Montezuma Castle National Monument
Beaver/Wet Beaver Creek Seepage Run
October 30, 2003

SUMMARY REPORT

National Park Service
Water Resources Division
Water Rights Branch
Jim Harte
Paul Christensen
Carmia Fiechtner

December 17, 2003

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Montezuma Castle National Monument
Beaver/Wet Beaver Creek Seepage Run
October 30, 2003

Acknowledgements

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Montezuma Castle National Monument
Seepage Run for Beaver/Wet Beaver Creek
October 30, 2003

Introduction

The National Park Service has initiated a project to investigate and describe the hydrology and water rights in the Montezuma Castle National Monument area. Part of the project includes conducting seepage runs along Beaver Creek and its tributary, Wet Beaver Creek. The information will be used for developing water budgets and plans to preserve and protect the water and water-related resources of the Monument. A reconnaissance-level seepage run, consisting of stream-discharge measurements taken at 10 different locations along a stream reach, was conducted in the monument area on June 13, 2002. A second seepage run was conducted during October 30, 2003 on the same stream reach. The purpose of the second seepage run was to evaluate the quality and importance of the measurement site cross sections measured on June 13, 2002 and to collect additional discharge data at the same cross sections. The October 30, 2003 seepage run was to measure discharge at the same ten locations measured during June 13, 2002. Flow conditions and property ownership considerations dictated that five new measurement sites be established and measured (Sites 11 – 15) along with measurements at five of the June 13, 2002 sites (Sites 1, 3, 4, 5, and 10). This report is a summary of the results of the October 30, 2003 seepage run.

Description of Study Area and Discharge Measurement Sites

Montezuma Castle National Monument consists of two Units, the Castle Unit and the Well Unit, located on Beaver Creek and Wet Beaver Creek respectively. The Castle Unit is located in Sections 8, 9, 16, and 17, T. 14 N., R. 5 E. and the Well Unit is located in Section 36, T. 15 N., R. 5 E. and Section 31 in T. 15 N., R. 6 E. Wet Beaver Creek flows generally from east to west and joins Dry Beaver Creek, which flows generally from north to south, in Section 4, T. 14 N., R. 5 E., near the town of McGuireville. Downstream of the confluence of Wet Beaver Creek and Dry Beaver Creek the stream is named Beaver Creek. Beaver Creek flows generally south to its confluence with the Verde River in Section 30, T. 14 N., R. 5 E., near the town of Camp Verde (Appendix A).

The study reach of Beaver/Wet Beaver Creek flows through a system dominated by the limestones and other sedimentary rocks of the Verde Formation and the sandstones and silty sandstones of the Supai Formation (Twenter and Metzger, 1963). Dissolution of the limestones over time is suspected of forming Montezuma Well and its associated "swallet" (solution channel) and may be responsible for the formation of other underground conduits through which water may discharge into or drain away from the Beaver/Wet Beaver Creek river system within the study reach. The stream channel itself is underlain with Quaternary gravel deposits which may store and transport large quantities of water below the ground surface.

During the June 13, 2002 seepage run, discharge measurements were made at nine locations (sites) on Wet Beaver Creek and one location on Beaver Creek. For reference purposes the measurement sites are numbered from upstream to downstream as Sites 10, 1, 2, 3, 4, 5, 6, 7, 8, and 9 (see Appendix B for Field Notebook site descriptions).

Site 10 is located at USGS surface water gauging station Number 09505200 in Section 24, T.15 N., R.6 E. (see Appendix C).

Site 1 is located approximately 0.1 miles upstream of the Southwestern Academy on the Section 22/23 line, T.15 N., R.6 E. On October 29 and 30, 2003 this site had two channels. The left channel carried most of the discharge. The right channel carried too little flow to measure with a pygmy meter (a bucket and stopwatch would be preferable) and the discharge was estimated to be less than 0.1 cfs.

Site 2 is located at the Beaver Creek Campground Bridge in Section 28, T.15 N., R.6 E.

Site 3 is located at Lawrence Crossing in Section 32, T.15 N., R.6 E.

Site 4 is located at the Montezuma Well outlet in Section 31, T.15 N., R.6 E.

Site 5 is located upstream of the golf course diversion in Section 31, T.15 N., R.6 E.

Site 6 is located on the golf course diversion ditch downstream of Wet Beaver Creek in Section 36, T.15 N., R.5 E.

Site 7 is located at a point north of the "white house" boarding school main building.

Site 8 is located on an 80-acre parcel of USFS administered land and approximately 50 yards downstream of a fence marking the boundary between private and USFS lands in Section 4, T.14 N., R.5 E.

Site 9 is located on Beaver Creek near the end of the interpretive trail in the MOCA Castle Unit in Section 17, T.14 N., R.5 E.

During the October 30, 2003 seepage run five measurement sites (Sites 11, 12, 13, 14, and 15) were added (see Appendix B for Field Notebook site descriptions).

Site 11 is on Beaver Creek approximately 1 river-mile upstream of Site 9 in the MOCA Castle Unit in Section 16, T.14 N., R.5 E. This site was established to replace Site 9 because it was not possible to make a reasonable discharge measurement at Site 9 on October 30, 2003 and a measuring site closer to the upstream boundary of the Castle Unit was desirable.

Site 12 is located on an 80-acre parcel of USFS-administered land approximately 150 yards downstream of Site 8 and just upstream of an exposed cliff face on river-right in Section 4, T.14 N., R.5 E. This site was established to replace Site 8 because it was not possible to make a reasonable discharge measurement at Site 8 on October 30, 2003.

Site 13 is located northwest of the "white house" boarding school main building near the end of a ramp cut perpendicular into the left bank using CAT-type equipment. This site was established to replace Site 7 because it was not possible to positively locate Site 7 from the written description.

Site 14 is located upstream of the Beaver Creek Campground Bridge adjacent to the most upstream campsite in the campground. This site was established to replace Site 2 because it was not possible to make a reasonable discharge measurement directly upstream or downstream of the campground bridge on October 30, 2003.

Site 15 is located approximately 100 feet upstream of the Lake Montezuma Avenue Bridge. This site was established to replace Site 6 (the golf course ditch) because Site 6 may be on private land and the location of Site 15 was determined to be more beneficial to document discharge gains or losses in Wet Beaver Creek. There are two channels at this site. The right channel carried most of the discharge and it was measured to be 8.02 cfs using a pygmy meter on October 30, 2003. The left channel carried too little flow to measure with a pygmy meter (a bucket and stopwatch would be preferable) and was estimated to be less than 0.3 cfs.

During the October 30, 2003 seepage run reconnaissance (conducted on October 28 and 29, 2003) it was observed that the stream channel at each measurement site generally consisted of cobbles and boulders. The stream banks consisted of boulders and cobbles with some vertical banks and some undercut banks, and riparian grasses with densely matted root systems with some vertical banks and some undercutting. The channel and bank conditions made it very difficult to locate good discharge measurement cross sections (without eddies, irregular channel bottoms, or vertical or undercut banks) and a significant number of cobbles and boulders were moved at most sites.

Methods

Handouts explaining the seepage run Schedule, Summary of Activities, Equipment, Team Assignments, and Protocol were emailed out to all participants in advance (Appendix D).

Measurement cross sections 1, 3, 4, 5, 11, 12, 13, 14, and 15 were established on October 28 and 29, 2003 with the aid of field notes from the June 13, 2002 seepage run (see Appendix E). A cross section at Site 10 has been previously established by the U.S. Geological Survey. Cross sections were marked with flagged rebar driven into the ground on each bank and a staff gage was located in non-turbulent water at each cross section. UTM coordinates, established using GPS, were recorded and digital photographs were taken at each cross section. Site and access descriptions were recorded in a field notebook for each cross section. Where necessary, boulders and cobbles were removed to construct a cross section with reasonably uniform flow and channel characteristics.

Standard USGS discharge measurement protocol was used for the seepage run (see Appendix F). Discharge measurements were made with a "pygmy" meter and standard wading rod marked in tenths. Revolutions were counted by ear or by automatic counter. Standard NPS Discharge Measurement Notes forms were used to record all data. A spin test with a minimum standard of 45 seconds was required before and after each measurement. Air and water temperatures were recorded before each measurement. Gage height was recorded before and after each measurement. Start and end times were recorded for each measurement. Sections (verticals) were spaced so the discharge in each section did not exceed 5% of the total discharge in the cross section. Minimum section width was .20 feet and water depth was recorded to .01 feet. Discharge measurements were taken at "about" 30 verticals per cross section.

Five teams of two people each participated in the seepage run. Each team made two scheduled discharge measurements at two measurement sites (Table 1). Discharge measurements were scheduled to be made at 0800, 1000, 1230, and 1430 hours. Rebar marking the cross sections and staff gages were removed after completing the second discharge measurement at each cross section.

Table 1. – October 30, 2003 MOCA Beaver/Wet Beaver Creek seepage run participants.

Team	**Agency**	**Sites Measured**	**Phone/email**
Zach Mondry	USFS, Coconino NF, Flagstaff, Az.	10, 1	928-527-3523 zmondry@fs.fed.us
Paul Christensen	NPS, WRD, Fort Collins, CO		970-225-3534 paul_christensen@nps.gov
Colleen Filippone	NPS, IMRO, Tucson, Az.	14, 3	520-546-1607 ext.3# colleen_filippone@nps.gov
Jeff Hughes	NPS, WRD, Fort Collins, CO		970-225-3527 jeff_hughes@nps.gov
Virginia Bartling	NPS, MOCA, Camp Verde, Az.	4, 13	928-567-5276 ext. 228 sherry_wood@nps.gov
Jeff Albright	NPS,WRD, Fort Collins, CO		970-225-3528 jeff_albright@nps.gov
Chris Gable	NPS, WRD, Fort Collins, CO	5, 15	970-225-3529 chris_gable@nps.gov
Carmia Fiechtner	NPS, WRD, Fort Collins, Co.		970-225-3534 carmia_fiechtner@partner.nps.gov
John Ward	Ward Groundwater, Tucson, Az.	12, 11	520-490-2435 ward_groundwater@cox.net
Jim Harte	NPS, WRD, Fort Collins, CO		970-225-3538 james_harte@nps.gov

Results and Discussion

Two discharge measurements were made at each of the ten designated cross sections, except for Sites 11 and 12 where 3 discharge measurements were made (see Table 2 and Appendix A). All discharge measurements were made reasonably close to the scheduled times and no significant problems were encountered. The average discharge (cfs) measured at each cross section, presented in order from upstream to downstream was; Site 10 (6.7), Site 1 (7.0), Site 14 (6.4), Site 3 (5.7), Site 4 (10), Site 5 (9.3), Site 15 (8.0), Site 13 (6.6), Site 12 (1.8), and Site 11 (1.4) (Appendix A).

Discharge between Sites 10 and 3 fell at a relatively consistent rate (ranging from 7.0 to 5.7 cfs) indicating the presence of active diversions and/or a losing stream reach.

Discharge increased from approximately 5.7 cfs to 10 cfs between Sites 3 and 4 indicating a gaining stream reach (an input of approximately 4.3 cfs somewhere downstream of Site 3). Walker Creek and Soda Spring are two possible sources of input into this stream reach. Red Tank Draw, which joins Wet Beaver Creek upstream of Site 4, was dry at the I-17 Sedona Interchange road bridge (approximately 1.5 miles south of I-17) but Red Tank Draw was not observed at its confluence with Wet Beaver Creek.

On December 4 and 5, 2003 John Ward of Ward Ground Water, Tucson, Az. made a site visit to MOCA and made the following observations:

1. I surveyed the area of Soda Springs. The outlet divides into 3 distinct streams that enter into Wet Beaver Creek. The total flow into the Creek from the spring exceeds 2 cfs and may be as much as 3 cfs. The marshes and pools near the spring would certainly lose a lot of water to ET. Two cfs is equal to the gain in streamflow between Lawrence Crossing and MOWE noted in the June 2002 seepage run report.
2. Walker Creek was flowing into Beaver Creek at ½ to 1 cfs. Checking upstream it appears that Walker Creek was flowing continuously all the way to the ranch property at Lander Spring. Judging from the near continuous strip of sycamore and cottonwood between Lander Spring and the confluence, I would guess that flow or underflow in Walker Creek is nearly perennial.
3. Flow in Beaver Creek just downstream of the lower boundary of the MOCA unit (dirt road access from the MOCA turnoff) was probably 2-3 cfs. About 2 river miles farther downstream where Montezuma Castle Road runs next to Beaver Creek, the Creek was not flowing. This observation supports the theory that Beaver Creek lost flow as it passes over the Verde Formation facies change.

The Soda Springs visit was an eye-opener. I was surprised to see that the discharge was that large, probably about the same as from the Well. Source areas for both springs are probably the same, also.

Discharge between Sites 4 and 13 decreased at a relatively consistent rate (ranging from 10 cfs to 6.6 cfs) indicating the presence of active diversions and/or a losing stream reach. The golf course diversion and Lake Montezuma residential area are located in this stream reach. The golf course diversion was not found on Wet Beaver Creek during the site reconnaissance on 10/29/2003. On 10/30/2003 John Ward, Ward Ground Water, estimated a discharge of approximately 1 cfs flowing through a ditch into a small reservoir in the SWNW Section 1, T.14 N., R.5 E., on the west side of Lake Montezuma Avenue. The ditch was likely the golf course diversion.

Discharge between Sites 13 and 12 decreased from 6.6 cfs to 1.8 cfs indicating a significant diversion and/or losing stream reach. This reach was not walked, therefore, the extent of man-made diversions is not known. Plate 1 in Geological Survey Bulletin 1177 shows the surficial geology in this reach of Wet Beaver Creek to be the "limestone of the thick limestone facies of the Verde Formation" and Quaternary "unconsolidated gravel, sand, silt and clay" (Twenter and Metzger, 1963). Figure 4.26 of the Arizona Department of Water Resources Verde River Watershed Study (Brown et al., 2000) shows the Wet Beaver Creek and Dry Beaver Creek channel bottoms located above the water table near T.14 N., R.5 E. Sections 3 and 4 indicating "losing" stream reaches. These references suggest that the decrease in discharge between Sites 13 and 12 can be at least partially attributed to the geologic setting in this reach.

Discharge between Site 12 (1.8 cfs) and Site 11 (1.4 cfs) showed no significant increase or decrease.

Table 2. – Summary of discharge measurement data for the 06/13/2002 and 10/30/2003 MOCA Beaver/Wet Beaver Creek seepage runs.

Site No.	Discharge 06/13/2002 (cfs)	Discharge 06/13/2002 (ave. cfs)	Discharge 10/30/2003 (cfs)	Discharge 10/30/2003 (ave. cfs)	Start Time (24 hrs)	End Time (24 hrs)	Start Gage Height (ft.)	End Gage Height (ft.)
10	6.28	6.28			1015	n/a	n/a	n/a
			6.75		1230	1330	0.38	0.38
			6.65	6.7	1415	1525	0.39	0.39
1	5.36	5.36			1045	1205		
			7.09		803	903	0.53	0.54
			6.86	6.98	1000	1055	0.54	0.53
2	5.37				1030	1145		
	4.86	5.115			1150	1300		
14			6.15		822	952	0.49	0.49
			6.59	6.37	1009	1056	0.48	0.48
3	5.68	5.68			1040	1130		
			5.8		1230	1307	0.59	0.59
			5.6	5.7	1400	1454	0.58	0.58
4	7.82				1030	1130		
	7.95	7.885			1135	1225		
			9.83		755	925	0.56	0.56
			10.06	9.94	1020	1115	0.56	0.56
5	7.89				1034	1106		
	7.74	7.815			1106	1146		
			9.41		803	904	0.4	0.4
			9.1	9.26	1003	1103	0.4	0.4
6	2.87				1217	1229		
	3.01	2.94			1230	1246		
15			8.38		1235	1324	0.53	0.53
			7.66	8.02	1433	1514	0.51	0.48
7	2.95	2.95			1500	1535		
13			6.86		1250	1335	0.55	0.57
			6.4	6.63	1435	1520	0.58	0.57
8	1.04	1.04			1503	1546		
12			1.84		1230	1312	0.31	0.32
			1.77		1330	1418	0.32	0.33
			1.88	1.83	1430	1505	0.33	0.33
9	0.28	0.28			1430	1500		
11			1.41		800	840	0.28	0.29
			1.39		850	931	0.29	0.29
			1.37	1.39	954	1046	0.29	0.29

Conclusions and Recommendations

Discharge measured at Site 3 and upstream to Site 10 (including Sites 10, 1, 2, and 3) was approximately the same or slightly less than the discharge measured during the June 13, 2002 seepage run. The trend in discharge from upstream to downstream in this reach was approximately the same as seen in the June 13, 2002 seepage run. No significant gains or losses were observed. Discharge measurements at Sites 10, 1, and 2 could be eliminated from future seepage runs. Site 10 is the USGS gage and 15-minute, hourly, and/or daily values stage/discharge data should be available. Site 3 could be retained because it is the next cross section upstream of the MOCA Well Unit and in spite of the Lawrence Crossing diversion it provides some information on discharge entering the Well Unit stream reach.

Discharge approximately doubled between Sites 3 and 4 (from approximately 5.7 cfs to approximately 10 cfs). In addition to other sources, Walker Creek, Soda Spring, and Red Tank Draw could contribute discharge to this stream reach. The source of this increase in discharge should be investigated further.

Discharge measured between Sites 4 and 13 (Sites 4, 5, 15, and 13) was higher than the discharge measured in the June 13, 2002 seepage run. The discharge measured at Site 13 was more than twice the discharge measured at Site 7 during the June 13, 2002 seepage run. Some of the difference in discharge at Site 13 could be attributed to the golf course diversion withdrawing less water during the 2003 seepage run than during the 2002 seepage run. This reach of the river is critical to determining inputs and withdrawals to Wet Beaver Creek because it is heavily populated and there are numerous water rights for surface water diversions and wells. All water rights should be mapped for this stream reach and an intensive stream survey should be done to locate inputs and withdrawals on the ground and establish additional discharge measurement cross sections, if possible. The WRD legal staff should review Arizona water law to determine if the Wet Beaver Creek bottom and banks (to some high water line) are public land and access via the creek as it flows through private land is allowed. If not, permission to access the creek will need to be obtained from private land owners. An intensive seepage run should be conducted on this stream reach.

Discharge decreased by approximately 4.8 cfs (from approximately 6.6 cfs to approximately 1.8 cfs) between Sites 13 and 12. This stream reach has not been surveyed and it is not known if the decrease is due to man-made diversions or natural losses due to geologic features (controls, karst features, or alluvial subsurface flow). This stream reach should be intensively surveyed to locate inputs and withdrawals on the ground and establish additional measurement cross sections. An intensive seepage run should be conducted on this stream reach. A hydrogeologic study may be required to determine if the losses are due in-part to natural losses.

Discharge between Sites 12 and 11 was approximately the same. Site 11 is in a more preferable location closer to the upstream boundary of the MOCA Castle Unit therefore, Site 9 could be eliminated from future seepage runs in favor of Site 11.

A new discharge measurement cross section should be established on Beaver Creek downstream of the MOCA Castle Unit. This site would be established to determine if water losses between Sites 13 and 12 are resurfacing downstream of the Castle Unit. A cross section could be established on USFS administered lands in the NESE Section 19 or in Section 20, T.14 N., R.5 E. USGS Station Number 09505500, Beaver Creek at Camp Verde, Arizona, was located near this site and collected stage data from 12/01/1912 to 03/31/1920. Although the cross section has likely changed significantly in 83 years a good measuring reach may be found at the old gage site.

References

Beck, D., 2003, Surface Water Quality-Assurance Plan for the Virgin River Synoptic Discharge Measurements of February 12, 2003. US Geological Survey, Las Vegas, Nevada, 29 p.

Brown C. A. et al., 2000, Verde River Watershed Study. Arizona Department of Water Resources, Phoenix, Arizona, 216 p.

Moser, E., 2002, Trip Report to Montezuma Castle for the Purpose of Conducting a Seepage Run on Wet Beaver Creek. USDOI, NPS, WRD, Fort Collins, Co., 4 p.

Twenter, F. R. and D. G. Metzger, 1963, Geology and Ground Water in Verde Valley-the Mogollon Rim Region Arizona. Geological Survey Bulletin 1177. US Geological Survey, Washington, US Government Printing Office, 132 p.

Appendices

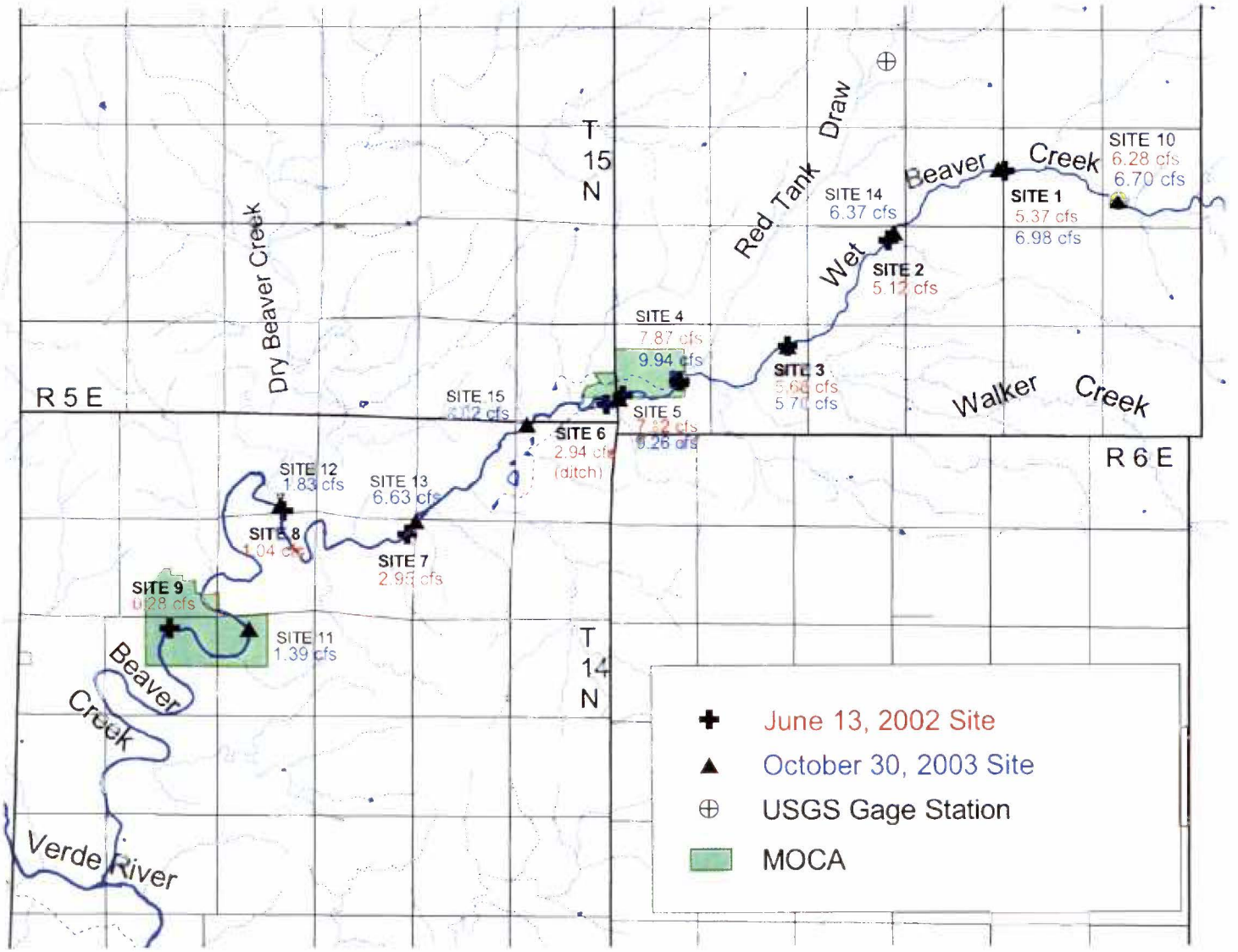
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App B: Site Descriptions, Site Photographs, and Discharge Measurement Notes Forms
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App D: Seepage Run Information Handouts
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App F: Protocol

APPENDIX A

Map of Discharge Measurement Sites with June 13, 2002 and October 30, 2003 Discharge

MOCA
October 30, 2003 Seepage Run
Beaver/Wet Beaver Creek
Yavapai County, Az

Montezuma Castle National Monument
Beaver/Wet Beaver Creek Seepage Runs, 2002 and 2003
Measurement Sites, Date of Measurement, and Discharge



APPENDIX B

Site Descriptions
Site Photographs
Discharge Measurement Notes Forms

Sites are arranged in order from upstream to downstream:

Site 10 – Wet Beaver Creek at USGS Station Number 09505200
Site 1 – Wet Beaver Creek Upstream of the Southwestern Academy
Site 14 – Wet Beaver Creek Upstream of the Beaver Creek Campground Bridge
Site 3 – Wet Beaver Creek at Lawrence Crossing
Site 4 – Wet Beaver Creek at Montezuma Well Outlet
Site 5 – Wet Beaver Creek Upstream of the Golf Course Diversion
Site 15 – Wet Beaver Creek Upstream of the Lake Montezuma Avenue Bridge
Site 13 – Wet Beaver Creek at the White House Boarding School
Site 12 – Wet Beaver Creek Upstream of Cliff Face on USFS at McGuireville
Site 11 – Beaver Creek east of MOCA Castle Unit Visitor Center

MOCA
October 30, 2003 Seepage Run
Beaver/Wet Beaver Creek
Yavapai County, Az.



SUMMARY MAP.10.30.2003_065

Beaver/Wet Beaver Creek Seepage Run Summary Map showing discharge measured at Sites 1, 2, 3, 4, 5, 7, 8, and 9 on 06/13/2002 (in parentheses) and Sites 10, 1, 2 (10/30/03 Site 14), 3, 4, 5, 15, 7 (10/30/03 Site 13), 8 (10/30/03 Site 12), and 9 (10/30/03 Site 11) on 10/30/2003.

Beaver/Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1657 hrs

SITE 10 GS Gaging Station 10-30-03

SITE DESCRIPTION:

GPS:

Accuracy:

- SITE IS ON WET BEAVER CR. @ THE USGS GAGE # 09505200 UPSTREAM OF THE SOUTHWESTERN ACADEMY and THE USFS BEAVER CR. Campground
- DISCHARGE WAS MEASURED AT A CROSS SECTION APPROX. 100 FEET UPSTREAM OF THE GAGE.

ACCESS: BELL TRAIL FROM TRAILHEAD NEAR BEAVER CR. Ranger STATION. GO 2 miles (DRIVE OR WALK) THEN (From Parking Spot) WALK ABOUT 1/4 mile TO GAGING STATION. (TAKE "Right hand" Trail, where Trail Forks, TO USGS GAGE)

R-7

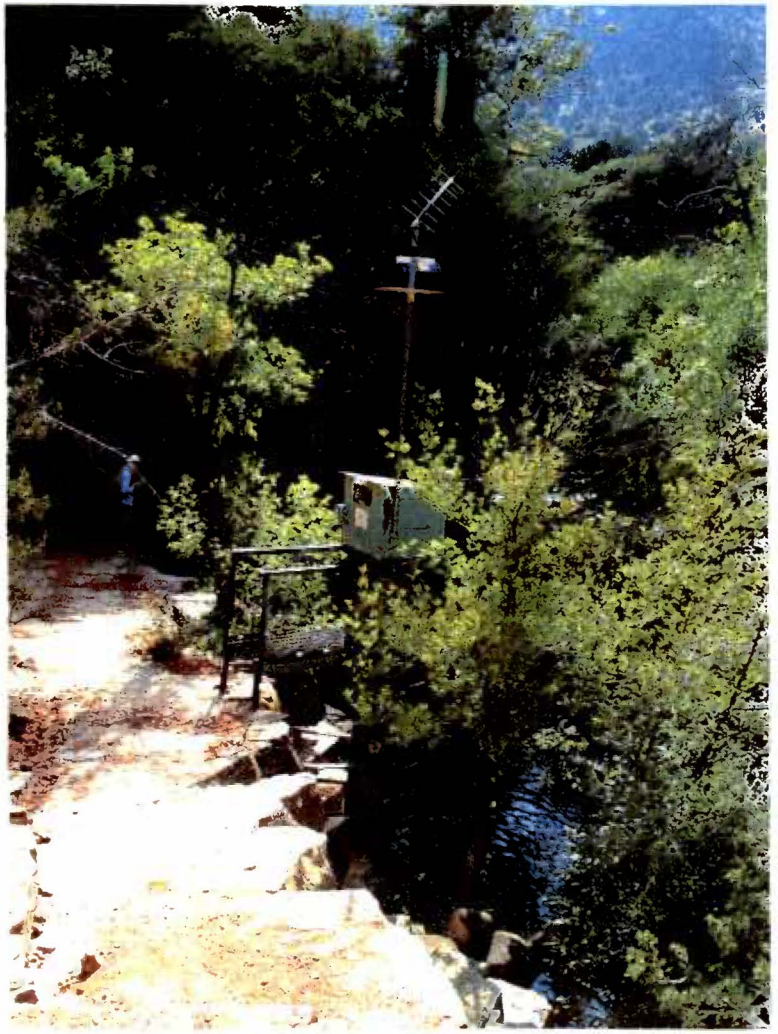


SITE 10.10.30.2003_055

Wet Beaver Creek at USGS Station Number 09505200

From downstream of cross section, on cliff above right bank, looking upstream at the concrete weir.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1155 hrs

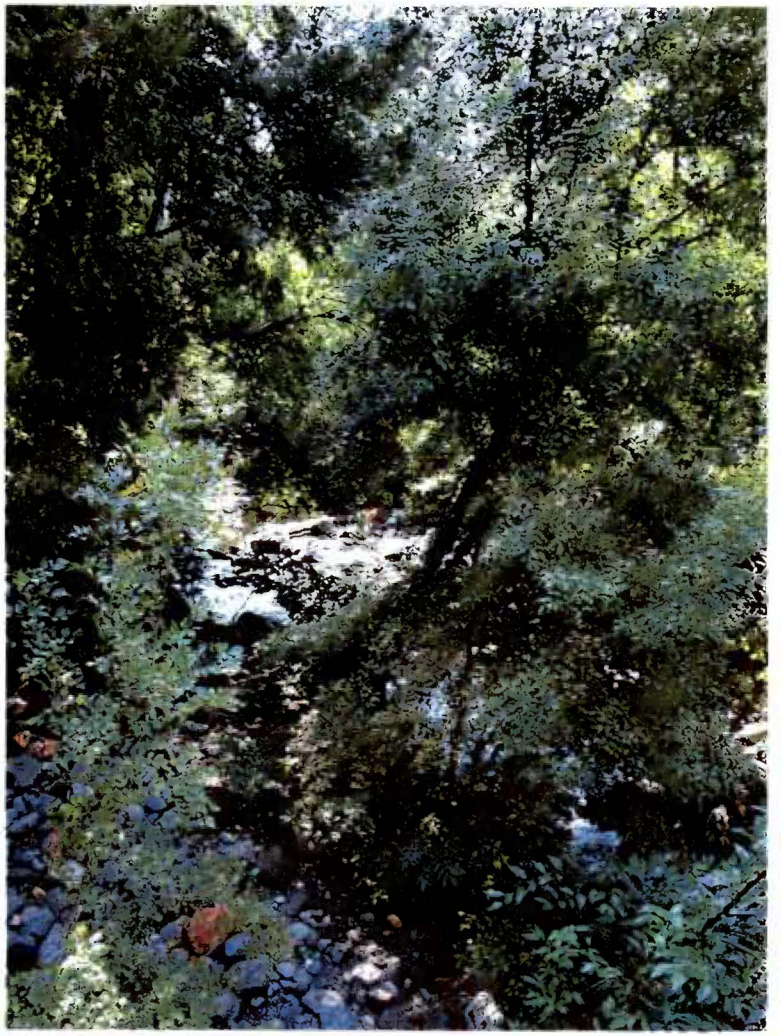


SITE 10.10.30.2003_056

Wet Beaver Creek at USGS Station Number 09505200

From downstream of cross section, on cliff above right bank, looking at USGS Station Number 09505200 equipment. Zach Mondry (USFS, Flagstaff, Az.) descending cliff to trail leading to cross section.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1156 hrs



SITE 10.10.30.2003_057

Wet Beaver Creek at USGS Station Number 09505200

From downstream of cross section, on right bank, looking upstream at trail leading to cross section. Cross section visible in the far ground.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1156 hrs



SITE 10.10.30.2003_058

Wet Beaver Creek at USGS Station Number 09505200

From upstream of the cross section, with measuring tape, looking downstream.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1337 hrs



SITE 10.10.30.2003_059

Wet Beaver Creek at USGS Station Number 09505200

From downstream of the cross section, with measuring tape, looking upstream.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1339 hrs

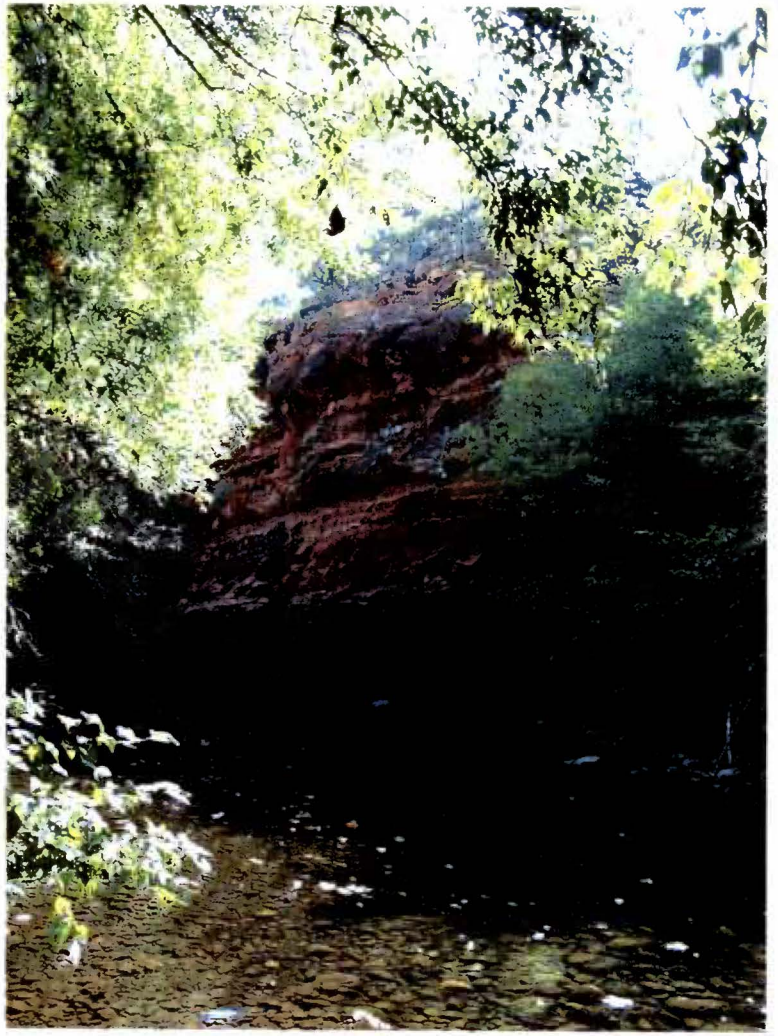


SITE 10.10.30.2003_060

Wet Beaver Creek at USGS Station Number 09505200

From downstream of the cross section, with measuring tape, looking across cross section from left bank to right bank.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1340 hrs



SITE 10.10.30.2003_061
Wet Beaver Creek at USGS Station Number 09505200

From cross section looking upstream.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1342 hrs

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HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	USGS Gaging Station				
Station Number:	10	WIDTH	22.000	# of Sections	37
Date:	10/30/2003	AREA	17.018	Sections > 5%	5
Measurement #:	1	VELOCITY	0.397	Sections > 10%	0
Pygmy or AA (p/a)	p			*Standard Error	5.43%
Rating # (1 or 2)	2	TOTAL DISCHARGE	6.754		FAIR

Print Header

Print Full Sheet

Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	1.4	0.10	0			0.000	0.000	0.000	0.000	0.000
	1.6	0.30	0.5	0	40	0.000	0.000	0.000	0.150	0.000
	2	0.55	0.65	3	53.7	0.085	0.085	0.085	0.358	0.030
	2.7	0.70	1	11	40.5	0.292	0.292	0.292	0.700	0.204
	3.4	0.70	1	18	41.9	0.444	0.444	0.444	0.700	0.311
	4.1	0.70	0.75	31	40.2	0.772	0.772	0.772	0.525	0.405
	4.8	0.70	1.1	27	40.7	0.668	0.668	0.668	0.770	0.515
	5.5	0.70	0.9	15	41.4	0.379	0.379	0.379	0.630	0.239
	6.2	0.70	1.05	12	42.5	0.302	0.302	0.302	0.735	0.222
	6.9	0.70	0.8	28	41.3	0.682	0.682	0.682	0.560	0.382
	7.6	0.70	0.7	34	40.5	0.837	0.837	0.837	0.490	0.410
	8.3	0.70	0.75	27	40.2	0.676	0.676	0.676	0.525	0.355
	9	0.70	1.1	17	40.2	0.437	0.437	0.437	0.770	0.337
	9.7	0.70	1.05	12	40.2	0.318	0.318	0.318	0.735	0.234
	10.4	0.70	1	10	42	0.260	0.260	0.260	0.700	0.182
	11.1	0.60	1.1	15	44	0.359	0.359	0.359	0.660	0.237
	11.6	0.50	0.75	25	41.3	0.613	0.613	0.613	0.375	0.230
	12.1	0.50	0.8	27	40.7	0.668	0.668	0.668	0.400	0.267
	12.6	0.50	0.8	19	40.5	0.482	0.482	0.482	0.400	0.193
	13.1	0.50	0.8	16	42	0.397	0.397	0.397	0.400	0.159
	13.6	0.50	0.7	18	40.7	0.456	0.456	0.456	0.350	0.160
	14.1	0.50	0.6	26	41.6	0.631	0.631	0.631	0.300	0.189
	14.6	0.50	0.75	7	40.5	0.197	0.197	0.197	0.375	0.074
	15.1	0.50	0.9	6	46.7	0.155	0.155	0.155	0.450	0.070
	15.6	0.50	0.85	9	43.2	0.231	0.231	0.231	0.425	0.098
	16.1	0.50	0.8	16	41.8	0.399	0.399	0.399	0.400	0.160
	16.6	0.50	0.75	18	40.7	0.456	0.456	0.456	0.375	0.171
	17.1	0.50	0.7	26	40.3	0.651	0.651	0.651	0.350	0.228
	17.6	0.50	0.7	18	41.5	0.448	0.448	0.448	0.350	0.157
	18.1	0.50	0.7	20	40.7	0.503	0.503	0.503	0.350	0.176
	18.6	0.60	0.65	11	43	0.277	0.277	0.277	0.390	0.108
	19.3	0.70	0.6	0	40	0.000	0.000	0.000	0.420	0.000
	20	0.70	0.6	0	40	0.000	0.000	0.000	0.420	0.000
	20.7	0.70	0.8	0	40	0.000	0.000	0.000	0.560	0.000
	21.4	0.85	0.7	13	42.4	0.326	0.326	0.326	0.595	0.194
	22.4	1.00	0.2	12	44.1	0.293	0.293	0.293	0.200	0.059
	23.4	0.50	0.25	0	40	0.000	0.000	0.000	0.125	0.000

S_q	S_d	S_t	S_j	S_s	S_h	S_v
5.43497	7.6408	5.844244	4.029204	2.8765		0 1.3339

b 7.640801
c 14.833
e
f

Select a Bed Type:
Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u
2

Select a Suspension Type:
Rod
Cable

Rod
1

b	c					# secs	5+ secs	10+ secs
						1	0	0
10.198039	20.09975	5.909235				1	0	0
7.94805622	15.51407	5.441458	22.23161		0	1	0	0
5.38516481	10.19804	5.888717	4.458095		0	1	0	0
5.38516481	10.19804	5.832949	2.587745		0	1	0	0
6.96020434	13.4825	5.900989	1.945449		0	1	1	0
4.9660001	9.30831	5.8806	2.031314		0	1	1	0
5.90459122	11.28968	5.852589	3.175098		0	1	0	0
5.16485595	9.731544	5.809773	4.261289		0	1	0	0
6.56220237	12.65899	5.856553	2.018721		0	1	1	0
7.41757428	14.42503	5.888717	1.898379		0	1	1	0
6.96020434	13.4825	5.900989	2.024144		0	1	1	0
4.9660001	9.30831	5.900989	2.637415		0	1	0	0
5.16485595	9.731544	5.900989	3.992902		0	1	0	0
5.38516481	10.19804	5.829057	5.188798		0	1	0	0
4.9660001	9.30831	5.753622	3.413774		0	1	0	0
6.96020434	13.4825	5.856553	2.085109		0	1	0	0
6.56220237	12.65899	5.8806	2.031314		0	1	0	0
6.56220237	12.65899	5.888717	2.32576		0	1	0	0
6.56220237	12.65899	5.829057	2.990336		0	1	0	0
7.41757428	14.42503	5.8806	2.498354		0	1	0	0
8.56997342	16.78624	5.844696	2.066193		0	1	0	0
6.96020434	13.4825	5.888717	7.428099		0	1	0	0
5.90459122	11.28968	5.658474	10.19295		0	1	0	0
6.21305691	11.9335	5.783259	6.037468		0	1	0	0
6.56220237	12.65899	5.836853	2.973284		0	1	0	0
6.96020434	13.4825	5.8806	2.498354		0	1	0	0
7.41757428	14.42503	5.896885	2.047555		0	1	0	0
7.41757428	14.42503	5.848636	2.557808		0	1	0	0
7.41757428	14.42503	5.8806	2.2119		0	1	0	0
7.94805622	15.51407	5.790778	4.778107		0	1	0	0
8.56997342	16.78624	5.909235				1	0	0
8.56997342	16.78624	5.909235				1	0	0
6.56220237	12.65899	5.909235				1	0	0
7.41757428	14.42503	5.813607	3.869411		0	1	0	0
25.0798724	50.03998	5.749966	4.44851		0	1	0	0
20.0997512	40.04997	5.909235				1	0	0

River at—

Angle coefficient	Dist. from initial point	...th	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge	
	LEW	1.4	0	.6								
		1.6	0.50	↓	0	40	0			0.150	0	.85
		2.0	0.65	↓	3	53.7	.084			0.358	0.027	0.030
		2.7	1.00		11	40.5	.291			0.700	0.204	
		3.4	1.00		18	41.9	.448			0.700	0.3101	.90
		4.1	0.75		31	40.2	.771			0.525	0.213	0.405 .92
		4.8	1.10		27	40.7	.668			0.77	0.514	.94
		5.5	0.90		15	41.4	.378			0.630	0.238	1.5
		6.2	1.05		12	42.5	.302			0.735	0.221	2.96
		6.9	0.80		28	41.3	.682			0.560	0.546	0.382 .97
		7.6	0.70		34	40.5	.837			0.490	0.410	.98
	10	8.3	0.75		27	40.2	.676			0.525	0.355	.99
		9.0	1.10		17	40.2	.437			0.770	0.337	
		9.7	1.05		12	40.2	.317			0.735	0.238	3.602
○		10.4	1.00		10	42.0	.259			0.700	0.207	0.182 1.00
		11.1	1.10		15	44.0	.358			0.660	0.2367	
	on boulder	11.6	0.75		25	41.3	.617			0.375	0.230	
	on boulder	12.1	0.80		27	40.7	.668			0.400	0.267	.99
		12.6	0.80		19	40.5	.488			0.400	0.193	.98
		13.1	0.80		16	42.0	.396			0.400	0.158	.97
	behind boulder	13.6	0.70		18	40.7	.458			0.350	0.159	0.160 .96 5.046
26	" "	14.1	0.60		26	41.6	.631			0.300	0.189	
		14.6	0.75		7	40.5	.196			0.375	0.074	.94
		15.1	0.90		6	46.7	.154			0.450	0.069	0.070 .92
		15.6	0.85		9	43.2	.231			0.425	0.098	.90
		16.1	0.80		16	41.8	.398			0.400	0.159	0.160
		16.6	0.75		18	40.7	.458			0.375	0.171	5.804
		17.1	0.70		26	40.3	.650			0.350	0.228	.85
		17.6	0.70		18	41.5	.447			0.350	0.156	
		18.1	0.70		20	40.7	.502			0.350	0.176	
.25		18.6	0.65		11	43.0	.276		0.390	0.401	0.110	0.108 .80
.1		19.2	0.60		0	40	0			0.420	0	6.483

		20.0	0.60	.6	0	40	0			0.2	0	
		20.7	0.80	↓	0	40	0			0.5	0	.80
.35 .5		21.4	0.70		13	42.4	.328			0.595	0.194	
/		22.4	0.20		12	44.1	.292			0.20	0.058	
REW		23.4	0.25		0	40				0	0	.85
									TOTAL	6.735		
										6.754		.90

R-12

1003

5 SECTIONS → 7%
ER 5.43%
F

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 1

Comp by _____ Checked by FIECHTNER

DATE _____

PARK MOCA COCONINO STATION #10 USGS gaging station

PERSONNEL: Meter NF Mondry Notes Christensen

MEASUREMENT TYPE (circle one) (Wading, Cable, Bridge, Boat, Ice; Upstr., Dnstr., ____ ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start 1230 G.H. .38 Stop 1330 G.H. 0.38

METER TYPE Pygmy S/N P90068 SPIN Before Meas. 1+min After _____

WEATHER clear, wind at times

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor
					1

FLOW: Width 22.000 Area 17.018 Ave. Vel. 0.397 G.H. _____ Disch. ~~6.735~~ 6.754

Method 0.6 Method coeff. ____ Hor. Angle coeff. ____ Susp. type _____ Susp. coeff. ____

Meter _____ ft. above bottom of weight No. Secs. 37 G.H. changes 0 ft. in 1 hrs.

FLOW _____

Cross Section _____

CONTROL _____

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 18 C (F) Water 59 C (F)

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

B-12a

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS cobble/boulder substrate digitizer # 41294

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	USGS Gaging Station				
Station Number:	10	WIDTH	22.000	# of Sections:	40
Date:	10/30/2003	AREA	16.578	Sections > 5%:	0
Measurement #:	2	VELOCITY	0.401	Sections > 10%:	0
Pygmy or AA (p/a)	p			*Standard Error:	5.21%
Rating # (1 or 2)	2	TOTAL DISCHARGE:	6.652		FAIR

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	1.4	0.10	0			0.000	0.000	0.000	0.000	0.000
	1.6	0.40	0.5	0	40	0.000	0.000	0.000	0.200	0.000
	2.2	0.60	0.95	6	40.1	0.175	0.175	0.175	0.570	0.100
	2.8	0.60	1.15	8	42.3	0.213	0.213	0.213	0.690	0.147
	3.4	0.45	0.95	20	41.9	0.490	0.490	0.490	0.428	0.209
	3.7	0.30	0.85	25	41.1	0.615	0.615	0.615	0.255	0.157
	4	0.30	0.75	30	41	0.734	0.734	0.734	0.225	0.165
	4.3	0.30	0.7	31	40.3	0.770	0.770	0.770	0.210	0.162
	4.6	0.30	0.9	30	41.4	0.727	0.727	0.727	0.270	0.196
	4.9	0.30	0.95	27	40	0.679	0.679	0.679	0.285	0.194
	5.2	0.30	0.9	26	40.4	0.649	0.649	0.649	0.270	0.175
	5.5	0.40	0.95	17	40.7	0.432	0.432	0.432	0.380	0.164
	6	0.50	1	12	40.3	0.317	0.317	0.317	0.500	0.159
	6.5	0.50	1.05	16	40.2	0.413	0.413	0.413	0.525	0.217
	7	0.40	0.75	30	40.1	0.750	0.750	0.750	0.300	0.225
	7.3	0.30	0.7	36	40.8	0.879	0.879	0.879	0.210	0.185
	7.6	0.35	0.7	35	40.1	0.869	0.869	0.869	0.245	0.213
	8	0.40	0.75	29	40.7	0.716	0.716	0.716	0.300	0.215
	8.4	0.40	1	25	41	0.617	0.617	0.617	0.400	0.247
	8.8	0.45	1	18	40.6	0.457	0.457	0.457	0.450	0.206
	9.3	0.60	1.05	14	42.2	0.350	0.350	0.350	0.630	0.220
	10	0.70	0.9	8	42.4	0.212	0.212	0.212	0.630	0.134
	10.7	0.70	1.15	13	41.2	0.334	0.334	0.334	0.805	0.269
	11.4	0.50	0.75	26	41.2	0.637	0.637	0.637	0.375	0.239
	11.7	0.30	0.75	28	40.1	0.702	0.702	0.702	0.225	0.158
	12	0.30	0.8	29	40.7	0.716	0.716	0.716	0.240	0.172
	12.3	0.50	0.75	20	40.9	0.501	0.501	0.501	0.375	0.188
	13	0.85	0.85	18	41.4	0.449	0.449	0.449	0.723	0.324
	14	1.00	0.4	16	42.7	0.391	0.391	0.391	0.400	0.156
	15	1.00	0.75	6	42.7	0.166	0.166	0.166	0.750	0.125
	16	0.75	0.8	16	43.5	0.384	0.384	0.384	0.600	0.231
	16.5	0.50	0.75	18	41.6	0.447	0.447	0.447	0.375	0.168
	17	0.50	0.7	26	41.2	0.637	0.637	0.637	0.350	0.223
	17.5	0.50	0.75	24	41	0.593	0.593	0.593	0.375	0.223
	18	0.75	0.7	17	41.4	0.426	0.426	0.426	0.525	0.223
	19	1.00	0.6	3	43.8	0.097	0.097	0.097	0.600	0.058
	20	1.00	0.6	0	40	0.000	0.000	0.000	0.600	0.000
	21	1.25	0.7	7	45.7	0.178	0.178	0.178	0.875	0.156
	22.5	1.20	0.25	6	40.7	0.173	0.173	0.173	0.300	0.052
	23.4	0.45	0.25	0	40	0.000	0.000	0.000	0.113	0.000

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S_c	S_d	S_t	S_i	S_s	S_n	S_v
5.205704	7.415	5.860787	3.812459	2.8337	0	1.2455

b	7.415031
c	14.37333
e	
f	

Select a Bed Type:

Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u

2

Select a Suspension Type:

Rod
Cable

Rod

1

b	c				# secs	5+ secs	10+ secs
					1	0	0
10.198039	20.09975	5.909235			1	0	0
5.6303491	10.71463	5.905106	8.881871	0	1	0	0
4.78576971	8.922688	5.817452	6.726421	0	1	0	0
5.6303491	10.71463	5.832949	2.277299	0	1	0	0
6.21305691	11.9335	5.864519	2.082229	0	1	0	0
6.96020434	13.4825	5.86852	1.97504	0	1	0	0
7.41757428	14.42503	5.896885	1.946841	0	1	0	0
5.90459122	11.28968	5.852589	1.980554	0	1	0	0
5.6303491	10.71463	5.909235	2.021256	0	1	0	0
5.90459122	11.28968	5.892795	2.049005	0	1	0	0
5.6303491	10.71463	5.8806	2.677051	0	1	0	0
5.38516481	10.19804	5.896885	4.004548	0	1	0	0
5.16485595	9.731544	5.900989	2.837228	0	1	0	0
6.96020434	13.4825	5.905106	1.962482	0	1	0	0
7.41757428	14.42503	5.876561	1.871257	0	1	0	0
7.41757428	14.42503	5.905106	1.877148	0	1	0	0
6.96020434	13.4825	5.8806	1.990155	0	1	0	0
5.38516481	10.19804	5.86852	2.080785	0	1	0	0
5.38516481	10.19804	5.884652	2.490921	0	1	0	0
5.16485595	9.731544	5.821308	3.525744	0	1	0	0
5.90459122	11.28968	5.813607	6.744062	0	1	0	0
4.78576971	8.922688	5.86053	3.740835	0	1	0	0
6.96020434	13.4825	5.86053	2.060506	0	1	0	0
6.96020434	13.4825	5.905106	2.001741	0	1	0	0
6.56220237	12.65899	5.8806	1.990155	0	1	0	0
6.96020434	13.4825	5.872534	2.214953	0	1	0	0
6.21305691	11.9335	5.852589	2.550454	0	1	0	0
12.6589889	25.07987	5.802141	3.050095	0	1	0	0
6.96020434	13.4825	5.802141	9.280883	0	1	0	0
6.56220237	12.65899	5.772063	3.118529	0	1	0	0
6.96020434	13.4825	5.844696	2.565363	0	1	0	0
7.41757428	14.42503	5.86053	2.060506	0	1	0	0
6.96020434	13.4825	5.86852	2.105094	0	1	0	0
7.41757428	14.42503	5.852589	2.73265	0	1	0	0
8.56997342	16.78624	5.760966	18.68749	0	1	0	0
8.56997342	16.78624	5.909235			1	0	0
7.41757428	14.42503	5.692874	8.46687	0	1	0	0
20.0997512	40.04997	5.8806	8.820505	0	1	0	0
20.0997512	40.04997	5.909235			1	0	0

B-14

1002 2

5 SECTIONS >5%
ERROR: 5.7%
FAIR

cpt,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 2

DATE 10/30/2003 Comp by _____ Checked by FIECHTNER

PARK COCONINO NF MOCA STATION #10 USGS gaging station

PERSONNEL: Meter Mondry Notes Christensen

MEASUREMENT TYPE (circle one) Wading Cable, Bridge, Boat, Ice; Upstr., Dnstr., ___ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 1415 G.H. 0.39 Stop: 1525 G.H. 0.39

METER TYPE pygmy S/N P90068 SPIN Before Meas/ Mnt After 50 sec +

WEATHER clear, warm, windy at times

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor

FLOW: Width 22.00 Area 16.578 Ave. Vel. 0.401 G.H. _____ Disch. 6.652

Method 0.6 Method coeff. ____ Hor. Angle coeff. ____ Susp. type _____ Susp. coeff. ____

Meter _____ ft. above bottom of weight No. Secs. 40 G.H. changes 0 ft. in 70/60 hrs.

FLOW _____

Cross Section _____

CONTROL _____

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 67 C F Water 58 C F

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS cobble/boulder substrate
digitizer #41294

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

B-15

1003 3

River at—

Angle coefficient	Dist. from initial point	Width	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
LEW	1.4		0	.6							
	1.6	0.4	0.50	↓	0	40	0			0.200 0.35	0
	2.2	0.6	0.95		6	40.1	.174	5		0.57	0.099
	2.8	0.6	1.15		8	42.3	.212	3		0.69	0.1467
	3.4	0.6 0.5	0.95		20	41.9	.489	90		0.523 0.478	0.256
	3.7	0.30	0.85		25	41.1	.615			0.255	0.157
	4.0	0.30	0.75		30	41.0	.733	4		0.225	0.165
	4.3	0.30	0.70		31	40.3	.769	70		0.210	0.1612
	4.6	0.30	0.90		30	41.4	.726	7		0.270	0.196
	4.9	0.30	0.95		27	40.0	.679			0.285	0.194
	5.2	0.30	0.90		26	40.4	.649			0.270	0.175
	5.5	0.30 0.40	0.95		17	40.7	.432			0.385 0.330	0.123
	6.0	0.50	1.00		12	40.3	.316	7		0.50	0.1589
	6.5	0.50	1.05		16	40.2	.413			0.525	0.217
⊙	7.0	0.40	0.75		30	40.1	.743	50		0.300	0.228
	7.3	0.30	0.70		36	40.8	.878	9		0.210	0.1845
	7.6	0.35	0.70		35	40.1	.869			0.245	0.213
	8.0	0.40	0.75		29	40.1	.718	6		0.300	0.2145
	8.4	0.40	1.00		25	41.0	.616	7		0.400	0.2487
	8.8	0.45	1.00		18	40.6	.456	7		0.450	0.2086
	9.3	0.60	1.05		14	42.2	.349	50		0.63	0.220
	10.0	0.70	0.90		8	42.4	.212			0.63	0.134
	10.7	0.70	1.15		13	41.2	.334			0.805	0.267
	11.4	0.50	0.75		26	41.2	.637			0.375	0.239
	11.7	0.30	0.75		28	40.1	.708	2		0.225	0.158
	12.0	0.30	0.80		29	40.7	.718	6		0.24	0.172
	12.3	0.5	0.75		20	40.9	.500	1		0.375	0.188
	13.09	0.85 0.75	0.85		18	41.4	.448	9		0.723 0.638	0.286
on rock	14.09	1.00	0.40		16	42.7	.390	1		0.40	0.156
	15.00	1.00	0.75		6	42.7	.168	6		0.75	0.1245
	16.00	0.75	0.80		16	43.5	.384			0.60	0.238
	16.50	0.50	0.75		18	41.6	.446	7		0.375	0.1678

Angle coefficient	Dist. from initial point	Width	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
	17.00	0.50	0.70		26	41.2	.637				.334 0.223
→	18.00	0.75	0.70		17	41.4	.425	86		0.525	0.223
	19.00	1.00	0.60		3	43.8	.096	7		0.600	0.058
	20.00	1.00	0.60		0	40.	0			0.600	0
	21.00	1.25	0.70		7	45.7	.178			0.875	0.156
	22.50	1.20	0.25		6	40.7	.172	3		0.300	0.052
REW	23.4		0.25		0	40	0				0
	17.5	0.50	0.75		24	41	.593			0.375	0.223
											6.652

B-15d

SITE 1 — 1340 MST 10-29-2003

SITE DESCRIPTION:

GPS: #26 12S 0436442
UTM 3837718
ACCURACY: 19 ft

- SITE 1 IS ON WET BEAVER CREEK ON USFS LAND
- THE SITE IS ≈50 YDS U.S. OF THE FENCE ALONG THE ROAD (WE SUPPOSE THE FENCE SYMBOLIZES A SECTION LINE)
- STAFF GAGE ≈5 ft U.S. OF CROSS SECTION, RIVER RIGHT
- STAFF GAGE READING: 0.51 ft
- CHANNEL WIDTH ≈ 12 ft

B-16

PHOTOS:

ACCESS: * MUST HAVE 4-WHEEL DRIVE



SITE 1.10.30.2003_048

Wet Beaver Creek upstream of the Southwestern Academy

From upstream of the cross section looking downstream at the cross section, with measuring tape.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 0904 hrs



SITE 1.10.30.2003_049

Wet Beaver Creek upstream of the Southwestern Academy

From upstream of the cross section, on the left bank, looking at the staff gage installed upstream of the cross section on river right.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 0907 hrs



SITE 1.10.30.2003_050
Wet Beaver Creek upstream of the Southwestern Academy

From downstream of the cross section looking upstream at the cross section, with measuring tape.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 0907 hrs



SITE 1.10.30.2003_051

Wet Beaver Creek upstream of the Southwestern Academy

From upstream of the cross section looking upstream.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 0909 hrs

Start 0803 — River at —

Angle coefficient	Dist. from initial point	ft	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge	
	LEW	4.0	0	.6			digitized			~~0.090~~	~~0.034~~	
		4.3	0.3	↓	15	42.1	.373			~~0.135~~	0.050	.85
		4.6	0.25	↓	16	40.6	~~.409~~	0.411		0.075	~~0.023~~	0.031 .043
		4.9	0.30		13	40.2	.341	0.342		0.090	0.015	0.031 .30
		5.2	0.45		13	42.5	~~.324~~	0.325		0.135	0.044	
		5.5	0.40		28	41.2	~~.683~~	0.684		0.120	0.082	.92
		5.8	0.50		24	40.3	.602	0.603		0.150	0.090	.94
		6.1	0.65		25	41.9	.604			0.195	0.118	
		6.4	0.55		26	41.0	.640			0.165	0.106	.96
		6.7	0.60		34	40.7	.833			0.180	0.150	.97
(110)		7.0	0.50		34	40.9	~~.829~~	0.830		0.150	0.124	.98
		7.3	0.50		31	41.3	.751	0.752		0.150	0.113	.99
		7.6	0.75		30	40.2	~~.747~~	0.748		0.225	0.168	
		7.9	0.90		32	40.7	.786			0.270	~~0.187~~	0.212
⊙		8.2	0.85		30	40.3	~~.745~~	0.746		0.255	0.190	1.00
		8.5	0.85		35	41.1	~~.848~~	1.849		0.255	0.216	0.217
		8.8	0.95		33	40.1	~~.821~~	0.822		0.285	0.234	
		9.1	1.15		40	40.3	.984			0.345	~~0.339~~	0.340 .99
		9.4	0.90		43	41.2	~~1.033~~	1.034		0.270	~~0.278~~	0.279 .98
		9.7	0.80		43	41.2	~~1.033~~	1.034		0.240	0.248	.97
on boulder	(20)	10.0	0.60		35	40.0	~~.871~~	1.872		0.180	0.157	.96
on boulder		10.3	0.50		39	40.3	~~.960~~	0.961		0.150	0.144	
on boulder		10.6	0.50		45	40.3	~~1.103~~	1.104		0.150	~~0.165~~	0.166 .94
on boulder		10.9	0.60		54	40.7	1.305			0.180	6.235	.92
		11.2	0.90		47	40.8	~~1.137~~	1.138		0.270	0.307	.90
		11.5	1.05		60	40.4	~~1.457~~	1.458		0.315	0.459	
		11.8	1.10		68	40.2	~~1.655~~	1.656		0.330	0.546	4.774
		12.1	0.95		59	40.0	~~1.447~~	1.448		0.285	~~0.412~~	0.413 .85
		12.4	0.95		47	40.3	1.151			0.285	0.328	
		12.7	0.95		45	40.1	~~1.108~~	1.109		0.285	0.316	
	(30)	13.0	0.90		41	40.6	~~1.000~~	1.001		0.270	0.270	.80
on cobble		13.3	0.65		40	41.2	~~0.963~~	0.964		0.195	~~0.189~~	0.188 6.289

		13.6	0.65	.6	31	40.2	.771	0.772		0.10	~~0.150~~	0.151
		13.9	0.80	↓	26	42.3	.621	0.622		0.24	0.149	.80
		14.2	0.70		27	42.1	~~.646~~	0.647		0.210	0.136	
		14.5	0.60		26	40.9	.641	0.642		0.180	0.115	0.116 2.73
		14.8	0.65		19	40.2	.481	0.485		0.195	~~0.094~~	.85 0.195
		15.1	0.80		11	42.2	.281	0.282		0.240	~~0.067~~	0.1168
38		15.4	0.70		6	43.3	.164			0.245	0.040	
	REW	15.8	0.40		0					0.080	0	.90
		and 0903										.92
							TOTAL			7.093	~~7.016~~	cfs .94
							AVE				~~0.185~~	.96 .97 .98 .99 1.00 .99 .98 .97 .96 .94 .92 .90 .85 .80

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0103

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	Wet Beaver Creek at Southwestern Academy				
Station Number:	1	WIDTH	11.800	# of Sections	37
Date:	10/30/2003	AREA	8.091	Sections > 5%	3
Measurement #:	2	VELOCITY	0.848	Sections > 10%	0
Pygmy or AA (p/a)	p			*Standard Error	4.21%
Rating # (1 or 2)	2	TOTAL DISCHARGE	6.861		GOOD

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficien	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	4	0.30	0			0.000	0.000	0.000	0.000	0.000
	4.6	0.60	0.25	14	45.6	0.326	0.326	0.326	0.150	0.049
	5.2	0.60	0.45	15	40.3	0.389	0.389	0.389	0.270	0.105
	5.8	0.45	0.5	23	41	0.570	0.570	0.570	0.225	0.128
	6.1	0.30	0.65	23	40.7	0.574	0.574	0.574	0.195	0.112
	6.4	0.30	0.55	26	41	0.640	0.640	0.640	0.165	0.106
	6.7	0.30	0.6	32	41.2	0.777	0.777	0.777	0.180	0.140
	7	0.30	0.5	30	40	0.752	0.752	0.752	0.150	0.113
	7.3	0.30	0.5	31	40.5	0.766	0.766	0.766	0.150	0.115
	7.6	0.30	0.75	30	40.4	0.744	0.744	0.744	0.225	0.167
	7.9	0.30	0.9	28	40.2	0.700	0.700	0.700	0.270	0.189
	8.2	0.30	0.85	29	40.6	0.717	0.717	0.717	0.255	0.183
	8.5	0.30	0.85	35	40.7	0.857	0.857	0.857	0.255	0.219
	8.8	0.30	0.95	37	40.7	0.904	0.904	0.904	0.285	0.258
	9.1	0.30	1.15	41	40.9	0.994	0.994	0.994	0.345	0.343
	9.4	0.30	0.9	45	40.4	1.101	1.101	1.101	0.270	0.297
	9.7	0.30	0.8	38	40.4	0.935	0.935	0.935	0.240	0.224
	10	0.30	0.6	39	40	0.968	0.968	0.968	0.180	0.174
	10.3	0.30	0.5	40	40.9	0.970	0.970	0.970	0.150	0.146
	10.6	0.30	0.5	48	40.2	1.178	1.178	1.178	0.150	0.177
	10.9	0.30	0.6	50	40.5	1.217	1.217	1.217	0.180	0.219
	11.2	0.27	0.9	48	40.5	1.169	1.169	1.169	0.248	0.289
	11.45	0.25	1.05	57	40.5	1.383	1.383	1.383	0.263	0.363
	11.7	0.25	1.05	60	40.3	1.461	1.461	1.461	0.263	0.384
	11.95	0.25	1.1	55	40.3	1.342	1.342	1.342	0.275	0.369
	12.2	0.25	0.95	55	40.1	1.348	1.348	1.348	0.238	0.320
	12.45	0.25	0.95	46	40	1.136	1.136	1.136	0.238	0.270
	12.7	0.28	0.95	43	40.3	1.056	1.056	1.056	0.261	0.276
	13	0.30	0.9	44	40	1.088	1.088	1.088	0.270	0.294
	13.3	0.30	0.65	37	40.6	0.906	0.906	0.906	0.195	0.177
	13.6	0.30	0.65	28	40.8	0.690	0.690	0.690	0.195	0.135
	13.9	0.30	0.8	23	41.8	0.560	0.560	0.560	0.240	0.134
	14.2	0.30	0.7	24	40.2	0.605	0.605	0.605	0.210	0.127
	14.5	0.45	0.6	22	41.3	0.543	0.543	0.543	0.270	0.147
	15.1	0.55	0.8	11	46.2	0.260	0.260	0.260	0.440	0.114
	15.6	0.35	0.45	0	0	0.000	0.000	0.000	0.158	0.000
	15.8	0.10	0.4	0	0	0.000	0.000	0.000	0.040	0.000

S_i	S_c	S_t	S	S	S_n	S	
4.208408	7.9576	5.875336	2.064676	2.8765		0	1.3339

b	7.957567
c	15.4915
e	
f	

Select a Bed Type:

Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u

2

Select a Suspension Type

Rod
Cable

Rod

1

b	c				# secs	5+ secs	10+ secs	
						1	0	0
20.0997512	40.04997	5.696367	3.863281		0	1	0	0
11.2896763	22.31204	5.896885	3.0746		0	1	0	0
10.198039	20.09975	5.86852	2.130684		0	1	0	0
7.94805622	15.51407	5.8806	2.12625		0	1	0	0
9.30830963	18.29149	5.86852	2.057647		0	1	0	0
8.56997342	16.78624	5.86053	1.941433		0	1	0	0
10.198039	20.09975	5.909235	1.961073		0	1	0	0
10.198039	20.09975	5.888717	1.949617		0	1	0	0
6.96020434	13.4825	5.892795	1.966691		0	1	0	0
5.90459122	11.28968	5.900989	2.00317		0	1	0	0
6.21305691	11.9335	5.884652	1.968751		0	1	0	0
6.21305691	11.9335	5.8806	1.885227		0	1	0	0
5.6303491	10.71463	5.8806	1.855154		0	1	0	0
4.78576971	8.922688	5.872534	1.803281		0	1	0	0
5.90459122	11.28968	5.892795	1.748807		0	1	0	0
6.56220237	12.65899	5.892795	1.836928		0	1	0	0
8.56997342	16.78624	5.909235	1.81788		0	1	0	0
10.198039	20.09975	5.872534	1.816261		0	1	0	0
10.198039	20.09975	5.900989	1.7137		0	1	0	0
8.56997342	16.78624	5.888717	1.697064		0	1	0	0
5.90459122	11.28968	5.888717	1.717425		0	1	0	0
5.16485595	9.731544	5.888717	1.633194		0	1	1	0
5.16485595	9.731544	5.896885	1.606463		0	1	1	0
4.9660001	9.30831	5.896885	1.64799		0	1	1	0
5.6303491	10.71463	5.905106	1.645589		0	1	0	0
5.6303491	10.71463	5.909235	1.732599		0	1	0	0
5.6303491	10.71463	5.896885	1.770844		0	1	0	0
5.90459122	11.28968	5.909235	1.755201		0	1	0	0
7.94805622	15.51407	5.884652	1.853833		0	1	0	0
7.94805622	15.51407	5.876561	2.011692		0	1	0	0
6.56220237	12.65899	5.836853	2.142385		0	1	0	0
7.41757428	14.42503	5.900989	2.093331		0	1	0	0
8.56997342	16.78624	5.856553	2.162132		0	1	0	0
6.56220237	12.65899	5.675555	5.188798		0	1	0	0
11.2896763	22.31204					1	0	0
12.6589889	25.07987					1	0	0
						1	0	0
						0	0	0
						0	0	0

B-25

0102 2

Start 1000 River at—

Angle coef.	Dist. from initial point		Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
	LEW	4.0	0	.6		Digitizer					
		4.6	0.25	↓	14	45.6	.325	0.326		0.200	0.065
		5.2	0.45		15	40.3	.388	0.389		0.270	0.105
		5.8	0.50		23	41.0	.569	0.570		0.225	0.128
		6.1	0.65		23	40.7	.573	0.574		0.195	0.112
		6.4	0.55		26	41.0	.640			0.165	0.106
		6.7	0.60		32	41.2	.776	0.777		0.180	0.140
		7.0	0.50		30	40.0	.751	0.752		0.150	0.112
		7.3	0.50		31	40.5	.766			0.150	0.115
		7.6	0.75		30	40.4	.744			0.225	0.168
		7.9	0.90		28	40.2	.699	0.700		0.270	0.189
		8.2	0.85		29	40.6	.717			0.255	0.183
		8.5	0.85		35	40.7	.856	0.857		0.255	0.218
		8.8	0.95		37	40.7	.904			0.285	0.258
⊙		9.1	1.15		41	40.9	.993	0.994		0.345	0.343
		9.4	0.90		45	40.4	1.100	1.101		0.270	0.297
	on boulder	9.7	0.80		38	40.4	0.934	0.935		0.240	0.224
	on boulder	10.0	0.60		39	40.0	0.967	0.968		0.180	0.174
	on boulder	10.3	0.50		46	40.9	0.970			0.150	0.146
	on boulder	10.6	0.50		48	40.2	1.177	1.178		0.150	0.177
	on boulder	10.9	0.60		50	40.5	1.216	← 1.216	1.217	0.180	0.219
.275		11.2	0.90		48	40.5	1.169			0.248	0.260
.25		11.45	1.05		57	40.5	1.382	1.383		0.263	0.363
.25		11.70	1.05		60	40.3	1.460	1.461		0.263	0.384
.25		11.95	1.10		55	40.3	1.341	1.342		0.275	0.369
.25		12.20	0.95		56	40.1	1.348			0.238	0.321
.25		12.45	0.95		46	40.0	1.135	1.136		0.238	0.270
.275		12.70	0.95		43	40.3	1.055	1.056		0.261	0.275
.3		13.0	0.90		44	40.0	1.087	1.088		0.270	0.293
	on cobble	13.3	0.65		37	40.6	0.906			0.195	0.177
		13.6	0.65		28	40.8	0.690			0.195	0.135
		13.9	0.80		23	41.8	0.559	0.560		0.240	0.134
		14.2	0.70	.6	24	40.2	.604			0.2	.127
.25		14.5	0.60	↓	22	41.3	.542			0.2	0.146
		15.1	0.80		11	46.2	.259			0.440	0.114
		15.6	0.45		0					0.158	0
	REN	15.8	0.40		0					0.04	0

6.918

6.861 cfs

R-26

0102

3 SECTIONS = 5%
E = 4.21%
C

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 2

DATE 10/30/03 MOCA

Comp by _____ Checked by FIECHTNER

PARK COCONINO NF STATION NO. 1 - SOUTHWESTERN ACADEMY WET BEAVER CR. (B)

PERSONNEL: Meter Mondry Notes Christensen

MEASUREMENT TYPE (circle one) (Wading) Cable, Bridge, Boat, Ice; Upstr., Dnstr., ___ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start 1000 G.H. 0.54 Stop 1055 G.H. 0.53

METER TYPE Pygmy S/N P90068 SPIN Before Meas. 1 min After 1 min+

WEATHER clear, some wind

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor

FLOW: Width 11.800 Area 8.091 Ave. Vel. 0.848 G.H. _____ Disch. 6.861

Method 0.6 Method coeff. ____ Hor. Angle coeff. ____ Susp. type _____ Susp. coeff. ____

Meter _____ ft. above bottom of weight No. Secs. 37 G.H. changes -0.1 ft. in 55/60 hrs.

FLOW _____

Cross Section _____

CONTROL _____

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 64 C (F) Water 56 C (F)

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

B-26a

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS cobbly boulder substrate

digitizer no 41294

dominant woody plant - Arizona alder and sycamore

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

SITE 14 - OVER '57 1431 MST 10-29-2003

(THIS SITE is .room of SITE 2.)

SITE DESCRIPTION:

GPS: #27 12S 0434709

UTM 3836693

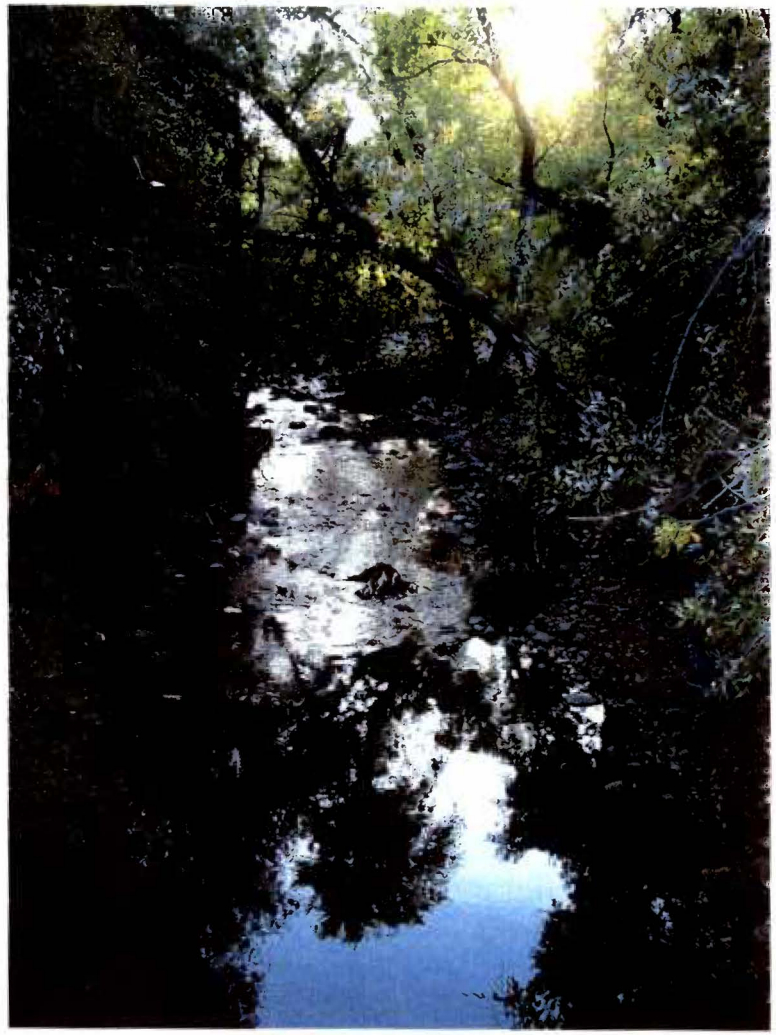
ACCURACY: 19 ft

- SITE 14 IS IN LIEU OF SITE 2
- ON WET BEAVER CREEK
- ADJACENT TO THE USFS BEAVER CREEK CAMPGROUND (ON THE U.S. SIDE OF THE BRIDGE)
- WALK STRAIGHT TOWARDS CREEK FROM OUTHOUSE
- CHANNEL WIDTH ≈ 9 ft
- STAFF GAGE ≈ 3ft U.S. OF CROSS SECTION, RIVER RIGHT
- STAFF GAGE READING: 0.45 ft

RT 27

PHOTOS:

ACCESS:



SITE 14.10.28.2003_020

Wet Beaver Creek upstream of the Beaver Creek Campground Bridge

From downstream of the cross section looking downstream.

Wet Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1639 hrs

B-28



SITE 14.10.28.2003_022

Wet Beaver Creek upstream of the Beaver Creek Campground Bridge

From downstream of the cross section looking upstream at the cross section with Carmia Fiechtner (NPS, WRD, Fort Collins, Co.) on the right bank and Jim Harte (NPS, WRD, Fort Collins, Co.) on the left bank.

Wet Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1649 hrs

R3-24



SITE 14.10.29.2003_039

Wet Beaver Creek upstream of the Beaver Creek Campground Bridge

From downstream of the cross section looking upstream at the cross section, with measuring tape. John Ward (Ward Ground Water, Tucson, Az.) and Jim Harte and Carmia Fiechtner (both NPS, WRD, Fort Collins, Co.) on right bank.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1431 hrs



SITE 14.10.29.2003_040

Wet Beaver Creek upstream of the Beaver Creek Campground Bridge

From upstream of the cross section looking downstream at the cross section marked by measuring tape with Jim Harte and Carmia Fiechtner (both NPS, WRD, Fort Collins, Co.).

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1432 hrs



SITE 14.10.30.2003_001

Wet Beaver Creek upstream of the Beaver Creek Campground Bridge

From downstream of the cross section looking upstream at the cross section located at the measuring tape. This cross section is approximately 30 feet upstream of the cross section located at this site on 10/28/03.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 0803 hrs

R-32

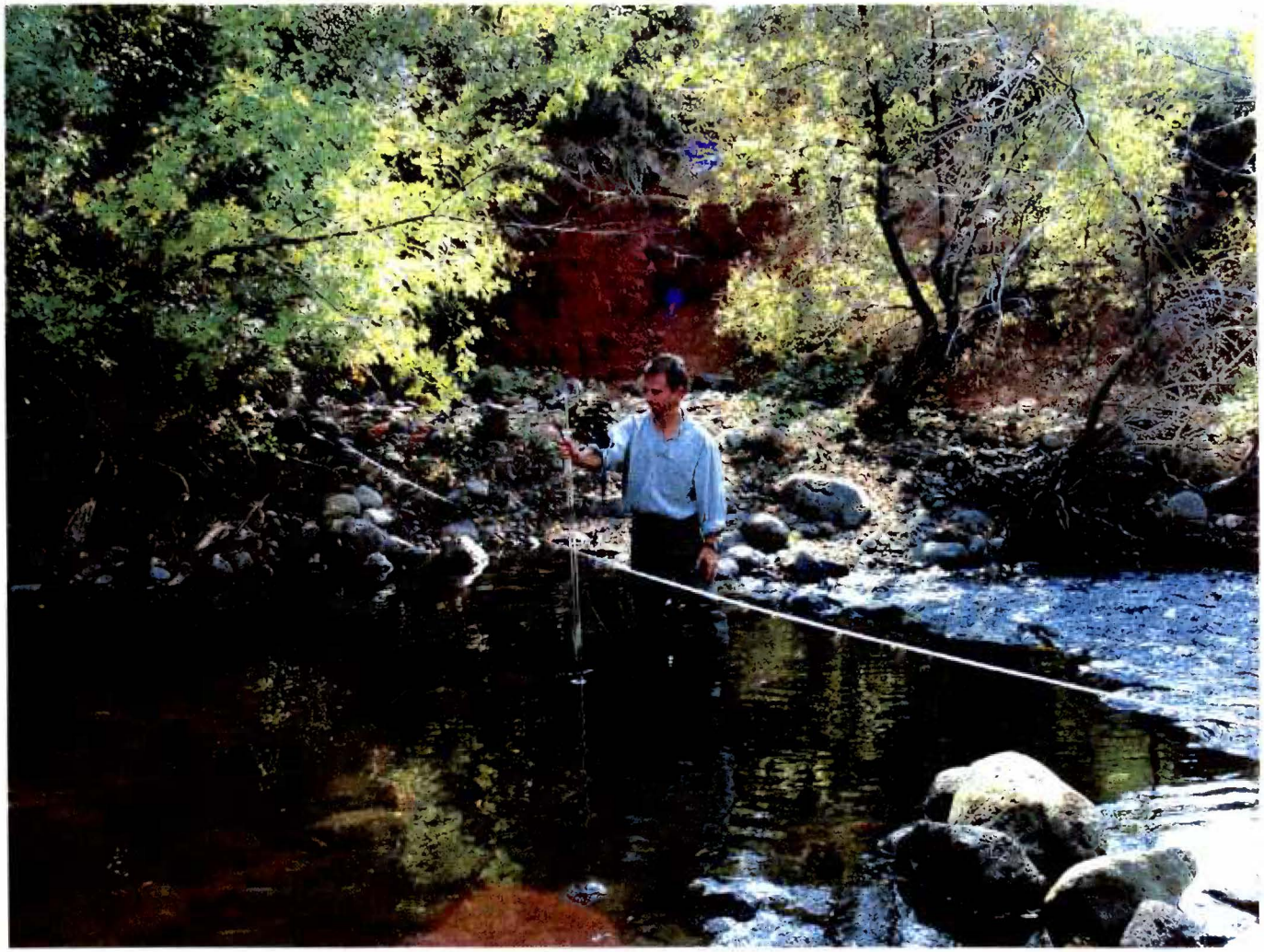


SITE 14.10.30.2003_005

Wet Beaver Creek upstream of the Beaver Creek Campground Bridge

From downstream of the cross section looking upstream with the cross section located at the measuring tape. This cross section is approximately 30 feet upstream of the cross section located at this site on 10/28/03.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 0903 hrs



SITE 14.10.30.2003_008

Wet Beaver Creek upstream of the Beaver Creek Campground Bridge

From upstream of the cross section looking at Jeff Hughes, NPS, WRD, Fort Collins, Co., measuring velocity at the cross section located at the measuring tape. This cross section is approximately 30 feet upstream of the cross section located at this site on 10/28/03.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1026 hrs



B-35

SITE 14.10.30.2003_009

Wet Beaver Creek upstream of the Beaver Creek Campground Bridge

From the right bank looking across the cross section located at the measuring tape. This cross section is approximately 30 feet upstream of the cross section located at this site on 10/28/03.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1104 hrs



SITE 14.10.30.2003_010

Wet Beaver Creek upstream of the Beaver Creek Campground Bridge

From upstream of the cross section looking downstream with the cross section located at the measuring tape. This cross section is approximately 30 feet upstream of the cross section located at this site on 10/28/03.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1104 hrs



SITE 14.10.30.2003_011

Wet Beaver Creek upstream of the Beaver Creek Campground Bridge

From downstream of the cross section looking at the staff gage installed on river right. This cross section is approximately 30 feet upstream of the cross section located at this site on 10/28/03.

Wet Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1105 hrs

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	Beaver Creek Campground				
Station Number:	14	WIDTH	20.200	# of Sections	37
Date:	10/30/2003	AREA	22.714	Sections > 5%	0
Measurement #:	1	VELOCITY	0.271	Sections > 10%	0
Pygmy or AA (p/a)	P			*Standard Error	6.60%
Rating # (1 or 2)	2	**TOTAL DISCHARGE**	6.150		**FAIR**

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	6.6	0.55	0			0.000	0.000	0.000	0.000	0.000
	7.7	1.20	0.68	4	46	0.115	0.115	0.115	0.816	0.094
	9	1.15	0.44	6	43.9	0.162	0.162	0.162	0.506	0.082
	10	0.85	0.52	6	42.7	0.166	0.166	0.166	0.442	0.073
	10.7	0.65	1.71	9	44.4	0.226	0.226	0.226	1.112	0.251
	11.3	0.55	1.9	9	40	0.247	0.247	0.247	1.045	0.258
	11.8	0.45	1.44	10	40.2	0.270	0.270	0.270	0.648	0.175
	12.2	0.45	1.5	9	42.9	0.233	0.233	0.233	0.675	0.157
	12.7	0.50	1.83	10	40.4	0.269	0.269	0.269	0.915	0.246
	13.2	0.45	1.9	11	40.1	0.295	0.295	0.295	0.855	0.252
	13.6	0.40	2.05	10	43	0.255	0.255	0.255	0.820	0.209
	14	0.40	2.11	8	43.1	0.209	0.209	0.209	0.844	0.177
	14.4	0.40	1.6	11	40.5	0.292	0.292	0.292	0.640	0.187
	14.8	0.35	1.5	16	42	0.397	0.397	0.397	0.525	0.208
	15.1	0.30	1.58	16	42.5	0.393	0.393	0.393	0.474	0.186
	15.4	0.30	1.75	11	40.1	0.295	0.295	0.295	0.525	0.155
	15.7	0.35	1.7	12	42.5	0.302	0.302	0.302	0.595	0.180
	16.1	0.40	1.83	11	43.4	0.275	0.275	0.275	0.732	0.201
	16.5	0.35	1.53	13	40.9	0.336	0.336	0.336	0.535	0.180
	16.8	0.30	1.7	11	41.9	0.283	0.283	0.283	0.510	0.145
	17.1	0.30	1.73	12	40.2	0.318	0.318	0.318	0.519	0.165
	17.4	0.35	1.65	9	41.9	0.237	0.237	0.237	0.577	0.137
	17.8	0.35	1.63	14	43.4	0.341	0.341	0.341	0.571	0.195
	18.1	0.35	1.5	12	44.1	0.293	0.293	0.293	0.525	0.154
	18.5	0.40	1.55	13	40.1	0.343	0.343	0.343	0.620	0.212
	18.9	0.45	1.22	12	40.3	0.317	0.317	0.317	0.549	0.174
	19.4	0.50	1.26	12	42.5	0.302	0.302	0.302	0.630	0.190
	19.9	0.55	1.24	11	42.6	0.279	0.279	0.279	0.682	0.190
	20.5	0.65	0.65	12	40.6	0.315	0.315	0.315	0.423	0.133
	21.2	0.75	0.83	12	40.1	0.319	0.319	0.319	0.623	0.198
	22	0.65	1.1	13	40.8	0.337	0.337	0.337	0.715	0.241
	22.5	0.65	0.95	10	42.9	0.255	0.255	0.255	0.618	0.158
	23.3	0.75	0.88	10	40.1	0.271	0.271	0.271	0.660	0.179
	24	0.95	0.96	10	41.8	0.261	0.261	0.261	0.912	0.238
	25.2	1.15	0.45	10	42.4	0.258	0.258	0.258	0.518	0.133
	26.3	0.80	0.45	3	42.5	0.099	0.099	0.099	0.360	0.036
	26.8	0.25	0	0	0	0.000	0.000	0.000	0.000	0.000

TR-20

1401

S_a	S_d	S_t	S_r	S_s	S_h	S_y
6.604771	5.0542	5.833964	5.586529	2.8765	0	1.3339

b	5.054198
c	9.378989
e	
f	

Select a Bed Type:

Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u

2

Select a Suspension Type:

Rod
Cable

Rod

1

b	c			# secs	5+ secs	10+ secs
				1	0	0
7.62008818	14.84126	5.682454	15.02263	0	1	0 0
11.5382941	22.8151	5.757289	9.555762	0	1	0 0
9.82118228	19.33449	5.802141	9.280883	0	1	0 0
3.54254699	6.180498	5.739061	6.226044	0	1	0 0
3.3053302	5.630349	5.909235	5.534444	0	1	0 0
4.00703471	7.226708	5.900989	4.934568	0	1	0 0
3.88730126	6.960204	5.794554	5.990315	0	1	0 0
3.38602094	5.818982	5.892795	4.982799	0	1	0 0
3.3053302	5.630349	5.905106	4.406984	0	1	0 0
3.15417818	5.27213	5.790778	5.330158	0	1	0 0
3.10085917	5.144056	5.787013	6.867504	0	1	0 0
3.71020552	6.562202	5.888717	4.458095	0	1	0 0
3.88730126	6.960204	5.829057	2.990336	0	1	0 0
3.74358395	6.637596	5.809773	3.033009	0	1	0 0
3.48758732	6.054177	5.905106	4.406984	0	1	0 0
3.55675681	6.213057	5.809773	4.281269	0	1	0 0
3.38602094	5.818982	5.775784	4.829387	0	1	0 0
3.83140355	6.835101	5.872534	3.708739	0	1	0 0
3.55675681	6.213057	5.832949	4.63719	0	1	0 0
3.51469804	6.116568	5.900989	3.992902	0	1	0 0
3.63080383	6.38208	5.832949	5.833119	0	1	0 0
3.66189325	6.45274	5.775784	3.644611	0	1	0 0
3.88730126	6.960204	5.749966	4.44851	0	1	0 0
3.79550092	6.754503	5.905106	3.623253	0	1	0 0
4.56032456	8.437194	5.896885	4.004548	0	1	0 0
4.44376412	8.184629	5.809773	4.261269	0	1	0 0
4.50101156	8.308816	5.805951	4.726846	0	1	0 0
7.94805622	15.51407	5.884652	4.039499	0	1	0 0
6.34741973	12.21306	5.905106	3.981258	0	1	0 0
4.9660001	9.30831	5.876561	3.698046	0	1	0 0
5.6303491	10.71463	5.794554	5.316019	0	1	0 0
6.02354197	11.53829	5.905106	4.920454	0	1	0 0
5.57913399	10.60693	5.836853	5.160535	0	1	0 0
11.2896763	22.31204	5.813607	5.245333	0	1	0 0
11.2896763	22.31204	5.809773	18.19521	0	1	0 0
					1	0 0

R-39

1401 2

River at—

Angle coefficient	Dist. from initial point	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
	LEW 6.6	0								0
	7.7	0.68		4	46.0	0.115			.816	0.094
	9.0	0.44		6	43.9	0.162			.506	0.082
	10.0	0.52		6	42.7	0.166			.442	0.073
	10.7	1.71		9	44.4	.226			1.112	0.251
	11.3	1.90		9	40	0.247			1.045	0.258
	11.8	1.44		10	40.2	0.270			0.618	0.175
	12.2	1.50		9	42.9	.233			0.675	0.157
	12.7	1.83		10	40.4	.269			0.915	0.246
	13.2	1.90		11	40.1	.295			0.855	0.252
	13.6	2.05		10	43.0	0.2645			0.820	0.2089
	14.0	2.11		8	43.1	.209			.844	0.1767
1.60	14.4	1.60		11	40.5	.292			.640	0.187
	14.8	1.50		16	42.0	.397			.525	.208
⊙	15.1	1.58		16	42.5	.393			.474	.186
	15.4	1.75		11	40.1	.295			.525	.155
	15.7	1.70		12	42.5	.302			.595	.180
	16.1	1.83		11	43.4	.275			.732	.201
	16.5	1.53		13	40.9	.336			.5365	.180
	16.8	1.70		11	41.9	.283			.510	.1445
17.1	17.1	1.73		12	40.2	.318			.519	.165
	17.4	1.65		9	41.9	.237			.578	.137
	17.8	1.63		14	43.9	.341			.571	.195
	18.1	1.50		12	44.1	.293			.525	.154
	18.5	1.55		13	40.1	.3423			.620	.212
	18.9	1.22		12	40.3	.317			.549	.174
	19.4	1.26		12	42.5	.302			.630	.190
	19.9	1.24		11	42.6	.279			.682	.190
	20.5	0.65		12	40.6	.215	0.315	.423	.546	.117 .091 0.133
	21.2	.83		12	40.1	.220	0.319		.623	.137 0.198
	22.0	1.10		13	40.8	.337			.715	.241
	22.5	.95		10	42.9	.255			.618	.1578

R-4

	23.3		.88		10	40.1	.271			.66	179
	24.0		.96		10	41.8	.261			.912	.238
	25.2		.45		10	42.4	.258			.518	.1343
	26.3	0.8	.45		3	42.5	.099			.360	.036
REW	26.8		0								0
										Total	6.040 6.150
⊙											

1 of 3

0.49 staff 8:20
0.49 9:52

U SECTIONS -- 22o
20R: 6.60%
1R

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 1

DATE 10/30/2003 Comp by _____ Checked by FECHTNER

New Site 14

PARK MOCA STATION Site 2 Beaver Ck Campground

PERSONNEL: Meter Jeff Hughes Notes Colleen Filippone

MEASUREMENT TYPE (circle one) (Wading,) Cable, Bridge, Boat, Ice; Upstr., Dnstr., ___ ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 8:22 G.H. .49 Stop: 9:52 G.H. 0.49

METER TYPE Pygmy Rickly-Tucson S/N _____ SPIN Before Meas. 59 After 76 sec

WEATHER partly cldy, no breeze

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor
8:20	0.49				
9:52	0.49				

FLOW: Width 20.200 Area 22.714 Ave. Vel. 0.271 G.H. _____ Disch. 6.150

Method wading 0.6 Method coeff. ____ Hor. Angle coeff. ____ Susp. type _____ Susp. coeff. ____

Meter _____ ft. above bottom of weight No. Secs. 37 G.H. changes 0 ft. in 1.5 hrs.

FLOW laminar

Cross Section cobbles & boulders - very irregular

CONTROL cobble/boulder control - small dam ≈ 4 ft. dam downstream of X-section

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 53.4 (F°) Water 55.0 C° (F°)

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

R-40

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS Using aquacount meter set to Pygmy ST 2 rating t=40sec SAE standard

X-section moved upstream ~ 20 yds from original point

Began at ~ 9:05

Troubleshooting meter 8-9AM

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	Beaver Creek Campground				
Station Number:	14	WIDTH	20.000	# of Sections	36
Date:	10/30/2003	AREA	22.657	Sections > 5%	0
Measurement #:	2	VELOCITY	0.291	Sections > 10%	0
Pygmy or AA (p/a)				*Standard Error	6.11%
Rating # (1 or 2)	2	TOTAL DISCHARGE	6.593		FAIR

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	6.7	0.30	0			0.000	0.000	0.000	0.000	0.000
	7.3	0.85	0.4	4	53	0.104	0.104	0.104	0.340	0.035
	8.4	1.00	0.8	4	40.9	0.125	0.125	0.125	0.800	0.100
	9.3	0.80	0.94	10	43.9	0.250	0.250	0.250	0.752	0.188
	10	0.60	1.01	10	42.4	0.258	0.258	0.258	0.606	0.156
	10.5	0.50	1.22	10	44.3	0.248	0.248	0.248	0.610	0.151
	11	0.45	1.83	12	44	0.293	0.293	0.293	0.824	0.241
	11.4	0.40	1.5	12	41.1	0.312	0.312	0.312	0.600	0.187
	11.8	0.40	1.44	11	41	0.289	0.289	0.289	0.576	0.166
	12.2	0.40	1.52	14	41.6	0.354	0.354	0.354	0.608	0.215
	12.6	0.40	1.78	12	40.1	0.319	0.319	0.319	0.712	0.227
	13	0.40	1.75	12	41.2	0.311	0.311	0.311	0.700	0.218
	13.4	0.40	1.43	14	41.3	0.357	0.357	0.357	0.572	0.204
	13.8	0.40	2.08	12	43.2	0.298	0.298	0.298	0.832	0.248
	14.2	0.40	2.05	11	42.8	0.278	0.278	0.278	0.820	0.228
	14.6	0.40	1.5	13	42.5	0.325	0.325	0.325	0.600	0.195
	15	0.40	1.95	11	43.6	0.274	0.274	0.274	0.780	0.213
	15.4	0.40	1.73	12	41.5	0.309	0.309	0.309	0.692	0.214
	15.8	0.40	1.7	13	43.4	0.319	0.319	0.319	0.680	0.217
	16.2	0.40	1.55	12	43	0.299	0.299	0.299	0.620	0.186
	16.6	0.40	1.55	12	40.2	0.318	0.318	0.318	0.620	0.197
	17	0.40	1.72	12	41.4	0.310	0.310	0.310	0.688	0.213
	17.4	0.40	1.65	11	42.8	0.278	0.278	0.278	0.660	0.184
	17.8	0.40	1.62	11	41.2	0.288	0.288	0.288	0.648	0.186
	18.2	0.40	1.5	13	43	0.322	0.322	0.322	0.600	0.193
	18.6	0.40	1.24	12	40.5	0.316	0.316	0.316	0.496	0.157
	19	0.45	1.25	12	41.8	0.307	0.307	0.307	0.562	0.173
	19.5	0.50	1.34	12	41.2	0.311	0.311	0.311	0.670	0.208
	20	0.50	1.28	12	43.5	0.296	0.296	0.296	0.640	0.190
	20.5	0.60	0.75	12	40.2	0.318	0.318	0.318	0.450	0.143
	21.2	0.75	0.83	13	42	0.328	0.328	0.328	0.623	0.204
	22	0.80	1.06	13	41.5	0.332	0.332	0.332	0.848	0.282
	22.8	0.85	0.99	11	41.8	0.284	0.284	0.284	0.842	0.239
	23.7	1.20	0.76	11	41.9	0.283	0.283	0.283	0.912	0.258
	25.2	1.50	0.45	10	41.7	0.262	0.262	0.262	0.675	0.177
	26.7	0.75	0	0	0	0.000	0.000	0.000	0.000	0.000

S_g	S_d	S_t	S_i	S_s	S_h	S_v
6.10837	4.8038	5.818433	4.974842	2.8921	0	1.3665

b	4.803795
c	8.871749
e	
f	

Select a Bed Type:

Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u

2

Select a Suspension Type:

Rod
Cable

Rod

1

b	c				# secs	5+ secs	10+ secs
					1	0	0
12.6589889	25.07987	5.461486	17.13257	0	1	0	0
6.56220237	12.65899	5.872534	13.418	0	1	0	0
5.68272341	10.82467	5.757289	5.457433	0	1	0	0
5.33923227	10.10097	5.813607	5.245333	0	1	0	0
4.56032456	8.437194	5.742686	5.514011	0	1	0	0
3.38602094	5.818982	5.753622	4.436796	0	1	0	0
3.88730126	6.960204	5.864519	4.097792	0	1	0	0
4.00703471	7.226708	5.86852	4.522022	0	1	0	0
3.84975806	6.876231	5.844696	3.466429	0	1	0	0
3.44824852	5.963361	5.905106	3.981258	0	1	0	0
3.48758732	6.054177	5.86053	4.109457	0	1	0	0
4.02809343	7.273386	5.856553	3.436803	0	1	0	0
3.12705554	5.207101	5.783259	4.343136	0	1	0	0
3.15417818	5.27213	5.798342	4.752474	0	1	0	0
3.88730126	6.960204	5.809773	3.880139	0	1	0	0
3.25186438	5.504406	5.768354	4.855034	0	1	0	0
3.51469804	6.116568	5.848636	4.144463	0	1	0	0
3.55675681	6.213057	5.775784	3.97678	0	1	0	0
3.79550092	6.754503	5.790778	4.319737	0	1	0	0
3.79550092	6.754503	5.900989	3.992902	0	1	0	0
3.52852856	6.148338	5.852589	4.132792	0	1	0	0
3.63080383	6.38208	5.798342	4.752474	0	1	0	0
3.67776928	6.488755	5.86053	4.547604	0	1	0	0
3.88730126	6.960204	5.790778	3.933809	0	1	0	0
4.50101156	8.308816	5.888717	4.027847	0	1	0	0
4.47213595	8.246211	5.836853	4.179485	0	1	0	0
4.2335473	7.72604	5.86053	4.109457	0	1	0	0
4.38848369	8.064438	5.772063	4.378247	0	1	0	0
6.96020434	13.4825	5.900989	3.992902	0	1	0	0
6.34741973	12.21306	5.829057	3.826518	0	1	0	0
5.1234667	9.643632	5.848636	3.77295	0	1	0	0
5.43208995	10.29711	5.836853	4.624388	0	1	0	0
6.87623069	13.30903	5.832949	4.63719	0	1	0	0
11.2896763	22.31204	5.840768	5.146405	0	1	0	0
					1	0	0

R-42

River at—

Angle coef. k	Dist. from initial point		Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
	LEW										
	6.7		0								0
	7.3	.85	0.40		4	53.0	.104			.340	.035
	8.4	1.0	.80		4	40.9	.125			.800	0.100
	9.3	.80	.94		10	43.9	.250			.752	.188
	10.0	.60	1.01		10	42.4	.258			.606	.156
	10.5	.5	1.22		10	44.3	.248			.610	.151
	11.0	.45	1.83		12	44.0	.293			.824	.241
	11.4	.40	1.50		12	41.1	.312			.600	.187
	11.8	.40	1.44		11	41.0	.289			.576	.166
	12.2	.40	1.52		14	41.6	.354			.608	.215
	12.6	.40	1.78		12	40.1	.319			.712	.227
	13.0	.40	1.75		12	41.2	.311			.700	.218
	13.4	.40	1.43		14	41.3	.357			.572	.204
	13.8	.40	2.08		12	43.2	.298			.832	.248
⊙	14.2	.40	2.05		11	42.8	.278			.820	.228
	14.6	.40	1.50		13	42.5	.325			.600	.195
	15.0	.40	1.95		11	43.6	.278			.780	.213
	15.4	.40	1.73		12	41.5	.309			.692	.214
	15.8	.40	1.70		13	43.4	.319			.680	.217
	16.2	.40	1.55		12	43.0	.299			.620	.186
	16.6	.40	1.55		12	40.2	.318			.620	.197
	17.0	.40	1.72		12	41.4	.310			.688	.213
	17.4	.40	1.65		11	42.8	.278			.660	.183
	17.8	.40	1.62		11	41.2	.288			.648	.187
	18.2	.40	1.50		13	43.0	.322			.600	.193
	18.6	.40	1.24		12	40.5	.316			.496	.157
	19.0	.45	1.25		12	41.8	.307			.563	.173
	19.5	.50	1.34		12	41.2	.311			.670	.208
	20.0	.50	1.28		12	43.5	.296			.640	.189
	20.5	.60	0.75		12	40.2	.318			.450	.143
	21.2	.75	.83		13	42.0	.328			.623	.204
	22.0	.80	1.06		13	41.5	.332			.848	.282
	22.8	.85	0.99		11	41.8	.284			.84	.239
	23.7	1.2	0.76		11	41.9	.283			.91	.258
	25.2	1.5	0.45		10	41.7	.262			.675	.177
	26.7		0								
	REW										

total = 6.597 cfs
6.593 cfs

12-42

U SECTIONS 2.2 %
EP 2.6.11%

(Sept,1999)

UNITED STATES
~~DOI/NPS-WRD~~
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 2

DATE 10/30/2003 Comp by _____ Checked by FIECHTNER

New SITE 14

PARK MOCA STATION #2 Beaver Ck Campground

PERSONNEL: Meter Jeff Hughes Notes Colleen Filippone

MEASUREMENT TYPE (circle one) (Wading) Cable, Bridge, Boat, Ice; Upstr., Dnstr., ___ ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 10:09 G.H. 0.485 Stop: 10:56 G.H. 0.485

METER TYPE Pygmy S/N Rickly-Tucson SPIN Before Meas. 765 After 585

WEATHER Sunny, breezy w/ gusts of wind

HIGH WATER MARK _____ Gage Height of Zero Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor
10:09	0.485				
10:56	0.485				

FLOW: Width 20.000 Area 22.657 Ave. Vel. 0.291 G.H. _____ Disch. 6.593

Method Wading 0.6 Method coeff. ____ Hor. Angle coeff. ____ Susp. type _____ Susp. coeff. ____

Meter _____ ft. above bottom of weight No. Secs. 36 G.H. changes 0 ft. ft. 47/60 hrs.

FLOW Laminar, slow

Cross Section cobbles/boulders, very irregular

CONTROL cobble/boulder control, small dam 2 4ft downstream of cross section

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 64.2 °F Water 55.8 °F

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

B-43

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS For this measurement was superior to the previous measurement at this site. Wading Rod placement seemed better. No meter problems

Rickly Tucson
Aquacount meter, Pygmy meter - 4' wading rod

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

SITE 3 - LG 4/ OVERCAST 0906MST 10-29-03
TEM 60

SITE DESCRIPTION:

GPS 12S 0432946 #23 & #22
UTM 3834849
ACCURACY: 24 ft

- SITE 3 IS ON WET BEAVER CREEK ON USFS LAND
- STAFF GAGE IS ≈6 ft U.S. OF CROSS SECTION ON RIVER LEFT
- CROSS SECTION ≈ 13 ft WIDE
- STAFF GAGE READING = 0.59 ft
- U.S. OF LAWRENCE'S CROSSING; ≈100 yds U.S.
- THE AREA IS ~~HIGHLY~~ VEGETATED ALONG THE BANKS, SO FOLLOW THE FLUORESCENT ORANGE FLAGGING
- MAY MOVE REBAR ± 1 ft ON RIVER LEFT TO CLEAR BOULDER

PHOTOS:

R-44

ACCESS:



SITE 3.10.29.2003_023

Wet Beaver Creek at Lawrence Crossing

From downstream of cross section looking upstream at diversion ditch located on right bank, downstream of cross section.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 0751 hrs

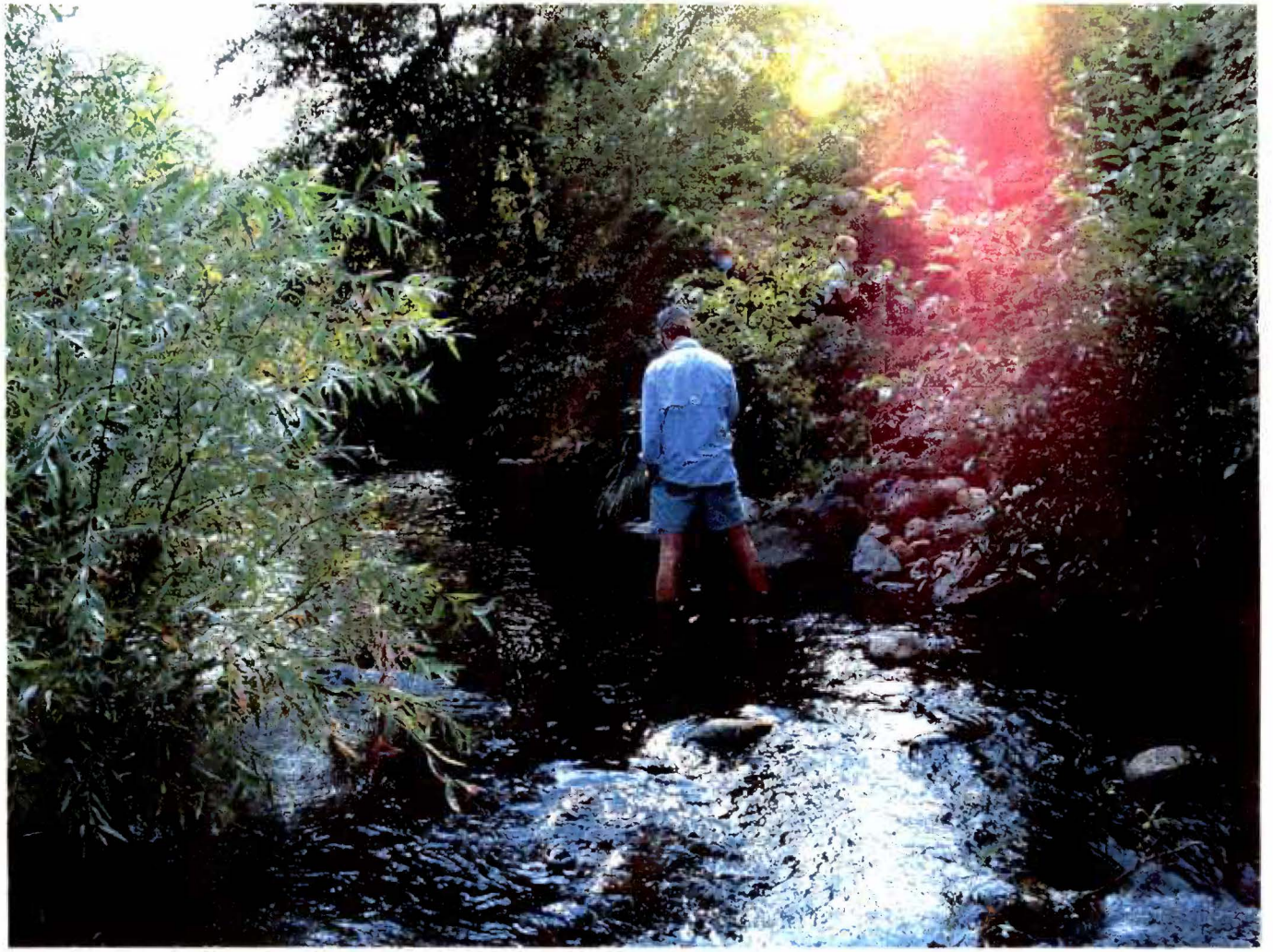


SITE 3.10.29.2003_024

Wet Beaver Creek at Lawrence Crossing

From downstream of cross section looking upstream at diversion located on right bank, downstream of cross section.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 0753 hrs



SITE 3.10.29.2003_025

Wet Beaver Creek at Lawrence Crossing

From downstream of cross section looking upstream at the cross section with Jim Harte (NPS, WRD, Fort Collins, Co.) measuring velocity.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 0843 hrs



SITE 3.10.29.2003_026

Wet Beaver Creek at Lawrence Crossing

From upstream of cross section looking downstream at the cross section with Jim Harte and Carmia Fiechtner (both NPS, WRD, Fort Collins, Co.) measuring velocity.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 0849 hrs

B-48



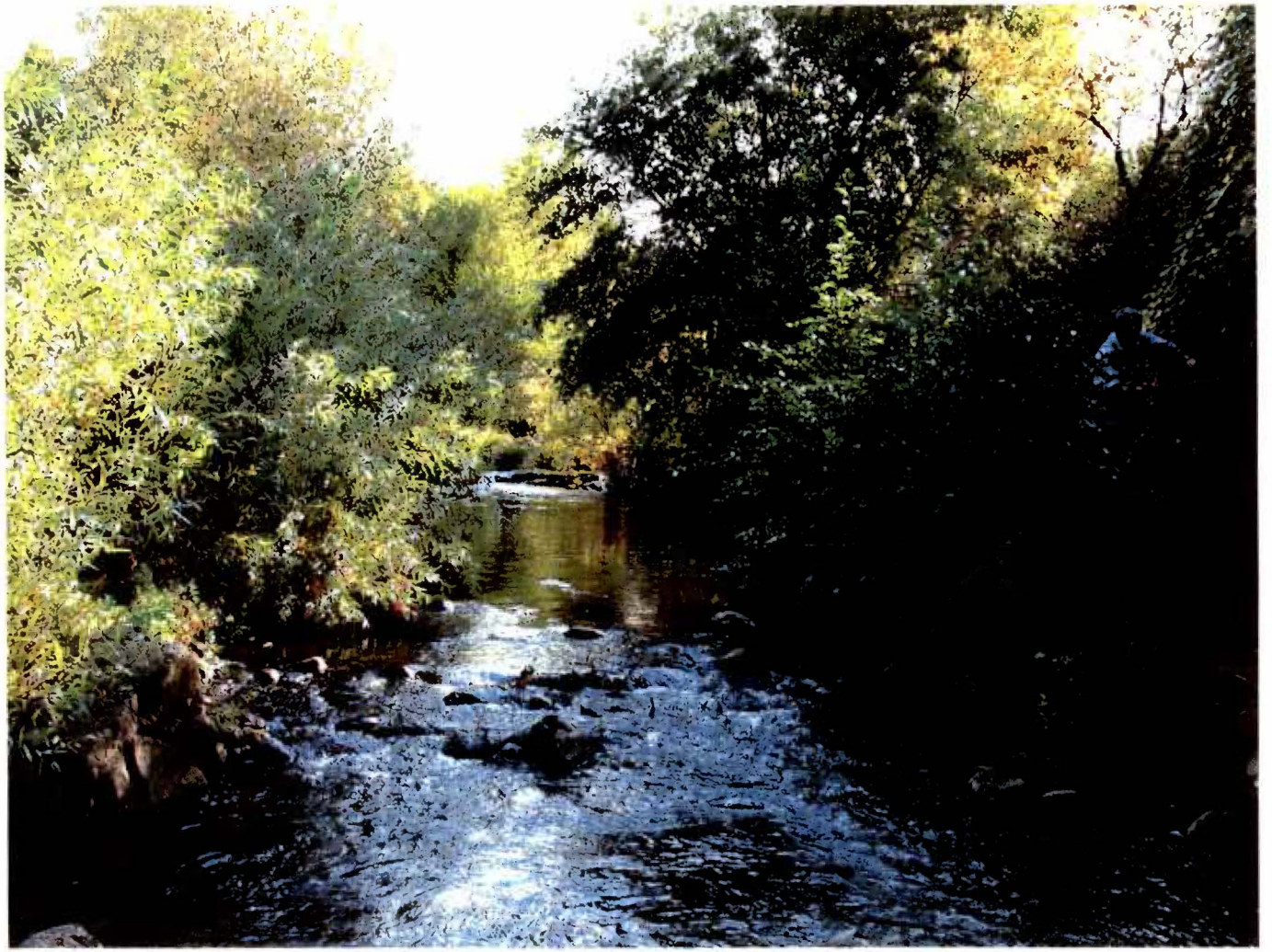
SITE 3.10.29.2003_027

Wet Beaver Creek at Lawrence Crossing

From upstream of cross section looking downstream at cross section, located at measuring tape, with staff gage installed on river left, upstream of the cross section with Jim Harte and Carmia Fiechtner (both NPS, WRD, Fort Collins, Co.).

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 0902 hrs

R-45

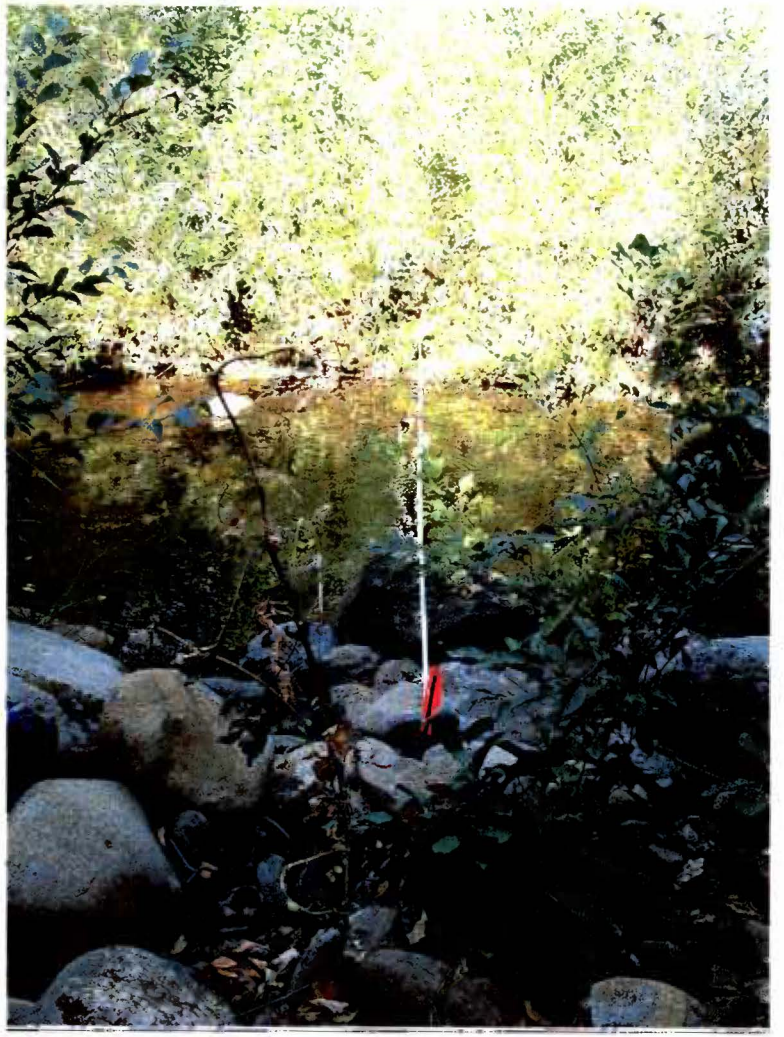


SITE 3.10.29.2003_028

Wet Beaver Creek at Lawrence Crossing

From downstream looking upstream at cross section, located at measuring tape.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 0906 hrs



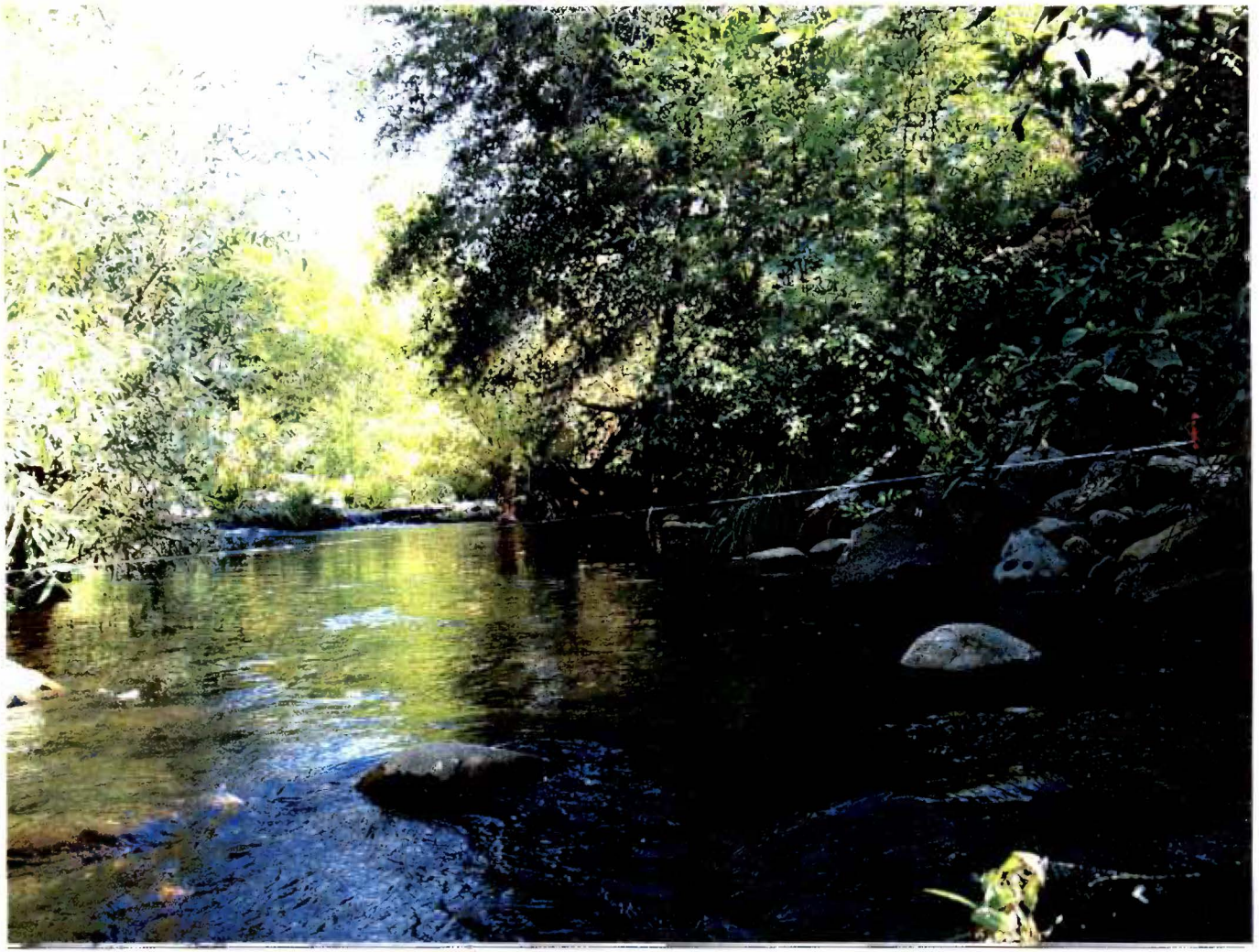
SITE 3.10.30.2003_015

Wet Beaver Creek at Lawrence Crossing

From the right bank looking across the cross section located at the measuring tape.

Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1324 hrs

13-51



SITE 3.10.30.2003_018

Wet Beaver Creek at Lawrence Crossing

From downstream of the cross section looking upstream with the cross section located at the measuring tape.

Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1325 hrs

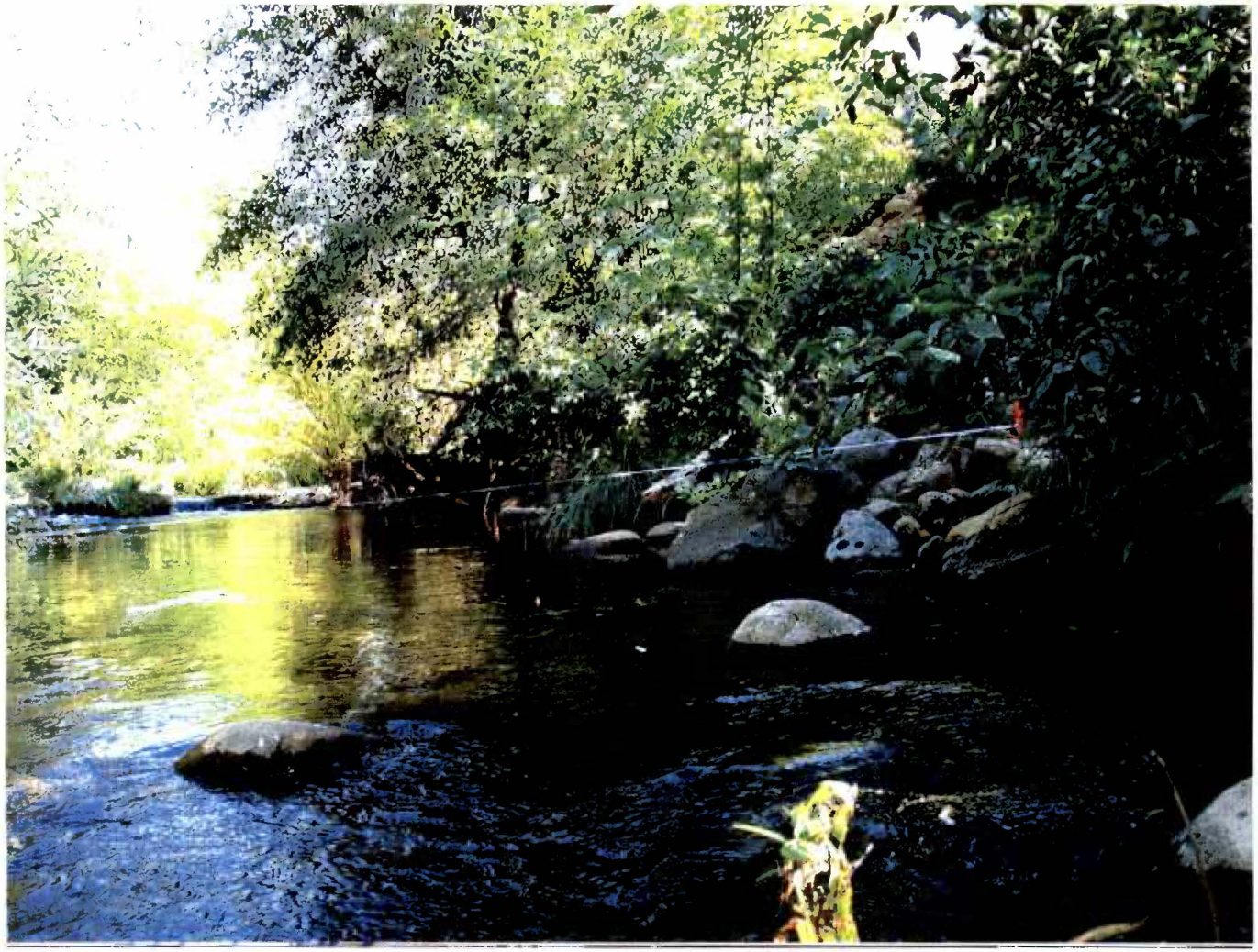


SITE 3.10.30.2003_019

Wet Beaver Creek at Lawrence Crossing

From downstream of the cross section looking upstream with the cross section located at the measuring tape.

Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1325 hrs



SITE 3.10.30.2003_020

Wet Beaver Creek at Lawrence Crossing

From downstream of the cross section looking upstream with the cross section located at the measuring tape.

Beaver Creek, Yavapai County, Az.
October 30, 2003 @ 1325 hrs

B-54

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Lovin, Hydrologist, US Geological Survey

Station Name:	Lawrence Crossing				
Station Number:	3	WIDTH	12.300	# of Sections	29
Date:	10/30/2003	AREA	10.780	Sections > 5%	2
Measurement #:	1	VELOCITY	0.538	Sections > 10%	0
Pygmy or AA (p/a)	p			*Standard Error	4.60%
Rating # (1 or 2)	2	TOTAL DISCHARGE	5.797		GOOD

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	5.5	0.15	0			0.000	0.000	0.000	0.000	0.000
	5.8	0.35	1.03	21	40.2	0.533	0.533	0.533	0.361	0.192
	6.2	0.40	1	18	41.7	0.446	0.446	0.446	0.400	0.178
	6.6	0.40	0.98	23	40.1	0.582	0.582	0.582	0.392	0.228
	7	0.40	0.88	30	40.3	0.746	0.746	0.746	0.352	0.263
	7.4	0.40	0.94	28	40.6	0.694	0.694	0.694	0.376	0.261
	7.8	0.40	0.91	19	41.1	0.475	0.475	0.475	0.364	0.173
	8.2	0.40	0.85	25	40.2	0.628	0.628	0.628	0.340	0.214
	8.6	0.40	1	16	41.2	0.404	0.404	0.404	0.400	0.162
	9	0.40	0.9	18	40.4	0.459	0.459	0.459	0.360	0.165
	9.4	0.40	0.95	18	40.7	0.456	0.456	0.456	0.380	0.173
	9.8	0.40	0.92	20	40.5	0.505	0.505	0.505	0.368	0.186
	10.2	0.40	1.02	25	41.3	0.613	0.613	0.613	0.408	0.250
	10.6	0.40	1.03	27	40.1	0.678	0.678	0.678	0.412	0.279
	11	0.40	0.95	29	41	0.711	0.711	0.711	0.380	0.270
	11.4	0.40	0.96	27	40.1	0.678	0.678	0.678	0.384	0.260
	11.8	0.40	1.2	21	41.5	0.517	0.517	0.517	0.480	0.248
	12.2	0.40	1.27	28	40.9	0.689	0.689	0.689	0.508	0.350
	12.6	0.35	1.28	31	40.6	0.765	0.765	0.765	0.448	0.343
	12.9	0.30	1.03	31	40.5	0.766	0.766	0.766	0.309	0.237
	13.2	0.30	0.95	30	40.8	0.737	0.737	0.737	0.285	0.210
	13.5	0.35	1.12	15	43.9	0.359	0.359	0.359	0.392	0.141
	13.9	0.40	1.11	11	40.4	0.293	0.293	0.293	0.444	0.130
	14.3	0.40	0.83	22	41.6	0.539	0.539	0.539	0.332	0.179
	14.7	0.40	0.82	21	40.8	0.526	0.526	0.526	0.328	0.172
	15.1	0.50	0.76	19	41.2	0.474	0.474	0.474	0.380	0.180
	15.7	0.80	0.67	12	41.2	0.311	0.311	0.311	0.536	0.167
	16.7	1.05	0.63	11	42.3	0.281	0.281	0.281	0.662	0.186
	17.8	0.55	0	0	0	0.000	0.000	0.000	0.000	0.000

R-57

03014

S_q	S_c	S_t	S	S_s	S_n	S_v
4.595066	5.7047	5.871585	2.479905	3.0285	0	1.6529

b 5.704657
c 10.85817
e
f

Select a Bed Type:
Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u
2

Select a Suspension Type:
Rod
Cable

Rod
1

b	c				# secs	5+ secs	10+ secs
					1	0	0
5.25022835	9.912598	5.900989	2.174095	0	1	0	0
5.38516481	10.19804	5.840768	2.572821	0	1	0	0
5.48003837	10.39823	5.905106	2.117307	0	1	0	0
6.02354197	11.53829	5.896885	1.965291	0	1	0	0
5.68272341	10.82467	5.884652	2.008862	0	1	0	0
5.84718656	11.16953	5.864519	2.367698	0	1	0	0
6.21305691	11.9335	5.900989	2.069133	0	1	0	0
5.38516481	10.19804	5.86053	2.922187	0	1	0	0
5.90459122	11.28968	5.892795	2.476064	0	1	0	0
5.6303491	10.71463	5.8806	2.498354	0	1	0	0
5.79110197	11.05203	5.888717	2.208836	0	1	0	0
5.29426289	10.00584	5.856553	2.085109	0	1	0	0
5.25022835	9.912598	5.905106	2.022701	0	1	0	0
5.6303491	10.71463	5.86852	1.994353	0	1	0	0
5.57913399	10.60693	5.905106	2.022701	0	1	0	0
4.62180821	8.569973	5.848636	2.193707	0	1	0	0
4.41588394	8.124046	5.872534	2.013103	0	1	1	0
4.38848369	8.064438	5.884652	1.951001	0	1	1	0
5.25022835	9.912598	5.888717	1.949617	0	1	0	0
5.6303491	10.71463	5.876561	1.972267	0	1	0	0
4.89181428	9.14983	5.757289	3.404567	0	1	0	0
4.92854551	9.228339	5.892795	4.445315	0	1	0	0
6.34741973	12.21306	5.844696	2.16656	0	1	0	0
6.41718395	12.35803	5.876561	2.183207	0	1	0	0
6.87623069	13.30903	5.86053	2.374696	0	1	0	0
7.72603979	15.05878	5.86053	4.109457	0	1	0	0
8.18462939	15.99852	5.817452	4.688414	0	1	0	0
					1	0	0

B-17

0301 2

River at—

Angle coefficient	Dist. from initial point		Depth ft	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
slightly under cut	REW 5.5										0
	5.8	.35	1.03		21	40.2	.533			.361	.192
	6.2	.4	1.00		18	41.7	.446			.400	.178
	6.6	.4	.98		23	40.1	.582			.392	.228
	7.0	.4	.88		30	40.3	.746			.352	.263
	7.4	.4	.94		28	40.6	.693	0.694		.376	.261
	7.8	.4	.91		19	41.1	.475			.364	.173
	8.2	.4	.85		25	40.2	.628			.340	.214
	8.6	.4	1.0		16	41.2	.404			.400	.162
	9.0	.4	.90		18	40.4	.459			.360	.165
	9.4	.4	.95		18	40.7	.456			.380	.173
	9.8	.4	.92		20	40.5	.505			.368	.186
	10.2	.4	1.02		25	41.3	.613			.408	.250
	10.6	.4	1.03		27	40.1	.678			.412	.279
⊙	11.0	.4	.95		29	41.0	.710	0.711		.380	.270
	11.4	.4	.96		27	40.1	.678			.384	.260
	11.8	.4	1.20		21	41.5	.517			.480	.248
	12.2	.4	1.27		28	40.9	.689			.508	.350
	12.6	.35	1.28		31	40.6	.764	0.765		.448	.342 0.343
	12.9	.3	1.03		31	40.5	.766			.309	.237
	13.2	.3	.95		30	40.8	.737			.285	.210
	13.5	.35	1.12		15	43.9	.359			.392	.141
	13.9	.4	1.11		11	40.4	.293			.444	.130
	14.3	.4	.83		22	41.6	.539			.332	.179
	14.7	.4	.82		21	40.8	.526			.328	.173 0.172
	15.1	.5	.76		19	41.2	.474			.380	.180
	15.7	.8	.67		12	41.2	.311			.536	.167
	16.7	1.05	.63		11	42.3	.281			.662	.186
	17.8										
										total	5.797

.0 .10 .20 .30 .40 .50 .60 .70 .75

.80 .85 .90 .92 .94 .96 .97 .98 .99 1.00 .99 .98 .97 .96 .94 .92 .90 .85 .80

⊙

7 SECTIONS - 2 GO
ERR 4.6%
GC

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
[redacted] WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 1

DATE 10/30/2003 Comp by _____ Checked by FIECHTNER

wet

PARK Beaver Ck STATION #3 Lawrence Crossing

PERSONNEL: Meter Jeff Hughes Notes Colleen Filippone

MEASUREMENT TYPE (circle one) Wading, Cable, Bridge, Boat, Ice; Upstr., Dnstr., ___ ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 12:30 G.H. 0.585 Stop: 13:07 G.H. 0.585

METER TYPE Pygmy S/N standard Rating 2 40 sec SPIN Before Meas. 745 After 75

WEATHER Breezy + sunny, gusty winds

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor
12:30	0.585				
13:07	0.585				

FLOW: Width 12.300 Area 10.780 Ave. Vel. 0.538 G.H. _____ Disch. 5.797

Method 0.6 reading Method coeff. ____ Hor. Angle coeff. ____ Susp. type _____ Susp. coeff. ____

Meter _____ ft. above bottom of weight No. Secs. 29 G.H. changes 0 ft. in 37/60 hrs.

FLOW laminar - small ripples - leaves floating

Cross Section small cobbles, pretty uniform

CONTROL cobble/boulder riffle ~ 15 ft downstream of X-section

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 73.8 (C) F° Water 55.9 C (F°)

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

B-57a

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS Good measurement, some sections effected by upstream cobbles/boulders

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	Lawrence Crossing				
Station Number:	3	WIDTH	12.300	# of Sections	32
Date:	10/30/2003	AREA	10.550	Sections > 5%	1
Measurement #:	2	VELOCITY	0.531	Sections > 10%	0
Pygmy or AA (p/a)	P			*Standard Error	4.43%
Rating # (1 or 2)	2	TOTAL DISCHARGE	5.604		GOOD

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distan	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	5.5	0.15	0			0.000	0.000	0.000	0.000	0.000
	5.8	0.35	0.93	18	42.2	0.441	0.441	0.441	0.326	0.143
	6.2	0.40	0.81	17	41.8	0.422	0.422	0.422	0.324	0.137
	6.6	0.35	0.93	21	41.5	0.517	0.517	0.517	0.326	0.168
	6.9	0.30	0.65	19	40.5	0.482	0.482	0.482	0.195	0.094
	7.2	0.30	0.8	29	41.1	0.709	0.709	0.709	0.240	0.170
	7.5	0.30	0.72	28	40.2	0.700	0.700	0.700	0.216	0.151
	7.8	0.35	0.81	20	40	0.511	0.511	0.511	0.284	0.145
	8.2	0.40	0.81	26	41	0.640	0.640	0.640	0.324	0.207
	8.6	0.40	0.74	24	40.2	0.605	0.605	0.605	0.296	0.179
	9	0.40	0.74	23	41.8	0.560	0.560	0.560	0.296	0.166
	9.4	0.40	0.93	21	40.7	0.527	0.527	0.527	0.372	0.196
	9.8	0.40	0.94	22	40.9	0.548	0.548	0.548	0.376	0.206
	10.2	0.40	0.93	21	40	0.535	0.535	0.535	0.372	0.199
	10.6	0.35	0.92	25	41.5	0.610	0.610	0.610	0.322	0.196
	10.9	0.30	0.99	27	41.2	0.661	0.661	0.661	0.297	0.196
	11.2	0.30	1.21	25	40.4	0.626	0.626	0.626	0.363	0.227
	11.5	0.30	1.3	21	40.3	0.532	0.532	0.532	0.390	0.207
	11.8	0.30	1.28	22	40.4	0.554	0.554	0.554	0.384	0.213
	12.1	0.30	1.2	25	40.3	0.627	0.627	0.627	0.360	0.226
	12.4	0.30	1.22	26	40.2	0.652	0.652	0.652	0.366	0.239
	12.7	0.30	1.35	30	40	0.752	0.752	0.752	0.405	0.304
	13	0.28	1.1	33	40.8	0.808	0.808	0.808	0.303	0.244
	13.25	0.30	1.02	32	40.4	0.792	0.792	0.792	0.306	0.242
	13.6	0.38	1.12	15	41.6	0.377	0.377	0.377	0.420	0.159
	14	0.45	1.1	11	41.9	0.283	0.283	0.283	0.495	0.140
	14.5	0.60	0.8	22	40.9	0.548	0.548	0.548	0.480	0.263
	15.2	0.65	0.78	21	41.2	0.521	0.521	0.521	0.507	0.264
	15.8	0.70	0.64	15	41.9	0.375	0.375	0.375	0.448	0.168
	16.6	0.70	0.63	14	42.5	0.348	0.348	0.348	0.441	0.153
	17.2	0.60	0.53	0	0	0.000	0.000	0.000	0.318	0.000
	17.8	0.30	0	0	0	0.000	0.000	0.000	0.000	0.000

B-5A

0302 1

S_q	S_d	S_t	S	S_s	S	S_v
4.426397	6.038	5.871053	2.355126	2.9635	0	1.5157

b	6.038036
c	11.54319
e	
f	

Select a Bed Type:

- Stable (even, firm, smooth)
- Stable (uneven, gravel-boulders)
- Soft (mud, silt)
- Moble (shifting sand, dunes)
- Stable (high velocity and VERTICAL angles)
- Unstable (high velocity and VERTICAL angles)

Stable (u

2

Select a Suspension Type:

- Rod
- Cable

Rod

1

b	c				# secs	5+ secs	10+ secs
					1	0	0
5.7362946	10.93711	5.821308	2.610149	0	1	0	0
6.48875547	12.50663	5.836853	2.764477	0	1	0	0
5.7362946	10.93711	5.848636	2.193707	0	1	0	0
7.94805622	15.51407	5.888717	2.32576	0	1	0	0
6.56220237	12.65899	5.864519	1.995746	0	1	0	0
7.22670801	14.03215	5.900989	2.00317	0	1	0	0
6.48875547	12.50663	5.909235	2.201123	0	1	0	0
6.48875547	12.50663	5.86852	2.057847	0	1	0	0
7.04654255	13.66071	5.900989	2.093331	0	1	0	0
7.04654255	13.66071	5.836853	2.142385	0	1	0	0
5.7362946	10.93711	5.8806	2.181695	0	1	0	0
5.68272341	10.82467	5.872534	2.156188	0	1	0	0
5.7362946	10.93711	5.909235	2.171034	0	1	0	0
5.79110197	11.05203	5.848636	2.087979	0	1	0	0
5.43208995	10.29711	5.86053	2.038418	0	1	0	0
4.59078821	8.50302	5.892795	2.072063	0	1	0	0
4.33507779	7.948056	5.896885	2.175621	0	1	0	0
4.38848369	8.064438	5.892795	2.148696	0	1	0	0
4.62180821	8.569973	5.896885	2.070599	0	1	0	0
4.56032456	8.437194	5.900989	2.046103	0	1	0	0
4.20920671	7.672658	5.909235	1.961073	0	1	1	0
4.9660001	9.30831	5.876561	1.91889	0	1	0	0
5.29426289	10.00584	5.892795	1.930498	0	1	0	0
4.89181428	9.14983	5.844696	3.1934	0	1	0	0
4.9660001	9.30831	5.832949	4.63719	0	1	0	0
6.56220237	12.65899	5.872534	2.156188	0	1	0	0
6.71501208	12.97558	5.86053	2.189224	0	1	0	0
8.06443775	15.75248	5.832949	3.220875	0	1	0	0
8.18462939	15.99852	5.809773	3.555432	0	1	0	0
9.6436323	18.97363				1	0	0
					1	0	0

55-57

0302 2

River at—

Angle coefficient	Dist. from initial point	...th	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge	
	LEW 5.5	0.15	0								undercut 0	
	5.8	0.35	0.93		18	42.2	.441			0.326	0.144	.85
	6.2	0.40	0.81		17	41.8	.422			0.324	0.137	
	6.6	0.35	0.93		21	41.5	.517			0.326	0.168	
	6.9	0.30	0.65		19	40.5	.482			0.195	0.094	.90
	7.2	0.30	0.80		29	41.1	.709			0.240	0.170	.92
	7.5	0.30	0.72		28	40.2	.700			0.216	0.151	.94
	7.8	0.35	0.81		20	40.0	.511			0.284	0.145	
	8.2	0.40	0.81		26	41.0	.640			0.324	0.207	.96
	8.6	0.40	0.74		24	40.2	.605			0.296	0.179	.97
	9.0	0.40	0.74		23	41.8	.560			0.296	0.166	.98 10
	9.4	0.40	0.93		21	40.7	.527			0.372	0.196	.99
	9.8	0.40	0.94		22	40.9	.548			0.376	0.206	
	10.2	0.40	0.93		21	40.0	.535			0.372	0.199	
⊙	10.6	0.35	0.92		25	41.5	.610			0.322	0.196	1.00
	10.9	0.30	0.99		27	41.2	.661			0.297	0.196	15
	11.2	0.30	1.21		25	40.4	.625	0.626		0.363	0.227	
	11.5	0.30	1.30		21	40.3	.532			0.390	0.207	.99
	11.8	0.30	1.28		22	40.4	.554			0.384	0.213	.98
	12.1	0.30	1.20		25	40.3	.627			0.360	0.226	.97
	12.4	0.30	1.22		26	40.2	.652			0.366	0.239	.96 20
	12.7	0.30	1.35		30	40.0	.752			0.405	0.305	0.304
	13.0	0.275	1.10		33	40.8	.808			0.303	0.244	.94
	13.25	0.30	1.02		32	40.4	.792			0.306	0.242	.92
	13.6	0.375	1.12		15	41.6	.377			0.420	0.158	0.159 .90
	14.0	0.45	1.10		11	41.9	.283			0.495	0.140	25
	14.5	0.60	0.80		22	40.9	.548			0.480	0.263	
	15.2	0.75	0.78		21	41.2	.521			0.588	0.305	.264 .85
15.8	~~16.0~~ 15.8	0.70	~~0.64~~ 0.64		15	41.9	.375			0.448	0.168	
~~16.0~~	16.6	0.70	0.63		14	42.5	.348			0.441	0.153	
	17.2		0.53		0		0				0	.80 0
	17.8 REW				0		0				0	

depth = 0.64

total = 5.603 cfs

E-60

0302 3

1 SECTION - 5%
ER: 14.43 %

(Sept,1999)

UNITED STATES
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DISCHARGE MEASUREMENT NOTES

Meas. No. 2

DATE 30 Oct 2003 Comp by _____ Checked by FIECHTNER

PARK MOCA STATION site #3 : wet Beaver Creek @ Lawrence Crossing

PERSONNEL: Meter Colleen Filippone Notes Jeff Hughes

MEASUREMENT TYPE (circle one) (Wading), Cable, Bridge, Boat, Ice; Upstr., Dnstr., ___ ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: ~~75~~ 1400 G.H. 0.58 Stop: 1454 G.H. 0.58

METER TYPE Pygmy S/N Pickly-Tucson SPIN Before Meas. 75 After 81 sec

WEATHER Sunny, windy w/ gusts of wind

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor
1400	0.58				
1454	0.58				

FLOW: Width 2.300 Area 0.550 Ave. Vel. 0.581 G.H. _____ Disch. 5.604

Method Cranking 0.6 Method coeff. ____ Hor. Angle coeff. ____ Susp. type _____ Susp. coeff. ____

Meter _____ ft. above bottom of weight No. Secs. 32 G.H. changes 0 ft. in 54/60 hrs.

FLOW Laminar - small ripple - floating leaves

Cross Section small cobbles, uniform

CONTROL cobble/boulder control ~15 ft downstream of X-section

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 66 C°(F°) Water 56.5 C°(F°)

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

B-602

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS _____

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

SITE 4 — 1255 MST 10-29-2003

SITE DESCRIPTION:

GPS: 12 S 0431165 UTM 3834313 AT 1150 hrs. (10|30|03)

ACCURACY: 38 FT. (10|30|03)

- SITE 4 IS ON WET BEAVER CREEK
- FROM MONTEZUMA WELL PARKING LOT
  - FOLLOW THE RIGHT TRAIL TO INTERSECTION
  - AT INTERSECTION, GO RIGHT
  - ≈30 ft FROM END OF TRAIL, DESCEND TO STREAM
  - CROSS THE STREAM
  - ≈100 ft U.S. IS CROSS SECTION
- STAFF ≈5 ft D.S. ON RIVER RIGHT
- STAFF GAGE READING: 0.55 ft
- CHANNEL WIDTH ≈12 ft
- SWALLIT Ditch GAGE @ 1145 = 0.87 (10|30|03)

PHOTOS:

B-4.1

ACCESS:



SITE 4.10.29.2003_034

Wet Beaver Creek at Montezuma Well Outlet

From upstream looking downstream at the cross section with John Ward of Ward Ground Water, Tucson, Az.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1253 hrs



SITE 4.10.29.2003_035

Wet Beaver Creek at Montezuma Well Outlet

From downstream looking upstream at the cross section with John Ward of Ward Ground Water, Tucson, Az.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1253 hrs

B-63



SITE 4.10.29.2003_036

Wet Beaver Creek at Montezuma Well Outlet

From downstream of cross section looking downstream.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1254 hrs

B-44

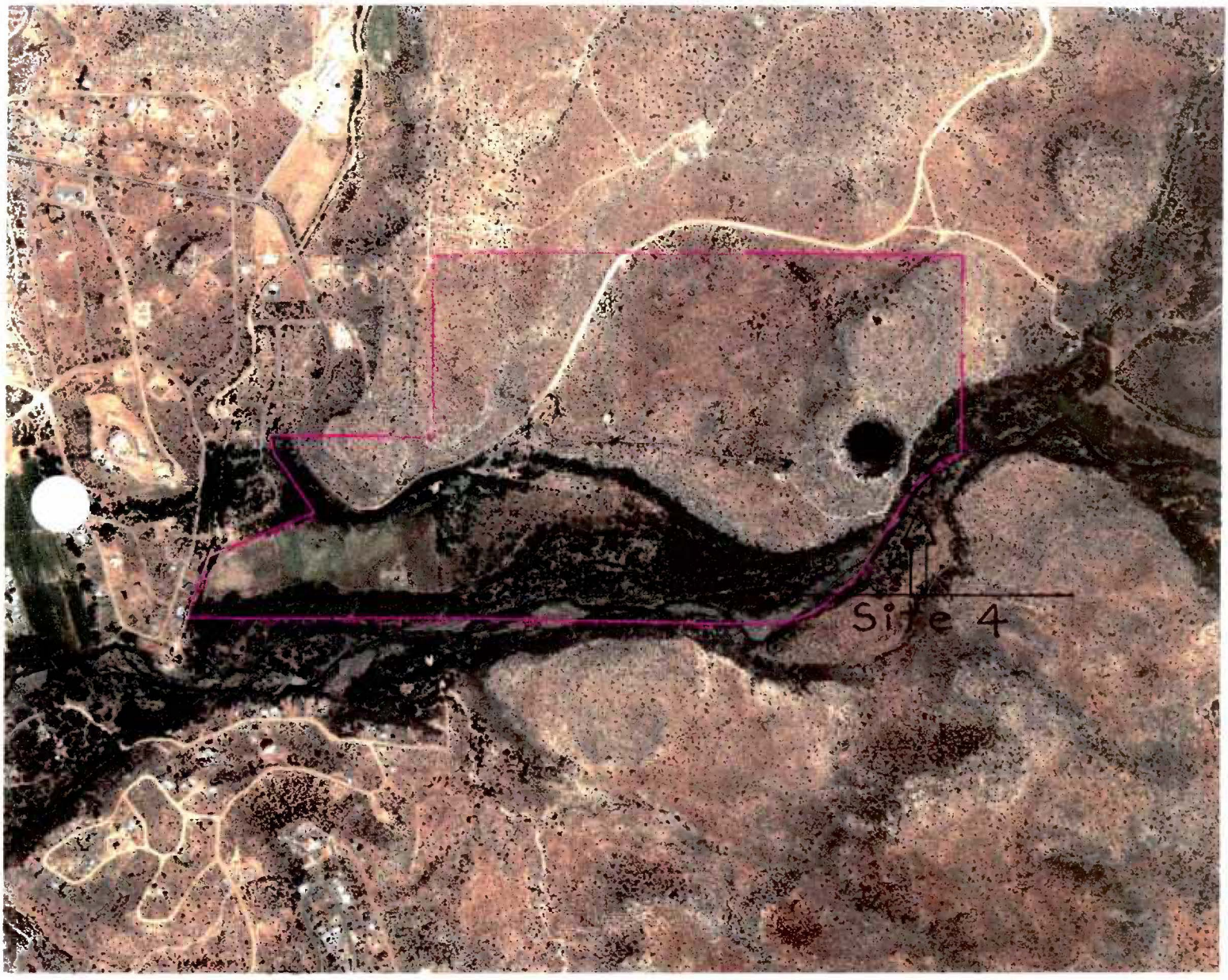


SITE 4.10.29.2003_037
Wet Beaver Creek at Montezuma Well Outlet

From the cross section looking upstream.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1254 hrs

B-65



Site 4--Location on Wet Beaver Creek near Montezuma Well, Montezuma Castle National Monument, Well Unit.

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	4				
Station Number:	4	WIDTH	15.200	# of Sections	37
Date:	10/30/2003	AREA	13.441	Sections > 5%	3
Measurement #:	1	VELOCITY	0.731	Sections > 10%	0
Pygmy or AA (p/a)	P			*Standard Error	5.81%
Rating # (1 or 2)	2	TOTAL DISCHARGE	9.830		FAIR

Print Header

Print Full Sheet

Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	0.5	0.15	0			0.000	0.000	0.000	0.000	0.000
	0.8	0.40	0.45	4	41.1	0.125	0.125	0.125	0.180	0.022
	1.3	0.50	0.48	4	48.1	0.111	0.111	0.111	0.240	0.027
	1.8	0.50	0.67	2	48.2	0.071	0.071	0.071	0.335	0.024
	2.3	0.50	0.62	5	40	0.151	0.151	0.151	0.310	0.047
	2.8	0.45	0.83	10	42.8	0.256	0.256	0.256	0.374	0.095
	3.2	0.50	0.87	10	40.3	0.270	0.270	0.270	0.435	0.117
	3.8	0.70	0.47	22	41.3	0.543	0.543	0.543	0.329	0.179
	4.6	0.65	1	22	40.7	0.550	0.550	0.550	0.650	0.358
	5.1	0.45	1.22	34	40	0.848	0.848	0.848	0.549	0.465
	5.5	0.33	1.23	46	40.7	1.117	1.117	1.117	0.400	0.446
	5.75	0.25	0.95	54	40.9	1.299	1.299	1.299	0.238	0.309
	6	0.28	1	57	40.5	1.383	1.383	1.383	0.275	0.380
	6.3	0.25	1	70	40.4	1.695	1.695	1.695	0.250	0.424
	6.5	0.20	0.96	79	40	1.928	1.928	1.928	0.192	0.370
	6.7	0.20	1.12	82	40.1	1.995	1.995	1.995	0.224	0.447
	6.9	0.25	1.12	86	40.3	2.081	2.081	2.081	0.280	0.583
	7.2	0.25	1.12	71	40.2	1.727	1.727	1.727	0.280	0.484
	7.4	0.25	1.18	64	40.2	1.560	1.560	1.560	0.295	0.460
	7.7	0.25	1.17	65	40	1.592	1.592	1.592	0.293	0.466
	7.9	0.25	1.22	59	40.8	1.420	1.420	1.420	0.305	0.433
	8.2	0.30	1	74	40	1.808	1.808	1.808	0.300	0.542
	8.5	0.30	0.95	76	40	1.856	1.856	1.856	0.285	0.529
	8.8	0.35	1.12	40	40.3	0.984	0.984	0.984	0.392	0.386
	9.2	0.40	1.14	21	40.9	0.524	0.524	0.524	0.456	0.239
	9.6	0.45	1.03	17	41.9	0.421	0.421	0.421	0.464	0.195
	10.1	0.50	1.05	9	40.5	0.245	0.245	0.245	0.525	0.128
	10.6	0.50	1.33	11	43.1	0.276	0.276	0.276	0.665	0.184
	11.1	0.60	1.3	9	47.7	0.212	0.212	0.212	0.780	0.166
	11.8	0.55	1.08	25	40.2	0.628	0.628	0.628	0.594	0.373
	12.2	0.40	1.2	26	40.2	0.652	0.652	0.652	0.480	0.313
	12.6	0.40	0.95	25	40.1	0.630	0.630	0.630	0.380	0.239
	13	0.45	0.92	13	40.9	0.336	0.336	0.336	0.414	0.139
	13.5	0.65	0.9	8	43.9	0.206	0.206	0.206	0.585	0.121
	14.3	0.80	0.45	9	42.1	0.237	0.237	0.237	0.360	0.085
	15.1	0.70	0.47	6	43.2	0.165	0.165	0.165	0.329	0.054
	15.7	0.30	0	0	0	0.000	0.000	0.000	0.000	0.000

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ANNI

S_q	S_d	S_t	S_i	S_s	S_n	S_v
5.810211	6.1464	5.852469	4.583489	2.8765	0	1.3339

b 6.146449
c 11.74611
e
f

Select a Bed Type:
Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u
2

Select a Suspension Type:
Rod
Cable

Rod
1

b	c				# secs	5+ secs	10+ secs
					1	0	0
11.2896763	22.31204	5.864519	13.48198	0	1	0	0
10.6069291	20.92911	5.611868	15.66687	0	1	0	0
7.72603979	15.05878	5.608606	28.00298	0	1	0	0
8.30381582	16.25256	5.909235	10.48669	0	1	0	0
6.34741973	12.21306	5.798342	5.30188	0	1	0	0
6.08518383	11.66696	5.896885	4.948683	0	1	0	0
10.8246654	21.37039	5.856553	2.162132	0	1	0	0
5.38516481	10.19804	5.8806	2.1532	0	1	0	0
4.56032456	8.437194	5.909235	1.891579	0	1	0	0
4.53040346	8.372468	5.8806	1.741389	0	1	0	0
5.6303491	10.71463	5.872534	1.664059	0	1	0	0
5.38516481	10.19804	5.888717	1.633194	0	1	0	0
5.38516481	10.19804	5.892795	1.536391	0	1	0	0
5.57913399	10.60693	5.909235	1.478227	0	1	0	0
4.89181428	9.14983	5.905106	1.463128	0	1	0	0
4.89181428	9.14983	5.896885	1.444809	0	1	1	0
4.89181428	9.14983	5.900989	1.527751	0	1	0	0
4.68557475	8.707379	5.900989	1.575139	0	1	0	0
4.71835128	8.77789	5.909235	1.565876	0	1	0	0
4.56032456	8.437194	5.876561	1.62026	0	1	0	0
5.38516481	10.19804	5.909235	1.507014	0	1	1	0
5.6303491	10.71463	5.909235	1.495209	0	1	1	0
4.89181428	9.14983	5.896885	1.808483	0	1	0	0
4.82044481	8.997041	5.872534	2.184715	0	1	0	0
5.25022835	9.912598	5.832949	2.77244	0	1	0	0
5.16485595	9.731544	5.888717	5.613036	0	1	0	0
4.25829509	7.780251	5.787013	4.790925	0	1	0	0
4.33507779	7.948056	5.625005	6.744062	0	1	0	0
5.04316077	9.472797	5.900989	2.069133	0	1	0	0
4.62180821	8.569973	5.900989	2.046103	0	1	0	0
5.6303491	10.71463	5.905106	2.067664	0	1	0	0
5.79110197	11.05203	5.872534	3.708739	0	1	0	0
5.90459122	11.28968	5.757289	7.008476	0	1	0	0
11.2896763	22.31204	5.825177	5.864559	0	1	0	0
10.8246654	21.37039	5.783259	9.395542	0	1	0	0
					1	0	0

River at—

Angle coefficient	Dist. from initial point		Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
	0.50										
	0.80	0.40	0.45		4	41.1	0.125			0.180	0.023
	1.30	0.50	0.48		4	48.1	0.111			0.24	0.027
	1.80	0.50	0.67		2	48.2	0.071	D.S. ROCK		0.335	0.024
	2.30	0.50	0.62		5	40.0	0.151	"		0.310	0.047
	2.80	0.45	0.83		10	42.8	0.236			0.338	0.098
	3.20	0.50	0.87		10	40.3	0.230 0.248	EDGE ROCK		0.435	0.117
	3.80	0.70	0.47		22	41.3	0.543	ON ROCK		0.329	0.179
	4.60	0.65	1.00		22	40.7	0.550	EDGE ROCK		0.650	0.358
	5.10	0.45	1.22		34	40.2	0.848			0.549	0.465
	5.50	0.33 0.40	1.23		46	40.7	1.117			0.400 0.523	0.446 0.209
INSERT →	5.75	0.25	0.95		54	40.9	1.309 <—>		TOP ROCK	0.238	0.309
	6.00	0.40 0.28	1.00		57	40.3	1.383			0.275	0.380
	6.30	0.25	1.00		70	40.4	1.695			0.250	0.424
	6.50	0.20	0.96		79	40.0	1.928			0.192	0.370
⊙	6.70	0.20	1.12		82	40.1	1.995			0.224	0.447
	6.90	0.25	1.12		86	40.3	2.081			0.280	0.583
	7.20	0.25	1.12		71	40.2	1.727			0.280	0.484
	7.40	0.25	1.18		64	40.2	1.560			0.295	0.460
	7.70	0.25	1.17		65	40.0	1.592			0.293	0.467
	7.90	0.25	1.22		59	40.8	1.420	EDGE ROCK		0.305	0.433
	8.20	0.30	1.00		74	40.0	1.808	TOP ROCK		0.300	0.542
	8.50	0.30	0.95		76	40.0	1.856	"		0.285	0.529
	8.80	0.35	1.12		40	40.3	0.984	EDGE ROCK		0.392	0.386
	9.20	0.40	1.14		21	40.9	0.524			0.456	0.239
	9.60	0.45	1.03		17	41.9	0.421			0.462	0.195
	10.10	0.50	1.05		9	40.5	0.245			0.525	0.128
	10.6	0.50	1.33		11	43.1	0.276			0.665	0.184
	11.1	0.60	1.30		9	47.7	0.212			0.780	0.165
	~~11.8~~		~~1.58~~		~~19~~	~~40.8~~	~~0.478~~			~~0.594~~	
	11.8	0.55	1.08		25	40.2	0.628			~~0.297~~ 0.367	0.373
	12.2	0.40	1.20		26	40.2	0.652			0.480	0.313
	12.6	0.40	0.95		25	40.1	0.630			0.380	0.239
	13.0	0.45	0.92		12	40.9	0.336 0.296			0.41	0.139
	13.5	0.45 0.45	0.90		8	43.9	0.206			0.5 ~~0.38~~	0.121
	~~14.1~~		0.84				0.237 0.217	TOP ROCK TOP ROCK		~~0.360~~	
	14.3	0.80	0.45		9	42.1	0.236			0.360	0.085 0.095
	15.1	0.70	0.47		6	43.2	0.165			0.329	0.054
LEW 0.00	15.7										9.830

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3 SECTIONS > 2%
E R : 5.81%
t

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 1

Comp by VBartling Checked by FIECHTNER

DATE 12/30/03

MONTEZUMA

PARK WELL STATION #4

PERSONNEL: Meter J. ALBRIGHT Notes VBARTLING

MEASUREMENT TYPE (circle one) (Wading) Cable, Bridge, Boat, Ice; (Upstr.) Dnstr., 4 (ft) mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 0755 G.H. 0.56 (0.57) Stop: 0925 G.H. 0.56 (0.57)

METER TYPE Pygmy S/N squaccount SPIN Before Meas. 1145 t After 1132

WEATHER overcast - Breezy

HIGH WATER MARK n/a Gage Height of .Zero .Flow. n/a ft.

CREST STAGE CHECKED: Yes/No n/a READING ft.

used temporary tape for today only

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor

FLOW: Width 15.200 Area 13.441 Ave. Vel. 0.731 G.H. Disch. 9.830

Method 0.6 Method coeff. Hor. Angle coeff. Susp. type Susp. coeff.

Meter ft. above bottom of weight No. Secs. 37 G.H. changes 0 ft. in 1.5 hrs.

FLOW Steady, uniform w/ concentrated (somewhat turbulent) flow through center of x-sect

Cross Section rough, cobble bed

CONTROL natural cobble bed d.s.

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range

S/N P/N

Conversion slope Conversion offset Ex. Volt. Output Range

NITROGEN TANK PRESSURE FEED BBL RATE per. min.

INTAKE/ORIFICE CLEANED TEMPERATURE: Air 59 C° (F°) Water 57.2 C° F°

PHOTOS TAKEN: Roll(s) # Frame(s) #

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OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time Samples: Yes/No Time

Method: EDI EWI Other

SEDIMENT: Yes/No Time Method: EDI EWI Other

BIOLOGICAL: Yes/No Time Type

OBSERVATIONS/COMMENTS

LEVEL NOTES

EQUIPMENT TYPE S/N

PERSONNEL: Instrument/Notes Rod

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Lovin, Hydrologist, US Geological Survey

Station Name:	4				
Station Number:	4	WIDTH	15.200	# of Sections	35
Date:	10/30/2003	AREA	13.626	Sections > 5%	2
Measurement #:	2	VELOCITY	0.739	Sections > 10%	0
Pygmy or AA (p/a)	P			*Standard Error	5.27%
Rating # (1 or 2)	2	TOTAL DISCHARGE	10.063		FAIR

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	0.5	0.25	0			0.000	0.000	0.000	0.000	0.000
	1	0.75	0.43	2	40.4	0.079	0.079	0.079	0.323	0.025
	2	1.00	0.68	3	46.3	0.093	0.093	0.093	0.680	0.064
	3	0.85	0.82	13	44.2	0.314	0.314	0.314	0.697	0.219
	3.7	0.60	0.45	23	41.8	0.560	0.560	0.560	0.270	0.151
	4.2	0.45	0.53	22	41.6	0.539	0.539	0.539	0.239	0.129
	4.6	0.45	1.2	25	40.5	0.624	0.624	0.624	0.540	0.337
	5.1	0.35	1.21	35	40.6	0.859	0.859	0.859	0.424	0.364
	5.3	0.20	1.2	33	40.3	0.818	0.818	0.818	0.240	0.196
	5.5	0.20	1.23	47	40.7	1.140	1.140	1.140	0.246	0.281
	5.7	0.20	0.98	50	40.2	1.226	1.226	1.226	0.196	0.240
	5.9	0.20	0.94	56	40.6	1.356	1.356	1.356	0.188	0.255
	6.1	0.20	0.98	62	40.5	1.501	1.501	1.501	0.196	0.294
	6.3	0.20	0.98	69	40.1	1.684	1.684	1.684	0.196	0.330
	6.5	0.20	1	78	40.3	1.890	1.890	1.890	0.200	0.378
	6.7	0.20	1.12	84	40.5	2.023	2.023	2.023	0.224	0.453
	6.9	0.20	1.11	82	40.2	1.990	1.990	1.990	0.222	0.442
	7.1	0.20	1.1	75	40.4	1.814	1.814	1.814	0.220	0.399
	7.3	0.20	1.2	69	40.1	1.684	1.684	1.684	0.240	0.404
	7.5	0.20	1.16	61	40.1	1.492	1.492	1.492	0.232	0.346
	7.7	0.20	1.15	57	40.2	1.393	1.393	1.393	0.230	0.320
	7.9	0.25	1.21	58	40.1	1.420	1.420	1.420	0.302	0.430
	8.2	0.25	0.99	78	40.2	1.895	1.895	1.895	0.248	0.469
	8.4	0.30	0.96	74	40.5	1.786	1.786	1.786	0.288	0.514
	8.8	0.35	1.1	47	40.8	1.138	1.138	1.138	0.385	0.438
	9.1	0.45	1.12	25	41	0.617	0.617	0.617	0.504	0.311
	9.7	0.80	1.15	11	40.9	0.289	0.289	0.289	0.920	0.266
	10.7	1.00	1.32	11	44	0.271	0.271	0.271	1.320	0.358
	11.7	0.80	1.1	22	41.6	0.539	0.539	0.539	0.880	0.474
	12.3	0.55	1.21	33	40.7	0.810	0.810	0.810	0.666	0.539
	12.8	0.55	0.93	26	40.5	0.648	0.648	0.648	0.512	0.331
	13.4	0.50	0.89	8	45.1	0.202	0.202	0.202	0.445	0.090
	13.8	0.80	0.91	8	42.5	0.212	0.212	0.212	0.728	0.154
	15	0.95	0.45	6	51.2	0.144	0.144	0.144	0.428	0.061
	15.7	0.35	0	0	0	0.000	0.000	0.000	0.000	0.000

(R-7)

04021

S_a	S_d	S_t	S_t	S_s	S_n	S_v
5.274013	5.8942	5.852487	3.830376	2.9086	0	1.4008

b 5.894245
c 11.22285
e
f

Select a Bed Type:
Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u
2

Select a Suspension Type:
Rod
Cable

Rod
1

b	c				# secs	5+ secs	10+ secs
					1	0	0
11.7986533	23.34166	5.892795	24.49942	0	1	0	0
7.62008818	14.84126	5.67212	19.61628	0	1	0	0
6.41718395	12.35803	5.746321	4.062811	0	1	0	0
11.2896763	22.31204	5.836853	2.142385	0	1	0	0
9.6436323	18.97363	5.844696	2.16656	0	1	0	0
4.62180821	8.569973	5.888717	2.073523	0	1	0	0
4.59078821	8.50302	5.884652	1.883886	0	1	0	0
4.62180821	8.569973	5.896885	1.912076	0	1	0	0
4.53040346	8.372468	5.8806	1.730498	0	1	0	0
5.48003837	10.39823	5.900989	1.69338	0	1	0	0
5.68272341	10.82467	5.884652	1.642878	0	1	0	0
5.48003837	10.39823	5.888717	1.593382	0	1	0	0
5.48003837	10.39823	5.905106	1.539531	0	1	0	0
5.38516481	10.19804	5.896885	1.48707	0	1	0	0
4.89181428	9.14983	5.888717	1.457017	0	1	0	0
4.92854551	9.228339	5.900989	1.464205	0	1	0	0
4.9660001	9.30831	5.892795	1.505472	0	1	0	0
4.62180821	8.569973	5.905106	1.539531	0	1	0	0
4.75174416	8.849649	5.905106	1.59635	0	1	0	0
4.78576971	8.922688	5.900989	1.629637	0	1	0	0
4.59078821	8.50302	5.905106	1.62016	0	1	0	0
5.43208995	10.29711	5.900989	1.48598	0	1	0	0
5.57913399	10.60693	5.888717	1.512543	0	1	1	0
4.9660001	9.30831	5.876561	1.731738	0	1	0	0
4.89181428	9.14983	5.86852	2.080785	0	1	0	0
4.78576971	8.922688	5.872534	4.509233	0	1	0	0
4.28345955	7.835311	5.753622	4.906342	0	1	0	0
4.9660001	9.30831	5.844696	2.16656	0	1	0	0
4.59078821	8.50302	5.8806	1.917532	0	1	1	0
5.7362946	10.93711	5.888717	2.050452	0	1	0	0
5.96336076	11.41257	5.713979	7.219699	0	1	0	0
5.84718658	11.16953	5.809773	6.761702	0	1	0	0
11.2896763	22.31204	5.514581	11.20378	0	1	0	0
					1	0	0

R-7

ANNEX 2

River at—

Angle coefficient	Dist. from initial point		Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
REW 10:20	0.50										
	1.00	0.75	0.43		2	40.4	0.079			0.322	0.025
	~~1.80~~		0.56								
	2.00	1.00	0.68		3	46.3	0.093			0.680	0.063
	3.00	0.85	0.82		13	44.2	0.314	EDGE ROCK		0.697	0.219
	3.70	0.60	0.45		23	41.8	0.560	TOP ROCK		0.270	0.151
	4.20	0.45	0.53		22	41.6	0.539	TOP ROCK		0.238	0.128
	4.60	0.45	1.20		25	40.5	0.624	EDGE ROCK		0.540	0.337
	5.10	0.35	1.21		35	40.6	0.859			0.427	0.367
	5.30	0.20	1.20		33	40.3	0.818			0.240	0.196
	5.50	0.20	1.23		47	40.7	1.140			0.246	0.281
	5.70	0.20	0.98		50	40.2	1.226			0.196	0.240
	5.90	0.20	0.94		56	40.6	1.356 ~~1.378~~			0.188	0.259
	6.10	0.20	0.98		62	40.5	1.501			0.196	0.294
⊙	6.30	0.20	0.98		69	40.1	1.684			0.196	0.330
	6.50	0.20	1.00		78	40.3	1.890			0.200	0.378
	6.70	0.20	1.12		84	40.5	2.023			0.224	0.453
	6.90	0.20	1.11		82	40.2	1.990			0.222	0.442
	7.10	0.20	1.10		75	40.4	1.814			0.220	0.399
	7.30	0.20	1.20		69	40.4	1.684			0.240	0.404
	7.50	0.20	1.16		61	40.1	1.492			0.232	0.346
	7.70	0.20	1.15		57	40.2	1.393			0.230	0.320
	7.90	0.25	1.21		58	40.1	1.420	EDGE ROCK		0.302	0.429
	8.20	0.25	0.99		76	40.2	1.895	TOP ROCK		0.247	0.468
	8.40	0.30	0.96		74	40.5	1.786	TOP ROCK		0.288	0.514
	8.80	0.35	1.10		47	40.8	1.137	EDGE ROCK		0.385	0.438
	9.10	0.45	1.12		25	41.0	0.617			0.504	0.311
	9.70	0.80	1.15		11	40.9	0.289			0.920	0.266
	10.70	1.00	1.32		11	44.0	0.271			1.320	0.358
	11.70	0.80	1.10		22	41.6	0.539			0.880	0.474
	12.30	0.55	1.21		33	40.7	0.810	WET		0.663	0.539
	12.80	0.50	0.93		26	40.5	~~0.648~~			~~0.282~~	0.332
										0.5120	

0.55

0.648

Angle coefficient	Dist. from initial point		Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
	13.40	0.50	0.89		8	45.1	0.207			0.44	0.088
	13.80	0.80	0.91		8	42.5	0.212			0.728	0.154
	15.00	0.95	0.45		6	51.2	0.144			0.428	0.061
LEW 11:15	15.70										

0402 3

2 SECTIONS 55%
EP 5.27%
F,

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 2

Comp by VBARTLING Checked by FIECHTNER

DATE 10/30/03

MONTEZUMA

PARK WELL STATION #4

PERSONNEL: Meter J. ALBRIGHT Notes V.BARTLING

MEASUREMENT TYPE (circle one) ~~Wading~~, Cable, Bridge, Boat, Ice; (Upstr), Dnstr., 4 ft, mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 1020 G.H. 0.56 (0.57) Stop: 1115 G.H. (0.56 - 0.57

METER TYPE Pygmy S/N Aquacount SPIN Before Meas. 1:32 After 1:16

WEATHER

HIGH WATER MARK Gage Height of .Zero .Flow. ft.

CREST STAGE CHECKED: Yes/No READING ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor

FLOW: Width 15.200 Area 13.626 Ave. Vel. 0.739 G.H. Disch. 10.063

Method 0.6 Method coeff. Hor. Angle coeff. Susp. type Susp. coeff.

Meter ft. above bottom of weight No. Secs. 35 G.H. changes 0 ft. in 55/60 hrs.

FLOW SAME AS MEAS #1 taken today

Cross Section

CONTROL

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range

S/N P/N

Conversion slope Conversion offset Ex. Volt. Output Range

NITROGEN TANK PRESSURE FEED BBL RATE per. min.

INTAKE/ORIFICE CLEANED TEMPERATURE: Air 64.6 C (F) Water 58.1 C (F)

PHOTOS TAKEN: Roll(s) # Frame(s) #

R-72a

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time Samples: Yes/No Time

Method: EDI EWI Other

SEDIMENT: Yes/No Time Method: EDI EWI Other

BIOLOGICAL: Yes/No Time Type

OBSERVATIONS/COMMENTS

LEVEL NOTES

EQUIPMENT TYPE S/N

PERSONNEL: Instrument/Notes Rod

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

SITE 5 1055 MST 10-29-2003

SITE DESCRIPTION:

GPS: #24 12S 0430130
UTM 3833989
ACCURACY: 16 ft

- SITE 5 IS ON WET BEAVER CREEK, PRE-GOLF COURSE DIVERSION
- ≈ 50 YDS U.S. OF FENCE LINE
- CROSS SECTION ≈ 16 ft WIDE
- STAFF GAGE ≈ 2 ft U.S.
- STAFF GAGE READING: 0.40 ft
- VEGETATED BANKS; LOOK FOR FLUORESCENT ORANGE FLAGGING

MS-72

PHOTOS:

ACCESS:
- DRIVE TO RESIDENCES AREA OF MONTEZUMA WELL
- PAST HOUSES, FIND A ROAD THROUGH PASTURE
- PARK NEAR FIRST FENCED/GATED AREA



SITE 5.10.29.2003_029

Wet Beaver Creek upstream of the golf course diversion

From upstream of the cross section looking upstream.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1013 hrs



SITE 5.10.29.2003_030

Wet Beaver Creek upstream of the golf course diversion

Form right bank looking at staff gage installed upstream of cross section on river left (cross section located at measuring tape).

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1059 hrs

12-75



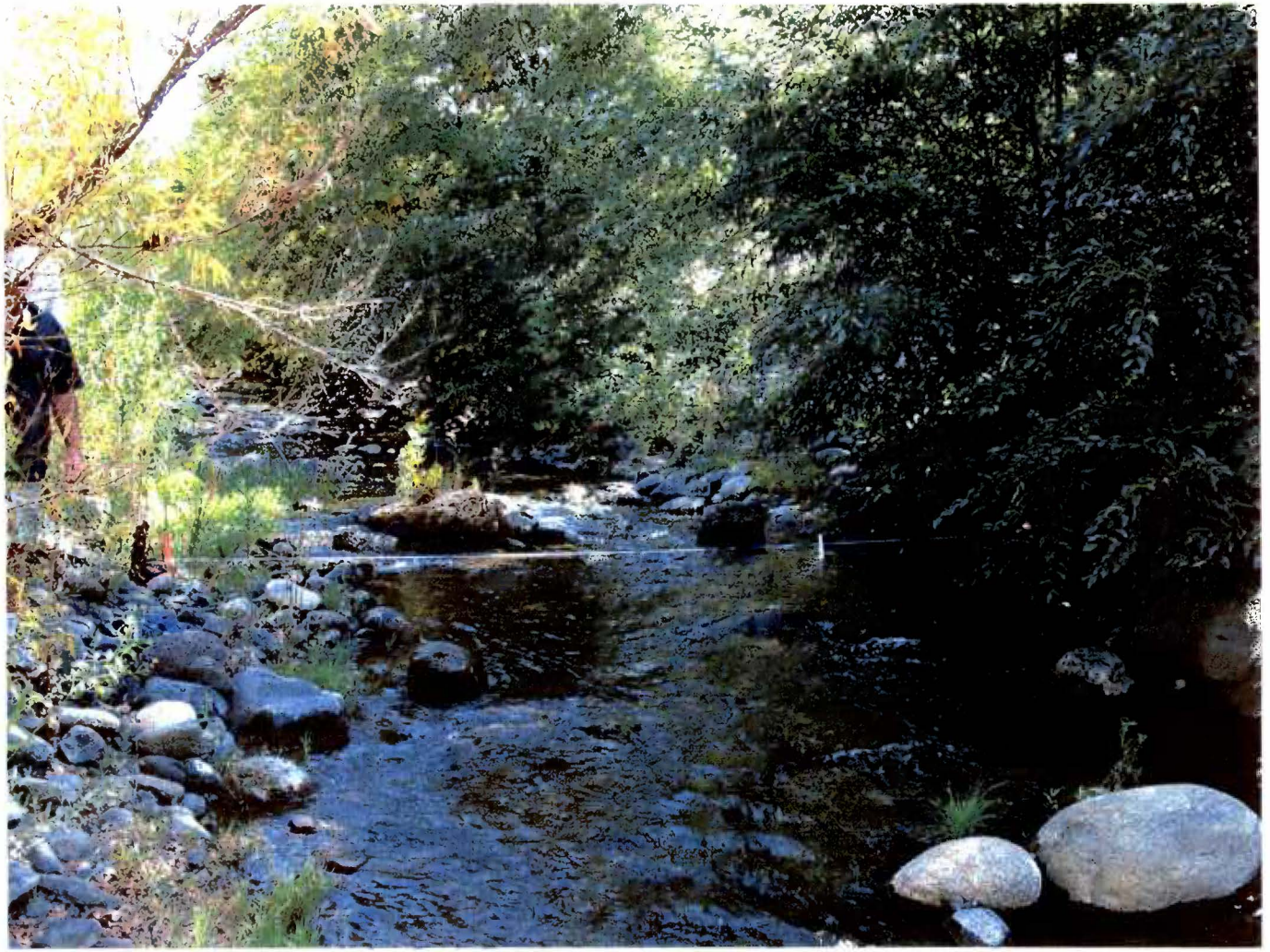
SITE 5.10.29.2003_031

Wet Beaver Creek upstream of the golf course diversion

From upstream of cross section looking downstream at cross section located at measuring tape.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1102 hrs

B-76



SITE 5.10.29.2003_032

Wet Beaver Creek upstream of the golf course diversion

From downstream of cross section looking upstream at cross section located at measuring tape.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1103 hrs

15-77



SITE 5.10.29.2003_033

Wet Beaver Creek upstream of the golf course diversion

From cross section looking downstream.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1104 hrs

HMS Version 2.6 Multi-Point Velocity Discharge Measurement Checker

Brian Loving, Hydrologist, USGS Geological Survey

Station Name:	Pre-diversion				
Station Number:	5	WIDTH	15.600	# of Sections	36
Date:	10/30/2003	AREA	10.482	Sections > 5%	3
Measurement #:	1	VELOCITY	0.898	Sections > 10%	0
Pygmy or AA (p/a)	p			*Standard Error	5.32%
Rating # (1 or 2)	2	TOTAL DISCHARGE	9.411		FAIR

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance		Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	2.5	0.50	0			0.000	0.000	0.000	0.000	0.000
	3.5	0.70	0.61	6	40.9	0.172	0.172	0.172	0.427	0.073
	3.9	0.40	0.67	5	45	0.138	0.138	0.138	0.268	0.037
	4.3	0.45	0.67	6	46.5	0.155	0.155	0.155	0.302	0.047
	4.8	0.45	0.73	6	49.5	0.148	0.148	0.148	0.329	0.048
	5.2	0.50	1.05	8	42	0.214	0.214	0.214	0.525	0.112
	5.8	0.50	0.98	19	42.67	0.459	0.459	0.459	0.490	0.225
	6.2	0.40	0.9	27	41.16	0.661	0.661	0.661	0.360	0.238
	6.6	0.50	0.82	33	41	0.804	0.804	0.804	0.410	0.330
	7.2	0.50	0.63	35	41.59	0.839	0.839	0.839	0.315	0.264
	7.6	0.35	0.78	42	40.91	1.017	1.017	1.017	0.273	0.278
	7.9	0.30	0.8	44	40.64	1.071	1.071	1.071	0.240	0.257
	8.2	0.30	0.76	41	40.92	0.993	0.993	0.993	0.228	0.227
	8.5	0.35	0.83	46	41.71	1.090	1.090	1.090	0.291	0.317
	8.9	0.35	0.99	51	41.09	1.223	1.223	1.223	0.347	0.424
	9.2	0.27	0.79	65	42.29	1.507	1.507	1.507	0.217	0.327
	9.45	0.25	0.8	60	40.3	1.461	1.461	1.461	0.200	0.292
	9.7	0.33	0.79	50	40.28	1.223	1.223	1.223	0.257	0.314
	10.1	0.35	0.84	52	40.4	1.267	1.267	1.267	0.294	0.373
	10.4	0.30	0.78	45	40.59	1.096	1.096	1.096	0.234	0.256
	10.7	0.30	0.8	61	40.49	1.478	1.478	1.478	0.240	0.355
	11	0.28	0.87	72	41.13	1.712	1.712	1.712	0.239	0.410
	11.25	0.25	0.87	78	40.7	1.872	1.872	1.872	0.218	0.407
	11.5	0.25	0.85	93	41.06	2.206	2.206	2.206	0.213	0.469
	11.75	0.25	0.75	95	40.49	2.285	2.285	2.285	0.188	0.428
	12	0.25	0.78	96	40.49	2.308	2.308	2.308	0.195	0.450
	12.25	0.25	0.75	110	40.59	2.634	2.634	2.634	0.188	0.494
	12.5	0.33	0.72	104	40.63	2.490	2.490	2.490	0.234	0.583
	12.9	0.35	0.91	62	40.55	1.500	1.500	1.500	0.319	0.478
	13.2	0.35	0.47	48	40.7	1.164	1.164	1.164	0.165	0.191
	13.6	0.45	0.46	30	40.3	0.746	0.746	0.746	0.207	0.154
	14.1	0.45	0.83	10	43.09	0.254	0.254	0.254	0.374	0.095
	14.5	0.45	0.83	4	44.2	0.118	0.118	0.118	0.374	0.044
	15	0.70	0.7	3	43.77	0.097	0.097	0.097	0.490	0.048
	15.9	1.55	0.54	18	42.61	0.437	0.437	0.437	0.837	0.366
	18.1	1.10	0	0	0	0.000	0.000	0.000	0.000	0.000

(5-79)

S_q	S_d	S_t	S_i	S_s	S_h	S_v
5.319574	6.9723	5.840126	3.875356	2.8921	0	1.3665

b	6.97228
c	13.49383
e	
f	

Select a Bed Type:

Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u

2

Select a Suspension Type:

Rod
Cable

Rod

1

b	c				# secs	5+ secs	10+ secs
					1	0	0
8.43719386	16.51499	5.872534	8.866664	0	1	0	0
7.72603979	15.05878	5.717532	11.82397	0	1	0	0
7.72603979	15.05878	5.665278	10.14764	0	1	0	0
7.1353428	13.84386	5.586967	10.8239	0	1	0	0
5.16485595	9.731544	5.829057	6.673489	0	1	0	0
5.48003837	10.39823	5.803283	2.477862	0	1	0	0
5.90459122	11.28968	5.862124	2.037852	0	1	0	0
6.41718395	12.35803	5.86852	1.921598	0	1	0	0
8.18462939	15.99852	5.84509	1.897048	0	1	0	0
6.71501208	12.97558	5.872132	1.79082	0	1	0	0
6.56220237	12.65899	5.88303	1.763337	0	1	0	0
6.87623069	13.30903	5.87173	1.803537	0	1	0	0
6.34741973	12.21306	5.840376	1.753877	0	1	0	0
5.43208995	10.29711	5.864918	1.694417	0	1	0	0
6.63759618	12.81525	5.817837	1.591509	0	1	0	0
6.56220237	12.65899	5.896885	1.606463	0	1	0	0
6.63759618	12.81525	5.897705	1.694364	0	1	0	0
6.27939798	12.07159	5.892795	1.676497	0	1	0	0
6.71501208	12.97558	5.885058	1.751201	0	1	0	0
6.56220237	12.65899	5.889124	1.600894	0	1	0	0
6.08518383	11.66696	5.863321	1.531754	0	1	0	0
6.08518383	11.66696	5.8806	1.491409	0	1	0	0
6.21305691	11.9335	5.866118	1.419588	0	1	0	0
6.96020434	13.4825	5.889124	1.404858	0	1	0	0
6.71501208	12.97558	5.889124	1.400512	0	1	0	0
6.96020434	13.4825	5.885058	1.346146	0	1	1	0
7.22670801	14.03215	5.883435	1.369108	0	1	1	0
5.84718656	11.16953	5.886683	1.59396	0	1	1	0
10.8246654	21.37039	5.8806	1.719897	0	1	0	0
11.0520337	21.83094	5.896885	1.965291	0	1	0	0
6.34741973	12.21306	5.787389	5.342883	0	1	0	0
6.34741973	12.21306	5.746321	14.46274	0	1	0	0
7.41757428	14.42503	5.762072	18.6762	0	1	0	0
9.47279695	18.62621	5.80557	2.640803	0	1	0	0
					1	0	0

B-8

05012

River at—

Angle coef.	Dist. from initial point		Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: Mid point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
R.R.	2.5'=i	0.5	0		0	0		0			
	3.5	0.7	0.61		6	40.9		0.172		0.427	0.073
	3.9	0.4	0.67		5	45		0.138		0.268	0.037
	4.3	0.45	0.67		6	46.5		0.155		0.3015	0.047
	4.8	0.45	0.73		6	49.5		0.148		0.3285	0.048
	5.2	0.5	1.05		8	42		0.214		0.525	0.112
	5.8	0.5	0.98		19	42.67		0.459		0.49	0.225
	6.2	0.4	0.90		27	41.16		0.661		0.36	0.238
	6.6	0.5	0.82		33	41.0		0.804		0.41	0.330
	7.2	0.5	0.63		35	41.59		0.839		0.315	0.264
	7.6	0.35	0.78		42	40.91		1.02		0.273	0.278
	7.9	0.3	0.80		44	40.64		1.07		0.24	0.257
	8.2	0.3	0.76		41	40.92		0.993		0.228	0.227
	8.5	0.35	0.83		46	41.71		1.09		0.2905	0.317
⊙	8.9	0.35	0.99		51	41.09		1.22		0.3465	0.424
	9.2	0.275	0.79		65	42.29		1.51		0.2725	0.327
	9.45	0.25	0.80		60	40.3		1.46		0.2	0.292
	9.7	0.325	0.79		50	40.28		1.22		0.25675	0.314
	10.1	0.35	0.84		52	40.4		1.27		0.294	0.373
	10.4	0.3	0.78		45	40.59		1.10		0.234	0.256
	10.7	0.3	0.80		61	40.49		1.48		0.24	0.355
	11.0	0.275	0.87		72	41.13		1.71		0.23925	0.410
	11.25	0.25	0.87		78	40.7		1.87		0.2175	0.407
	11.5	0.25	0.85		93	41.06		2.21		0.2125	0.469
	11.75	0.25	0.75		95	40.49		2.28		0.1875	0.428
	12	0.25	0.78		96	40.49		2.31		0.195	0.450
	12.25	0.25	0.75		110	40.59		2.63		0.1875	0.494
	12.5	0.325	0.72		104	40.63		2.49		0.234	0.583
	12.9	0.35	0.91		62	40.55		1.50		0.3185	0.478
	13.2	0.35	0.47		48	40.7		1.16		0.1645	0.191
	13.6										
R.L.	18.2'										

	DIST.	W	D		REV	T		V		A	Q
	13.2		0.47		48	40.7					
	13.6	0.45	0.46		30	40.3		0.746		0.207	0.154
	14.1	0.45	0.83		10	43.09		0.254		0.3735	0.095
	14.5	0.45	0.83		4	44.2		0.118		0.3735	0.044
	15.0	0.7	0.70		3	43.77		0.097		0.49	0.048
	15.9	1.55	0.54		18	42.61		0.437		0.837	0.366
	18.1										9.411cfs
⊙											

15-R1

A501 3

5 SECTIONS - 2.60
ERR 5.32%
FA

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

PRE-DIVERSION

Meas. No. 5-1

DATE 10/30/2003 Comp by FIECHTNER Checked by GABLE FIECHTNER

PARK MOCA STATION MEASUREMENT 1, SITE 5

PERSONNEL: Meter CHRIS GABLE Notes CARMIA FIECHTNER

MEASUREMENT TYPE (circle one) (Wading) Cable, Bridge, Boat, Ice; Upstr. (Dnstr.) 4 (ft) mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start 0803 G.H. 0.40-0.41 Stop 0904 G.H. 0.40-0.41

METER TYPE PYGMY S/N USGS P90223 SPIN Before Meas. 1107 After 48

WEATHER LIGHTLY OVERCAST

HIGH WATER MARK _____ Gage Height of Zero Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor

FLOW: Width 15.600 Area 10.482 Ave. Vel. 0.898 G.H. _____ Disch. 9.411

Method 0.6 Method coeff. _____ Hor. Angle coeff. _____ Susp. type ROD Susp. coeff. _____

Meter _____ ft. above bottom of weight No. Secs. 36 G.H. changes 0 ft. in ≈ 1 hrs.

FLOW SLIGHTLY TURBULENT, NON-UNIFORM, VARIED

Cross Section NON-UNIFORM, ROUGH, COBBLE & BOULDER

CONTROL STEP-POOL, RIFFLE ≈ 15 ft D.S.

* SLIGHT ALGAE ON ROCKS

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 15.8 (C) F° Water 14.5 (C) F°

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

R-91a

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS _____

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	Pre-diversion				
Station Number:	5	WIDTH	15.600	# of Sections	36
Date:	10/30/2003	AREA	10.717	Sections > 5%	0
Measurement #:	2	VELOCITY	0.849	Sections > 10%	0
Pygmy or AA (p/a)	p			*Standard Error	4.81%
Rating # (1 or 2)	2	TOTAL DISCHARGE	9.099		GOOD

Print Header

Print Full Sheet

Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	2.5	0.50	0			0.000	0.000	0.000	0.000	0.000
	3.5	1.00	0.61	7	43.53	0.186	0.186	0.186	0.610	0.113
	4.5	1.00	0.68	6	43.83	0.163	0.163	0.163	0.680	0.111
	5.5	0.75	1.01	13	41.02	0.336	0.336	0.336	0.758	0.254
	6	0.50	0.87	26	41.45	0.634	0.634	0.634	0.435	0.276
	6.5	0.50	0.88	31	40.81	0.761	0.761	0.761	0.440	0.335
	7	0.50	0.77	35	41.23	0.846	0.846	0.846	0.385	0.326
	7.5	0.50	0.7	37	41.98	0.878	0.878	0.878	0.350	0.307
	8	0.50	0.8	43	41.05	1.037	1.037	1.037	0.400	0.415
	8.5	0.43	0.8	41	40.39	1.006	1.006	1.006	0.340	0.342
	8.85	0.35	0.9	52	41.08	1.247	1.247	1.247	0.315	0.393
	9.2	0.35	0.78	60	40.83	1.443	1.443	1.443	0.273	0.394
	9.55	0.35	0.8	52	40.48	1.265	1.265	1.265	0.280	0.354
	9.9	0.30	0.8	48	40.68	1.164	1.164	1.164	0.240	0.279
	10.15	0.25	0.85	54	40.63	1.308	1.308	1.308	0.213	0.278
	10.4	0.25	0.78	49	40.3	1.199	1.199	1.199	0.195	0.234
	10.65	0.25	0.86	57	40.57	1.381	1.381	1.381	0.215	0.297
	10.9	0.23	0.86	65	40.77	1.562	1.562	1.562	0.194	0.302
	11.1	0.20	0.9	77	40.39	1.862	1.862	1.862	0.180	0.335
	11.3	0.20	0.75	94	40.47	2.262	2.262	2.262	0.150	0.339
	11.5	0.20	0.75	87	40.44	2.097	2.097	2.097	0.150	0.315
	11.7	0.20	0.7	93	40.67	2.227	2.227	2.227	0.140	0.312
	11.9	0.20	0.7	95	40.66	2.275	2.275	2.275	0.140	0.319
	12.1	0.20	0.68	93	40.77	2.222	2.222	2.222	0.136	0.302
	12.3	0.20	0.65	105	40.57	2.517	2.517	2.517	0.130	0.327
	12.5	0.20	0.65	103	40.59	2.468	2.468	2.468	0.130	0.321
	12.7	0.20	0.88	72	40.59	1.735	1.735	1.735	0.176	0.305
	12.9	0.35	0.85	55	40.85	1.324	1.324	1.324	0.298	0.394
	13.4	0.50	0.43	30	40.7	0.739	0.739	0.739	0.215	0.159
	13.9	0.50	0.73	13	40.65	0.338	0.338	0.338	0.365	0.123
	14.4	0.55	0.63	9	46.05	0.219	0.219	0.219	0.347	0.076
	15	0.80	0.7	8	41.27	0.217	0.217	0.217	0.560	0.122
	16	0.80	0.54	21	40.5	0.529	0.529	0.529	0.432	0.229
	16.6	0.50	0.72	6	46.63	0.155	0.155	0.155	0.360	0.056
	17	0.75	0.65	4	45.09	0.116	0.116	0.116	0.488	0.057
	18.1	0.55	0	0	0	0.000	0.000	0.000	0.000	0.000

B-82

S_a	S_d	S_t	S_i	S_s	S_h	S_v
4.805317	7.1002	5.854177	3.123621	2.8921		0 1.3665

b 7.100212
c 13.76067
e
f

Select a Bed Type:
Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u
2

Select a Suspension Type:
Rod
Cable

Rod
1

b	c				# secs	5+ secs	10+ secs
					1	0	0
8.43719386	16.51499	5.770949	8.034662	0	1	0	0
7.62008818	14.84126	5.759862	9.539756	0	1	0	0
5.33923227	10.10097	5.867719	3.721575	0	1	0	0
6.08518383	11.66696	5.850611	2.064065	0	1	0	0
6.02354197	11.53829	5.876158	1.953899	0	1	0	0
6.79452917	13.14011	5.859335	1.892289	0	1	0	0
7.41757428	14.42503	5.829834	1.871859	0	1	0	0
6.56220237	12.65899	5.866518	1.780373	0	1	0	0
6.56220237	12.65899	5.893203	1.796716	0	1	0	0
5.90459122	11.28968	5.865318	1.684703	0	1	0	0
6.71501208	12.97558	5.875352	1.612636	0	1	0	0
6.56220237	12.65899	5.889531	1.677467	0	1	0	0
6.56220237	12.65899	5.88141	1.71985	0	1	0	0
6.21305691	11.9335	5.883435	1.660835	0	1	0	0
6.71501208	12.97558	5.896885	1.704646	0	1	0	0
6.14833759	11.79865	5.88587	1.634021	0	1	0	0
6.14833759	11.79865	5.877771	1.574479	0	1	0	0
5.90459122	11.28968	5.893203	1.493724	0	1	0	0
6.96020434	13.4825	5.889939	1.409058	0	1	0	0
6.96020434	13.4825	5.891162	1.441357	0	1	0	0
7.41757428	14.42503	5.881814	1.415586	0	1	0	0
7.41757428	14.42503	5.882219	1.406601	0	1	0	0
7.62008818	14.84126	5.877771	1.416615	0	1	0	0
7.94805622	15.51407	5.88587	1.364635	0	1	0	0
7.94805622	15.51407	5.885058	1.372632	0	1	0	0
6.02354197	11.53829	5.885058	1.525802	0	1	0	0
6.21305691	11.9335	5.874546	1.654548	0	1	0	0
11.7986533	23.34166	5.8806	1.970877	0	1	0	0
7.1353428	13.84386	5.882825	3.682009	0	1	0	0
8.18462939	15.99852	5.680725	6.485182	0	1	0	0
7.41757428	14.42503	5.857745	6.544633	0	1	0	0
9.47279695	18.62621	5.888717	2.178664	0	1	0	0
7.22670801	14.03215	5.660852	10.17709	0	1	0	0
7.94805622	15.51407	5.714334	14.74046	0	1	0	0
					1	0	0

R-82

River at—

Angle coefficient	Dist. from initial point	Width	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
	2.50		0					0			0
	3.50	1.0	0.61		7	43.53		0.186		0.61	0.113
	4.50	1.0	0.68		6	43.83		0.163		0.68	0.111
	5.50	0.75	1.01		13	41.02		0.336		0.7575	0.254
	6.00	0.5	0.87		26	41.45		0.634		0.435	0.276
	6.50	0.5	0.88		31	40.81		0.761		0.44	0.335
	7.00	0.5	0.77		35	41.23		0.846		0.385	0.326
	7.50	0.5	0.70		37	41.98		0.878		0.35	0.307
	8.00	0.5	0.80		43	41.05		1.04		0.40	0.415
	8.50	0.425	0.80		41	40.39		1.01		0.34	0.342
	8.85	0.35	0.90		52	41.08		1.25		0.315	0.393
	9.20	0.35	0.78		60	40.83		1.44		0.273	0.394
	9.55	0.35	0.80		52	40.78		1.27		0.28	0.354
	9.90	0.3	0.80		48	40.68		1.16		0.24	0.279
⊙	10.15	0.25	0.85		54	40.63		1.31		0.2125	0.278
	10.40	0.25	0.78		49	40.30		1.20		0.195	0.234
	10.65	0.25	0.86		57	40.57		1.38		0.215	0.297
	10.90	0.225	0.86		65	40.77		1.56		0.1935	0.302
	11.10	0.2	0.90		77	40.39		1.86		0.18	0.335
	11.30	0.2	0.75		94	40.47		2.26		0.15	0.339
	11.50	0.2	0.75		87	40.44		2.10		0.15	0.315
	11.70	0.2	0.70		93	40.67		2.23		0.14	0.312
	11.90	0.2	0.70		95	40.60		2.28		0.14	0.319
	12.10	0.2	0.68		93	40.77		2.22		0.136	0.302
	12.30	0.2	0.65		105	40.57		2.52		0.13	0.327
	12.50	0.2	0.65		103	40.59		2.47		0.13	0.321
	12.70	0.2	0.88		72	40.59		1.74		0.176	0.305
	12.90	0.35	0.85		55	40.85		1.32		0.2975	0.394
	13.40	0.5	0.43		30	40.70		0.739		0.215	0.159
	13.90										

	DIST	W	D	REV	t	V	A	Q
	13.40							
	13.90	0.5	0.73	13	40.65	0.338	0.365	0.123
	14.40	0.55	0.63	9	46.05	0.219	0.3465	0.076
	15.00	0.80	0.70	8	41.27	0.217	0.56	0.122
	16.00	0.80	0.54	21	40.50	0.529	0.432	0.229
	16.60	1.0	0.72	6	46.03	0.155	0.36	0.056
	17.00	0.75	0.65	4	45.09	0.116	0.4875	0.057
	18.10							~~9.10~~ 9.099
⊙								

B-84

0 SECTIONS -> 7%
ERROR: 4.81%
GOOD

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

PRE - DIVERSION

Meas. No. 5-2

DATE 10/30/2003 Comp by FIECHTNER Checked by GABLE FIECHTNER

PARK MOCA STATION MEASUREMENT 2, SITE 5

PERSONNEL: Meter CHRIS GABLE Notes CARMIA FIECHTNER

MEASUREMENT TYPE (circle one) (Wading), Cable, Bridge, Boat, Ice; Upstr., Dnstr., 4 ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 10:03 G.H. 0.40-0.41 Stop: 11:03 G.H. 0.40-0.41

METER TYPE PYGMY S/N USGS P90223 SPIN Before Meas. 1:09 After 1:20

WEATHER LIGHTLY OVERCAST

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor

FLOW: Width 15.6 Area 10.717 Ave. Vel. 0.849 G.H. _____ Disch. 9.099 cfs x 9.1

Method 0.6 Method coeff. _____ Hor. Angle coeff. _____ Susp. type ROD Susp. coeff. _____

Meter _____ ft. above bottom of weight No. Secs. 30 G.H. changes 0 ft. in 1 hrs.

FLOW SLIGHTLY TURBULENT, NON-UNIFORM, VARIED

Cross Section NON-UNIFORM, ROUGH, COBBLE & BOULDER

CONTROL STEP-POOL, RIFFLE * 15ft D.S.

* SLIGHT ALGAE ON ROCKS

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 19.1 (C) F° Wat (C) F°

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

B-84a

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS _____

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

15

SITE ~~16~~: SLG OVERCAST 1504 MST 10-~~29~~-2003

SITE DESCRIPTION:

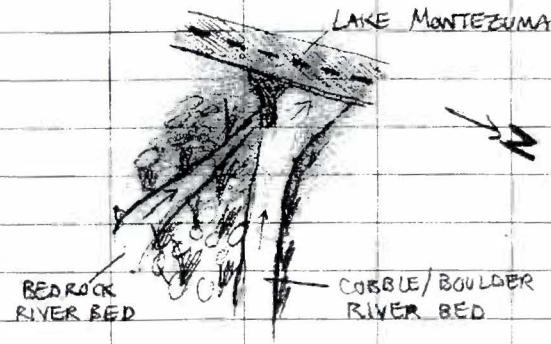
GPS: ~~#28~~ 29 ~~12S 0428003~~ 12S 0428615

~~UTM 3833537~~ UTM 3833563

ACCURACY: ~~16ft~~ 18ft

- SITE 15 IS IN LIEU OF SITE 6
- ON WET BEAVER CREEK
- ≈ 50 YDS U.S. OF BRIDGE ON ~~RIVER RIGHT~~ RIGHT CHANNEL & ≈ 5 YDS U.S. OF BRIDGE ON LEFT CHANNEL
- CHANNEL WIDTH ≈ 7 ft (RIGHT CHANNEL)
- STAFF GAGE ~10 ft U.S. OF CROSS SECTION ON RIVER LEFT AMONGST REEDS
- STAFF GAGE READING: 0.50 ft

R-05



PHOTOS:

ACCESS: TAKE LAKE MONTEZUMA ROAD. CROSS BRIDGE TURN LEFT AT BEAVER VISTA ROAD PARK AT SYCAMORE COMMUNITY PARK. PARK IN LOT. WALK NORTH TO WET BEAVER CREEK. CROSS SECTION IS ON RIGHT CHANNEL APPROX. 100 FEET UPSTREAM OF BRIDGE.



SITE 15.10.29.2003_038

Wet Beaver Creek upstream of the Lake Montezuma Avenue Bridge

From upstream of the cross section looking at an instream earthen diversion.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1329 hrs

13-41



SITE 15.10.29.2003_041

Wet Beaver Creek upstream of the Lake Montezuma Avenue Bridge

From downstream of the cross section on the left channel looking upstream.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1457 hrs

B-87

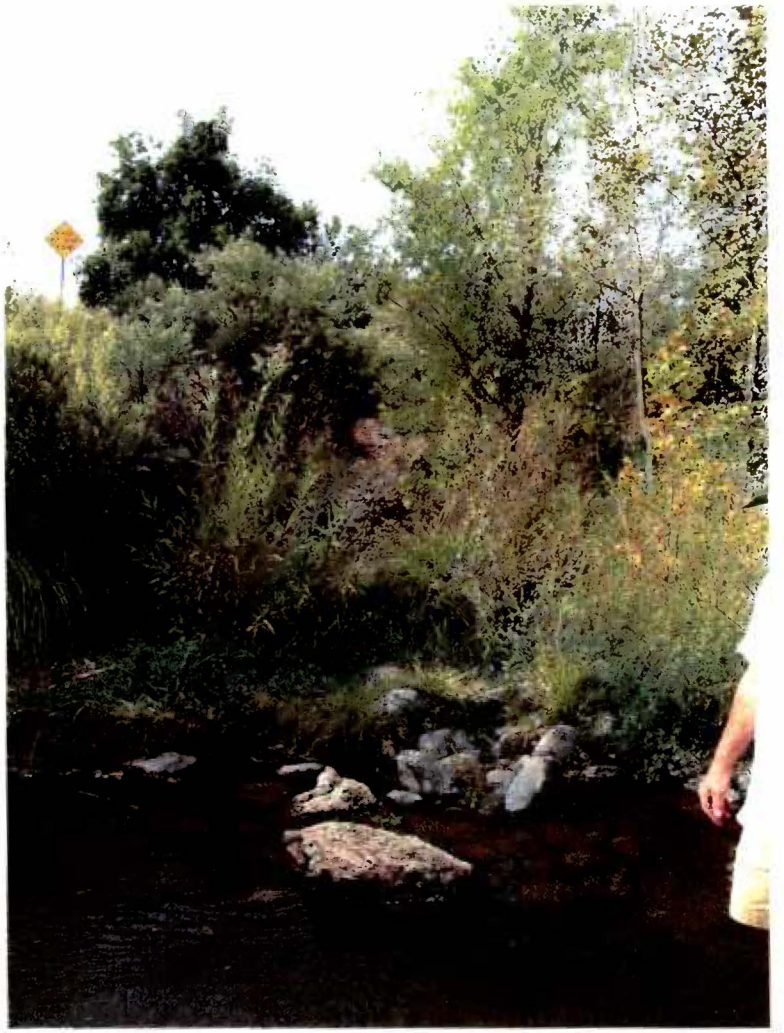


SITE 15.10.29.2003_042

Wet Beaver Creek upstream of the Lake Montezuma Avenue Bridge

From upstream of the cross section on the left channel looking downstream.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1457 hrs



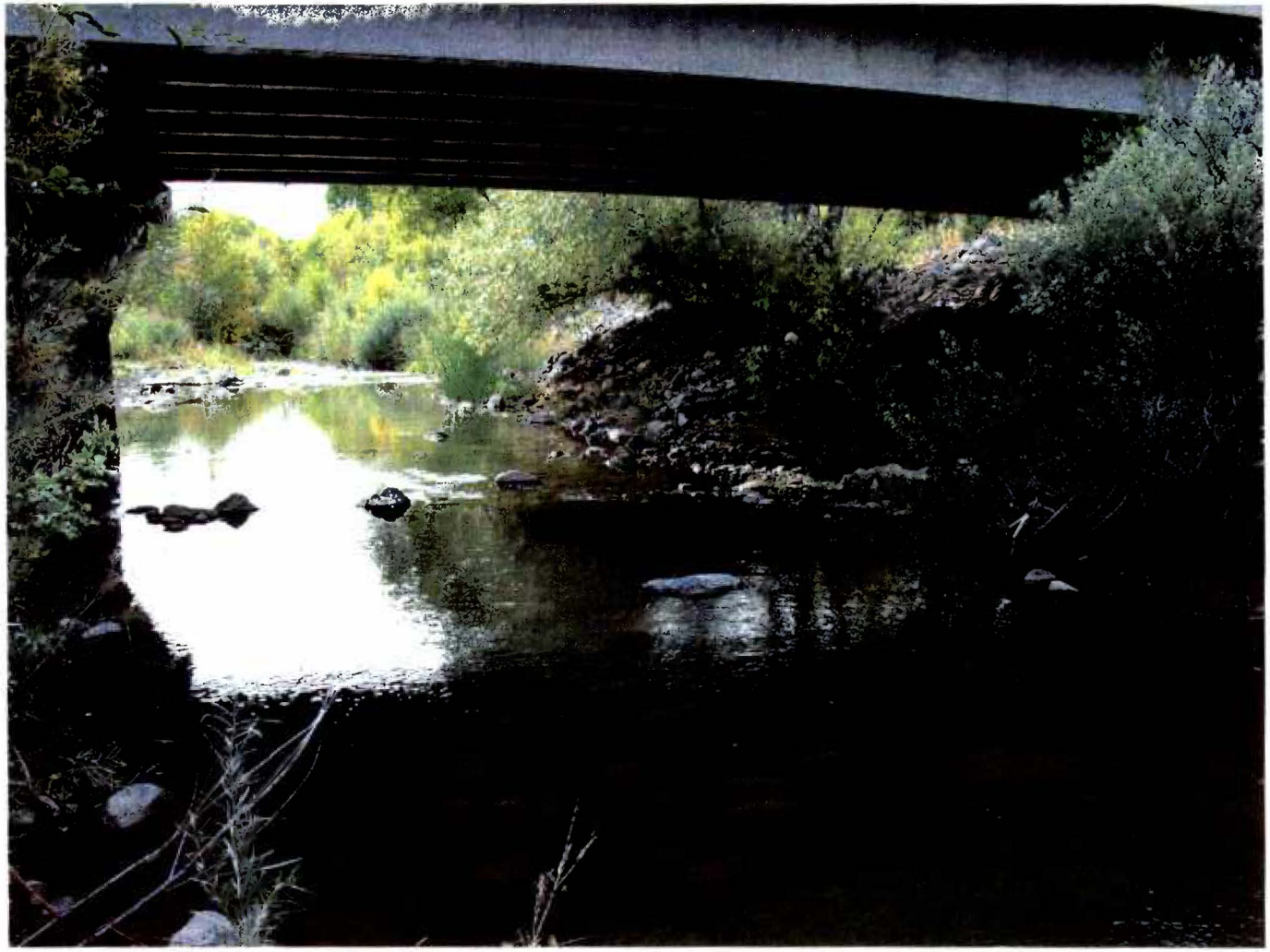
SITE 15.10.29.2003_043

Wet Beaver Creek upstream of the Lake Montezuma Avenue Bridge

From downstream of the cross section on the right channel, on the left bank, looking to the right bank.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1500 hrs

13-84



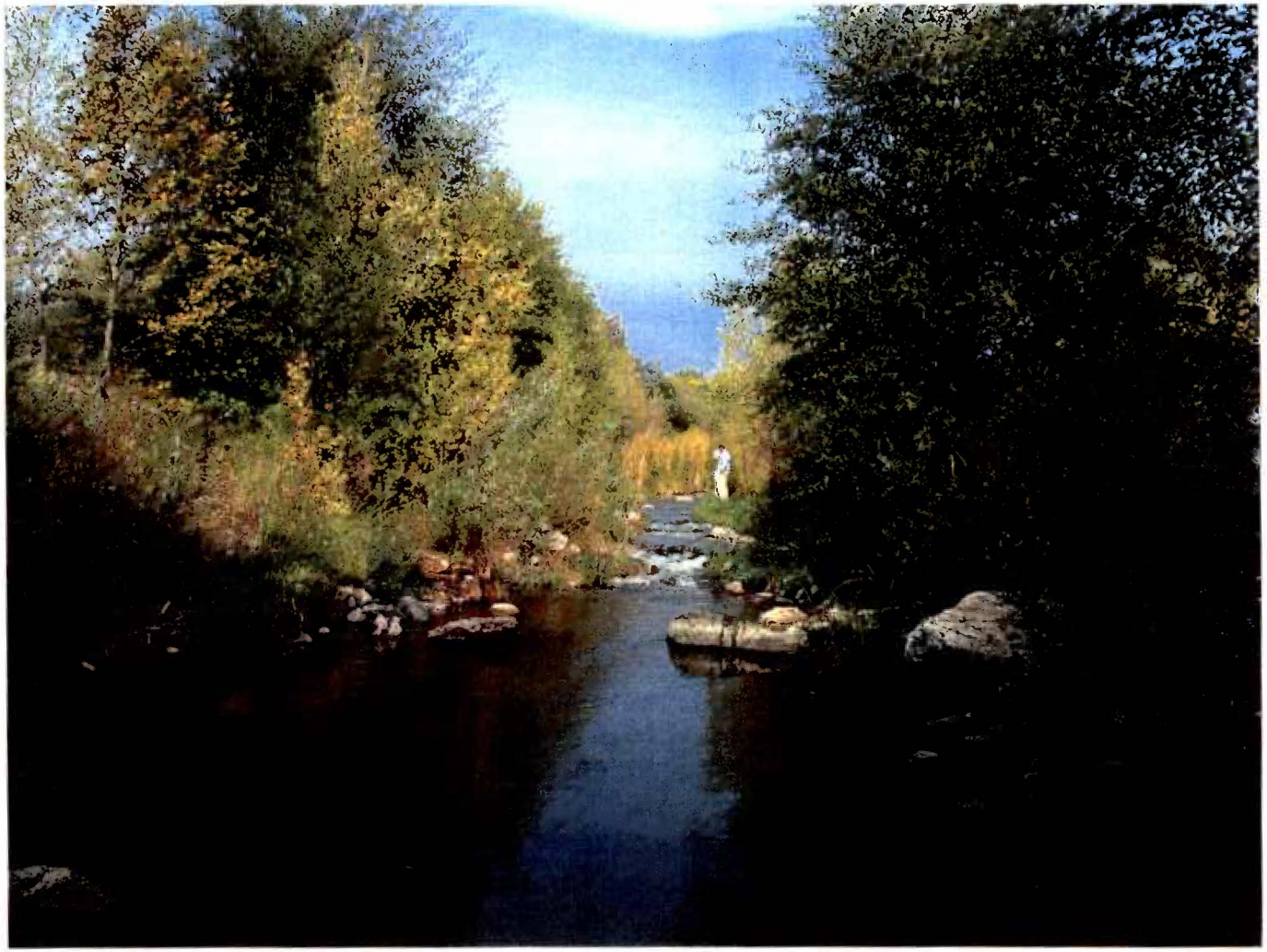
SITE 15.10.29.2003_044

Wet Beaver Creek upstream of the Lake Montezuma Avenue Bridge

From downstream of the cross section on the right channel looking downstream.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1500 hrs

13-90



13-91

SITE 15.10.29.2003_045

Wet Beaver Creek upstream of the Lake Montezuma Avenue Bridge

From downstream of the cross section on the right channel looking upstream. Jim Harte (NPS, WRD, Fort Collins, Co.) and John Ward (Ward Ground Water, Tucson, Az.) standing on the left bank at the cross section.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1502 hrs



SITE 15.10.29.2003_046

Wet Beaver Creek upstream of the Lake Montezuma Avenue Bridge

From upstream of the cross section (with measuring tape) on the right channel looking downstream. A staff gage is installed upstream of the cross section on river left. John Ward (Ward Ground Water, Tucson, Az.) in the stream and Jim Harte and Carmia Fiechtner (NPS, WRD, Fort Collins, Co.) on left bank.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1519 hrs

13-92



SITE 15.10.29.2003_047

Wet Beaver Creek upstream of the Lake Montezuma Avenue Bridge

From downstream of the cross section on the right channel looking upstream. Jim Harte and Carmia Fiechtner (NPS, WRD, Fort Collins, Co.) and John Ward (Ward Ground Water, Tucson, Az.) on the left bank.

Wet Beaver Creek, Yavapai County, Az.
October 29, 2003 @ 1520 hrs

13-93

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	Post-diversion				
Station Number:	15	WIDTH	7.550	# of Sections	30
Date:	10/30/2003	AREA	6.746	Sections > 5%	6
Measurement #:	1	VELOCITY	1.243	Sections > 10%	0
Pygmy or AA (p/a)	p			*Standard Error	5.04%
Rating # (1 or 2)	2	TOTAL DISCHARGE	8.382		FAIR

Print Header

Print Full Sheet

Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	0.9	0.48	0			0.000	0.000	0.000	0.000	0.000
	1.7	0.53	0.83	3	46.67	0.093	0.093	0.093	0.436	0.040
	1.95	0.25	0.84	31	40.83	0.760	0.760	0.760	0.210	0.160
	2.2	0.25	1	50	40.79	1.208	1.208	1.208	0.250	0.302
	2.45	0.23	1.07	87	40.69	2.085	2.085	2.085	0.241	0.502
	2.65	0.20	1.04	80	40.76	1.916	1.916	1.916	0.208	0.399
	2.85	0.20	1	76	40.5	1.833	1.833	1.833	0.200	0.367
	3.05	0.20	0.99	84	40.62	2.017	2.017	2.017	0.198	0.399
	3.25	0.23	1.1	77	40.49	1.858	1.858	1.858	0.248	0.460
	3.5	0.25	1.08	80	40.83	1.913	1.913	1.913	0.270	0.516
	3.75	0.25	1.01	83	40.42	2.003	2.003	2.003	0.253	0.506
	4	0.25	1.03	80	42.19	1.852	1.852	1.852	0.258	0.477
	4.25	0.25	0.98	71	40.57	1.712	1.712	1.712	0.245	0.419
	4.5	0.25	0.92	69	40.46	1.669	1.669	1.669	0.230	0.384
	4.75	0.25	0.98	61	40.44	1.480	1.480	1.480	0.245	0.363
	5	0.25	1.01	56	40.37	1.363	1.363	1.363	0.253	0.344
	5.25	0.25	1.1	49	40.52	1.193	1.193	1.193	0.275	0.328
	5.5	0.25	1.15	50	40.73	1.210	1.210	1.210	0.288	0.348
	5.75	0.25	1.16	43	40.89	1.041	1.041	1.041	0.290	0.302
	6	0.25	1.09	50	40.96	1.204	1.204	1.204	0.273	0.328
	6.25	0.25	1.06	53	40.26	1.296	1.296	1.296	0.265	0.343
	6.5	0.23	0.87	56	40.55	1.358	1.358	1.358	0.196	0.266
	6.7	0.23	0.8	48	40.42	1.172	1.172	1.172	0.180	0.211
	6.95	0.25	0.78	38	40.64	0.929	0.929	0.929	0.195	0.181
	7.2	0.25	0.74	29	40.31	0.722	0.722	0.722	0.185	0.134
	7.45	0.25	0.8	27	40.3	0.675	0.675	0.675	0.200	0.135
	7.7	0.25	0.72	17	41.18	0.428	0.428	0.428	0.180	0.077
	7.95	0.25	0.8	10	40.92	0.266	0.266	0.266	0.200	0.053
	8.2	0.25	0.8	6	47.11	0.154	0.154	0.154	0.200	0.031
	8.45	0.13	0.62	6	47.11	0.100	0.100	0.100	0.078	0.008

B-94

1501 1

S_q	S_d	S_f	S_l	S_s	S_n	S_v
5.042849	5.7955	5.857564	3.287846	3.0056	0	1.6043

b 5.795536
c 11.0496
e
f

Select a Bed Type:
Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u
2

Select a Suspension Type:
Rod
Cable

Rod
1

b	c				
6.34741973	12.21306	5.659493	19.75176		0
6.27939798	12.07159	5.875352	1.954175		0
5.38516481	10.19804	5.876964	1.700607		0
5.08290942	9.557399	5.881005	1.443985		0
5.20710143	9.821182	5.878175	1.480953		0
5.38516481	10.19804	5.888717	1.500697		0
5.43208995	10.29711	5.883841	1.458291		0
4.9660001	9.30831	5.889124	1.494814		0
5.04316077	9.472797	5.875352	1.481703		0
5.33923227	10.10097	5.891978	1.461326		0
5.25022835	9.912598	5.821695	1.496096		0
5.48003837	10.39823	5.88587	1.531879		0
5.79110197	11.05203	5.890346	1.543588		0
5.48003837	10.39823	5.891162	1.600313		0
5.33923227	10.10097	5.89402	1.840144		0
4.9660001	9.30831	5.887903	1.707359		0
4.78576971	8.922688	5.879387	1.699876		0
4.75174416	8.849649	5.872936	1.778351		0
5.00419822	9.389782	5.870124	1.702675		0
5.1234667	9.643632	5.893525	1.665483		0
6.08518383	11.66696	5.886683	1.642284		0
6.56220237	12.65899	5.891978	1.716434		0
6.71501208	12.97558	5.88303	1.840086		0
7.04654255	13.66071	5.896476	1.984664		0
6.56220237	12.65899	5.896885	2.025583		0
7.22670801	14.03215	5.861326	2.715162		0
6.56220237	12.65899	5.87173	5.03622		0
6.56220237	12.65899	5.644642	10.28574		0
8.30881582	16.25256	5.644642	18.00728		0

# secs	5+ secs	10+ secs
1	0	0
1	0	0
1	0	0
1	0	0
1	1	0
1	0	0
1	0	0
1	0	0
1	1	0
1	1	0
1	1	0
1	1	0
1	1	0
1	0	0
1	0	0
1	0	0
1	0	0
1	0	0
1	0	0
1	0	0
1	0	0
1	0	0
1	0	0
1	0	0
1	0	0
1	0	0
1	0	0
1	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

B-95

1501 2

River at—

Angle coefficient	Dist. from initial point	Width	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
	0.90										
RR	1.70	0525	0.83		3	46.67		0.093		0.43575	0.040
	1.95	0.25	0.84		31	40.83		0.760		0.21	0.160
	2.20	0.25	1.00		50	40.79		1.21		0.25	0.302
	2.45	0.225	1.07		87	40.69		2.08		0.24075	0.502
	2.65	0.2	1.04		80	40.76		1.92		0.208	0.399
	2.85	0.2	1.00		76	40.50		1.83		0.2	0.367
	3.05	0.2	0.99		84	40.62		2.02		0.198	0.399
	3.25	0.225	1.10		77	40.49		1.86		0.2475	0.460
	3.50	0.25	1.08		80	40.83		1.91		0.27	0.516
	3.75	0.25	1.01		83	40.42		2.00		0.2525	0.506
	4.00	0.25	1.03		80	42.19		1.85		0.2575	0.477
	4.25	0.25	0.98		71	40.57		1.71		0.245	0.419
	4.50	0.25	0.92		69	40.76		1.67		0.23	0.384
	4.75	0.25	0.98		61	40.44		1.18		0.245	0.363
○	5.00	0.25	1.01		56	40.37		1.36		0.2525	0.344
	5.25	0.25	1.10		49	40.52		1.19		0.275	0.328
	5.50	0.25	1.15		50	40.73		1.21		0.2875	0.348
	5.75	0.25	1.16		43	40.89		1.04		0.29	0.302
	6.00	0.25	1.09		50	40.96		1.20		0.2725	0.328
	6.25	0.25	1.06		53	40.26		1.30		0.265	0.343
	6.50	0.225	0.87		56	40.55		1.36		0.19575	0.266
	6.70	0.225	0.80		48	40.42		1.17		0.18	0.211
	6.95	0.25	0.78		38	41.64		0.929		0.195	0.181
	7.20	0.25	0.74		29	40.31		0.722		0.185	0.134
	7.45	0.25	0.80		27	40.30		0.675		0.2	0.135
	7.70	0.25	0.72		17	41.18		0.428		0.18	0.077
	7.95	0.25	0.80		10	40.92		0.266		0.2	0.053
	8.20	0.25	0.80		6	47.11		0.154	×0.65	0.2	0.031
	8.45	0.125	0.62						↘ 0.1001	0.0775	0.008
											8.38
R.L.	8.6										

$V = 0.9604R + 0.0312$ $\Sigma 0.41$

(S-96)

LEFT CHANNEL

	DIST	W	D	REV	T	√	A	Q
RR	0.10							
	1.00	0.55	0.22	25	40.30	0.627	0.121	0.076
	1.20	0.25	0.30	33	40.45	0.815	0.075	0.061
	1.50	0.25	0.48	17	40.97	0.430	0.12	0.052
	1.70	0.20	0.29	20	42.85	0.479	0.058	0.028
	1.90	0.20	0.32	21	40.36	0.531	0.064	0.034
	2.10	0.20	0.30	8	45.47	0.200	0.06	0.012
	2.30	0.20	0.24	5	47.89	0.131	0.048	0.006
	2.50	0.40	0.20	9	43.58	0.230	0.08	0.018
	3.10							0.2870
								≈0.3 cfs
○								

6 SECTIONS - 20
ERROR: 5.04%
FAIR

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

POST-DIVERSION

Meas. No. 15-1

DATE 10/30/2003

Comp by FIECHTNER Checked by GABLE FIECHTNER

PARK MOCA STATION POST-DIVERSION, 15-1

PERSONNEL: Meter CHRIS GABLE Notes CARMIA FIECHTNER

MEASUREMENT TYPE (circle one) (Wading) Cable, Bridge, Boat, Ice; Upstr., (Dnstr.,) (10ft.) mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 1235 G.H. 0.53 Stop: 1324 G.H. 0.53

METER TYPE PYGMY S/N USGS P90223 SPIN Before Meas. 1:20 After 58

WEATHER CLEAR

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor

FLOW: Width 7.550 Area 6.746 Ave. Vel. 1.243 G.H. _____ Disch. 8.382

Method 0.6 Method coeff. ____ Hor. Angle coeff. ____ Susp. type ROD Susp. coeff. ____

Meter ____ ft. above bottom of weight No. Secs. 30 G.H. changes 0 ft. in ≈ 5/6 hrs.

FLOW VARIED, NON-UNIFORM, TURBULENT

Cross Section NON-UNIFORM, ROUGH, COBBLE & BOULDER

CONTROL STEP POOL, RIFFLE ≈ 30 FT D.S.
* SLIGHT ALGAE ON ROCKS
* VEGETATION ON BANKS, NEED A COEFFICIENT (ASSUMED 0.65)

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 24.8 (C) F° Wate (C) F°

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

B-96a

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS _____

*LOOK UP COEFFICIENT FOR LAST VERTICAL

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	Post-diversion				
Station Number:	15	WIDTH	7.550	# of Sections	31
Date:	10/30/2003	AREA	6.386	Sections > 5%	6
Measurement #:	2	VELOCITY	1.200	Sections > 10%	0
Pygmy or AA (p/a)	p			*Standard Error	4.74%
Rating # (1 or 2)	2	TOTAL DISCHARGE	7.665		GOOD

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uniform, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	0.9	0.40	0			0.000	0.000	0.000	0.000	0.000
	1.7	0.53	0.82	2	40.43	0.079	0.079	0.079	0.431	0.034
	1.95	0.23	0.82	23	40.43	0.578	0.578	0.578	0.185	0.107
	2.15	0.20	0.93	53	40.4	1.291	1.291	1.291	0.186	0.240
	2.35	0.20	1	71	41.91	1.658	1.658	1.658	0.200	0.332
	2.55	0.20	1.01	88	40.93	2.096	2.096	2.096	0.202	0.423
	2.75	0.20	1.11	85	40.47	2.048	2.048	2.048	0.222	0.455
	2.95	0.20	0.98	87	40.56	2.091	2.091	2.091	0.196	0.410
	3.15	0.20	0.98	83	40.33	2.008	2.008	2.008	0.196	0.394
	3.35	0.20	1.1	66	40.33	1.603	1.603	1.603	0.220	0.353
	3.55	0.20	1.07	79	40.5	1.905	1.905	1.905	0.214	0.408
	3.75	0.20	1.05	73	40.54	1.761	1.761	1.761	0.210	0.370
	3.95	0.20	1.01	73	40.4	1.767	1.767	1.767	0.202	0.357
	4.15	0.20	0.94	72	40.6	1.734	1.734	1.734	0.188	0.326
	4.35	0.20	0.88	64	40.4	1.553	1.553	1.553	0.176	0.273
	4.55	0.23	0.82	58	40.33	1.412	1.412	1.412	0.185	0.261
	4.8	0.25	0.82	48	40	1.184	1.184	1.184	0.205	0.243
	5.05	0.25	0.87	39	40.27	0.961	0.961	0.961	0.218	0.209
	5.3	0.25	0.98	39	40.38	0.959	0.959	0.959	0.245	0.235
	5.55	0.25	1.08	35	40.4	0.863	0.863	0.863	0.270	0.233
	5.8	0.25	1.05	37	40.54	0.908	0.908	0.908	0.263	0.238
	6.05	0.25	1.02	56	40.51	1.359	1.359	1.359	0.255	0.347
	6.3	0.25	1	57	40.48	1.384	1.384	1.384	0.250	0.346
	6.55	0.25	0.75	51	41.04	1.225	1.225	1.225	0.188	0.230
	6.8	0.25	0.73	42	40.49	1.027	1.027	1.027	0.183	0.188
	7.05	0.25	0.71	44	41.12	1.059	1.059	1.059	0.178	0.188
	7.3	0.25	0.78	35	40.43	0.863	0.863	0.863	0.195	0.168
	7.55	0.25	0.7	38	41.49	0.911	0.911	0.911	0.175	0.159
	7.8	0.25	0.78	10	45.93	0.240	0.240	0.240	0.195	0.047
	8.05	0.33	0.73	12	43.01	0.299	0.299	0.299	0.237	0.071
	8.45	0.20	0.6	12	43.01	0.194	0.194	0.194	0.120	0.023

B-97

1502 1

S_o	S_d	S_i	S_r	S_c	S_n	S_v
4.740828	6.0233	5.87246	2.847697	2.9839	0	1.5587

b 6.023306
c 11.5262
e
f

Select a Soil Type:
- Stable (even, firm, smooth)
- Stable (uneven, gravel-boulders)
- Soft (mud, silt)
- Moble (shifting sand, dunes)
- Stable (high velocity and VERTICAL angles)
- Unstable (high velocity and VERTICAL angles)

Stable (u
2

Select a Suspension Type:
- Rod
- Cable

Rod
1

b	c				# secs	5+ secs	10+ secs
					1	0	0
6.41718395	12.35803	5.89157	24.5137	0	1	0	0
6.41718395	12.35803	5.89157	2.122238	0	1	0	0
5.7362946	10.93711	5.892795	1.667176	0	1	0	0
5.38516481	10.19804	5.832559	1.546607	0	1	0	0
5.33923227	10.10097	5.871329	1.44162	0	1	1	0
4.92854551	9.228339	5.889939	1.451615	0	1	1	0
5.48003837	10.39823	5.886277	1.44262	0	1	1	0
5.48003837	10.39823	5.895657	1.460365	0	1	1	0
4.9660001	9.30831	5.895657	1.562432	0	1	0	0
5.08290942	9.557399	5.888717	1.483656	0	1	1	0
5.16485595	9.731544	5.88709	1.519062	0	1	0	0
5.33923227	10.10097	5.892795	1.517514	0	1	0	0
5.68272341	10.82467	5.884652	1.525913	0	1	0	0
6.02354197	11.53829	5.892795	1.577439	0	1	0	0
6.41718395	12.35803	5.895657	1.622881	0	1	0	0
6.41718395	12.35803	5.909235	1.711206	0	1	0	0
6.08518383	11.66696	5.898115	1.821433	0	1	0	0
5.48003837	10.39823	5.893612	1.822876	0	1	0	0
5.04316077	9.472797	5.892795	1.881198	0	1	0	0
5.16485595	9.731544	5.88709	1.853039	0	1	0	0
5.29426289	10.00584	5.88831	1.641809	0	1	0	0
5.38516481	10.19804	5.889531	1.632957	0	1	0	0
6.96020434	13.4825	5.866918	1.693814	0	1	0	0
7.1353428	13.84386	5.889124	1.785454	0	1	0	0
7.32074686	14.2258	5.86372	1.769377	0	1	0	0
6.71501208	12.97558	5.89157	1.881602	0	1	0	0
7.41757428	14.42503	5.849031	1.851158	0	1	0	0
6.71501208	12.97558	5.684877	5.744612	0	1	0	0
7.1353428	13.84386	5.790401	4.320907	0	1	0	0
8.56997342	16.78624	5.790401	7.564628	0	1	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0

B-94

1502 2

River at—

Angle coefficient	Dist. from initial point		Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
RR	0.90										
	1.70	0.525	0.82		2	40.43		0.079		0.4305	0.034
	1.95	0.225	0.82		23	40.43		0.578		0.1845	0.107
	2.15	0.2	0.93		53	40.40		1.291		0.186	0.240
	2.35	0.2	1.00		71	41.91		1.658		0.2	0.332
	2.55	0.2	1.01		88	40.93		2.096		0.202	0.423
	2.75	0.2	1.11		85	40.47		2.048		0.222	0.455
	2.95	0.2	0.98		87	40.56		2.091		0.196	0.410
	3.15	0.2	0.98		83	40.33		2.008		0.196	0.394
	3.35	0.2	1.10		66	40.33		1.603		0.22	0.353
	3.55	0.2	1.07		79	40.50		1.905		0.214	0.408
	3.75	0.2	1.05		73	40.54		1.761		0.21	0.370
	3.95	0.2	1.01		73	40.40		1.767		0.202	0.357
	4.15	0.2	0.94		72	40.60		1.734		0.188	0.326
○	4.35	0.2	0.88		64	40.40		1.553		0.176	0.273
	4.55	0.225	0.82		58	40.33		1.412		0.1845	0.261
	4.80	0.25	0.82		48	40.00		1.184		0.205	0.243
	5.05	0.25	0.87		39	40.27		0.961		0.2175	0.209
	5.30	0.25	0.98		39	40.38		0.959		0.245	0.235
	5.55	0.25	1.08		35	40.40		0.863		0.27	0.233
	5.80	0.25	1.05		37	40.54		0.908		0.2625	0.238
	6.05	0.25	1.02		56	40.51		1.359		0.255	0.347
	6.30	0.25	1.00		57	40.48		1.384		0.25	0.346
	6.55	0.25	0.75		51	41.04		1.225		0.1875	0.230
	6.80	0.25	0.73		42	40.49		1.027		0.1825	0.188
	7.05	0.25	0.71		44	41.12		1.059		0.1775	0.188
	7.30	0.25	0.78		35	40.43		0.863		0.195	0.168
	7.55	0.25	0.70		38	41.49		0.911		0.175	0.159
	7.80	0.25	0.78		10	45.93		0.240		0.195	0.047
	8.05	0.325	0.73		12	43.01		0.299	x 0.65	0.23725	0.071
	8.45	0.20	0.60						→ 0.194	0.12	0.023
											~~7.67~~ 7.665

66-27

1502 3

5 SECTIONS - 32.
ER: R: 4.74%
G

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

POST-DIVERSION

Meas. No. 15-2

DATE 10/30/2003

Comp by FIECHTNER Checked by GABLE FIECHTNER

PARK MOCA STATION POST-DIVERSION, 15-2

PERSONNEL: Meter CHRIS GABLE Notes CARMIA FIECHTNER

MEASUREMENT TYPE (circle one) (Wading), Cable, Bridge, Boat, Ice; Upstr., Dnstr., 10 (ft), mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 1433 G.H. 0.51 Stop: 1514 G.H. 0.48

METER TYPE PYGMY S/N USGS P90223 SPIN Before Meas. 125 After 115

WEATHER CLEAR, BREEZY

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor

FLOW: Width 7.550 Area 6.386 Ave. Vel. 1.200 G.H. _____ Disch. 7.665

Method 0.6 Method coeff. _____ Hor. Angle coeff. _____ Susp. type ROD Susp. coeff. _____

Meter _____ ft. above bottom of weight No. Secs. 31 G.H. changes 0.03 ft. in 2 3/4 hrs.

FLOW VARIED, NON-UNIFORM TURBULENT

Cross Section NON-UNIFORM, ROUGH, COBBLE & BOULDER

CONTROL STEP POOL, RIFFLE 230 ft. D.S.
- SLIGHT ALGAE ON ROCKS
- VEGETATION ON BANKS, ASSUME COEFFICIENT OF 0.65

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 21.0 (C) F° Water 16.7 (C) F°

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

B-99a

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS _____

*LOOK UP COEFFICIENT FOR LAST VERTICAL

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

SITE 13

1616 MST 10-28-2003

SITE DESCRIPTION:

GPS: #21 12S 0426763 UTM 3831986

ACCURACY: 16 ft

- SITE 13 IS ON WET BEAVER CREEK ON USFS LAND, SURROUNDED BY PRIVATE PROPERTY
- THIS SITE IS PROBABLY D.S. OF SITE 7
- STAFF IS 25 ~~20~~ ft U.S. OF CROSS SECTION ON RIVER ~~RIGHT~~ LEFT
- CROSS SECTION ≈ 5ft WIDE
- STAFF GAGE READING: 0.49 ~~ft~~
- NEAR WHITE PILLARED HOUSE (AKA "TEENAGERS")

B-100

PHOTOS: Folder: SITE 13 Whitehouse: Photos:

ACCESS: PARK NEAR WHITE-PILLARED HS (WHERE PERMISSION FOR TRESPASSING WAS GRANTED) Linda

- TAKE PATH TOWARDS CREEK THAT LINES UP DIRECTLY WITH HOUSE'S ENTRANCE PATH
- GO NORTH ~~BETWEEN TWO~~ ALONG PATH (LEFT) UNTIL A BULL-DOZED PATH APPEARS WHICH LEADS TO SITE 13



SITE 13.10.28.2003_014

Wet Beaver Creek at the white house boarding school

From upstream of the cross section, with measuring tape, looking downstream.

Wet Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1523 hrs



SITE 13.10.28.2003_015

Wet Beaver Creek at the white house boarding school

From upstream of the cross section, with measuring tape, looking downstream.

Wet Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1524 hrs

13-102



SITE 13.10.28.2003_016

Wet Beaver Creek at the white house boarding school

From downstream of the cross section, with measuring tape, looking upstream. Jim Harte (NPS, WRD, Fort Collins, Co.) on left bank.

Wet Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1525 hrs

B-103



SITE 13.10.28.2003_019

Wet Beaver Creek at the white house boarding school

From upstream of the cross section looking at staff gage installed on river left with Jim Harte (NPS, WRD, Fort Collins, Co.).

Wet Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1531 hrs

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	13				
Station Number:	13	WIDTH	5.900	# of Sections	27
Date:	10/30/2003	AREA	4.586	Sections > 5%	8
Measurement #:	1	VELOCITY	1.495	Sections > 10%	2
Pygmy or AA (p/a)				*Standard Error	4.61%
Rating # (1 or 2)	2	TOTAL DISCHARGE	6.858		GOOD

Print Header

Print Full Sheet

Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uniform, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	0.5	0.10	0			0.000	0.000	0.000	0.000	0.000
	0.7	0.20	0.63	7	43	0.188	0.188	0.188	0.126	0.024
	0.9	0.20	0.63	11	42.7	0.279	0.279	0.279	0.126	0.035
	1.1	0.20	0.68	16	42.3	0.394	0.394	0.394	0.136	0.054
	1.3	0.20	0.69	14	45	0.330	0.330	0.330	0.138	0.046
	1.5	0.20	0.69	16	42	0.397	0.397	0.397	0.138	0.055
	1.7	0.20	0.8	20	40.3	0.508	0.508	0.508	0.160	0.081
	1.9	0.20	0.82	34	40.4	0.839	0.839	0.839	0.164	0.138
	2.1	0.20	0.78	40	40	0.992	0.992	0.992	0.156	0.155
	2.3	0.20	0.97	43	40.4	1.053	1.053	1.053	0.194	0.204
	2.5	0.20	1	51	40.2	1.250	1.250	1.250	0.200	0.250
	2.7	0.20	1.02	62	40.1	1.516	1.516	1.516	0.204	0.309
	2.9	0.20	1.1	69	40.3	1.676	1.676	1.676	0.220	0.369
	3.1	0.20	1.1	86	40.2	2.086	2.086	2.086	0.220	0.459
	3.3	0.20	1.21	119	40.3	2.867	2.867	2.867	0.242	0.694
	3.5	0.20	1.22	124	40.3	2.986	2.986	2.986	0.244	0.729
	3.7	0.20	1.2	115	40.4	2.765	2.765	2.765	0.240	0.664
	3.9	0.20	1.12	73	40.3	1.771	1.771	1.771	0.224	0.397
	4.1	0.20	1.1	57	40.5	1.383	1.383	1.383	0.220	0.304
	4.3	0.20	0.95	70	40.5	1.691	1.691	1.691	0.190	0.321
	4.5	0.20	1.1	87	40.1	2.115	2.115	2.115	0.220	0.465
	4.7	0.20	0.9	97	40.3	2.343	2.343	2.343	0.180	0.422
	4.9	0.20	0.89	71	40.1	1.732	1.732	1.732	0.178	0.308
	5.1	0.20	0.88	51	40.6	1.238	1.238	1.238	0.176	0.218
	5.3	0.25	0.5	31	41	0.757	0.757	0.757	0.125	0.095
	5.6	0.55	0.3	15	40.2	0.390	0.390	0.390	0.165	0.064
	5.4	0.40	0	0	0	0.000	0.000	0.000	0.000	0.000

13-105

1301 1

S_q	S_d	S_i	S	S_s	S_h	S_v
4.608218	6.5585	5.874991	2.244291	3.0788		0 1.7602

b	6.558468
c	12.60552
e	
f	

Select a Bed Type:

Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u
2

Select a Suspension Type:

Rod
Cable

Rod
1

b	c				# secs	5+ secs	10+ secs
					1	0	0
8.18462939	15.99852	5.790778	7.928807	0	1	0	0
8.18462939	15.99852	5.802141	4.739659	0	1	0	0
7.62008818	14.84126	5.817452	3.015933	0	1	0	0
7.51731181	14.6301	5.717532	3.803554	0	1	0	0
7.51731181	14.6301	5.829057	2.990336	0	1	0	0
6.56220237	12.65899	5.896885	2.20576	0	1	0	0
6.41718395	12.35803	5.892795	1.897024	0	1	0	0
6.71501208	12.97558	5.909235	1.804561	0	1	0	0
5.52904196	10.50149	5.892795	1.772122	0	1	0	0
5.38516481	10.19804	5.900989	1.683602	0	1	0	0
5.29426289	10.00584	5.905106	1.583742	0	1	0	0
4.9660001	9.30831	5.896885	1.541788	0	1	1	0
4.9660001	9.30831	5.900989	1.443748	0	1	1	0
4.59078821	8.50302	5.896885	1.312317	0	1	1	1
4.56032456	8.437194	5.896885	1.296383	0	1	1	1
4.62180821	8.569973	5.892795	1.326672	0	1	1	0
4.89181428	9.14983	5.896885	1.516406	0	1	1	0
4.9660001	9.30831	5.888717	1.633194	0	1	0	0
5.6303491	10.71463	5.888717	1.53751	0	1	0	0
4.9660001	9.30831	5.905106	1.437765	0	1	1	0
5.90459122	11.28968	5.896885	1.39428	0	1	1	0
5.96336076	11.41257	5.905106	1.52663	0	1	0	0
6.02354197	11.53829	5.884652	1.688484	0	1	0	0
10.198039	20.09975	5.86852	1.956512	0	1	0	0
16.7862377	33.39328	5.900989	3.06548	0	1	0	0
					1	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0

R-104

1301 2

River at—

Angle coef. ficient	Dist. from initial point		Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
	0.50										
	0.70	0.20	0.63		7	43.0	0.188			0.126	0.024
	0.90	0.20	0.63		11	42.7	0.274			0.126	0.035
	1.10	0.20	0.68		16	42.3	0.394			0.136	0.054
	1.30	0.20	0.69		14	45.0	0.330			0.138	0.046
	1.50	0.20	0.69		16	42.0	0.397			0.138	0.055
	1.70	0.20	0.80		20	40.3	0.508			0.160	0.081
	1.90	0.20	0.82		34	41.4	0.839			0.164	0.138
	2.10	0.20	0.78		40	40.0	0.992			0.156	0.155
	2.30	0.20	0.97		43	40.4	1.053			0.194	0.204
	2.50	0.20	1.00		51	40.2	1.250			0.200	0.250
	2.70	0.20	1.02		62	40.1	1.516			0.204	0.309
	2.90	0.20	1.10		69	40.3	1.676			0.220	0.369
	3.10	0.20	1.10		86	40.2	2.086			0.220	0.459
⊙	3.30	0.20	1.21		119	40.3	2.867			0.242	0.694
	3.50	0.20	1.22		124	40.3	2.996			0.244	0.729
	3.70	0.20	1.20		115	40.4	2.765			0.240	0.664
	3.90	0.20	1.12		73	40.3	1.771			0.224	0.399
	4.10	0.20	1.10		57	40.5	1.383			0.220	0.304
	4.30	0.20	0.95		70	40.5	1.691			0.190	0.321
	4.50	0.20	1.10		67	40.1	2.115			0.220	0.465
	4.70	0.20	0.90		99	40.3	2.343			0.180	0.422
	4.90	0.20	0.89		91	40.1	1.732			0.178	0.308
	5.10	0.20	0.88		51	40.6	1.238			0.176	0.218
	5.30	0.25	0.50		31	41.0	0.757			0.125	0.095
	5.60	0.55	0.30		15	40.2	0.390			0.165	0.064
	6.40										
											6,858

.0 .10 .20 .30 .40 .50 .60 .70 .75

.80 .85 .90 .92 .94 .96 .97 .98 .99 1.00 .99 .98 .97 .96 .94 .92 .90 .85 .80

.0 .10 .20 .30 .40 .50 .60 .70 .75

.80 .85 .90 .92 .94 .96 .97 .98 .99 1.00 .99 .98 .97 .96 .94 .92 .90 .85 .80

.0 .10 .20 .30 .40 .50 .60 .70 .75

1301 3

2 SECTIONS >10%
8 SECTIONS > 5%
ER 4.61
GOOD

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 1

DATE 10/30/03 Comp by VBartling Checked by FIECHTNER

PARK MOCA/MOWE STATION #7C13)

PERSONNEL: Meter J. ALBRIGHT Notes V.BARTLING

MEASUREMENT TYPE (circle one) (Wading) Cable, Bridge, Boat, Ice; Upstr., (Dnstr.) 25 (ft.) mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 1250 G.H. 0.55 Stop: 1335 G.H. 0.57-0.58

METER TYPE Price AA S/N aquaCount SPIN Before Meas. 1:26 / After 1:36

WEATHER Sunny WINDY - Hi scattered clouds

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor

FLOW: Width 5.900 Area 4.586 Ave. Vel. 1.495 G.H. _____ Disch. 6.858

Method 0.6 Method coeff. ____ Hor. Angle coeff. ____ Susp. type _____ Susp. coeff. ____

Meter _____ ft. above bottom of weight No. Secs. 27 G.H. changes +0.2-0.3 ft. in 3/4 hrs.

FLOW STEADY / UNIFORM / LAMINAR - TURBID - SLIGHTLY RISING STAGE

Cross Section UNIFORM / COBLE BED / MOD. ROUGH

CONTROL STABLE CHANNEL CONTROLLED BY COBLE BED

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 73 C (F°) Water 59.4 C (F°)

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

B-107a

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS INSIGNIFICANT AMT. WATER BEYOND REW.

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	13				
Station Number:	13	WIDTH	5.900	# of Sections	27
Date:	10/30/2003	AREA	4.523	Sections > 5%	8
Measurement #:	2	VELOCITY	1.415	Sections > 10%	2
Pygmy or AA (p/a)	p			*Standard Error	4.62%
Rating # (1 or 2)	2	TOTAL DISCHARGE	6.400		GOOD

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	0.5	0.10	0			0.000	0.000	0.000	0.000	0.000
	0.7	0.20	0.63	7	42.7	0.189	0.189	0.189	0.126	0.024
	0.9	0.20	0.62	12	44.2	0.292	0.292	0.292	0.124	0.036
	1.1	0.20	0.68	16	42.2	0.395	0.395	0.395	0.136	0.054
	1.3	0.20	0.68	15	40.2	0.390	0.390	0.390	0.136	0.053
	1.5	0.20	0.66	17	40.1	0.438	0.438	0.438	0.132	0.058
	1.7	0.20	0.79	21	41.1	0.522	0.522	0.522	0.158	0.082
	1.9	0.20	0.8	32	40.5	0.790	0.790	0.790	0.160	0.126
	2.1	0.20	0.91	29	40.5	0.719	0.719	0.719	0.182	0.131
	2.3	0.20	0.93	37	40.1	0.917	0.917	0.917	0.186	0.171
	2.5	0.20	1	57	40.2	1.393	1.393	1.393	0.200	0.279
	2.7	0.20	0.98	63	40.5	1.525	1.525	1.525	0.196	0.299
	2.9	0.20	1.02	66	40	1.616	1.616	1.616	0.204	0.330
	3.1	0.20	1.1	80	40	1.952	1.952	1.952	0.220	0.429
	3.3	0.20	1.25	121	40.3	2.915	2.915	2.915	0.250	0.729
	3.5	0.20	1.25	124	40.2	2.994	2.994	2.994	0.250	0.748
	3.7	0.20	1.18	93	40.2	2.253	2.253	2.253	0.236	0.532
	3.9	0.20	1.18	71	40.1	1.732	1.732	1.732	0.236	0.409
	4.1	0.20	0.98	57	40.2	1.393	1.393	1.393	0.196	0.273
	4.3	0.20	0.95	66	40.3	1.604	1.604	1.604	0.190	0.305
	4.5	0.20	0.98	90	40.2	2.181	2.181	2.181	0.196	0.428
	4.7	0.20	0.9	93	40.3	2.248	2.248	2.248	0.180	0.405
	4.9	0.20	0.88	55	40	1.352	1.352	1.352	0.176	0.238
	5.1	0.20	0.9	33	40.2	0.820	0.820	0.820	0.180	0.148
	5.3	0.25	0.43	23	41.9	0.558	0.558	0.558	0.108	0.060
	5.6	0.55	0.3	13	40.9	0.336	0.336	0.336	0.165	0.056
	6.4	0.40	0	0	0	0.000	0.000	0.000	0.000	0.000

13-108

1302 1

S_o	S_d	S_i	S_r	S_s	S_n	S_a
4.616514	6.672	5.881861	2.248271	3.0788	0	1.7602

b	6.672046
c	12.83915
e	
f	

Select a Bed Type:
- Stable (even, firm, smooth)
- Stable (uneven, gravel-boulders)
- Soft (mud, silt)
- Moble (shifting sand, dunes)
- Stable (high velocity and VERTICAL angles)
- Unstable (high velocity and VERTICAL angles)

Stable (u
2

Select a Suspension Type:
- Rod
- Cable

Rod
1

b	c				# secs	5+ secs	10+ secs	
						1	0	0
8.18462939	15.99852	5.802141	7.86884		0	1	0	0
8.30881582	16.25256	5.746321	4.460225		0	1	0	0
7.62008818	14.84126	5.821308	3.007398		0	1	0	0
7.62008818	14.84126	5.900989	3.06548		0	1	0	0
7.83531128	15.28295	5.905106	2.629496		0	1	0	0
6.63759618	12.81525	5.864519	2.187724		0	1	0	0
6.56220237	12.65899	5.888717	1.931873		0	1	0	0
5.84716656	11.16953	5.888717	1.987344		0	1	0	0
5.7362946	10.93711	5.905106	1.847189		0	1	0	0
5.38516481	10.19804	5.900989	1.629637		0	1	0	0
5.48003837	10.39823	5.888717	1.585909		0	1	0	0
5.29426289	10.00584	5.909235	1.55866		0	1	1	0
4.9660001	9.30831	5.909235	1.472748		0	1	1	0
4.47213595	8.246211	5.896885	1.305842		0	1	1	1
4.47213595	8.246211	5.900989	1.295428		0	1	1	1
4.68557475	8.707379	5.900989	1.410727		0	1	1	0
4.68557475	8.707379	5.905106	1.52663		0	1	1	0
5.48003837	10.39823	5.900989	1.629637		0	1	0	0
5.6303491	10.71463	5.896885	1.56209		0	1	0	0
5.48003837	10.39823	5.900989	1.424475		0	1	1	0
5.90459122	11.28968	5.896885	1.411764		0	1	1	0
6.02354197	11.53829	5.909235	1.644385		0	1	0	0
5.90459122	11.28968	5.900989	1.910706		0	1	0	0
11.7986533	23.34166	5.832949	2.143836		0	1	0	0
16.7862377	33.39328	5.872534	3.708739		0	1	0	0
						1	0	0
						0	0	0
						0	0	0
						0	0	0
						0	0	0
						0	0	0
						0	0	0
						0	0	0
						0	0	0
						0	0	0
						0	0	0
						0	0	0

B-109

1302 2

River at—

Angle coefficient	Dist. from initial point	.n	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
REW 1435	0.50										
	0.70	0.20	0.63		7	42.7	0.189			0.126	0.024
	0.90	0.20	0.62		12	44.2	0.292			0.124	0.036
	1.10	0.20	0.68		16	42.2	0.395			0.136	0.0537
	1.30	0.20	0.68		15	40.2	0.390			0.136	0.0530
	1.50	0.20	0.66		17	401	0.438			0.132	0.058
	1.70	0.20	0.79		21	41.1	0.522			0.158	0.082
	1.90	0.20	0.80		32	40.5	0.790			0.160	0.126
	2.10	0.20	0.91		29	40.5	0.719			0.182	0.131
	2.30	0.20	0.93		37	40.1	0.917			0.186	0.171
	2.50	0.20	1.00		57	40.2	1.393			0.200	0.279
	2.70	0.20	0.98		63	40.5	1.525			0.196	0.299
	2.90	0.20	1.02		66	40.0	1.616			0.204	0.330
	3.10	0.20	1.10		80	40.0	1.952			0.220	0.429
○	3.30	0.20	1.25		121	40.3	2.915			0.250	0.729
	3.50	0.20	1.25		124	40.2	2.994			0.250	0.748
	3.70	0.20	1.18		93	40.2	2.253			0.236	0.532
	3.90	0.20	1.18		71	40.1	1.732			0.236	0.409
	4.10	0.20	0.98		57	40.2	1.393			0.196	0.273
	4.30	0.20	0.95		66	40.3	1.604			0.190	0.305
	4.50	0.20	0.98		90	40.2	2.181			0.196	0.428
	4.70	0.20	0.90		93	40.3	2.248			0.180	0.405
	4.90	0.20	0.88		55	40.0	1.352			0.176	0.238
	5.10	0.20	0.90		33	40.2	0.819			0.180	0.147
	5.30	0.25	0.48		23	41.9	0.558			0.108	0.060
	5.60	0.55	0.30		13	40.9	0.336			0.165	0.058
LEW 1520	6.40										6.400

B-110

1302 3-

2 SECTIONS >10%
8 SEC 'S >5%
ERROR 62%
GOOD

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 2

DATE 10/30/03 Comp by BARTLING Checked by FIECHTNER

PARK NOCA/MOWE STATION #7(13)

PERSONNEL: Meter J. ALBRIGHT Notes

MEASUREMENT TYPE (circle one) Wading, Cable, Bridge, Boat, Ice; Upstr., Dnstr., ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 1445 G.H. 0.58 Stop: 0.57 G.H.

METER TYPE Pygmy S/N aquacount SPIN Before Meas. 1:36 After 1:05

WEATHER

HIGH WATER MARK Gage Height of .Zero .Flow. ft.

CREST STAGE CHECKED: Yes/No READING ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor

FLOW: Width 5.900 Area 4.523 Ave. Vel. 1.415 G.H. Disch. 6.400

Method 0.6 Method coeff. Hor. Angle coeff. Susp. type Susp. coeff.

Meter ft. above bottom of weight No. Secs. 27 G.H. changes -0.01 ft. in 3/4 hrs.

FLOW

Cross Section SAME AS MEAS #1 taken today

CONTROL

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range

S/N P/N

Conversion slope Conversion offset Ex. Volt. Output Range

NITROGEN TANK PRESSURE FEED BBL RATE per. min.

INTAKE/ORIFICE CLEANED TEMPERATURE: Air 72 C° (F) Water 60.8 C° (F)

PHOTOS TAKEN: Roll(s) # Frame(s) #

B-110a

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time Samples: Yes/No Time

Method: EDI EWI Other

SEDIMENT: Yes/No Time Method: EDI EWI Other

BIOLOGICAL: Yes/No Time Type

OBSERVATIONS/COMMENTS

LEVEL NOTES

EQUIPMENT TYPE S/N

PERSONNEL: Instrument/Notes Rod

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

12 7

SITE 8 - TLY OVERCAST ≈ 80's 1346 MST 10-28-2003

SITE DESCRIPTION:

GPS: #20 12S 0424540 UTM 3832252

ACCURACY: 17 ft

- SITE 12/8 IS ON WET BEAVER CREEK ON USFS LAND, SURROUNDED BY PRIVATE PROPERTY
- ≈ 200 YDS D.S. OF SITE 8
- CROSS SECTION ≈ 6 ft WIDE
- LARGE COBBLE & BOULDER BAR RIVER LEFT
- ROCK MOUND SUPPORTS REBAR ON RIVER LEFT
- STAFF GAGE ≈ 10 ft U.S. OF CROSS SECTION ON RIVER RIGHT
- STAFF GAGE READING: ≈ 0.49 ft

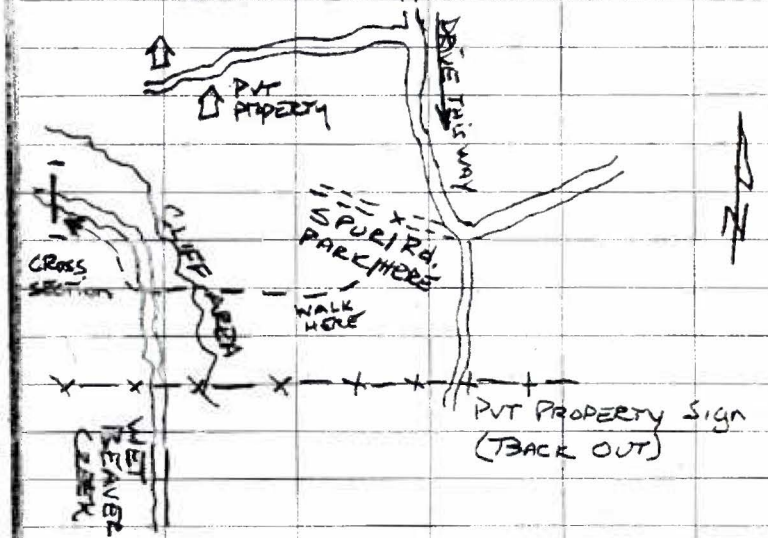
PHOTOS:

W-111-03

EXIT I-17

ACCESS: SWSE SEC 4 GAS

PARK ON A SPUR ROAD WEST SIDE OF AN INTERSECTION OF 3 ROADS



WALK WEST TO CLIFF, DROP DOWN TO RIVER, WALK ABOUT 200 YARDS DOWN STREAM OF PVT FENCE TO A RAKE ABOVE A POOL.



SITE 12.10.28.2003_008

Wet Beaver Creek upstream of cliff face on USFS at McGuireville

From cross section looking downstream toward cliff face.

Wet Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1336 hrs

B-112

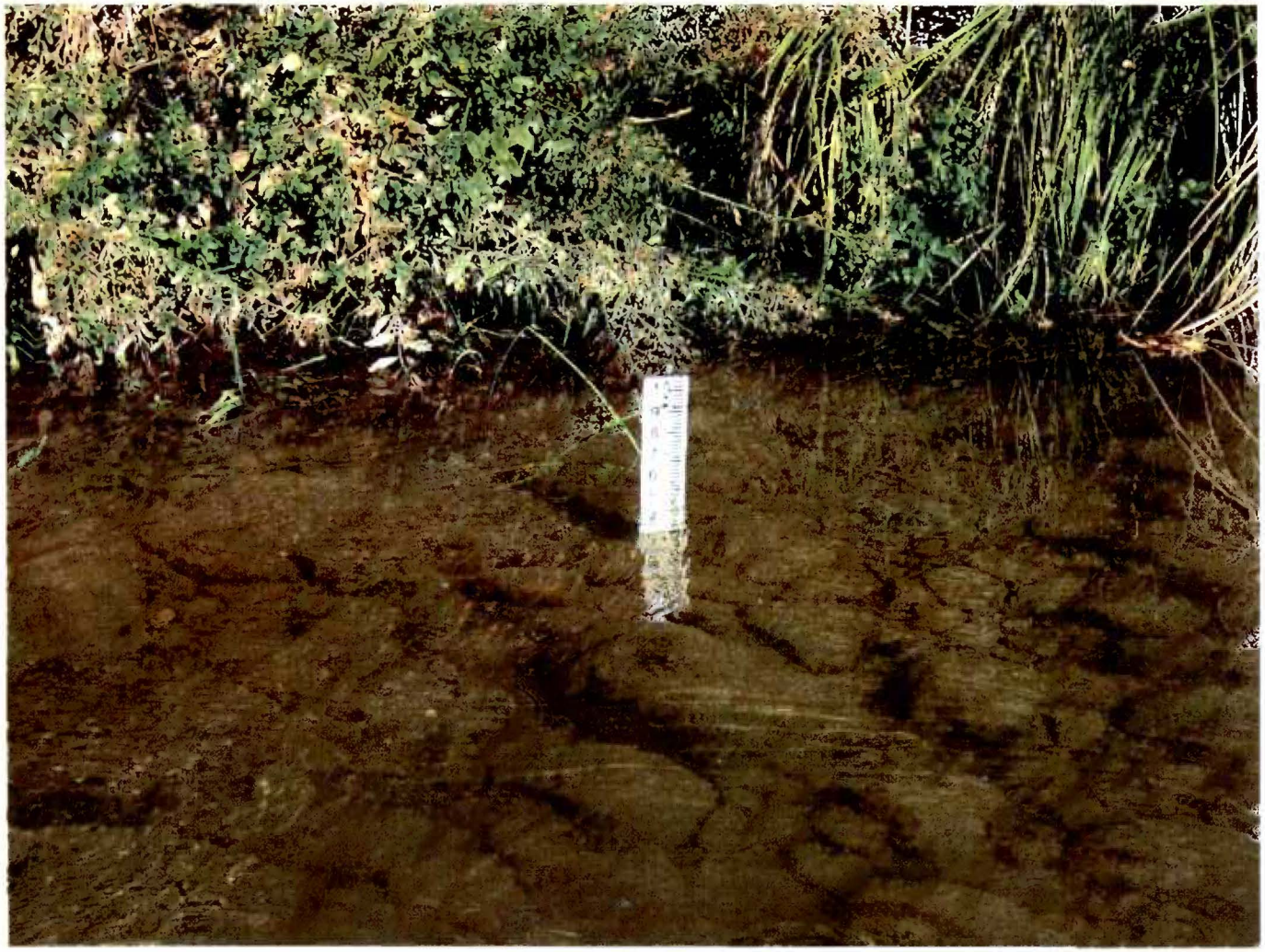


SITE 12.10.28.2003_009

Wet Beaver Creek upstream of cliff face on USFS at McGuireville

From upstream of cross section looking upstream.

Wet Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1336 hrs



SITE 12.10.28.2003_010

Wet Beaver Creek upstream of cliff face on USFS at McGuireville

From upstream of cross section looking at staff gage installed on river right.

Wet Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1343 hrs

B-114



SITE 12.10.28.2003_011

Wet Beaver Creek upstream of cliff face on USFS at McGuireville

From downstream of cross section looking upstream at cross section, with measuring tape, and staff gage installed on river right.

Wet Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1344 hrs

13-115

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	McGuireville				
Station Number:	12	WIDTH	6.500	# of Sections	33
Date:	10/30/2003	AREA	3.207	Sections > 5%	9
Measurement #:	1	VELOCITY	0.574	Sections > 10%	0
Pygmy or AA (p/a)	P			*Standard Error	5.67%
Rating # (1 or 2)	2	TOTAL DISCHARGE	1.842		FAIR

Print Header

Print Full Sheet

Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	0.2	0.10	0			0.000	0.000	0.000	0.000	0.000
	0.4	0.20	0.32	9	42.8	0.233	0.233	0.233	0.064	0.015
	0.6	0.20	0.35	7	42.8	0.188	0.188	0.188	0.070	0.013
	0.8	0.20	0.35	8	43.3	0.209	0.209	0.209	0.070	0.015
	1	0.20	0.51	26	41	0.640	0.640	0.640	0.102	0.065
	1.2	0.20	0.5	34	40.3	0.841	0.841	0.841	0.100	0.084
	1.4	0.20	0.55	47	40.3	1.151	1.151	1.151	0.110	0.127
	1.6	0.20	0.56	65	40	1.592	1.592	1.592	0.112	0.178
	1.8	0.20	0.6	62	40.4	1.505	1.505	1.505	0.120	0.181
	2	0.20	0.58	61	40.2	1.489	1.489	1.489	0.116	0.173
	2.2	0.20	0.64	40	40.1	0.989	0.989	0.989	0.128	0.127
	2.4	0.20	0.62	37	40.4	0.911	0.911	0.911	0.124	0.113
	2.6	0.20	0.6	31	40.2	0.772	0.772	0.772	0.120	0.093
	2.8	0.20	0.62	17	42	0.420	0.420	0.420	0.124	0.052
	3	0.20	0.66	9	41.3	0.240	0.240	0.240	0.132	0.032
	3.2	0.20	0.66	10	40	0.271	0.271	0.271	0.132	0.036
	3.4	0.20	0.67	19	40.7	0.480	0.480	0.480	0.134	0.064
	3.6	0.20	0.64	26	41	0.640	0.640	0.640	0.128	0.082
	3.8	0.20	0.67	30	40.9	0.736	0.736	0.736	0.134	0.099
	4	0.20	0.67	30	40.7	0.739	0.739	0.739	0.134	0.099
	4.2	0.20	0.59	20	41.9	0.490	0.490	0.490	0.118	0.058
	4.4	0.20	0.52	14	42.7	0.346	0.346	0.346	0.104	0.036
	4.6	0.20	0.53	12	41	0.312	0.312	0.312	0.106	0.033
	4.8	0.20	0.54	9	41.3	0.240	0.240	0.240	0.108	0.026
	5	0.20	0.44	8	44.3	0.205	0.205	0.205	0.088	0.018
	5.2	0.20	0.44	6	40.5	0.173	0.173	0.173	0.088	0.015
	5.4	0.20	0.41	4	44	0.119	0.119	0.119	0.082	0.010
	5.6	0.20	0.41	0	60	0.000	0.000	0.000	0.082	0.000
	5.8	0.20	0.37	0	60	0.000	0.000	0.000	0.074	0.000
	6	0.20	0.35	0	60	0.000	0.000	0.000	0.070	0.000
	6.2	0.20	0.35	0	60	0.000	0.000	0.000	0.070	0.000
	6.4	0.25	0.25	0	60	0.000	0.000	0.000	0.063	0.000
	6.7	0.15	0	0	0	0.000	0.000	0.000	0.000	0.000

B-116

1201 1

S_1	S_2	S_3	S_4	S_5	S_6	S_7
5.671583	10.51	5.763158	4.019276	2.9442	0	1.4752

b	10.6096
c	20.91474
e	
f	

Select a Bed Type:

Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u

2

Select a Suspension Type:

Rod
Cable

Rod

1

b	c				# secs	5+ secs	10+ secs
					1	0	0
15.75248	31.31393	5.798342	5.974596	0	1	0	0
14.4250349	28.64134	5.798342	7.888833	0	1	0	0
14.4250349	28.64134	5.779516	6.902758	0	1	0	0
10.0058422	19.70958	5.86852	2.057647	0	1	0	0
10.198039	20.09975	5.896885	1.895667	0	1	0	0
9.30830963	18.29149	5.896885	1.725518	0	1	1	0
9.14982993	17.96879	5.909235	1.565676	0	1	1	0
8.56997342	16.78624	5.892795	1.592225	0	1	1	0
8.84964915	17.35699	5.900989	1.597518	0	1	1	0
8.06443775	15.75248	5.905106	1.805871	0	1	1	0
8.30881582	16.25256	5.892795	1.851183	0	1	1	0
8.56997342	16.78624	5.900989	1.945449	0	1	1	0
8.30881582	16.25256	5.829057	2.780405	0	1	0	0
7.83531128	15.28295	5.856553	5.738796	0	1	0	0
7.83531128	15.28295	5.909235	4.906342	0	1	0	0
7.72603979	15.05878	5.8806	2.339729	0	1	0	0
8.06443775	15.75248	5.86852	2.057647	0	1	0	0
7.72603979	15.05878	5.872534	1.973655	0	1	1	0
7.72603979	15.05878	5.8806	1.970877	0	1	1	0
8.70737865	17.06674	5.832949	2.277299	0	1	0	0
9.82118228	19.33449	5.802141	3.575234	0	1	0	0
9.6436323	18.97363	5.86852	4.08613	0	1	0	0
9.47279695	18.62621	5.856553	5.738796	0	1	0	0
11.5382941	22.8151	5.742686	7.078916	0	1	0	0
11.5382941	22.8151	5.888717	8.77432	0	1	0	0
12.3580338	24.47211	5.753622	14.40009	0	1	0	0
12.3580338	24.47211	5.27504			1	0	0
13.6607118	27.10093	5.27504			1	0	0
14.4250349	28.64134	5.27504			1	0	0
14.4250349	28.64134	5.27504			1	0	0
20.0997512	40.04997	5.27504			1	0	0
					1	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0

River at—

Angle coefficient	Dist. from initial point		Depth	Observation depth	Revolutions	Time in seconds	VELOCITY (FPS) At point (FPS)	VELOCITY (FPS) Mean in vertical	Adjusted for hor. angle or	Area	Discharge	
REW	0.2	0.10 .20	0	.6	0		0				0	SLOPING BANK
	.4	0.20	.32		9	42.8	.233			.064	.015	.85
	.6		.35		7	42.8	.188			.07	.013	
	.8		.35		8	43.3	.209			.07	.015	.90
	1.0		.51		26	41.0	.640			.102	.065	
	1.2		.50		34	40.3	.841			.10	.084	.92
	1.4		.55		47	40.3	1.151			.11	.127	.94
	1.6		.56		65	40.0	1.592			.112	.178	
	1.8		.60		62	40.4	1.505			.120	.181	.96
	2.0		.58		61	40.2	1.489			.116	.175 -.173	.97
	2.2		.64		40	40.1	.989			.128	.127	.98
	2.4		.62		37	40.4	.911			.124	.113	.99
	2.6		.60		31	40.2	.772			.12	.093	
	2.8		.62 ~~.66~~		17 ~~14~~	42 ~~42.9~~	.420 ~~.345~~			.124	.052	
⊙	3.0		.66 ~~.65~~		9	41.3	.240			.132	.032 ~~.032~~	1.00
	3.2		.66		10	40.0	.271			.132	.036	
	3.4		.67		19	40.7	.480			.134	.064	
	3.6		.64		26 ~~25~~	41.0	.640			.128	.082	.99
	3.8		.67		30	40.9	.736			.134	.099	.98
	4.0		.67		30	40.7	.739			.134	.099	.97
	4.2		.59		20	41.9	.490			.118	.058	.96
	4.4		.52		14	42.7	.346			.104	.036	
	4.6		.53		12	41.0	.312			.106	.033	.94
	4.8		.54		9	41.3	.240			.108	.026	.92
	5.0		.44		8	44.3	.205			.088	.018	.90
	5.2		.44		6	40.5	.173			.088	.015	
	5.4		.41		4	44.0	.119			.082	.010	
	5.6		.41		0	~~60+~~	~~0~~			.082	0	.85
	5.8		.37		0	60+	—			.074	0	
	6.0		.35		0	60+	—			.07	0	
	6.2		.35		0	60+	—			.07	0	.80
	6.4	0.25	.25		0	60+	—			0.063 .05	0	
LEW	6.7	0.05	—		0		—			3.199	0	

BIVERT

15.931

Q = 1.844 ~~2~~

1201 3

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving: Hydrologist, US Geological Survey

Station Name:	McGuireville				
Station Number:	12	WIDTH	6.500	# of Sections	33
Date:	10/30/2003	AREA	3.383	Sections > 5%	9
Measurement #:	2	VELOCITY	0.525	Sections > 10%	0
Pygmy or AA (p/a)	P			*Standard Error	7.41%
Rating # (1 or 2)	2	TOTAL DISCHARGE	1.774		FAIR

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uniform, gravel-boulders)

Correction Coefficien:	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	0.2	0.10	0			0.000	0.000	0.000	0.000	0.000
	0.4	0.20	0.31	0	60	0.000	0.000	0.000	0.062	0.000
	0.6	0.20	0.42	4	40.6	0.126	0.126	0.126	0.084	0.011
	0.8	0.20	0.46	9	43.8	0.229	0.229	0.229	0.092	0.021
	1	0.20	0.44	14	40.4	0.364	0.364	0.364	0.088	0.032
	1.2	0.20	0.51	23	40	0.583	0.583	0.583	0.102	0.060
	1.4	0.20	0.55	39	40.1	0.965	0.965	0.965	0.110	0.106
	1.6	0.20	0.57	48	40.1	1.181	1.181	1.181	0.114	0.135
	1.8	0.20	0.58	59	40.6	1.427	1.427	1.427	0.116	0.166
	2	0.20	0.62	53	40.1	1.301	1.301	1.301	0.124	0.161
	2.2	0.20	0.67	48	40.4	1.172	1.172	1.172	0.134	0.157
	2.4	0.20	0.72	50	40	1.232	1.232	1.232	0.144	0.177
	2.6	0.20	0.71	39	40.4	0.958	0.958	0.958	0.142	0.136
	2.8	0.20	0.66	26	41.1	0.639	0.639	0.639	0.132	0.084
	3	0.20	0.65	23	40.4	0.578	0.578	0.578	0.130	0.075
	3.2	0.20	0.65	31	40	0.776	0.776	0.776	0.130	0.101
	3.4	0.20	0.68	28	41.1	0.685	0.685	0.685	0.136	0.093
	3.6	0.20	0.72	17	40	0.439	0.439	0.439	0.144	0.063
	3.8	0.20	0.68	11	43.3	0.275	0.275	0.275	0.136	0.037
	4	0.20	0.66	8	42.2	0.213	0.213	0.213	0.132	0.028
	4.2	0.20	0.68	7	42.7	0.189	0.189	0.189	0.136	0.026
	4.4	0.20	0.62	10	43.7	0.251	0.251	0.251	0.124	0.031
	4.6	0.20	0.55	7	42.7	0.189	0.189	0.189	0.110	0.021
	4.8	0.20	0.46	6	44.5	0.161	0.161	0.161	0.092	0.015
	5	0.20	0.45	5	41.8	0.146	0.146	0.146	0.090	0.013
	5.2	0.20	0.43	4	41.5	0.124	0.124	0.124	0.086	0.011
	5.4	0.20	0.43	3	43.6	0.097	0.097	0.097	0.086	0.008
	5.6	0.20	0.47	2	51.9	0.068	0.068	0.068	0.094	0.006
	5.8	0.20	0.46	0	60	0.000	0.000	0.000	0.092	0.000
	6	0.20	0.42	0	60	0.000	0.000	0.000	0.084	0.000
	6.2	0.20	0.37	0	60	0.000	0.000	0.000	0.074	0.000
	6.4	0.25	0.25	0	60	0.000	0.000	0.000	0.063	0.000
	6.7	0.15	0	0	0	0.000	0.000	0.000	0.000	0.000

R-114

12021

S_q	S_d	S_t	S_r	S_s	S_h	S_v
7.407986	10.051	5.748731	6.262654	2.9442	0	1.4752

b	10.05085
c	19.78097
e	
f	

Select a Suspension Type:

Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u

Rod
Cable

Rod

2

1

b	c				# secs	5+ secs	10+ secs
					1	0	0
16.2525592	32.32001	5.27504			1	0	0
12.0715929	23.89338	5.884652	13.32186	0	1	0	0
11.0520337	21.83094	5.760966	6.131765	0	1	0	0
11.5382941	22.8151	5.892795	3.348053	0	1	0	0
10.0058422	19.70958	5.909235	2.115806	0	1	0	0
9.30830963	18.29149	5.905106	1.819198	0	1	1	0
8.99704134	17.65749	5.905106	1.712454	0	1	1	0
8.84964915	17.35699	5.884652	1.617926	0	1	1	0
8.30881582	16.25256	5.905106	1.663542	0	1	1	0
7.72603979	15.05878	5.892795	1.716186	0	1	1	0
7.22670801	14.03215	5.909235	1.690912	0	1	1	0
7.32074686	14.2258	5.892795	1.823138	0	1	1	0
7.83531128	15.28295	5.864519	2.059078	0	1	0	0
7.94805622	15.51407	5.892795	2.121791	0	1	0	0
7.94805622	15.51407	5.909235	1.942658	0	1	1	0
7.62008818	14.84126	5.864519	2.015917	0	1	1	0
7.22670801	14.03215	5.909235	2.621579	0	1	0	0
7.62008818	14.84126	5.779516	4.816565	0	1	0	0
7.83531128	15.28295	5.821308	6.708779	0	1	0	0
7.62008818	14.84126	5.802141	7.86884	0	1	0	0
8.30881582	16.25256	5.764655	5.429146	0	1	0	0
9.30830963	18.29149	5.802141	7.86884	0	1	0	0
11.0520337	21.83094	5.735447	9.692806	0	1	0	0
11.2896763	22.31204	5.836853	10.97168	0	1	0	0
11.7986533	23.34166	5.848636	13.6097	0	1	0	0
11.7986533	23.34166	5.768354	18.61217	0	1	0	0
10.8246654	21.37039	5.493653	29.52861	0	1	0	0
11.0520337	21.83094	5.27504			1	0	0
12.0715929	23.89338	5.27504			1	0	0
13.6607118	27.10093	5.27504			1	0	0
20.0997512	40.04997	5.27504			1	0	0
					1	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0

B-120

12023

River at—

Angle coefficient	Dist. from initial point	'	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point (FPS)	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area (FT^2)	Discharge (CFS)	
REW	.20	0.10	0				0				0	.80
	.40	.2	~~.32~~ .31		0	60+	0			~~.062~~ .060	0	
					8	47.7	~~.156~~ .155				~~.010~~	.85
	.60	.2	~~.44~~ .42		4	40.6	.126			~~.078~~ .084	~~.020~~ .011	
	.80	.2	.46		9	~~43.8~~ 43.9	~~.330~~ .228			.092	~~.031~~ .021	
	1.0	.2	~~.46~~ .44		14	40.4	.364			~~.092~~ .088	.032	.90
	1.2	.2	.51		23	40.0	.583			.102	.060	.92
	1.4	.2	.55		39	40.1	.965			.11	.106	.94
	1.6	.2	.57		48	40.1	1.181			~~.116~~ .114	.135	
	1.8	.2	.58		59	40.6	1.427			.116	.166	.96
	2.0	.2	.62		53	40.1	1.301			.124	.161	.97
	2.2	.2	.67		48	40.4	1.172			.134	.157	.98
	2.4	.2	.72		50	40.0	1.232			.144	.177	.99
	2.6	.2	.71		39	40.4	.958			.142	.136	
	2.8	.2	.66		26	41.1	.639			.132	.084	
⊙	3.0	.2	.65		23	40.4	.578			.13	.075	1.00
	3.2	.2	.65		31	40.0	.776			.13	.101	
	3.4	.2	.68		28	41.1	.685			.136	.093	
	3.6	.2	.72		17	40.0	.439			.144	.063	.99
	3.8	.2	.68		11	43.3	.275			.136	.037	.98
	4.0	.2	.66		8	42.2	.213			.132	.028	.97
	4.2	.2	.68		7	42.7	.189			.136	.026	.96
	4.4	.2	.62		10	43.7	.251			.124	.031	
	4.6	.2	.55		7	42.7	.189			.11	.021	.94
	4.8	.2	.46		6	44.5	.161			.092	.015	.92
	5.0	.2	.45		5	41.8	.146			.09	.013	.90
	5.2	.2	.43		4	41.5	.124			.086	.011	
	5.4	.2	.43		3	43.6	.097			.086	.008	
	5.6	.2	.47		2	51.9	.068			.094	.006	.85
	5.8	.2	.46		0	60+	—				0	
	6.0	.2	.42		0	60+	—				0	
	6.2	.2	.37		0	60+	—				0	.80
	6.4	.26	.25		0	60+	—				0	
LEW	6.7	~~.3~~ 0.15								3.07	0	.75

14.366

~-1.774

12-121

1202 3

5 SECTIONS = 5%
ERROR: 7.41%
F

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 2

Comp by J. HARTE Checked by FIECHTNER

DATE 10/30/03

PARK MOCA STATION * (NEW) OLD SITE (12) 8 - WET BEAVER Cr. @ McGuireville on USFS LANDS (80 ACRES)

PERSONNEL: Meter J. WARD Notes J. HARTE

MEASUREMENT TYPE (circle one) (Wading), Cable, Bridge, Boat, Ice; Upstr., Dnstr., ___ ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 1330 G.H. .32 Stop: 1418 G.H. .33

METER TYPE Pygmy S/N USGS P70237 SPIN Before Meas. 45 SEC After 45 SEC

WEATHER Sunny, light intermittent Breeze

HIGH WATER MARK ___ Gage Height of .Zero .Flow. ___ ft.

CREST STAGE CHECKED: Yes/No ___ READING ___ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor
1330	.32				
1418	.33				

6.500 3.383 0.525 1.774

FLOW: Width ~~6.68'~~ Area ~~3.07 FT²~~ Ave. Vel. ~~.463 FPS~~ G.H. .33' Disch. 1.77 cfs

Method .6 Method coeff. ___ Hor. Angle coeff. ___ Susp. type ___ Susp. coeff. ___

Meter ___ ft. above bottom of weight No. Secs. 33 G.H. changes +0.01 ft. in 48/60 hrs.

FLOW VARIED, NON-UNIFORM, EDDY EFFECT NEAR LEW

Cross Section Rough Cobble / Boulder

CONTROL Poor Approx. 30 FEET DOWNSTREAM OF Cross SECTION

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range ___

S/N ___ P/N ___

Conversion slope ___ Conversion offset ___ Ex. Volt. ___ Output Range ___

NITROGEN TANK PRESSURE ___ FEED ___ BBL RATE ___ per. min.

INTAKE/ORIFICE CLEANED ___ TEMPERATURE: Air 75.2 C (F) Water 59.7 C (F)

PHOTOS TAKEN: Roll(s) # ___ Frame(s) # ___

B-12a

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time ___ Samples: Yes/No Time ___

Method: EDI ___ EWI ___ Other ___

SEDIMENT: Yes/No Time ___ Method: EDI ___ EWI ___ Other ___

BIOLOGICAL: Yes/No Time ___ Type ___

OBSERVATIONS/COMMENTS Cross Section is Approx. 10 FEET Downstream of A Pool. Channel is Cobble. MEASUREMENT ESTIMATED To be Fair-To-Poor.

* THIS IS SITE # 12 AND IT Replaces Site 8 MEASURED IN 2002. SITE 12 is Approximately 100-150 yds. Downstream of Site 8 and Just upstream OF A BARE CLIFF FACE on River Right.

LEVEL NOTES

EQUIPMENT TYPE ___ S/N ___

PERSONNEL: Instrument/Notes ___ Rod ___

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	McGuireville				
Station Number:	12	WIDTH	6.500	# of Sections	33
Date:	10/30/2003	AREA	3.411	Sections > 5%	9
Measurement #:	3	VELOCITY	0.551	Sections > 10%	0
Pygmy or AA (p/a)	P			*Standard Error	7.50%
Rating # (1 or 2)	2	TOTAL DISCHARGE	1.880		FAIR

Print Header

Print Full Sheet

Clear Sheet

* Standard error computed using OFR 92-144 Method

Red

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	0.2	0.10	0			0.000	0.000	0.000	0.000	0.000
	0.4	0.20	0.33	4	60.3	0.095	0.095	0.095	0.066	0.006
	0.6	0.20	0.41	6	45.7	0.157	0.157	0.157	0.082	0.013
	0.8	0.20	0.47	6	41	0.172	0.172	0.172	0.094	0.016
	1	0.20	0.46	17	41.3	0.427	0.427	0.427	0.092	0.039
	1.2	0.20	0.52	20	40.6	0.504	0.504	0.504	0.104	0.052
	1.4	0.20	0.54	27	41.2	0.661	0.661	0.661	0.108	0.071
	1.6	0.20	0.58	53	40.3	1.294	1.294	1.294	0.116	0.150
	1.8	0.20	0.56	59	40.3	1.437	1.437	1.437	0.112	0.161
	2	0.20	0.64	48	40.2	1.178	1.178	1.178	0.128	0.151
	2.2	0.20	0.69	48	40.5	1.169	1.169	1.169	0.138	0.161
	2.4	0.20	0.66	56	40.4	1.362	1.362	1.362	0.132	0.180
	2.6	0.20	0.65	47	40.5	1.146	1.146	1.146	0.130	0.149
	2.8	0.20	0.7	31	41	0.757	0.757	0.757	0.140	0.106
	3	0.20	0.68	26	41.2	0.637	0.637	0.637	0.136	0.087
	3.2	0.20	0.69	28	40	0.703	0.703	0.703	0.138	0.097
	3.4	0.20	0.7	29	40.1	0.726	0.726	0.726	0.140	0.102
	3.6	0.20	0.71	16	41.3	0.403	0.403	0.403	0.142	0.057
	3.8	0.20	0.7	11	40.1	0.295	0.295	0.295	0.140	0.041
	4	0.20	0.67	10	46.1	0.240	0.240	0.240	0.134	0.032
	4.2	0.20	0.64	12	41.6	0.308	0.308	0.308	0.128	0.039
	4.4	0.20	0.63	11	41.9	0.283	0.283	0.283	0.126	0.036
	4.6	0.20	0.55	9	40.5	0.245	0.245	0.245	0.110	0.027
	4.8	0.20	0.47	10	41.8	0.261	0.261	0.261	0.094	0.025
	5	0.20	0.45	9	41.8	0.238	0.238	0.238	0.090	0.021
	5.2	0.20	0.44	8	40.4	0.221	0.221	0.221	0.088	0.019
	5.4	0.20	0.43	7	41	0.195	0.195	0.195	0.086	0.017
	5.6	0.20	0.47	4	49.6	0.109	0.109	0.109	0.094	0.010
	5.8	0.20	0.46	2	47.5	0.072	0.072	0.072	0.092	0.007
	6	0.20	0.41	2	42.7	0.076	0.076	0.076	0.082	0.006
	6.2	0.20	0.37	0	60	0.000	0.000	0.000	0.074	0.000
	6.4	0.25	0.3	0	60	0.000	0.000	0.000	0.075	0.000
	6.7	0.15	0	0	0	0.000	0.000	0.000	0.000	0.000

B-122

1203 1

S_a	S_d	S_i	S_s	S_{ss}	S_{sr}	S_v
7.499088	9.8808	5.784803	6.377227	2.9442	0	1.4752

b	9.880758
c	19.43835
e	
f	

Select a Bed Type:

Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u

2

Select a Suspension Type:

Rod
Cable

Rod

1

b	c			# secs	5+ secs	10+ secs
					1	0 0
15.2829451	30.36896	5.267678	19.21977	0	1	0 0
12.3580338	24.47211	5.692874	9.966077	0	1	0 0
10.8246654	21.37039	5.86852	8.889734	0	1	0 0
11.0520337	21.83094	5.856553	2.724699	0	1	0 0
9.82118228	19.33449	5.884652	2.21037	0	1	0 0
9.47279695	18.62621	5.86053	2.038418	0	1	0 0
8.84964915	17.35699	5.896885	1.665967	0	1	1 0
9.14982993	17.96879	5.896885	1.614408	0	1	1 0
8.06443775	15.75248	5.900989	1.7137	0	1	1 0
7.51731181	14.6301	5.888717	1.717425	0	1	1 0
7.83531128	15.28295	5.892795	1.640501	0	1	1 0
7.94805622	15.51407	5.888717	1.728012	0	1	1 0
7.41757428	14.42503	5.86852	1.956512	0	1	1 0
7.62008818	14.84126	5.86053	2.060506	0	1	0 0
7.51731181	14.6301	5.909235	2.000308	0	1	1 0
7.41757428	14.42503	5.905106	1.98169	0	1	1 0
7.32074686	14.2258	5.856553	2.930697	0	1	0 0
7.41757428	14.42503	5.905106	4.406984	0	1	0 0
7.72603979	15.05878	5.678999	5.768565	0	1	0 0
8.06443775	15.75248	5.844696	4.156135	0	1	0 0
8.18462939	15.99852	5.832949	4.63719	0	1	0 0
9.30830963	18.29149	5.888717	5.613036	0	1	0 0
10.8246654	21.37039	5.836853	5.160535	0	1	0 0
11.2896763	22.31204	5.836853	5.817396	0	1	0 0
11.5382941	22.8151	5.892795	6.390976	0	1	0 0
11.7986533	23.34166	5.86852	7.528413	0	1	0 0
10.8246654	21.37039	5.563822	16.12113	0	1	0 0
11.0520337	21.83094	5.631627	27.70492	0	1	0 0
12.3580338	24.47211	5.802141	25.57541	0	1	0 0
13.6607118	27.10093	5.27504			1	0 0
16.7862377	33.39328	5.27504			1	0 0
					1	0 0
					0	0 0
					0	0 0
					0	0 0
					0	0 0
					0	0 0

R-123

1203 2

River at—

Angle coefficient	Dist. from initial point (FT)	(FT)	Depth (FT)	Observation depth	Revolutions	Time in seconds	VELOCITY (FPS) At point	VELOCITY Mean in vertical	Adjusted for hor. angle or	Area (FT^2)	Discharge (CFS)
REW	.2		0								
	.40	.2	.33		4	60.3	.095			.066	.006
	.60	.2	.41		6	45.7	.157			.082	.013
	.80	.2	.47		6	41.0	.172			.094	.016
	1.0	.2	.46		17	41.3	.427			.092	.039
	1.2	.2	.52		20	40.6	.504			.104	.052
	1.4	.2	.54		27	41.2	.661			.108	.071
	1.6	.2	.58		63	40.3	1.294			.116	.150
	1.8	.2	.56		59	40.3	1.437			.112	.161
	2.0	.2	.64		48	40.2	1.178			.128	.151
	2.2	.2	.69		48	40.5	1.169			.138	.161
	2.4	.2	.66		56	40.4	1.362			.132	.180
	2.6	.2	.65		47	40.5	1.146			.13	.149
	2.8	.2	.70		31	41.0	.757			.14	.106
⊙	3.0	.2	.68		26	41.2	.637			.136	.087
	3.2	.2	.69		28	40.0	.703			.138	.097
	3.4	.2	.70		29	40.1	.726			.14	.102
	3.6	.2	.71		16	41.3	.403			.142	.057
	3.8	.2	.70		11	40.1	.295			.14	.041
	4.0	.2	.67		10	46.1	.240			.134	.032
	4.2	.2	.64		12	41.6	.308			.128	.039
	4.4	.2	.63		11	41.9	.283			.126	.036
	4.6	.2	.55		9	40.5	.245			.11	.027
	4.8	.2	.47		10	41.8	.261			.094	.024
	5.0	.2	.45		9	41.8	.238			.09	.021
	5.2	.2	.44		8	40.4	.221			.088	.019
	5.4	.2	.43		7	41.0	.195			.086	.017
	5.6	.2	.47		4	49.6	.109			.094	.010
	5.8	.2	.46		2	47.5	.072			.092	.007
	6.0	.2	.41		2	42.7	.076			.082	.006
	6.2	.2	.37		0	60+	—				—
	6.4	.25	.30		0	60+	—				0
LEW	6.7	.2 (0.15)									0

15.371

1.880

B-124

12033

3 SECTIONS —> %
ERROR: 7.50 %
FAIR

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 3

Comp by J. HARTE Checked by FIECHTNER

DATE 10/30/03

PARK MOCA STATION * OLD NEW SITE 8 (12) WET BEAVER CR @ McGUIREVILLE ON USFS LAND (80 ACRES)

PERSONNEL: Meter J. WARD Notes J. HARTE

MEASUREMENT TYPE (circle one) (Wading), Cable, Bridge, Boat, Ice; Upstr., Dnstr., ___ ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 1430 G.H. .33 Stop: 1505 G.H. .33

METER TYPE Pygmy S/N USGS P50237 SPIN Before Meas. 45+562 After 45+

WEATHER SUNNY, LIGHT INTERMITTENT BREEZE

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes/No _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor
1430	.33				
1505	.33				

6.500 3.411 0.551 1.880

FLOW: Width 6.68 FT Area 3.26 FT² Ave. Vel. .496 FT/S G.H. .33 Disch. 1.88 CFS

Method .6 Method coeff. ____ Hor. Angle coeff. ____ Susp. type ____ Susp. coeff. ____

Meter ____ ft. above bottom of weight No. Secs. 33 G.H. changes 0 ft. in 35/60 hrs.

FLOW VARIED, NON-UNIFORM, EDDY EFFECT NEAR LEW

Cross Section ROUGH COBBLE / BOULDER

CONTROL POOL APPROX. 30 FEET DOWNSTREAM OF CROSS SECTION

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 70.7 C° (F) Water 60.4 C° (F)

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

B-124d

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS CROSS SECTION IS X 10 FEET DOWNSTREAM OF A POOL. CHANNEL BOTTOM IS COBBLE.

MEASUREMENT POOR-TO-FAIR

*THIS SITE IS #12 AND IT REPLACES SITE 8 MEASURED IN 2002. SITE 12 IS APPROXIMATELY 100-150 YARDS DOWNSTREAM OF SITE 8 AND JUST UPSTREAM OF A BARE CLIFF FACE ON RIVER RIGHT

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

SITE 9 – 1' Mtly Overcast 1025 MST 10-28-03
~ 70's

SITE DESCRIPTION:

GPS: #018 12 S 0424012 UTM 3830227
Accuracy: 18 Ft
#019 12 S 0424012 UTM 3830224
Accuracy: 17 Ft

SITE 11 IS on BEAVER CREEK Approximately DUE EAST OF THE CASTLE UNIT VISITOR CENTER
THE CHANNEL IS ABOUT 6 FEET WIDE AT THIS CROSS SECTION
THERE IS SEEPAGE ON BOTH SIDES OF THE CHANNEL HOWEVER THE FLOW IN THE CHANNEL LIKELY ACCOUNTS FOR ~ 95-99% OF THE DISCHARGE
WE INSTALLED Rebar Endpins on both banks and a (1 FOOT) STAFF GAGE ABOUT 6 FEET DOWNSTREAM OF THE CROSS SECTION IN THE CHANNEL ON RIVER LEFT:

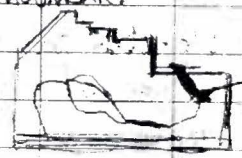
PHOTOS:

R-17

ACCESS:

ADDITIONAL LOCATION COMMENTS:

- ≈ 100 YDS D.S. OF LARGE POND INTERSECTED BY PARK BOUNDARY*



- STAFF GAGE READING: ≈ 0.43 ft.

(* THE PARK BOUNDARIES MAY BE EXTENDED IN THE NEAR FUTURE)

- DISTINCT BOULDER ON RIVER LEFT; STAFF GAGE APPROX. 2 ft U.S. OF BOULDER
- SITE 11 IS USED IN LIEU OF SITE 9 DUE TO A MORE PREFERRABLE CROSS SECTION



SITE 11.10.28.2003_002

Beaver Creek east of MOCA Castle Unit Visitor Center

From cross section, with measuring tape, looking from right bank to left bank with staff gage installed downstream of cross section on river left.

Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1022 hrs



SITE 11.10.28.2003_003

Beaver Creek east of MOCA Castle Unit Visitor Center

From cross section looking at staff gage installed downstream of cross section on river left.

Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1023 hrs



SITE 11.10.28.2003_004

Beaver Creek east of MOCA Castle Unit Visitor Center

From downstream of cross section looking upstream at cross section, with measuring tape, and staff gage installed downstream of cross section on river left.

Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1023 hrs



SITE 11.10.28.2003_005

Beaver Creek east of MOCA Castle Unit Visitor Center

From upstream of cross section looking downstream at cross section, with measuring tape, and staff gage installed downstream of cross section on river left.

Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1024 hrs

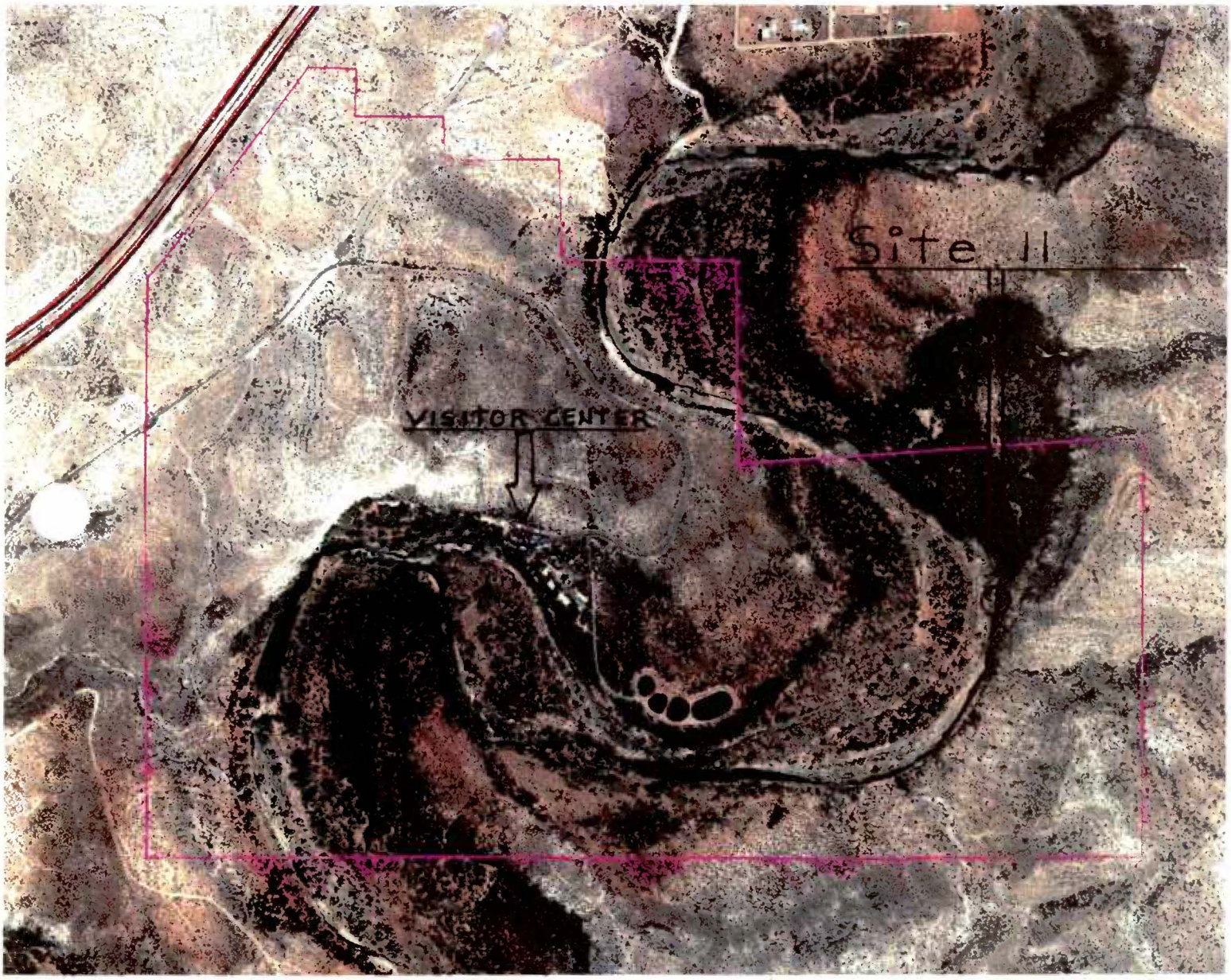


SITE 11.10.28.2003_007

Beaver Creek east of MOCA Castle Unit Visitor Center

From cross section, with measuring tape, looking from left bank to right bank.

Beaver Creek, Yavapai County, Az.
October 28, 2003 @ 1025 hrs



Site 11--Location on Beaver Creek east of the Montezuma Castle NM, Castle Unit, Visitor Center.

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	Castle Unit				
Station Number:	11	WIDTH	6.200	# of Sections	32
Date:	10/30/2003	AREA	3.238	Sections > 5%	4
Measurement #:	1	VELOCITY	0.437	Sections > 10%	0
Pygmy or AA (p/a)				*Standard Error	5.51%
Rating # (1 or 2)	2	TOTAL DISCHARGE	1.413		FAIR

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficien	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	3.8	0.10	0.45			0.000	0.000	0.000	0.045	0.000
	4	0.20	0.48	24	41.4	0.588	0.588	0.588	0.096	0.056
	4.2	0.20	0.43	27	40.4	0.673	0.673	0.673	0.086	0.058
	4.4	0.20	0.43	23	41.4	0.565	0.565	0.565	0.086	0.049
	4.6	0.20	0.49	31	40.4	0.768	0.768	0.768	0.098	0.075
	4.8	0.20	0.53	22	41.6	0.539	0.539	0.539	0.106	0.057
	5	0.20	0.5	11	41.4	0.286	0.286	0.286	0.100	0.029
	5.2	0.20	0.5	9	45.6	0.221	0.221	0.221	0.100	0.022
	5.4	0.20	0.63	17	45.2	0.392	0.392	0.392	0.126	0.049
	5.6	0.20	0.63	13	42.6	0.324	0.324	0.324	0.126	0.041
	5.8	0.20	0.63	6	40.2	0.175	0.175	0.175	0.126	0.022
	6	0.20	0.62	11	41	0.289	0.289	0.289	0.124	0.036
	6.2	0.20	0.62	15	43.1	0.365	0.365	0.365	0.124	0.045
	6.4	0.20	0.6	15	41.6	0.377	0.377	0.377	0.120	0.045
	6.6	0.20	0.5	16	42.7	0.391	0.391	0.391	0.100	0.039
	6.8	0.20	0.49	14	42.8	0.345	0.345	0.345	0.098	0.034
	7	0.20	0.5	15	42.8	0.368	0.368	0.368	0.100	0.037
	7.2	0.20	0.52	18	42.4	0.439	0.439	0.439	0.104	0.046
	7.4	0.20	0.51	21	40	0.535	0.535	0.535	0.102	0.055
	7.6	0.20	0.56	22	40.2	0.557	0.557	0.557	0.112	0.062
	7.8	0.20	0.59	29	40.7	0.716	0.716	0.716	0.118	0.084
	8	0.20	0.49	30	40.7	0.739	0.739	0.739	0.098	0.072
	8.2	0.20	0.44	23	40.6	0.575	0.575	0.575	0.088	0.051
	8.4	0.20	0.48	29	40.9	0.712	0.712	0.712	0.096	0.068
	8.6	0.20	0.5	29	40.4	0.721	0.721	0.721	0.100	0.072
	8.8	0.20	0.5	25	41.7	0.607	0.607	0.607	0.100	0.061
	9	0.20	0.55	10	40.3	0.270	0.270	0.270	0.110	0.030
	9.2	0.20	0.5	15	41.7	0.377	0.377	0.377	0.100	0.038
	9.4	0.20	0.51	17	40.5	0.434	0.434	0.434	0.102	0.044
	9.6	0.20	0.52	10	41.7	0.262	0.262	0.262	0.104	0.027
	9.8	0.20	0.5	3	49.4	0.090	0.090	0.090	0.100	0.009
	10	0.10	0.43	0	0	0.000	0.000	0.000	0.043	0.000

R-127

1101 1

S_q	S_u	S_t	S	S_s	S_n	S_v
5.511339	9.9507	5.83713	3.792882	2.9635	0	1.5157

b 9.950672
c 19.59381
e
f

Select a Bed Type:
Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u
2

Select a Suspension Type:
Rod
Cable

Rod
1

b	c			# secs	5+ secs	10+ secs	
11.2896763	22.31204				1	0	0
10.6069291	20.92911	5.852589	2.110909	0	1	0	0
11.7986533	23.34166	5.802795	2.02702	0	1	0	0
11.7986533	23.34166	5.852589	2.136556	0	1	0	0
10.3982346	20.50593	5.892795	1.94823	0	1	1	0
9.6436323	18.97363	5.844696	2.16656	0	1	0	0
10.198039	20.09975	5.852589	4.573193	0	1	0	0
10.198039	20.09975	5.696367	6.41453	0	1	0	0
8.18462939	15.99852	5.710437	3.036526	0	1	0	0
8.18462939	15.99852	5.805951	3.890869	0	1	0	0
8.18462939	15.99852	5.900989	8.704993	0	1	0	0
8.30881582	16.25256	5.86852	4.522022	0	1	0	0
8.30881582	16.25256	5.787013	3.330963	0	1	0	0
8.56997342	16.78624	5.844696	3.1934	0	1	0	0
10.198039	20.09975	5.802141	3.050095	0	1	0	0
10.3982346	20.50593	5.798342	3.535139	0	1	0	0
10.198039	20.09975	5.798342	3.303425	0	1	0	0
9.82118228	19.33449	5.813607	2.625097	0	1	0	0
10.0058422	19.70958	5.909235	2.171034	0	1	0	0
9.14982993	17.96879	5.900989	2.145676	0	1	0	0
8.70737865	17.06674	5.8806	1.990155	0	1	1	0
10.3982346	20.50593	5.8806	1.970877	0	1	1	0
11.5382941	22.8151	5.884652	2.124767	0	1	0	0
10.6069291	20.92911	5.872534	1.992956	0	1	0	0
10.198039	20.09975	5.892795	1.985935	0	1	1	0
10.198039	20.09975	5.840768	2.090838	0	1	0	0
9.30830963	18.29149	5.896885	4.948683	0	1	0	0
10.198039	20.09975	5.840768	3.202556	0	1	0	0
10.0058422	19.70958	5.888717	2.651188	0	1	0	0
9.82118228	19.33449	5.840768	5.146405	0	1	0	0
10.198039	20.09975	5.57012	20.73585	0	1	0	0
11.7986533	23.34166				1	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0

B-133

1101 2

River at—

Angle coefficient	Dist. from initial point	n	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
0800	3.8	0.10 ~~.5~~	.45	.6	—	—				~~.07~~	0.045
	4.0	.2	.48	.6	24	41.4	.592	0.588		.096	.057
	4.2	.2	.43	.6	27	40.4	.673			.086	.058
	4.4	.2	.43	.6	23	41.4	.568	5		.086	.050
	4.6	.2	.49	.6	31	40.4	.768			.098	.075
	4.8	.2	.53	.6	22	41.6	.539			.106	.057
	5.0	.2	.50	.6	11	41.4	.288	6		.100	.029
	5.2	.2	.50	.6	9	45.6	.221			.100	.022
	5.4	.2	.63	.6	17	45.2	.392			.126	.049
	5.6	.2	.63	.6	13	42.6	.324			.126	.041
	5.8	.2	.63	.6	6	40.2	.174	5		.126	.022
	6.0	.2	.62	.6	11	41.0	.289			.124	.036
	6.2	.2	.62	.6	15	43.1	.365			.124	.045
	6.4	.2	.60	.6	15	41.6	.377			.120	.045
○	6.6	.2	.50	.6	16	42.7	.391			.100	.039
	6.8	.2	.49	.6	14	42.8	.345			.098	.034
	7.0	.2	.50	.6	15	42.8	.368			.100	.037
	7.2	.2	.52	.6	18	42.4	.439			.104	.046
	7.4	.2	.51	.6	21	40.0	.535			.102	.055
	7.6	.2	.56	.6	22	40.2	.557			.112	.062
	7.8	.2	.59	.6	29	40.7	.715	6		.117	.084
	8.0	.2	.49	.6	30	40.7	.739			.098	.072
	8.2	.2	.44	.6	23	40.6	.575			.088	.051
	8.4	.2	.48	.6	29	40.9	~~.720~~	0.712		.0996	.071 0.068
	8.6	.2	.50	.6	29	40.4	.721			.100	.072
	8.8	.2	.50	.6	25	41.7	.607			.100	.061
	9.0	.2	.55	.6	10	40.3	.269	70		.110	.030
	9.2	.2	.50	.6	15	41.7	.377			.100	.038
	9.4	.2	.51	.6	17	40.5	.434			.102	.044
	9.6	.2	.52	.6	10	41.7	.262			.104	.027
0840	9.8	.2	.50	.6	3	49.4	.089	90		.100	.009
	10	0.10 ~~.2~~	.43	—	—	—	—			0.043 ~~.086~~	1.418

13.714

3.225

1.413

EM-134

1101 3

AU SECTION(S) = 10%
X-SECTIONS > 5%
E : 5.51%
FAIL

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 1

DATE 10/30/03 Comp by JW Checked by JH FIECHTNER

PARK MOCA STATION Site 9 (11)-BENEER CK @ CASTLE UNIT

PERSONNEL: Meter ~~FYGMY (RC-2)~~ J. HART Notes J. WARD

MEASUREMENT TYPE (circle one) (Wading) Cable, Bridge, Boat, Ice; Upstr., Dnstr., ___ ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 0800 G.H. 0.28 Stop: 0840 G.H. .29

METER TYPE PYGMY S/N P90237 SPIN Before Meas. 45+ After 45+

WEATHER PT. CLOUDY 56°F

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes (No) _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor
0732	0.28				
0841	0.29				

3.238 0.437 1.413

FLOW: Width 6.2 Ft Area 3.33 ft² Ave. Vel. .457 FPS G.H. .29 Disch. 1.42 cfs

Method .6 Method coeff. ____ Hor. Angle coeff. ____ Susp. type ____ Susp. coeff. ____

Meter ____ ft. above bottom of weight No. Secs. 32 G.H. changes ±0.01 ft. in 2/3 hrs.

FLOW VARIED, NON-UNIFORM, EDDY EFFECT NEAR MID-CHANNEL

Cross Section Rough Cobble/Boulder, dense root mat banks with some undercutting

CONTROL Cobble/Boulder STEP APPROX. 10 FEET DOWNSTREAM OF CROSS SECTION

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 55.9 (C) (F) Water 54.7 (C) (F)

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

12-124

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS

LEFT BANK SLIGHTLY UNDERCUT, MATTED ROOTS, WATER NOT MOVING

* THIS IS SITE # 11 AND IT Replaces Site 9 MEASURED IN 2002. SITE 11 IS APPROX. ONE RIVER-mile UPSTREAM OF SITE 9, due EAST OF THE VISITOR CENTER, AND below A WEST-FACING CLIFF FACE CONTAINING TWO "Windows" THAT GIVE THE CLIFF FACE THE Appearance of an Indian Ruin.

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Lovin, Hydrologist, US Geological Survey

Station Name:	Castle Unit				
Station Number:	11	WIDTH	6.200	# of Sections	32
Date:	10/30/2003	AREA	3.380	Sections > 5%	5
Measurement #:	2	VELOCITY	0.411	Sections > 10%	0
Pygmy or AA (p/a)	P			*Standard Error	6.32%
Rating # (1 or 2)	2	TOTAL DISCHARGE	1.389		FAIR

Print Header

Print Full Sheet

Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	3.8	0.10	0.46			0.000	0.000	0.000	0.046	0.000
	4	0.20	0.48	31	40.2	0.772	0.772	0.772	0.096	0.074
	4.2	0.20	0.5	27	40	0.679	0.679	0.679	0.100	0.068
	4.4	0.20	0.5	20	40.6	0.504	0.504	0.504	0.100	0.050
	4.6	0.20	0.51	22	40.7	0.550	0.550	0.550	0.102	0.056
	4.8	0.20	0.51	27	41.1	0.662	0.662	0.662	0.102	0.068
	5	0.20	0.61	26	41.5	0.633	0.633	0.633	0.122	0.077
	5.2	0.20	0.63	20	41.6	0.493	0.493	0.493	0.126	0.062
	5.4	0.20	0.61	16	43.4	0.385	0.385	0.385	0.122	0.047
	5.6	0.20	0.61	10	40.6	0.268	0.268	0.268	0.122	0.033
	5.8	0.20	0.62	6	49.7	0.147	0.147	0.147	0.124	0.018
	6	0.20	0.62	4	45	0.117	0.117	0.117	0.124	0.014
	6.2	0.20	0.62	4	44.3	0.118	0.118	0.118	0.124	0.015
	6.4	0.20	0.61	7	43	0.188	0.188	0.188	0.122	0.023
	6.6	0.20	0.5	15	40.4	0.388	0.388	0.388	0.100	0.039
	6.8	0.20	0.48	20	41.8	0.491	0.491	0.491	0.096	0.047
	7	0.20	0.48	23	40.6	0.575	0.575	0.575	0.096	0.055
	7.2	0.20	0.54	23	40.5	0.577	0.577	0.577	0.108	0.062
	7.4	0.20	0.54	22	41.2	0.544	0.544	0.544	0.108	0.059
	7.6	0.20	0.58	25	41.4	0.611	0.611	0.611	0.116	0.071
	7.8	0.20	0.6	25	41.1	0.615	0.615	0.615	0.120	0.074
	8	0.20	0.6	22	41.1	0.545	0.545	0.545	0.120	0.065
	8.2	0.20	0.58	27	40	0.679	0.679	0.679	0.116	0.079
	8.4	0.20	0.52	24	41.2	0.591	0.591	0.591	0.104	0.061
	8.6	0.20	0.5	23	40.4	0.578	0.578	0.578	0.100	0.058
	8.8	0.20	0.5	15	40.5	0.387	0.387	0.387	0.100	0.039
	9	0.20	0.55	11	40.3	0.293	0.293	0.293	0.110	0.032
	9.2	0.20	0.52	7	43.1	0.187	0.187	0.187	0.104	0.019
	9.4	0.20	0.51	5	46.8	0.134	0.134	0.134	0.102	0.014
	9.6	0.20	0.52	3	46.4	0.093	0.093	0.093	0.104	0.010
	9.8	0.20	0.5	0	0	0.000	0.000	0.000	0.100	0.000
	10	0.10	0.44	0	0	0.000	0.000	0.000	0.044	0.000

B-135

11021

S_q	S_d	S_t	S_i	S_s	S_n	S_v
6.316504	9.5323	5.831365	4.915909	2.9635	0	1.5157

b	9.532294
c	18.74408
e	
f	

Select a Bed Type:

Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u
2

Select a Suspension Type:

Rod
Cable

Rod
1

b	c				# secs	5+ secs	10+ secs
11.0520337	21.83094				1	0	0
10.6069291	20.92911	5.900989	1.945449	0	1	1	0
10.198039	20.09975	5.909235	2.021256	0	1	0	0
10.198039	20.09975	5.884652	2.21037	0	1	0	0
10.0058422	19.70958	5.8806	2.1532	0	1	0	0
10.0058422	19.70958	5.864519	2.037002	0	1	0	0
8.43719386	16.51499	5.848636	2.064775	0	1	1	0
8.18462939	15.99852	5.844696	2.257464	0	1	0	0
8.43719386	16.51499	5.775784	3.109967	0	1	0	0
8.43719386	16.51499	5.884652	4.991034	0	1	0	0
8.30881582	16.25256	5.560685	10.86872	0	1	0	0
8.30881582	16.25256	5.717532	14.71245	0	1	0	0
8.30881582	16.25256	5.742686	14.49403	0	1	0	0
8.43719386	16.51499	5.790778	7.928807	0	1	0	0
10.198039	20.09975	5.892795	3.083723	0	1	0	0
10.6069291	20.92911	5.836853	2.270685	0	1	0	0
10.6069291	20.92911	5.884652	2.124767	0	1	0	0
9.47279695	18.62621	5.888717	2.12328	0	1	0	0
9.47279695	18.62621	5.86053	2.16065	0	1	0	0
8.84964915	17.35699	5.852589	2.086545	0	1	1	0
8.56997342	16.78624	5.864519	2.082229	0	1	1	0
8.56997342	16.78624	5.864519	2.159166	0	1	0	0
8.84964915	17.35699	5.909235	2.021256	0	1	1	0
9.82118228	19.33449	5.86053	2.108007	0	1	0	0
10.198039	20.09975	5.892795	2.121791	0	1	0	0
10.198039	20.09975	5.888717	3.092849	0	1	0	0
9.30830963	18.29149	5.896885	4.432536	0	1	0	0
9.82118228	19.33449	5.787013	7.948788	0	1	0	0
10.0058422	19.70958	5.655086	12.29761	0	1	0	0
9.82118228	19.33449	5.668695	19.65295	0	1	0	0
10.198039	20.09975				1	0	0
11.5382941	22.8151				1	0	0

B-134

1102 2

River at—

Angle coefficient	Dist. from initial point		Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
										0.046	
	3.8	0.10	.46	—				RE		.092	
	4.0	.2	.48	.6	31	40.2	.772			.096	.074
	4.2	.2	.50	.6	27	40.0	.679			.100	.068
	4.4	.2	.50	.6	20	40.6	.504			.100	.050
	4.6	.2	.51	.6	22	40.7	.550			.102	.056
	4.8	.2	.51	.6	27	41.1	.662			.102	.0678
	5.0	.2	.61	.6	26	41.5	.633			.122	.077
	5.2	.2	.63	.6	20	41.6	.493			.126	.062
	5.4	.2	.61	.6	16	43.4	.385			.122	.047
	5.6	.2	.61	.6	10	46.6	.268			.122	.0373
	5.8	.2	.62	.6	6	49.7	.147			.124	.018
	6.0	.2	.62	.6	4	45.0	.1167			.124	.014
	6.2	.2	.62	.6	4	44.3	.118			.124	.015
	6.4	.2	.61	.6	7	43.0	.1878			.122	.023
⊙	6.6	.2	.50	.6	15	40.4	.388			.100	.039
	6.8	.2	.48	.6	20	41.8	.491			.096	.047
	7.0	.2	.48	.6	23	40.6	.575			.096	.055
	7.2	.2	.54	.6	23	40.5	.577			.108	.062
	7.4	.2	.54	.6	22	41.2	.544			.108	.059
	7.6	.2	.58	.6	25	41.4	.611			.116	.071
	7.8	.2	.60	.6	25	41.1	.615			.120	.074
	8.0	.2	.60	.6	22	41.1	.545			.120	.065
	8.2	.2	.58	.6	27	40.0	.679			.116	.079
	8.4	.2	.52	.6	24	41.2	.591			.104	.061
	8.6	.2	.50	.6	23	40.4	.578			.100	.058
	8.8	.2	.50	.6	15	40.5	.387			.100	.039
	9.0	.2	.55	.6	11	40.3	.293			.110	.032
	9.2	.2	.52	.6	7	43.1	.187			.104	.019
	9.4	.2	.51	.6	5	46.8	.134			.102	.014
	9.6	.2	.52	.6	3	46.4	.093			.104	.009
	9.8	.2	.50	.6	0					.100	0
	10.0	0.10 .2	.44	—				LE			1.3869

0.010

0931

3overt

12.802

3.382

W-137

5 SECTIONS = 2%.
ER = 6.32%

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. X 2

DATE 10/30/03 Comp by JW Checked by JH FIECHTNER

PARK MOCA STATION *SITE-9 (11) - BEAVER CT. @ CASTLE UNIT

PERSONNEL: Meter ~~PYGMY~~ J. HARZ Notes P90237 J. WARD

MEASUREMENT TYPE (circle one) (Wading) Cable, Bridge, Boat, Ice; Upstr., Dnstr., ___ ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 0850 G.H. .29 Stop: 0931 G.H. .29

METER TYPE PYGMY S/N P90237 SPIN Before Meas. 45+ After 45+

WEATHER P7, CLOUDY COOL

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes (No) _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor
0850	0.29				
0931	0.29				

0.411 1.389

FLOW: Width 6.2 FT Area 3.38 FT² Ave. Vel. .427 FT/S G.H. .29 Disch. 1.39 CFS

Method .6 Method coeff. ___ Hor. Angle coeff. ___ Susp. type ___ Susp. coeff. ___

Meter ___ ft. above bottom of weight No. Secs. 32 G.H. changes 0 ft. in 4'/60 hrs.

FLOW VARIED, NON-UNIFORM, EDDY EFFECT NEAR MID-CHANNEL

Cross Section Rough Cobble/Boulder, dense root-mat banks with some undercutting

CONTROL Cobble/Boulder STEP Approx 10 FEET Downstream of Cross Section

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 61 C (F°) Water 54.9 C (F°)

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

R-137c

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS _____

*THIS IS SITE #11 and it REPLACES SITE 9 MEASURED IN 2002. SITE 11 is Approximately ONE RIVER-MILE UPSTREAM OF SITE 9, due EAST OF THE VISITOR CENTER, and BELOW A WEST-FACING CLIFF FACE CONTAINING TWO "Windows" THAT MAKE THE CLIFF FACE APPEAR TO BE AN Indian Ruin.

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

HMST v2.6 One-Point Velocity Discharge Measurement Checker

By Brian Loving, Hydrologist, US Geological Survey

Station Name:	Castle Unit				
Station Number:	11	WIDTH	6.200	# of Sections	32
Date:	10/30/2003	AREA	3.317	Sections > 5%	6
Measurement #:	3	VELOCITY	0.413	Sections > 10%	0
Pygmy or AA (p/a)	p			*Standard Error	6.58%
Rating # (1 or 2)	2	TOTAL DISCHARGE	1.369		FAIR

Print Header | Print Full Sheet | Clear Sheet

* Standard error computed using OFR 92-144 Method

Rod

Stable (uneven, gravel-boulders)

Correction Coefficient	Distance	Width	Depth	Revolutions	Seconds	Velocity At Point	Mean Velocity	Adjusted Velocity	Area	Discharge
	3.8	0.10	0.45			0.000	0.000	0.000	0.045	0.000
	4	0.20	0.46	31	40.3	0.770	0.770	0.770	0.092	0.071
	4.2	0.20	0.5	23	40.3	0.579	0.579	0.579	0.100	0.058
	4.4	0.20	0.49	22	41.3	0.543	0.543	0.543	0.098	0.053
	4.6	0.20	0.5	23	40.2	0.581	0.581	0.581	0.100	0.058
	4.8	0.20	0.5	27	42.3	0.644	0.644	0.644	0.100	0.064
	5	0.20	0.61	25	41	0.617	0.617	0.617	0.122	0.075
	5.2	0.20	0.63	18	41.3	0.450	0.450	0.450	0.126	0.057
	5.4	0.20	0.61	13	42.5	0.325	0.325	0.325	0.122	0.040
	5.6	0.20	0.61	10	45.3	0.243	0.243	0.243	0.122	0.030
	5.8	0.20	0.62	6	45.9	0.157	0.157	0.157	0.124	0.019
	6	0.20	0.62	4	63.7	0.092	0.092	0.092	0.124	0.011
	6.2	0.20	0.62	5	47.3	0.133	0.133	0.133	0.124	0.016
	6.4	0.20	0.58	8	41.3	0.217	0.217	0.217	0.116	0.025
	6.6	0.20	0.5	17	42.4	0.416	0.416	0.416	0.100	0.042
0.99	6.8	0.20	0.48	21	40	0.535	0.535	0.530	0.096	0.051
0.99	7	0.20	0.48	22	40.7	0.550	0.550	0.545	0.096	0.052
0.99	7.2	0.20	0.53	21	40	0.535	0.535	0.530	0.106	0.056
0.99	7.4	0.20	0.54	23	40.6	0.575	0.575	0.570	0.108	0.062
	7.6	0.20	0.48	23	40.3	0.579	0.579	0.579	0.096	0.056
	7.8	0.20	0.6	23	40.6	0.575	0.575	0.575	0.120	0.069
	8	0.20	0.61	26	41.5	0.633	0.633	0.633	0.122	0.077
	8.2	0.20	0.58	29	40.9	0.712	0.712	0.712	0.116	0.083
	8.4	0.20	0.52	28	40.5	0.695	0.695	0.695	0.104	0.072
	8.6	0.20	0.5	21	40.6	0.528	0.528	0.528	0.100	0.053
	8.8	0.20	0.58	14	40.1	0.367	0.367	0.367	0.116	0.043
	9	0.20	0.55	11	40.5	0.292	0.292	0.292	0.110	0.032
	9.2	0.20	0.52	9	41.6	0.239	0.239	0.239	0.104	0.025
	9.4	0.20	0.52	4	48.4	0.111	0.111	0.111	0.104	0.011
	9.6	0.20	0.52	3	63	0.077	0.077	0.077	0.104	0.008
	9.8	0.20	0.5	0	0	0.000	0.000	0.000	0.100	0.000
	10	0.10	0	0	0	0.000	0.000	0.000	0.000	0.000

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1103 1

S_q	S_d	S_t	S_i	S_s	S_l	S_v
6.578868	9.5302	5.796419	5.24827	2.9635	0.137931	1.5157

b	9.530232
c	18.73992
e	
f	

Select a Bed Type:

Stable (even, firm, smooth)
Stable (uneven, gravel-boulders)
Soft (mud, silt)
Moble (shifting sand, dunes)
Stable (high velocity and VERTICAL angles)
Unstable (high velocity and VERTICAL angles)
Stable (u

2

Select a Suspension Type:

Rod
Cable

Rod

1

b	c				# secs	5+ secs	10+ secs
11.2896763	22.31204				1	0	0
11.0520337	21.83094	5.896885	1.946841	0	1	1	0
10.198039	20.09975	5.896885	2.120299	0	1	0	0
10.3982346	20.50593	5.856553	2.162132	0	1	0	0
10.198039	20.09975	5.900989	2.118804	0	1	0	0
10.198039	20.09975	5.817452	2.053818	0	1	0	0
8.43719386	16.51499	5.86852	2.080785	0	1	1	0
8.18462939	15.99852	5.856553	2.543004	0	1	0	0
8.43719386	16.51499	5.809773	3.880139	0	1	0	0
8.43719386	16.51499	5.706904	5.655479	0	1	0	0
8.30881582	16.25256	5.685917	10.01151	0	1	0	0
8.30881582	16.25256	5.187392	20.15337	0	1	0	0
8.30881582	16.25256	5.638284	12.42842	0	1	0	0
8.84964915	17.35699	5.856553	6.54993	0	1	0	0
10.198039	20.09975	5.813507	2.812291	0	1	0	0
10.6069291	20.92911	5.909235	2.171034	1	1	0	0
10.6069291	20.92911	5.8806	2.1532	1	1	0	0
9.6436323	18.97363	5.909235	2.171034	1	1	0	0
9.47279695	18.62621	5.884652	2.124767	1	1	0	0
10.6069291	20.92911	5.896885	2.120299	0	1	0	0
8.56997342	16.78624	5.884652	2.124767	0	1	1	0
8.43719386	16.51499	5.848636	2.064775	0	1	1	0
8.84964915	17.35699	5.872534	1.992956	0	1	1	0
9.82118228	19.33449	5.888717	2.007443	0	1	1	0
10.198039	20.09975	5.884652	2.180181	0	1	0	0
8.84964915	17.35699	5.905106	3.318514	0	1	0	0
9.30830963	18.29149	5.888717	4.458095	0	1	0	0
9.82118228	19.33449	5.844696	5.785957	0	1	0	0
9.82118228	19.33449	5.602107	15.75812	0	1	0	0
9.82118228	19.33449	5.203466	25.25187	0	1	0	0
10.198039	20.09975				1	0	0
					1	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0
					0	0	0

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River at—

Angle coefficient	Dist. from initial point		Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or ----	Area	Discharge
1000	3.8	0.10 .2	.45	.6						RB	(VERTICAL)
	4.0	.2	.46	.6	31	40.3	.770			0.092	.0781
	4.2	.2	.50	.6	23	40.3	.579			.100	.058
	4.4	.2	.49	.6	22	41.3	.543			.098	.053
	4.6	.2	.50	.6	23	40.2	.581			.100	.058
	4.8	.2	.50	.6	27	42.3	.644			.100	.064
	5.0	.2	.61	.6	25	41.0	.617			.122	.075
	5.2	.2	.63	.6	18	41.3	.450			.126	.057
	5.4	.2	.61	.6	13	42.5	.325			.122	.040
	5.6	.2	.61	.6	10	45.3	.243			.122	.030
	5.8	2	.62	.6	6	45.9	.157			.124	.019
	6.0	.2	.62	.6	4	63.7	.098 2			.124	.0121
	6.2	.2	.62	.6	5	47.3	.133			.124	.016 0.557
	6.4	.2	.58	.6	8	41.3	.217			.116	.025
°	6.6	.2	.50	.6	17	42.4	.416			0.100 .110	.046 2.00
	6.8	.2	.48	.6	21	40.0	.535		.99	.096	.051 (.050) °
	7.0	.2	.48	.6	22	40.7	.550		.99	.096	.052 (.052)
	7.2	.2	.53	.6	21	40.0	.535		.98	.106	.057 (.056)
	7.4	.2	.54	.6	23	40.6	.575		.99	.108	.062 (.061)
	7.6	.2	.48	.6	23	40.3	.579		—	.096	.056 .801
	7.8	.2	.60	.6	23	40.6	.575			.120	.069
	8.0	.2	.61	.6	26	41.5	.633			.122	.077
	8.2	.2	.58	.6	28	40.9	.712			.116 .108	.083 .053
	8.4	.2	.52	.6	28	40.5	.695			.104	.072
	8.6	.2	.50	.6	21	40.6	.528			.100	.053
	8.8	.2	.58	.6	14	40.1	.366 7			.116	.042 3 1.303
	9.0	.2	.55	.6	11	40.5	.292			.110	.032
	9.2	.2	.52	.6	9	41.6	.239			.104	.025
	9.4	.2	.52	.6	4	48.4	.110 1			.104	.011
	9.6	.2	.52	.6	3	63	.077			.104	.008
	9.8	.2	.50	.6	0		0			.104 0	
1046	10.0	0.10 .2		.6				L B			

12.767 3.292 1.379 1.369

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1003

0 SECTIONS = 5 Co.
ERROR: 6.58%
F

(Sept,1999)

UNITED STATES
DOI-NPS-WRD
WATER RIGHTS BRANCH

DISCHARGE MEASUREMENT NOTES

Meas. No. 3

DATE 10/30/03 Comp by JW Checked by FIECHTNER

PARK MOCA STATION Site - 9 (11) - Beaver Cr @ Castle Unit

PERSONNEL: Meter J HARTE Notes J WARD

MEASUREMENT TYPE (circle one) (Wading) Cable, Bridge, Boat, Ice; Upstr., Dnstr., ___ ft., mi. of gage

Measurement Time/G.H.: Local Standard (24hr) Start: 0954 G.H. .29 Stop: 1046 G.H. .29

METER TYPE PYGMY S/N P90237 SPIN Before Meas. 457 After 457

WEATHER SUNNY

HIGH WATER MARK _____ Gage Height of .Zero .Flow. _____ ft.

CREST STAGE CHECKED: Yes/(No) _____ READING _____ ft.

GAGE READINGS

Time	Staff Plate	Sensor	Time	Staff Plate	Sensor
0954	0.29				
1046	0.29				

3.317 0.413 ~~1.377~~ 1.369

FLOW: Width 6.2 FT Area ~~329 FT²~~ Ave. Vel. ~~.426 $F_{/S}$~~ G.H. .29 Disch. ~~1.38~~

Method .6 Method coeff. ____ Hor. Angle coeff. ____ Susp. type ____ Susp. coeff. ____

Meter ____ ft. above bottom of weight No. Secs. 32 G.H. changes 0 ft. in 52/60 hrs.

FLOW VARIED, NON-UNIFORM, EDDY EFFECT NEAR MID-CHANNEL

Cross Section Rough Cobble/boulder, dense root-mat banks with some undercutting

CONTROL Cobble/Boulder STEP Approx. 10 FEET Downstream of Cross Section

CHANGED Sensor/Datalogger parameters (circle if yes)? If yes fill in applicable spaces below:

Make/Model/PSI Range _____

S/N _____ P/N _____

Conversion slope _____ Conversion offset _____ Ex. Volt. _____ Output Range _____

NITROGEN TANK PRESSURE _____ FEED _____ BBL RATE _____ per. min.

INTAKE/ORIFICE CLEANED _____ TEMPERATURE: Air 72 C° (F°) Water _____ C° (F°)

PHOTOS TAKEN: Roll(s) # _____ Frame(s) # _____

R-1400

OTHER MEASUREMENTS

WATER QUALITY: Yes/No Time _____ Samples: Yes/No Time _____

Method: EDI _____ EWI _____ Other _____

SEDIMENT: Yes/No Time _____ Method: EDI _____ EWI _____ Other _____

BIOLOGICAL: Yes/No Time _____ Type _____

OBSERVATIONS/COMMENTS

* THIS SITE IS # 11 AND IT REPLACES SITE 9 MEASURED IN 2002. SITE 11 IS APPROXIMATELY ONE RIVER-MILE UPSTREAM OF SITE 9, DUE EAST OF THE VISITOR CENTER, AND BELOW A WEST-FACING CLIFF FACE CONTAINING TWO "WINDOWS" THAT GIVE THE CLIFF FACE THE APPEARENCE OF AN INDIAN RUIN.

LEVEL NOTES

EQUIPMENT TYPE _____ S/N _____

PERSONNEL: Instrument/Notes _____ Rod _____

STATION	B.S.	H.I.	F.S.	ELEV.	COMMENTS

APPENDIX C

USGS Station Number 09505200 Information

MOCA
October 30, 2003 Seepage Run
Beaver/Wet Beaver Creek
Yavapai County, Az

Water Resources

Data Category: Site Information | Geographic Area: Arizona | GO

USGS 09505200 Wet Beaver Creek Near Rimrock, AZ

Available data for this site | Station home page | GO

Station Description

LOCATION
Latitude 34°40'29", Longitude 111°40'17" NAD27,
Yavapai County, Arizona , Hydrologic Unit 15060202

DRAINAGE AREA
111.00 square miles

GAGE
Datum of gage is 4,020. feet above sea level NGVD29.

STATION TYPE:
Surface Water

STATION DATA:

Data Type	Begin Date	End Date	Count
Real-time	This is a real-time site		
Peak streamflow	1962-02-12	2002-09-10	41
Daily streamflow	1961-10-01	2002-09-30	13444
Water Quality Samples	1967-09-15	1977-06-21	5

SITE OPERATION:
Site is located in Arizona; record is maintained by Arizona

CONTACT INFORMATION
Email questions about this station to gs-w-az_NWISWeb_Data_Inquiries@usgs.gov

Questions about data gs-w-az_NWISWeb_Data_Inquiries@usgs.gov Top
Feedback on this website gs-w-az_NWISWeb_Maintainer@usgs.gov Explanation of terms

**** USGS 09505200 Wet Beaver Creek Near Rimrock, AZ**
http://waterdata.usgs.gov/az/nwis/nwisman?

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0.75 0.73 sd

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Water Resources

Data Category: Real-time | Geographic Area: Arizona | GO

USGS 09505200 Wet Beaver Creek Near Rimrock, AZ

PROVISIONAL DATA SUBJECT TO REVISION

Available data for this site: Recent daily | GO

Station operated in cooperation with the Salt River Valley Water Users' Association, the Arizona Department of Water Resources, and the USGS.

Available Parameters	Output format	Days	
All 4 parameters available at this site 00060 Discharge Maximum (DD 01) 00060 Discharge Mean (DD 01) 00065 Gage height Mean (DD 02)	Table	31 (1-730)	get data

Date	Gage height, feet (DD 02) (Mean)	Stream-flow (ft^3/s) (DD 01) (Maximum)	Stream-flow (ft^3/s) (DD 01) (Mean)	Precip-itation total, inches (DD 03) (Sum)
10/05/2003	2.77	7.40	7.20	.00
10/06/2003	2.77	7.40	7.20	.00
10/07/2003	2.77	7.40	7.30	.00
10/08/2003	2.77	7.40	7.20	.00
10/09/2003	2.77	7.40	7.20	.00
10/10/2003	2.78	7.60	7.30	.00
10/11/2003	2.78	7.60	7.40	.00
10/12/2003	2.77	7.40	7.20	.00
10/13/2003	2.77	7.40	7.20	.00
10/14/2003	2.77	7.40	7.10	.00
10/15/2003	2.77	7.40	7.20	.00
10/16/2003	2.77	7.80	7.30	.00
10/17/2003	2.77	7.40	7.20	.00
10/18/2003	2.77	7.40	7.20	.00

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10/19/2003	2.77	7.40	7.20	.00
10/20/2003	2.77	7.40	7.20	.00
10/21/2003	2.77	7.40	7.20	.00
10/22/2003	2.77	7.40	7.20	.00
10/23/2003	2.77	7.40	7.30	.00
10/24/2003	2.77	7.40	7.30	.00
10/25/2003	2.77	7.40	7.20	.00
10/26/2003	2.77	7.40	7.20	.00
10/27/2003	2.78	7.60	7.40	.00
10/28/2003	2.78	7.60	7.40	.00
10/29/2003	2.78	7.40	7.40	.00
10/30/2003	2.78	7.60	7.40	.00
10/31/2003	2.78	7.60	7.40	.00
11/01/2003	2.79	7.80	7.70	.11
11/02/2003	2.80	7.80	7.80	.05
11/03/2003	2.80	7.80	7.80	.00
11/04/2003	2.80	7.80	7.70	.00

Questions about data gs-w-az_NWISWeb_Data_Inquiries@usgs.gov Top
eedback on this websitegs-w-az_NWISWeb_Maintainer@usgs.gov Explanation of terms

Daily Data for Arizona
http://waterdata.usgs.gov/az/nwis/dv?

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0.92 0.9 sd

C-3

Daily Streamflow Statistics for the Nation

USGS 09505200 Wet Beaver Creek Near Rimrock, AZ

Available data for this site: Surface-water: Daily streamflow statistics | GO

Yavapai County, Arizona
Hydrologic Unit Code 15060202
Latitude 34°40'29", Longitude 111°40'17" NAD27
Drainage area 111.00 square miles
Gage datum 4,020. feet above sea level NGVD29

Output formats

HTML table of all data | Tab-separated data | Reselect output format

Day of month	Mean of daily mean values for this day for 37 years of record[1], in ft^3/s											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	16.5	38.0	152	103	21.2	6.93	6.51	13.4	12.7	6.85	9.41	9.01
2	15.6	29.3	123	97.8	17.3	6.92	6.48	9.08	14.1	6.91	8.99	8.05
3	12.2	24.4	107	95.7	17.4	6.93	6.51	10.4	7.47	6.95	8.66	8.73
4	11.0	21.0	92.2	108	18.7	7.03	6.51	14.9	7.14	7.06	8.71	7.77
5	12.5	26.7	128	98.4	18.5	6.91	6.82	9.14	59.5	6.99	9.82	10.8
6	63.1	30.8	150	99.6	13.9	6.93	6.89	14.0	21.1	7.59	8.36	25.5
7	150	34.1	87.8	95.9	11.8	6.88	6.74	10.8	9.16	41.9	8.12	46.5
8	167	39.1	83.9	85.4	13.4	6.84	6.76	7.55	7.53	10.2	7.65	13.1
9	24.5	104	86.7	75.7	16.4	6.79	6.70	7.41	7.07	7.63	10.1	9.50
10	18.7	58.2	90.5	81.3	13.8	6.78	6.75	10.2	15.6	7.12	8.54	42.3
11	18.2	67.5	93.1	83.9	11.3	6.76	6.67	8.69	11.4	6.94	8.72	17.9
12	16.7	61.8	174	83.8	10.9	6.74	6.95	8.14	8.89	6.90	23.2	12.1
13	19.0	71.7	112	87.1	10.1	6.72	6.95	10.8	8.99	6.95	12.2	10.3
14	30.8	140	99.8	76.2	9.90	6.71	6.80	9.77	7.53	7.00	11.2	8.89
15	28.7	174	92.0	68.0	9.46	6.66	9.33	9.41	9.27	6.99	13.2	9.69
16	26.3	64.8	96.2	58.8	9.35	6.62	10.7	7.58	7.65	6.97	11.4	9.68
17	128	57.7	112	55.2	8.01	6.64	13.4	7.08	7.15	7.07	17.0	12.2
18	61.1	77.7	112	49.3	7.61	6.63	7.60	7.16	7.06	7.45	11.4	138
19	33.2	126	103	48.0	7.43	6.58	7.74	8.09	7.07	88.4	9.67	63.4
20	24.9	130	98.5	53.1	7.29	6.53	6.95	8.00	7.08	36.7	9.55	18.6
21	25.1	73.5	97.8	51.9	7.28	6.50	8.79	7.48	6.95	11.9	8.89	14.7
22	27.9	68.9	116	47.6	7.57	6.54	9.98	9.19	6.95	9.17	8.52	43.8
23	18.0	59.2	97.5	47.6	7.21	6.55	8.27	55.0	26.5	7.99	23.3	38.7

24	13.8	49.7	97.9	41.9	7.13	6.53	7.79	12.8	14.4	8.93	15.9	22.0
25	36.6	46.3	83.8	39.9	7.09	6.52	10.7	7.96	7.98	31.5	84.6	26.3
26	63.6	46.0	77.0	35.8	7.52	6.55	8.93	7.72	7.14	15.2	22.1	51.2
27	48.1	47.7	83.2	32.5	7.22	6.48	15.5	9.89	7.08	11.1	13.5	17.8
28	34.2	100	108	32.1	7.08	6.49	7.90	7.32	7.01	10.3	10.2	64.4
29	27.8	57.2	103	28.2	7.04	6.53	14.3	7.08	6.97	9.37	8.88	30.4
30	67.3		90.4	24.6	7.01	6.49	7.21	7.00	6.92	11.5	11.3	83.1
31	38.3		96.5		6.96		20.2	6.95		11.8		27.8

1 -- Available period of record may be less than value shown for certain days of the year.

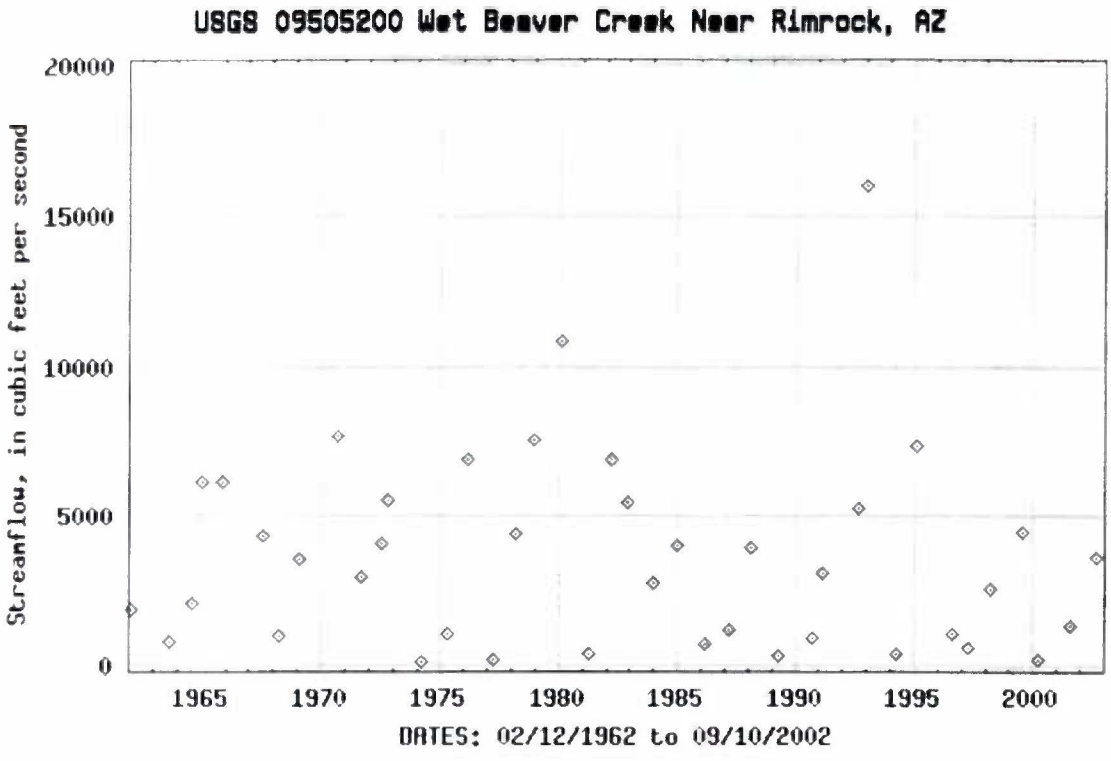
Questions about data h2oteam@usgs.gov
Feedback on this websitegs-w_support_nwisweb@usgs.gov

Top
Explanation of terms

Surface Water data for USA: Daily Streamflow Statistics
http://waterdata.usgs.gov/nwis/dvstat?

Retrieved on 2003-11-06 16:23:51 EST
Department of the Interior, U.S. Geological Survey
Privacy Statement || Disclaimer || Accessibility
0.78 0.79 nadww01

USGS


USGS 09505200 Wet Beaver Creek Near Rimrock, AZ
Streanflow, in cubic feet per second
20000
15000
10000
5000
0
1965
1970
1975
1980
1985
1990
1995
2000
DATES: 02/12/1962 to 09/10/2002

APPENDIX D

Seepage Run Information Handouts

MOCA
October 30, 2003 Seepage Run
Beaver/Wet Beaver Creek
Yavapai County, Az

Montezuma Castle National Monument
Wet Beaver Creek Seepage Run
Wednesday, October 29 and Thursday, October 30, 2003
SUMMARY OF ACTIVITIES

Wednesday, October 29, 2003, 4:00pm

All participants will meet in the lobby of the Camp Verde Comfort Inn. We'll pass out information packets and discuss the logistics of the seepage run, assign teams, assign team measuring sites, distribute equipment, and discuss discharge measurement protocol. Each team can drive to their measuring sites and determine how long it will take to get to each site and where the measuring cross-section is located. We can meet back at the Comfort Inn after teams have seen their measuring sites and answer any questions.

Thursday, October 30, 2003, 08:00am

Each team will be assigned two measurement sites on Wet Beaver Creek. Each team will make 2 discharge measurements at each site. At the first site measurements will be taken 08:00am and 10:00am. At the second site measurements will be taken at 12:30pm and 2:30pm. This schedule should give each team time to relocate to the second site, have a bite to eat, and start the first measurement at 12:30pm (please refer to the "**SCHEDULE**"). You will need a sack lunch and water.

The cross section at each measuring site will be marked on the right bank and left bank with rebar wrapped with orange flagging. The measuring tape can be stretched between the two pieces of rebar using the rebar as end pins or you can use some other type of metal pins. **(If for some reason the rebar has been removed set your own cross section for the measurement).** A staff gage attached to a piece of rebar will be installed in the stream channel within easy view of the cross section at each measuring site. **(If for some reason the staff plate has been removed set a staff gage using your engineer's ruler).**

After completing the second discharge measurement at each of the 2 sites, (and after noting the ending time and ending staff gage reading), remove the flagged rebar endpins and staff gage and return them at the end of the day. We will meet at the Montezuma Castle NM Office at 527 Main Street in Camp Verde following the last discharge measurement of the day. At the Montezuma Castle NM office you will turn in the (4) Discharge Measurement Notes forms you will have filled out and any equipment and we can discuss any problems encountered during the seepage run. We should be done around 4:00pm.

Thank you very much for your participation in the seepage run!

Montezuma Castle National Monument
Wet Beaver Creek Seepage Run
Wednesday, October 29 and Thursday, October 30, 2003
SCHEDULE

Wednesday, October 29, 2003

4:00pm – All participants meet at the Camp Verde Comfort Inn lobby for orientation
- Team Assignments
  - Distribute equipment and information packets
  - Discuss schedule for October 30
  - Discuss site assignments
  - Discuss site access
  - Discuss discharge measurement schedule
  - Discuss discharge measurement protocol
- Drive to measurement sites
- Return to Comfort Inn with any questions

6:00pm - Adjourn

Thursday, October 30, 2003

08:00am – Teams start the first discharge measurement at the first site
10:00am – Teams start the second discharge measurement at the first site

Lunch – Teams move to their second measurement site

12:30pm – Teams start the first discharge measurement at the second site
2:30pm – Teams start the second discharge measurement at the second site

4:00pm (as soon as the last discharge measurement is completed) – All teams meet at the Montezuma Castle NM office at 527 Main Street in Camp Verde
- Hand in measurement note sheets
- Hand in equipment
- Discuss any problems with seepage run
- Done for the day!

Montezuma Castle National Monument
Wet Beaver Creek Seepage Run
Thursday, October 30, 2003

EQUIPMENT LIST
TEAM ASSIGNMENTS

The Montezuma Castle NM Wet Beaver Creek seepage run will begin at 08:00 on Thursday, October 30, 2003. We will meet in the lobby of the Comfort Inn in Camp Verde at 4pm on Wednesday, October 29 to discuss the seepage run schedule, teams, assigned measurement sites, logistics, protocol, hand out equipment and information packets, and do a dry run to the measurement sites.

We'll need (6) pygmy meters (5 working meters and 1 spare) and associated equipment:

1. Pygmy meter
2. Wading rod
3. Digitizer/Counter w/pigtail
4. Measuring tape
5. Clip board
6. Q-tips and oil
7. Engineer's Ruler
8. Metal pins
9. Stop watch
10. Extra batteries
11. Thermometer
12. Vice Grips

Pygmy meters will be supplied by:

1. NPS WRD (Fort Collins) – 3 pygmy meters with equipment
2. Colleen Filippone (NPS, Tucson) – 1 pygmy meter with equipment
3. Virginia Bartling (NPS, Montezuma Castle NM) – 1 pygmy meter with equipment
4. Zach Mondry (USFS, Flagstaff) – 1 pygmy meter with equipment

Vehicles will be supplied by:

1. Paul Christensen – 4 x 4 SUV
2. Jeff Albright – Rental (4 x 4 ?)
3. Zach Mondry – USFS vehicle
4. Colleen Filippone – NPS vehicle
5. Virginia Bartling – NPS vehicle

Recommended equipment:

1. Waders/wading shoes
2. Calculator
3. Cell phone
4. Wrist watch
5. Sack lunch
6. Water
7. sunscreen/bug juice

Team Assignments:

Measurement	Notes
1. Chris Gable	Carmia Fiechtner
2. Jim Harte	John Ward
3. Jeff Hughes	Colleen Filippone.
4. Jeff Albright	Virginia Bartling
5. Zach Mondry	Paul Christensen

Montezuma Castle National Monument
Wet Beaver Creek Seepage Run
Thursday, October 30, 2003
PROTOCOL

For this seepage run we will be using standard USGS discharge measurement protocol. A copy of the "Surface Water Quality-Assurance Plan for the Virgin River Synoptic Discharge Measurements of February 12, 2003" is attached. Please review the Section entitled "Direct Measurements of Discharge" beginning on page 9. The standard protocol we'll use for each discharge measurement includes:

1. A spin test will be performed before the **start** and after the **end** of each discharge measurement **(NOTE: the "end" spin test from measurement 1 can be used for the "start" spin test for measurement 2, and so on, but start and end spin test results must be recorded on each Discharge Measurement Notes form)**. The spin test should be performed in a windless area and the cups must spin freely for a minimum of 45 seconds. Record the time and results of each spin test (in minutes and seconds or "45+ seconds" is acceptable) on the Discharge Measurement Notes form.
2. A measuring tape will be stretched tight and level between the cross section end points (in this case the orange-flagged rebar or metal pins you provide).
3. A staff gage reading will be taken before the **start** and after the **end** of each discharge measurement and recorded with the time on the Discharge Measurement Notes form.
4. The **start** time and **end** time of each discharge measurement will be recorded on the Discharge Measurement Notes form.
5. Wading rod "depth" measurements will be recorded to 100ths of a foot (.01).
6. Sections (verticals) will be spaced to ensure that the **discharge in each section does not exceed 5% of the total discharge**. Vertical spacing **should be not less than .25 feet** and **will be not less than .20 feet**. (NOTE: There will likely be a few sections less than .2 feet wide but they should account for little or no discharge).
7. Discharge measurements will be taken at "about" 30 verticals per measurement section. For measurement sections where it is not possible to fit in 30 verticals the maximum number of verticals will be measured while maintaining a spacing of **not less than .20 feet**.
8. Compute the discharge from the first measurement and adjust section (vertical) widths, if necessary, to ensure that the discharge in each section does not exceed 5% of the total discharge.
9. Compute the total discharge for each measurement following the measurement and record the total discharge on the Discharge Measurement Notes form. Fill out the Discharge Measurement Notes sheet completely for each measurement.
10. After the third discharge measurement is completed remove the flagged rebar endpins and proceed to the second discharge measuring site.

APPENDIX E

June 13, 2002 Seepage Run Report by Eric Moser

MOCA
October 30, 2003 Seepage Run
Beaver/Wet Beaver Creek
Yavapai County, Az

Trip Report to Montezumas Castle for the Purpose of Conducting a Seepage Run on Wet Beaver Creek

Eric Moser
Hydrologist, WRB
June 26, 2002

Purpose

A seepage run was conducted on Wet Beaver Creek on June 13, 2002 by members of the National Park Service (NPS) and National Forest Service (NFS). Park Service employees included Eric Moser, and Scott Grover of the Water Resources Division, Water Rights Branch (WRB), and Virgina Bartling of Montezumas Castle National Monument (MOCA), and John Rihs of Grand Canyon National Park. Forest Service employees included Zackary Mondry and Jack Norman of Coconino National Forest. The purpose was to ascertain gains and losses on a portion of the stream from Coconino National Forest down stream through the two units of MOCA. Presently the stream becomes segmented in the lower, Castle unit. There are thirteen surface diversion in the Wet Beaver/Beaver Creek drainage shown in the Arizona Department of Water Resources (ADWR) study of the Verde River (ADWR, 2000). Ten diversions are on Wet Beaver and Beaver Creek, two on Red Tank Draw, and one on Walker Creek, both tributaries to Wet Beaver Creek. A reconnoiter of the stream was done on June 12, by Moser and Grover to identify good access points and ground truth the ADWR map.

Surface Diversions Descriptions

The map included shows the project area, including location of diversions indicated by ADWR maps and their status. The two diversions on Red Tank Draw and the one on Walker Creek were not included, because both streams were dry at their confluence with Wet Beaver Creek, and at least Red Tank Draw was dry throughout its course upstream past the noted diversions. The Walker Creek diversion is a good distance upstream without good access. The remaining ten diversions are marked on the map, A-K, starting at the upstream end.

Ditch A. A begins as an earthen dug ditch, but through the center portion of Section 23, T15N R 6E, about one mile east of the Southwestern Academy it runs as a 24" welded pipe. The pipe ends abruptly about 10 feet above the stream on an outcrop of Supai, red sandstone, Formation in the NW ¼ of the SE ¼ of Section 23.

Ditch B. Ditch B is actually the same ditch line as A. This portion carries a six inch pipe running water from a capped spring at about the 4260' elevation, on the south side of Wet Beaver Creek, one half mile upstream of the Southwestern Academy in the SE ¼ of the NW ¼ of Section 23. This ditch appears on the state registry (reg# 4A-880.0) under the name of Beaver Creek Ranch. The quantity listed is 7238 acre-feet per year, which works out to about 10 cfs on a mean daily basis. The piped spring aqueduct may be filed under Clanci Enterprises (reg# 36-66012.0), for the amount of 48.8 acre-feet per year, which is 0.07 cfs mean daily.

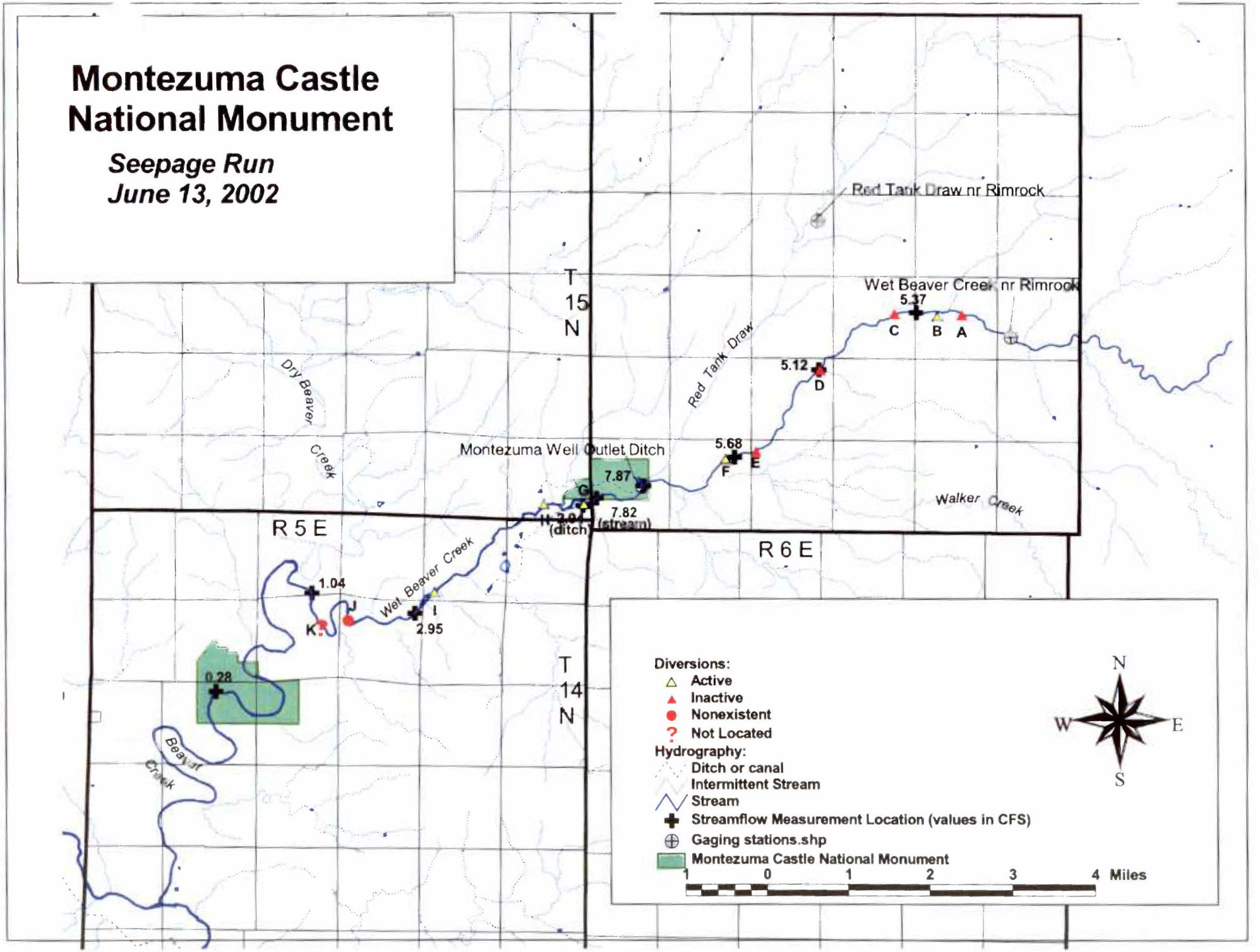
Ditch C. C is dry with many large slumps in places effectively breaching it throughout its length. Long sections are choked nearly to the top with fines that have sifted downslope on the dry, south aspect. The headwork is a 18" culvert in the bank leading to a masonry drop structure at ground level near the back of the floodplain the leads to another pipe, and eventually into a earthen dug ditch. This may be either registered to Mary Stimpson (reg# 36-62725.0) with a quantity of 45 acre-feet per year (0.06 cfs mean daily), or under registry # 36-104753.0, with a quantity of 85 acre-feet per year (0.12 cfs mean daily). The latter registry has no name attached.

Ditch D. D was dry and has no effective headwork in the stream. There was heavy growth of brush and small trees in the first one hundred yards with large breaches. This ditch is registered with the state with no name (reg# 36-32517.1). The amount is 78 acre-feet per year, which is 0.11 cfs on a mean daily basis.

Ditch E. E is dry with many large breaches. It has no discernible headwork in the stream and has been washed away at the road crossing. This ditch is registered to the Soda Springs Ranch (reg# 36-28573.0) with a quantity of 618.4 acre-feet per year, or a mean daily flow of 0.86 cfs.

Ditch F. F begins just downstream of Lawrence Crossing. The headwork is a loose rock dam about 2 feet high that creates enough head to shunt water into the ditch. The initial intake was estimated at 1-2 cfs. However the ditch has several large leaks that vent immediately into the stream which courses at the foot of the slope below the ditch throughout its length. Within one half mile the ditch goes onto the Soda Spring Ranch property, and was estimated to running no more than ¼ cfs. This ditch does not appear on the state registry.

Ditch G. This ditch is the water source for the Beaver Creek Golf Course irrigation. The headwork is a loose rock dam in the stream, about two feet high that creates enough head to push into the ditch. The ditch flow was measured on 6/13/02 and will be discussed further on. This ditch appears on the state surface water registry (reg#


Montezuma Castle
National Monument
Seepage Run
June 13, 2002
Red Tank Draw nr Rimrock
Wet Beaver Creek nr Rimrock
5.37
C
B
A
5.12
D
Red Tank Draw
Dry Beaver Creek
Montezuma Well Outlet Ditch
5.68
F
E
7.87
G
7.82
(stream)
(ditch)
Walker Creek
T 15 N
R 5 E
R 6 E
T 14 N
Wet Beaver Creek
1.04
J
K
I
2.95
0.28
Beaver Creek
Diversions:
Active
Inactive
Nonexistent
Not Located
Hydrography:
Ditch or canal
Intermittent Stream
Stream
Streamflow Measurement Location (values in CFS)
Gaging stations.shp
Montezuma Castle National Monument
N
W
E
S
1 0 1 2 3 4 Miles

E-4

*--two measurements made at these locations. Flow is an average.

Conclusions

There is a large gain in flow (about 50%) between Lawrence Crossing and the Well outlet, a distance of about one stream mile. There are four tributary sources including Walker Creek, Red Tank Draw and Soda Spring between these points. Although there was no surface flow at the confluence of Walker Creek or Red Tank draw there may have been water movement in the valley alluvial. Also the size of Soda Spring or any other spring in that area is not known. This location is the approximate surface contact between the Supai sandstone and overlying, younger Verde limestone. Contacts are often sources of significant groundwater movement. The Supai is probably the source for many of the springs, and certainly the principle source of Montezumas Well, although the Verde probably also contributes (Konieczki and Leake, 1997)

Ditch F, which is the water source for the Beaver Creek Golf Course irrigation draws off three cfs, and is the greatest single diversion on the system. The Beaver Creek Golf Club is registered with the State (reg# 36-29341.1), filed on June 29, 1979, with a priority date of June 11, 1919, for amount of water annually of 2622 acre-feet. This works out to about 3.62 cfs on a mean daily basis.

There is a steady loss totaling over four cfs between the upper and lower units of MOCA, beyond that amount diverted in the golf course ditch. This loss may be mostly natural recharge into thicker alluvium or the underlying Verde Formation. Or, it may be induced by groundwater pumping from the alluvium or Verde Formation, if in the latter case the two units are hydraulically connected. Also Ditch I, which may be in a different location than mapped in the Verde River study, may be active and have claims on the state registry of surface water diversions for up to 1.1 cfs.

APPENDIX F

Protocol

MOCA
October 30, 2003 Seepage Run
Beaver/Wet Beaver Creek
Yavapai County, Az

Montezuma Castle National Monument
Wet Beaver Creek Seepage Run
Thursday, October 30, 2003
PROTOCOL

For this seepage run we will be using standard USGS discharge measurement protocol. A copy of the "Surface Water Quality-Assurance Plan for the Virgin River Synoptic Discharge Measurements of February 12, 2003" is attached. Please review the Section entitled "Direct Measurements of Discharge" beginning on page 9. The standard protocol we'll use for each discharge measurement includes:

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9. Compute the total discharge for each measurement following the measurement and record the total discharge on the Discharge Measurement Notes form. Fill out the Discharge Measurement Notes sheet completely for each measurement.
10. After the third discharge measurement is completed remove the flagged rebar endpins and proceed to the second discharge measuring site.

Surface Water Quality-Assurance Plan for the Virgin River Synoptic Discharge Measurements of February 12, 2003

Prepared by D. Beck
January 28, 2003

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CONVERSION FACTORS

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
foot (ft)	0.3048	meter
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer

Temperature: Degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) by using the formula °F = [1.8(°C)]+32. Degrees Fahrenheit can be converted to degrees Celsius by using the formula °C = 0.556(°F-32).

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929, formerly called "Sea-Level Datum of 1929"), which is derived from a general adjustment of the first-order leveling networks of the United States and Canada

Surface Water Quality-Assurance Plan for the Virgin River Synoptic Discharge Measurements of February 12, 2003

Introduction

Rapid population growth in southern Nevada has increased demand for additional water supplies. There are numerous pending applications before the Nevada State Engineer to develop regional ground-water resources near the Virgin River. The Virgin River originates in Zion National Park in Utah, flows in a southwest direction across Utah, Arizona, and Nevada, and discharges into the Overton Arm of Lake Mead. The river sustains riparian habitat for diverse wildlife, with a significant reach listed as critical habitat for the endangered Virgin River chub and woundfin minnow. Resource managers have concerns about the effects these future ground-water withdrawals could have on riparian ecosystems adjacent to the river and within nearby spring-discharge areas. Efforts are currently underway to acquire additional data to assess and predict the effects of these future ground-water withdrawals on the regional flow system. As part of these efforts, a seepage run is being conducted along the Virgin River in Nevada to identify potential losing and gaining reaches of the river.

A series of synoptic surface-water discharge measurements will be collected at about 19 sites along a selected reach of the lower Virgin River on February 12, 2003. The location of the measuring sites starts with the USGS surface-water gage (09413700) on the Virgin River above the Narrows near Littlefield, Arizona, and extends south to the former USGS gage (09415250) above Lake Mead near Overton, Nevada. Water and air temperature will be measured during the discharge measurements and water samples will be collected at the beginning, midpoint, and end of the measurements for determining specific conductance. A compilation of the discharge measurements and water-quality data will be provided by letter to the cooperating agencies by June 1, 2003 and will be incorporated into the USGS Nevada District's annual data report for Water Year 2003.

Responsibilities

Quality assurance (QA) is an active process. Achieving and maintaining high-quality standards for surface-water data are accomplished by specific actions carried out by specific persons. Errors and deficiencies can result when individuals fail to carry out their responsibilities. Clear and specific statements of responsibilities promote an understanding of each person's duties in the overall process of assuring surface-water data quality.

This section of the QA Plan provides a detailed and comprehensive summary of responsibilities related to the quality assurance of the collection of surface-water and water-quality data as part of the Virgin River synoptic run. The following is a list of responsibilities of District and other personnel involved in the collection, processing, storage, analysis, or publication of the aforementioned surface-water data.

The **Field Person** is responsible for correctly and accurately making discharge measurements of various types and in a safe manner, which includes, but is not limited to: testing, operating, and maintaining streamflow measuring equipment; following the procedures described in this quality-assurance plan; computing all discharge measurement notes in the field; and notifying the Project Chief, in a timely manner, if certain problems arise that would impact the completion or quality of the discharge measurements.

The **Project Chief** is responsible for coordinating all hydrologic data-collection activities with the various agencies and appropriate District personnel, preparing and distributing a comprehensive quality-assurance/safety plan to all participants, ensuring that all field personnel understand and follow all procedures and policies contained in the quality-assurance plan, documenting the location and description of discharge-measurement sites, checking and reviewing all field notes for completeness and accuracy, and preparing the data for provisional release and subsequent publication.

The **Data-Base Administrator** is responsible for creating new sites in the data base, plotting station locations on the District Master Map and assigning station numbers, and managing and maintaining the District surface-water database.

The **Surface-Water Specialist** is responsible for evaluating the collection of surface-water data activities for technical soundness and conformance to District quality-assurance procedures, and providing technical assistance to the project chief in the design and execution of project objectives.

Collection of Streamflow Data

The collection of streamflow data for the Virgin River synoptic run will be a collaborative effort between the U.S. Geological Survey (USGS), the National Park Service (NPS), the U.S. Fish and Wildlife Service (USFWS), the Las Vegas Valley Water Authority (LVVWA), the Nevada Division of Water Resources (NDWR), the Virgin Valley Water District, and Vidler Water Company, Inc. It is imperative that all participants are familiar with the procedures and policies described within this quality-assurance plan.

The highest priority in collecting streamflow data is employee safety. Training will be provided to all individuals who are involved in activities near, in, or over water as specified in WRD Memorandum 2000.11 http://1stop.usgs.gov/safety/memos/wrd/wrdpolicy00.11.html.

It is the policy of this District that all personnel involved in the collection of stage and discharge data are informed, trained, and follow the surface-water data-collection policies and procedures established by the WRD, technical offices, and the District.

Rounding and Accuracy

As accurately as we try to record our observations, we need to remember that our observations are seldom exact. The numbers are generally rounded off, thus being estimates of some true value. The procedure for rounding off number is described in Suggestions to Authors (ed. 7, p.119) and is presented in Appendix 1.

The accuracy and reporting of streamflow records are described in the annual data book and is presented in Appendix 1. Typically, streamflow values are recorded to three significant figures. Elsewhere in this report the level of accuracy required is discussed.

Site Documentation

Thorough documentation of qualitative and quantitative information describing each gaging station is required. This documentation, in the form of a station description, letter of permission, and photographs, provides a permanent historic record of site characteristics, structures, equipment, instrumentation, altitudes, location, and changes in conditions at each site.

A station description is prepared for each gaging station, water quality, or sediment data-collection site and becomes part of the permanent record for each station. **It is District policy that a rough draft station description will be written within 6 weeks of the site location being finalized and a complete description is written at the time the records are computed.**

Establishment of New Surface-water Stations

In the process of establishing a new surface-water data-collection station or reestablishing an old station, the following steps should be taken to make a record of site evaluation and to insure assignment of downstream order number, entry into the District's Master and Active Station Lists, and creation of necessary National Water Information System (NWIS) Files. A checklist for establishing a new site is located in a FrameMaker file on the DG at **\project\data\swater\templates\gage.install.checklist**.

A station description shall be prepared within 6 weeks once the site location has been finalized. It is understood that several aspects of the station description will be estimated, but that a minimum station description should be prepared including a road log. The location of the site will be determined in river miles for those sites where applicable. A sketch of the site shall be made at this time showing the relative locations of the reference marks. A location map will be prepared.

The field or project office should prepare and send a copy of a brief station description and a location map to the DBA within 6 weeks along with the NWIS surface-water site data form (http://wwwnwis.er.usgs.gov/conversion/nwisdocs3_2/gw/SW-site-form.pdf) so that station can be entered into NWIS.

After the construction of a station or the selection of a measurement site, a global positioning system (GPS) receiver should be used to determine the coordinates of the station. The DBA will use the coordinates determined by the GPS for locating the station on the District's master station map file, as well as, maintaining this map file.

Once the site is established the DBA will determine the drainage area, where applicable, within 6 months.

The DBM will update the District's Master List. All established sites that have relevance to determination of station numbers or drainage area within Nevada or within the District's operational boundaries will be included in the Master List of surface water sites.

The DBA will establish the NWIS Site File for any new site, which will be processing and/or storing data in the NWIS system.

Station Identification Number Assignment

The station identification number is a mandatory entry to the Station Header File, in NWIS on our DG computer. Each station for which data are entered in NWIS must have a single station identification number, unique to that one site, **which is assigned by the Data-Base Administrator**. The number should never be assigned to another site, except when the relocation of a site does not significantly change the drainage area of the basin upstream, and streamflow at the new site is equivalent to the old site. Should a station be destroyed or removed from service, its unique number will continue to be associated

in the historical files with the data from the deactivated site. In the event of an incorrect entry, corrections will be made by the DBA.

All Geological Survey offices are required to develop station identification numbers that conform to the current USGS criteria. A station identification number may be an eight-digit downstream order number or may be composed of latitude, longitude, and a two-digit sequence number (a total of 15 digits). In unusual circumstances, where an 8-digit downstream order number is not available, the DBA may assign a 9-digit or 10-digit downstream order number. The following sites require station identification numbers.

- Regular surface-water stations
- Regular surface-water water-quality sites
- Partial-record (surface-water and water-quality stations)
- **Surface-water sites at which miscellaneous measurements are made**
- Spring stations where discharge measurements are made

When a downstream order number is used, the number must contain eight-digits, thus, any preceding or following zeros must be included, such as "09421500". Punctuation such as periods or dashes must not be used in the number.

Photographs

Photographs of the data-collection sites or other areas are made by field personnel for the purpose of documenting channel and site conditions, or to supplement various forms of written descriptions. Each photograph that becomes part of the station record should be identified by writing on the back of the photograph with a permanent-ink marker, the station, date, from where the photograph was taken (left or right bank, position relative to a fixed structure) what the photograph is showing, and who took the photograph. The same information is required for photographs taken with a digital camera.

Direct Measurements of Discharge

Direct measurements of discharge are made using any one of a number of methods approved by WRD. The most common is the current-meter method.

A current-meter measurement is the summation of the products of the subsection areas of the stream cross-section and their respective average velocities (Rantz and others, 1982, p. 80). Procedures used for current-meter measurements are described in Rantz

and others (1982, p. 139); Carter and Davidian, 1968, p. 7, and Buchanan and Somers, 1969, p. 1.

When personnel make measurements of stream discharge, attempts are made to minimize errors. Sources of errors are identified in Sauer and Meyer, 1992. These include random errors such as depth errors associated with soft, uneven, or mobile streambeds, or uncertainties in mean velocity associated with vertical-velocity distribution errors and pulsation errors. These errors also include systematic errors, or bias, associated with improperly calibrated equipment or the improper use of such equipment. To minimize systematic errors, field trips can be rotated to different personnel.

District policies related to the measurement of discharge by use of the current-meter method, in accordance with WRD policies, include the following topics: Meter Use and Measurement Rating standardization, which are discussed below.

Field personnel who have questions concerning the appropriate procedures for making stage and discharge measurements should address their questions to the Project Chief.

Meter Use

The criteria for meter selection for wading measurements are well documented by Buchanan and Somers (1969) and Rantz and others (1982). These references are a little vague, however, in suggesting meter settings in shallow depths below the depths recommended for the meter. Table 1 provides the criteria used for meter selection. The following is an attempt to clarify and expand on instructions found in Rantz and others (1982).

Table 1. Current meter and velocity measurement

Water Depth (feet)	Use Meter	Section width (feet)	Method	Comments
2.5 and deeper	Type A, AA	0.4 or wider	0.2 and 0.8[1]	Meters not recommended for measuring velocities within 0.5 feet of the water surface or streambed. Velocities less than 0.2 feet per second may be subject to error.
1.25 to 2.5	Type A, AA	0.4 or wider	0.6	
0.3 to 1.25[2]	Pygmy	0.2 or wider	0.6	Meters not recommended for measuring velocities within 0.3 feet of the water surface or streambed. Velocities less than 0.25 feet per second or greater than 2.5 feet per second may be subject to error.
0.0 to 0.3	Use surface float, volumetric, weir, flume, or dye methods.			

[1] If the 0.2-velocity for the section is more than twice the 0.8-velocity at the section or if the 0.2-velocity is smaller than the 0.8-velocity; then the 0.6-velocity needs to be measured. The average for the section is determined by averaging the 0.2 and 0.8 readings and then adding this average to the 0.6 reading to determine the average for the section.

[2] There is an unknown under registration error when the meter is used in depths less than 0.75 ft.

For measurements where the majority of depths will be between 1.5 ft and 2.5 ft, use the standard AA meter and 0.6 depth settings. If some of the depths are less than 1.5 ft, do not change to a pygmy meter, but continue to use the AA meter, and continue to use the 0.6-depth setting to a water depth of 1.2 ft. For depths less than 1.2 ft, still use the 0.6 depth setting. There will be some error, but it is considered negligible since the total number of verticals with depths less than 1.2 ft should be relatively small. Do not use the so-called 0.5 depth method. **For this synoptic run, it is recommended that the initial section widths be determined by dividing the cross-sectional width by 30 and rounding up to the nearest tenth of a foot. However, minimum section widths will not be less than 0.5 ft for the AA meter or less than 0.3 ft for the pygmy meter. After the first measurement, adjust section widths, if necessary, to ensure that the discharge in each section does not exceed 5% of the total discharge.**

When the majority of depths in a measuring section are between 0.3 ft and 1.5 ft, and velocities are between 0.2 ft/s and 2.5 ft/s, the pygmy meter should be used with 0.6 depth settings. As Rantz and others (1982) points out, the 0.6-method places the pygmy closer to the streambed than 0.3 ft. The 0.6-method is still recommended at these shallow depths; do not use the 0.5-method. To quote Rantz and others (1982), "From a practical standpoint, however, when it is necessary to measure velocities where water depths are as shallow as 0.3 ft, the 0.6-depth method is used. It is recognized, however, that the results obtained in the situation are only approximate values that underestimate the true velocity. Efforts made to date to define shallow-depth coefficients for natural streams have been unsuccessful." (There is minor under-registration error at 0.75 ft, with up to 5 percent error at 0.30 ft, due to boundary effects.)

If a minor number of sections have depths less than 0.3 ft, continue to use the 0.6-method as long as the meter cups are covered with water.

If 25 percent of the verticals are equal to or less than 0.3 ft, the section should not be used for a meter measurement. Try to narrow and/or deepen the section, keeping in mind the velocity and number of sections requirements. If this is not practical, consider using a flume, a portable weir plate, making a volumetric measurement, or timing floats.

If cross sections have one or two very steep or vertical banks, it is recommended that a velocity measurement be made as close to the bank as possible. The depth of the water at that bank should be measured and a velocity estimate made. The velocity estimate is made by calculating a percentage of the velocity measurement of the section closest to the bank. The percentages typically range from 50 to 75 % and are based on flow and channel conditions and the judgment of the hydrographer. The percentage estimated will be written on the field note under the Revolution and Time columns, i.e., "75% of previous (or next) section," and the calculated value entered under the Velocity at Point column.

Meter Rating Tables

The most recent meter-rating table must be used. If a standard meter (either AA or pygmy) rating is being used, the rating must be of **June 1999 (6/99)**. These ratings are presented in OSW Memorandum 99.05 (http://water.usgs.gov/admin/memo/SW/sw99.05.html). If a meter has been individually rated that rating is to be used.

Measurement Rating Standardization

All personnel should be aware that a measurement rating DOES NOT imply a rating of the work done to obtain the measurement. Measurement conditions and methods used are to be rated, not performance.

Assumptions:

Essentially ideal conditions, with exceptions noted.

- Meters are in good condition.
- The cross section is in a reasonably straight reach.
- Flow is uniform, no eddies, slack water, or turbulence.
- Streambed is uniform and free of numerous boulders or vegetation.

Definition of a good meter measurement.

- Mean velocity greater than 0.5 ft/s.
- **Five percent or less of flow in each vertical is preferred, the sum of the 2 largest verticals may not exceed 15 percent of flow.**
- **Mean depth greater than 150 percent of minimum limit of meter.**

If conditions are less than ideal, measurements should be down-rated. If the conditions do not meet those listed above for good and are better than those listed below for poor, the measurement should be considered fair.

If a Standard AA meter is used under the following conditions, the measurement is considered to be poor.

- If mean depth is less than 1.0 ft (Pygmy meter should be used).
- If mean velocity is 0.2 ft/s or less.
- If any two verticals have more than a combined total of 20 percent of flow.

If a Pygmy meter is used under the following conditions, the measurement is poor.

- If mean depth is less than 0.30 ft -- generally not acceptable.
- If mean velocity is 0.25 ft/s or less or > 2.5 ft/s.
- If any two vertical's have 20 percent or more of flow.

Depth criteria for meter selection

Field personnel select the type of current meter to be used for each discharge measurement on the basis of criteria provided by the OSW (written commun., 1995). Meters are used with caution when a measurement must be made in conditions outside of the ranges of the method provided by OSW. Any deviations from those criteria are noted and the measurement accuracy is downgraded accordingly.

It is recommended that a change of meters not be made during a measurement in response to the occurrence of two or more subsections in a single measurement cross section that exceed the stated ranges of depth and velocity. A change of meters is allowed during a measurement when a very shallow overflow or secondary channel is measured along with a larger, deeper main channel.

Number of measurement subsections

The spacing of observation verticals in the measurement section can affect the accuracy of the measurement (Rantz and others, 1982, p. 179). The WRD criteria are that observations of depth and velocity be made at a minimum of about 30 verticals, which are normally necessary so that no more than 5 percent of the total flow is measured in any one vertical. Even under the worst conditions the discharge computed for each vertical should not exceed 10 percent of the total discharge and ideally not exceed more than 5 percent (Rantz and others, 1982, p. 140).

Exceptions to this policy are allowed in circumstances where accuracy would be sacrificed if this number of verticals were maintained, such as for measurements during rapidly changing stage (Rantz and others, 1982, p. 174), which is presented in the "Flood Conditions" section of this report. Fewer verticals than are ideal are sometimes used for very narrow streams (about 12-feet wide when an AA meter is used and about 5 feet wide when a pygmy meter is used).

Measurement of discharge is essentially a sampling process, and the accuracy of sampling results typically decreases markedly when the number of samples is less than about 25.

Field Notes

Thorough documentation of field observations and data-collection activities performed by field personnel is a necessary component of surface-water data collection and analysis. Field personnel will record discharge measurements, on either discharge measurement forms (refer to Buchanan and Somers (1969) for the various types of discharge forms) or on an electronic field notebook, to ensure that clear, thorough, and systematic notations are made during field observations. Original observations, once written on the note sheet, are not erased, electronic notes are written over and changed is noted under remarks. Original data are corrected by crossing the value out then writing the correct value. Some examples of original data on a discharge-measurement note sheet include gage readings, date, time of gage readings, depth, width of section, depth of meter, number of revolutions, and time. Examples of information on a discharge- measurement note sheet that is derived from original data, but not in itself original data, include the total discharge on the front sheet, mean gage height, and mean velocity. Derived data can be erased for the purpose of correction.

It is District policy that all discharge measurements are calculated in their <u>entirety</u> before field personnel leave the field site, unless emergency evacuation is required for reasons of safety or if the measurement is being made at a site that does not have a rating.

The following are instructions for filling out Discharge Measurement Notes Form 9-275-F (Rev. 10-81). These detailed instructions are provided to improve and assure

consistency in information. It is expected that complete and thorough notes will improve efficiency when working records.

Meas. No.---Number measurements consecutively. Number measurements even if they are not used or are only field estimates. Indirect measurements should also be numbered.

Comp. by---Initials of person computing measurement.

Checked by---Initials of person checking measurement. Should not be same person who computed measurement. **All measurements will be checked**.

Sta. No.---Station number always must be included, if available.

Line for stream name---Identify stream by name that is on the station description.

Date---Enter month, day, and year.

Party---List first initial and last name of person making measurement followed by (m), then name of person servicing gage followed by (g), and then name of person taking notes (n).

Width---Area---Vel---If measurement is all one channel, list properly rounded values with velocity computed from area and discharge shown on front sheet. If more than one channel for a low-flow wading measurement, do not list combined values, simply note the number of channels. On high-flow measurements, list any overflow channels separately if appropriate. See the section on "Number of Measurement Subsections" on when to include or exclude piers as part of the stream area. Examples of proper rounding are 0.87; 3.05; 14.2; 108; 1,090 ft.

G.H.---List the mean gage height from the Correct M.G.H. box under gage readings. If debris were removed from control or well flushed, record both before and after gage heights. An * can be used to footnote further explanation if needed.

Disch.---List total discharge over control section. Use a properly rounded value. Examples of proper rounding are 0.87; 3.05; 14.2; 108; 1,090; 43,500 cfs.

Method---Proper entries are 0.6, 0.2/0.8, vol., est., flume. Other methods can be explained under remarks.

No. secs---Count and record total number of verticals where depth and velocity were noted.

G.H. change---Actual change in gage height from time measurement began until measurement ended. May need to be determined from plot on back of measurement note. Include + or - depending on direction of change.

in___hrs---Time for measurement to nearest 0.1 hour. Corresponds to G.H. change time.

Susp.---Enter weight used for cable measurement (50c, 75c, 100c, etc.) or rod (R) if used.

Method coef.---Usually 1.0. Refer to WSP 2175 (Rantz and others, 1982, p. 133, 148, 155, 170) for proper techniques to be used.

Hor. Angle coef.---If all flow is normal to the cross section, enter 1.0. If direction of flow varies, enter "varies" or "noted". If flow angle is constant, enter coefficient used.

Susp coef.---Enter 1.0 unless explained under remarks.

Meter No.---Enter number stamped on yoke so that performance of individual meter may be tracked.

Type of meter.---Either AA, Pyg, OM or flume.

Date rated.---Enter "6/99" if standard table of June 1999 is used, otherwise the date the meter was rated.

Tag checked.---Measure and record here the spacing of any tags set for high-water measurement. Tag spacing is usually referenced to the center-line of the meter cups with tension on the cable. Check spacing before and after each measurement.

Meter_____ft. above bottom of wt.---Enter distance from bottom of weight to centerline of meter cups. Use 0.55 or 0.60 whichever is closest, 0.90 or 1.0 whichever is correct. Distance will change with weight used, so measure to eliminate later doubts.

Spin before meas_____after___---Document satisfactory condition of meter by noting time of recent spin test or OK. Before each measurement, inspect meter for dents and/or fouled pivot, and spin cups to be sure that cups do not wobble excessively and that they stop slowly. The NUC or PC is responsible for seeing that all meters are in condition to make accurate measurements and the procedures that the NUC has implemented are followed. See section "Acceptable Equipment" for District spin test policy.

Meas plots---Leave blank if control is very unstable. Enter percent plus or minus to the current rating if control is stable. All measurements should be plotted on field curves in order to evaluate trends and determine need for check measurements.

Levels obtained---Enter yes if levels were run, leave blank otherwise.

GAGE READINGS:

Time---List time of first outside gage reading made before entering gage, changing the control, or making the discharge measurement. List time for first inside reading of recorders, tapes, and dials. List time for resetting of recorders. List start and finish times for measurement. List time of final gage readings. Be sure to read outside gage. List any other times needed to determine mean gage height of measurement. Time is listed as HHMM using military time. See the section "Gage Height Records and Time Changes" on time procedures.

Blank column---To be used for actual reading of inside staff in stilling well or any other reading not having its own labeled column. Column should be labeled "Well" if well reading is made.

Inside---For stilling well, list tape reading; for pressure system, list dial reading, or readout.

ADR--- Digital reading from dial or punch. Dial and punch readings should be the same, explain if different or reset.

BDR or similar recorder--- Record observed value.

Graphic---Pen reading.

Outside---Read this gage on arrival, and before leaving. Remember this is the reference gage for a transducer, and indicates if there is communication to a stilling well. Read again if there is a change due to purging or flushing.

Weighted M.G.H.---Determined from gage height change during measurement. This procedure is described in Rantz and others (1982, p. 170-173).

G.H. Correction---List if correction needed.

Correct M.G.H.---Gage height for measurement. Should be initialed by person who checks measurement against gage heights stored in ADAPS, to indicate agreement with final determination.

WATER QUALITY MEASUREMENTS

No____Yes____Time____---Check if water quality measurement was made or not, if yes enter time.

Samples Collected

No____Yes____Time____---Check if water quality samples were collected or not, if yes enter time.

Method Used

EDI____EWI____Other____---Check the method used to collect the water quality sample was equal-discharge-increment (EDI), equal-width-increment (EWI), or other. The most complete discussion of sampling techniques is found in Edwards and Glysson (1988).

SEDIMENT SAMPLES

No____Yes____Time____---Check if sediment samples were collected or not; if yes, enter time.

Method Used

EDI____EWI____Other____---Check the method used to collect the sediment sample was equal-discharge-increment (EDI), equal-width-increment (EWI) or other. The most complete discussion of sampling techniques is found in Edwards and Glysson (1988).

BIOLOGICAL SAMPLES

Yes____No____Time____Type____--- Check if biological samples were collected or not; if yes, enter time and type of sample.

Check bar found---For use with wire-weight gage. List elevation of check bar to the nearest thousandth, once per visit. If the bar reading is changed, note the new reading to the nearest thousandth and the time.

Wading, cable, etc.---Indicate type of measurement and location of measurement section relative to gage.

Measurements rated--- Either circle or underline one rating only. No combined rating such as "fair to poor" should be used.

Flow---Describe flow conditions (smooth, turbulent, eddies, standing waves, dunes etc.).

Cross section---Describe measurement section (sand, cobbles, boulders, bedrock concrete, etc.).

Control---Describe what control is composed of, section or channel, presence of drift, vegetation, any change since previous visit, any change made currently that might change gage height at this stage or later. **It is critical that this description be made at every visit**.

Gage operating---OK or yes, if operating properly; if not, say no and explain in REMARKS.

Weather---Describe weather condition and document any inclement type such as high wind, rain, or heavy snow.

Intake/orifice cleaned---Yes or no. If gage height changed due to cleaning, describe under remarks.

Air____°C@____Water____°C@_____---List air and water temperatures to nearest half degree Celsius, and the time the reading was made as HHMM using military time.

Record removed---Yes or no.

Extreme indicator---List max and min peak indicator clip readings. Show gage height before applying constants and constants on chart, digital leader, or measurement.

Nitrogen Tank___Feed---List pressures from gages on tank.

Bbl rate---Count and list number of bubbles in one minute.

CSG checked___Stick reading---List readings for crest-stage gages as needed to describe which gage read and what reading was. Stick reading should be noted and then added to pin elevation to obtain final CSG reading. Indicate if marks are good or fair or not reliable. Be sure to clean marks off stick and record CSG. If none, enter NONE.

Observer---Usually blank, but any discussion with an observer should be noted

HWM---Record marks in stilling well (check silt level at same time) and then wipe off inside staff and/or well near staff so that next peak will leave new marks. Use hand or string level to record any outside marks near gage for peak since last visit. Check against recorded peak and determine reason for any difference, if possible. If any record was lost since last visit, observe channel to determine recent flow range. If no marks can be found near gage, flag or otherwise mark HWMs upstream and downstream to be leveled to later. If no marks or indications of high flow are found, record NONE.

Remarks---Document any comments that may relate to record computation or general safety.

G.H. of zero flow---If required, the PZF should be recorded each time it can be accurately and safely determined at most natural sites. PZFs on streams that go dry are especially important (Rantz and others, 1982, p. 146).

Measurement Checking

1. Each trained person making discharge measurements is solely responsible for completely and accurately filling out the 'front sheet', and the computational accuracy of the measurement.

2. Someone other than the person who computed the measurement will check every measurement after each trip. The checker is expected to check the following:

    a. Section velocity and section area, not done for electronically computed measurements.

    b. Summation of width area, and discharge, not done for electronically computed measurements.

    c. Determination of mean gage height.

    d. Recomputed sum of partial areas and discharges.

3. As part of annual computation of records, the checker will check the determination of mean gage height with possible datum changes and comparison to recorded gage heights.

4. Deficiencies found in the content, accuracy, clarity, or thoroughness of field notes are identified with colored pencil and communicated to field person making the measurement by oral means. The deficiencies are remedied by providing specific instructions by the PC to individuals who fail to record notations that meet USGS and District standards.

Notations associated with miscellaneous surface-water data-collection activities are to be documented on a discharge measurement form. All miscellaneous notes are required to include, at minimum, initials and last name of field-party members, date, time associated with observations, purpose of the site visit, gage readings, gage operation, and control.

Acceptable Equipment

Equipment used for the measurement of surface-water discharge must be approved by the Project Chief and meet all WRD and District requirements for accuracy and

suitability. An array of acceptable equipment for measuring discharge includes current meters, timers, wading rods, bridge cranes, tag lines, and others (Rantz and others, 1982, p. 82; and Smoot and Novak, 1968). Although an official list of acceptable equipment is not available, Buchanan and Somers (1969), Carter and Davidian (1968), and Edwards and Glysson (1988) discuss the equipment used by the U.S. Geological Survey.

The meters most commonly used by District personnel for measuring surface-water discharge are the Price AA current meter and the Price pygmy current meter. Methods followed by District personnel for inspecting, repairing, and cleaning these meters are described in Smoot and Novak (1968, p. 9), Rantz and others (1982, p. 93), and Buchanan and Somers (1969, p. 7).

The ultimate responsibility for the good condition and accuracy of a current meter rests with field person who uses it (OSW Memorandum 89.07 http://water.usgs.gov/admin/memo/SW/sw89.07.html). A timed spin test made a few minutes before a measurement does not ensure that the meter will not become damaged or fouled during the measurement. Field personnel must assess apparent changes in velocity or visually inspect the meter periodically during the measurement to ensure that the meter continues to remain in proper operating condition.

Electronic Measurements

If an AquaCalc-type instrument is used, the current meter must be equipped with either a magnetic or optic head. The AquaCalc-type instruments will not be used with current meters equipped with a cat whisker.

Spin tests

It is District policy that spin tests are required for each field trip. Spin-test results are documented in a meter log for each instrument by the hydrographer responsible for the meter. This log is part of the archived data of WRD (Office of Surface Water memorandum 89.07 http://water.usgs.gov/admin/memo/SW/sw89.07.html) and should be kept in the office. Repairs are made to meters when deficiencies are identified through the spin test or inspection.

At least prior to the first discharge measurement of each day, field personnel are required to do a timed spin test (in office, field vehicle, or motel) and note it on the discharge measurement note. Acceptable times for a spin test are given in table 3. Thereafter, field personnel will inspect the meter before and after each measurement to see that the meter is in good condition, that the cups spin freely, and the cups do not come to an abrupt stop. Descriptive notations are made at the appropriate location on the field-note sheet concerning the meter condition, such as "OK" or "free" or other such comments for these subsequent checks during the day.

Table 2. Spin test limits

Meter	Normal (minutes)	Minimum for field operation (minutes)
Type A, AA	4	1.5
Ice, Vane	3	1.5
Pygmy	1.5	0.5

Care and Maintenance

The care and maintenance of vertical-axis current meters (AA and pygmy) is required to keep the meter in the same good condition as when it was obtained from the manufacturer or was recalibrated. Cleaning, adjustment, and repair maintain this condition. OSW Memorandum 99.06 http://water.usgs.gov/admin/memo/SW/sw99.06.html supplements the instructions found in TWRI, Book 8, Chapter B2, Calibration and maintenance of vertical-axis type current meters (Smoot and Novak, 1968).

After a day of use in the field

1. The pivot and contact-chamber cap should be removed to clean and lightly oil upper and lower bearing surfaces with current-meter oil. (Do not use "3-in-1" type oil, which becomes gummy when exposed to water.)

2. The bearing surfaces should be examined for wear or damage, especially the pivot point. The pivot should feel sharp, as opposed to rounded or dull. It should not have a burr detectable visually or to the fingernail, a magnifying glass is helpful for the visual inspection.

3. The pivot should be replaced if needed and the adjustment of the cat whisker(s) checked. The cat whiskers should touch lightly to give a distinct signal and to minimize drag. Any old-style cat whiskers with beaded contacts should be removed and replaced with the currently available cat whiskers, which have no bead. The penta-count mechanism should be operating freely with no indication of binding or misalignment.

4. After replacing the contact-chamber cap, the meter should be spun to observe that it is operating properly. This should not necessarily be a timed spin test, but the meter should be observed as turning freely, coming to a smooth and gradual stop, and not rotating with a discernible wobble. If one of these conditions is observed, or some other malfunction or damage is noted, further adjustment or repair is required to ensure proper operation before the meter is used again.

5. During the day, before making a discharge measurement, the meter should be inspected for damage, fouling, and water on the bearing surfaces. (When inspecting for water, look for a milky emulsification of oil and water on the lower bearing and pivot and droplets of water in the contact chamber.) If water is found on the bearing surfaces, they should be dried and re-oiled, because the presence of water on these surfaces will affect the lubricant viscosity, significantly changing the performance of the meter. The lower bearing is probably more vulnerable to the entrance of water.

After each field trip

The meters used should be completely disassembled, inspected, and cleaned Repairs should be made if needed.

Low-Flow Conditions

Streamflow conditions encountered by District personnel during periods of low flow are typically quite different from those encountered during periods of medium and high flow. Low-flow discharge measurements are made to define or confirm the lower portions of stage-discharge relations for gaging stations, **as part of seepage runs to identify channel gains or losses**, and to help in the interpretation of other associated data. Additionally, low-flow measurements are made to define the relation between low-flow characteristics in one basin and those of a nearby basin for which more data are available (OSW Memorandum 85.17 http://water.usgs.gov/admin/memo/SW/sw85.17.html).

In many situations, low flows are associated with factors that reduce the accuracy of discharge measurements. These factors include algae growth that impedes the free movement of current-meter buckets and larger percentages of the flow moving in the narrow spaces between cobbles. When natural conditions are in the range considered by the field personnel to be undependable, the cross section is physically improved for measurement by removal of debris or large cobbles, construction of dikes to reduce the amount of non-flowing water, or other such efforts (Buchanan and Somers, 1969, p. 39). After modification of the cross section, the flow is allowed to stabilize before the discharge measurement by current meter or flume is initiated.

Cold-Weather Conditions

Surface-water activities in this District include making streamflow-discharge measurements during cold weather conditions. **Cold temperatures**, wind, snow, and ice can create difficulties in collecting data. These factors also can create dangers to field personnel (WRD Policy Memorandum 2000.03 http://wwwoper.er.usgs.gov/memos/wrd/wrdpolicy00.03.html). The highest priority in collecting streamflow data during winter periods is employee safety.

Measurement of Temperature

Field measurements of temperature should include both an air temperature reading and a water temperature reading that represents the mean temperature of the stream.

The two devices used in measuring temperature are the alcohol thermometer and the thermistor. The thermometer is the most widely used device for temperature measurements.

Before any temperature readings are made, inspect the thermometer to be certain the column is not separated, the bulb is clean, and the protective case is free of sand and (or) debris. These factors can have a pronounced effect on temperature readings. Because the thermometer is easily broken, it is also advisable to carry extra thermometers of equal quality as spares.

Acceptable Equipment

Both the general purpose hand thermometers and thermistors should be checked or calibrated against a certified thermometer meeting specifications of the National Institute of Standards and Technology (NIST) to a minimum of two temperatures: 0 degree Celsius (°C) and room temperature. Calibrated thermometers and thermistors should be marked to let the user know user know if it has been calibrated (this can be done by using red fingernail polish).

General purpose thermometers found to be more than 0.5°C in error should not be used.

Air Temperature

Air temperature readings should be made using a dry thermometer placed in a shaded area protected from strong winds but open to adequate air circulation. Avoid areas that

may have radiant heat effects such as near metal walls or sides of vehicles. Allow the thermometer to equilibrate 3 to 5 minutes before recording the temperature. Record the temperature to the nearest 0.5°C and the time of day that the measurement was made.

Water Temperature

Water temperature should be made in such a manner as to represent the mean temperature of the stream at the time of observation. To make this measurement, suspend, place, or hold a thermometer in the main flow of the stream. Shade the thermometer to prevent erroneous readings caused by direct solar radiation. The thermometer should be immersed in the stream for a minimum of 1 minute prior to making measurements. (Thermistor probes should be immersed for a minimum of 3 minutes if the thermistor is an integral part of a combination probe such as is the case of the dissolved oxygen probe.) Record the temperature to the nearest 0.5°C and the time of day that the measurement was made.

Measurement of Specific Conductance

Conductance is the reciprocal of resistance in ohms, and is a measure of the capacity of water or other substance to conduct an electrical current. Specific conductance is the conductance corrected to 25 degrees Celsius and is reported in microsiemens per centimeter (µS/cm) at 25°C. Specific conductance indicates the concentration of dissolved solids in water.

Acceptable Equipment

There are many conductivity meters available on the market. All meters come with operating instructions and users should be totally familiar with these instructions.

Conductivity electrodes must be clean to produce accurate results. Electrodes should be cleaned thoroughly before and after a measurement is made. In most cases, thoroughly rinsing electrode with deionized water, after use, will keep the electrode clean.

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