ETHEKWINI MUNICIPALITY

Wewe River Floodline at the Proposed Burbreeze Pedestrian Bridge

Final Report

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For:	SiVEST Civil Engineering Division

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1 INTRODUCTION

SiVEST Civil Engineering Division was appointed by SiVEST Environmental Division to carry out a flood line assessment on the Wewe Stream, in the vicinity of the proposed pedestrian bridge between Sandfields and Burbreeze. Approximate coordinates of the site are:

Latitude 29°32'20.04"S

Longitude 31°08'24.33"E

This investigation aims to achieve the following objectives:

- Study the catchment characteristics of the Wewe River
- Estimate the 100 year flood peak
- Study the river morphology adjacent to the site
- Create a hydrodynamic model of the rivers and impose the 100 year flood scenario.
- Produce a flood line drawing and a succinct report describing the methods utilised.
- Estimate the effects of the bridge on the river and surrounding areas.

Figure 1: Locality map (Google Earth)

2 METHODOLOGY

A floodline study is the result of analyses based on two different scientific procedures. The first procedure involves hydrology, whereby storm flows are estimated from a catchment using statistics to predict the magnitude of various storm events based on historical data. The second procedure relates to hydraulics, which simulates the area under investigation during the flood flow. This involves:

a) Creating a virtual 3-dimensional frame which simulates the water course in terms of its slope, topography, and roughness,

b) Introducing the various flood scenarios calculated during the hydrological analysis, and

c) Recording the results such as water levels and velocities.

2.1 Hydrology

The objective of a hydrological study, in the context of flood line and flood risk assessments, is to estimate the peak flow rate within the river in question for a particular return period. The estimation of peak flow rates are typically achieved by stochastic or deterministic methods.

- *Stochastic methods* involve analysis of long flow records near the point of interest in the river. There is no flow gauging station on the Wewe River near to the Burbreeze bridge site thus stochastic methods are not applicable to this study.
- *Deterministic methods* have been developed to estimate floods where reliable statistical data is not available. Simplistically, hypothetical rainfall events are imposed on a catchment area.

Stochastic methods are usually considered superior to deterministic methods, largely because real data records are involved, rather than hypothetical scenarios. Unfortunately stream flow records are seldom long enough (or have not necessarily recorded many extreme events) and are therefore seldom used.

The deterministic method of calculating flood flows for different return periods involved the following steps, as outlined in the SANRAL Drainage Manual, 6th Edition:

- Determine the catchment area of the point of interest on the river.
- Determine the length of the watercourse above the point of interest.
- Calculate the average slope of the river within the catchment (10/85 method)
- Select the appropriate SDF basin number
- Identify the mean annual precipitation of the study area.
- Determine the appropriate design rainfall values to be used, for various return periods

The point of interest along the Wewe Stream is situated downstream of the Dudley Pringle Dam. It is thus necessary to perform hydrological calculations for the catchment of the dam as well as the catchment for the bridge site downstream of the dam.

Of the deterministic methods to be employed, the Standard Design Flood (SDF) is considered to be the most appropriate for Dudley Pringle Dam, due to the large catchment size. The Rational Method is considered to be the most appropriate for the bridge site catchment downstream of the Dudley Pringle dam because this catchment is smaller than 15km^2.

Results of the calculations are summarised in section 3, while calculation tables are included in Appendix A.

2.2 Hydraulics

2.2.1 Wewe River at Dudley Pringle Dam

Peak flow into the dam is not the same as the discharge over the dam spillway for any given instant. All incoming flows are attenuated in the dam, then water is discharged depending on the water levels in the dam and the spillway characteristics. Inflow is obtained using the SDF method and the outflow will be determined using a depth-storage equation/model in Microsoft Excel for the dam spillway. The following parameters were obtained for this calculation:

- The surface area of the dam at full supply
- The side slopes of the dam
- The design height of the spillway
- The length of the spillway
- The spillway height above the dam bed

The depth-storage spillway calculation data is included in Appendix B.

2.2.2 Wewe Stream at Bridge Site

River morphology was assessed through inspection of highly detailed aerial photography, in order to estimate hydraulic properties such as roughness of the river itself and flood plain areas.

The pedestrian bridge site was surveyed and a 3D terrain model was then produced for use in HEC-RAS, a commonly used software for this type of flood modelling. A series of cross-sections was extracted from the terrain model and input into the hydraulic model to represent the Wewe River. After assigning appropriate roughness and other parameters, the depth of inundation was modelled. HEC-RAS output data is included in Appendix C.

2.3 Effects of the constructed bridge

A bridge element was designed in HEC-RAS according to the bridge design supplied by Ethekwini Municipality Engineering Unit. The HEC-RAS model was re-run incorporating the bridge element at the proposed bridge site. The post-construction output data is also included in Appendix C.

Stormwater runoff from the bridge was estimated to determine what effect it may have on receiving areas.

3 RESULTS

3.1 Hydrology

The catchments of the Dudley Pringle dam and the proposed bridge site downstream of the dam are shown in Figure 2.

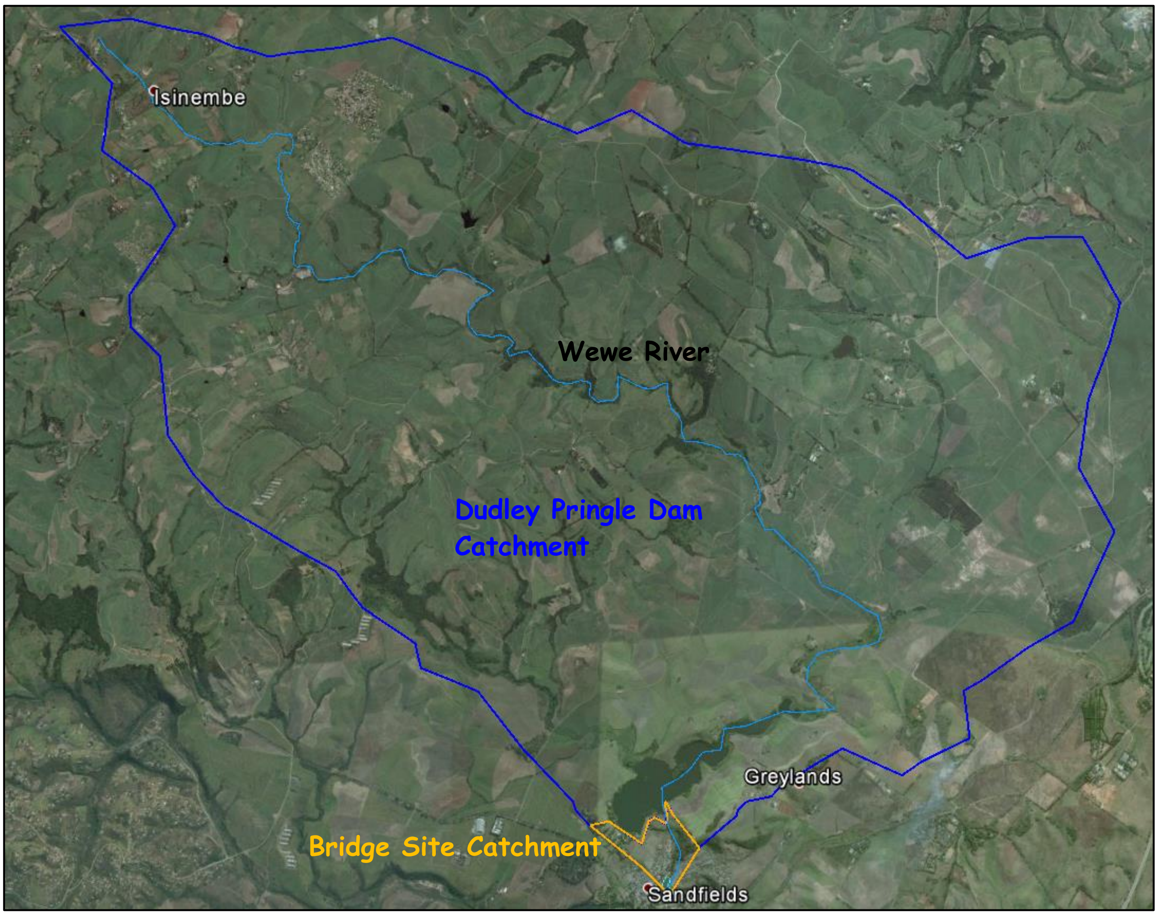


Figure 2: Catchments areas (Google Earth)

3.1.1 Dudley Pringle Dam - Standard Design Flood

The catchment area for the Dudley Pringle Dam in particular is considered large, and worthy of a circumspect approach. The Standard Design Flood was developed by Alexander in response to record floods associated with cyclonic activity off the eastern seaboard of Kwazulu-Natal and Mozambique. Alexander's method is considered robust, and the most appropriate deterministic method to be applied for this section of the study. See Table 1 for calculation parameters and results.

Parameter	Wewe River – at the Dudley Pringle Dam
Catchment Area	57.7km²
Longest Watercourse	17.2km
Average Slope (10/85 method)	0.01475
SDF Basin	24 Newlands
Runoff Coefficient	0.80
Time of Concentration	3.08 hours
Average Intensity	41.28 mm/hour
Q_{100}	529m³/s

Table 1: Summary of key hydrological parameters used for the Standard Design Flood.

3.1.2 Bridge Site– Rational Method

Due to the small catchment area of the proposed bridge site downstream of the Dudley Pringle Dam, the Rational Method was used to determine peak flows in the catchment. As identified in the SANRAL Drainage Manual, 6th Edition this method is appropriate for catchments smaller than 15km². See Table 2 for calculation parameters and results.

Parameter	Wewe Stream – at proposed Pedestrian Bridge site
Catchment Area	0.4km²
Longest Watercourse	0.8km
Average Slope (10/85 method)	0.00482
Runoff Coefficient	0.44
Time of Concentration	0.45 hours
Average Intensity	193.8 mm/hour
Q_{100}	9.3m³/s

Table 2: Summary of key hydrological parameters used for the Rational Method.

3.2 Hydraulics

The water levels in the dam were determined using the run-off inflows combined with the dam's surface area-volume relationship, then the outflows from the dam could be determined by the spillway rating curve. The spillway rating curve for Dudley Pringle Dam was determined using the available properties of the spillway. The rating curve relates the water level in the dam to outflow over the dam spillway. The two equations were executed with a time step of 1 second, from the start of storm rainfall 00:00:00, to the time when spillway flow returned to normal. The Dam spillway model yielded a peak outflow of 423m³/s at 4 hours and 18 minutes after the first rainfall.

See Figure 3 for the combined Hydrograph of the outflow from Dudley Pringle Dam and the Bridge Site catchment downstream of the dam. Due to the small size of the Bridge Site catchment, it had no effect on the maximum flow through the river at the proposed site. 423m³/s is thus the maximum or peak flow for the 100 year flood at the bridge site.

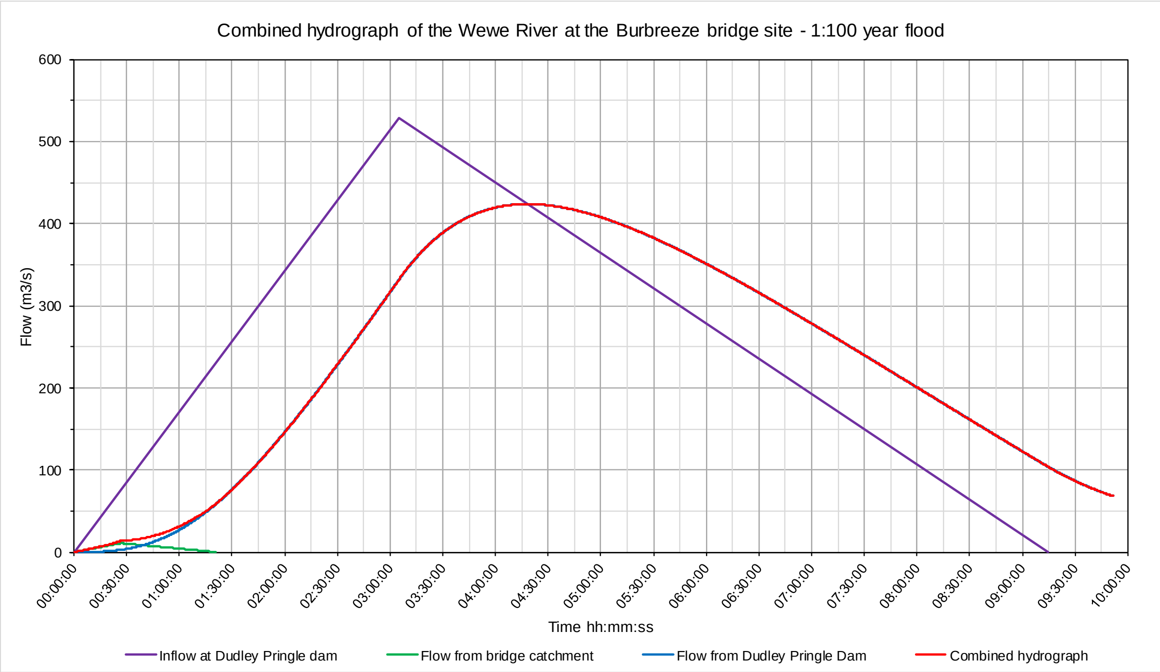


Figure 3: Inflow and outflow hydrographs of Dudley Pringle Dam, and combined hydrograph for flow at the bridge site

Figure 4 shows the geometry set up for the Wewe Stream model in HEC-RAS in which 10 cross sections were taken through the river in the vicinity of the proposed bridge site. Parameters included in the hydraulic model included the following:

- Channel Roughness (Manning's N): 0.04
- Overbank Roughness (Manning's N): 0.06

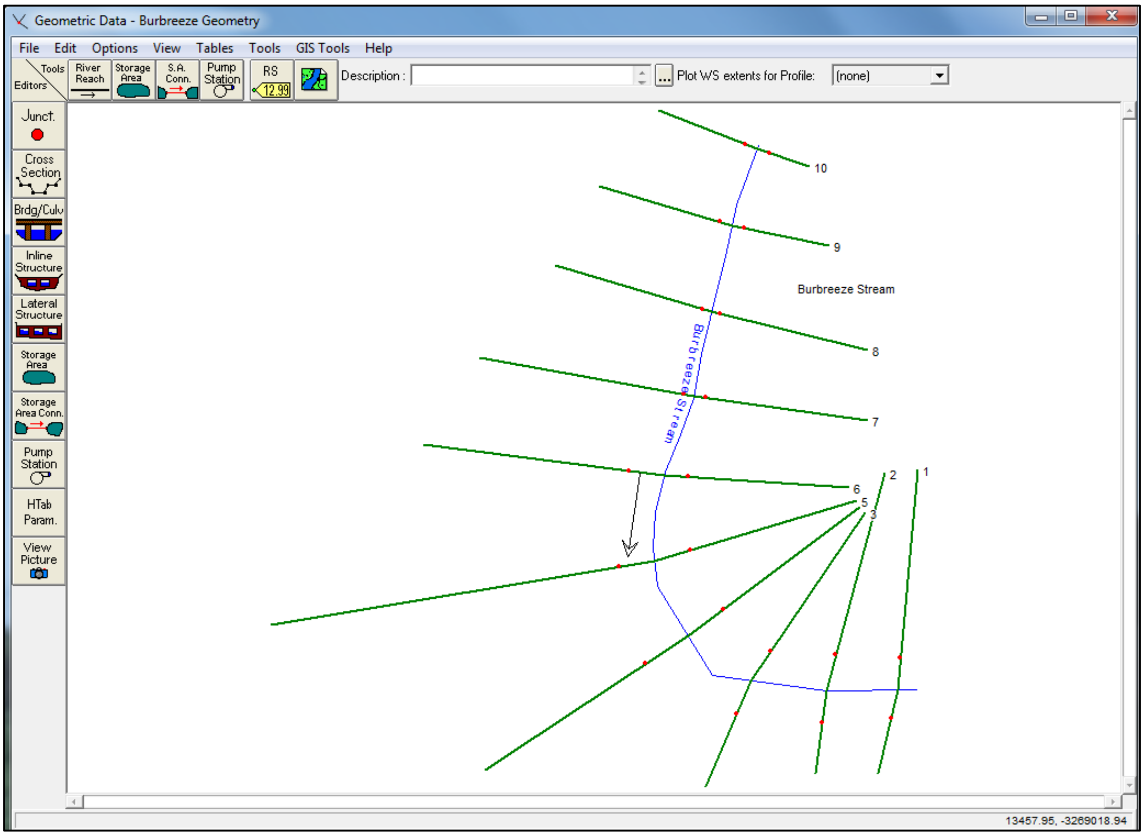


Figure 4: HEC-RAS model geometry of the Burbreeze/ Wewe Stream

The flow value 423m³/s was run through the model in order to determine the 100 year flood line in the vicinity of the proposed bridge site. A typical cross section through the river in flood is presented as Figure 5.

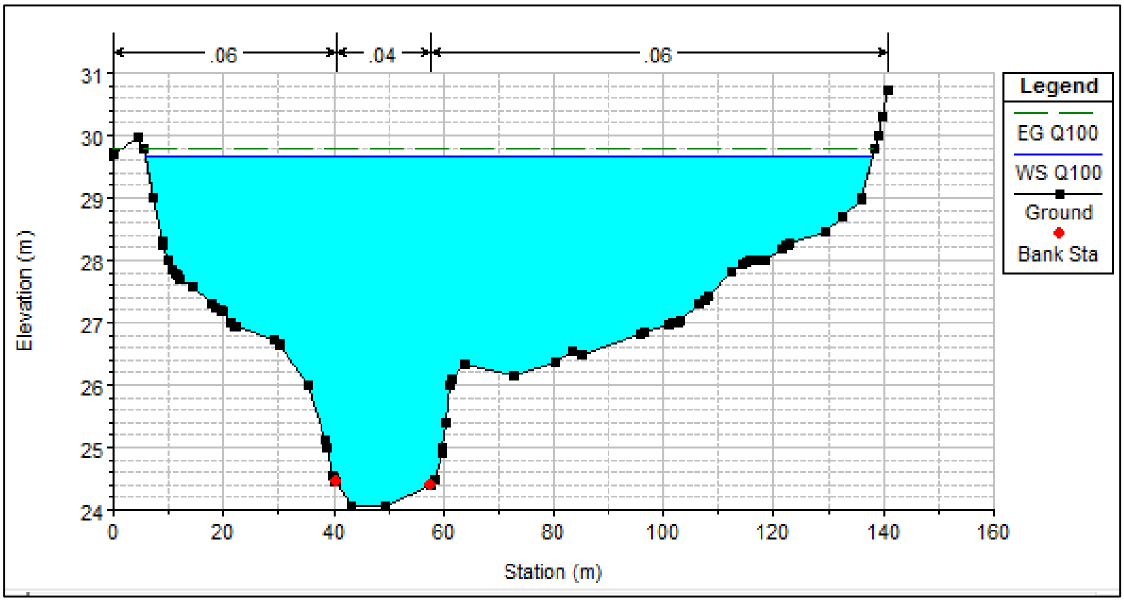


Figure 5: Cross section 5 of the HEC-RAS model during the 100 year flood.

Appendix C contains the output data from the HEC-RAS model. The plan drawing of the 100 year flood line at the bridge site is attached as Appendix D.

3.3 Effects of the constructed bridge

A bridge element was incorporated into the HEC-RAS model in order to model the effects of the proposed bridge once it has been constructed. The bridge element was designed according to the General Arrangement Drawing provided by the Ethekwini Municipality Engineering Unit, attached as Appendix E. The bridge length in the Design Drawing is 36 meters, however the HEC-RAS model output shows that the river width at the proposed bridge site during the 100year flood is estimated to reach approximately 125 meters. The pier spacing is 17.8 meters, which was taken directly from the Ethekwini Design Drawing, and the length of the bridge element between abutments in the HEC-RAS model is 125 meters in order to account for the wider river during flood. Figure 6 shows the model element had 6 piers between abutments as opposed to the Ethekwini Design containing one pier. The bridge deck and pier dimensions were modelled according to the Ethekwini Design.

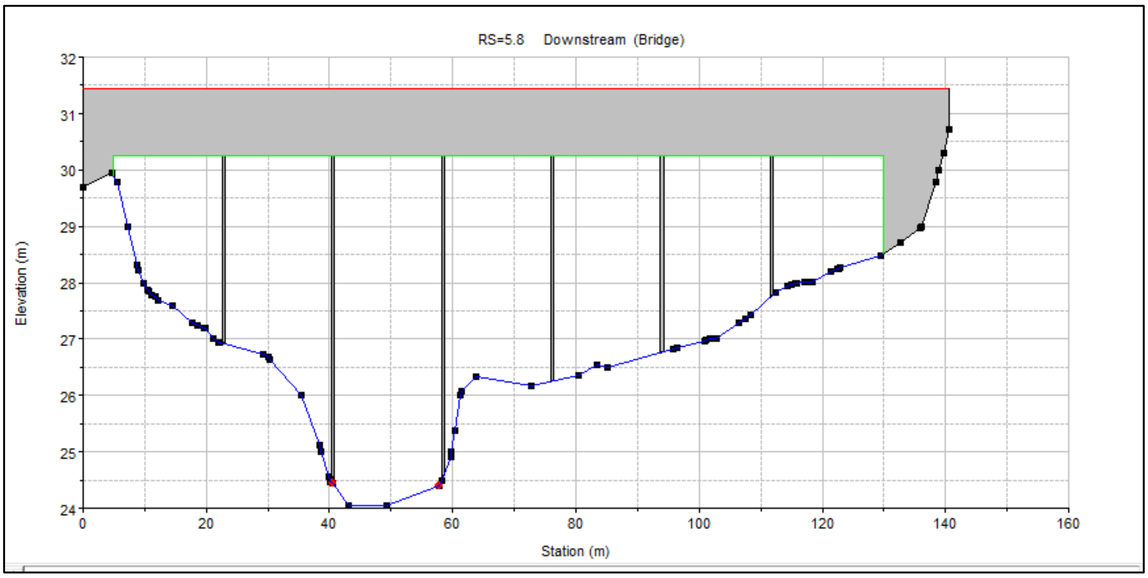


Figure 6: Bridge element in the HEC-RAS model

The model was then re-run with the bridge element in place between river cross sections 5 and 6, as seen in Figure 7.

The output data of the model including the bridge element is contained in Appendix C. By comparing the data with those of the pre-construction data, one can see that there is approximately a 0.005 m rise in the water surface elevation in the cross sections 9 to 6 upstream of the bridge. Similarly there is an increase in the water velocity in cross sections 9 to 6 of approximately 0.01m/s. There is no change in the data downstream of the bridge element.

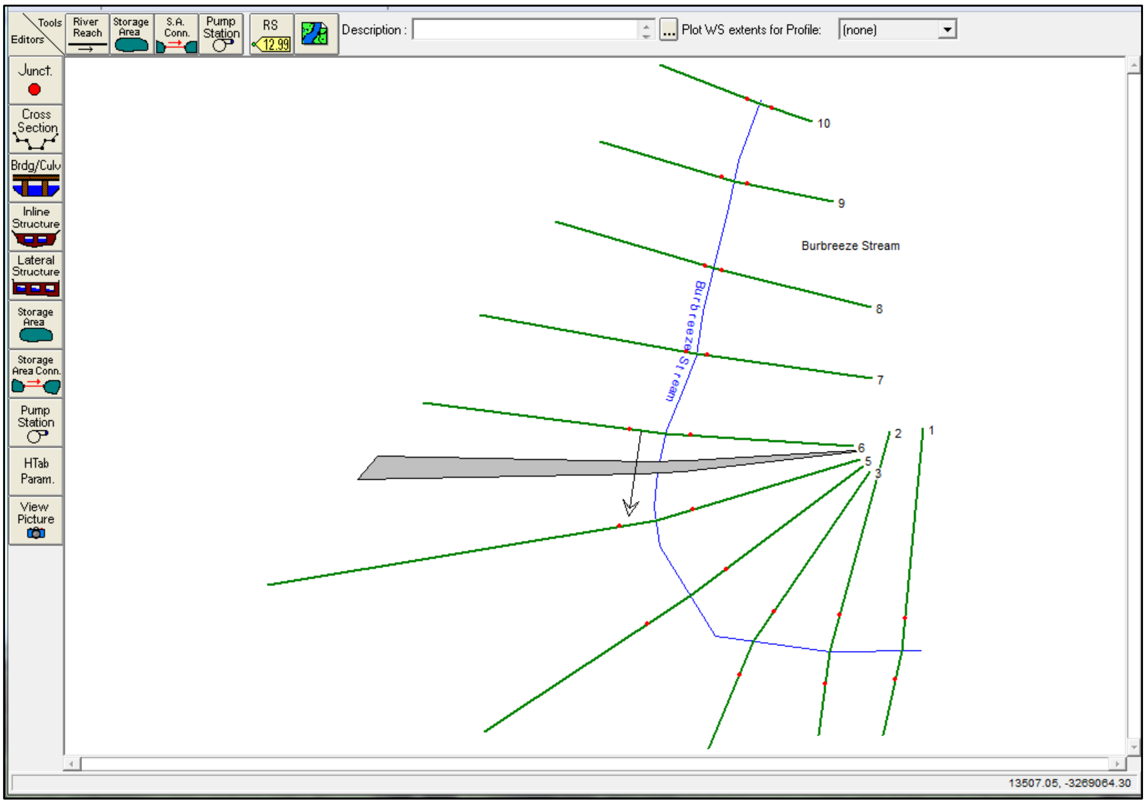


Figure 7: Plan view of the bridge element in the HEC-RAS model geometry

It was also necessary to assess the predicted effect on stormwater runoff volumes of the pedestrian bridge after construction. The bridge has a length of 125 meters between abutments. One can be conservative and estimate that an approach ramp of 20 meters on either side of the bridge is to be constructed. This results in an overall concrete length of 165 meters. The bridge width is 2.6 meters. These dimensions yield a hardened surface area of 429m^2. The table below summarises the additional stormwater runoff associated with the bridge after construction.

Parameter	
Bridge Surface Area	429m^2
Runoff Coefficient (concrete surface)	1
100 year Average Rainfall Intensity (Bridge Site catchment)	193.8 mm/hour
Bridge Runoff	0.0231m^3/s

Table 3: Additional Stormwater Runoff associated with Burbreeze Pedestrian Bridge after construction

4 DISCUSSION

While every effort has been made to predict, as accurately as possible, the effects of a hypothetical 100 year flood on the river in question, designers should allow for significant error that is the norm in hydrological calculations. This may be done at the discretion of the developer, and may take the form of a freeboard allowance or a buffer zone.

Post-construction of the bridge, the HEC-RAS model revealed that the water surface elevation during a 100 year flood was estimated to increase by 0.05meters which is considered a negligible value. The placement of a Pedestrian Bridge as designed by Ethekwini would thus not impose any significant effect on the flow in the river.

Post-construction stormwater runoff from the bridge would be approximately 0.0231m^3/s. This value can be considered to have a negligible effect on receiving areas.

5 REFERENCES

The South African National Roads Agency Limited (2006) *Drainage Manual, 5th Edition.* Kruger A, Gomes N. The South African National Roads Agency Limited, Pretoria, South Africa

Alexander WJR (1991) *Flood Hydrology for Southern Africa.* Department of Civil Engineering, University of Pretoria.

APPENDIX A

Hydrology

Description of catchment	Standard Design Flood - Dudley Pringle Dam		
River detail	Wewe River		
Calculated by	L. Kidgell	Date	28-04-2015

Physical characteristics

Size of catchment (A)	57.68	km²	Time of Concentration (T_C) $T_c = \left(\frac{0,87\ L^2}{1000\ S_{av}}\right)^{0,385}$	3.08	hours
Longest watercourse (L)	17.717	km			
Average slope (S_{av})	0.014750428	m/m			
SDF basin (0)#	24		Time of concentration, t (= 60 T_C)	185	minutes
2-year return period rainfall (M)	76	mm	Days of thunder per year (R)	15	days/year

TR102 n-day rainfall data

Weather Service station	Newlands	Mean annual precipitation (MAP)		910	mm	
Weather Service station number	240 269	Coordinates	29–59'	&	30–39'	

Duration (days)	Return period (years)					
	2	5	10	20	50	100	200
1	76	114	145	181	235	284	340
2	95	142	181	224	290	348	415
3	105	154	192	235	298	354	415
7	126	179	219	262	325	378	436

Rainfall

Return period (years), T	2	5	10	20	50	100	200
Point precipitation depth (mm) $P_{t,T}$	33.77	56.97	74.52	92.06	115.26	132.81	150.36
Area reduction factor (%), ARF (= $(90000-12800\ln A+9830\ln t)^{0,4}$)	96%	96%	96%	96%	96%	96%	96%
Average intensity (mm/hour), I_T (= $P_{t,T}$ x ARF / T_C)	10.50	17.71	23.16	28.62	35.83	41.28	46.74

Run-off coefficients

Calibration factors	C_2 (2-year return period) (%)	15	C_{100} (100-year return period) (%)	80

Return period (years)	2	5	10	20	50	100	200
Return period factors (Y_T)	0	0.84	1.28	1.64	2.05	2.33	2.58
Run-off coefficient (C_T), $C_T = \frac{C_2}{100} + \left(\frac{Y_T}{2,33}\right)\left(\frac{C_{100}}{100} - \frac{C_2}{100}\right)$	0.15	0.38	0.51	0.61	0.72	0.80	0.87
Peak flow (m³/s), $Q_T = 0.278 \times C_T I_T A$	25.23	109.04	188.18	278.55	414.39	529.15	651.29

Table 3C.7

		2	5	10	20	50	100	200
T_C < 6 hours	Modified Hershfield equation	33.77	56.97	74.52	92.06	115.26	132.81	150.36
		38.46	64.88	84.86	104.85	131.27	151.26	171.24
6 hours < T_C < 24 hours	Linear interpolation between modified Hershfield equation point rainfall and 1-day point rainfall from TR102	-	-	-	-	-	-	-
T_C > 24 hours	Linear interpolation between n-day point rainfall values from TR103	-	-	-	-	-	-	-

Description of Catchment	Rational Method - Burbreeze Pedestrian Bridge Catchment			
River detail	Wewe Stream			
Calculated by	LK	**Date**	29-04-2015	

Physical characteristics

Size of catchment (A)	0.3956	km²	Rainfall Region		
Longest Watercourse	0.83	km	**Area Distribution Factors**		
Average slope (S_{av})	0.004819277	m/m	Rural (α)	Urban (β)	Lakes(γ)
Dolomite Area ($D_{\%}$)	0	%	0.5	0.5	0
Mean Annual Rainfall (MAR)	978	mm			
Catchment Characteristics	Flat/permeable	%			
r - look up from Table 3C.3	s over fairly rough surface	0.3			

Rural (1)				**Urban** (2)			
Surface Slope	**%**	**Factor**	**C_s**	**Description**	**%**	**Factor**	**C_2**
Vleis and Pans	0	0.05	-	**Lawns**			
Flat Areas	40	0.11	0.044	Sandy, flat (<2%)	1	0.075	0.001
Hilly	55	0.2	0.110	Sandy, steep (>7%)	0	0.175	-
Steep Areas	5	0.3	0.015	Heavy soil, flat (<2%)	1	0.15	0.002
Total	100	-	0.169	Heavy soil, steep (>7%)	0	0.3	-
Permeability	**%**	**Factor**	**C_p**	**Residential Areas**			
Very Permeable	20	0.05	0.010	Houses	78	0.4	0.312
Permeable	60	0.1	0.060	Flats	0	0.6	-
Semi-permeable	20	0.2	0.040	**Industry**			
Impermeable	0	0.3	-	Light industry	0	0.65	-
Total	100	-	0.110	Heavy Industry	0	0.75	-
Vegetation	**%**	**Factor**	**C_v**	**Business**			
Thick bush and plantation	40	0.05	0.020	City Centre	0	0.825	-
Light bush and farm-lands	50	0.15	0.075	Suburban	0	0.6	-
Grasslands	10	0.25	0.025	Streets	20	0.825	0.165
No Vegetation	0	0.3	-	Maximum flood	0	1.00	-
Total	100	-	0.120	Total	100	-	0.479

Time of concentration (T_c)	Defined Watercourse	Notes:
Overland flow	Defined watercourse	
$T_c = 0.604\left(\frac{rL}{\sqrt{S_{av}}}\right)^{0.467}$	$T_c = \left(\frac{0,87 L^2}{1000 S_{av}}\right)^{0,385}$	
1.1 Hours	0.45 Hours	

Run-off coefficient

Return period (years), T	**2**	**5**	**10**	**20**	**50**	**100**	**Max**
Run-off coefficient, C_1 ($C_1 = C_s + C_p + C_v$)	0.399	0.399	0.399	0.399	0.399	0.399	0.399
Adjusted for dolomitic areas, C_{1D} ($= C_1(1-D_{\%})+C_1D_{\%}(\Sigma(D_{factor} \times C_{s\%}))$)	0.399	0.399	0.399	0.399	0.399	0.399	0.399
Adjustment factor for initial saturation, F_t	0.5	0.55	0.6	0.67	0.83	1	1
Adjusted run-off coefficient, C_{1T} ($= C_{1D} \times F_t$)	0.1995	0.21945	0.2394	0.26733	0.33117	0.399	0.399
Combined run-off coeffiecient C_T ($= \alpha C_{1T} + \beta C_2 + \gamma C_3$)	0.339375	0.34935	0.359325	0.37329	0.40521	0.439125	0.439125

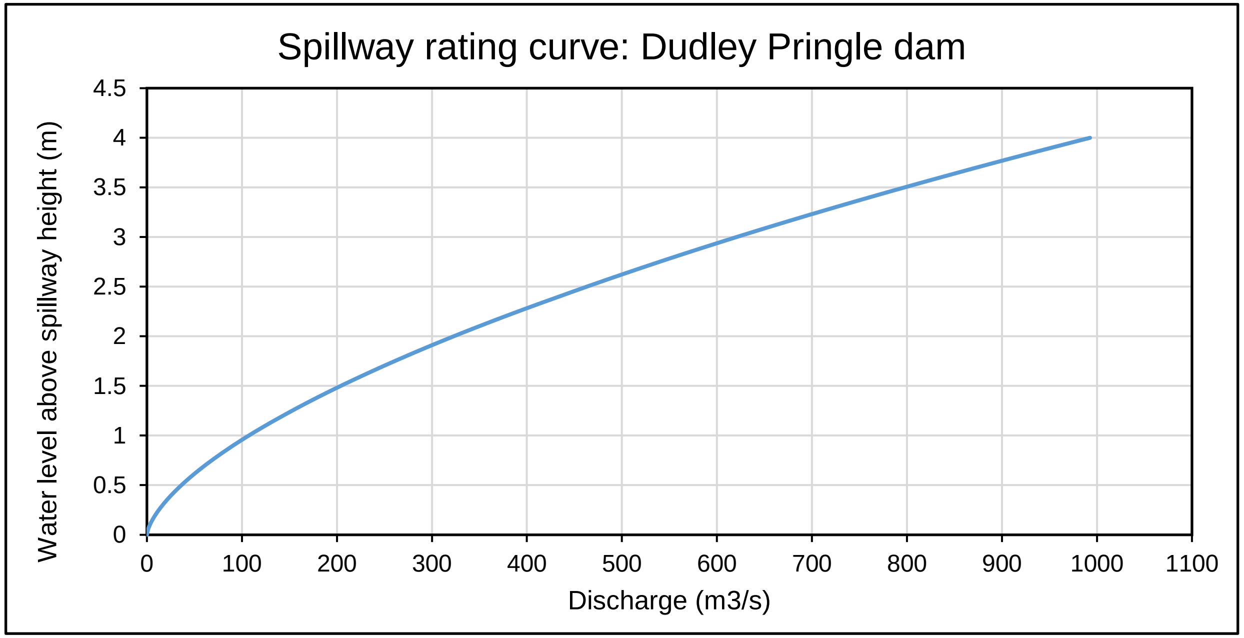
Rainfall

Return period (years), T	**2**	**5**	**10**	**20**	**50**	**100**	**Max**
Point Rainfall (mm), P_T	24.8	37.2	46.9	57.4	73.2	86.8	102.2
Point Intensity (mm/hour), P_{iT} ($=P_T/T_C$)	55.3	83.0	104.7	128.1	163.4	193.8	227.9
Area Reduction Factor (%), ARF_T	99	99	99	99	99	99	99
Average Intensity (mm/hour), I_T ($= P_{iT} \times ARF_T$)	54.8	82.1	103.6	126.8	161.7	191.8	225.7
Return period (years), T	**2**	**5**	**10**	**20**	**50**	**100**	**Max**
Peak flow (m³/s), $Q_T = \frac{C_T I_T A}{3,6}$	2.0	3.2	4.1	5.2	7.2	9.3	10.9

APPENDIX B

Dam Spillway Data

Spillway parameters			
Item	Unit	Label	Value
Spillway height above dam bed	m	P	3.578
Length of Spillway	m	L	58
Design head of spillway	m	Hd	4
Discharge coefficient	-	Cd	0.483



APPENDIX C

HEC RAS Output Data

HEC-RAS Plan: Pre-construction River: Burbreeze Stream Reach: Burbreeze Stream Profile: Q100

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Burbreeze Stream	10	Q100	424.00	24.80	29.8020	29.80	31.34	0.009973	7.11	98.41	29.58	1.02
Burbreeze Stream	9	Q100	424.00	24.85	29.3552	28.05	30.40	0.008598	6.23	116.58	39.09	0.94
Burbreeze Stream	8	Q100	424.00	24.75	29.3836		30.14	0.007800	6.04	138.63	54.27	0.90
Burbreeze Stream	7	Q100	424.00	24.58	29.5137		29.92	0.004059	4.49	188.95	73.13	0.65
Burbreeze Stream	6	Q100	424.00	24.40	29.6708		29.81	0.000888	2.25	324.92	99.88	0.31
Burbreeze Stream	5	Q100	424.00	24.05	29.6752		29.78	0.000645	1.98	392.75	132.38	0.27
Burbreeze Stream	4	Q100	424.00	24.80	29.6275		29.76	0.000845	2.06	316.34	94.32	0.30
Burbreeze Stream	3	Q100	424.00	24.56	29.3376		29.71	0.002289	3.30	192.04	60.27	0.49
Burbreeze Stream	2	Q100	424.00	24.08	28.9531		29.63	0.003643	4.16	144.51	47.93	0.62
Burbreeze Stream	1	Q100	424.00	23.99	28.7824	28.37	29.56	0.004001	4.48	147.12	59.41	0.65

HEC-RAS Plan: Post-construct River: Burbreeze Stream Reach: Burbreeze Stream Profile: Q100

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Burbreeze Stream	10	Q100	424.00	24.80	29.8020	29.80	31.34	0.009973	7.11	98.41	29.58	1.02
Burbreeze Stream	9	Q100	424.00	24.85	29.3594	28.05	30.40	0.008562	6.22	116.74	39.10	0.94
Burbreeze Stream	8	Q100	424.00	24.75	29.3891		30.14	0.007750	6.02	138.93	54.29	0.90
Burbreeze Stream	7	Q100	424.00	24.58	29.5185		29.93	0.004037	4.48	189.31	73.15	0.65
Burbreeze Stream	6	Q100	424.00	24.40	29.6748	27.06	29.81	0.000885	2.24	325.31	99.89	0.31
Burbreeze Stream	5.8		Bridge									
Burbreeze Stream	5	Q100	424.00	24.05	29.6752		29.78	0.000645	1.98	392.75	132.38	0.27
Burbreeze Stream	4	Q100	424.00	24.80	29.6275		29.76	0.000845	2.06	316.34	94.32	0.30
Burbreeze Stream	3	Q100	424.00	24.56	29.3376		29.71	0.002289	3.30	192.04	60.27	0.49
Burbreeze Stream	2	Q100	424.00	24.08	28.9531		29.63	0.003643	4.16	144.51	47.93	0.62
Burbreeze Stream	1	Q100	424.00	23.99	28.7824	28.37	29.56	0.004001	4.48	147.12	59.41	0.65

APPENDIX D

Flood Line Drawing

THIS DRAWING HAS BEEN PREPARED UNDER THE CONTROLS ESTABLISHED BY THE SiVEST QUALITY MANAGEMENT SYSTEM AND MEETS THE REQUIREMENTS OF THE SETA QUALITY GRADING SYSTEM THAT IS ISO COMPLIANT

GENERAL NOTES

1. THIS DRAWING PROVIDES INFORMATION RELATED TO THE FORM OF THE WORK WHEN COMPLETED TOGETHER WITH GUIDANCE, WHERE FUNDAMENTAL TO THE DESIGN, FOR THE SEQUENCE OF CONSTRUCTION. THIS DRAWING DOES NOT PURPORT TO INCLUDE ANY NECESSARY PRECAUTIONS, ITEMS OR COMPONENTS REQUIRED FOR CONSTRUCTION SAFETY. ALL SUCH PRECAUTIONS MUST BE TAKEN AND ITEMS OR COMPONENTS SUPPLIED BY THE CONTRACTOR.
2. ANY DISCREPANCIES ARE TO BE CONFIRMED WITH THE ENGINEER ON SITE PRIOR TO WORK PROCEEDING.
3. ONLY WRITTEN DIMENSIONS SHALL BE USED.

REFERENCE DRAWINGS

Revision Details	By	Date	Suffix

DURBAN OFFICE
4 Pencarrow Crescent
La Lucia Ridge Office Estate
Umhlanga Rocks 4320
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email: info@sivest.co.za

Client
ETHEKWINI MUNICIPALITY

Project Title
BURBREEZE PEDESTRIAN BRIDGE BASIC ASSESSMENT

Drawing Title
WEWE RIVER 100 YEAR FLOODLINE

Scale 1:500
ON ORIGINAL PLAN 0 10 20 30 40 50

DRAWN
BY : LK DATE: 2015/05/14

DESIGNED
BY : LK DATE: 2015/05/12
SIGNATURE :

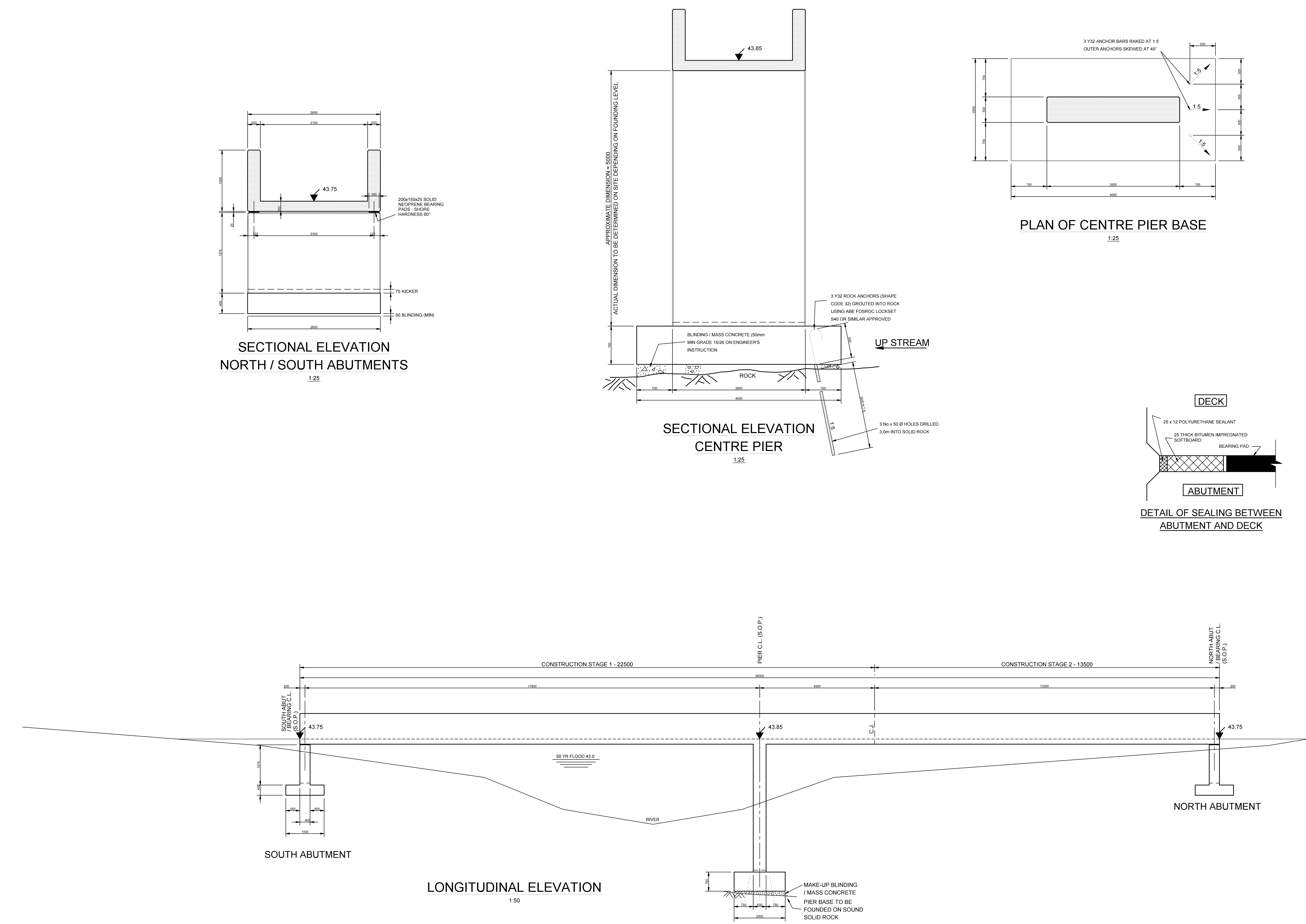
CHECKED ON BEHALF OF SiVEST
BY : LH Pr No: *
SIGNATURE : DATE :

FOR INFORMATION ONLY

SiVEST Drawing Number: 12622-5000
Revision: 0

APPENDIX E

Bridge Design Drawing



ETHEKWINI MUNICIPALITY
ENGINEERING UNIT

ROADS PROVISION - STRUCTURES

REDUCED PLAN USE SCALE BELOW

0 10 20 30 40 50 60 70

70mm ON ORIGINAL PLAN

Revision	Date	Description

NOTE: No construction work to commence until land and servitude acquisitions have been completed

Acquisitions completed

Date Engineer

UNDERGROUND SERVICES CHECKED

SERVICE	DATE	SIGNATURE
S.W.DRAINS		
SEWERS		
WATER MAINS		
G.P.O.CABLES		
ELECTRIC CABLES		
S.A.R. CABLES		
E.S.C. CABLES		
OIL PIPE LINE		

NOTE: Only underground services affected by new construction work are shown. Care must be taken during excavations for road foundations, trenches etc., to avoid damage to underground services such as sewers, drains, cables, water mains and connections. Wherever possible these must be located before work proceeds.

Contract No
1R - xxxx

Project Title
CONSTRUCTION OF A PROPOSED PEDESTRIAN BRIDGE, BURBREEZE, WARD 62

Drawing Title
GENERAL ARRANGEMENT

Scales: AS SHOWN
Reference

Designed: J.v.H.
Date: 08-2014
Checked
Drawn: P.G.F

Manager Structures

Deputy Head : Roads Provision

A.M. Peters
Head Engineering

Drawing XXXXX
Sheet 1 of Sheets

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