RC-1564-HO-DGN-RD -DPR -004 - D0

NATIONAL HIGHWAYS & INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.
(MINISTRY OF ROAD TRANSPORT & HIGHWAYS, GOVT. OF INDIA)
3RD FLOOR, PTI BUILDING, 4-PARLIAMENT STREET, NEW DELHI – 110001

NHIDCL
BUILDING INFRASTRUCTURE - BUILDING THE NATION

Consultancy Services for Feasibility Study, Preparation of Detailed Project Report and providing Pre-Construction Services for upgradation to 2 lane with paved shoulder from (i) Km 44.500 to Km 142.000 of Chattroo Village & (ii) Km 235.000 (Vailoo Village) to Km 269.000 (Khanabal) of Khellani – Kishtwar – Chattroo - Khanabal Section of NH 244 in the state of Jammu and Kashmir.

FINAL DETAILED PROJECT REPORT

KHELLANI TO CHATTROO SECTION

Volume – IB : Hydrology Report

February 2021

Rodic

Rodic Consultants Pvt. Ltd.
In JV with
Monarch Surveyors and Engineering Consultants Pvt. Ltd

MONARCH
An ISO 9001:2000 Registered

HYDRAULIC CALCULATION FOR VIADUCT CUM BRIDGE @ 34+235

Name of River / Stream / Nala	Chainage(km)
Local Stream	34.235

Sr. No.	Segmental Length(m)	Cumulative Segmental Length(m)	Elevation (m)
1	0	0	840
2	1000	1000	883
3	1000	2000	900
4	1000	3000	924
5	1000	4000	935
6	1000	5000	946
7	1000	6000	957
8	1000	7000	964
9	1000	8000	972
10	1000	9000	978
11	1000	10000	985
12	1000	11000	989
13	1000	12000	995
14	1000	13000	1000
15	1000	14000	1022
16	1000	15000	1032
17	1000	16000	1045
18	1000	17000	1052
19	1000	18000	1056
20	1000	19000	1059
21	1000	20000	1064
22	1000	21000	1069
23	1000	22000	1072
24	1000	23000	1075
25	1000	24000	1080

Catchment Area in Sq Km(A)	55
Longest Stream Length in Km (L)	24
Centroid Length in Km (Lc)	13.20
Point Rainfall Value (50 years)in mm	220
Point Rainfall Value (100 years)in mm	240
Subzone =	7

1 Empirical Method

Dickens Formula

Q	=	CA^(3/4)	
A		55	Km^2
C	=	19	
Q		384	Cumecs

2 Rational method

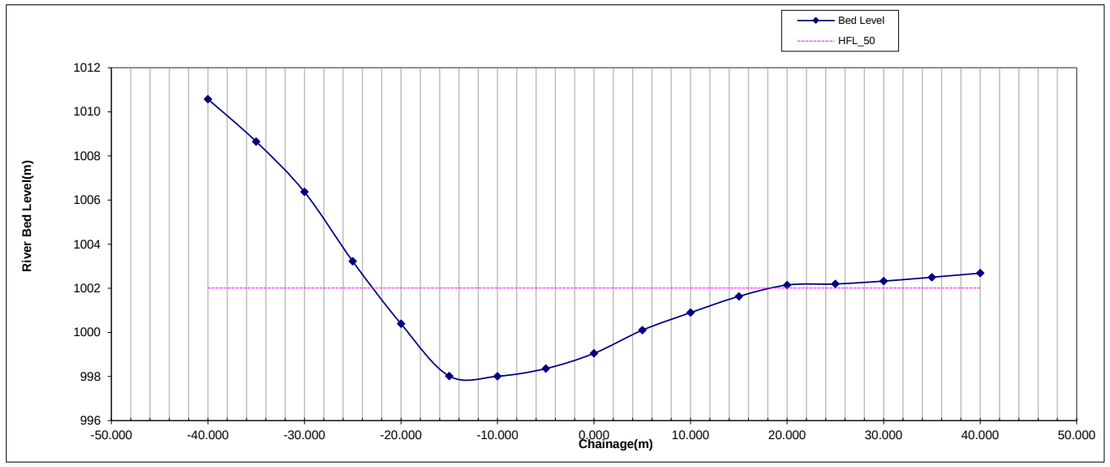
Catchment Area, A	=	55	Km^2	=	5500.000	Hectares
Length of longest stream	=	24.000	Km			
Height, H	=	240.00	m			
Time of Concentration by SP-13 formula	=	$(0.87*L^3/H)^{0.385}$				
tc	=	4.51	Hours			
50 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7	=	220	mm			
tp	=	7.30				
Design storm duration	=	8.0	hrs			
Conversion ratio for tc hours as per CWC FER for Subzone- 7	=	0.695				
tc hr rainfall	=	152.90	mm			
From code SP 13 Intensity of rainfall, Ic	=	4.16	cm/hr			
		3.39	cm/hr			
100 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7		240.00	mm			
Conversion ratio for tc hours as per CWC FER for Subzone- 7		0.695				
Conversio						
tc hr rainfall	=	166.80	mm			
From code SP 13 Intensity of rainfall, Ic	=	4.53	cm/hr			
		3.70	cm/hr			
From code SP 13 ' f ' Curve, Spread factor ' f '	=	0.934				
Runoff Co-efficient as per terrain condition, P	=	0.7				
Design discharge, Q50	=	0.0278PfAIc Cumecs				
	=	415.53	Cumecs		Say Q50=	**416**
Design discharge, Q100	=	0.0278PfAIc Cumecs				
	=	453.31	Cumecs		Say Q100=	**453**

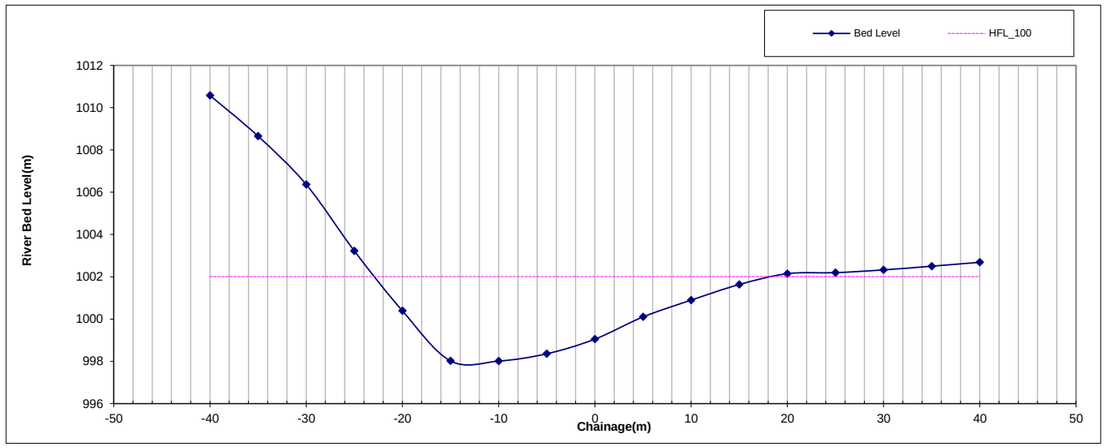
CROSS SECTION AT BRIDGE

HFL _50	1002.01				Q50=	416			
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-40.000	1010.576	1002.011	998.011	5.000	0.000	0.000	0.000	0.000	0.000
-35.000	1008.652	1002.011	998.011	5.000	0.000	0.000	0.000	0.000	0.000
-30.000	1006.368	1002.011	998.011	5.000	0.000	0.000	0.000	0.000	0.000
-25.000	1003.225	1002.011	998.011	5.000	0.000	0.000	0.000	0.000	0.000
-20.000	1000.389	1002.011	998.011	5.000	1.622	0.811	1.622	4.055	5.257
-15.000	998.02	1002.011	998.011	5.000	3.991	2.806	2.369	14.032	5.533
-10.000	998.011	1002.011	998.011	5.000	4.000	3.995	0.009	19.978	5.000
-5.000	998.358	1002.011	998.011	5.000	3.653	3.827	0.347	19.133	5.012
0.000	999.05	1002.011	998.011	5.000	2.961	3.307	0.692	16.535	5.048
5.000	1000.1	1002.011	998.011	5.000	1.911	2.436	1.050	12.180	5.109
10.000	1000.895	1002.011	998.011	5.000	1.116	1.513	0.795	7.567	5.063
15.000	1001.634	1002.011	998.011	5.000	0.377	0.746	0.739	3.732	5.054
20.000	1002.147	1002.011	998.011	5.000	0.000	0.188	0.377	0.942	5.014
25.000	1002.195	1002.011	998.011	5.000	0.000	0.000	0.000	0.000	0.000
30.000	1002.326	1002.011	998.011	5.000	0.000	0.000	0.000	0.000	0.000
35.000	1002.501	1002.011	998.011	5.000	0.000	0.000	0.000	0.000	0.000
40.000	1002.686	1002.011	998.011	5.000	0.000	0.000	0.000	0.000	0.000
							Sum =	98.155	46.089
								R	2.130
								n	0.055
								K	2954.09151
								S	0.03
								V	5.21
								Keq	2954.0915
								Q	**511.66**
								Dd (max)	4.000
								Dd (av)	1.310
							Unobstructed Width	W	75.000
							Gross length of structure		75.000

CROSS SECTION AT BRIDGE

HFL _100	1002.01				Q100=	453			
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-40.000	1010.576	1002.01	998.011	5.000	0.000	0.000	0.000	0.000	0.000
-35.000	1008.652	1002.01	998.011	5.000	0.000	0.000	0.000	0.000	0.000
-30.000	1006.368	1002.01	998.011	5.000	0.000	0.000	0.000	0.000	0.000
-25.000	1003.225	1002.01	998.011	5.000	0.000	0.000	0.000	0.000	0.000
-20.000	1000.389	1002.01	998.011	5.000	1.622	0.811	1.622	4.055	5.257
-15.000	998.02	1002.01	998.011	5.000	3.991	2.806	2.369	14.032	5.533
-10.000	998.011	1002.01	998.011	5.000	4.000	3.995	0.009	19.978	5.000
-5.000	998.358	1002.01	998.011	5.000	3.653	3.827	0.347	19.133	5.012
0.000	999.05	1002.01	998.011	5.000	2.961	3.307	0.692	16.535	5.048
5.000	1000.1	1002.01	998.011	5.000	1.911	2.436	1.050	12.180	5.109
10.000	1000.895	1002.01	998.011	5.000	1.116	1.513	0.795	7.567	5.063
15.000	1001.634	1002.01	998.011	5.000	0.377	0.746	0.739	3.732	5.054
20.000	1002.147	1002.01	998.011	5.000	0.000	0.188	0.377	0.942	5.014
25.000	1002.195	1002.01	998.011	5.000	0.000	0.000	0.000	0.000	0.000
30.000	1002.326	1002.01	998.011	5.000	0.000	0.000	0.000	0.000	0.000
35.000	1002.501	1002.01	998.011	5.000	0.000	0.000	0.000	0.000	0.000
40.000	1002.686	1002.01	998.011	5.000	0.000	0.000	0.000	0.000	0.000
							Sum =	98.155	46.09
								R	2.13
								n	0.055
								K	2954.09
								S	0.0300
								V	5.21
								Keq	2954.09
								Q	**511.66**
								Dd (max)	4.00
								Dd (av)	1.31
							Unobstructed Width	W	75.000
							Gross length of structure		75.000


Bed Level
HFL_50
River Bed Level(m)
1012
1010
1008
1006
1004
1002
1000
998
996
-50.000
-40.000
-30.000
-20.000
-10.000
0.000
10.000
20.000
30.000
40.000
50.000
Chainage(m)


Bed Level
HFL_100
River Bed Level(m)
1012
1010
1008
1006
1004
1002
1000
998
996
-50
-40
-30
-20
-10
0
10
20
30
40
50
Chainage(m)

Hydrological and Hydraulic Parameters relating to Proposed Bridge across Local River at Ch. 255.770 of Gauharganj to Bhopal Road, (NH-12)

Deepest Bed Level	998.011	m	
HFL information received from local official	NA		
Waterway available (Abutment to Abutment)	**75**	m	
Top of Deck	1008.975	m GTS	
HFL information received from local enquiry	4m above LBL	m GTS	

Discharge Calculation		
Catchment Area =	55.00	Sq. Km
Discharge by Rational Formula (Q50) =	415.53	Cumec
Discharge by Rational Formula (Q100) =	453.31	Cumec
Discharge by Unit Hydrograph Method (Q50) =	511.66	Cumec
Discharge by Unit Hydrograph Method(Q100) =	511.66	Cumec
Discharge by Dicken's Formula =	383.73	Cumec

Adopted Discharge		
Second max discharge	**679.9636**	**Cumec**
For Fixing Effective Clear Waterway normal to flow	**511.66**	**Cumec**
For Fixing HFL	**511.66**	**Cumec**
Max. Discharge	**511.66**	**Cumec**

Waterway			
Wetted perimeter as per Lacey's Formula	**108.6**	**m**	
Waterway Provided (Abutment to Abutment)	**75.0**	**m**	
Fluming ratio	**0.69**	**m**	**OK**

Summary of Calculation for Proposed Bridge	**A 75 m Total Waterway seems to be adequate.**					
Waterway available (m)	**Afflux h (m)**		**Vel under Bridge (m/sec)**		**HFL (m) with afflux**	
L (m)	**Q50**	**Q100**	**Q50**	**Q100**	**Q50**	**Q100**
75	0.000	0.000	5.21	5.21	1002.01	1002.01

Scour Calculation

There is no need to calculate the scour in Hard Rocky Strata.

Recommendation

It is recommended to propose the Bridge of 75m waterway subject to Structural Adequacy.

HYDRAULIC CALCULATION FOR MAJOR BRIDGE AT CH. 37+157

Name of River / Stream / Nala	Chainage(km)
Local Stream	37+157

Sr. No.	Segmental Length(m)	Cumulative Segmental Length(m)	Elevation (m)
1	0	0	856
2	2000	2000	859
3	2000	4000	869
4	2000	6000	892
5	2000	8000	908
6	2000	10000	913
7	2000	12000	924
8	2000	14000	958
9	2000	16000	986
10	2000	18000	991
11	2000	20000	1000
12	2000	22000	1125
13	2000	24000	1150
14	2000	26000	1165
15	2000	28000	1167
16	2000	30000	1172
17	2000	32000	1178
18	2000	34000	1185
19	2000	36000	1200
20			

Catchment Area in Sq Km(A)	115
Longest Stream Length in Km (L)	36
Centroid Length in Km (Lc)	16.00
Point Rainfall Value (50 years)in mm	220
Point Rainfall Value (100 years)in mm	240
Subzone =	7

1 Empirical Method

Dickens Formula

Q	=	CA^(3/4)	
A		115	Km^2
C	=	19	
Q		667	Cumecs

2 Rational method

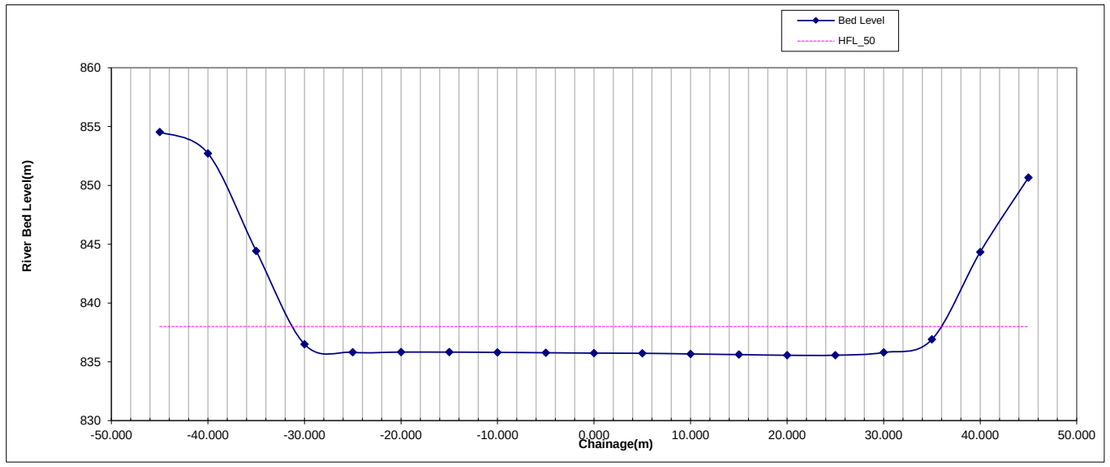
Catchment Area, A	=	115	Km^2	=	11500.000	Hectares
Length of longest stream	=	36.000	Km			
Height, H	=	344.00	m			
Time of Concentration by SP-13 formula	=	$(0.87*L^3/H)^{0.385}$				
tc	=	6.28	Hours			
50 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7	=	220	mm			
tp	=	8.73				
Design storm duration	=	9.6	hrs			
Conversion ratio for tc hours as per CWC FER for Subzone- 7	=	0.720				
tc hr rainfall	=	158.40	mm			
From code SP 13 Intensity of rainfall, Ic	=	3.15	cm/hr			
		2.52	cm/hr			
100 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7		240.00	mm			
Conversion ratio for tc hours as per CWC FER for Subzone- 7		0.720				
Conversio						
tc hr rainfall	=	172.80	mm			
From code SP 13 Intensity of rainfall, Ic	=	3.44	cm/hr			
		2.75	cm/hr			
From code SP 13 ' f ' Curve, Spread factor ' f '	=	0.856				
Runoff Co-efficient as per terrain condition, P	=	0.7				
Design discharge, Q50	=	0.0278PfAIc Cumecs				
	=	603.37	Cumecs		Say Q50=	**603**
Design discharge, Q100	=	0.0278PfAIc Cumecs				
	=	658.22	Cumecs		Say Q100=	**658**

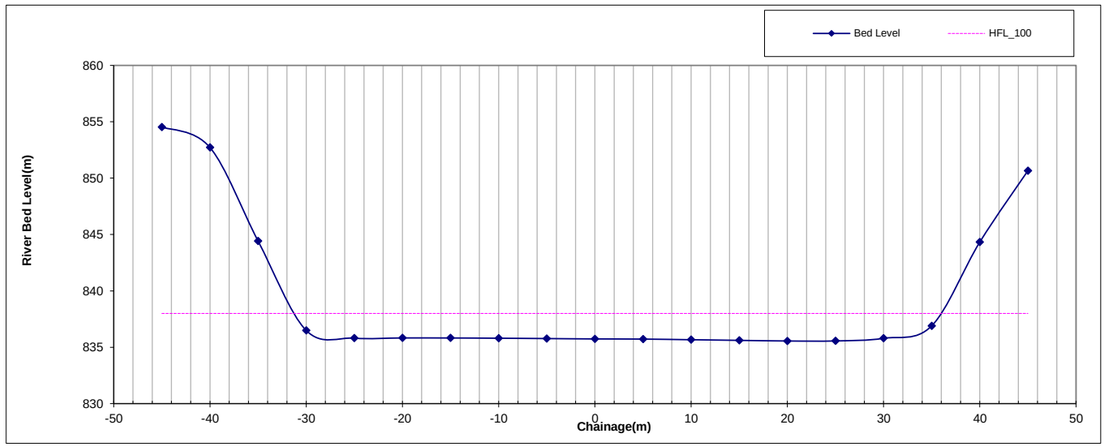
CROSS SECTION AT BRIDGE

HFL _50	838.00				Q50=	692			
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
		838	835.555	0.000	0.000	0.000	0.000	0.000	0.000
		838	835.555	0.000	2.445	1.223	2.445	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
-45.000	854.532	838	835.555	0.000	0.000	1.223	2.445	0.000	0.000
-40.000	852.719	838	835.555	5.000	0.000	0.000	0.000	0.000	0.000
-35.000	844.423	838	835.555	5.000	0.000	0.000	0.000	0.000	0.000
-30.000	836.497	838	835.555	5.000	1.503	0.752	1.503	3.758	5.221
-25.000	835.808	838	835.555	5.000	2.192	1.848	0.689	9.238	5.047
-20.000	835.827	838	835.555	5.000	2.173	2.183	0.019	10.913	5.000
-15.000	835.823	838	835.555	5.000	2.177	2.175	0.004	10.875	5.000
-10.000	835.802	838	835.555	5.000	2.198	2.188	0.021	10.938	5.000
-5.000	835.77	838	835.555	5.000	2.230	2.214	0.032	11.070	5.000
0.000	835.738	838	835.555	5.000	2.262	2.246	0.032	11.230	5.000
5.000	835.724	838	835.555	5.000	2.276	2.269	0.014	11.345	5.000
10.000	835.668	838	835.555	5.000	2.332	2.304	0.056	11.520	5.000
15.000	835.612	838	835.555	5.000	2.388	2.360	0.056	11.800	5.000
20.000	835.555	838	835.555	5.000	2.445	2.417	0.057	12.083	5.000
25.000	835.56	838	835.555	5.000	2.440	2.443	0.005	12.213	5.000
30.000	835.793	838	835.555	5.000	2.207	2.324	0.233	11.618	5.005
35.000	836.899	838	835.555	5.000	1.101	1.654	1.106	8.270	5.121
40.000	844.33	838	835.555	5.000	0.000	0.551	1.101	2.753	5.120
45.000	850.659	838	835.555	5.000	0.000	0.000	0.000	0.000	0.000
		838	835.555	0.000	2.445	1.223	2.445	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838	835.555	0.000	2.445	2.445	0.000	0.000	0.000
							Sum =	149.620	75.516
								R	1.981
								n	0.055
								K	4291.36654
								S	0.026
								V	4.62
								Keq	4291.3665
								Q	**691.96**
								Dd (max)	2.445
								Dd (av)	1.660
							Unobstructed Width	W	90.000
							Gross length of structure		90.000

CROSS SECTION AT BRIDGE

HFL _100	838.00						Q100=	692	
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
		838.00	835.555	0.000	0.000	0.000	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	1.223	2.445	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
-45.000	854.532	838.00	835.555	0.000	0.000	1.223	2.445	0.000	0.000
-40.000	852.719	838.00	835.555	5.000	0.000	0.000	0.000	0.000	0.000
-35.000	844.423	838.00	835.555	5.000	0.000	0.000	0.000	0.000	0.000
-30.000	836.497	838.00	835.555	5.000	1.503	0.752	1.503	3.758	5.221
-25.000	835.808	838.00	835.555	5.000	2.192	1.848	0.689	9.238	5.047
-20.000	835.827	838.00	835.555	5.000	2.173	2.183	0.019	10.913	5.000
-15.000	835.823	838.00	835.555	5.000	2.177	2.175	0.004	10.875	5.000
-10.000	835.802	838.00	835.555	5.000	2.198	2.188	0.021	10.938	5.000
-5.000	835.77	838.00	835.555	5.000	2.230	2.214	0.032	11.070	5.000
0.000	835.738	838.00	835.555	5.000	2.262	2.246	0.032	11.230	5.000
5.000	835.724	838.00	835.555	5.000	2.276	2.269	0.014	11.345	5.000
10.000	835.668	838.00	835.555	5.000	2.332	2.304	0.056	11.520	5.000
15.000	835.612	838.00	835.555	5.000	2.388	2.360	0.056	11.800	5.000
20.000	835.555	838.00	835.555	5.000	2.445	2.417	0.057	12.083	5.000
25.000	835.56	838.00	835.555	5.000	2.440	2.443	0.005	12.213	5.000
30.000	835.793	838.00	835.555	5.000	2.207	2.324	0.233	11.618	5.005
35.000	836.899	838.00	835.555	5.000	1.101	1.654	1.106	8.270	5.121
40.000	844.33	838.00	835.555	5.000	0.000	0.551	1.101	2.753	5.120
45.000	850.659	838.00	835.555	5.000	0.000	0.000	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	1.223	2.445	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
		838.00	835.555	0.000	2.445	2.445	0.000	0.000	0.000
							Sum =	149.620	75.52
								R	1.98
								n	0.055
								K	4291.37
								S	0.0260
								V	4.62
								Keq	4291.37
								Q	**691.96**
								Dd (max)	2.45
								Dd (av)	1.66
							Unobstructed Width	W	90.000
							Gross length of structure		90.000


Bed Level
HFL_50
River Bed Level(m)
860
855
850
845
840
835
830
-50.000
-40.000
-30.000
-20.000
-10.000
0.000
10.000
20.000
30.000
40.000
50.000
Chainage(m)


Bed Level
HFL_100
River Bed Level(m)
860
855
850
845
840
835
830
-50
-40
-30
-20
-10
0
10
20
30
40
50
Chainage(m)

Hydrological and Hydraulic Parameters relating to Proposed Bridge across Local River at Ch. 31.157 of Khellani- Chatroo, (NH-244)

Deepest Bed Level	835.555	m	
HFL information received from local official	NA		
Waterway available (Abutment to Abutment)	**90**	m	
Top of Deck	856.347	m GTS	
HFL information received from local enquiry	3m above LBL	m GTS	

Discharge Calculation		
Catchment Area =	115.00	Sq. Km
Discharge by Rational Formula (Q50) =	603.37	Cumec
Discharge by Rational Formula (Q100) =	658.22	Cumec
Discharge by Unit Hydrograph Method(Q100) =	691.96	Cumec
Discharge by Unit Hydrograph Method (Q50) =	691.96	Cumec
Discharge by Unit Hydrograph Method(Q100) =	691.96	Cumec
Discharge by Dicken's Formula =	667.23	Cumec
Adopted Discharge		
For Fixing Effective Clear Waterway normal to flow	**691.96**	**Cumec**
For Fixing HFL	**691.96**	**Cumec**
Max. Discharge	**691.96**	**Cumec**
Waterway		
Wetted perimeter as per Lacey's Formula	**126.3**	**m**
Waterway Provided (Abutment to Abutment)	**90.0**	**m**
Fluming ratio	**0.71**	**m**

OK

Summary of Calculation for Proposed Bridge	**A 90 m Total Waterway seems to be adequate.**					
Waterway available (m)	**Afflux h (m)**		**Vel under Bridge (m/sec)**		**HFL (m) with afflux**	
L (m)	**Q50**	**Q100**	**Q50**	**Q100**	**Q50**	**Q100**
90	0.000	0.000	4.84	4.84	838.00	838.00

Scour Calculation

There is no need to calculate the scour in Rocky Strata.

Note:-

Recommendation

It is recommended to proposed span of 4x22.5 i.e 90m waterway subject to Structural Adequacy.

HYDRAULIC CALCULATION FOR MAJOR BRIDGE AT CH. 63+005

Name of River / Stream / Nala			Chainage(km)
Local Stream			63+005
Sr. No.	Segmental Length(m)	Cumulative Segmental Length(m)	Elevation (m)
1	0	0	917
2	2000	2000	920
3	2000	4000	1000
4	2000	6000	1106
5	2000	8000	1116
6	2000	10000	1146
7	2000	12000	1174
8	2000	14000	1225
9	2000	16000	1266
10	2000	18000	1341
11	2000	20000	1410
12	2000	22000	1518
13	2000	24000	1591
14	2000	26000	1707
15	2000	28000	1747
16	2000	30000	1707
17	2000	32000	1910
18	2000	34000	1886
19	2000	36000	2010
20	2000	38000	2012
21	2000	40000	2047
22	2000	42000	2064
23	2000	44000	2112
24	2000	46000	2111
25	2000	48000	2126
25	2000	50000	2160
25	2000	52000	2277
25	2000	54000	2359
25	2000	56000	2426
26	2000	58000	2469
27	2000	60000	2500
28	2000	62000	2575
29	2000	64000	2689
30	1000	65000	2717
Catchment Area in Sq Km(A)			796
Longest Stream Length in Km (L)			65
Centroid Length in Km (Lc)			22.60
Point Rainfall Value (50 years)in mm			220
Point Rainfall Value (100 years)in mm			240
Subzone =			7

1 Empirical Method

Dickens Formula

Q	=	CA^(3/4)	
A		796	Km^2
C	=	19	
Q		2847	Cumecs

2 Rational method

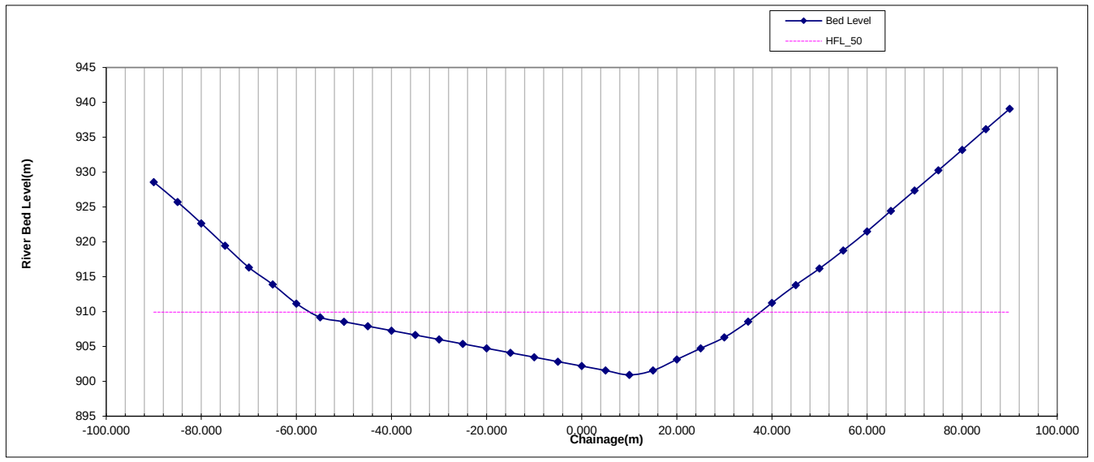
Catchment Area, A	=	796	Km^2	=	79600.000	Hectares
Length of longest stream	=	65.000	Km			
Height, H	=	1800.00	m			
Time of Concentration by SP-13 formula	=	$(0.87*L^3/H)^{0.385}$				
tc	=	6.57	Hours			
50 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7	=	220	mm			
tp	=	12.70				
Design storm duration	=	14.0	hrs			
Conversion ratio for tc hours as per CWC FER for Subzone- 7	=	0.845				
tc hr rainfall	=	185.90	mm			
From code SP 13 Intensity of rainfall, Ic	=	3.03	cm/hr			
		2.83	cm/hr			
100 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7		240.00	mm			
Conversion ratio for tc hours as per CWC FER for Subzone- 7		0.845				
Conversio						
tc hr rainfall	=	202.80	mm			
From code SP 13 Intensity of rainfall, Ic	=	3.30	cm/hr			
		3.09	cm/hr			
From code SP 13 ' f ' Curve, Spread factor ' f '	=	0.601				
Runoff Co-efficient as per terrain condition, P	=	0.7				
Design discharge, Q50	=	0.0278PfAIc Cumecs				
	=	2821.23	Cumecs		Say Q50=	**2821**
Design discharge, Q100	=	0.0278PfAIc Cumecs				
	=	3077.71	Cumecs		Say Q100=	**3078**

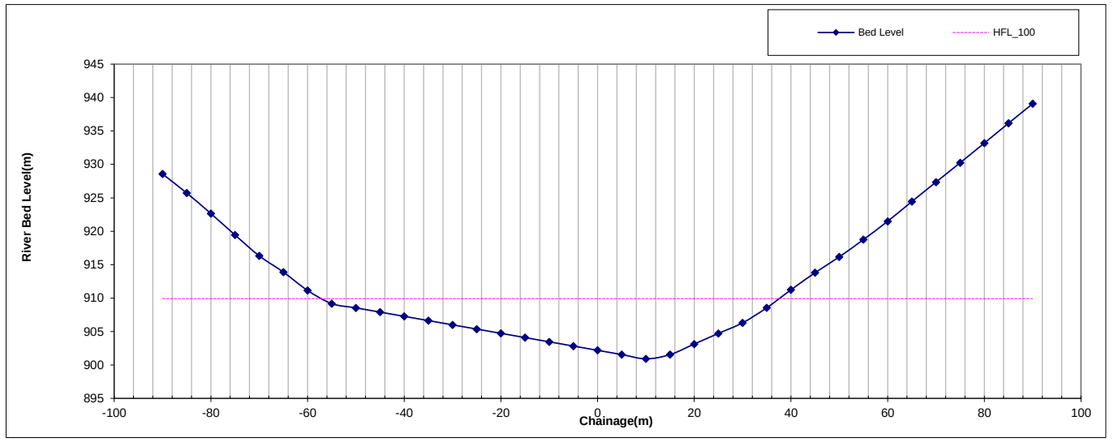
CROSS SECTION AT BRIDGE

HFL _50	909.92				Q50=	2347			
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-90.000	928.57	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-85.000	925.72	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-80.000	922.652	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-75.000	919.439	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-70.000	916.326	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-65.000	913.895	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-60.000	911.153	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-55.000	909.177	909.92	900.920	5.000	0.743	0.371	0.743	1.857	5.055
-50.000	908.541	909.92	900.920	5.000	1.379	1.061	0.636	5.305	5.040
-45.000	907.906	909.92	900.920	5.000	2.014	1.696	0.635	8.482	5.040
-40.000	907.271	909.92	900.920	5.000	2.649	2.332	0.635	11.658	5.040
-35.000	906.636	909.92	900.920	5.000	3.284	2.967	0.635	14.833	5.040
-30.000	906.001	909.92	900.920	5.000	3.919	3.601	0.635	18.007	5.040
-25.000	905.366	909.92	900.920	5.000	4.554	4.236	0.635	21.182	5.040
-20.000	904.731	909.92	900.920	5.000	5.189	4.871	0.635	24.357	5.040
-15.000	904.095	909.92	900.920	5.000	5.825	5.507	0.636	27.535	5.040
-10.000	903.46	909.92	900.920	5.000	6.460	6.142	0.635	30.712	5.040
-5.000	902.825	909.92	900.920	5.000	7.095	6.777	0.635	33.887	5.040
0.000	902.19	909.92	900.920	5.000	7.730	7.412	0.635	37.062	5.040
5.000	901.555	909.92	900.920	5.000	8.365	8.047	0.635	40.237	5.040
10.000	900.92	909.92	900.920	5.000	9.000	8.683	0.635	43.413	5.040
15.000	901.552	909.92	900.920	5.000	8.368	8.684	0.632	43.420	5.040
20.000	903.136	909.92	900.920	5.000	6.784	7.576	1.584	37.880	5.245
25.000	904.72	909.92	900.920	5.000	5.200	5.992	1.584	29.960	5.245
30.000	906.304	909.92	900.920	5.000	3.616	4.408	1.584	22.040	5.245
35.000	908.557	909.92	900.920	5.000	1.363	2.489	2.253	12.447	5.484
40.000	911.237	909.92	900.920	5.000	0.000	0.681	1.363	3.407	5.182
45.000	913.805	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
50.000	916.168	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
55.000	918.76	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
60.000	921.488	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
65.000	924.44	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
70.000	927.349	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
75.000	930.248	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
80.000	933.186	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
85.000	936.154	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
90.000	939.075	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
							Sum =	467.685	102.018
								R	4.584
								n	0.055
								K	23466.094
								S	0.01
								V	5.02
								Keq	23466.094
								Q	**2346.61**
								Dd (max)	9.000
								Dd (av)	2.600
							Unobstructed Width	W	180.000
							Gross length of structure		180.000

CROSS SECTION AT BRIDGE

HFL _100	909.92						Q100=	2347	
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-90.000	928.57	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-85.000	925.72	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-80.000	922.652	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-75.000	919.439	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-70.000	916.326	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-65.000	913.895	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-60.000	911.153	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
-55.000	909.177	909.92	900.920	5.000	0.743	0.371	0.743	1.857	5.055
-50.000	908.541	909.92	900.920	5.000	1.379	1.061	0.636	5.305	5.040
-45.000	907.906	909.92	900.920	5.000	2.014	1.696	0.635	8.482	5.040
-40.000	907.271	909.92	900.920	5.000	2.649	2.332	0.635	11.658	5.040
-35.000	906.636	909.92	900.920	5.000	3.284	2.967	0.635	14.833	5.040
-30.000	906.001	909.92	900.920	5.000	3.919	3.601	0.635	18.007	5.040
-25.000	905.366	909.92	900.920	5.000	4.554	4.236	0.635	21.182	5.040
-20.000	904.731	909.92	900.920	5.000	5.189	4.871	0.635	24.357	5.040
-15.000	904.095	909.92	900.920	5.000	5.825	5.507	0.636	27.535	5.040
-10.000	903.46	909.92	900.920	5.000	6.460	6.142	0.635	30.712	5.040
-5.000	902.825	909.92	900.920	5.000	7.095	6.777	0.635	33.887	5.040
0.000	902.19	909.92	900.920	5.000	7.730	7.412	0.635	37.062	5.040
5.000	901.555	909.92	900.920	5.000	8.365	8.047	0.635	40.237	5.040
10.000	900.92	909.92	900.920	5.000	9.000	8.683	0.635	43.413	5.040
15.000	901.552	909.92	900.920	5.000	8.368	8.684	0.632	43.420	5.040
20.000	903.136	909.92	900.920	5.000	6.784	7.576	1.584	37.880	5.245
25.000	904.72	909.92	900.920	5.000	5.200	5.992	1.584	29.960	5.245
30.000	906.304	909.92	900.920	5.000	3.616	4.408	1.584	22.040	5.245
35.000	908.557	909.92	900.920	5.000	1.363	2.489	2.253	12.447	5.484
40.000	911.237	909.92	900.920	5.000	0.000	0.681	1.363	3.407	5.182
45.000	913.805	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
50.000	916.168	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
55.000	918.76	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
60.000	921.488	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
65.000	924.44	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
70.000	927.349	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
75.000	930.248	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
80.000	933.186	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
85.000	936.154	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
90.000	939.075	909.92	900.920	5.000	0.000	0.000	0.000	0.000	0.000
							Sum =	467.685	102.02
								R	4.58
								n	0.055
								K	23466.09
								S	0.0100
								V	5.02
								Keq	23466.09
								Q	**2346.61**
								Dd (max)	9.00
								Dd (av)	2.60
							Unobstructed Width	W	180.000
							Gross length of structure		180.000


Bed Level
HFL_50
River Bed Level(m)
945
940
935
930
925
920
915
910
905
900
895
-100.000
-80.000
-60.000
-40.000
-20.000
0.000
20.000
40.000
60.000
80.000
100.000
Chainage(m)


Bed Level
HFL_100
River Bed Level(m)
945
940
935
930
925
920
915
910
905
900
895
-100
-80
-60
-40
-20
0
20
40
60
80
100
Chainage(m)

Hydrological and Hydraulic Parameters relating to Proposed Bridge across Local River at Ch. 31.157 of Khellani- Chatroo, (NH-244)

Deepest Bed Level	900.92	m	
HFL information received from local official	NA		
Waterway available (Abutment to Abutment)	**180**	m	
Top of Deck	943.427	m GTS	
HFL information received from local enquiry	10m above LBL	m GTS	

Discharge Calculation		
Catchment Area =	796.00	Sq. Km
Discharge by Rational Formula (Q50) =	2821.23	Cumec
Discharge by Unit Hydrograph Method(Q100) =	2346.61	Cumec
Discharge by Unit Hydrograph Method (Q50) =	2346.61	Cumec
Discharge by Unit Hydrograph Method(Q100) =	2346.61	Cumec
Discharge by Dicken's Formula =	2847.33	Cumec
Adopted Discharge		
Second max discharge	**4271.001**	**Cumec**
For Fixing Effective Clear Waterway normal to flow	**2346.61**	**Cumec**
For Fixing HFL	**2346.61**	**Cumec**
Max. Discharge	**2346.61**	**Cumec**
Waterway		
Wetted perimeter as per Lacey's Formula	**232.5**	**m**
Waterway Provided (Abutment to Abutment)	**180.0**	**m**
Fluming ratio	**0.77**	**m**

OK

Summary of Calculation for Proposed Bridge	**A 180 m Total Waterway seems to be adequate.**					
Waterway available (m)	**Afflux h (m)**		**Vel under Bridge (m/sec)**		**HFL (m) with afflux**	
L (m)	**Q50**	**Q100**	**Q50**	**Q100**	**Q50**	**Q100**
180	0.000	0.000	5.82	5.82	909.92	909.92

Scour Calculation

There is no need to calculate the scour in Rocky Strata.

Note:-

Recommendation

It is recommended to proposed span of 180m waterway subject to Structural Adequacy.

HYDRAULIC CALCULATION FOR MAJOR BRIDGE AT CH. 65+025

Name of River / Stream / Nala			Chainage(km)
Local Stream			65.025
Sr. No.	Segmental Length(m)	Cumulative Segmental Length(m)	Elevation (m)
1	0	0	840
2	2000	2000	885
3	2000	4000	945
4	2000	6000	955
5	2000	8000	975
6	2000	10000	985
7	2000	12000	995
8	2000	14000	1000
9	2000	16000	1100
10	2000	18000	1200
11	2000	20000	1340
12	2000	22000	1390
13	2000	24000	1460
14	2000	26000	1520
15	2000	28000	1580
16	2000	30000	1630
17	2000	32000	1680
18	2000	34000	1720
19	2000	36000	1800
20	2000	38000	1840
21	2000	40000	1875
22	2000	42000	1900
23	2000	44000	1932
24	2000	46000	1983
25	2000	48000	2021
26	1300	49300	2040
Catchment Area in Sq Km(A)			98
Longest Stream Length in Km (L)			49.3
Centroid Length in Km (Lc)			22.50
Point Rainfall Value (50 years)in mm			220
Point Rainfall Value (100 years)in mm			240
Subzone =			7

1 Empirical Method

Dickens Formula

Q	=	CA^(3/4)	
A		98	Km^2
C	=	19	
Q		592	Cumecs

2 Rational method

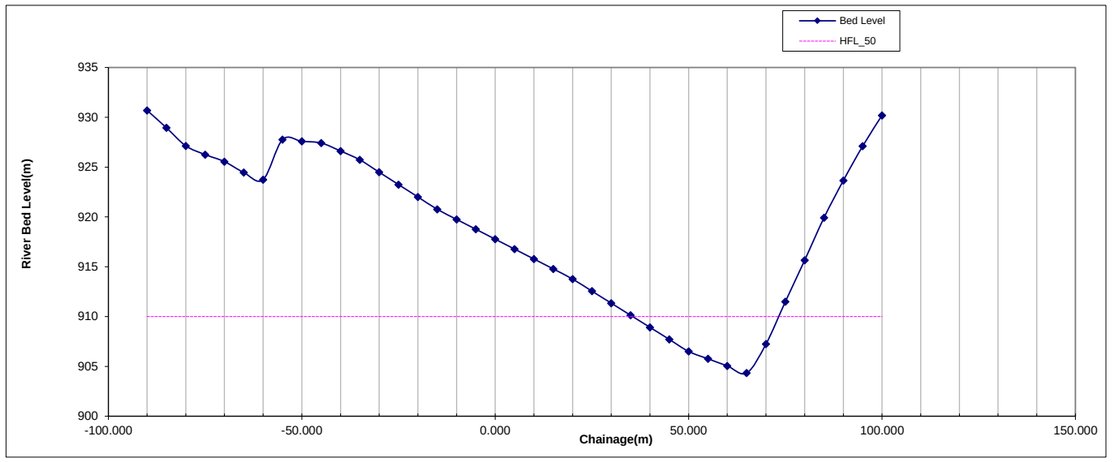
Catchment Area, A	=	98	Km^2	=	9800.000	Hectares
Length of longest stream	=	49.300	Km			
Height, H	=	1200.00	m			
Time of Concentration by SP-13 formula	=	$(0.87*L^3/H)^{0.385}$				
tc	=	5.58	Hours			
50 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7	=	220	mm			
tp	=	10.28				
Design storm duration	=	11.3	hrs			
Conversion ratio for tc hours as per CWC FER for Subzone- 7	=	0.677				
tc hr rainfall	=	148.94	mm			
From code SP 13 Intensity of rainfall, Ic	=	3.48	cm/hr			
		2.67	cm/hr			
100 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7		240.00	mm			
Conversion ratio for tc hours as per CWC FER for Subzone- 7		0.677				
Conversio tc hr rainfall	=	162.48	mm			
From code SP 13 Intensity of rainfall, Ic	=	3.80	cm/hr			
		2.91	cm/hr			
From code SP 13 ' f ' Curve, Spread factor ' f '	=	0.882				
Runoff Co-efficient as per terrain condition, P	=	0.7				
Design discharge, Q50	=	0.0278PfAIc Cumecs				
	=	586.27	Cumecs		Say Q50=	**586**
Design discharge, Q100	=	0.0278PfAIc Cumecs				
	=	639.57	Cumecs		Say Q100=	**640**

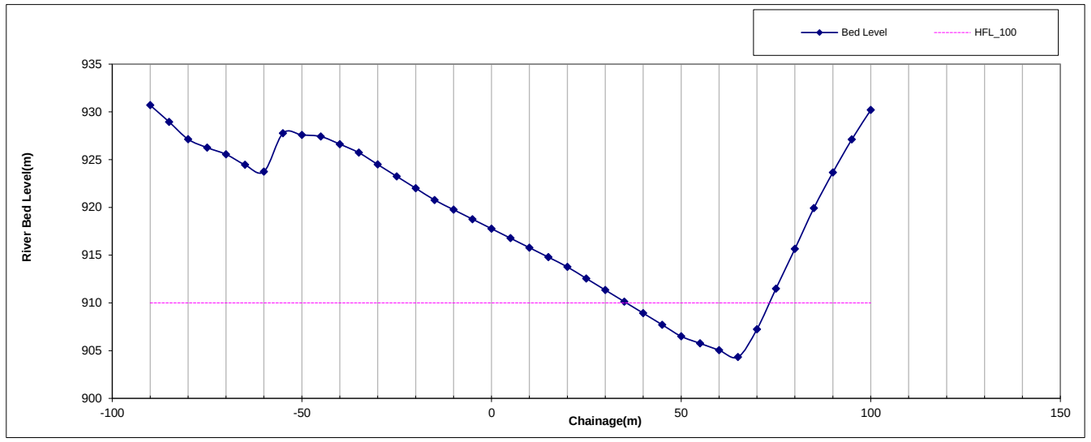
CROSS SECTION AT BRIDGE

HFL _50	910.00				Q50=	760			
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-100	933.643	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-95	932.281	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-90.000	930.695	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-85.000	928.948	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-80.000	927.135	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-75.000	926.257	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-70.000	925.552	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-65.000	924.457	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-60.000	923.743	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-55.000	927.757	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-50.000	927.586	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-45.000	927.416	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-40.000	926.618	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-35.000	925.727	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-30.000	924.488	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-25.000	923.248	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-20.000	922.008	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-15.000	920.769	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-10.000	919.757	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-5.000	918.762	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
0.000	917.767	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
5.000	916.772	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
10.000	915.777	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
15.000	914.782	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
20.000	913.764	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
25.000	912.553	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
30.000	911.343	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
35.000	910.132	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
40.000	908.921	910	904.332	5.000	1.079	0.539	1.079	2.697	5.115
45.000	907.71	910	904.332	5.000	2.290	1.684	1.211	8.422	5.145
50.000	906.499	910	904.332	5.000	3.501	2.895	1.211	14.477	5.145
55.000	905.759	910	904.332	5.000	4.241	3.871	0.740	19.355	5.054
60.000	905.046	910	904.332	5.000	4.954	4.597	0.713	22.987	5.051
65.000	904.332	910	904.332	5.000	5.668	5.311	0.714	26.555	5.051
70.000	907.242	910	904.332	5.000	2.758	4.213	2.910	21.065	5.785
75.000	911.486	910	904.332	5.000	0.000	1.379	2.758	6.895	5.710
80.000	915.65	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
85.000	919.921	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
90.000	923.652	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
95.000	927.109	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
100.000	930.195	910	904.332	5.000	0.000	0.000	0.000	0.000	0.000
							Sum =	122.455	42.055
								R	2.912
								n	0.055
								K	4539.944603
								S	0.028
								V	6.20
								Keq	4539.944603
								Q	**759.68**
								Dd (max)	5.668
								Dd (av)	0.610
							Unobstructed Width	W	200.000
							Gross length of structure		200.000

CROSS SECTION AT BRIDGE

HFL _100	910.00						Q100=	760	
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-100	933.643	910.00	904.332	5	0	0.000	0.000	0.000	0.000
-95	932.281	910.00	904.332	5	0.000	0.000	0.000	0.000	0.000
-90.000	930.695	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-85.000	928.948	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-80.000	927.135	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-75.000	926.257	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-70.000	925.552	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-65.000	924.457	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-60.000	923.743	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-55.000	927.757	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-50.000	927.586	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-45.000	927.416	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-40.000	926.618	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-35.000	925.727	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-30.000	924.488	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-25.000	923.248	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-20.000	922.008	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-15.000	920.769	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-10.000	919.757	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
-5.000	918.762	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
0.000	917.767	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
5.000	916.772	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
10.000	915.777	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
15.000	914.782	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
20.000	913.764	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
25.000	912.553	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
30.000	911.343	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
35.000	910.132	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
40.000	908.921	910.00	904.332	5.000	1.079	0.539	1.079	2.697	5.115
45.000	907.71	910.00	904.332	5.000	2.290	1.684	1.211	8.422	5.145
50.000	906.499	910.00	904.332	5.000	3.501	2.895	1.211	14.477	5.145
55.000	905.759	910.00	904.332	5.000	4.241	3.871	0.740	19.355	5.054
60.000	905.046	910.00	904.332	5.000	4.954	4.597	0.713	22.987	5.051
65.000	904.332	910.00	904.332	5.000	5.668	5.311	0.714	26.555	5.051
70.000	907.242	910.00	904.332	5.000	2.758	4.213	2.910	21.065	5.785
75.000	911.486	910.00	904.332	5.000	0.000	1.379	2.758	6.895	5.710
80.000	915.65	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
85.000	919.921	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
90.000	923.652	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
95.000	927.109	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
100.000	930.195	910.00	904.332	5.000	0.000	0.000	0.000	0.000	0.000
							Sum =	122.455	42.06
								R	2.91
								n	0.055
								K	4539.94
								S	0.0280
								V	6.20
								Keq	4539.94
								Q	**759.68**
								Dd (max)	5.67
								Dd (av)	0.61
							Unobstructed Width	W	200.000
							Gross length of structure		200.000


Bed Level
HFL_50
935
930
925
920
915
910
905
900
River Bed Level(m)
-100.000
-50.000
0.000
50.000
100.000
150.000
Chainage(m)


Bed Level
HFL_100
935
930
925
920
915
910
905
900
River Bed Level(m)
-100
-50
0
50
100
150
Chainage(m)

Hydrological and Hydraulic Parameters relating to Proposed Bridge across Local River at Ch. 255.770 of Gauharganj to Bhopal Road, (NH-12)

Deepest Bed Level	904.332	m	
HFL information received from local official	NA		
Waterway available (Abutment to Abutment)	**200**	m	
Top of Deck	431.805	m GTS	
HFL information received from local enquiry	3m above LBL	m GTS	

Discharge Calculation		
Catchment Area =	98.00	Sq. Km
Discharge by Rational Formula (Q50) =	586.27	Cumec
Discharge by Rational Formula (Q100) =	639.57	Cumec
Discharge by Unit Hydrograph Method (Q50) =	759.68	Cumec
Discharge by Unit Hydrograph Method(Q100) =	759.68	Cumec
Discharge by Unit Hydrograph Method (Q50) =	759.68	Cumec
Discharge by Unit Hydrograph Method(Q100) =	759.68	Cumec
Discharge by Dicken's Formula =	591.80	Cumec

Adopted Discharge		
For Fixing Effective Clear Waterway normal to flow	**759.68**	**Cumec**
For Fixing HFL	**759.68**	**Cumec**
Max. Discharge	**759.68**	**Cumec**

Waterway			
Wetted perimeter as per Lacey's Formula	**132.3**	**m**	
Waterway Provided (Abutment to Abutment)	**200.0**	**m**	
Fluming ratio	**1.51**	**m**	**OK**

Summary of Calculation for Proposed Bridge	**A 200 m Total Waterway seems to be adequate.**					
Waterway available (m)	**Afflux h (m)**		**Vel under Bridge (m/sec)**		**HFL (m) with afflux**	
L (m)	**Q50**	**Q100**	**Q50**	**Q100**	**Q50**	**Q100**
200	0.000	0.000	6.2	6.2	910.00	910.00

Scour Calculation

There is no need to calculate the scour in Rocky Strata.

Note:-

As per Geotechnical investigation Report it appears that below 1.5m to 3m depth in river bed there is a grayish color highly weathered & fractured basalt where scouring possibility is negligible.

Recommendation

It is recommended to proposed span of 200m waterway subject to Structural Adequacy.

HYDRAULIC CALCULATION FOR MAJOR BRIDGE AT CH. 73+143

Name of River / Stream / Nala	Chainage(km)
Local Stream	73+143

Sr. No.	Segmental Length(m)	Cumulative Segmental Length(m)	Elevation (m)
1	0	0	856
2	2000	2000	859
3	2000	4000	869
4	2000	6000	892
5	2000	8000	908
6	2000	10000	913
7	2000	12000	924
8	2000	14000	958
9	2000	16000	986
10	2000	18000	991
11	2000	20000	1000
12	2000	22000	1125
13	2000	24000	1150
14	2000	26000	1165
15	2000	28000	1167
16	2000	30000	1172
17	2000	32000	1178
18	2000	34000	1185
19	2000	36000	1200

Catchment Area in Sq Km(A)	115
Longest Stream Length in Km (L)	36
Centroid Length in Km (Lc)	16.00
Point Rainfall Value (50 years)in mm	220
Point Rainfall Value (100 years)in mm	240
Subzone =	7

1 Empirical Method

Dickens Formula

Q	=	CA^(3/4)	
A		115	Km^2
C	=	19	
Q		667	Cumecs

2 Rational method

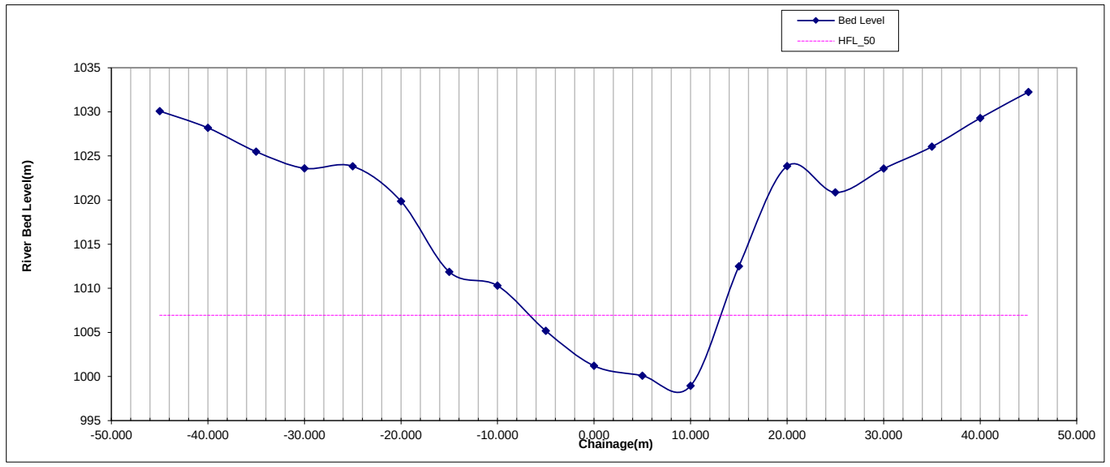
Catchment Area, A	=	115	Km^2	=	11500.000	Hectares
Length of longest stream	=	36.000	Km			
Height, H	=	344.00	m			
Time of Concentration by SP-13 formula	=	$(0.87*L^3/H)^{0.385}$				
tc	=	6.28	Hours			
50 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7	=	220	mm			
tp	=	8.73				
Design storm duration	=	9.6	hrs			
Conversion ratio for tc hours as per CWC FER for Subzone- 7	=	0.720				
tc hr rainfall	=	158.40	mm			
From code SP 13 Intensity of rainfall, Ic	=	3.15	cm/hr			
		2.52	cm/hr			
100 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7		240.00	mm			
Conversion ratio for tc hours as per CWC FER for Subzone- 7		0.720				
Conversio						
tc hr rainfall	=	172.80	mm			
From code SP 13 Intensity of rainfall, Ic	=	3.44	cm/hr			
		2.75	cm/hr			
From code SP 13 ' f ' Curve, Spread factor ' f '	=	0.856				
Runoff Co-efficient as per terrain condition, P	=	0.7				
Design discharge, Q50	=	0.0278PfAIc Cumecs				
	=	603.37	Cumecs		Say Q50=	**603**
Design discharge, Q100	=	0.0278PfAIc Cumecs				
	=	658.22	Cumecs		Say Q100=	**658**

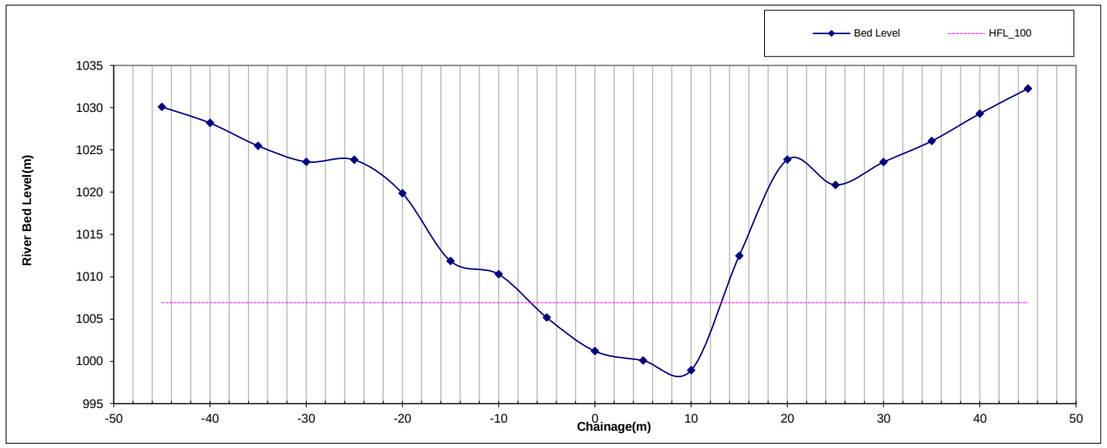
CROSS SECTION AT BRIDGE

HFL _50	1006.94				Q50=	764			
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-45.000	1030.084	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-40.000	1028.186	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-35.000	1025.484	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-30.000	1023.597	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-25.000	1023.83	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-20.000	1019.868	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-15.000	1011.865	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-10.000	1010.293	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-5.000	1005.179	1006.944	998.944	5.000	1.765	0.882	1.765	4.412	5.302
0.000	1001.207	1006.944	998.944	5.000	5.737	3.751	3.972	18.755	6.386
5.000	1000.092	1006.944	998.944	5.000	6.852	6.294	1.115	31.472	5.123
10.000	998.944	1006.944	998.944	5.000	8.000	7.426	1.148	37.130	5.130
15.000	1012.485	1006.944	998.944	5.000	0.000	4.000	8.000	20.000	9.434
20.000	1023.849	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
25.000	1020.86	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
30.000	1023.564	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
35.000	1026.048	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
40.000	1029.292	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
45.000	1032.255	1006.944	998.944	5.000	0.000	0.000	0.000	0.000	0.000
							Sum =	111.770	31.375
								R	3.562
								n	0.055
								K	4740.13564
								S	0.026
								V	6.84
								Keq	4740.1356
								Q	**764.32**
								Dd (max)	8.000
								Dd (av)	1.120
							Unobstructed Width	W	100.000
							Gross length of structure		100.000

CROSS SECTION AT BRIDGE

HFL _100	1006.94				Q100=	764			
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-45.000	1030.084	1006.94	998.944	0.000	0.000	0.000	0.000	0.000	0.000
-40.000	1028.186	1006.94	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-35.000	1025.484	1006.94	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-30.000	1023.597	1006.94	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-25.000	1023.83	1006.94	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-20.000	1019.868	1006.94	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-15.000	1011.865	1006.94	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-10.000	1010.293	1006.94	998.944	5.000	0.000	0.000	0.000	0.000	0.000
-5.000	1005.179	1006.94	998.944	5.000	1.765	0.882	1.765	4.412	5.302
0.000	1001.207	1006.94	998.944	5.000	5.737	3.751	3.972	18.755	6.386
5.000	1000.092	1006.94	998.944	5.000	6.852	6.294	1.115	31.472	5.123
10.000	998.944	1006.94	998.944	5.000	8.000	7.426	1.148	37.130	5.130
15.000	1012.485	1006.94	998.944	5.000	0.000	4.000	8.000	20.000	9.434
20.000	1023.849	1006.94	998.944	5.000	0.000	0.000	0.000	0.000	0.000
25.000	1020.86	1006.94	998.944	5.000	0.000	0.000	0.000	0.000	0.000
30.000	1023.564	1006.94	998.944	5.000	0.000	0.000	0.000	0.000	0.000
35.000	1026.048	1006.94	998.944	5.000	0.000	0.000	0.000	0.000	0.000
40.000	1029.292	1006.94	998.944	5.000	0.000	0.000	0.000	0.000	0.000
45.000	1032.255	1006.94	998.944	5.000	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
								0.000	0.000
								0.000	0.000
								0.000	0.000
							Sum =	111.770	31.37
								R	3.56
								n	0.055
								K	4740.14
								S	0.0260
								V	6.84
								Keq	4740.14
								Q	**764.32**
								Dd (max)	8.00
								Dd (av)	1.12
							Unobstructed Width	W	100.000
							Gross length of structure		100.000


Bed Level
HFL_50
River Bed Level(m)
1035
1030
1025
1020
1015
1010
1005
1000
995
-50.000
-40.000
-30.000
-20.000
-10.000
0.000
10.000
20.000
30.000
40.000
50.000
Chainage(m)


Bed Level
HFL_100
River Bed Level(m)
1035
1030
1025
1020
1015
1010
1005
1000
995
-50
-40
-30
-20
-10
0
10
20
30
40
50
Chainage(m)

Hydrological and Hydraulic Parameters relating to Proposed Bridge across Local River at Ch. 31.157 of Khellani- Chatroo, (NH-244)

Deepest Bed Level	998.944	m	
HFL information received from local official	NA		
Waterway available (Abutment to Abutment)	**100**	m	
Top of Deck	1033.604	m GTS	
HFL information received from local enquiry	8m above LBL	m GTS	

Discharge Calculation		
Catchment Area =	115.00	Sq. Km
Discharge by Rational Formula (Q50) =	603.37	Cumec
Discharge by Rational Formula (Q100) =	658.22	Cumec
Discharge by Unit Hydrograph Method(Q100) =	764.32	Cumec
Discharge by Unit Hydrograph Method (Q50) =	764.32	Cumec
Discharge by Unit Hydrograph Method(Q100) =	764.32	Cumec
Discharge by Dicken's Formula =	667.23	Cumec
Adopted Discharge		
For Fixing Effective Clear Waterway normal to flow	**764.32**	**Cumec**
For Fixing HFL	**764.32**	**Cumec**
Max. Discharge	**764.32**	**Cumec**
Waterway		
Wetted perimeter as per Lacey's Formula	**132.7**	**m**
Waterway Provided (Abutment to Abutment)	**100.0**	**m**
Fluming ratio	**0.75**	**m**

OK

Summary of Calculation for Proposed Bridge	**A 100 m Total Waterway seems to be adequate.**					
Waterway available (m)	**Afflux h (m)**		**Vel under Bridge (m/sec)**		**HFL (m) with afflux**	
L (m)	**Q50**	**Q100**	**Q50**	**Q100**	**Q50**	**Q100**
100	0.000	0.000	6.84	6.84	1006.94	1006.94

Scour Calculation

There is no need to calculate the scour in Rocky Strata.

Note:-

Recommendation

It is recommended to proposed span of 4x25 i.e 100m waterway subject to Structural Adequacy.

HYDRAULIC CALCULATION FOR MAJOR BRIDGE AT CH. 81+130

Name of River / Stream / Nala	Chainage(km)
Local Stream	81+130

Sr. No.	Segmental Length(m)	Cumulative Segmental Length(m)	Elevation (m)
1	0	0	1054
2	3000	3000	1064
3	3000	6000	1108
4	3000	9000	1106
5	3000	12000	1116
6	3000	15000	1146
7	3000	18000	1174
8	3000	21000	1225
9	3000	24000	1266
10	3000	27000	1341
11	3000	30000	1410
12	3000	33000	1518
13	3000	36000	1591
14	3000	39000	1707
15	3000	42000	1747
16	3000	45000	1707
17	3000	48000	1910
18	3000	51000	1886
19	3000	54000	2010
20	3000	57000	2012
21	3000	60000	2047
22	3000	63000	2064
23	3000	66000	2112
24	3000	69000	2111
25	3000	72000	2126
25	3000	75000	2160
25	3000	78000	2277
25	3000	81000	2359
25	3000	84000	2426
26	1200	85200	2384
Catchment Area in Sq Km(A)			1086
Longest Stream Length in Km (L)			85.2
Centroid Length in Km (Lc)			37.50
Point Rainfall Value (50 years)in mm			220
Point Rainfall Value (100 years)in mm			240
Subzone =			7

1 Empirical Method

Dickens Formula

Q	=	CA^(3/4)	
A		1086	Km^2
C	=	19	
Q		3594	Cumecs

2 Rational method

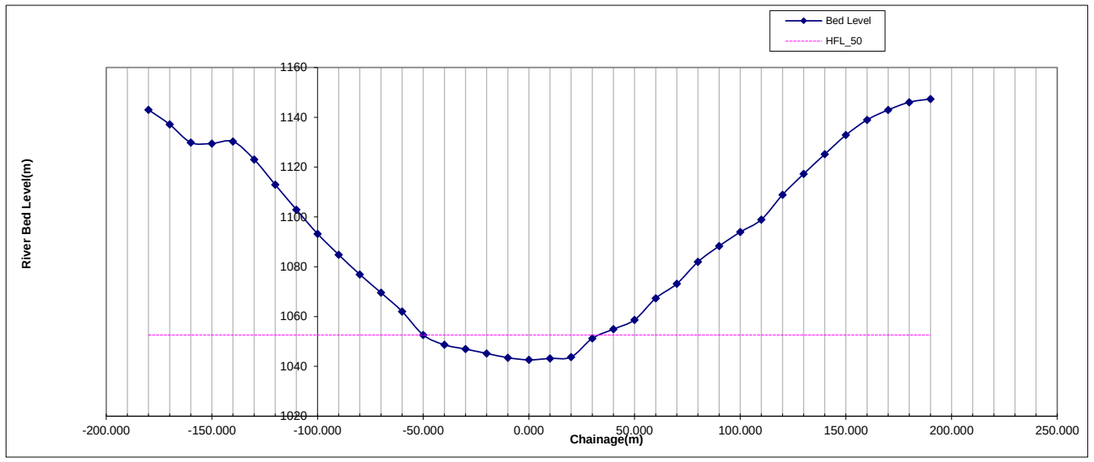
Catchment Area, A	=	1086	Km^2	=	108600.000	Hectares
Length of longest stream	=	85.200	Km			
Height, H	=	1330.00	m			
Time of Concentration by SP-13 formula	=	$(0.87*L^3/H)^{0.385}$				
tc	=	10.09	Hours			
50 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7	=	220	mm			
tp	=	15.23				
Design storm duration	=	16.8	hrs			
Conversion ratio for tc hours as per CWC FER for Subzone- 7	=	0.720				
tc hr rainfall	=	158.40	mm			
From code SP 13 Intensity of rainfall, Ic	=	2.07	cm/hr			
		1.57	cm/hr			
100 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7		240.00	mm			
Conversion ratio for tc hours as per CWC FER for Subzone- 7		0.720				
Conversio tc hr rainfall	=	172.80	mm			
From code SP 13 Intensity of rainfall, Ic	=	2.26	cm/hr			
		1.71	cm/hr			
From code SP 13 ' f ' Curve, Spread factor ' f '	=	0.589				
Runoff Co-efficient as per terrain condition, P	=	0.7				
Design discharge, Q50	=	0.0278PfAIc Cumecs				
	=	2574.13	Cumecs		Say Q50=	**2574**
Design discharge, Q100	=	0.0278PfAIc Cumecs				
	=	2808.14	Cumecs		Say Q100=	**2808**

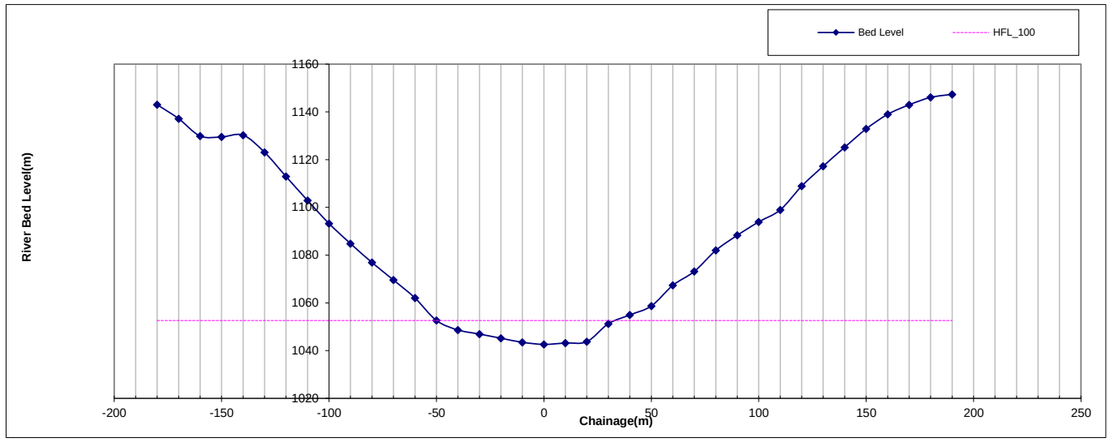
CROSS SECTION AT BRIDGE

HFL _50	**1052.62**				**Q50=**	**3652**			
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-190	1145.459	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-180.000	1143.035	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-170.000	1137.154	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-160.000	1129.893	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-150.000	1129.488	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-140.000	1130.263	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-130.000	1123.065	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-120.000	1112.911	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-110.000	1102.904	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-100.000	1093.228	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-90.000	1084.83	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-80.000	1076.908	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-70.000	1069.587	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-60.000	1062.064	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-50.000	1052.633	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-40.000	1048.666	1052.621	1042.621	10.000	3.955	1.978	3.955	19.775	10.754
-30.000	1046.938	1052.621	1042.621	10.000	5.683	4.819	1.728	48.190	10.148
-20.000	1045.21	1052.621	1042.621	10.000	7.411	6.547	1.728	65.470	10.148
-10.000	1043.482	1052.621	1042.621	10.000	9.139	8.275	1.728	82.750	10.148
0.000	1042.621	1052.621	1042.621	10.000	10.000	9.570	0.861	95.695	10.037
10.000	1043.193	1052.621	1042.621	10.000	9.428	9.714	0.572	97.140	10.016
20.000	1043.766	1052.621	1042.621	10.000	8.855	9.142	0.573	91.415	10.016
30.000	1051.249	1052.621	1042.621	10.000	1.372	5.114	7.483	51.135	12.490
40.000	1054.954	1052.621	1042.621	10.000	0.000	0.686	1.372	6.860	10.094
50.000	1058.678	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
60.000	1067.34	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
70.000	1073.164	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
80.000	1081.972	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
90.000	1088.288	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
100.000	1093.926	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
110.000	1098.931	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
120.000	1108.907	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
130.000	1117.252	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
140.000	1125.172	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
150.000	1132.863	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
160.000	1138.955	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
170.000	1142.956	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
180.000	1146.061	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
190.000	1147.334	1052.621	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
							Sum =	558.430	93.852
								R	5.950
								n	0.055
								K	33339.388
								S	0.012
								V	6.54
								Keq	33339.388
								Q	**3652.15**
								Dd (max)	10.000
								Dd (av)	1.490
							Unobstructed Width	W	375.000
							Gross length of structure		375.000

CROSS SECTION AT BRIDGE

HFL _100	**1052.62**						**Q100=**	**3652**	
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-190	1145.459	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-180.000	1143.035	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-170.000	1137.154	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-160.000	1129.893	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-150.000	1129.488	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-140.000	1130.263	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-130.000	1123.065	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-120.000	1112.911	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-110.000	1102.904	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-100.000	1093.228	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-90.000	1084.83	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-80.000	1076.908	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-70.000	1069.587	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-60.000	1062.064	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-50.000	1052.633	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
-40.000	1048.666	1052.62	1042.621	10.000	3.955	1.978	3.955	19.775	10.754
-30.000	1046.938	1052.62	1042.621	10.000	5.683	4.819	1.728	48.190	10.148
-20.000	1045.21	1052.62	1042.621	10.000	7.411	6.547	1.728	65.470	10.148
-10.000	1043.482	1052.62	1042.621	10.000	9.139	8.275	1.728	82.750	10.148
0.000	1042.621	1052.62	1042.621	10.000	10.000	9.570	0.861	95.695	10.037
10.000	1043.193	1052.62	1042.621	10.000	9.428	9.714	0.572	97.140	10.016
20.000	1043.766	1052.62	1042.621	10.000	8.855	9.142	0.573	91.415	10.016
30.000	1051.249	1052.62	1042.621	10.000	1.372	5.114	7.483	51.135	12.490
40.000	1054.954	1052.62	1042.621	10.000	0.000	0.686	1.372	6.860	10.094
50.000	1058.678	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
60.000	1067.34	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
70.000	1073.164	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
80.000	1081.972	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
90.000	1088.288	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
100.000	1093.926	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
110.000	1098.931	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
120.000	1108.907	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
130.000	1117.252	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
140.000	1125.172	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
150.000	1132.863	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
160.000	1138.955	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
170.000	1142.956	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
180.000	1146.061	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
190.000	1147.334	1052.62	1042.621	10.000	0.000	0.000	0.000	0.000	0.000
							Sum =	558.430	93.85
								R	5.95
								n	0.055
								K	33339.39
								S	0.0120
								V	6.54
								Keq	33339.39
								Q	**3652.15**
								Dd (max)	10.00
								Dd (av)	1.49
							Unobstructed Width	W	375.000
							Gross length of structure		375.000


Bed Level
HFL_50
River Bed Level(m)
1160
1140
1120
1100
1080
1060
1040
1020
-200.000
-150.000
-100.000
-50.000
0.000
50.000
100.000
150.000
200.000
250.000
Chainage(m)


Bed Level
HFL_100
River Bed Level(m)
1160
1140
1120
1100
1080
1060
1040
1020
-200
-150
-100
-50
0
50
100
150
200
250
Chainage(m)

Hydrological and Hydraulic Parameters relating to Proposed Bridge across Local River at Ch. 31.157 of Khellani- Chatroo, (NH-244)

Deepest Bed Level	1042.621	m	
HFL information received from local official	NA		
Waterway available (Abutment to Abutment)	**375**	m	
Top of Deck	1152.826	m GTS	
HFL information received from local enquiry	10m above LBL	m GTS	

Discharge Calculation		
Catchment Area =	1086.00	Sq. Km
Discharge by Rational Formula (Q50) =	2574.13	Cumec
Discharge by Rational Formula (Q100) =	2808.14	Cumec
Discharge by Unit Hydrograph Method(Q100) =	3652.15	Cumec
Discharge by Unit Hydrograph Method (Q50) =	3652.15	Cumec
Discharge by Unit Hydrograph Method(Q100) =	3652.15	Cumec
Discharge by Dicken's Formula =	3594.40	Cumec
Adopted Discharge		
For Fixing Effective Clear Waterway normal to flow	**3652.15**	**Cumec**
For Fixing HFL	**3652.15**	**Cumec**
Max. Discharge	**3652.15**	**Cumec**
Waterway		
Wetted perimeter as per Lacey's Formula	**290.1**	**m**
Waterway Provided (Abutment to Abutment)	**375.0**	**m**
Fluming ratio	**1.29**	**m**

OK

Summary of Calculation for Proposed Bridge	**A 375 m Total Waterway seems to be adequate.**					
Waterway available (m)	**Afflux h (m)**		**Vel under Bridge (m/sec)**		**HFL (m) with afflux**	
L (m)	**Q50**	**Q100**	**Q50**	**Q100**	**Q50**	**Q100**
375	0.000	0.000	6.54	6.54	1052.62	1052.62

Scour Calculation

There is no need to calculate the scour in Rocky Strata.

Note:-

Recommendation

It is recommended to proposed span of 375m waterway subject to Structural Adequacy.

HYDRAULIC CALCULATION FOR MAJOR BRIDGE AT CH. 82+970

Name of River / Stream / Nala	Chainage(km)
Local Stream	82+970

Sr. No.	Segmental Length(m)	Cumulative Segmental Length(m)	Elevation (m)
1	0	0	1078
2	2000	2000	1135
3	2000	4000	1140
4	2000	6000	1150
5	2000	8000	1156
6	2000	10000	1161
7	2000	12000	1167
8	2000	14000	1169
9	2000	16000	1174
10	2000	18000	1178
11	2000	20000	1185
12	2000	22000	1195
13	2000	24000	1225
14	2000	26000	1275
15	2000	28000	1295
16	2000	30000	1375
17	2000	32000	1455
18	2000	34000	1495
19	2000	36000	1525
20	2000	38000	1535
21	2000	40000	1558
Catchment Area in Sq Km(A)			673
Longest Stream Length in Km (L)			40
Centroid Length in Km (Lc)			24.80
Point Rainfall Value (50 years)in mm			220
Point Rainfall Value (100 years)in mm			240
Subzone =			7

1 Empirical Method

Dickens Formula

Q	=	CA^(3/4)	
A		673	Km^2
C	=	19	
Q		2511	Cumecs

2 Rational method

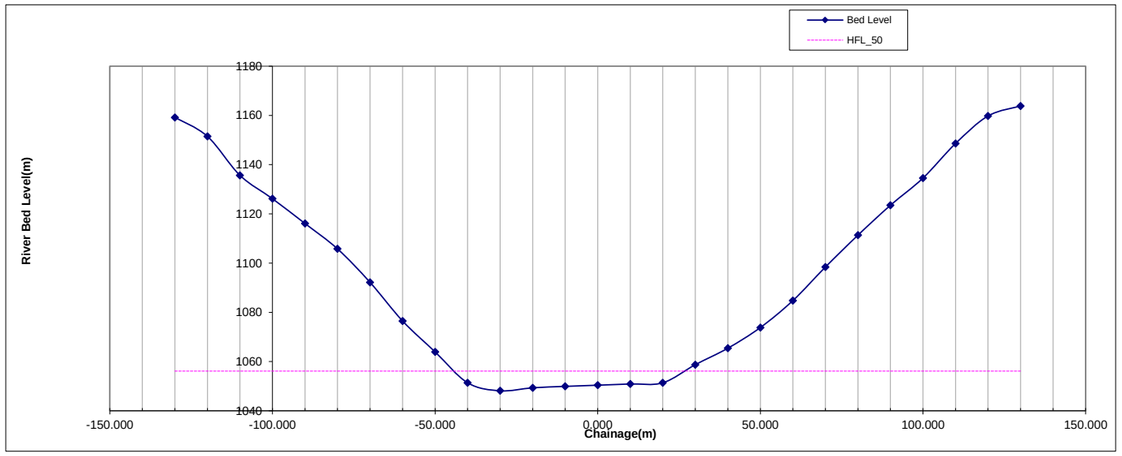
Catchment Area, A	=	673	Km^2	=	67300.000	Hectares
Length of longest stream	=	40.000	Km			
Height, H	=	480.00	m			
Time of Concentration by SP-13 formula	=	$(0.87*L^3/H)^{0.385}$				
tc	=	6.23	Hours			
50 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7	=	220	mm			
tp	=	10.75				
Design storm duration	=	11.8	hrs			
Conversion ratio for tc hours as per CWC FER for Subzone- 7	=	0.895				
tc hr rainfall	=	196.90	mm			
From code SP 13 Intensity of rainfall, Ic	=	3.17	cm/hr			
		3.16	cm/hr			
100 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7		240.00	mm			
Conversion ratio for tc hours as per CWC FER for Subzone- 7		0.895				
Conversio						
tc hr rainfall	=	214.80	mm			
From code SP 13 Intensity of rainfall, Ic	=	3.46	cm/hr			
		3.45	cm/hr			
From code SP 13 ' f ' Curve, Spread factor ' f '	=	0.607				
Runoff Co-efficient as per terrain condition, P	=	0.7				
Design discharge, Q50	=	0.0278PfAIc Cumecs				
	=	2516.19	Cumecs		Say Q50=	**2516**
Design discharge, Q100	=	0.0278PfAIc Cumecs				
	=	2744.93	Cumecs		Say Q100=	**2745**

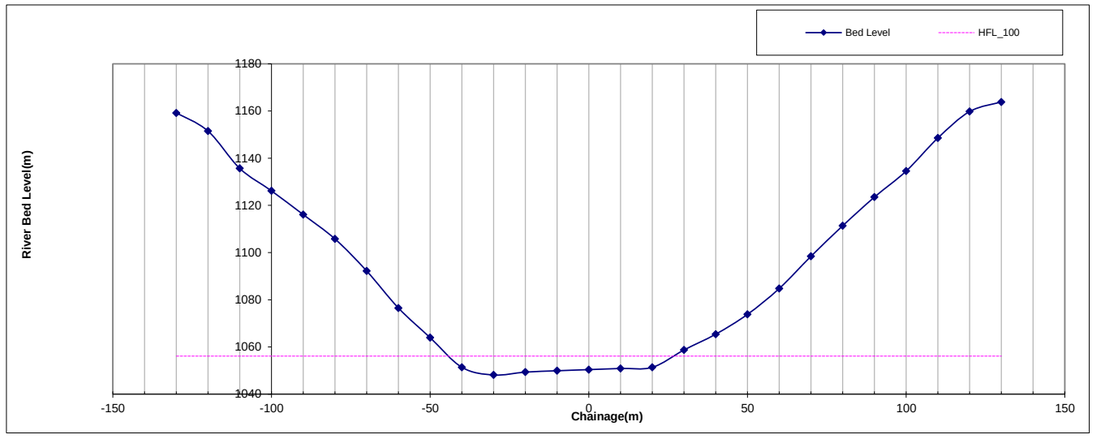
CROSS SECTION AT BRIDGE

HFL _50	1056.12				Q50=	2794			
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-130.000	1159.185	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-120.000	1151.503	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-110.000	1135.669	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-100.000	1126.161	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-90.000	1116.092	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-80.000	1105.783	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-70.000	1092.192	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-60.000	1076.498	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-50.000	1063.935	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-40.000	1051.372	1056.122	1048.122	10.000	4.750	2.375	4.750	23.750	11.071
-30.000	1048.122	1056.122	1048.122	10.000	8.000	6.375	3.250	63.750	10.515
-20.000	1049.327	1056.122	1048.122	10.000	6.795	7.398	1.205	73.975	10.072
-10.000	1049.908	1056.122	1048.122	10.000	6.214	6.505	0.581	65.045	10.017
0.000	1050.395	1056.122	1048.122	10.000	5.727	5.971	0.487	59.705	10.012
10.000	1050.881	1056.122	1048.122	10.000	5.241	5.484	0.486	54.840	10.012
20.000	1051.368	1056.122	1048.122	10.000	4.754	4.998	0.487	49.975	10.012
30.000	1058.729	1056.122	1048.122	10.000	0.000	2.377	4.754	23.770	11.073
40.000	1065.413	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
50.000	1073.819	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
60.000	1084.773	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
70.000	1098.408	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
80.000	1111.356	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
90.000	1123.512	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
100.000	1134.545	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
110.000	1148.576	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
120.000	1159.784	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
130.000	1163.816	1056.122	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
							Sum =	414.810	82.783
								R	5.011
								n	0.055
								K	22084.74033
								S	0.016
								V	6.73
								Keq	22084.7403
								Q	**2793.52**
								Dd (max)	8.000
								Dd (av)	1.660
							Unobstructed Width	W	250.000
							Gross length of structure		250.000

CROSS SECTION AT BRIDGE

HFL _100	1056.12						Q100=	2792	
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-130.000	1159.185	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-120.000	1151.503	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-110.000	1135.669	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-100.000	1126.161	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-90.000	1116.092	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-80.000	1105.783	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-70.000	1092.192	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-60.000	1076.498	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-50.000	1063.935	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
-40.000	1051.372	1056.12	1048.122	10.000	4.748	2.374	4.748	23.740	11.070
-30.000	1048.122	1056.12	1048.122	10.000	7.998	6.373	3.250	63.730	10.515
-20.000	1049.327	1056.12	1048.122	10.000	6.793	7.395	1.205	73.955	10.072
-10.000	1049.908	1056.12	1048.122	10.000	6.212	6.502	0.581	65.025	10.017
0.000	1050.395	1056.12	1048.122	10.000	5.725	5.968	0.487	59.685	10.012
10.000	1050.881	1056.12	1048.122	10.000	5.239	5.482	0.486	54.820	10.012
20.000	1051.368	1056.12	1048.122	10.000	4.752	4.995	0.487	49.955	10.012
30.000	1058.729	1056.12	1048.122	10.000	0.000	2.376	4.752	23.760	11.072
40.000	1065.413	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
50.000	1073.819	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
60.000	1084.773	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
70.000	1098.408	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
80.000	1111.356	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
90.000	1123.512	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
100.000	1134.545	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
110.000	1148.576	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
120.000	1159.784	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
130.000	1163.816	1056.12	1048.122	10.000	0.000	0.000	0.000	0.000	0.000
							Sum =	414.670	82.78
								R	5.01
								n	0.055
								K	22072.62
								S	0.0160
								V	6.73
								Keq	22072.62
								Q	**2791.99**
								Dd (max)	8.00
								Dd (av)	1.66
							Unobstructed Width	W	250.000
							Gross length of structure		250.000


Bed Level
HFL_50
River Bed Level(m)
1180
1160
1140
1120
1100
1080
1060
1040
-150.000
-100.000
-50.000
0.000
50.000
100.000
150.000
Chainage(m)


Bed Level
HFL_100
River Bed Level(m)
1180
1160
1140
1120
1100
1080
1060
1040
-150
-100
-50
0
50
100
150
Chainage(m)

Hydrological and Hydraulic Parameters relating to Proposed Bridge across Local River at Ch. 31.157 of Khellani- Chatroo, (NH-244)

Deepest Bed Level	1048.122	m	
HFL information received from local official	NA		
Waterway available (Abutment to Abutment)	**250**	m	
Top of Deck	1163	m GTS	
HFL information received from local enquiry	8m above LBL	m GTS	

Discharge Calculation		
Catchment Area =	673.00	Sq. Km
Discharge by Rational Formula (Q50) =	2516.19	Cumec
Discharge by Rational Formula (Q100) =	2744.93	Cumec
Discharge by Unit Hydrograph Method(Q100) =	2791.99	Cumec
Discharge by Unit Hydrograph Method (Q50) =	2791.99	Cumec
Discharge by Unit Hydrograph Method(Q100) =	2791.99	Cumec
Discharge by Dicken's Formula =	2510.53	Cumec
Adopted Discharge		
Second max discharge	**4187.99**	**Cumec**
For Fixing Effective Clear Waterway normal to flow	**2793.52**	**Cumec**
For Fixing HFL	**2791.99**	**Cumec**
For Estimation of Scour	**3629.59**	**Cumec**
Max. Discharge	**4187.99**	**Cumec**
Waterway		
Wetted perimeter as per Lacey's Formula	**253.7**	**m**
Waterway Provided (Abutment to Abutment)	**250.0**	**m**
Fluming ratio	**0.99**	**m**

OK

Summary of Calculation for Proposed Bridge	**A 250 m Total Waterway seems to be adequate.**					
Waterway available (m)	**Afflux h (m)**		**Vel under Bridge (m/sec)**		**HFL (m) with afflux**	
L (m)	**Q50**	**Q100**	**Q50**	**Q100**	**Q50**	**Q100**
250	0.000	0.000	6.73	6.73	1056.12	1056.12

Scour Calculation

There is no need to calculate the scour in Rocky Strata.

Note:-

Recommendation

It is recommended to proposed span of 250m waterway subject to Structural Adequacy.

HYDRAULIC CALCULATION FOR MAJOR BRIDGE AT CH. 89+141

Sr. No.	Segmental Length(m)	Cumulative Segmental Length(m)	Elevation (m)
1	0	0	1118
2	3000	3000	1135
3	3000	6000	1140
4	3000	9000	1150
5	3000	12000	1156
6	3000	15000	1161
7	3000	18000	1167
8	3000	21000	1169
9	3000	24000	1174
10	3000	27000	1178
11	3000	30000	1185
12	3000	33000	1195
13	3000	36000	1225
14	3000	39000	1275
15	3000	42000	1295
16	3000	45000	1375
17	3000	48000	1455
18	3000	51000	1550
19	3000	54000	1575
20	3000	57000	1625
21	3000	60000	1675
22	3000	63000	1724
23	3000	66000	1765
24	3000	69000	1795
25	3000	72000	1834
25	3000	75000	1867
25	3000	78000	1895
25	3000	81000	2145
	1000	82000	2384
Catchment Area in Sq Km(A)			1500
Longest Stream Length in Km (L)			82
Centroid Length in Km (Lc)			37.50
Point Rainfall Value (50 years)in mm			220
Point Rainfall Value (100 years)in mm			240
Subzone =			7

1 Empirical Method

Dickens Formula

Q	=	CA^(3/4)	
A		1500	Km^2
C	=	19	
Q		4580	Cumecs

2 Rational method

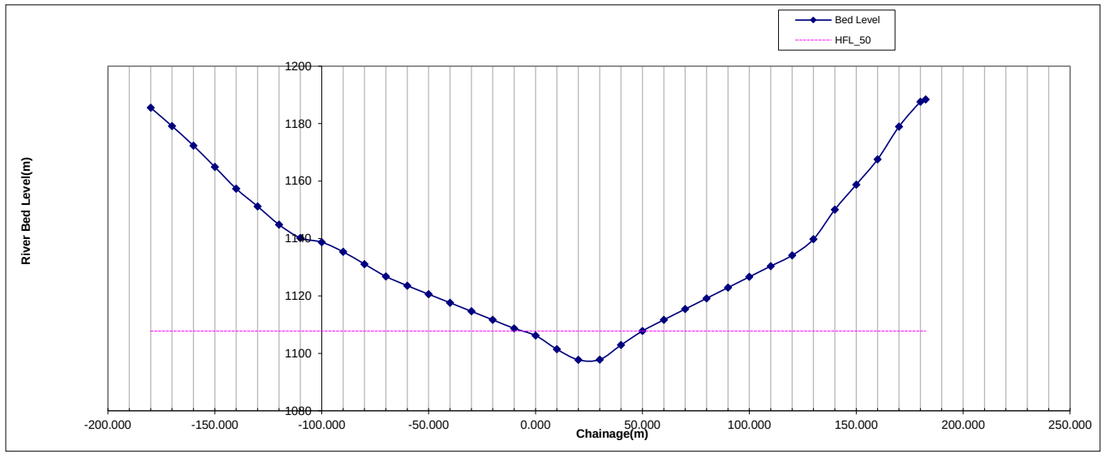
Catchment Area, A	=	1500	Km^2	=	150000.000	Hectares
Length of longest stream	=	82.000	Km			
Height, H	=	1266.00	m			
Time of Concentration by SP-13 formula	=	$(0.87*L^3/H)^{0.385}$				
tc	=	9.83	Hours			
50 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7	=	220	mm			
tp	=	13.61				
Design storm duration	=	15.0	hrs			
Conversion ratio for tc hours as per CWC FER for Subzone- 7	=	0.895				
tc hr rainfall	=	196.90	mm			
From code SP 13 Intensity of rainfall, Ic	=	2.12	cm/hr			
		2.00	cm/hr			
100 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7		240.00	mm			
Conversion ratio for tc hours as per CWC FER for Subzone- 7		0.895				
Conversio						
tc hr rainfall	=	214.80	mm			
From code SP 13 Intensity of rainfall, Ic	=	2.31	cm/hr			
		2.18	cm/hr			
From code SP 13 ' f ' Curve, Spread factor ' f '	=	0.572				
Runoff Co-efficient as per terrain condition, P	=	0.7				
Design discharge, Q50	=	0.0278PfAIc Cumecs				
	=	3530.52	Cumecs		Say Q50=	**3531**
Design discharge, Q100	=	0.0278PfAIc Cumecs				
	=	3851.47	Cumecs		Say Q100=	**3851**

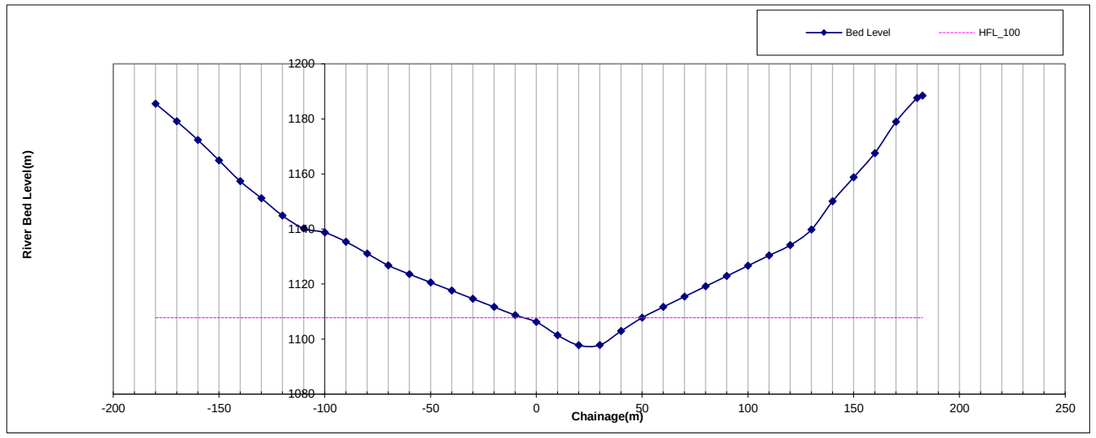
CROSS SECTION AT BRIDGE

HFL _50	1107.75				Q50=	2830			
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-190	1188.608	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-180.000	1185.528	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-170.000	1179.115	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-160.000	1172.345	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-150.000	1164.903	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-140.000	1157.335	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-130.000	1151.18	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-120.000	1144.843	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-110.000	1140.192	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-100.000	1138.719	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-90.000	1135.361	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-80.000	1131.073	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-70.000	1126.786	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-60.000	1123.567	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-50.000	1120.591	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-40.000	1117.615	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-30.000	1114.639	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-20.000	1111.664	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-10.000	1108.688	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
0.000	1106.209	1107.75	1097.750	10.000	1.541	0.770	1.541	7.705	10.118
10.000	1101.416	1107.75	1097.750	10.000	6.334	3.938	4.793	39.375	11.089
20.000	1097.75	1107.75	1097.750	10.000	10.000	8.167	3.666	81.670	10.651
30.000	1097.83	1107.75	1097.750	10.000	9.920	9.960	0.080	99.600	10.000
40.000	1102.901	1107.75	1097.750	10.000	4.849	7.385	5.071	73.845	11.212
50.000	1107.771	1107.75	1097.750	10.000	0.000	2.424	4.849	24.245	11.114
60.000	1111.673	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
70.000	1115.413	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
80.000	1119.154	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
90.000	1122.894	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
100.000	1126.635	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
110.000	1130.375	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
120.000	1134.116	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
130.000	1139.749	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
140.000	1150.066	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
150.000	1158.759	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
160.000	1167.572	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
170.000	1178.959	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
180.000	1187.586	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
182.500	1188.442	1107.75	1097.750	2.500	0.000	0.000	0.000	0.000	0.000
							Sum =	326.440	64.184
								R	5.086
								n	0.055
								K	17553.217
								S	0.026
								V	8.67
								Keq	17553.217
								Q	**2830.37**
								Dd (max)	10.000
								Dd (av)	0.890
							Unobstructed Width	W	365.000
							Gross length of structure		365.000

CROSS SECTION AT BRIDGE

HFL _100	1107.75						Q100=	2830	
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-190	1188.608								
-180.000	1185.528	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-170.000	1179.115	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-160.000	1172.345	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-150.000	1164.903	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-140.000	1157.335	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-130.000	1151.18	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-120.000	1144.843	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-110.000	1140.192	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-100.000	1138.719	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-90.000	1135.361	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-80.000	1131.073	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-70.000	1126.786	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-60.000	1123.567	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-50.000	1120.591	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-40.000	1117.615	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-30.000	1114.639	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-20.000	1111.664	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
-10.000	1108.688	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
0.000	1106.209	1107.75	1097.750	10.000	1.541	0.770	1.541	7.705	10.118
10.000	1101.416	1107.75	1097.750	10.000	6.334	3.938	4.793	39.375	11.089
20.000	1097.75	1107.75	1097.750	10.000	10.000	8.167	3.666	81.670	10.651
30.000	1097.83	1107.75	1097.750	10.000	9.920	9.960	0.080	99.600	10.000
40.000	1102.901	1107.75	1097.750	10.000	4.849	7.385	5.071	73.845	11.212
50.000	1107.771	1107.75	1097.750	10.000	0.000	2.424	4.849	24.245	11.114
60.000	1111.673	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
70.000	1115.413	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
80.000	1119.154	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
90.000	1122.894	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
100.000	1126.635	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
110.000	1130.375	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
120.000	1134.116	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
130.000	1139.749	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
140.000	1150.066	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
150.000	1158.759	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
160.000	1167.572	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
170.000	1178.959	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
180.000	1187.586	1107.75	1097.750	10.000	0.000	0.000	0.000	0.000	0.000
182.500	1188.442	1107.75	1097.750	2.500	0.000	0.000	0.000	0.000	0.000
							Sum =	326.440	64.18
								R	5.09
								n	0.055
								K	17553.22
								S	0.0260
								V	8.67
								Keq	17553.22
								Q	**2830.37**
								Dd (max)	10.00
								Dd (av)	0.89
							Unobstructed Width	W	365.000
							Gross length of structure		365.000


Bed Level
HFL_50
River Bed Level(m)
1200
1180
1160
1140
1120
1100
1080
-200.000
-150.000
-100.000
-50.000
0.000
50.000
100.000
150.000
200.000
250.000
Chainage(m)


Bed Level
HFL_100
River Bed Level(m)
1200
1180
1160
1140
1120
1100
1080
-200
-150
-100
-50
0
50
100
150
200
250
Chainage(m)

Hydrological and Hydraulic Parameters relating to Proposed Bridge across Local River at Ch. 31.157 of Khellani- Chatroo, (NH-244)

Deepest Bed Level	1097.75	m	
HFL information received from local official	NA		
Waterway available (Abutment to Abutment)	**365**	m	
Top of Deck	1152.826	m GTS	
HFL information received from local enquiry	10m above LBL	m GTS	

Discharge Calculation		
Catchment Area =	1500.00	Sq. Km
Discharge by Rational Formula (Q50) =	3530.52	Cumec
Discharge by Rational Formula (Q100) =	3851.47	Cumec
Discharge by Unit Hydrograph Method(Q100) =	2830.37	Cumec
Discharge by Unit Hydrograph Method (Q50) =	2830.37	Cumec
Discharge by Unit Hydrograph Method(Q100) =	2830.37	Cumec
Discharge by Dicken's Formula =	4579.54	Cumec
Adopted Discharge		
Second max discharge	**4245.56**	**Cumec**
For Fixing Effective Clear Waterway normal to flow	**2830.37**	**Cumec**
For Fixing HFL	**2830.37**	**Cumec**
For Estimation of Scour	**3679.48**	**Cumec**
Max. Discharge	**4245.56**	**Cumec**
Waterway		
Wetted perimeter as per Lacey's Formula	**312.8**	**m**
Waterway Provided (Abutment to Abutment)	**365.0**	**m**
Fluming ratio	**1.17**	**m**

OK

Summary of Calculation for Proposed Bridge	**A 365 m Total Waterway seems to be adequate.**					
Waterway available (m)	**Afflux h (m)**		**Vel under Bridge (m/sec)**		**HFL (m) with afflux**	
L (m)	**Q50**	**Q100**	**Q50**	**Q100**	**Q50**	**Q100**
365	0.000	0.000	8.67	8.67	1107.75	1107.75

Scour Calculation

There is no need to calculate the scour in Rocky Strata.

Note:-

Recommendation

It is recommended to proposed span of 365m waterway subject to Structural Adequacy.

HYDRAULIC CALCULATION FOR MAJOR BRIDGE AT CH. 99+181

Name of River / Stream / Nala	Chainage(km)
Local Stream	99+181

Sr. No.	Segmental Length(m)	Cumulative Segmental Length(m)	Elevation (m)
1	0	0	856
2	2000	2000	859
3	2000	4000	869
4	2000	6000	892
5	2000	8000	908
6	2000	10000	913
7	2000	12000	924
8	2000	14000	958
9	2000	16000	986
10	2000	18000	991
11	2000	20000	1000
12	2000	22000	1125
13	2000	24000	1150
14	2000	26000	1165
15	2000	28000	1167
16	2000	30000	1172
17	2000	32000	1178
18	2000	34000	1185
19	2000	36000	1200
20			

Catchment Area in Sq Km(A)	72
Longest Stream Length in Km (L)	36
Centroid Length in Km (Lc)	16.00
Point Rainfall Value (50 years)in mm	220
Point Rainfall Value (100 years)in mm	240
Subzone =	7

1 Empirical Method

Dickens Formula

Q	=	CA^(3/4)	
A		72	Km^2
C	=	19	
Q		470	Cumecs

2 Rational method

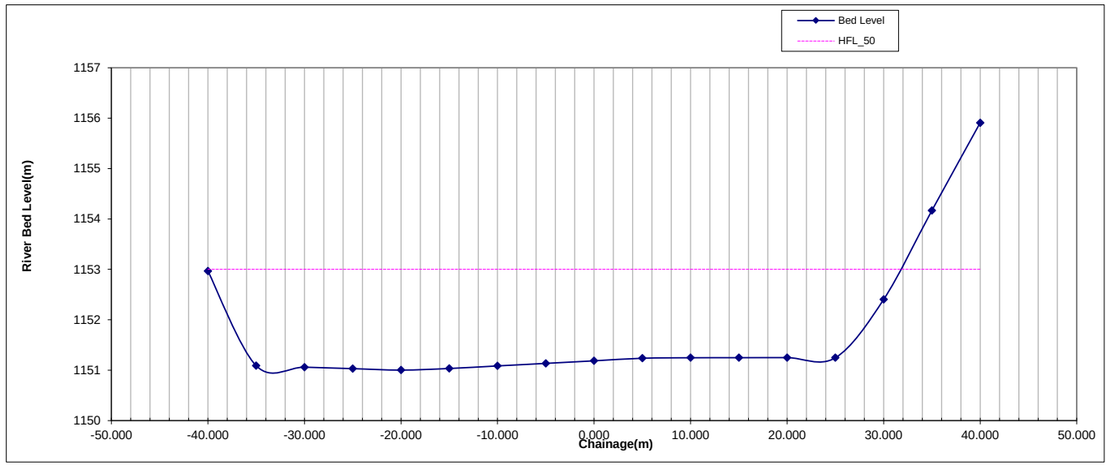
Catchment Area, A	=	72	Km^2	=	7200.000	Hectares
Length of longest stream	=	36.000	Km			
Height, H	=	344.00	m			
Time of Concentration by SP-13 formula	=	$(0.87*L^3/H)^{0.385}$				
tc	=	6.28	Hours			
50 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7	=	220	mm			
tp	=	8.73				
Design storm duration	=	9.6	hrs			
Conversion ratio for tc hours as per CWC FER for Subzone- 7	=	0.810				
tc hr rainfall	=	178.20	mm			
From code SP 13 Intensity of rainfall, Ic	=	3.15	cm/hr			
		2.84	cm/hr			
100 years Return period rainfall for 24 hours as per CWC Flood Estimation Report for subzone 7		240.00	mm			
Conversion ratio for tc hours as per CWC FER for Subzone- 7		0.810				
Conversio						
tc hr rainfall	=	194.40	mm			
From code SP 13 Intensity of rainfall, Ic	=	3.44	cm/hr			
		3.10	cm/hr			
From code SP 13 ' f ' Curve, Spread factor ' f '	=	0.914				
Runoff Co-efficient as per terrain condition, P	=	0.7				
Design discharge, Q50	=	0.0278PfAIc Cumecs				
	=	403.18	Cumecs		Say Q50=	**403**
Design discharge, Q100	=	0.0278PfAIc Cumecs				
	=	439.84	Cumecs		Say Q100=	**440**

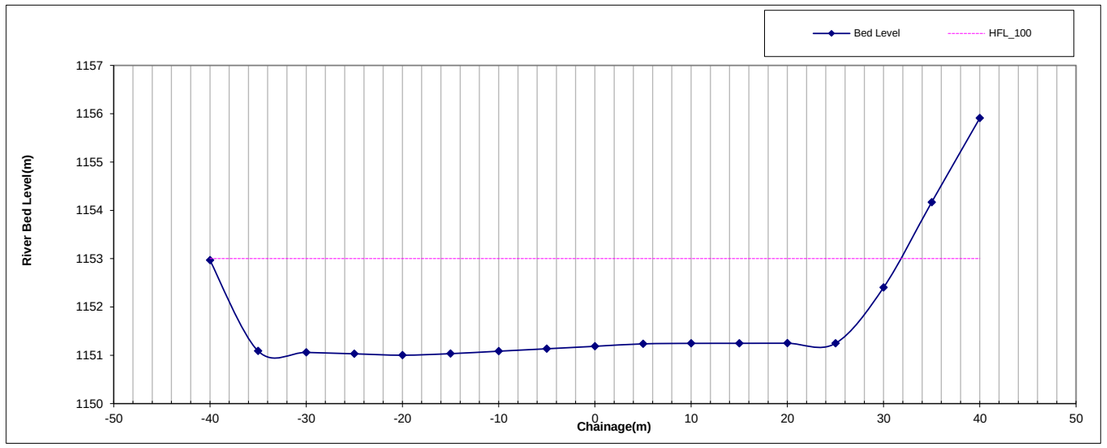
CROSS SECTION AT BRIDGE

HFL _50	1153.00				Q50=	485			
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-40.000	1152.968	1153.002	1151.002	5.000	0.034	0.017	0.034	0.085	5.000
-35.000	1151.089	1153.002	1151.002	5.000	1.913	0.973	1.879	4.867	5.341
-30.000	1151.06	1153.002	1151.002	5.000	1.942	1.928	0.029	9.638	5.000
-25.000	1151.031	1153.002	1151.002	5.000	1.971	1.957	0.029	9.783	5.000
-20.000	1151.002	1153.002	1151.002	5.000	2.000	1.986	0.029	9.928	5.000
-15.000	1151.034	1153.002	1151.002	5.000	1.968	1.984	0.032	9.920	5.000
-10.000	1151.085	1153.002	1151.002	5.000	1.917	1.942	0.051	9.712	5.000
-5.000	1151.135	1153.002	1151.002	5.000	1.867	1.892	0.050	9.460	5.000
0.000	1151.186	1153.002	1151.002	5.000	1.816	1.842	0.051	9.207	5.000
5.000	1151.237	1153.002	1151.002	5.000	1.765	1.790	0.051	8.952	5.000
10.000	1151.247	1153.002	1151.002	5.000	1.755	1.760	0.010	8.800	5.000
15.000	1151.248	1153.002	1151.002	5.000	1.754	1.754	0.001	8.772	5.000
20.000	1151.25	1153.002	1151.002	5.000	1.752	1.753	0.002	8.765	5.000
25.000	1151.247	1153.002	1151.002	5.000	1.755	1.753	0.003	8.767	5.000
30.000	1152.403	1153.002	1151.002	5.000	0.599	1.177	1.156	5.885	5.132
35.000	1154.169	1153.002	1151.002	5.000	0.000	0.299	0.599	1.497	5.036
40.000	1155.909	1153.002	1151.002	5.000	0.000	0.000	0.000	0.000	0.000
							Sum =	124.040	80.511
								R	1.541
								n	0.055
								K	3008.41897
								S	0.026
								V	3.91
								Keq	3008.419
								Q	**485.09**
								Dd (max)	2.000
								Dd (av)	1.650
							Unobstructed Width	W	75.000
							Gross length of structure		75.000

CROSS SECTION AT BRIDGE

HFL _100	1153.00				Q100=	485			
Offset(m)	Bed Level	Natural HFL	LWL	Distance	h	Avg h	Diff in h	Area	Perimeter
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m^2)	(m)
-40.000	1152.968	1153.00	1151.002	5.000	0.034	0.017	0.034	0.085	5.000
-35.000	1151.089	1153.00	1151.002	5.000	1.913	0.973	1.879	4.867	5.341
-30.000	1151.06	1153.00	1151.002	5.000	1.942	1.928	0.029	9.638	5.000
-25.000	1151.031	1153.00	1151.002	5.000	1.971	1.957	0.029	9.783	5.000
-20.000	1151.002	1153.00	1151.002	5.000	2.000	1.986	0.029	9.928	5.000
-15.000	1151.034	1153.00	1151.002	5.000	1.968	1.984	0.032	9.920	5.000
-10.000	1151.085	1153.00	1151.002	5.000	1.917	1.942	0.051	9.712	5.000
-5.000	1151.135	1153.00	1151.002	5.000	1.867	1.892	0.050	9.460	5.000
0.000	1151.186	1153.00	1151.002	5.000	1.816	1.842	0.051	9.207	5.000
5.000	1151.237	1153.00	1151.002	5.000	1.765	1.790	0.051	8.952	5.000
10.000	1151.247	1153.00	1151.002	5.000	1.755	1.760	0.010	8.800	5.000
15.000	1151.248	1153.00	1151.002	5.000	1.754	1.754	0.001	8.772	5.000
20.000	1151.25	1153.00	1151.002	5.000	1.752	1.753	0.002	8.765	5.000
25.000	1151.247	1153.00	1151.002	5.000	1.755	1.753	0.003	8.767	5.000
30.000	1152.403	1153.00	1151.002	5.000	0.599	1.177	1.156	5.885	5.132
35.000	1154.169	1153.00	1151.002	5.000	0.000	0.299	0.599	1.497	5.036
40.000	1155.909	1153.00	1151.002	5.000	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
							Sum =	124.040	80.51
								R	1.54
								n	0.055
								K	3008.42
								S	0.0260
								V	3.91
								Keq	3008.42
								Q	**485.09**
								Dd (max)	2.00
								Dd (av)	1.65
							Unobstructed Width	W	75.000
							Gross length of structure		75.000


Bed Level
HFL_50
River Bed Level(m)
1157
1156
1155
1154
1153
1152
1151
1150
-50.000
-40.000
-30.000
-20.000
-10.000
0.000
10.000
20.000
30.000
40.000
50.000
Chainage(m)


Bed Level
HFL_100
River Bed Level(m)
1157
1156
1155
1154
1153
1152
1151
1150
-50
-40
-30
-20
-10
0
10
20
30
40
50
Chainage(m)

Hydrological and Hydraulic Parameters relating to Proposed Bridge across Local River at Ch. 99.181 of Khellani- Chatroo, (NH-244)

Deepest Bed Level	1151.002	m	
HFL information received from local official	NA		
Waterway available (Abutment to Abutment)	**75**	m	
Top of Deck	1160.849	m GTS	
HFL information received from local enquiry	2m above LBL	m GTS	

Discharge Calculation		
Catchment Area =	72.00	Sq. Km
Discharge by Rational Formula (Q50) =	403.18	Cumec
Discharge by Rational Formula (Q100) =	439.84	Cumec
Discharge by Unit Hydrograph Method(Q100) =	485.09	Cumec
Discharge by Unit Hydrograph Method (Q50) =	485.09	Cumec
Discharge by Unit Hydrograph Method(Q100) =	485.09	Cumec
Discharge by Dicken's Formula =	469.63	Cumec
Adopted Discharge		
For Fixing Effective Clear Waterway normal to flow	**485.09**	**Cumec**
For Fixing HFL	**485.09**	**Cumec**
Max. Discharge	**485.09**	**Cumec**
Waterway		
Wetted perimeter as per Lacey's Formula	**105.7**	**m**
Waterway Provided (Abutment to Abutment)	**75.0**	**m**
Fluming ratio	**0.71**	**m**

OK

Summary of Calculation for Proposed Bridge	**A 75 m Total Waterway seems to be adequate.**					
Waterway available (m)	**Afflux h (m)**		**Vel under Bridge (m/sec)**		**HFL (m) with afflux**	
L (m)	**Q50**	**Q100**	**Q50**	**Q100**	**Q50**	**Q100**
75	0.000	0.000	4.05	4.05	1153.00	1153.00

Scour Calculation

There is no need to calculate the scour in Rocky Strata.

Note:-

Recommendation

It is recommended to proposed span of 3x25 i.e 75m waterway subject to Structural Adequacy.