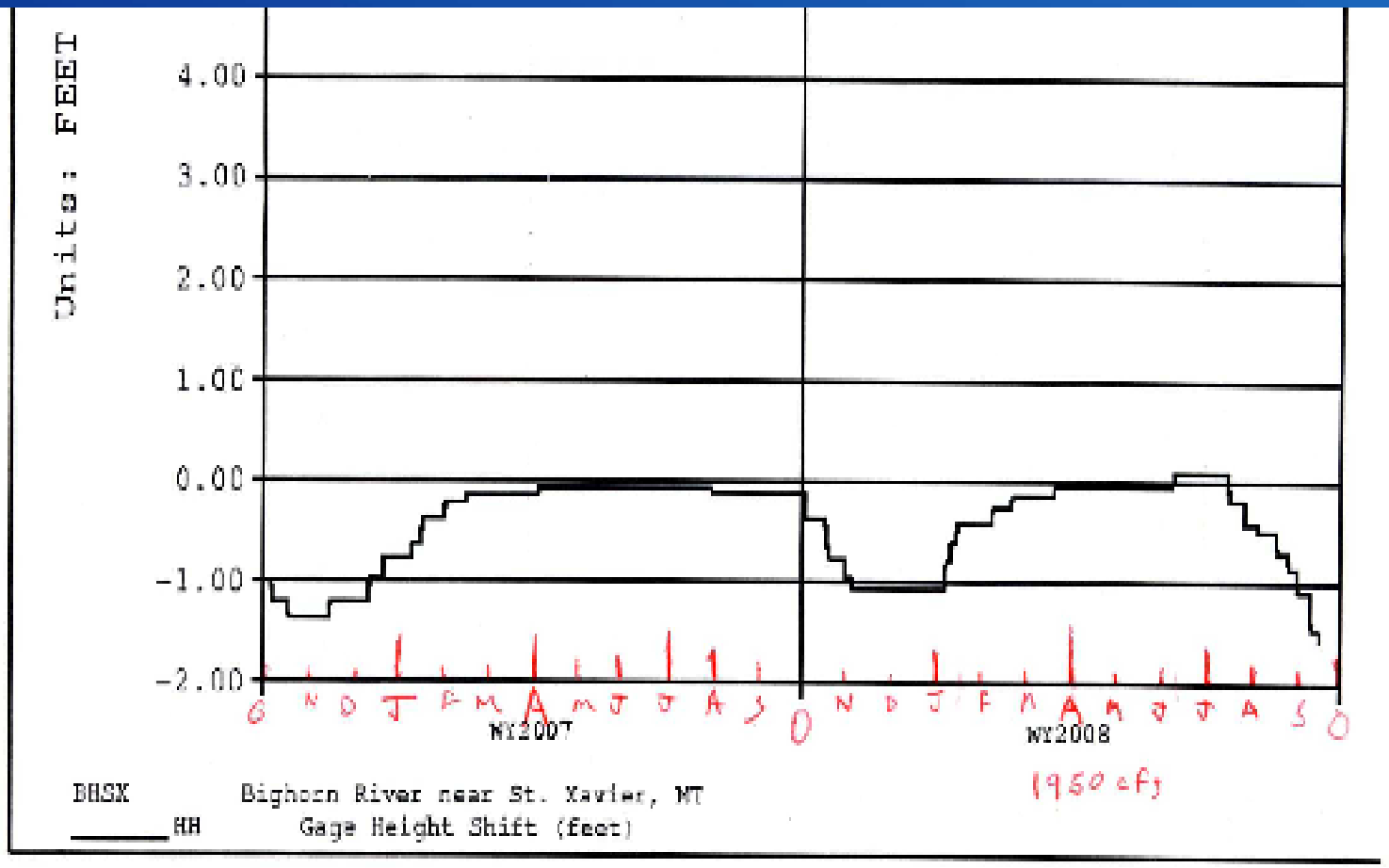
Bighorn River near St. Xavier MT

Gage Height Shift (Feet) Oct. 06-Sept. 08



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