STREAM GAUGING II

FIELDWORK REPORT

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GROUP#: 4 - HTC 2013-2014

PAMPANGA FIELDWORK REPORT

I. INTRODUCTION:

The chosen site of the fieldwork was the Pampanga river basin in Arayat at the aftermath of typhoon Santi. There are two water level stations, the telemetered water level recording station (sensor cable /electronic data logger system), located at the right bank downstream at the approaching end of the San Agustin bridge. The fieldwork was conducted from the 15th to the 25th of October 2013 to assess the effect of the flooding that occurred during the typhoon. The class was divided into four groups and each group were assigned a different method for each day. Four different methods were employed for the fieldwork, namely, the Acoustic Doppler Current Profiler (ADCP), the Conventional Current Meter method, the Slope-Area method and the Float method.

Asides from the fieldwork, field visits to various selected sites with certain relevance to training were undertaken. These trips were a part of the fieldwork as the sites had certain significances that are related to the Hydrology Training Course.

Fig.1a: Pampanga River with Mount Arayat in the background

	Country	Philippines
	Region	Central Luzon
	City	Cabanatuan, Palayan
	Source	
- location		Sierra Madre, Central Luzon
	Mouth	Manila Bay
- location		Hagonoy, Bulacan, Central Luzon

- elevation	0 m (0 ft)
- coordinates	[14°46′N 120°39′E](#)
Length	260 km (162 mi)
Basin	9,759 km^2 (3,768 sq mi)

II. OBJECTIVES/AIM:

The objective of the fieldwork was to get some hands on practical as part our training requirements in the Hydrology Training Course. The aim was to take measurements by learning how to set-up, calibrate, the use and procedures involved in the various tools and instruments namely the Acoustic Doppler Current Profiler (ADCP), the Conventional Current meter, the Float method and the Slope-Area method, their limitations and advantages.

Fig.IIa: The ADCP

Fig.IIb: Conventional Current Meter

Fig.IIc: Float Method

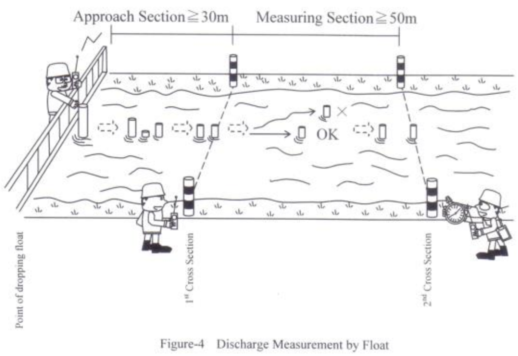


Figure-4 Discharge Measurement by Float

Fig.IId: Slope-Area Method (Total Station)

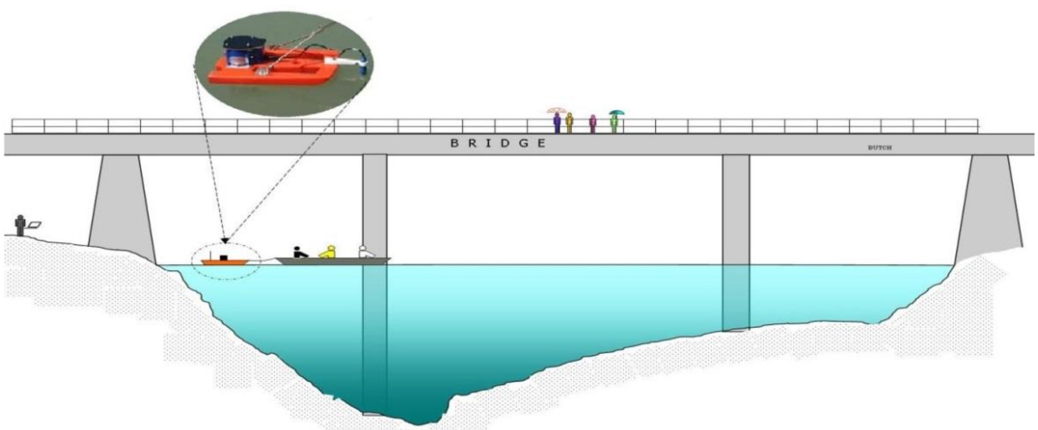
III. METHODOLOGY:

The group was assigned to take on the ADCP, the Float method, the Conventional Current Meter method and the Slope-Area method respectively on successive days.

- ACOUSTIC DOPPLER CURRENT PROFILER (ADCP)- DAY 1

The ADCP was assembled at the right bank upstream of the bridge. The various parts, cables and the software were set-up. After assembling the ADCP it was then calibrated to relay signals to the computer run software. Calibrating involved thawing, tilting and rolling while rotating in a circle. After calibration the ADCP was then towed by boat facing upstream across the river. Two transects were made and the results obtained.

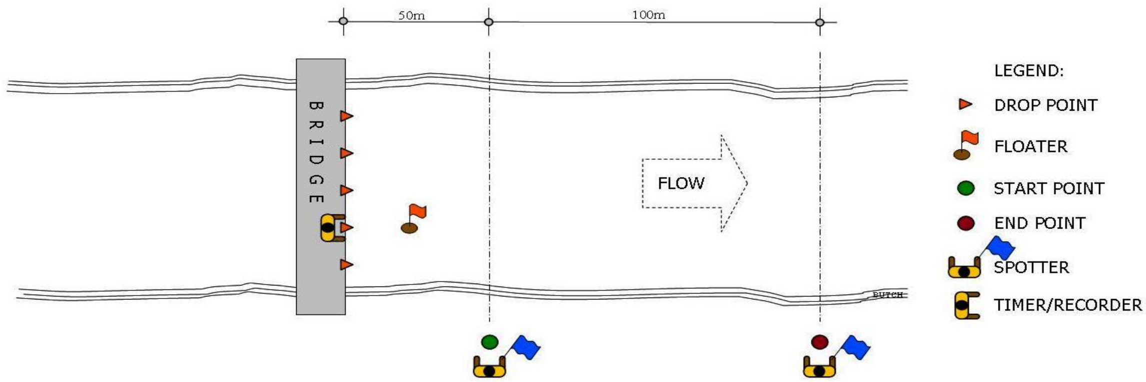
Fig.IIIa: ADCP Transact of the river



- FLOAT METHOD- DAY 2

For this method bamboos were utilised with bright flags attach to the floating end for sighting. Sections on the ridge were divided into equal distances (5meters) in accord with the flow of the river and the bamboos dropped one at a time at each marked distances. Along the bank downstream of the bridge measurements of distance (30m & 50m) were taken at two points and members with stop watches recording the time the floats passed the points from the time it was dropped and recorded.

Fig. IIIb.: The Float method

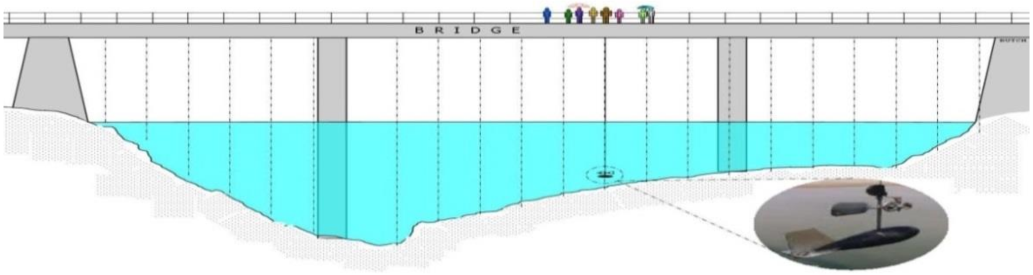


➢ THE CONVENTIONAL CURRENT METER METHOD- DAY 3

Before measurements were taken the Current meter was set up on site at the San Agustin Bridge. The velocimeter use was the price type AA current meter with a sounding reel of 20 meters in length. The stream channel cross section was divided into 17 5 meter vertical subsections. In each subsection, the area was obtained by measuring the width and depth of the subsection, and the water velocity determined using the current meter. The measurements began at the left bank facing downstream of the bridge to the right bank. The measurements proceeded as follows;

- Winch out the first point of gauging
- Lower the weight until it touches the water. Zero the depth counter and record
- Lower the bomb until it touches the bed. Raise (Lift) the bomb until there is a sag in the main cable.
- Read the depth counter giving the depth of water at that point. Record it. Calculate your points (0.2, 0.8)
- Raise the instrument until the propeller is on the surface of the water.
- Zero the depth counter then lower the instrument to the calculated depth on counter and stop.
- Hook up the counter to the cableway terminal and take the revolution counted with time (60s).
- Lower the instrument to the next depth (0.2, 0.8). Take the revolution
- For depth above 1m (0.2, 0.6, 0.8).
- Read the staff gauge at the beginning , mid through , and at the end of the measurement

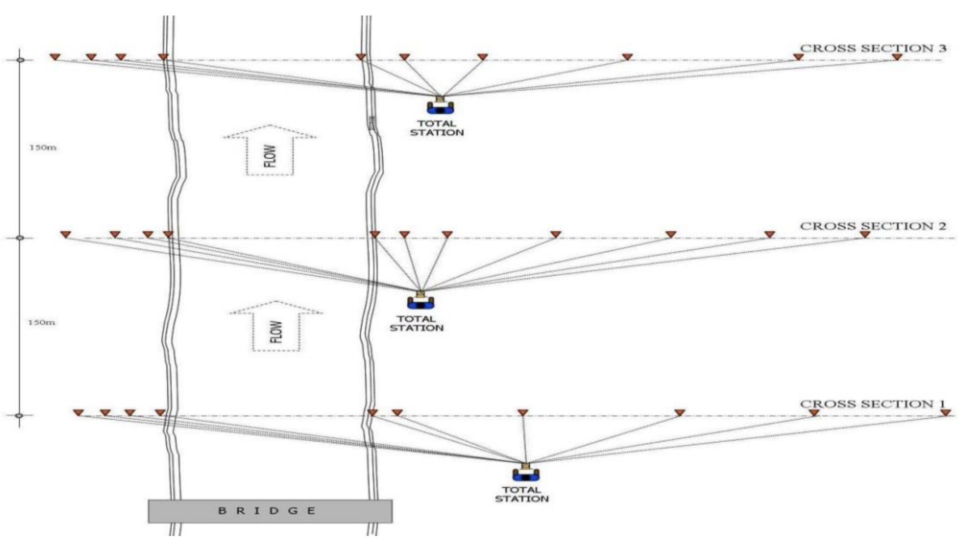
Fig. IIIc. The Conventional Current Meter method



- THE SLOPE-AREA METHOD- DAY 4

The last day's assignment was to use the indirect approach of the Slope-Area method with the use of the Total Station. The highest flood mark left by typhoon Santi was first located. After locating this flood mark three cross sections were measured and marked to be used on both sides of the bank. The bench mark (BM) was then identified on the left bank upstream of the bridge and used as the reference point of getting the elevation of each point. These elevations are to be used to determine the profile of the river from the highest flood marks on both banks to the thalweg. Before any measurements were taken the Total Station was always oriented towards the North direction. As it locates the prism a beeping occurs and thus the vertical distance, horizontal distance and the horizontal angle to the prism is automatically given. For each cross section various points were selected for measuring on both banks.

Fig.IIId: The Slope-Area method



IV. RESULTS:

The following tables and graphs provide the calculations, findings and results of the four methods that were used.

a. THE ACOUSTIC DOPPLER CURRENT PROFILER (ADCP)

Table showing Discharge summary

Discharge Measurement Summary

Date Measured: Thursday, October 17, 2013

Site Information	
Site Name	Arayat Stn
Station Number	001
Location	Arayat Pampanga

Measurement Information	
Party	HTC - Grp 4
Boat/Motor	1
Meas. Number	1

System Information	
System Type	RS-M9
Serial Number	3860
Firmware Version	3.00
Software Version	3.7

System Setup	
Transducer Depth (m)	0.00
Salinity (ppt)	0.0
Magnetic Declination (deg)	0.0

Units	
Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings			
Track Reference	Bottom-Track	Left Method	Sloped Bank
Depth Reference	Vertical Beam	Right Method	Sloped Bank
Coordinate System	ENU	Top Fit Type	Power Fit
		Bottom Fit Type	Power Fit

Discharge Results	
Width (m)	130.596
Area (m2)	703.897
Mean Speed (m/s)	0.672
Total Q (m3/s)	473.139
Maximum Measured Depth	11.086
Maximum Measured Speed	1.876

Measurement Results

Tr		Time			Distance				Mean Vel		Discharge							%
#		Time	Duration	Temp.	Track	DMG	Width	Area	Boat	Water	Left	Right	Top	Middle	Bottom	Total	MBTotal	Measured
2	L	1:40:59 PM	0:12:41	29.0	170.35	129.00	130.596	703.897	0.224	0.672	-0.02	0.00	25.95	365.10	82.12	473.139	--	77.2
			Mean	29.0	170.35	129.00	130.596	703.897	0.224	0.672	-0.02	0.00	25.95	365.10	82.12	473.139	0.000	77.2
			Std Dev	0.0	0.00	0.00	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.0
			COV	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Exposure Time: 0:12:41

Tr2=20131017134059.riv;

Comments

Tr2=20131017134059.riv - Fair weather;

Compass Calibration

Passed Calibration
Calibration duration = 66 seconds
M7.00 = Magnetic influence is acceptable
Q9 = Magnetic field is uniform
H9 = Complete horizontal rotation
V9 = High pitch/roll
Recommendation(s):
Avoid any changes to the instrument setup or its orientation to the magnetic influences detected during the compass calibration.
Measurements should be made in locations with similar magnetic influences as the location of the compass calibration.

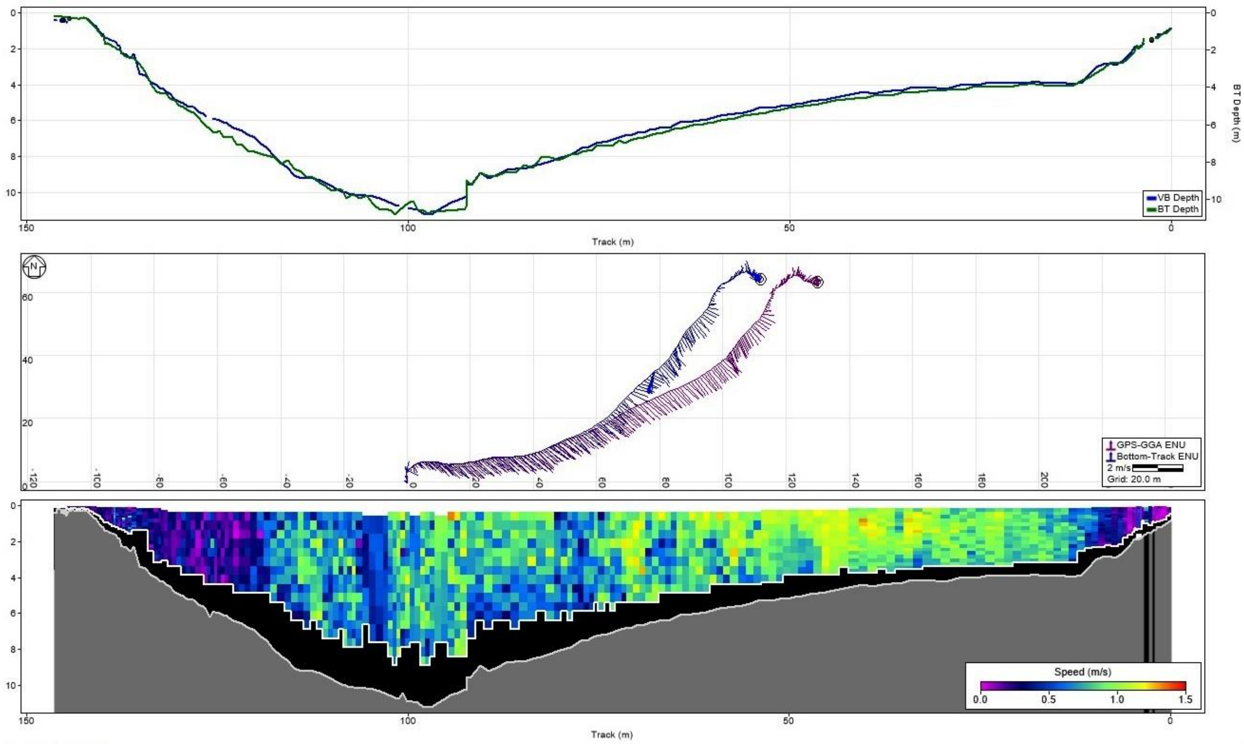
System Test

System Test: PASS

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

Report generated using SonTek RiverSurveyor Live v3.7

Graphs showing cross- sections of the river bed



b. THE FLOAT METHOD

Tabulated results for the float method

	Time	Staff gage (m)	As of	Distance (m)
Start	11:30	3.16	11:00 AM	100
End	12:05	3.12	12:00 NN	100
Average	6:05			100

								Divided Area			
Measuring Line		Time of Drop	Traveling Time (secs)	Average traveling time (1st trial + 2nd trial)/2	Velocity of Float (m/s)	Corr. Coef.	Corr. Velo. (m/s)	Section 1	Section 2	Average Area (sq.m.)	Divided Q (cu.m/s)
No. 1	1st trial	11:30	186	186	0.5376	0.85	0.45699	27.75	27.33	27.54	12.5855
	2nd trial	failed	0								
No. 2	1st trial	failed	0	123	0.8130	0.85	0.69106	105.9	62.025	83.9625	58.0229
	2nd trial	11:44	123								
No. 3	1st trial	11:47	118	127	0.7874	0.85	0.66929	229.65	113.5	171.575	114.834
	2nd trial	11:51	136								
No. 4	1st trial	11:55	120	128	0.7813	0.85	0.66406	338.7	144.7	241.7	160.504
	2nd trial	11:58	136								
No. 5	1st trial	12:02	140	140	0.7143	0.85	0.60714	338.05	146.9	242.475	147.217
	2nd trial	failed	0								
									Total Q		493.163

c.THE CONVENTIONAL CURRENT METER METHOD

Tabulated results for the Conventional Current meter

Discharge Measurement (Current Meter) for :		*Arayat*		River:	*Pampanga*	PRFFC
DM #: 2	Date:	Oct. 18, 2013	Team:		Group 4	FFB
Gage Height: Start: 4.68	End: 4.57	Inst. # :	Price AA	Wx:	fair	PAGASA
Observation Time: Start: 10:55	End: 3:00	Calibration Eqtn.: V = 0.702	N+ 0.013		note: just input negative value	hth/ 97
Vertical dist. to water surface (m) = 11.00					for latter if eqtn. is minus.	
Total Area (m^2) =	**405.42**		**Ave. Gage Height =**	**4.63**	**Sectional Width (m) =**	**120.0**
Total Q (m^3/s) =	**325.70**		**Ave. Vel. (m/s) =**	**0.803**		

Dist. from Initial point	Width (mts.)	Depth (ep for pier) (mts.)	Vert. Angle 4^0-36^0	Angle Corrected Depth	Observation Depth 0.2 Rev.	0.2 Time	0.6 Rev.	0.6 Time	0.8 Rev.	0.8 Time	Velocity at point for 0.6 only	Velocity Mean (0.2,0.6 (0.2 & 0.8)	Area (m^2)	Q (cumecs)	Remarks Excellent, Good Fair, Poor
0				0											LWE
5	5	2.3		2.300	60	62			60	65	x	0.677	11.50	7.78	
10	5	4.11	8	3.989	90	64			75	62	x	0.931	19.95	18.57	
15	5	4.56	10	4.368	95	65			80	65	x	0.958	21.84	20.92	
20	5	8.18	5	8.129	95	63			30	64	x	0.707	40.65	28.73	ripples
25	5			x							x	x	x	x	turbulent
30	5			x							x	x	x	x	pier
35	5			x							x	x	x	x	too deep
40	5			x							x	x	x	x	too deep
45	5	9.72	19	8.881	85	62			75	60	x	0.933	44.40	41.43	
50	5	9.63	4	9.597	90	60			50	62	x	0.823	47.99	39.47	
55	5	8.1	5	8.049	85	64			60	65	x	0.803	40.25	32.32	
60	5	6.72	5	6.671	85	65			60	63	x	0.806	33.35	26.89	
65	5	5.2		5.200	85	62			70	62	x	0.891	26.00	23.15	
70	5	5.25		5.250	85	64			65	62	x	0.847	26.25	22.24	
75	5	5.05		5.050	80	61			60	64	x	0.802	25.25	20.26	
80	5	4.45		4.450	80	61			60	62	x	0.813	22.25	18.09	
85	5	4		4.000	60	63			65	64	x	0.704	20.00	14.08	
90	5			x							x	x	x	x	waterlily
95	5			x							x	x	x	x	pier
100	5			x							x	x	x	x	turbulent
105	5			x							x	x	x	x	pier
110	5	2.55		2.550	55	63			50	61	x	0.607	12.75	7.74	
115	5	2.6		2.600	30	66			25	64	x	0.310	13.00	4.03	
120	x			x							x	x	x	x	RWE
	#REF!			x							x	x	x	x	shallow

	At distance 25 - 40 & 90 - 105, no velocity measurement was made due to obstraction	**Total Area =**	**405.42**
Rem:	from the pier that may alter the true measurement from ripples or turbulent. Also, at	**Total Discharge =**	**325.70**
	stn 35-40 the elevation from surface water to river bed is too deep.	**Ave. Velocity =**	**0.803**

d.THE SLOPE-AREA METHOD

Tabulated calculations and results for the Slope-Area method

Slope-Area Cross-Section Computation

Station: Survey Date:
River: *Arayat River* Gage Ht.= *9.11* meters

Cross-Section number ONE (1)

Station	Distance	Elevation	Water Sfc. elev.	Depth	Mean Depth	Area	Wetted Perimeter
0		8.129	8.129	0			
25.509	25.509	6.825	8.129	1.304	0.652	16.63187	25.54231
42.67	17.161	6.709	8.129	1.42	1.362	23.37328	17.16139
75.27	32.6	6.31	8.129	1.819	1.6195	52.7957	32.60244
104.001	28.731	7.073	8.129	1.056	1.4375	41.30081	28.74113
116.728	12.727	6.352	8.129	1.777	1.4165	18.0278	12.74741
141.631	24.903	5.969	8.129	2.16	1.9685	49.02156	24.90595
175.413	33.782	5.12	8.129	3.009	2.5845	87.30958	33.79267
191.773	16.36	4.991	8.129	3.138	3.0735	50.28246	16.36051
196.461	4.688	4.343	8.129	3.786	3.462	16.22986	4.732573
200.129	3.668	3.569	8.129	4.56	4.173	15.30656	3.748773
217.429	17.3	0.0745	8.129	8.0545	6.30725	109.1154	17.64941
222.429	5	-0.4755	8.129	8.6045	8.3295	41.6475	5.030159
227.429	5	-1.3755	8.129	9.5045	9.0545	45.2725	5.080354
232.429	5	-2.3255	8.129	10.4545	9.9795	49.8975	5.08945
237.429	5	-3.1955	8.129	11.3245	10.8895	54.4475	5.075126
242.429	5	-4.9955	8.129	13.1245	12.2245	61.1225	5.314132
247.429	5	-6.0755	8.129	14.2045	13.6645	68.3225	5.11531
252.429	5	-6.9755	8.129	15.1045	14.6545	73.2725	5.080354
257.429	5	-7.6255	8.129	15.7545	15.4295	77.1475	5.042073
262.429	5	-7.6855	8.129	15.8145	15.7845	78.9225	5.00036
267.429	5	-8.1755	8.129	16.3045	16.0595	80.2975	5.023953
272.429	5	-7.6755	8.129	15.8045	16.0545	80.2725	5.024938
277.429	5	-6.3755	8.129	14.5045	15.1545	75.7725	5.166237
282.429	5	-5.5755	8.129	13.7045	14.1045	70.5225	5.063596
286.429	4	-4.2755	8.129	12.4045	13.0545	52.218	4.205948
289.429	3	-2.7455	8.129	10.8745	11.6395	34.9185	3.367625
292.429	3	-1.6755	8.129	9.8045	10.3395	31.0185	3.185106
300.429	8	-0.5755	8.129	8.7045	9.2545	74.036	8.075271
301.429	1	0.88	8.129	7.249	7.97675	7.97675	1.765922
314.571	13.142	3.877	8.129	4.252	5.7505	75.57307	13.4794
318.913	4.342	6.808	8.129	1.321	2.7865	12.09898	5.238676
321.651	2.738	6.713	8.129	1.416	1.3685	3.746953	2.739648

Total Width =	321.65	meters	Hydraulic Radius(r) =	4.99	meters
Total Area =	1627.90	meters²	Mean Section Depth =	5.061073	meters
Wetted Perimeter(P) =	326.148	meters			

Slope-Area Cross-Section Computation

Station: *0* Survey *0*
River: *Arayat River* Gage ht.= *9.11* meters

Cross-Section number TWO (2)

Station	Distance	Elevation	Water Sfc. elev.	Depth	Mean Depth	Area	Wetted Perimeter
0		8.001	8.001	0			
18.2	18.2	7.99	8.001	0.011	0.0055	0.1001	18.2
58.972	40.772	7.701	8.001	0.3	0.1555	6.340046	40.77302
67.263	8.291	7.612	8.001	0.389	0.3445	2.85625	8.291478
74.655	7.392	7.365	8.001	0.636	0.5125	3.7884	7.396126
85.681	11.026	7.243	8.001	0.758	0.697	7.685122	11.02667
98.611	12.93	7.168	8.001	0.833	0.7955	10.28582	12.93022
120.597	21.986	7.151	8.001	0.85	0.8415	18.50122	21.98601
147.577	26.98	7.141	8.001	0.86	0.855	23.0679	26.98
158.263	10.686	7.063	8.001	0.938	0.899	9.606714	10.68628
163.171	4.908	7.014	8.001	0.987	0.9625	4.72395	4.908245
260.233	97.062	7.093	8.001	0.908	0.9475	91.96624	97.06203
266.634	6.401	6.909	8.001	1.092	1	6.401	6.403644
269.411	2.777	4.979	8.001	3.022	2.057	5.712289	3.381809
276.167	6.756	3.533	8.001	4.468	3.745	25.30122	6.909012
302.942	26.775	2.566	8.001	5.435	4.9515	132.5764	26.79246
325.942	23	1.949	8.001	6.052	5.7435	132.1005	23.00827
334.942	9	1.649	8.001	6.352	6.202	55.818	9.004999
345.942	11	0.849	8.001	7.152	6.752	74.272	11.02905
356.942	11	0.449	8.001	7.552	7.352	80.872	11.00727
362.942	6	0.049	8.001	7.952	7.752	46.512	6.013319
384.942	22	-0.551	8.001	8.552	8.252	181.544	22.00818
395.942	11	-1.251	8.001	9.252	8.902	97.922	11.02225
399.942	4	1.749	8.001	6.252	7.752	31.008	5
402.442	2.5	2.932	8.001	5.069	5.6605	14.15125	2.765771
411.878	9.436	6.056	8.001	1.945	3.507	33.09205	9.939692
418.479	6.601	7.127	8.001	0.874	1.4095	9.304109	6.687319
420.497	2.018	7.086	8.001	0.915	0.8945	1.805101	2.018416

Total Width =	420.50	meters	Hydraulic Radius(r) =	2.62	meters
Total Area =	1107.31	meters²	Mean Section Depth =	2.633345	meters
Wetted Perimeter(P) =	423.232	meters			

Slope-Area Cross-Section Computation

Station: *0* Survey *0.00*
River: *Arayat River* Gage ht.= *9.11* meters

Cross-Section number THREE (3)

Station	Distance	Elevation	Water Sfc. elev.	Depth	Mean Depth	Area	Wetted Perimeter
0		7.979	7.979	0			
21.521	21.521	7.976	7.979	0.003	0.0015	0.032282	21.521
66.242	44.721	7.283	7.979	0.696	0.3495	15.62999	44.72637
146.794	80.552	6.674	7.979	1.305	1.0005	80.59228	80.5543
166.819	20.025	6.482	7.979	1.497	1.401	28.05503	20.02592
182.931	16.112	2.722	7.979	5.257	3.377	54.41022	16.54491
186.095	3.164	1.393	7.979	6.586	5.9215	18.73563	3.431783
199.628	13.533	1.016	7.979	6.963	[illegible]	91.67931	13.53825
216.628	17	0.4335	7.979	7.5455	7.25425	123.3223	17.00998
226.628	10	0.216	7.979	7.763	7.65425	76.5425	10.00237
234.628	8	0.016	7.979	7.963	7.863	62.904	8.0025
248.628	14	-0.584	7.979	8.563	8.263	115.682	14.01285
259.628	11	-0.884	7.979	8.863	8.713	95.843	11.00409
281.628	22	-1.284	7.979	9.263	9.063	199.386	22.00364
287.628	6	-1.384	7.979	9.363	9.313	55.878	6.000833
295.628	8	-1.884	7.979	9.863	9.613	76.904	8.01561
308.628	13	-2.084	7.979	10.063	9.963	129.519	13.00154
314.628	6	-0.484	7.979	8.463	9.263	55.578	6.20967
317.318	2.69	0.711	7.979	7.268	7.8655	21.1582	2.943489
324.345	7.027	3.269	7.979	4.71	5.989	42.0847	7.478108
329.542	5.197	5.446	7.979	2.533	3.6215	18.82094	5.634549
335.94	6.398	5.667	7.979	2.312	2.4225	15.49916	6.401816

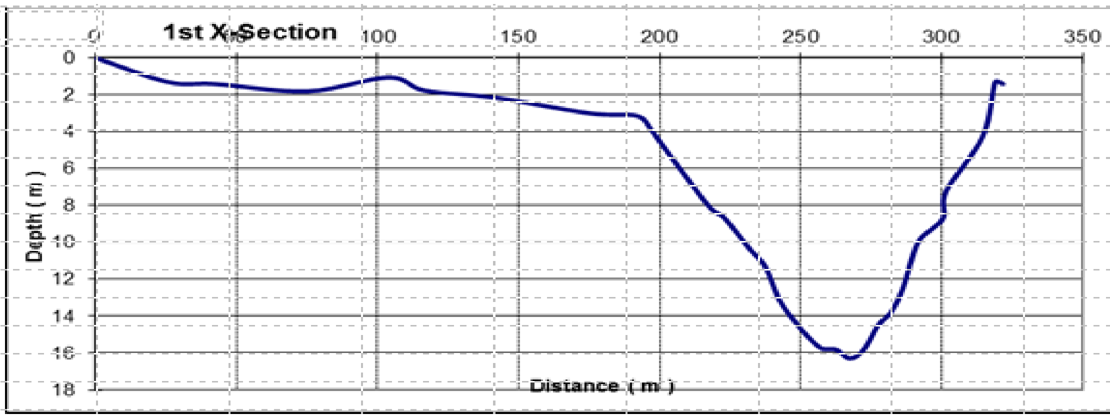
Total Width =	335.94	meters	Hydraulic Radius(r) =	4.08	meters
Total Area =	1378.26	meters²	Mean Section Depth =	4.102686	meters
Wetted Perimeter(P) =	338.064	meters			

Cross-Section from Slope Area method

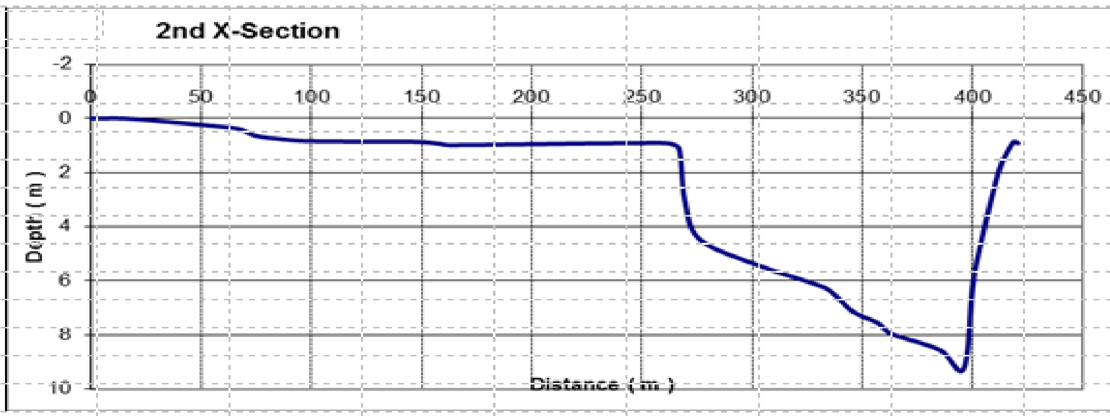
Station: *0* Date: *0*

River: *Arayat River* Gage Ht. 9.11 meters

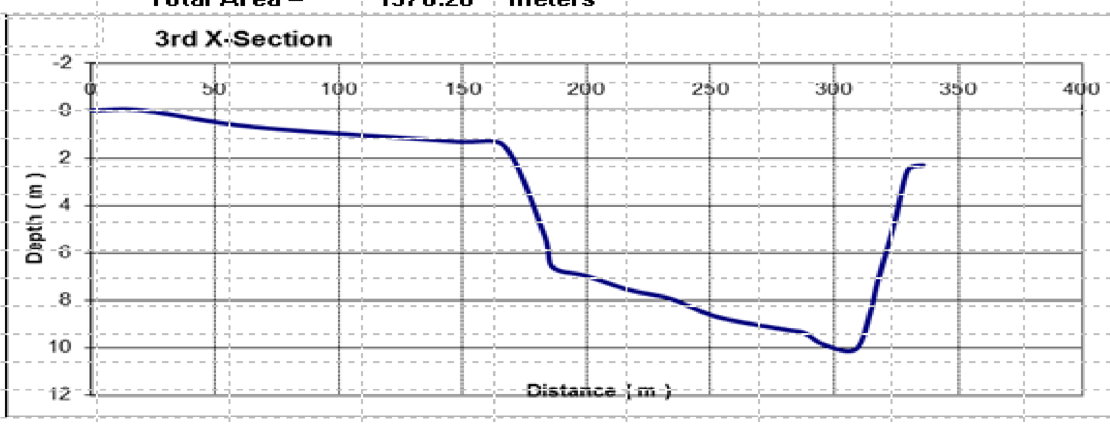
Total Area = 1627.90 meters^2



Total Area = 1107.31 meters^2



Total Area = 1378.26 meters^2



Cross-Section Summary

Slope-Area Summary Sheet (3-Section)

Station:	*Arayat*	River:	*Pampanga*
Flood Date:	*22-Oct-13*	Drainage Area:	*6,487*
Gauge Height:	*8.78*	Meas. #:	*4*

❖❖❖

X - Section Properties:

			Highwater Marks										
X-Sect.	Width	Area	Left Bank	Right Bank	Average Water Sfc.	d_m (mean depth)	n	r	K	K^3/A^2	α	F	State of Flow
1	321.65	1627.90	6.713	8.129	7.421	5.061	0.035	4.99	136572.1	9.6E+08	1	0.312	tranquil
2	420.50	1107.31	6.086	8.001	7.0435	2.633	0.035	2.62	60263.82	1.8E+08	1	0.636	tranquil
3	335.94	1378.26	5.667	7.979	6.823	4.103	0.035	4.08	100968.1	5.4E+0	Table	0.410	tranquil

note: Assume no sub-divided sections, hence α is always 1!!

Reach Properties:

Reach	Length	Δh Fall	k	reach condition	K_U/K_D	K_U/K_D Condition	Ave. A	Q by formula	Ave V
1-2	150	0.3775	0	contracting	2.266236	poor	1367.606	3049.902	2.230
2-3	150	0.2205	0.5	expanding	0.59686	poor	1242.785	3572.588	2.875
1-2-3	300	0.598	0	contracting	1.352626	good	1371.156	**3579.188**	2.610

n - roughness coefficient
K - conveyance
K_w - wtd. conveyance (Geometric mean of K of 2 sections).
F - Froude no (indicates the state of flow).
α - velocity head coefficient
r - hydraulic radius
k - coefficient for differences in velocity heads between 2 sections
h_v - velocity head
h_f - energy loss due to boundary friction in the reach.
S - friction slope

Discharge Computation:(comparison)

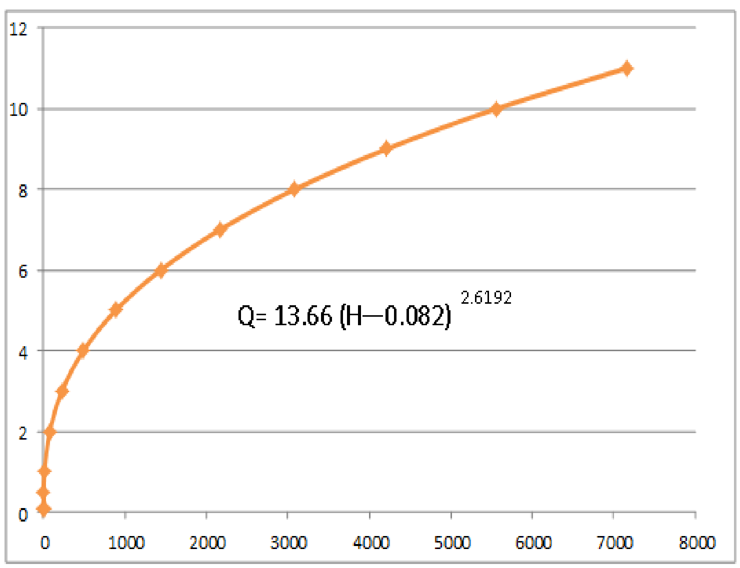
		h_v							
Reach	Assumed Q	U/S	D/S	Δh_v	h_f	$S=h_f/L$	$S^{1/2}$	K_w	Computed Q
1-2	3049.902	0.2466368	0.533055	-0.28642	0.091082	0.000607	0.024642	90721.3	2235.531
2-3	3572.588	0.5330545	0.344075	0.18898	0.31499	0.0021	0.045825	78004.64	3574.564
Rem:									

$Q_{1\text{-}2\text{-}3}$ = 3579.19 cumecs

Discharge

H-Q TABLE

HIEGHTS	DISCHARGE, Q
0.082	0
0.1	4
0.5	1.391
1	10.918
2	75.212
3	225.737
4	488.433
5	885.897
6	1438.571
7	2165.348
8	3083.93
9	4211.06
10	5563.69
11	7154.101



RATING CURVE

FINAL RESULTS

Method	Date of measurement	Stage (m)	Discharge (m^3/sec)
ADCP	17.10.2013	5.4	473.139
FLOAT	18/10/2013	3.2	269.0
CURRENT METER	21/10/2013	4.7	350.0
SLOPE- AREA	22/10/2013	8.2	3579.19

The results obtained are not the same for each method because of errors and characteristics of the river as in terms of its rate of flow each day and the changes in size or width of the river.

V. DISCUSSION/ANALYSIS:

Each result was dependent on the type of method employed. The correct assembling, calibration and operational procedures and channel characteristics were important factors affecting the measurements.

- The ADCP

The ADCP is convenient and highly accurate system designed specifically to measure river discharge, 3-Dimensional water currents, cross-sections, depths, and bathymetry from a moving or stationary vessel in both shallow and deep channels. As seen from the results all these data are automatically calculated and displayed for immediate analysis. Use of the ADCP is more suitable to low flow and medium flow away from debris and other limiting sources.

- The Float method

This is an indirect method that utilizes floats to measure discharge usually during high flow (flooding events) and medium flow. This method is inexpensive and simple for measuring surface velocity. Average velocity is obtained using a correction factor. The basic idea is to measure the time that it takes the object to float a specified distance downstream. As observed in the results it is not suitable for low flow measurement as three trials failed because of lateral movement or drifting towards the banks as a result of low flow velocities. It requires high velocities that would more or less keep the floats in a straight trajectory.

- The Conventional Current Meter method

Applying the 1point (0.6) 2 point (0.2, 0.8) and 3 point (0.2, 0.6, 0.8) velocity profile method depending on the depth criteria is essential in getting the correct measurements. Strong current flow with debris may drag the line out and may not give the correct depth. Applying the dryline or wetline correction is then required. Another problem that was encountered in the results was the length of the reel line. There were some points that were missed because of the failure of the weight to reach the river bed. It was too deep. However, this method is more suitable to conduct during medium flow and does give a good measure of the data concerned.

- The Slope-Area method

Slope area is a time consuming method but this method is used when no other equipments are available. Through channel characteristics, water surface profiles, and roughness coefficient the slope area of a river can be computed. The selection of suitable reach is probably the important element of a survey. The computation used is based on hydraulic (Mannings formulae) formulas for uniform steady flow:

Q = R2/3 S1/2/n where Q = total discharge

A = Cross – section Area, V = Mean Velocity in cross – section

n = Roughness coefficients, R = Hydraulic radius, S = Slope of water surface

As can be seen in the results it is tedious and time consuming thus the likelihood of errors in measurements and calculations are eminent if careless. It is however, a good method to use especially after flooding events when obtaining cross-sections and rating curves when flow is then uniform in a straight section of the channel.

From the final results table, it can be seen that the water level was receding and the velocity and discharge decreasing. The Slope-Area result was more indicative of the flooding that occurred during the typhoon Santi onslaught.

VI. CONCLUSION:

For the different methods and methodologies that were applied and their respective results obtained and discussed it is obvious that not all of them can be used without certain setbacks. They can be used accordingly as the situation allows or to complement each other. Thus, it can be concluded that the ADCP, Slope-Area, and the Conventional Current Meter cannot be used during high flow because of the limitations that were discussed. The same can be said of the Float method during low flow. The Slope-Area is more suitable after floods and when complimented by either the ADCP or the Current meter can provide very reliable data. The fieldwork exercise was a very good experience on how various flow measurement are obtain, the discharge and advantages and disadvantages of the four methods. Another important factor to be considered is the geometry or shape of the river channel when applying these methods.

VII. FIELD VISITS:

The purpose of the field visits was to determine the significance of each site and how it relates to the Hydrologist Training Course. The significance of each site are the hydrological storage, distribution and use of water in the respective sites as follows;

LA MESA DAM AND ECO-PARK

- Water storage, treatment and regulation of supply
- Water level monitoring and regulation
- Hydrologically based eco-park system

PANTABANGAN DAM

- Water storage for irrigation purposes
- Generation of hydro-electric power
- Flood control and water level monitoring

ANGAT DAM FLOOD FORECASTING AND WARNING SYSTEM

- Storage and water supply
- Irrigation and sewerage supply
- Hydro-electric power generation
- Water level monitoring and flood forecasting system
- irrigation

CALUMPIT MDRRMC

- Mega dyke designed to protect against floods
- Local flood monitoring, awareness, preparedness and combating operations system

CONG DADONG DAM IN ARAYAT, PAMPANGA

- Storage and irrigation purposes

These are the hydrological significances as summarised for each site.

VIII. SOURCES:

- ✓ Hydrological Training Course lecture notes 2013-2014
- ✓ Wikipedia.org