

Discharge Measurements at Niger River and its Tributaries Sota, Tinkisso and Niandan



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BGR Bundesanstalt für
Geowissenschaften
und Rohstoffe



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Abbreviations

A	Area in m ²
ABN	Autorité du Bassin du Niger
ADCP	Acoustic Doppler Currentmeter Profiler
AGES	Groundwater Advice to the Niger Basin Authority
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe
Q	Discharge in m ³ /s
RDI	Teledyne RDInstruments (manufacturer of hydrometric instruments)
V	Flow velocity in m/s

Results of Discharge Measurements

Discharge measurements were carried out at Niger River in Malanville, Niamey and Kouroussa and at the tributaries Sota River close to Malanville; Niandan River at Baro station and Tinkisso River at SAG station.

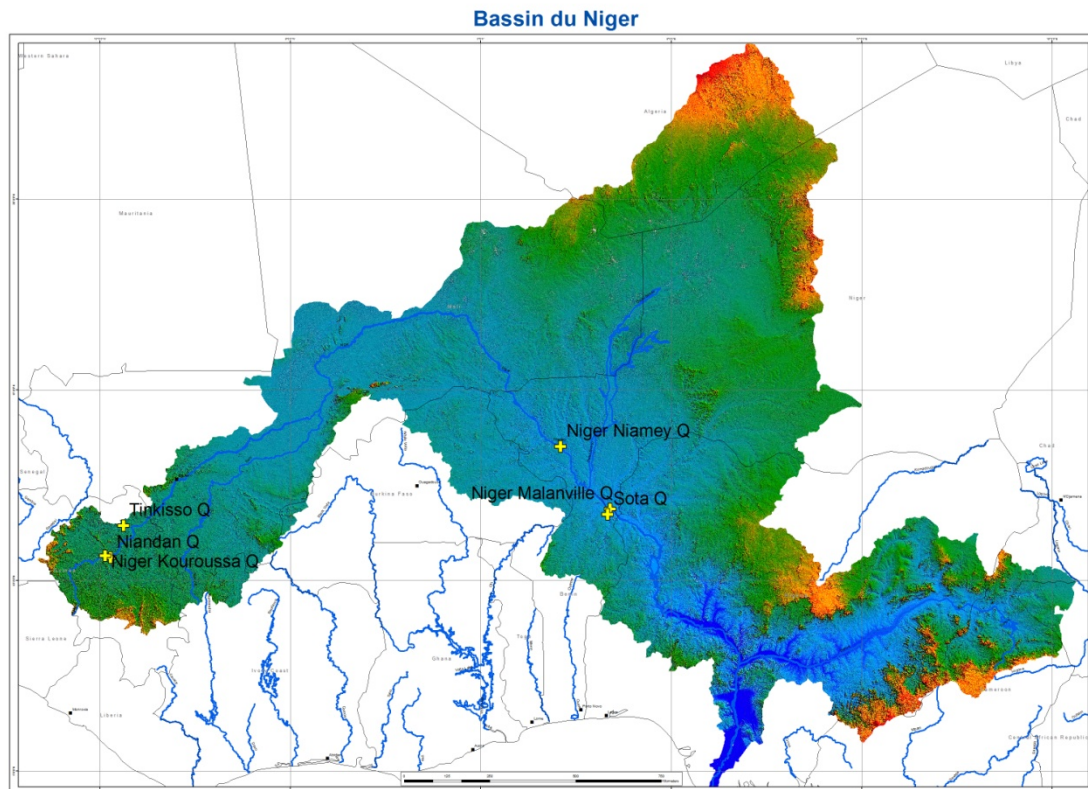


Fig. 1 Niger Basin and location of gauging stations

Niger, Malanville

Malanville gauging station is the furthest downstream station where discharge measurements were carried out during this mission.

The night before the first measurement was carried out, a heavy thunderstorm with strong rainfall for about 1.5 hours was observed in Malanville. As a result, the water level was rising the following morning which made it necessary to carry out several measurements at different times. The first measurements were started on the morning of 19th, followed by four further measurements on late afternoon the same day. On 20th, two measurements in the morning and two in the evening followed (Fig. 7).

Measurements were carried out from the bridge and from a boat (or pirogue). Both options have certain disadvantages:

- A boat is often too fast for measurements at low water levels (the movement of the ADCP should be slower than the flow velocity)
- When measuring from a bridge, one can move as slow as necessary, but pillars can disturb the flow (Fig. 3)



Fig. 2 Discharge measurement at Malanville from bridge and pirogue

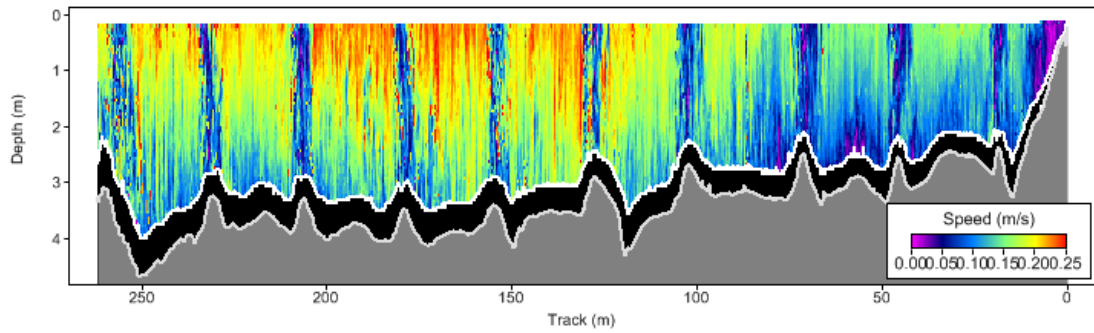


Fig. 3 Cross-section of Niger at Malanville gauging station, measured from bridge

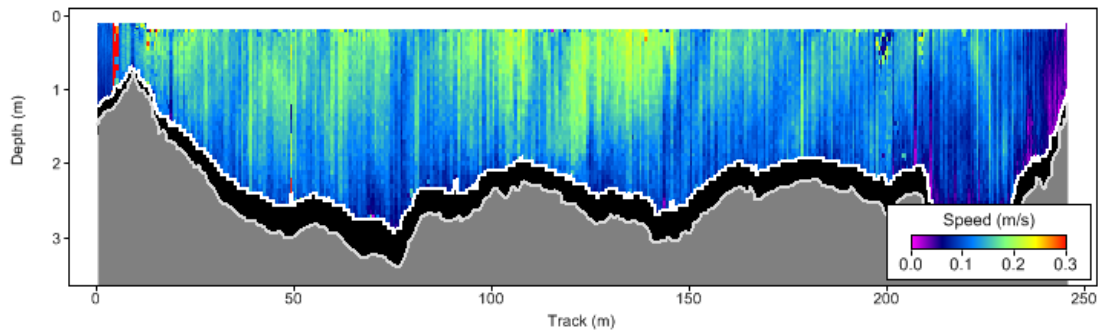


Fig. 4 Cross-section of Niger at Malanville gauging station, measured with pirogue

Results of measurement at water level of 3.91 m with BGR instrument

Start Date	Start Time	Width (m)	Area (m ²)	Total Q (m ³ /s)	% of Q measured
19.05.2012	16:39:22	254.63	770.2	74.73	77.2
19.05.2012	16:57:18	262.3	682.9	75.116	74.1
19.05.2012	17:03:41	260.44	631.7	72.874	78.5
19.05.2012	17:11:14	263.66	626.8	75.502	80.7
	Mean	260.26	677.9	74.555	77.6
	Std Dev	3.45	57.6	1.009	2.4

Discharge in a river depends not only on water level. Besides overflowing channels and plant growth that cause variable cross sections there is a hysteresis effect caused by changing longitudinal slope of the water surface if water levels are changing during measurements.

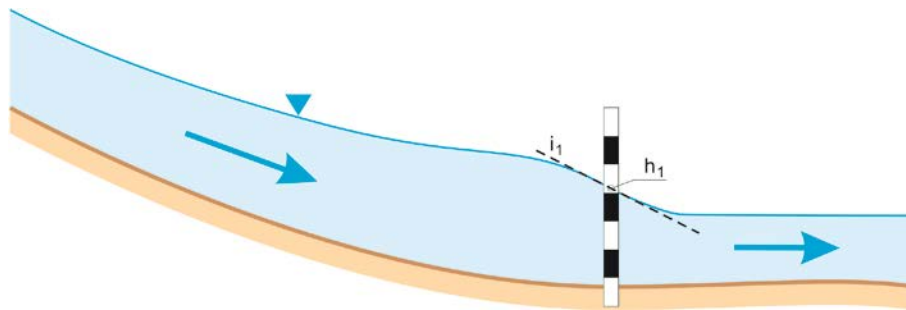


Fig. 5 Longitudinal slope at rising water level

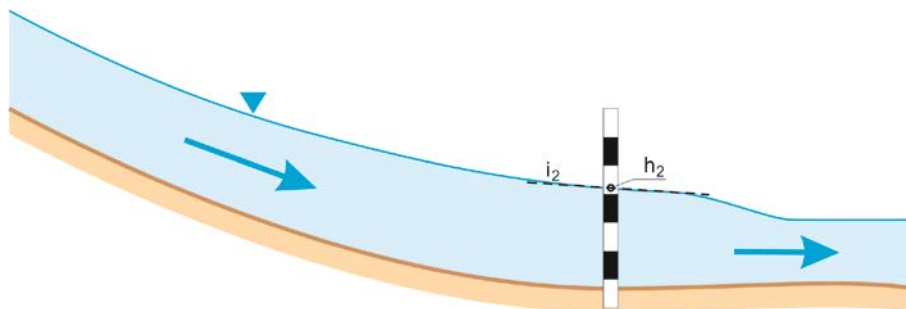


Fig. 6 Longitudinal slope at falling water level

(Drawings: Ulrich Gersdorf, BGR)

In the sketches above (Fig. 5, Fig. 6), gauge heights are equal ($h_1 = h_2$), but the rising water level in the top sketch leads to higher longitudinal slope, which causes higher flow velocities. Due to higher flow velocity, the total discharge is higher if water level is rising while the discharge measurement is carried out.

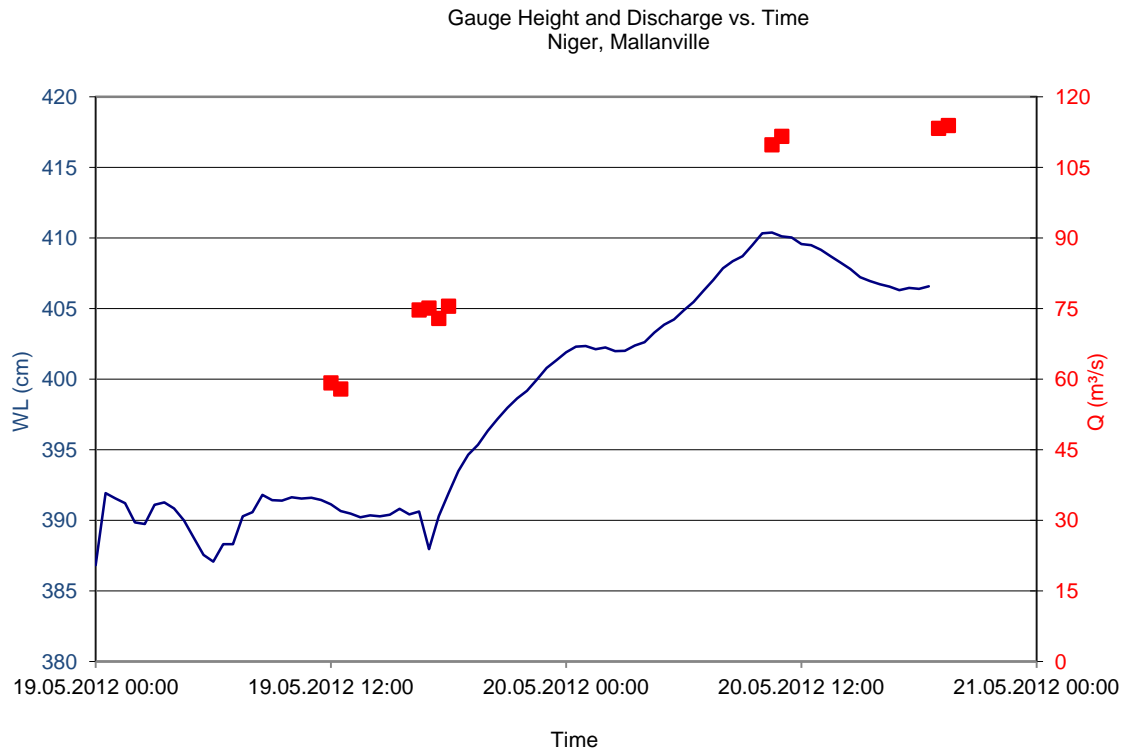


Fig. 7 Development of gauge height and discharge vs. time, Niger River at Malanville

As water levels are not constant during the discharge measurements (Fig. 7), the results from the late afternoon of 19th and from the evening of the 20th should not be used for the comparison with the rating curve available at ABN.

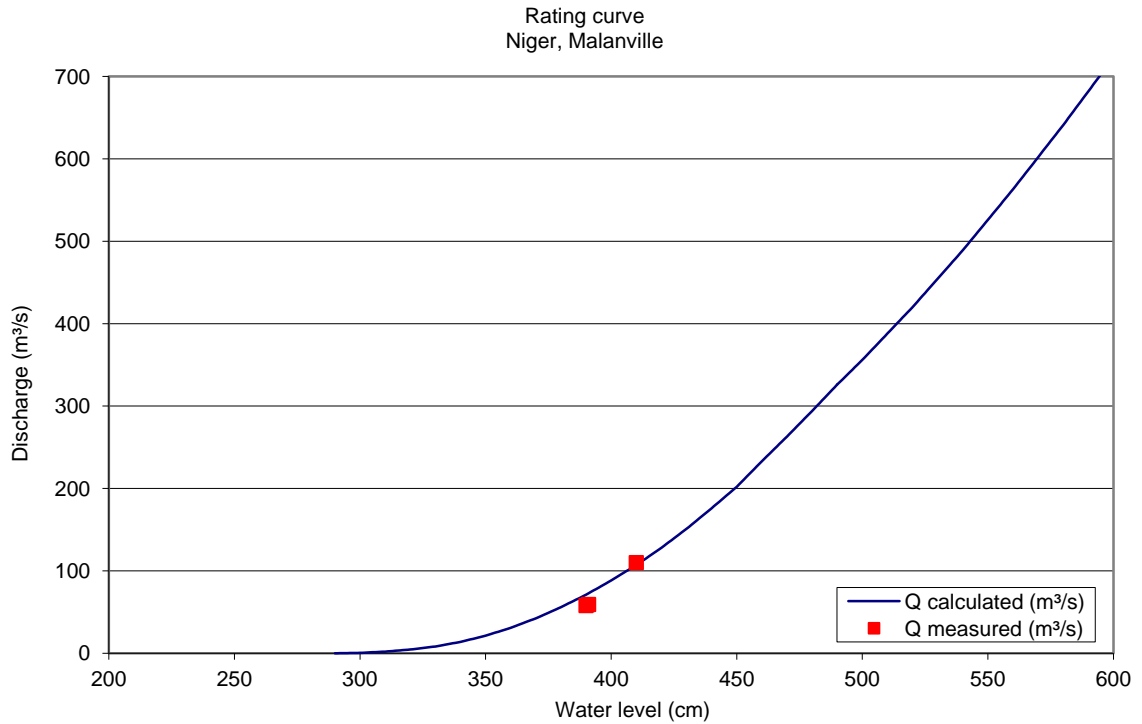


Fig. 8 Rating curve of Niger River at Malanville gauging station

(Rating curve provided by ABN)

Comparison with results of ABN instrument

The cross-section measured with the RDI instrument owned by ABN shows some blanks in the velocity profile, probably due to the fact that the boat velocity was too high.

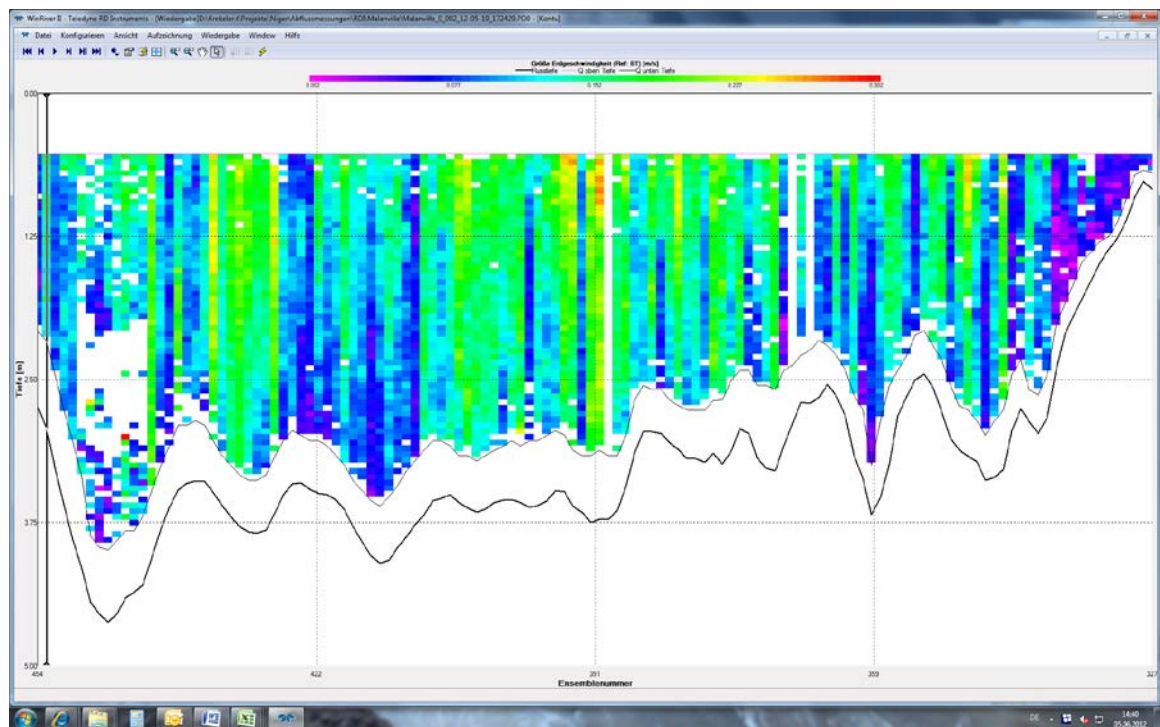


Fig. 9 Cross-section at Malanville measured with ABN ADCP

A general rule is that the boat velocity must be lower than the flow velocity. As the flow velocity was very low during the discharge measurements (av. 0.1 m/s) this was hard to archive. The rubber boat of ABN which is equipped with an outboard engine is generally too fast. Undesirable effects on the results of the measurements are probable.

Results of measurements at water level of 3.91 m with ABN instrument

Transect	Start time	Q total	Width	Area	Velocity.
		m ³ /s	m	m ²	m/s
Malanville000	17:13:08	84.851	280.32	809.01	0.102
Malanville001	17:19:17	80.283	274.07	857.78	0.098
Malanville002	17:23:56	87.559	256.81	806.52	0.112
Malanville003	17:28:44	88.415	255.24	877.64	0.108
Mean		85.277	266.61	837.74	0.105
Standard dev.		3.659	12.5	35.56	0.006

The measurements of ABN show about 12 % higher results as the BGR measurements.

Niger, Niamey

At Niamey gauging station twelve single measurements with the BGR owned SonTec ADCP were carried out. For four additional measurements the ABN owned RDI ADCP was used to get the opportunity to compare the results.



Fig. 10 Discharge measurement with both ADCP (left ABN instrument, right BGR instrument)

The Niger gauge station in Niamey is well situated. The cross section has an almost triangular shape; hence, even if water levels are low, there is some discharge in a clear defined river bed.

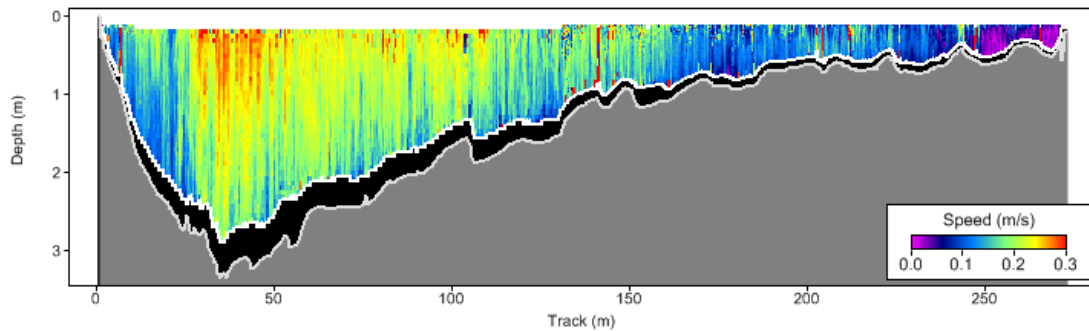


Fig. 11 Cross-section and velocity distribution at Niamey gauging station

Niamey gauging station had constant water level of 1.58 m before, during and after the measurements. Hence, the measured discharge values were not influenced by variable flow.

The measured discharge is lower than the value given by the rating curve. The measurements with the BGR instrument give a mean discharge of 62.9 m³/s. The single results are as follows:

Start Date	Start Time	Width (m)	Area (m ²)	Total Q (m ³ /s)	Measured (%)
16.05.2012	11:28:36	256.45	366.5	63.886	75.5
16.05.2012	11:40:23	257.23	380	61.188	75.6
16.05.2012	11:53:23	255.06	380.7	62.795	78.4
16.05.2012	12:07:06	263.96	378.9	62.059	78.1
16.05.2012	13:47:38	260.77	387.5	63.159	77.2
16.05.2012	13:58:26	261.61	379	59.872	77.9
16.05.2012	14:27:28	257.06	377.7	62.573	75.4
16.05.2012	14:37:48	237.38	360.7	62.743	74
16.05.2012	14:44:09	236.43	364.7	63.463	75.7
16.05.2012	14:50:44	245.18	366.6	65.134	73.5
16.05.2012	14:58:24	244.86	371.4	66.024	75
16.05.2012	15:05:42	238.07	358.5	61.704	72.9
	Mean	251.17	372.7	62.883	75.8
	Std Dev	9.72	8.8	1.594	1.7

The rating curve gives a discharge of about 107 m³/s for a corresponding water level of 1.58 m.

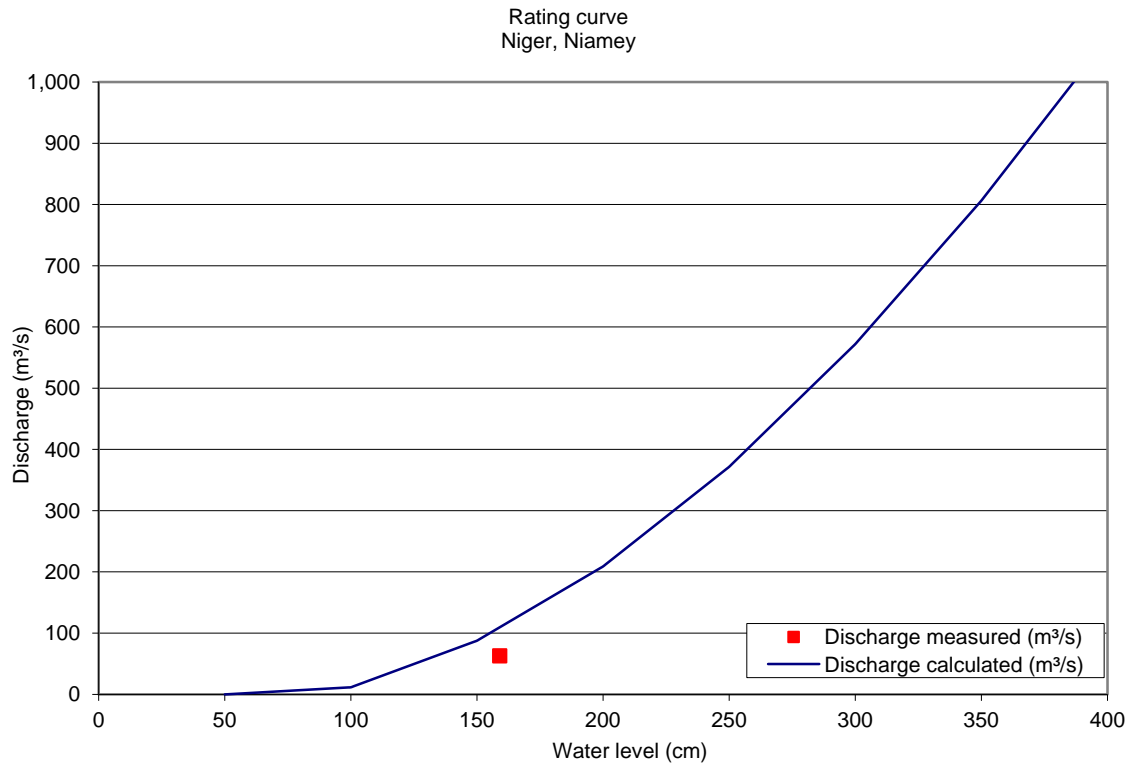


Fig. 12 Rating curve of Niamey gauging station

(Rating curve provided by ABN)

Comparison with results from ABN instrument

In the following table the results from ABN measurements at Niamey gauging station are summarised:

	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Transect 7	Transect 8
Q total (m³/s)	-24.285	50.11	61.721	59.234	60.194	51.271	-94.979	53.731
width (m)	350.118	174.287	229.079	202.694	280.948	211.145	391.429	197.35
max V (m/s)	1.815	1.827	1.698	1.238	1.14	1.214	1.396	1.119
max Depth (m)	25.07	24.708	3.373	3.205	3.25	3.178	3.303	3.215
Total Ensembles	936	1194	328	447	501	562	682	352
Bad Ensembles	568	679	72	181	223	273	459	139
% Bad Ensembles	60.7	56.9	22.0	40.5	44.5	48.6	67.3	39.5

Results from transect 1, 2 and 7 have an extremely high number of bad ensemble (more than 50 %), which is not acceptable. Hence, these results should not be considered in the final interpretation. At transects 3, 4, 6 and 8, other results like width and maximum velocity are generally within the expected range. The only transect with an acceptable number of bad ensembles is number 3 (22 %). As a final

result, the total discharge given in transect 3 of 61.7 m³/s fits well with the result from the BGR instrument of 62.9 m³/s.

Niger, Kouroussa

Minimal flow velocity was observed at Kouroussa gauging station. The only side where flow could be measured was downstream of the gauging station, where water from a large, about 120 m wide, pool discharged into a small channel of 7 m width.



Fig. 13 Niger River at Kouroussa gauging station and downstream of station

The cross-section was levelled and velocity was measured by floating particles over certain distances:

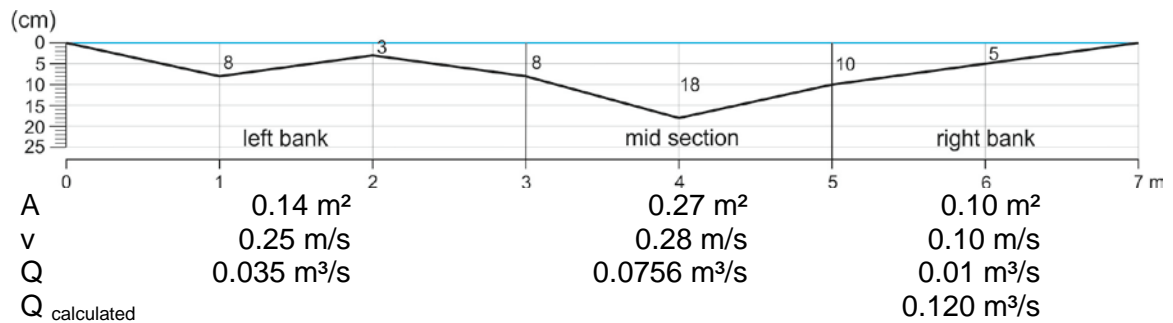


Fig. 14 Cross section of Niger river downstream of Kouroussa gauging station

(Drawing: Ulrich Gersdorf, BGR)

Due to elevated flow velocity close to the water surface, the total discharge is calculated to 80 % of the sum of the above calculated discharges for single segments (80% of 0.12 m³/s).

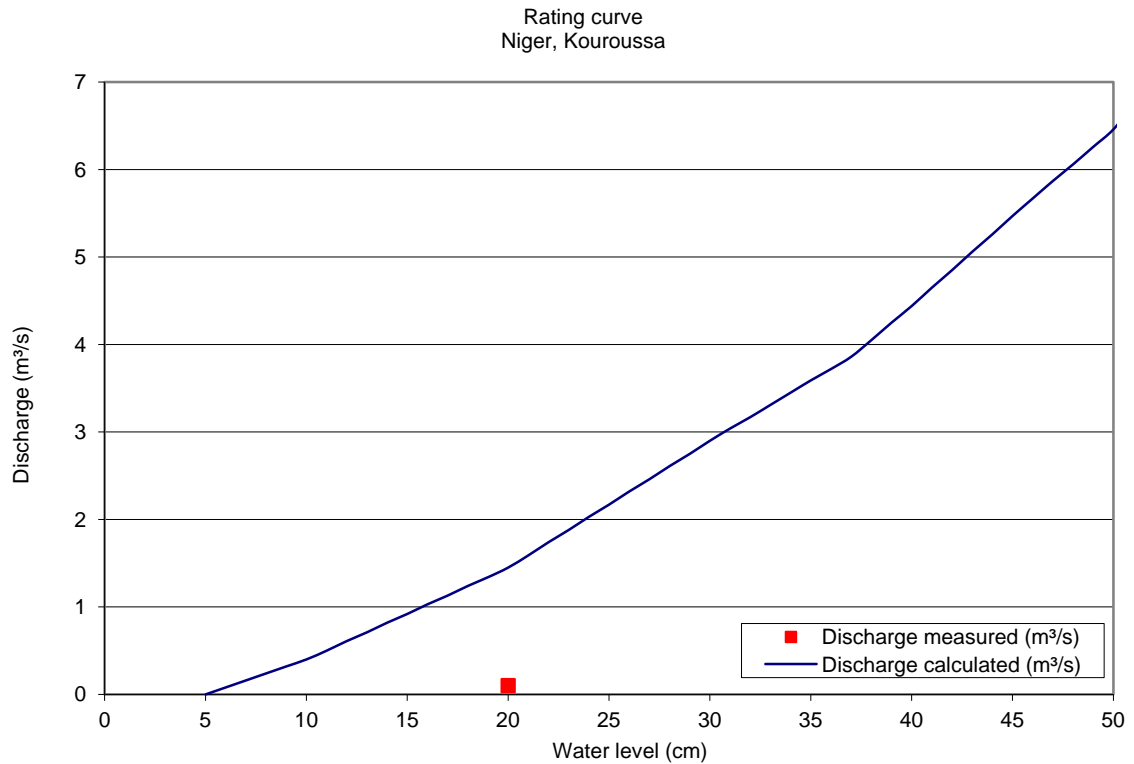


Fig. 15 Rating curve of Niger river at Kouroussa gauging station

(Rating curve provided by ABN)

Total discharge of Niger at Kouroussa gauging station at a corresponding water level of 0.20 m was measured at about 0.1 m³/s and is much lower than the calculated after the rating curve.

Sota, Malanville

Sota is a tributary to Niger close to Malanville. Reasonable flow was observed at Sota. The discharge measurement was carried out from a pirogue.



Fig. 16 Discharge measurement at Sota River at Malanville

(Photo: Sven Menge, BGR/AGES)

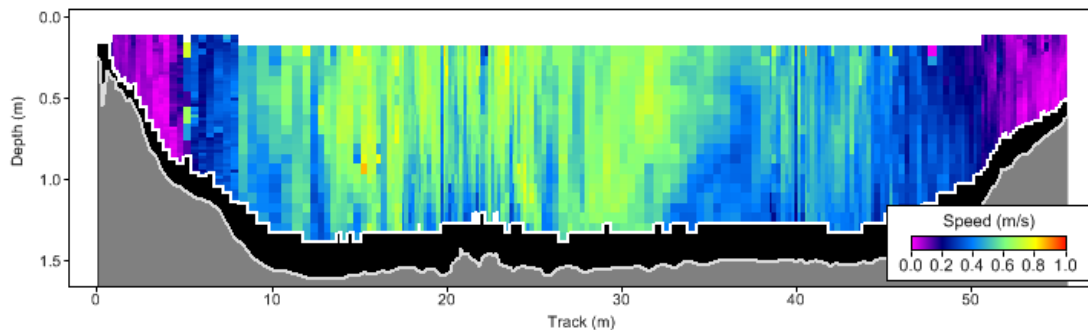


Fig. 17 Cross-section and velocity distribution of Sota River, Malanville

Results of discharge measurements with BGR owned SonTec ADCP

Start Date	Start Time	Width (m)	Area (m ²)	Total Q (m ³ /s)	Measured (%)
20.05.2012	14:20:54	27.11	37.7	22.337	72.7
20.05.2012	14:26:30	30.91	29.5	23.502	72.2
20.05.2012	14:30:12	41.67	30.8	23.157	73.2
20.05.2012	14:43:25	46.71	55.2	22.402	74
20.05.2012	14:55:52	41.7	35.6	23.052	71.7
	Mean	37.62	37.7	22.89	72.7
	Std Dev	7.36	9.2	0.451	0.8

At Sota River a discharge of 22.9 m³/s was gauged for a corresponding water level of 3.21 m.

Tinkisso, SAG

At Tinkisso no flow was observed. However, some discharge measurements were carried out, but the results were highly different. At least the results indicate the same flow direction.



Fig. 18 Discharge measurement with ABN equipment

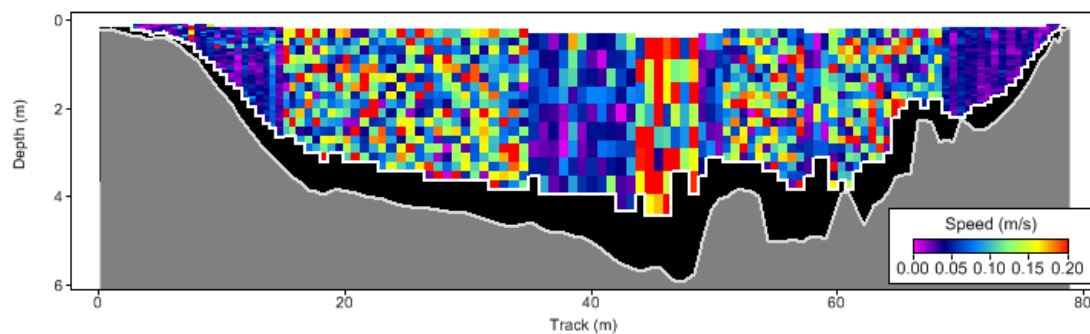


Fig. 19 Cross-section of Tinkisso at SAG gauging station

All measurements of BGR and ABN give discharge values of less than $10 \text{ m}^3/\text{s}$ for the corresponding water level of 1.44 m. No further conclusion about the flow can be made from the available data.

Niandan, Baro

At Niandan River, Baro gauging station, a wide railway bridge was available to carry out measurements. In the middle of the river a sandbank surrounded the bridge pier. The blank section that indicates the sandbank is clearly displayed in the following sketch.

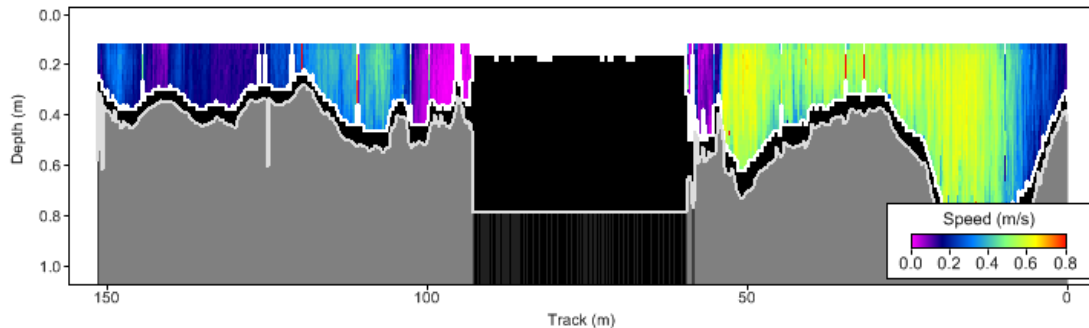


Fig. 20 Cross-section of Niandan river at Baro gauging station

The river had sufficient flow velocity and discharge was easily measured. The results of the single measurements are summarised in the following table.

Start Date	Start Time	Width (m)	Area (m ²)	Total Q (m ³ /s)	Measured (%)
28.05.2012	15:18:11	127.49	68.5	20.47	64.3
28.05.2012	15:31:46	125.87	64.5	20.41	63.3
28.05.2012	15:57:17	110.59	58.7	21.14	61.2
28.05.2012	16:03:31	126.05	60.6	21.02	59.7
	Mean	122.5	45.2	20.8	62.1
	Std Dev	8.0	4.3	0.4	2.1

In general the gauged discharge values fit well with the rating curve, although the low category groups in the curve seem to be linearly interpolated.

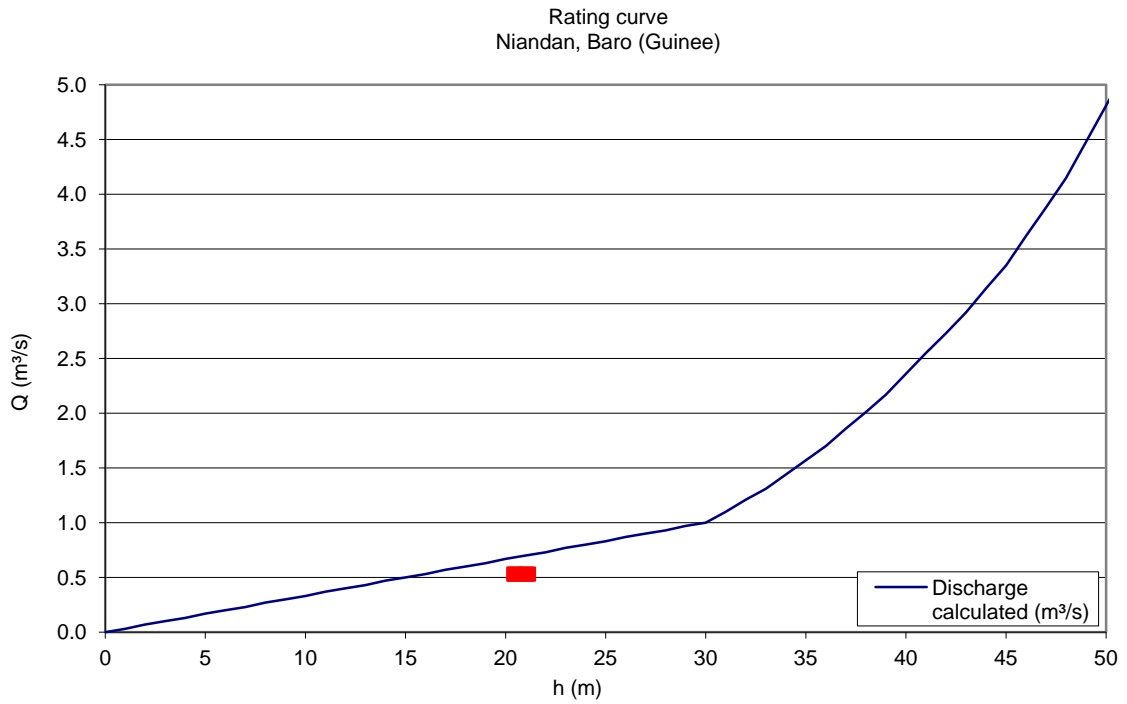


Fig. 21 Rating curve of Niandan river at Baro gauging station

(Rating curve provided by ABN)

The total discharge at Niandan River, Baro gauging station for a corresponding water level of 0.53 m was 21 m^3/s .

ANNEX

Discharge Measurement Summary

Date Measured: Sunday, May 20, 2012

Site Information		Measurement Information	
Site Name	niger malanville	Party	
Station Number		Boat/Motor	
Location		Meas. Number	

System Information		System Setup		Units	
System Type	RS-M9	Transducer Depth (m)	0.06	Distance	m
Serial Number	2456	Salinity (ppt)	0.0	Velocity	m/s
Firmware Version	2.00	Magnetic Declination (deg)	-0.2	Area	m ²
Software Version	2.50			Discharge	m ³ /s
				Temperature	degC

Discharge Calculation Settings				Discharge Results	
Track Reference	Bottom-Track	Left Method	Sloped Bank	Width (m)	308.23
Depth Reference	Vertical Beam	Right Method	Sloped Bank	Area (m ²)	792.6
Coordinate System	ENU	Top Fit Type	Power Fit	Mean Speed (m/s)	0.109
		Bottom Fit Type	Power Fit	Total Q (m ³ /s)	86.196

Measurement Results																		
Tr		Time			Distance			Mean Vel		Discharge						%		
#		Time	Duration	Temp.	Track	DMG	Width	Area	Boat	Water	Left	Right	Top	Middle	Bottom	Total	LCTotal	Measured
1	R	11:23:16 AM	0:33:07	29.7	260.09	245.77	261.77	825.1	0.131	0.072	0.54	0.00	3.69	51.76	3.76	59.759	--	86.6
2	L	11:57:13 AM	0:35:50	30.0	257.84	244.02	694.02	914.9	0.120	0.064	0.69	-0.02	3.63	50.97	2.92	58.188	--	87.6
3	R	4:39:22 PM	0:17:34	31.2	255.61	240.01	257.01	784.4	0.243	0.096	1.54	-0.01	5.25	63.07	5.23	75.089	--	84.0
4	L	4:57:18 PM	0:05:52	31.1	243.16	229.57	264.57	699.2	0.691	0.107	0.41	1.45	6.28	61.49	5.44	75.069	--	81.9
5	R	5:03:41 PM	0:07:18	31.1	240.44	237.79	262.79	646.9	0.549	0.113	0.76	0.20	6.03	62.33	3.77	73.090	--	85.3
6	L	5:11:14 PM	0:08:04	31.1	250.70	246.06	266.06	638.3	0.518	0.120	0.66	0.04	6.22	66.71	2.70	76.331	--	87.4
7	R	9:24:23 AM	0:42:32	30.9	263.50	245.56	275.56	840.4	0.103	0.129	2.06	0.00	6.46	94.81	5.06	108.392	--	87.5
8	L	10:07:45 AM	0:49:10	32.1	251.59	237.71	262.71	839.6	0.085	0.131	2.29	-0.02	6.50	95.93	5.33	110.027	--	87.2
9	R	6:50:14 PM	0:24:47	32.4	255.21	242.12	268.12	866.7	0.172	0.130	0.96	-0.06	6.68	99.49	5.60	112.668	--	88.3
10	L	7:15:29 PM	0:13:26	32.4	248.52	243.66	269.66	870.3	0.308	0.130	1.08	-0.05	6.73	100.04	5.55	113.348	--	88.3
			Mean	31.2	252.66	241.23	308.23	792.6	0.292	0.109	1.10	0.15	5.74	74.66	4.54	86.196	0.000	86.4
			Std Dev	0.9	6.90	4.89	128.69	92.6	0.207	0.023	0.62	0.44	1.12	19.31	1.07	21.209	0.000	2.0
			COV	0.0	0.027	0.020	0.418	0.117	0.708	0.214	0.562	2.831	0.194	0.259	0.237	0.246	0.000	0.023

Exposure Time: 3:57:40

Tr1=20120519112316.riv; Tr2=20120519115711.riv; Tr3=20120519163920.riv; Tr4=20120519165716.riv; Tr5=20120519170339.riv; Tr6=20120519171112.riv; Tr7=20120520092423.riv; Tr8=20120520100743.riv; Tr9=20120520185014.riv; Tr10=20120520191528.riv;

Comments
Tr1=20120519112316.riv - ; Tr2=20120519115711.riv - ; Tr3=20120519163920.riv - ; Tr4=20120519165716.riv - ; Tr5=20120519170339.riv - ; Tr6=20120519171112.riv - ; Tr7=20120520092423.riv - ; Tr8=20120520100743.riv - ; Tr9=20120520185014.riv - ; Tr10=20120520191528.riv - ;

Compass Calibration
Not Loaded

System Test
Not Loaded

Station Number: 111150000

Meas. No: 0

Station Name: Malanville

Date: 05/19/2012

Party:	Width: 266.6 m	Processed by:
Boat/Motor:	Area: 837.7 m ²	Mean Velocity: 0.102 m/s
Gage Height: 3.840 m	G.H.Change: 0.000 m	Discharge: 85.3 m ³ /s

Area Method: Avg. Course	ADCP Depth: 0.250 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (0.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m ²	Diff.: 0.000%
Depth Sounder: Not Used	Top Est: Power (0.1667)	Control1: Unspecified	
		Control2: Unspecified	
		Control3: Unspecified	

Screening Thresholds:		ADCP:
BT 3-Beam Solution: YES	Max. Vel.: 0.353 m/s	Type/Freq.: Rio Grande / 1200 kHz
WT 3-Beam Solution: NO	Max. Depth: 4.75 m	Serial #: 8549 Firmware: 10.16
BT Error Vel.: 0.10 m/s	Mean Depth: 3.15 m	Bin Size: 5 cm Blank: 25 cm
WT Error Vel.: 0.15 m/s	% Meas.: 69.50	BT Mode: 5 BT Pings: 1
BT Up Vel.: 0.30 m/s	Water Temp.: None	WT Mode: 11 WT Pings: 1
WT Up Vel.: 0.50 m/s	ADCP Temp.: 30.8 °C	WZ : 5
Use Weighted Mean Depth: YES		

Performed Diag. Test: NO

Project Name: Malanville.mmt

Performed Moving Bed Test: NO

Software: 2.08

Performed Compass Test: NO

Meas. Location:

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	12.0	12.0	162	16.5	58.7	9.48	0.088	0.103	84.9	280.3	809.0	17:13	17:18	0.87	0.11	4	8
001	L	10.0	18.0	123	14.0	56.4	8.77	-0.093	1.28	80.3	274.1	857.8	17:19	17:23	0.99	0.09	4	9
002	R	5.00	20.0	128	15.6	60.9	10.2	0.635	0.196	87.6	256.8	806.5	17:23	17:28	0.88	0.11	2	9
003	L	6.00	17.0	145	14.5	61.1	10.6	0.891	1.34	88.4	255.2	877.6	17:28	17:33	0.80	0.10	18	14
Mean		8.25	16.8	139	15.1	59.3	9.77	0.380	0.729	85.3	266.6	837.7	Total	00:20	0.88	0.10	7	10
SDev		3.30	3.40	18	1.14	2.23	0.808	0.460	0.671	3.66	12.5	35.6			0.08	0.01		
SD/M		0.40	0.20	0.13	0.08	0.04	0.08	1.21	0.92	0.04	0.05	0.04			0.09	0.06		

Remarks:

Discharge for transects in *italics* have a total Q more than 5% from the mean

Discharge Measurement Summary

Date Measured: Wednesday, May 16, 2012

Site Information		Measurement Information	
Site Name	maison blanche	Party	
Station Number		Boat/Motor	
Location		Meas. Number	

System Information		System Setup		Units	
System Type	RS-M9	Transducer Depth (m)	0.06	Distance	m
Serial Number	2456	Salinity (ppt)	0.0	Velocity	m/s
Firmware Version	2.00	Magnetic Declination (deg)	-0.2	Area	m ²
Software Version	2.50			Discharge	m ³ /s
				Temperature	degC

Discharge Calculation Settings				Discharge Results	
Track Reference	Bottom-Track	Left Method	Sloped Bank	Width (m)	297.51
Depth Reference	Vertical Beam	Right Method	Sloped Bank*	Area (m ²)	383.3
Coordinate System	ENU	Top Fit Type	Power Fit	Mean Speed (m/s)	0.166
		Bottom Fit Type	Power Fit	Total Q (m ³ /s)	62.994

Measurement Results																		
Tr		Time			Distance				Mean Vel		Discharge						%	
#		Time	Duration	Temp.	Track	DMG	Width	Area	Boat	Water	Left	Right	Top	Middle	Bottom	Total	LCTotal	Measured
1	R	11:28:36 AM	0:10:54	30.3	271.47	249.92	269.92	367.9	0.415	0.174	0.30	0.00	7.31	48.23	8.01	63.842	--	75.5
2	L	11:40:23 AM	0:07:45	30.7	254.79	245.63	414.63	380.0	0.548	0.161	0.00	0.00	7.09	46.27	7.82	61.181	--	75.6
3	R	11:53:23 AM	0:13:07	30.1	266.75	249.07	255.07	380.7	0.339	0.165	0.00	0.00	6.48	49.20	7.02	62.697	--	78.5
4	L	12:07:06 PM	0:11:35	31.4	273.35	257.93	263.93	378.8	0.393	0.164	0.00	0.00	6.59	48.47	6.99	62.052	--	78.1
5	R	1:47:38 PM	0:10:20	30.9	272.16	254.91	645.91	514.2	0.439	0.126	1.60	0.00	6.92	48.74	7.44	64.701	--	75.3
6	L	1:58:26 PM	0:11:07	31.1	248.96	239.64	261.64	379.0	0.373	0.158	0.00	0.00	6.47	46.63	6.79	59.893	--	77.9
7	R	2:27:28 PM	0:09:27	30.8	275.27	245.07	257.07	377.7	0.485	0.166	0.03	0.00	7.48	47.17	7.87	62.550	--	75.4
8	L	2:37:48 PM	0:05:57	31.1	235.44	213.03	237.38	360.7	0.659	0.174	0.16	0.00	7.59	46.41	8.58	62.747	--	74.0
9	R	2:44:09 PM	0:06:16	30.9	236.52	214.43	236.43	364.6	0.629	0.174	0.02	0.00	7.53	48.00	7.86	63.408	--	75.7
10	L	2:50:44 PM	0:06:06	31.0	234.63	222.17	245.17	366.6	0.641	0.178	0.15	0.00	7.81	47.87	9.31	65.130	--	73.5
11	R	2:58:24 PM	0:06:55	30.9	236.03	221.85	244.85	371.4	0.569	0.178	0.04	0.00	7.74	49.53	8.70	66.015	--	75.0
12	L	3:05:42 PM	0:04:42	31.0	224.49	215.06	238.06	358.5	0.796	0.172	0.10	0.00	7.67	44.99	8.95	61.707	--	72.9
			Mean	30.8	252.49	235.73	297.51	383.3	0.524	0.166	0.20	0.00	7.22	47.63	7.94	62.994	0.000	75.6
			Std Dev	0.3	17.89	16.36	114.78	40.2	0.134	0.014	0.43	0.00	0.48	1.29	0.78	1.666	0.000	1.7
			COV	0.0	0.071	0.069	0.386	0.105	0.255	0.082	2.156	0.000	0.066	0.027	0.098	0.026	0.000	0.022

Exposure Time: 1:44:11

Tr1=20120516112836.riv; Tr2=20120516114023.riv; Tr3=20120516115322.riv; Tr4=20120516120706.riv; Tr5=20120516134738.riv; Tr6=20120516135825.riv; Tr7=20120516142726.riv; Tr8=20120516143746.riv; Tr9=20120516144407.riv; Tr10=20120516145042.riv; Tr11=20120516145824.riv; Tr12=20120516150541.riv;

Comments
Tr1=20120516112836.riv - ; Tr2=20120516114023.riv - ; Tr3=20120516115322.riv - ; Tr4=20120516120706.riv - ; Tr5=20120516134738.riv - ; Tr6=20120516135825.riv - ; Tr7=20120516142726.riv - ; Tr8=20120516143746.riv - ; Tr9=20120516144407.riv - ; Tr10=20120516145042.riv - ; Tr11=20120516145824.riv - ; Tr12=20120516150541.riv - ;

Compass Calibration
Not Loaded

System Test
Not Loaded

Discharge Measurement Summary

Date Measured: Sunday, May 20, 2012

Site Information		Measurement Information	
Site Name	sota	Party	
Station Number		Boat/Motor	
Location		Meas. Number	

System Information		System Setup		Units	
System Type	RS-M9	Transducer Depth (m)	0.06	Distance	m
Serial Number	2456	Salinity (ppt)	0.0	Velocity	m/s
Firmware Version	2.00	Magnetic Declination (deg)	-1.8	Area	m ²
Software Version	2.50			Discharge	m ³ /s
				Temperature	degC

Discharge Calculation Settings				Discharge Results			
Track Reference	Bottom-Track	Left Method	Sloped Bank	Width (m)	37.62		
Depth Reference	Vertical Beam	Right Method	Sloped Bank	Area (m ²)	37.7		
Coordinate System	ENU	Top Fit Type	Power Fit	Mean Speed (m/s)	0.639		
		Bottom Fit Type	Power Fit	Total Q (m ³ /s)	22.889		

Measurement Results																		
Tr		Time			Distance				Mean Vel		Discharge						%	
#		Time	Duration	Temp.	Track	DMG	Width	Area	Boat	Water	Left	Right	Top	Middle	Bottom	Total	LCTotal	Measured
1	L	2:20:54 PM	0:03:16	28.9	62.75	21.11	27.11	37.7	0.320	0.593	0.01	0.41	3.07	16.24	2.60	22.336	--	72.7
2	R	2:26:30 PM	0:03:13	28.8	82.23	24.91	30.91	29.5	0.426	0.798	0.52	-0.12	3.31	17.12	2.66	23.501	--	72.9
3	R	2:30:12 PM	0:02:58	28.9	54.21	37.67	41.67	30.8	0.305	0.753	0.00	0.34	3.28	16.95	2.59	23.156	--	73.2
4	R	2:43:25 PM	0:03:33	28.8	64.80	42.71	46.71	55.2	0.304	0.406	-0.01	-0.03	3.21	16.63	2.59	22.401	--	74.2
5	R	2:55:52 PM	0:04:15	28.7	47.71	38.70	41.70	35.6	0.187	0.648	0.00	0.54	3.32	16.52	2.67	23.051	--	71.7
			Mean	28.8	62.34	33.02	37.62	37.7	0.308	0.639	0.10	0.23	3.24	16.69	2.62	22.889	0.000	72.9
			Std Dev	0.1	11.68	8.43	7.36	9.2	0.076	0.138	0.21	0.25	0.09	0.31	0.04	0.451	0.000	0.8
			COV	0.0	0.187	0.255	0.196	0.245	0.246	0.215	1.998	1.114	0.029	0.019	0.014	0.020	0.000	0.011

Exposure Time: 0:17:15

Tr1=20120520132058.riv; Tr2=20120520132635.riv; Tr3=20120520133016.riv; Tr4=20120520134329.riv; Tr5=20120520135556.riv;

Comments
Tr1=20120520132058.riv - ; Tr2=20120520132635.riv - ; Tr3=20120520133016.riv - ; Tr4=20120520134329.riv - ; Tr5=20120520135556.riv - ;

Compass Calibration
Not Loaded

System Test
Not Loaded

Parameters and settings marked with a * are not constant for all files.

Report generated using SonTek RiverSurveyor Live v2.50

Discharge Measurement Summary

Date Measured: Monday, May 28, 2012

Site Information				Measurement Information			
System Information		System Setup		Units			
System Type	RS-M9	Transducer Depth (m)	0.06	Distance	m		
Serial Number	2456	Salinity (ppt)	0.0	Velocity	m/s		
Firmware Version	2.00	Magnetic Declination (deg)	-5.5	Area	m ²		
Software Version	2.50			Discharge	m ³ /s		
				Temperature	degC		

Discharge Calculation Settings				Discharge Results			
Track Reference	Bottom-Track	Left Method	Sloped Bank	Width (m)	126.68		
Depth Reference	Vertical Beam	Right Method	Sloped Bank	Area (m ²)	66.5		
Coordinate System	ENU	Top Fit Type	Power Fit	Mean Speed (m/s)	0.308		
		Bottom Fit Type	Power Fit	Total Q (m ³ /s)	20.440		

Measurement Results																		
Tr		Time			Distance			Mean Vel		Discharge						%		
#		Time	Duration	Temp.	Track	DMG	Width	Area	Boat	Water	Left	Right	Top	Middle	Bottom	Total	LCTotal	Measured
1	R	3:18:11 PM	0:12:56	33.3	153.78	124.49	127.49	68.5	0.198	0.299	0.04	0.01	4.92	13.17	2.33	20.470	--	64.3
2	L	3:31:46 PM	0:13:44	33.5	173.46	122.87	125.87	64.5	0.211	0.316	0.06	0.02	4.99	12.92	2.42	20.410	--	63.3
			Mean	33.4	163.62	123.68	126.68	66.5	0.204	0.308	0.05	0.02	4.95	13.04	2.38	20.440	0.000	63.8
			Std Dev	0.1	9.84	0.81	0.81	2.0	0.006	0.009	0.01	0.00	0.04	0.12	0.04	0.030	0.000	0.5
			COV	0.0	0.060	0.007	0.006	0.030	0.030	0.029	0.156	0.214	0.007	0.009	0.019	0.001	0.000	0.008

Exposure Time: 0:26:40
 Tr1=20120528151810.riv; Tr2=20120528153145.riv;

Comments

Compass Calibration

Not Loaded

System Test

Not Loaded